Application Note

Advantages of Using TPS65219 PMIC to Power AM62 Processor Versus a Discrete Power Design

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ABSTRACT

This application note discusses the advantages of using TPS65219 power management IC (PMIC) to power the AM62 processor and principal peripherals versus a discrete power design. Benefits such as design size, system control, Linux drivers, time-to-market and scalability can be reviewed. For any questions or technical support, use the Power Management E2E forum.

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1 Introduction

As systems continue to shrink in both size and power usage, while growing in functionality, designers face the challenge of how to effectively power embedded processor systems. Embedded processor systems require a power design that can be implemented quickly and optimize board space. One option for creating the power tree is to use an individual power regulator integrated circuit (IC) for each rail of the processor, FPGA, or SoC. This is commonly referred to as a discrete design. The other option is to use a multichannel power management IC, or PMIC.

More advanced power designs such as in EV charging, HMI, and HVAC controllers require high-performance power designs with features such as power sequencing, low-power modes and monitoring elements. PMICs unify many common power-management functions into a single energy-efficient chip, which can simplify designs, shrink power design sizes, and optimize processor performance. This application report compares two Sitara AM62 Starter Kit EVM power designs and outlines the benefits of using a highly integrated TPS65219 PMIC versus a discrete regulator approach.

2 Design Size

As consumers expect electronics to continue reducing in size and cost, power management is an area of opportunity for designers to reduce board space. Using a single PMIC, in place of many external components, can help reduce board space as well as make schematic design and layout simpler.

TPS65219 is a high power-density PMIC which integrates 3 bucks and 4 LDOs in a small 5mm x 5mm or 4mm x 4mm package. The TPS65219 PMIC is able to provide up to 60% power design size savings compared to the discrete design for powering AM62. The six discrete power ICs used in the SK-AM62B EVM can be replaced by a single TPS65219 chip in the SK-AM62B-P1 EVM. TPS65219 further shrinks the overall BOM size when considering the passive components in each design. The high 2.3Mhz switching frequency of TPS65219 allows fewer and smaller size inductors and output capacitors. Figure 2-1 shows the PCB layout of the TPS65219 PMIC vs discrete power design for AM62.

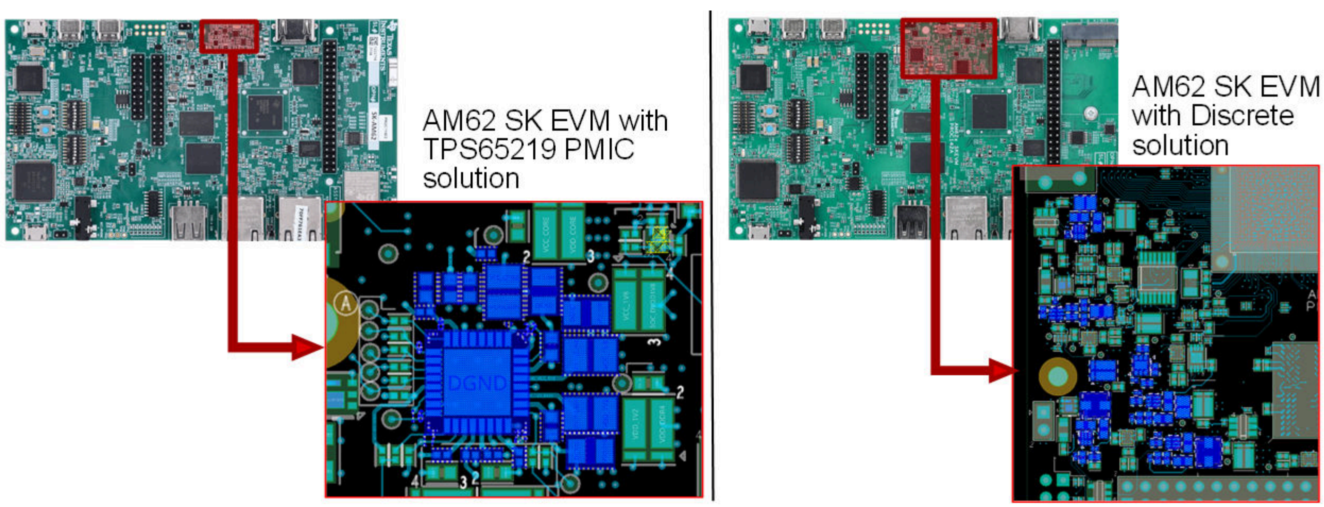

Figure 2-1. PCB Layout of AM62 SK EVM With TPS65219 PMIC Power Design vs Discrete Design

Table 2-1 provides a comparison of PMIC vs discrete design size and component count based on varying AM62x use cases of Vdd_core operation. TPS65219 PMIC leverages integration to simplify the total BOM reducing the total design size of parts to 37.98 mm2 for the 4mm x 4mm and 46.98 mm2 for the 5mm x 5mm package. In addition, a PMIC design decreases the number of total BOM components from 51 to 27.

Table 2-1. BOM comparison of AM62 SK EVM with TPS65219 PMIC power design vs discrete design

	AM62 SK EVM with TPS65219 PMIC design	AM62 SK EVM with TPS65219 PMIC design	AM62 SK EVM with discrete design	AM62 SK EVM with discrete design
PMIC package size	4x4mm2 (-RSM)	5x5mm2 (-RHB)	-	-
VDD_Core Operation	0.75V or 0.85V	0.75V or 0.85V	0.85V	0.75V
Number of ICs	1	1	6	7
Number of Passives (Inductor, capacitor, resistor)	26	26	34	38
Sequencer components	Integrated within TPS65219 IC	Integrated within TPS65219 IC	6	6
Total BOM components	27	27	46	51
Total BOM size	37.98mm	46.98mm	62.22mm	78.16mm

2.1 Greater Level of System Control, Safety, and Flexibility

AM62 requires controlled power-up and power-down sequences to properly operate subsystems and downstream components. Power sequencing is critical in voltage rails that must turn on in specific orders to make sure of operational safely and reliability. Sequencing the rails also helps stagger the inrush current during power-up, which reduces system stress and prevents unexpected reverse bias conditions.

TPS65219 PMIC simplifies the BOM with built-in voltage supervisors and a digital sequencer integrated within the PMIC. Meanwhile the discrete SK-AM62B design requires 6 additional components to enable a daisy-chain sequence, which does not have the same level of control and precision as the TPS65219's sequencer capabilities. The TPS65219 sequencer has a built-in memory that allows digitally controlled sequencing and information that can be read back to the processor through I2C. The advantages of the TPS65219 digital power sequencer in comparison to a discrete implementation is:

- Reduced external component count and smaller footprint.
- Greater precision and customization of the sequence. TPS6521905 has 16 slots that can be configured as 0ms, 1.5ms, 3ms or 10ms durations.
- Flexibility to include sequencing across several TPS65219-devices and additional peripherals or discrete devices in the system. Power up and down sequence can also be reprogrammed through I2C.

The TPS65219 also provides undervoltage and overcurrent protection, Short-to-GND-detection, Residual-Voltage detection, WARM-warning, and Thermal Shutdown.

2.2 Linux Driver Benefits

TPS65219 can enable power savings and optimize the performance of the AM62 through PMIC specific Linux drivers available that have been pushed upstream to the Linux kernel. These certified and tested drivers have already been integrated to the AM62 SDK, and provide impressive control over details such as power rail voltages and power sequencing. Linux drivers developed specifically for these PMICs enable the system to trigger reboots, soft restarts and low-power modes; and also enable dynamic voltage scaling, adapting buck-converter voltages to match the system's current power needs. Figure 2-2 outlines the TPS65219 PMIC driver features available.

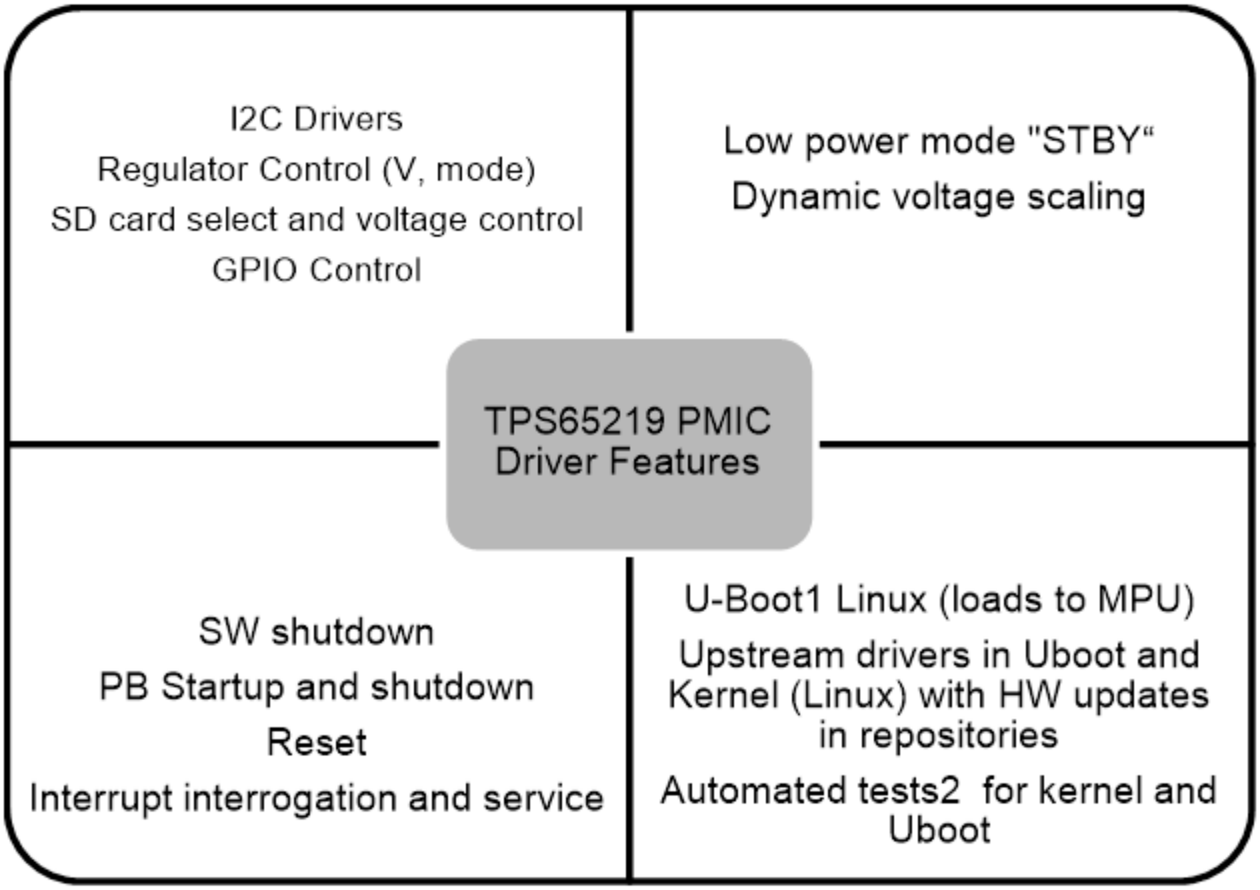

Figure 2-2. TPS65219 PMIC Driver Features

2.3 Accelerate Your Time to Market and Scale one PMIC Across Multiple Projects

TPS65219 was co-developed with AM62 to meet all power specifications and optimize the performance of the processor and the principal peripherals such as microSD card and LPDDR4/DDR4 memory. TPS65219 is available in several pre-configured configurations to power different AM62 use-cases. Learn more about these configurations in *Powering the AM62x with the TPS65219 PMIC* , application note.

TPS65219 is scalable to power multiple other processors and SoCs on the market. Table 2-2 includes a comparison of TPS65219 devices and the recommended application use case. This table also includes the collateral resources that are available to support new designs. The Application Note describes how the power and digital resources of the TPS65219 PMIC are used to meet the requirements of specific processors and SoCs. A full summary of the default non-volatile memory (NVM) register settings for each orderable can be found in the Technical Reference Manual (TRM).

TPS6521905 is the user-programmable version that comes with all the power rails OFF by default and can be programmed to meet the power requirements of any processors or SoCs. TPS6521905 can reduce design cost and time, and is often reusable across different projects. There is also the possibility to reprogram a single part number to substitute for several different part numbers, simplifying the supply chain.

Table 2-2. TPS65219 Device Comparison Table

Device Name	Processor / SoC	Application use case			Collateral	
		Vin	Memory	VDD_Core	Technical Reference Manual (TRM)	Application Note
TPS6521905	Any: User-programmable PMIC	ANY	ANY	ANY	-	TPS65219 Non-Volatile Memory (NVM) Programming Guide
TPS6521901	AM62, AM62 SIP, AM64	5V	DDR4	0.75V	SLVUCH3	AM62: SLVAFD0 AM64: SLVAFE9 AM243: SLVAFK3
TPS6521902	AM62, AM62 SIP, AM64	3.3V	LPDDR4	0.75V	SLVUCL0	
TPS6521903	AM62, AM62 SIP, AM64	3.3V	DDR4	0.75V	SLVUCJ2	
TPS6521904	AM62, AM62 SIP, AM64, AM243	3.3V	DDR4	0.85V	SLVUCL1	
TPS6521907	AM62, AM62 SIP, AM64, AM243	5V	DDR4	0.85V	SLVUCL9	
TPS6521908	AM62, AM62 SIP, AM64, AM243	3.3V	LPDDR4	0.85V	SLVUCM0	
TPS6521906	AM335	5V	DDR3L	1.1V	-	-
TPS6521909	AM62A, AM67	5V	LPDDR4	0.85V or 0.75V	-	-
TPS6521910	AM62A, AM67	5V	LPDDR4	0.85V or 0.75V	-	-
TPS652190C	NXP i.MX 8M Plus	3.3V	DDR4	0.85V	SLVUCV3	SLVAFQ2

3 Summary

Utilizing a PMIC can reduce system size and layout versus discrete power designs as well as provide other on chip monitoring and diagnostics. TPS65219 PMIC can optimize design size, allow a greater level of system control, safety and flexibility, while also accelerating time to market and scalability.

4 References

- Texas Instruments, *Powering the AM62x with the TPS65219 PMIC* , application note.

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