Application Note

Three Methods to Power Automotive Infotainment and Cluster Designs

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ABSTRACT

This application note describes the three methods for powering an automotive infotainment and cluster system using Texas Instruments' scalable Power Management Integrated Circuits (PMIC). The recommended power design depends on the business case, time to market, and required deliverables for the project. These factors determine whether a custom, catalog, or user-programmable design is most appropriate for the customer's project.

The first option for selecting a PMIC is a catalog programmed device. These PMICs are programmed and available on ti.com. For 7+ rail processors, TPS65219-Q1 powers systems with applications needing 3 Bucks and 4 LDOs. For higher current applications requiring over 4A, the FlexPower portfolio (LP8732-Q1, LP8733-Q1, LP8752x-Q1, and LP8756x-Q1) offers configurability to maximize rail usage and size.

For projects requiring programmable settings that are different from available catalog PMICs, a custom programmed device can be considered to meet the customer's specifications. Custom programmed PMICs must have a qualifying business case and at least six months before releasing the PMIC to market. TI will support samples of the device prior to production for the customer to verify and change the settings as needed to optimize the design for the use case. TPS65219-Q1 and the FlexPower product line are available for custom programming for infotainment and cluster applications.

If a faster time to market is needed and an existing catalog PMIC does not meet the programming requirements, the user-programmable TPS6521905-Q1 is available on ti.com. The companion user-friendly GUI and programming guide make using this device simple and accessible. TI's best in class customer service is available to provide support in the programming process.

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1 Introduction

Complex and interactive infotainment products enhance the in-vehicle experience with real-time diagnostics and engaging displays. Premium audio amplifiers, head units, and rear seat entertainment are a few of the features that drive an integrated cabin experience. These sophisticated systems require reliable and optimized power designs. Small, flexible, optimized power designs with accessible support minimize development time and advance the system power technology. TIs' infotainment and cluster Power Management Integrated Circuit (PMIC) portfolio offers a range of configuration options to support requirements for powering an automotive system. Depending on the customer's needs, TI offers three methods for providing customers with an optimized power design: catalog, custom, or user-programmable devices.

Table 1-1. PMIC Power Designs Overview

Design Type	Catalog Programmed	Custom Programmed	User-Programmable
Business Case Required	No	Yes	No
Factory Programmed	Yes	Yes	No
Availability	ti.com	Contact your local TI sales office	ti.com
Design Resources Available	User Guides for select processors	Custom Technical Reference Manual available at release to market	NVM Programming guide
Custom Deliverables	No	Yes: PPAP, Data sheet with POA, Custom OTP topside marking	No
Customizable NVM	No	Yes	Yes
Time to Market	Fastest	Fast	Faster
Support Multiple System on a Chip	Varies	Custom	Yes

2 PMICs Pre-Programmed for Target SoCs

Most infotainment and cluster designs do not require advanced integrated functional safety features, making this application opportune for an optimized power design. For a variety of popular processors, user guides and reference designs are available on the Power for Embedded Systems tool for easy device selection and system design using catalog orderable parts available on TI.com.

2.1 TPS65219-Q1: Pre-Programmed PMIC for 7+ Rail Processors

To power systems similar to AM62x Sitara™ processors, TPS65219-Q1 offers functional safety-capable features without added overhead. Reference designs and technical reference manuals are available for easy set up. With the small 5x5mm package, TPS65219-Q1 has a compact footprint given the excellent powering capabilities. For applications requiring advanced functional safety with an ASIL-B target, consider selecting TPS65224-Q1, which offers functionality with AM62x-Q1 plus advanced functional safety features.

TPS65219-Q1 has three buck converters and four low-dropout regulators optimized to support systems with up to 14+ rails (2x TPS65219-Q1, 7 rails each). Buck1 has the ability to supply up to 3.5A core rail, and Buck2 and Buck3 each support up to 2A. The default output voltages for each buck converter can be selected through I2C interface. With the GPIO pin, multiple TPS65219-Q1 devices can be synchronized for access to additional power rails. Safety features such as undervoltage sensing and temperature thresholds can be set to meet the requirements for the system.

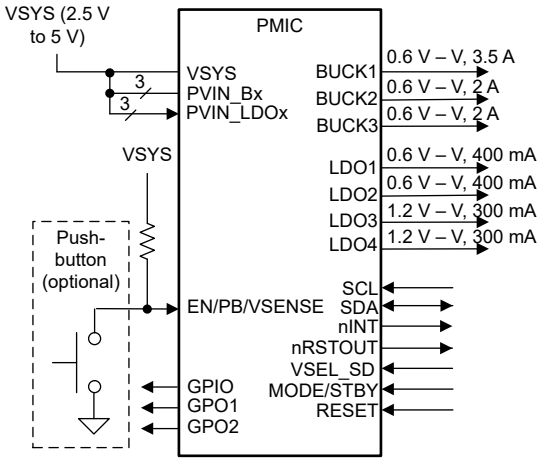

Figure 2-1. TPS65219-Q1 Simplified Schematic

Additionally, TPS65219-Q1 has multi-function pins to adjust to the desired mode. The EN/PB/VSENSE can be configured as a push-button, power-fail comparator input, or a device enable pin. The MODE/RESET pin can be set to MODE for forcing the buck-converters into PWM or permit auto-entry in PFM-mode. The RESET function can force a cold reset and sequence down all enabled rails. The MODE/STBY pin allows the PMIC to operate in a low power mode at light load. These pins are two of the several multi-function pins that make TPS65219-Q1 customizable. Settings can be tested quickly with the available TPS65219 EVM and accompanying user-friendly GUI.

TPS65219-Q1 shares a GUI with the non-automotive version, TPS65219.

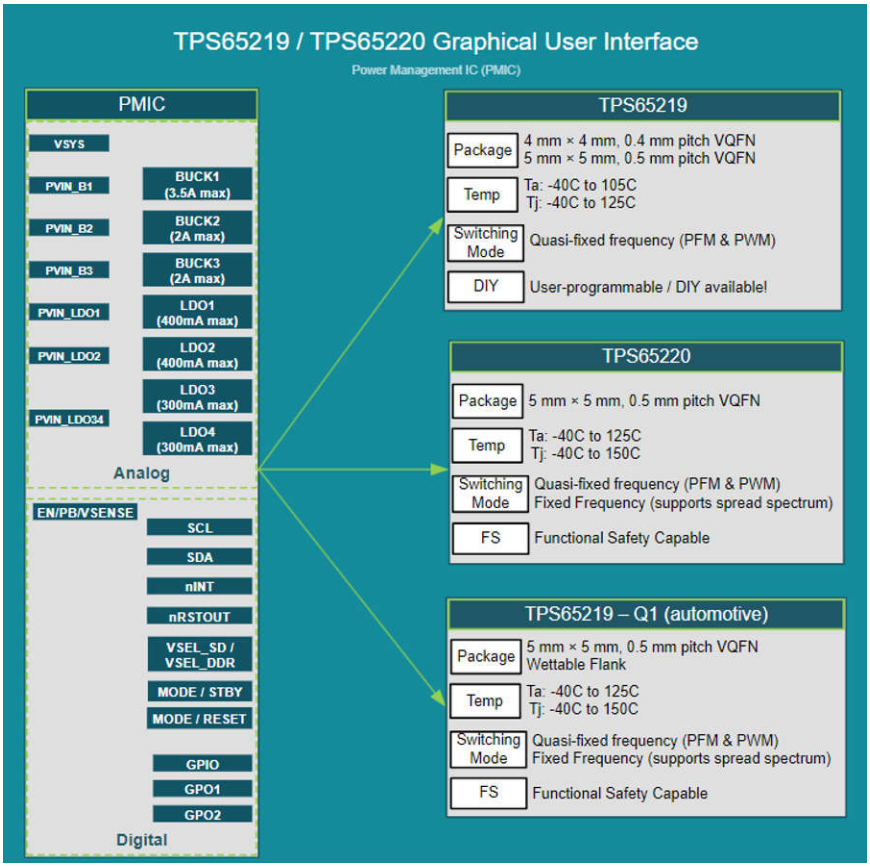

Figure 2-2. TPS65219-Q1 Graphical User Interface

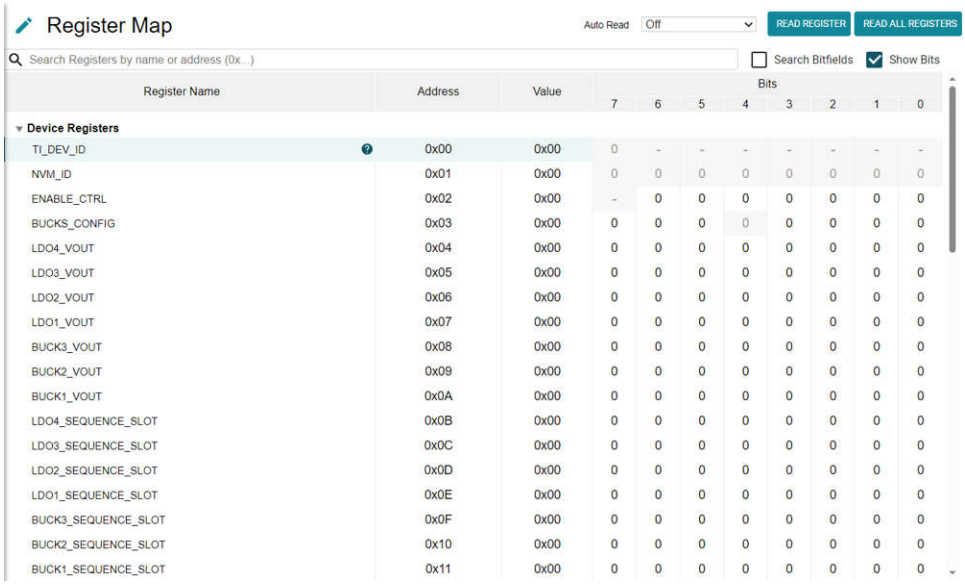

Figure 2-3. TPS65219-Q1 Register Map

2.2 LP8732-Q1, LP8733-Q1, LP8752X-Q1, LP8756X-Q1: Multi-Phase Configurable FlexPower PMICs for Processor Attach

The FlexPower product line (LP8732-Q1, LP8733-Q1, LP8752x-Q1, and LP8756x-Q1) is a second option for flexible, optimized PMICs for processor attach. FlexPower devices offer automotive-grade features with multi-phase configurability, making them designed for a variety of systems on a chip. FlexPower PMICs have the scalability of discrete components, as well as the sequencing and monitoring features of a PMIC. The scalability enables all rails to be utilized strategically and optimized for a specific system.

With 2-4 buck converters per device, FlexPower PMICs are small and can be combined to expand their power rail count to match the system's exact requirements. Their flexible configurability allows for optimized regulator usage. Additionally, I2C configurability allows programming of settings at start-up. FlexPower PMICs are an optimized portfolio for reducing the power footprint and improving the board layout with helpful scalability and minimized device count.

Contact your local TI sales for additional support and resources.

Table 2-1. Key Infotainment and Cluster Processor Power Designs

Processor Vendor	Processor Family	TI PMIC Design	Available Resources
Texas Instruments	Sitara AM62x-Q1	TPS65219-Q1	• Powering the AM62x with the TPS65219 PMIC • TPS65219-Q1 Product Folder
	Sitara AM62A/P-Q1	TPS65224-Q1	• TPS652224-Q1 Product Folder
	Jacinto DRA78x	TPS65219-Q1	• TPS65219-Q1 Product Folder

Table 2-1. Key Infotainment and Cluster Processor Power Designs (continued)

Processor Vendor	Processor Family	TI PMIC Design	Available Resources
SemiDrive	X9SP	LP87521-Q1 LP87562/3-Q1	• *User Guide Pending* • The Benefits of FlexPower PMIC Devices
	X9P/U	LP87521/4-Q1 LP87561/2-Q1 LP8732-Q1	• Power Supply Design for SemiDrive X9P/X9U • The Benefits of FlexPower PMIC Devices
	X9H	LP87523-Q1 LP87565-Q1	• Power Supply Design for SemiDrive X9H Using LP875230C-Q1 and LP87565V-Q1 • The Benefits of FlexPower PMIC Devices
	X9CC	LP87524-Q1 LP87565-Q1 LP8732-Q1	• *User Guide Pending* • The Benefits of FlexPower PMIC Devices
NXP	i.MX 8 / 9	TPS65219-Q1 *Or* LP875640-Q1 LP8733-Q1	• TPS65219-Q1 Product Folder • Power Supply Design for NXP i.MX 8 Using the LP875640- Q1 and LP8733-Q1
Renesas	R-Car M3/W/N	LP87565-Q1 LP8732-Q1 LP87334A-Q1	• Power Supply Design for Renesas R-Car M3 Using LP87565U-Q1, LP873245-Q1, and LP87334A-Q1
	R-Car D3	LP87524-Q1	• LP8752x-Q1 Configuration Guide
	R-Car H3	LP87561-Q1 LP87562-Q1 LP87524-Q1	• LP8756x-Q1 Configuration Guide • LP8752x-Q1 Configuration Guide
Telechips	TCC8050/53	LP87563-Q1 LP8733-Q1	• LP8756x-Q1 Configuration Guide
	TCC8059	LP87563-Q1 LP87524-Q1	• LP8756x-Q1 Configuration Guide
	TCC803x	TPS65219-Q1 TPS65224-Q1 *Or* TPS6593-Q1	• TPS65219-Q1 Product Folder • TPS652224-Q1 Product Folder • TPS6593-Q1 Product Folder
MediaTek	MT2712	TPS6593-Q1	• TPS6593-Q1 Product Folder
	MT2712P/S/H/E	LP87563-Q1 TPS65917-Q1	• LP8756x-Q1 Configuration Guide
	MT2712M	TPS65919-Q1 LP8733-Q1	• LP8733-Q1 and LP8732-Q1 Configuration Guide
	MT2712C	TPS65919-Q1 LP87522-Q1	• LP8752x-Q1 Configuration Guide
AutoChips	AC8015	LP87522-Q1 LP8732-Q1	• Power Supply Design for AC8015 Using LP87522EQ1 and LP873244-Q1
	AC8025	TPS6593-Q1	• TPS6593-Q1 Product Folder

3 Custom Programmed PMICs

If a PMIC with the customer's desired configuration is not available in TI's online catalog, a custom PMIC programmed to meet the customer's requirements can be proposed. Once the PMIC has been selected, the PMIC team can work with each customer to evaluate the business case and determine whether a custom design can be supported. Upon confirmation, the customer can be provided with samples to refine their OTP settings. The PMIC team can work with the customer throughout the design and evaluation process to provide samples that meet the customer's deadlines. The team can redefine the OTP for the correct definition to match the customer's requirements.

After the OTP has been approved and finalized by the customer, the custom PMIC can be released to market in 4-6 months. The customer can receive a customer orderable production part number, a PPAP, and the ability to place large quantity orders upon release.

Customers can contact a local TI sales office to work with a TI representative to support their project plan.

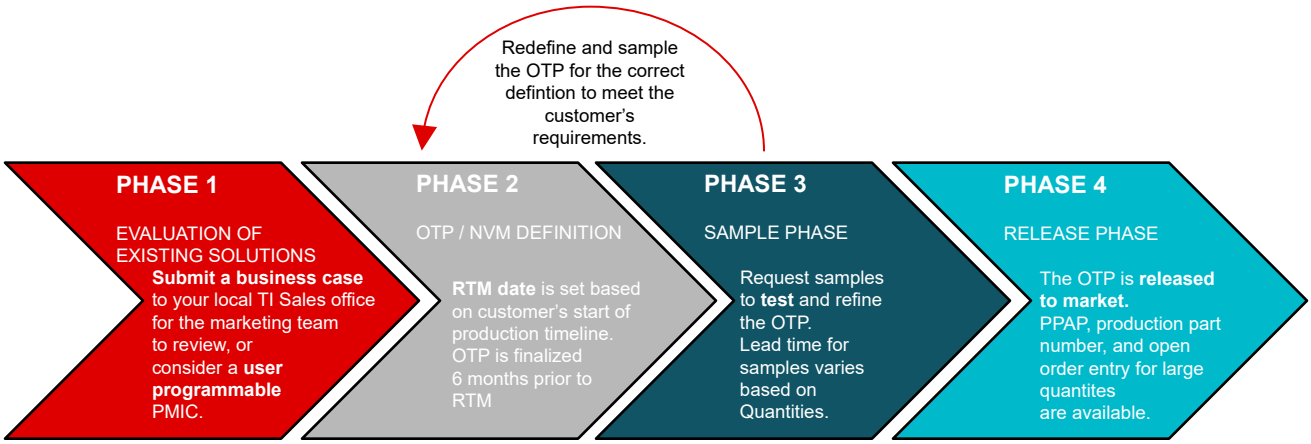

Figure 3-1. Custom Programmed PMIC Design Process

Table 3-1. Infotainment and Cluster PMIC Specification Comparison

GPN	LP8732-Q1	LP8733-Q1	LP8752x-Q1	LP8756x-Q1	TPS65219-Q1	TPS6521905-Q1
Buck1	2A	3A	4A	4A	3.5A	3.5A
Buck2	2A	3A	3A	4A	2A	2A
Buck3	-	-	2A	4A	2A	2A
Buck4	-	-	1A	4A	-	-
Multi-Phase Buck Converters	Yes	Yes	Yes	Yes	No	No
Max Current per Multi-Phase	4A	6A	10A	16A	-	-
LDO1/ LSW	0.3A	0.3A	-	-	0.3A	0.3A
LDO2/ LSW	0.3A	0.3A	-	-	0.3A	0.3A
LDO3/ LSW	-	-	-	-	0.4A	0.4A
LDO4/ LSW	-	-	-	-	0.4A	0.4A
I2C	Yes	Yes	Yes	Yes	Yes	Yes
Push/Enable Pin	No	No	No	No	Yes	Yes
User-Programmable	No	No	No	No	No	Yes

4 TPS6521905-Q1: User-Programmable PMIC

For easy customization and rapid sample testing, a user-programmable PMIC with a generic OTP offers excellent flexibility for the customer to change the power rail voltages and sequencing in minutes.

For infotainment applications, TPS6521905-Q1 captures the features of TPS65219-Q1 with the additional capability of user programmability that allows changes to the system settings during the design process for fast prototyping. TPS6521905-Q1 empowers customers to use a blank OTP PMIC to create a custom program for projects with a short timeline or without a large volume business case.

This user-programmable PMIC removes the need for external resistors, a microcontroller, or factory programming. Instead, the PMIC can be programmed, and reprogrammed, using I2C communication to refine the PMIC to meet the exact specifications desired. Rather than requiring new parts for every change to the PMIC settings, a single chip can be reprogrammed to refine the settings needed for several applications. The user programming guide supports rapid custom device generation that cuts down on development time and improves accessibility to custom programmed settings.

The user-programmable PMIC TPS6521905-Q1 is a fast, flexible, and accessible device for a custom infotainment PMIC.

5 Summary

Custom, catalog, and user-programmable PMICs provide options for powering infotainment and cluster systems. FlexPower PMICs and TPS65219-Q1 have pre-programmed parts in TI's catalog with many user guides available to power popular processors. However, if an OTP part for the desired processor does not exist, a custom OTP can be created, dependent upon meeting business case requirements. If a custom OTP is not the right fit, TPS6521905-Q1 offers a user-programmable device available for any use case.

Regardless of the method of programming, TI's PMIC portfolio has flexible, optimized devices available to meet the requirements of infotainment and cluster applications.

6 References

- Texas Instruments, *Learn About TI's Automotive PMIC Portfolio and TPS65219-Q1 for Powering Sitara AM62x-Q1*.
- Texas Instruments, *TPS65219-Q1 Automotive Power Management Integrated Circuit (PMIC) for ARM® Cortex®-A53 Processors*.
- Texas Instruments, *The Benefits of FlexPower PMIC Devices*, application brief.
- Texas Instruments, *TPS6521905-Q1 Automotive User-Programmable Integrated Power Management IC for ARM Cortex - A53 Processors*.

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