LMR36503-Q1 3 V–65 V, 0.3-A Buck Converter Optimized for Size and Light Load Efficiency

1 Features

- AEC-Q100-qualified for automotive applications:
  - Device temperature grade 1: –40°C to +125°C, T_A
- >70% efficiency at 5 mA
  - 4 µA I_q (switching) at 24 V_{IN} to 3.3 V_{OUT} (fixed output option)
- Miniature solution size and low component cost:
  - Ultra-small, 2-mm × 2-mm HotRod™ package with wettable flanks
  - Highest power density with internal compensation and reduced external component count
- Designed for automotive applications:
  - Junction temperature range –40°C to +150°C
  - Optimized for CISPR 25 EMI standard with spread spectrum frequency modulation
  - Wide input voltage range: 3.0 V (falling threshold) to 65 V
  - Adjustable, 3.3-V and 5-V fixed output voltage option available
  - Synchronizable with MODE/SYNC pin variant
  - PFM and Forced PWM selection with MODE/SYNC pin variant
  - Adjustable switching frequency: 200 kHz to 2.2 MHz with RT pin variant
  - Pin compatible with the LMR36506-Q1 (65 V, 600 mA)

2 Applications

- Advanced driver assistance systems (ADAS)
- Body electronics and lighting
- Infotainment and cluster

3 Description

The LMR36503-Q1 is the industry's smallest 65 V, 0.3 A synchronous step-down DC/DC converter in 2-mm x 2-mm HotRod™ package. This robust and highly reliable converter can handle input voltage transients up to 70 V, provide excellent EMI performance and support fixed 3.3 V, 5 V and other adjustable output voltages with very few external components and a simple PCB layout.

The LMR36503-Q1 uses the peak current mode control architecture with internal compensation to maintain stable operation with minimal output capacitance over the wide switching frequency range from 200 kHz to 2.2 MHz. The LMR36503-Q1 operates during input voltage dips as low as 3 V, making it an excellent choice for a wide input automotive power supply designed to withstand severe cold crank start impulses. The open drain PGOOD output in the LMR36503-Q1, with the glitch filter and delayed release, provides a true indication of the output voltage status, eliminating the requirement for an external supervisor. A seamless transition from FPWM to PFM, with a very low standby quiescent current, enables high efficiency at ultra low output loads. The compact solution size and rich feature set of the LMR36503-Q1 are designed to simplify implementation for a wide range of automotive end equipment.

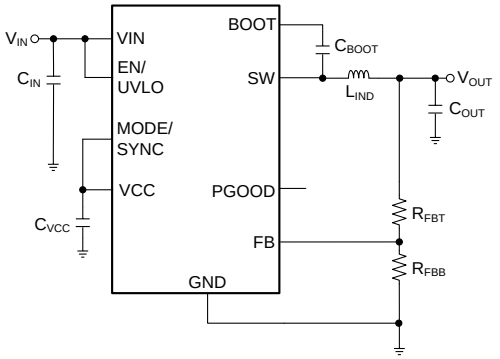
Device Information[1]

PART NUMBER	PACKAGE	BODY SIZE (NOM)
LMR36503-Q1	VQFN-HR (9)	2.00 mm × 2.00 mm

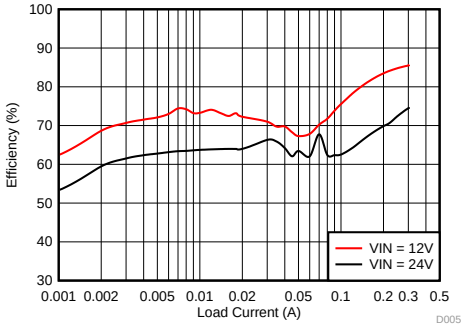
(1) For all available packages, see the orderable addendum at the end of the data sheet.

ADVANCE INFORMATION

Simplified Schematic



Efficiency vs Output Current
V_{OUT} = 3.3 V (Fixed), 2.2 MHz



An IMPORTANT NOTICE at the end of this data sheet addresses availability, warranty, changes, use in safety-critical applications, intellectual property matters and other important disclaimers. ADVANCE INFORMATION for pre-production products; subject to change without notice.

4 Device and Documentation Support

4.1 Documentation Support

4.1.1 Related Documentation

For related documentation see the following:

- Texas Instruments, *Thermal Design by Insight not Hindsight Application Report*
- Texas Instruments, *A Guide to Board Layout for Best Thermal Resistance for Exposed Pad Packages Application Report*
- Texas Instruments, *Semiconductor and IC Package Thermal Metrics Application Report*
- Texas Instruments, *Thermal Design Made Simple with LM43603 and LM43602 Application Report*
- Texas Instruments, *PowerPAD™ Thermally Enhanced Package Application Report*
- Texas Instruments, *PowerPAD Made Easy Application Report*
- Texas Instruments, *SBVA025 Using New Thermal Metrics Application Report*
- Texas Instruments, *Layout Guidelines for Switching Power Supplies Application Report*
- Texas Instruments, *Simple Switcher PCB Layout Guidelines Application Report*
- Texas Instruments, *Construction Your Power Supply- Layout Considerations Application Report*
- Texas Instruments, *Low Radiated EMI Layout Made Simple with LM4360x and LM4600x Application Report*

4.2 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on ti.com. In the upper right corner, click on *Alert me* to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

4.3 Support Resources

TI E2E™ support forums are an engineer's go-to source for fast, verified answers and design help — straight from the experts. Search existing answers or ask your own question to get the quick design help you need.

Linked content is provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's Terms of Use.

4.4 Trademarks

HotRod, PowerPAD, E2E are trademarks of Texas Instruments.
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4.5 Electrostatic Discharge Caution



These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

4.6 Glossary

SLYZ022 — *TI Glossary*.

This glossary lists and explains terms, acronyms, and definitions.

5 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

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PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
PMR36503MSCQRPETQ1	PREVIEW	VQFN-HR	RPE	9	250	TBD	Call TI	Call TI	-40 to 150		

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".
RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.
Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

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