

# TPS53689T Dual-channel ( $N + M \leq 8$ phase) D-CAP+™, Step-down, Multiphase Controllers with TLVR support, PMBus and VR14 SVID Interfaces

## 1 Features

- Input voltage range: 4.5 V to 17 V
- Output voltage range: 0.25 V to 5.5 V
- Dual output supporting N+M phase configurations ( $N+M \leq 8$ ,  $M \leq 4$ )
- Native trans-inductor voltage regulator (TLVR) topology support, with  $L_C$  open and short protection
- Fully compatible with TI smart power stages
- Supports voltage- and current-source  $I_{mon}$  power stages, with internal 1 k $\Omega$  resistor
- Support for traditional (legacy mode) and limp mode power stage fault identification
- Supports dual side power delivery with 12"+ trace length
- Intel® VR14 SVID compliant with PSYS support
- Backward compatible to VR13.HC/VR13.0 SVID
- Automatic NVM fault status logging
- Enhanced D-CAP+ control to provide superior transient performance with excellent dynamic current sharing
- Dynamic phase shedding with programmable thresholds for optimizing efficiency at light and heavy loads
- Configurable with non-volatile memory (NVM) for low external component count
- Individual per-phase IMON calibration, with multi-slope gain calibration to increase system accuracy
- Diode braking with programmable timeout for reduced transient overshoot
- Programmable per-phase valley current limit (OCL)
- PMBus™ v1.3.1 system interface for telemetry of voltage, current, power, temperature, and fault conditions
- Programmable loop compensation through PMBus
- 5.00 mm × 5.00mm, 40-pin, QFN package

## 2 Applications

- [Data center & enterprise computing rack server](#)
- [Hardware accelerator](#)
- [Network interface card \(NIC\)](#)
- [ASIC and high performance client](#)

## 3 Description

The TPS53689T is a VR14 SVID compliant step down controller with trans-inductor voltage regulator (TLVR) topology support, two channels, built-in non-volatile memory (NVM), and PMBus™ interface, and is fully compatible with TI smart power stages. Advanced control features such as the D-CAP+ architecture provide fast transient response, low output capacitance, and good dynamic current sharing. Adjustable control of output voltage slew rate and adaptive voltage positioning are natively supported. In addition, the device supports the PMBus communication interface for reporting the telemetry of voltage, current, power, temperature, and fault conditions to the host system. All programmable parameters can be configured through the PMBus interface and can be stored in NVM as the new default values, to minimize the external component count.

### Package Information

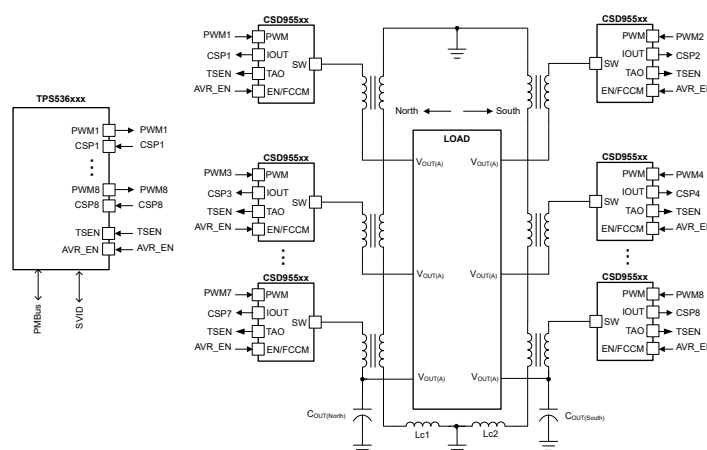
| PART NUMBER | PACKAGE <sup>(1)</sup> | PACKAGE SIZE <sup>(2)</sup> |
|-------------|------------------------|-----------------------------|
| TPS53689T   | RSB (QFN, 40)          | 5.00 mm × 5.00mm            |

- (1) For all available packages, see the orderable addendum at the end of the data sheet.
- (2) The package size (length × width) is a nominal value and includes pins, where applicable.

### Device Information

| PART NUMBER <sup>(1)</sup> | PHASE COUNT |
|----------------------------|-------------|
| TPS53689T                  | 8 phases    |

- (1) See the *Device Comparison Table*



**Simplified Application (Interleaved TLVR)**



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## 4 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

| DATE           | REVISION | NOTES           |
|----------------|----------|-----------------|
| September 2023 | *        | Initial Release |

## 5 Device and Documentation Support

TI offers an extensive line of development tools. Tools and software to evaluate the performance of the device, generate code, and develop solutions are listed below.

### 5.1 Documentation Support

### 5.2 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on [ti.com](https://www.ti.com). Click on *Subscribe to updates* 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.

### 5.3 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.

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### 5.4 Trademarks

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### 5.5 Electrostatic Discharge Caution



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

### 5.6 Glossary

[TI Glossary](#) This glossary lists and explains terms, acronyms, and definitions.

## 6 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.

PACKAGING INFORMATION

| Orderable part number        | Status<br>(1) | Material type<br>(2) | Package   Pins  | Package qty   Carrier | RoHS<br>(3) | Lead finish/<br>Ball material<br>(4) | MSL rating/<br>Peak reflow<br>(5) | Op temp (°C) | Part marking<br>(6) |
|------------------------------|---------------|----------------------|-----------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| <a href="#">TPS53689TRSB</a> | Active        | Production           | WQFN (RSB)   40 | 3000   LARGE T&R      | Yes         | NIPDAUAG                             | Level-2-260C-1 YEAR               | -40 to 125   | TPS<br>53689T       |
| TPS53689TRSB.A               | Active        | Production           | WQFN (RSB)   40 | 3000   LARGE T&R      | Yes         | NIPDAUAG                             | Level-2-260C-1 YEAR               | -40 to 125   | TPS<br>53689T       |

- (1) **Status:** For more details on status, see our [product life cycle](#).
- (2) **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.
- (3) **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.
- (4) **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.
- (5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.
- (6) **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "-" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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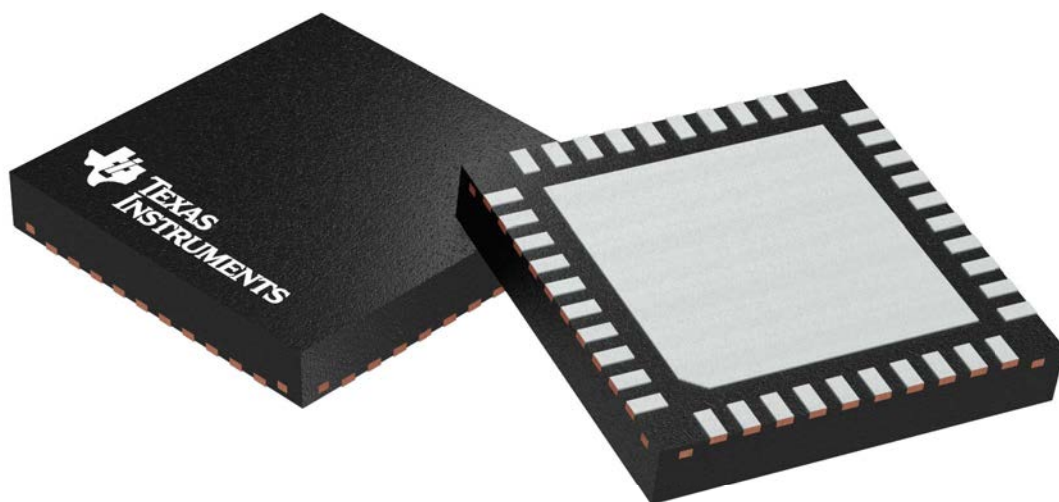
## GENERIC PACKAGE VIEW

**RSB 40**

**WQFN - 0.8 mm max height**

5 x 5 mm, 0.4 mm pitch

PLASTIC QUAD FLATPACK - NO LEAD



Images above are just a representation of the package family, actual package may vary.  
Refer to the product data sheet for package details.

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