TPS25772-Q1 Automotive Dual USB Type-C Power Delivery Controller with Buck-Boost Regulator

1 Features

- AEC-Q100 qualified with the following results:
  - Device temperature grade 1: -40°C to +125°C ambient operating temperature range
  - Device HBM ESD Classification Level 2
  - Device CDM ESD Classification Level C5
  - Enhanced connector pin ESD protection
- USB Power Delivery (PD) controller with Programmable Power Supply (PPS) support
  - Wide \( V_{IN} \): 5.5 V to 18 V (40-V maximum)
  - Integrated buck-boost sources up to 60-W USB PD output power
  - \( V_{BUS} \) output: 3 - 21 V with ± 20-mV step size
  - \( I_{BUS} \) output: ± 50-mA current limit step size
    - Up to 5 A, 3 V ≤ \( V_{BUS} \) ≤ 11 V
    - Up to 3 A, 11 V ≤ \( V_{BUS} \) ≤ 21 V
  - \( V_{BUS} \) short circuit to \( V_{BAT} \) and GND protection
  - Switching frequency: 300, 400, 450 kHz
  - Sync In / Out with dithering
- USB port configurations options
  - 2 USB-PD Ports (TPS25772-Q1)
  - 1 USB-PD and 1 USB-C Ports (TPS25766-Q1)
  - 1 USB-PD and 1 Type-A Ports (TPS25764-Q1)
- Compliant to USB
  - Type-C power delivery rev 3.0
    - CC logic, \( V_{CONN} \) source and discharge
    - USB cable polarity detection
  - Battery charging specification rev 1.2
    - DCP: Dedicated Charging Port
    - 2.7-V divider-3 mode
    - 1.2-V divider mode
  - Short to \( V_{BUS} \) and \( V_{BAT} \) protection
  - \( P_X \_DP \) and \( P_X \_DM \)
  - \( P_X \_CC1 \) and \( P_X \_CC2 \)

2 Applications

- Automotive USB Power Delivery Chargers
- Automotive USB Hubs/Media Ports
- Automotive USB Rear Seat Entertainment
- Automotive USB Head Unit

3 Description

The TPS257xx-Q1 is dual USB Type-C® PD and BC1.2 charging port controller for use in automotive dual USB port applications that include charge only and charging with USB 2.0 or 3.0 data. Functionality includes: an ARM Cortex M0™; USB port controller with Type-C cable plug and orientation detection; USB Battery Charging Specification Version 1.2 (BC1.2) detection; USB Endpoint PHY; device power management and supervisory circuitry; connector pin protection over-voltage and short-circuit protection; and integrated buck-boost converter.

Full 60-W output power is achievable over 6.8 V ≤ \( V_{IN} \) ≤ 18 V at up to 70°C ambient temperature (\( T_A \)). An intelligent System Policy Manager maximizes delivered USB power while protecting the system from automotive battery transient and over-temperature conditions.

Device configuration settings are selected through an intuitive graphical user interface (GUI).

Device Information

<table>
<thead>
<tr>
<th>PART NUMBER</th>
<th>PACKAGE(1)</th>
<th>BODY SIZE</th>
</tr>
</thead>
<tbody>
<tr>
<td>TPS25764-Q1(2)</td>
<td>RQL (QFN-29)</td>
<td>6 mm x 5 mm</td>
</tr>
<tr>
<td>TPS25766-Q1(2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TPS25772-Q1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

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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 preproduction products; subject to change without notice.
## 4 Device Comparison Table

<table>
<thead>
<tr>
<th>PART NUMBER</th>
<th>Port A</th>
<th>Port B</th>
<th>Port A Output Power</th>
<th>Alternate Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>'25761-Q1 (1)</td>
<td>USB-PD</td>
<td>n/a</td>
<td>30 W</td>
<td>No</td>
</tr>
<tr>
<td>'25762-Q1 (1)</td>
<td>USB-PD</td>
<td></td>
<td>60 W</td>
<td>No</td>
</tr>
<tr>
<td>'25763-Q1 (1)</td>
<td>USB-PD</td>
<td>Type-A</td>
<td>60 W</td>
<td>Yes (DisplayPort™)</td>
</tr>
<tr>
<td>'25764-Q1 (1)</td>
<td>USB-PD</td>
<td>USB-C</td>
<td>60 W</td>
<td>No</td>
</tr>
<tr>
<td>'25766-Q1 (3)</td>
<td>USB-PD</td>
<td>USB-PD</td>
<td>60 W</td>
<td>No</td>
</tr>
</tbody>
</table>

(1) PRODUCT PREVIEW status.
5 Device and Documentation Support
5.1 Documentation Support
5.1.1 Related Documentation

Please visit TI homepage for latest technical document including application notes, user guides, and reference designs.

*IC Package Thermal Metrics* application report, *Semiconductor and IC Package Thermal Metrics*.

5.2 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on 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

*TI E2E™* is a trademark of Texas Instruments.

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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.
# PACKAGE OPTION ADDENDUM

## PACKAGING INFORMATION

<table>
<thead>
<tr>
<th>Orderable Device</th>
<th>Status (1)</th>
<th>Package Type</th>
<th>Package Drawing</th>
<th>Pins</th>
<th>Package Qty</th>
<th>Eco Plan (2)</th>
<th>Lead finish/Ball material (4)</th>
<th>MSL Peak Temp (3)</th>
<th>Op Temp (°C)</th>
<th>Device Marking (4/5)</th>
<th>Samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTP25772A0WRQLTQ1</td>
<td>ACTIVE</td>
<td>VQFN-HR</td>
<td>RQL</td>
<td>29</td>
<td>250</td>
<td>Non-RoHS &amp; Non-Green</td>
<td>Call TI</td>
<td>Call TI</td>
<td>-40 to 125</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TPS25772QWRRLQ1</td>
<td>PREVIEW</td>
<td>VQFN-HR</td>
<td>RQL</td>
<td>29</td>
<td>3000</td>
<td>Non-RoHS &amp; Non-Green</td>
<td>Call TI</td>
<td>Call TI</td>
<td>-40 to 125</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(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 finish/Ball material - Orderable Devices 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.

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