TPS65981 USB Type-C and USB PD Controller, Power Switch, and High Speed Multiplexer

1 Features

- USB Power Delivery (PD) Controller
  - Mode Configuration for Source (Host), Sink (Device), or Source-Sink
  - Bi-Phase Marked Encoding/Decoding (BMC)
  - Physical Layer (PHY) Protocol
  - Policy Engine
  - Configurable at Boot and Host-Controlled
- USB Type-C Specification Compliant
  - Detect USB Cable Plug Attach
  - Cable Orientation and Role Detection
  - Assign CC and VCONN Pins
  - Advertise Default, 1.5 A or 3 A for Type-C Power
- Port Power Switch
  - 5-V, 3-A Switch to VBUS for Type-C Power
  - 5-V to 20-V, 3-A Bidirectional Switch to or from VBUS for USB PD Power
  - 5-V, 600-mA Switches for VCONN
  - Overcurrent Limiter, Overvoltage Protector
  - Slew Rate Control
  - Hard Reset Support
- Port Data Multiplexer
  - USB 2.0 HS Data, UART Data, and Low Speed Endpoint
  - Sideband Use Data for Alternate Modes (DisplayPort, for Example)
- Power Management
  - Gate Control and Current Sense for External 5-V to 20-V, 5-A Bidirectional Switch (Back-to-Back NFETs)
  - Power Supply from 3.3-V or VBUS Source
  - 3.3-V LDO Output for Dead Battery Support
- QFN Package for Reliable Manufacturing
  - 0.5-mm Pitch
  - 2-Layer PCB Compatibility

2 Applications

- After-Market Automotive Infotainment
- Industrial Equipment
- Medical Equipment
- Notebooks, Tablets and Ultrabooks
- Monitors and TVs
- USB PD Hosts, Devices, and Dual-Role Ports

3 Description

The TPS65981 device is a stand-alone, USB Type-C and Power Delivery (PD) controller providing cable plug and orientation detection at the USB Type-C connector. Upon cable detection, the TPS65981 device communicates on the CC wire using the USB PD protocol. When cable detection and USB PD negotiation are complete, the TPS65981 device enables the appropriate power path and configures alternate mode settings for internal and (optional) external multiplexers.

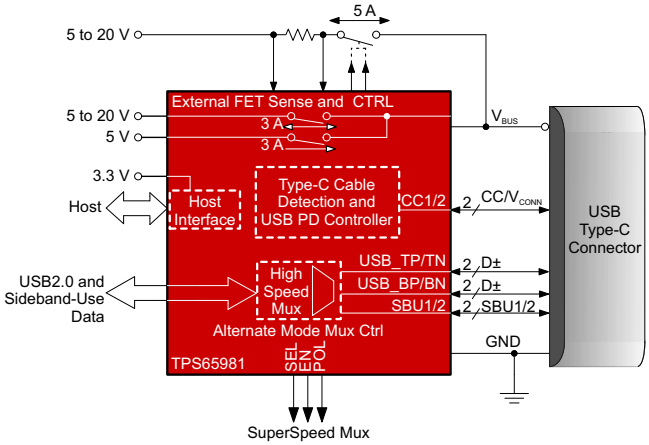
The mixed-signal front end on the CC pins provides default (900 mA), 1.5-A or 3-A current for Type-C power sources, detects a plug event and determines the USB Type-C cable orientation, and autonomously negotiates USB PD contracts by adhering to the specified biphase-marked coding (BMC) and physical-layer (PHY) protocol.

Device Information(1)

PART NUMBER	PACKAGE	BODY SIZE (NOM)
TPS65981	VQFN (56 pin)	8.00 mm × 8.00 mm

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

Simplified Diagram



PRODUCT PREVIEW

4 Description (continued)

The port power switch provides up to 3 A downstream at 5 V for legacy and Type-C USB power. An additional bidirectional switch path provides USB PD power up to 3 A at a maximum of 20 V as either a source (host), sink (device), or source-sink.

The TPS65981 device is also an upstream-facing port (UFP), downstream-facing port (DFP), or dual-role port for data. The port data multiplexer passes data to or from the top or bottom D+/D– signal pair at the port for USB 2.0 HS and has a USB 2.0 Low-Speed Endpoint. Additionally, the sideband-use (SBU) signal pair is used for auxiliary or alternate modes of communication (DisplayPort, for example).

The power management circuitry uses 3.3 V inside the system and also uses VBUS to start up and negotiate power for a dead-battery or no-battery condition.

5 Device and Documentation Support

5.1 Documentation Support

5.1.1 Related Documentation

for related documentation, see the following:

- USB Power Delivery Specification Revision 2.0, V1.1 (May 7th, 2015)
- USB Type-C Specification Release 1.1 (April 3rd, 2015)
- USB Battery Charging Specification Revision 1.2 (December 7th, 2010)
- W25Q80 data sheet - http://www.elinux.org/images/f/f5/Winbond-w25q32.pdf
- NSR20F30NXT5G data sheet - http://www.onsemi.com/pub_link/Collateral/NSR20F30-D.PDF

5.2 Community Resources

The following links connect to TI community resources. Linked contents are 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.

TI E2E™ Online Community ***TI's Engineer-to-Engineer (E2E) Community.*** Created to foster collaboration among engineers. At e2e.ti.com, you can ask questions, share knowledge, explore ideas and help solve problems with fellow engineers.

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5.3 Trademarks

E2E is a trademark of Texas Instruments.
All other trademarks are the property of their respective owners.

5.4 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.

5.5 Glossary

SLYZ022 — *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.

PRODUCT PREVIEW

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
TPS65981ABIRTQR	PREVIEW	QFN	RTQ	56	2500	TBD	Call TI	Call TI	-40 to 85		
TPS65981ABTRTQR	PREVIEW	QFN	RTQ	56	2500	TBD	Call TI	Call TI	-40 to 105		

(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) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been defined.
Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(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.

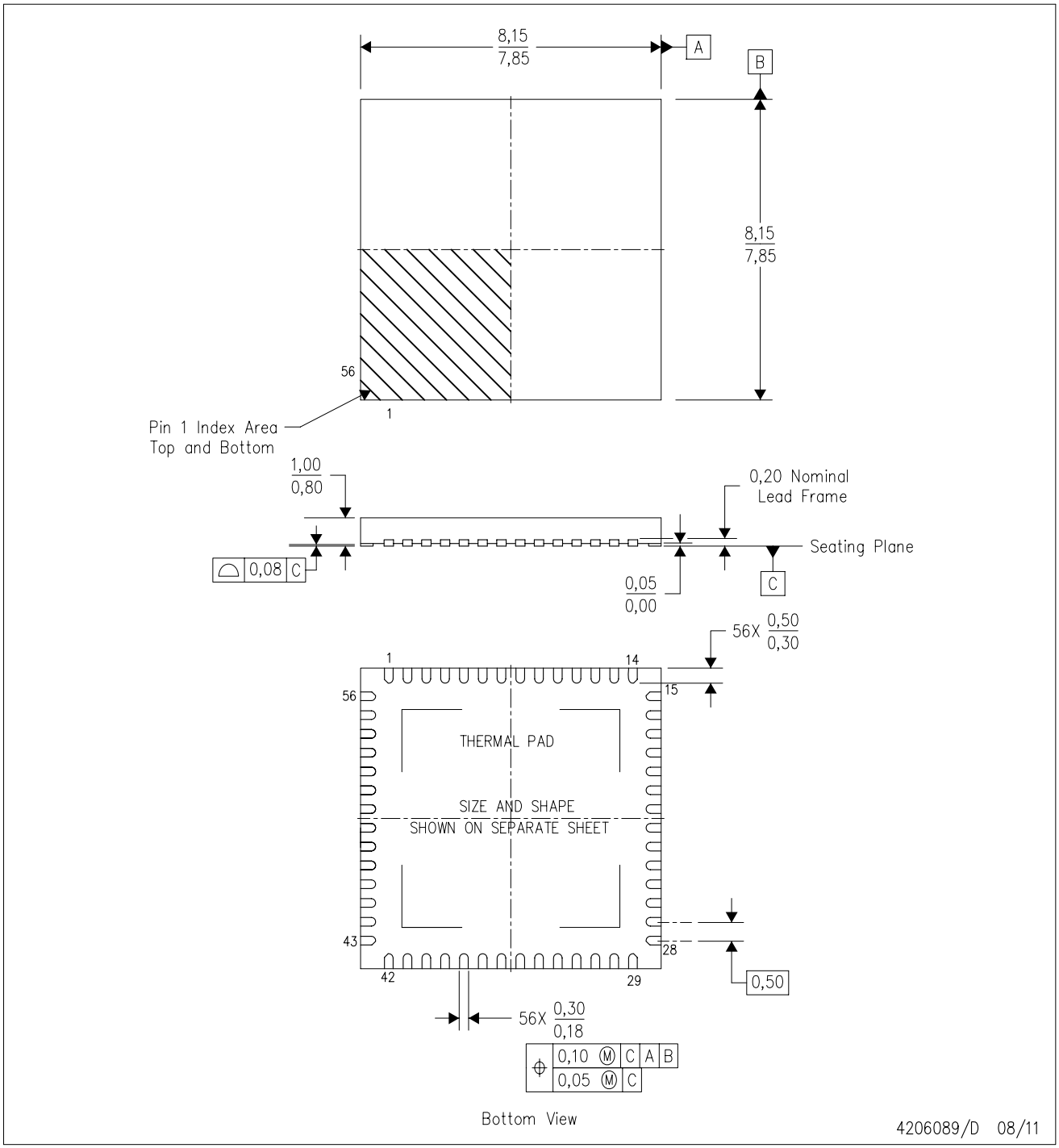
OTHER QUALIFIED VERSIONS OF TPS65981 :

- Automotive: TPS65981-Q1

NOTE: Qualified Version Definitions:

- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects

RTQ (S–PVQFN–N56) PLASTIC QUAD FLATPACK NO–LEAD



NOTES:
A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5–1994.
B. This drawing is subject to change without notice.
C. QFN (Quad Flatpack No–Lead) Package configuration.
D. The package thermal pad must be soldered to the board for thermal and mechanical performance.
E. See the additional figure in the Product Data Sheet for details regarding the exposed thermal pad features and dimensions.
F. Package complies to JEDEC MO–220.

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