

# bq24780S 1- to 4-Cell Hybrid Power Boost Mode Battery Charge Controller With Power and Processor Hot Monitoring

## 1 Features

- Industrial Innovative Charge Controller With Hybrid Power Boost Mode
  - Adapter and Battery Provides Power to System Together for Intel® CPU Turbo Mode
  - Ultra-Fast Transient Response of 150  $\mu$ s to Enter Boost Mode
  - Hybrid Power Boost Mode from 4.5- to 24-V System
  - Charge 1- to 4-Cell Battery Pack from 4.5- to 24-V Adapter
- High Accuracy Power and Current Monitoring for CPU Throttling
  - Comprehensive  $\overline{\text{PROCHOT}}$  Profile
  - $\pm 2\%$  Current Monitor Accuracy
  - $\pm 5\%$  System Power Monitor Accuracy (PMON)
- Automatic NMOS Power Source Selection from Adapter or Battery
  - ACFET Fast Turn on in 100  $\mu$ s
- Programmable Input Current, Charge Voltage, Charge and Discharge Current Limit
  - $\pm 0.4\%$  Charge Voltage (16-mV step)
  - $\pm 2\%$  Input Current (128-mA/step)
  - $\pm 2\%$  Charge Current (64-mA/step)
  - $\pm 2\%$  Discharge Current (512-mA/step)
- High Integration
  - Battery LEARN Function
  - Battery Present Monitor
  - Boost Mode Indicator
  - Loop Compensation
  - BTST Diode
- Enhanced Safety Features for Overvoltage Protection, Overcurrent Protection, Battery, Inductor, and MOSFET Short-Circuit Protection
- Switching Frequency: 600 kHz, 800 kHz, and 1 MHz
- Realtime System Control on ILIM Pin to Limit Charge and Discharge Current
- 0.65 mA Adapter Standby Quiescent Current for Energy Star

## 2 Applications

- Notebook, Ultrabook, Detachable, and Tablet PC
- Handheld Terminal
- Industrial and Medical Equipment
- Portable Equipment

## 3 Description

The bq24780S device is a high-efficiency, synchronous battery charger, offering low component count for space-constrained, multi-chemistry battery charging applications.

The bq24780S device supports hybrid power boost mode (previously called "turbo boost mode"). It allows battery discharge energy to system when system power demand is temporarily higher than adapter maximum power level. Therefore, adapter does not crash.

The bq24780S device uses two charge pumps to separately drive N-channel MOSFETs (ACFET, RBFET, and BATFET) for automatic system power source selection.

Through SMBus, system power management microcontroller programs input current, charge current, discharge current, and charge voltage DACs with high regulation accuracies.

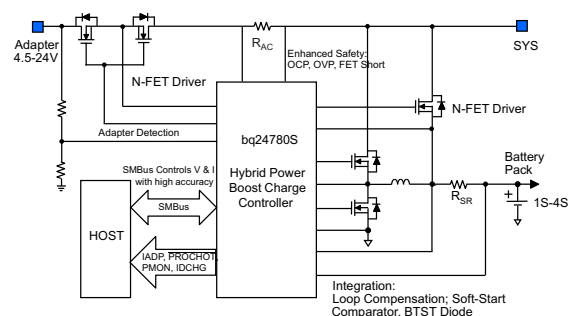
The bq24780S device monitors adapter current (IADP), battery discharge current (IDCHG), and system power (PMON) for host to throttle back CPU speed or reduce system power when needed.

The bq24780S device charges 1-, 2-, 3-, or 4-series Li+ cells.

### Device Information<sup>(1)</sup>

PART NUMBER	PACKAGE	BODY SIZE (NOM)
bq24780S	WQFN (28)	4.00 × 4.00 mm <sup>2</sup>

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



## 4 Revision History

### Changes from Original (April 2015) to Revision A

Page

- 
- Added email link to request the full datasheet ..... 2
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Contact TI via at: [bq24780s\\_request@list.ti.com](mailto:bq24780s_request@list.ti.com) for full data sheet.

## 5 Device and Documentation Support

### 5.1 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](http://e2e.ti.com), you can ask questions, share knowledge, explore ideas and help solve problems with fellow engineers.

**Design Support** *TI's Design Support* Quickly find helpful E2E forums along with design support tools and contact information for technical support.

### 5.2 Trademarks

E2E is a trademark of Texas Instruments.

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### 5.3 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.

### 5.4 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.

**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
BQ24780SRUYR	ACTIVE	WQFN	RUY	28	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	BQ 24780S	<a href="#">Samples</a>
BQ24780SRUYT	ACTIVE	WQFN	RUY	28	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	BQ 24780S	<a href="#">Samples</a>

(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.

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**TAPE AND REEL INFORMATION**

**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
BQ24780SRUYR	WQFN	RUY	28	3000	330.0	12.4	4.25	4.25	1.15	8.0	12.0	Q2
BQ24780SRUYT	WQFN	RUY	28	250	180.0	12.4	4.25	4.25	1.15	8.0	12.0	Q2

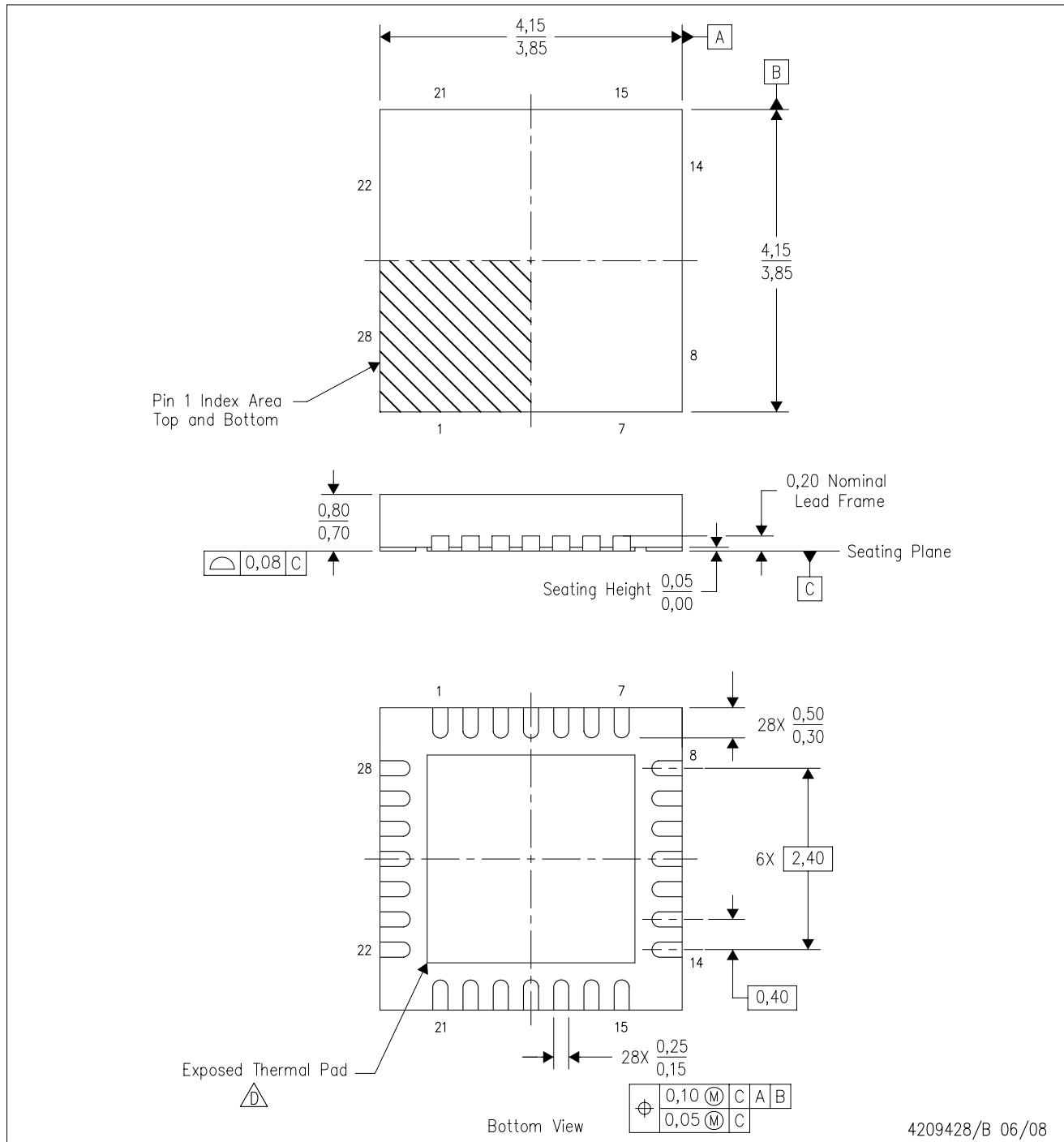
**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
BQ24780SRUYR	WQFN	RUY	28	3000	367.0	367.0	35.0
BQ24780SRUYT	WQFN	RUY	28	250	210.0	185.0	35.0

RUY (S-PWQFN-N28)

PLASTIC QUAD FLATPACK NO-LEAD



4209428/B 06/08

- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
  - B. This drawing is subject to change without notice.
  - C. QFN (Quad Flatpack No-Lead) package configuration.
  - $\triangle$  D. The package thermal pad must be soldered to the board for thermal and mechanical performance. See the Product Data Sheet for details regarding the exposed thermal pad dimensions.



## THERMAL PAD MECHANICAL DATA

RUY (S-PWQFN-N28)

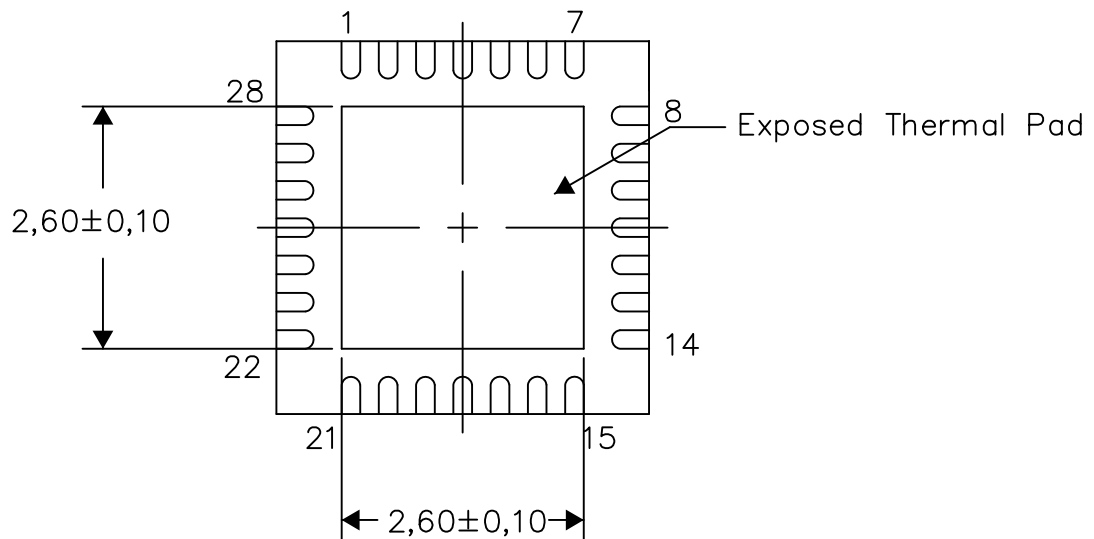
PLASTIC QUAD FLATPACK NO-LEAD

### THERMAL INFORMATION

This package incorporates an exposed thermal pad that is designed to be attached directly to an external heatsink. The thermal pad must be soldered directly to the printed circuit board (PCB). After soldering, the PCB can be used as a heatsink. In addition, through the use of thermal vias, the thermal pad can be attached directly to the appropriate copper plane shown in the electrical schematic for the device, or alternatively, can be attached to a special heatsink structure designed into the PCB. This design optimizes the heat transfer from the integrated circuit (IC).

For information on the Quad Flatpack No-Lead (QFN) package and its advantages, refer to Application Report, QFN/SON PCB Attachment, Texas Instruments Literature No. SLUA271. This document is available at [www.ti.com](http://www.ti.com).

The exposed thermal pad dimensions for this package are shown in the following illustration.



Bottom View

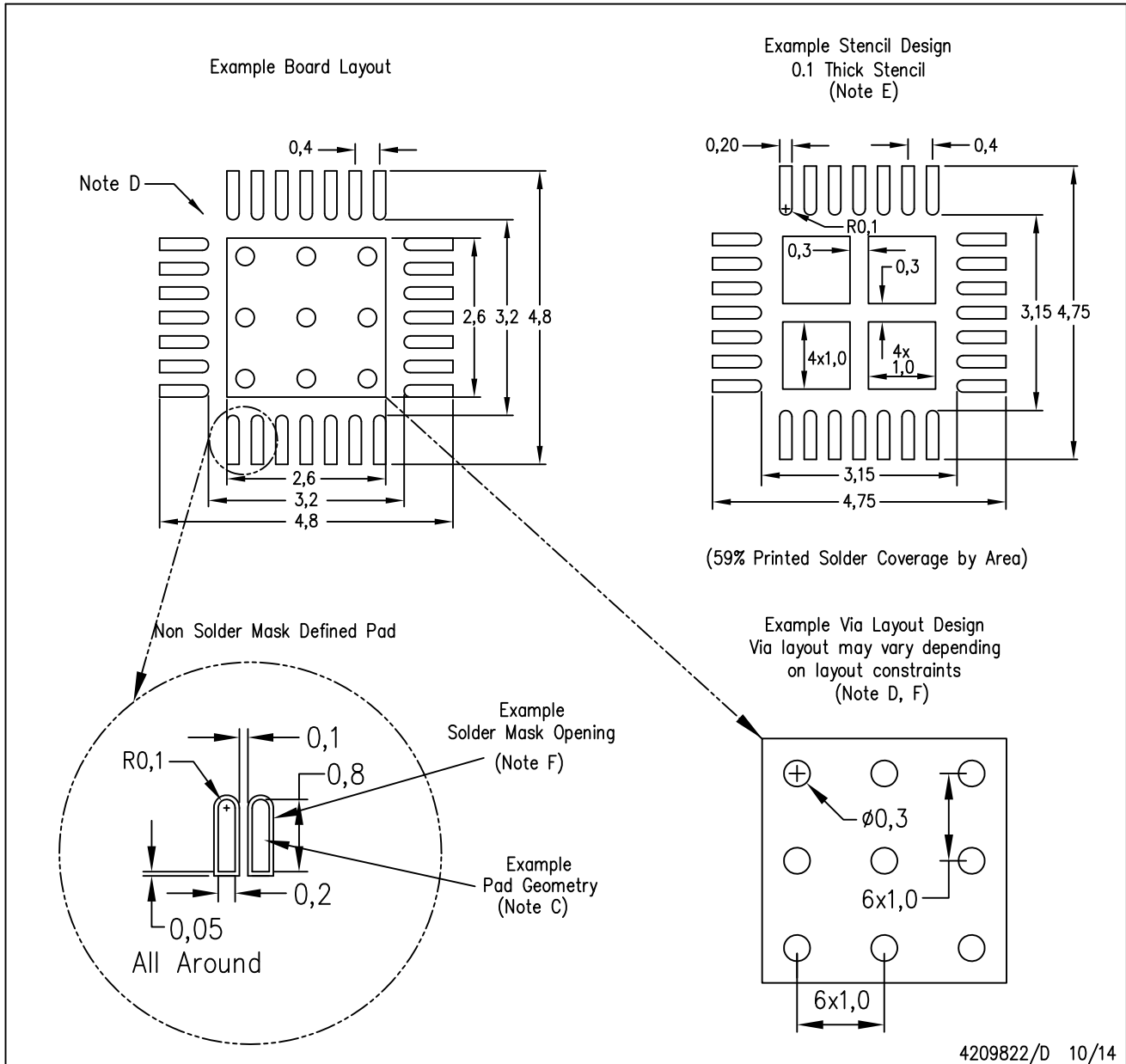
Exposed Thermal Pad Dimensions

4209490/E 10/14

NOTE: All linear dimensions are in millimeters

RUY (S-PWQFN-N28)

PLASTIC QUAD FLATPACK NO-LEAD



- NOTES:
- All linear dimensions are in millimeters.
  - This drawing is subject to change without notice.
  - Publication IPC-7351 is recommended for alternate designs.
  - This package is designed to be soldered to a thermal pad on the board. Refer to Application Note, Quad Flat-Pack Packages, Texas Instruments Literature No. SLUA271, and also the Product Data Sheets for specific thermal information, via requirements, and recommended board layout. These documents are available at [www.ti.com](http://www.ti.com) <<http://www.ti.com>>.
  - Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC 7525 for stencil design considerations.
  - Customers should contact their board fabrication site for recommended solder mask tolerances and via tenting recommendations for vias placed in the thermal pad.

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RFID	<a href="http://www.ti-rfid.com">www.ti-rfid.com</a>
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### Applications

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Computers and Peripherals	<a href="http://www.ti.com/computers">www.ti.com/computers</a>
Consumer Electronics	<a href="http://www.ti.com/consumer-apps">www.ti.com/consumer-apps</a>
Energy and Lighting	<a href="http://www.ti.com/energy">www.ti.com/energy</a>
Industrial	<a href="http://www.ti.com/industrial">www.ti.com/industrial</a>
Medical	<a href="http://www.ti.com/medical">www.ti.com/medical</a>
Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
Space, Avionics and Defense	<a href="http://www.ti.com/space-avionics-defense">www.ti.com/space-avionics-defense</a>
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