



# THE DATASHEET OF TPS40195RGYT



## TPS40195 4.5-V to 20-V Synchronous Buck Controller With Synchronization and Power Good

### 1 Features

- Input Operating Voltage Range: 4.5 V to 20 V
- Output Voltage as Low as 0.591 V  $\pm 0.5\%$
- 180° Bi-Directional Out-of-Phase Synchronization
- Internal 5-V Regulator
- High and Low MOSFET Sense Overcurrent
- 100-kHz to 600-kHz Switching Frequency
- Enable and Power Good
- Programmable UVLO and Hysteresis
- Thermal Shutdown at 150°C
- Selectable Soft Start
- Prebias Output Safe

### 2 Applications

- Digital TV
- Entry-Level and Midrange Servers
- Networking Equipment
- Non-Isolated DC-DC modules

### 3 Description

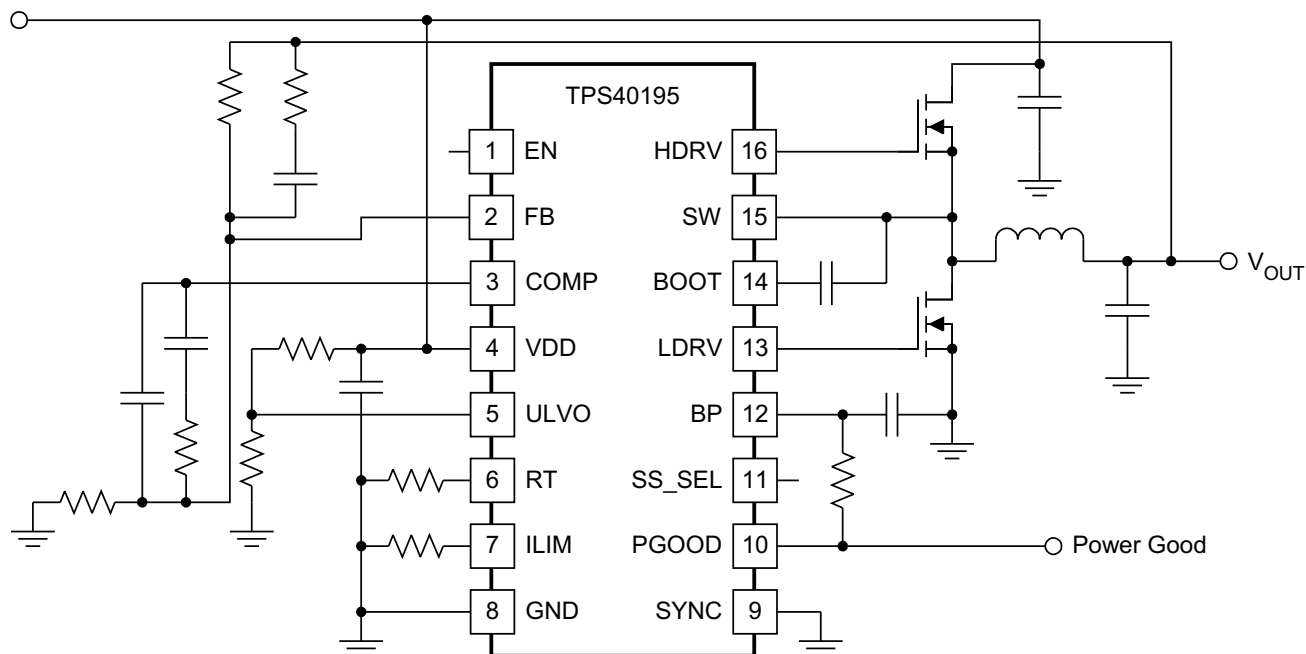
The TPS40195 is a flexible synchronous buck controller that operates from a nominal 4.5-V to 20-V supply. This controller implements voltage mode control with the switching frequency adjustable from 100 kHz to 600 kHz. Flexible features found on this device include selectable soft-start time, programmable short-circuit limit, programmable undervoltage lockout (UVLO) and synchronization capability. An adaptive anti-cross conduction scheme is used to prevent shoot through current in the power FETs. Overcurrent detection is done by sensing the voltage drop across the low-side MOSFET when it is on, and comparing it with a user-programmable threshold.

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

PART NUMBER	PACKAGE	BODY SIZE (NOM)
TPS40195	TSSOP (16)	5.00 mm x 4.40 mm
	VQFN (16)	4.00 mm x 3.50 mm

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

#### Simplified Application Diagram



UDG-06066



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## 4 Revision History

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

<b>Changes from Revision E (July 2012) to Revision F</b>	<b>Page</b>
• Editorial changes only; no technical revisions .....	<b>1</b>
• Added <i>ESD Ratings</i> table, <i>Feature Description</i> section, <i>Device Functional Modes</i> , <i>Application and Implementation</i> section, <i>Power Supply Recommendations</i> section, <i>Layout</i> section, <i>Device and Documentation Support</i> section, and <i>Mechanical, Packaging, and Orderable Information</i> section. ....	<b>1</b>
• Removed <i>Ordering Information</i> table .....	<b>1</b>

<b>Changes from Revision D (November 2008) to Revision E</b>	<b>Page</b>
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## 5 Description (continued)

The threshold is set with a single external resistor connected from ILIM to GND. Pulse-by-pulse limiting (to prevent current runaway) is provided by sensing the voltage across the high-side MOSFET when it is on and terminating the cycle when the voltage drop rises above a fixed threshold of 550 mV. When the controller senses an output short circuit, both MOSFETs are turned off and a timeout period is observed before attempting to restart. This provides limited power dissipation in the event of a sustained fault. Synchronization on this device is bi-directional. Devices can be synchronized 180° out of phase to a chosen master TPS40195 running at a fixed 250 kHz or 500 kHz, or can be synchronized to an outside clock source anywhere in the 100 kHz to 600 kHz range.

## 6 Device and Documentation Support

### 6.1 Device Support

#### 6.1.1 Third-Party Products Disclaimer

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### 6.2 Device Support

#### 6.2.1 Related Parts

The following parts have characteristics similar to the TPS40195 and may be of interest.

**Table 1. Related Parts**

DEVICE	DESCRIPTION
TPS40100	Midrange Input Synchronous Controller with Advanced Sequencing and Output Margining
TPS40075	Wide Input Synchronous Controller with Voltage Feed Forward
TPS40190	Low Pin Count Synchronous Buck Controller
TPS40192/3	4.5V to 18V Input, Low Pin Count, Synchronous Buck Controller with Power Good

### 6.3 Documentation Support

#### 6.3.1 Related Documentation

These references may be found on the web at [www.power.ti.com](http://www.power.ti.com) under Technical Documents. Many design tools and links to additional references, including design software, may also be found at [www.power.ti.com](http://www.power.ti.com)

- *Under The Hood Of Low Voltage DC/DC Converters*, SEM 1500 Topdevice 5, 2002 Seminar Series
- *Understanding Buck Power Stages in Switch-mode Power Supplies*, [SLVA057](#), March 1999
- *Design and Application Guide for High Speed MOSFET Gate Drive Circuits*, SEM 1400, 2001 Seminar Series
- *Designing Stable Control Loops*, SEM 1400, 2001 Seminar Series
- Additional PowerPAD™ information may be found in Applications Briefs [SLMA002](#) and [SLMA004](#)
- QFN/SON PCB Attachment, Texas Instruments Literature Number [SLUA271](#), June 2002

### 6.4 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on [ti.com](http://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.

### 6.5 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.

### 6.6 Trademarks

E2E is a trademark of Texas Instruments.

All other trademarks are the property of their respective owners.

## 6.7 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.

## 6.8 Glossary

[SLYZ022](#) — *TI Glossary*.

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

## 7 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
TPS40195PW	ACTIVE	TSSOP	PW	16	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	40195	<a href="#">Samples</a>
TPS40195PWR	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	40195	<a href="#">Samples</a>
TPS40195RGYR	ACTIVE	VQFN	RGY	16	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	40195	<a href="#">Samples</a>
TPS40195RGYT	ACTIVE	VQFN	RGY	16	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	40195	<a href="#">Samples</a>
TPS40195RGYTG4	ACTIVE	VQFN	RGY	16	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	40195	<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) **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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## TAPE AND REEL INFORMATION



### QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



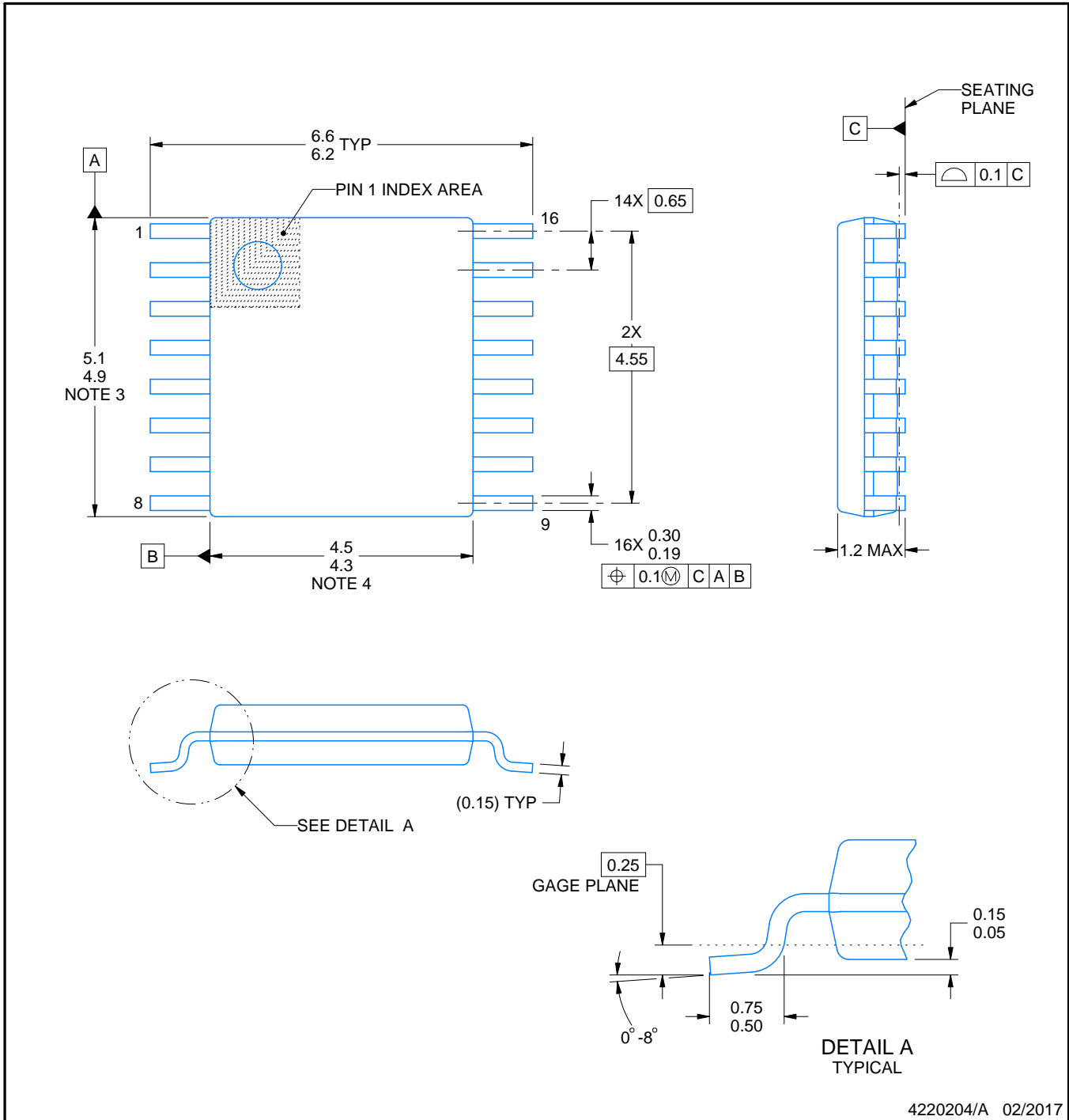
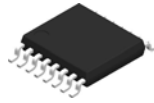
\*All dimensions are nominal

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
TPS40195PWR	TSSOP	PW	16	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
TPS40195RGYR	VQFN	RGY	16	3000	330.0	12.4	3.71	4.21	1.11	8.0	12.0	Q1
TPS40195RGYT	VQFN	RGY	16	250	180.0	12.5	3.71	4.21	1.11	8.0	12.0	Q1

**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TPS40195PWR	TSSOP	PW	16	2000	367.0	367.0	35.0
TPS40195RGYR	VQFN	RGY	16	3000	338.0	355.0	50.0
TPS40195RGYT	VQFN	RGY	16	250	338.0	355.0	50.0



4220204/A 02/2017

NOTES:

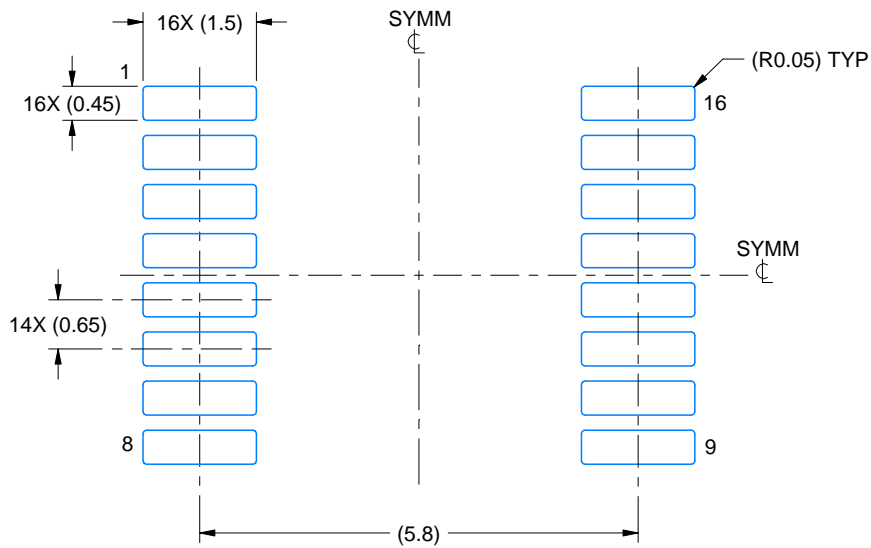
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
5. Reference JEDEC registration MO-153.

# EXAMPLE BOARD LAYOUT

PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE: 10X



SOLDER MASK DETAILS

4220204/A 02/2017

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

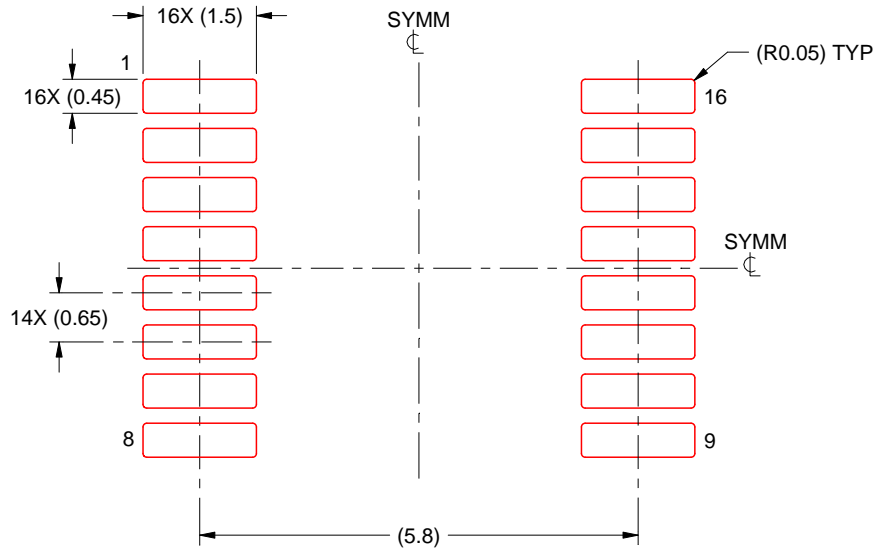
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# EXAMPLE STENCIL DESIGN

PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE: 10X

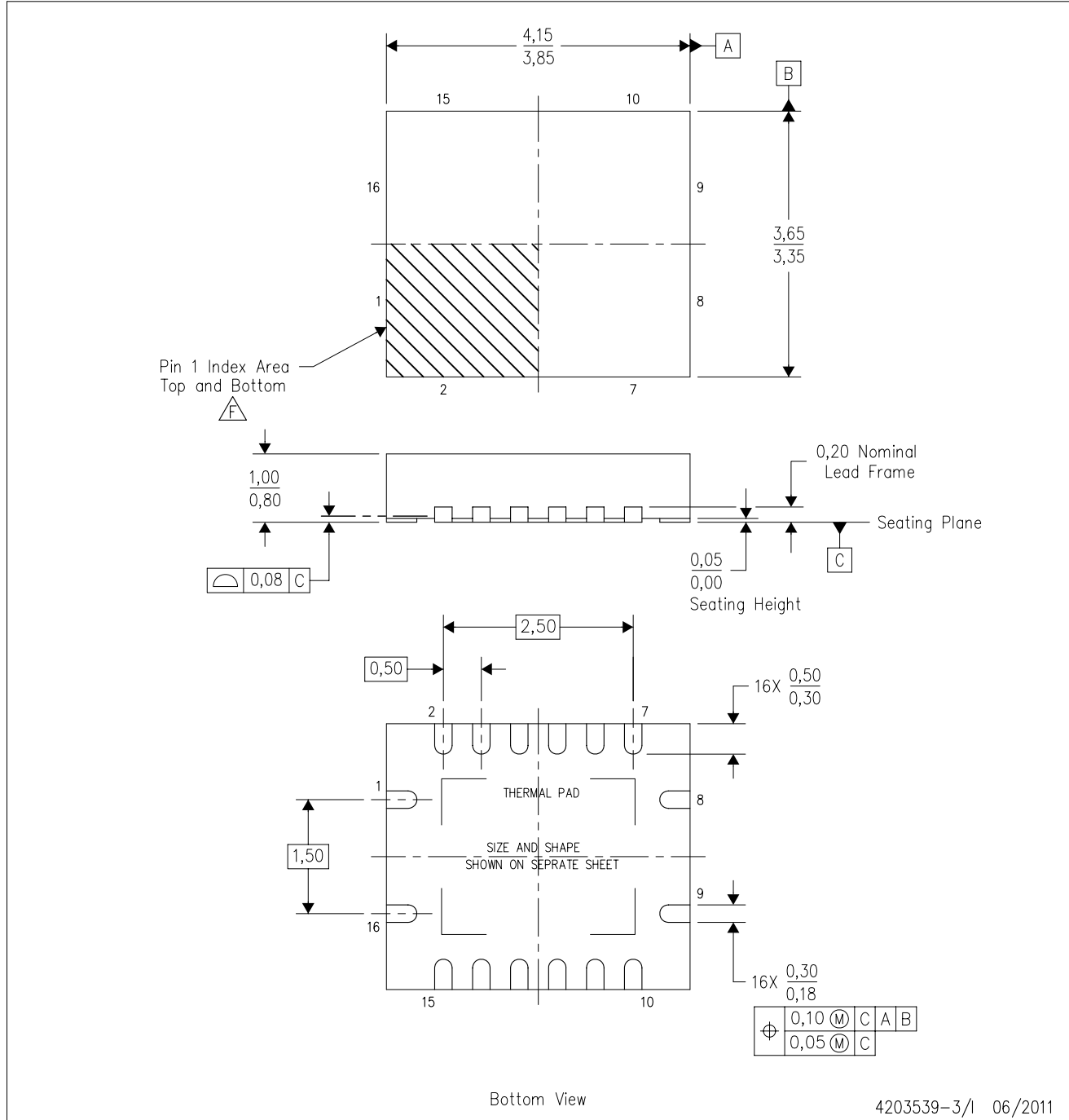
4220204/A 02/2017

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

RGY (R-PVQFN-N16)

PLASTIC QUAD FLATPACK NO-LEAD



- 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.
  - 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. Pin 1 identifiers are located on both top and bottom of the package and within the zone indicated. The Pin 1 identifiers are either a molded, marked, or metal feature.
  - G. Package complies to JEDEC MO-241 variation BA.

RGY (R-PVQFN-N16)

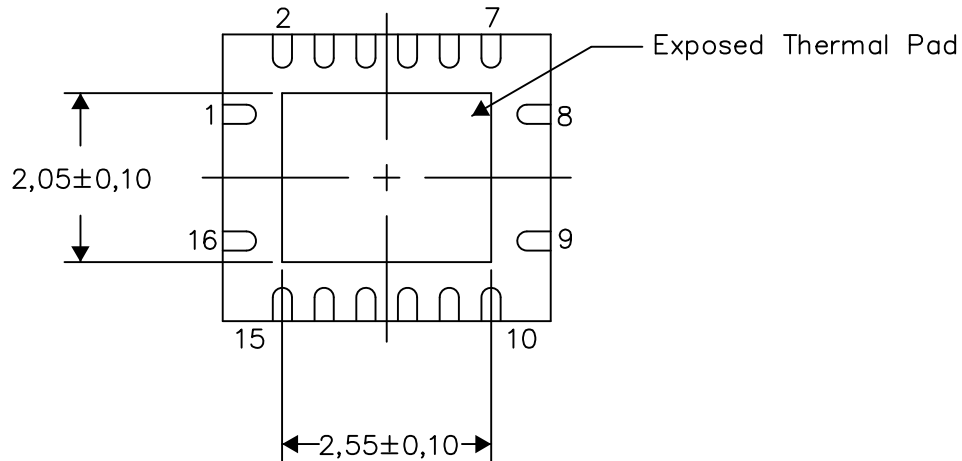
PLASTIC QUAD FLATPACK NO-LEAD

**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

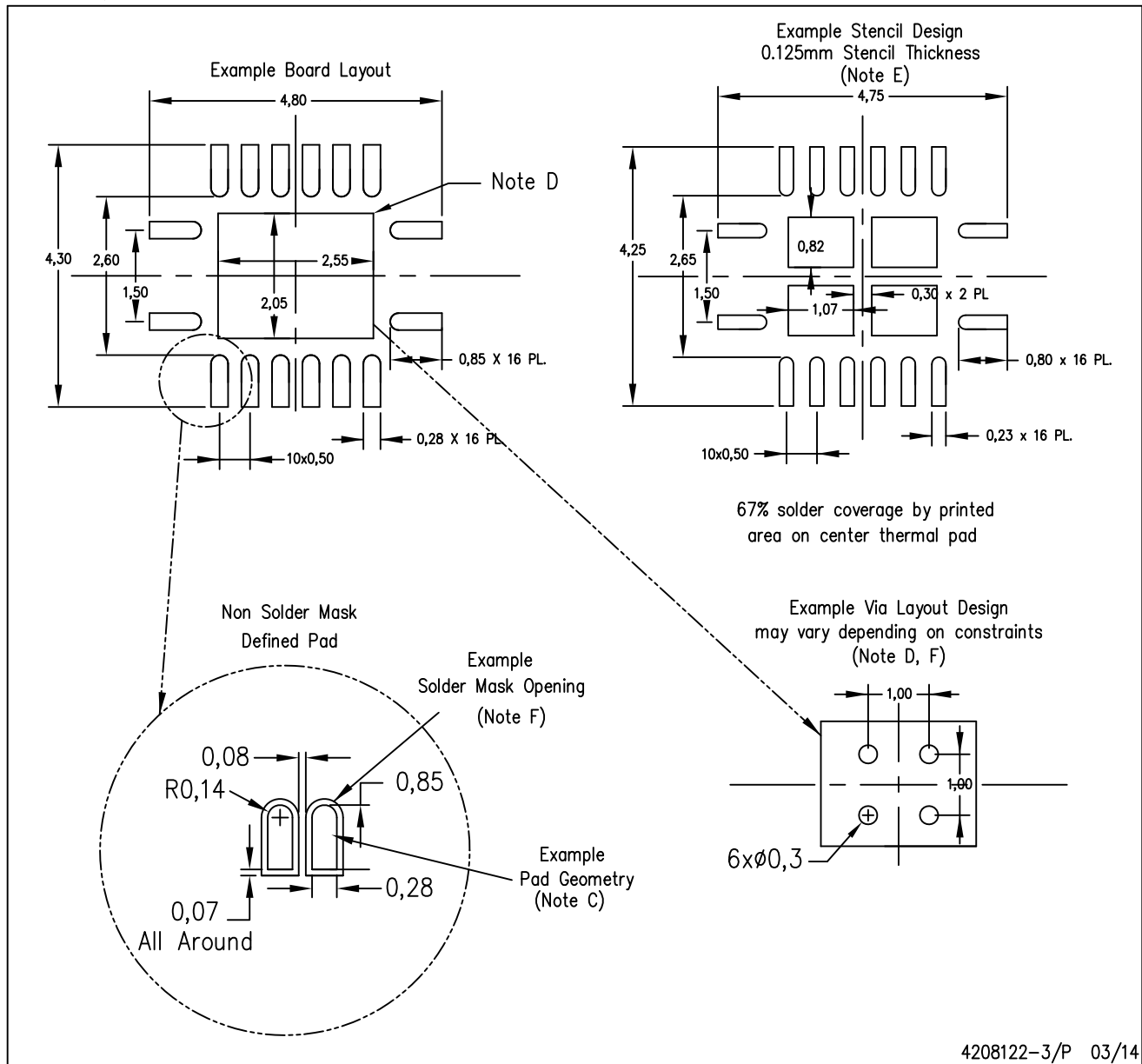
Exposed Thermal Pad Dimensions

4206353-3/P 03/14

NOTE: All linear dimensions are in millimeters

RGY (R-PVQFN-N16)

PLASTIC QUAD FLATPACK NO-LEAD



4208122-3/P 03/14

- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Publication IPC-7351 is recommended for alternate designs.
  - D. This package is designed to be soldered to a thermal pad on the board. Refer to Application Note, Quad Flat-Pack QFN/SON PCB Attachment, 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>>.
  - E. 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.
  - F. Customers should contact their board fabrication site for minimum solder mask web tolerances between signal pads.

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