TPS65313-Q1 High-Voltage Power-Management IC for Automotive Applications

1 Device Overview

1.1 Features

- Qualified for Automotive Applications
- AEC-Q100 Qualified with the Following Results:
  - Device Temperature Grade 1: –40°C to +125°C Ambient Operating Temperature
  - Device HBM ESD Classification Level 2
  - Device CDM ESD Classification Level C4B
- Synchronous Buck Preregulator (BUCK1)
  - Input Voltage Range from 4 V to 36 V
  - Output Currents up to 3.1 A
  - Factory-Selectable Output Voltage of 3.3 V or 3.6 V
- Synchronous Buck Regulator (BUCK2)
  - Fixed Input Voltage of 3.3 V or 3.6 V
  - Output Currents up to 2 A
  - Factory-Selectable Output Voltage of 1.2 V, 1.25 V, 1.8 V, or 2.3 V
- Synchronous Boost Regulator (BOOST)
  - Fixed Input Voltage of 3.3 V or 3.6 V
  - Output Currents up to 600 mA
  - Output Voltage of 5 V
- Phase-Locked Loop (PLL)
  - Output Frequency Around 2.2 MHz.
  - Supports Modulated or Unmodulated External Clock at SYNC_IN Pin
- For All Regulators
  - Soft-Start Feature
  - Independent Voltage monitoring With Diagnostics
  - Overcurrent, Overload, Overvoltage, Undervoltage, and Thermal Protection
  - Internal Loop Compensation
- 3-µA Quiescent Current in the OFF State
- SPI for Control and Diagnostics
- Two General-Purpose External-Voltage Monitors
- Integrated Q&A Watchdog and Reset Supervisor for MCU or DSP
- Supports System-Level Functional Safety Requirements up to ASIL-C (ISO 26262)
- Thermally Enhanced 40-Pin VQFNP Package With 0.5-mm Pitch

1.2 Applications

- Multirail DC Distributed Power Systems
- Functional Safety-Relevant Applications
  - Automotive ADAS Applications
  - Industrial Applications
  - Machinery and Transportation Applications

1.3 Description

The TPS65313-Q1 device is a power management IC (PMIC), meeting the requirements of MCU-controlled or DSP-controlled automotive and industrial, machinery, or transportation systems. With the integration of commonly used features, the device helps reduce board space and system cost.

The device includes one high-voltage (HV) off-battery synchronous buck regulator combined with one low-voltage (LV) buck and one boost regulator that are powered from the HV buck regulator. The device features a low quiescent current in the OFF state to reduce current consumption in case the system is permanently connected to the battery. All outputs are protected against overvoltage, overload, and overtemperature conditions.

All regulated supply outputs with independent monitoring and protection functions can support up to ASIL-B system-level functional safety requirements, including mandatory and programmable diagnostics (analog and logic built-in-self-test) to prevent latent faults. The device also integrates a programmable supervisor, watchdog functions, and a processor error pin monitor.

Device Information[1]

PART NUMBER	PACKAGE	BODY SIZE (NOM)
TPS65313-Q1	VQFNP (40)	6.00 mm × 6.00 mm

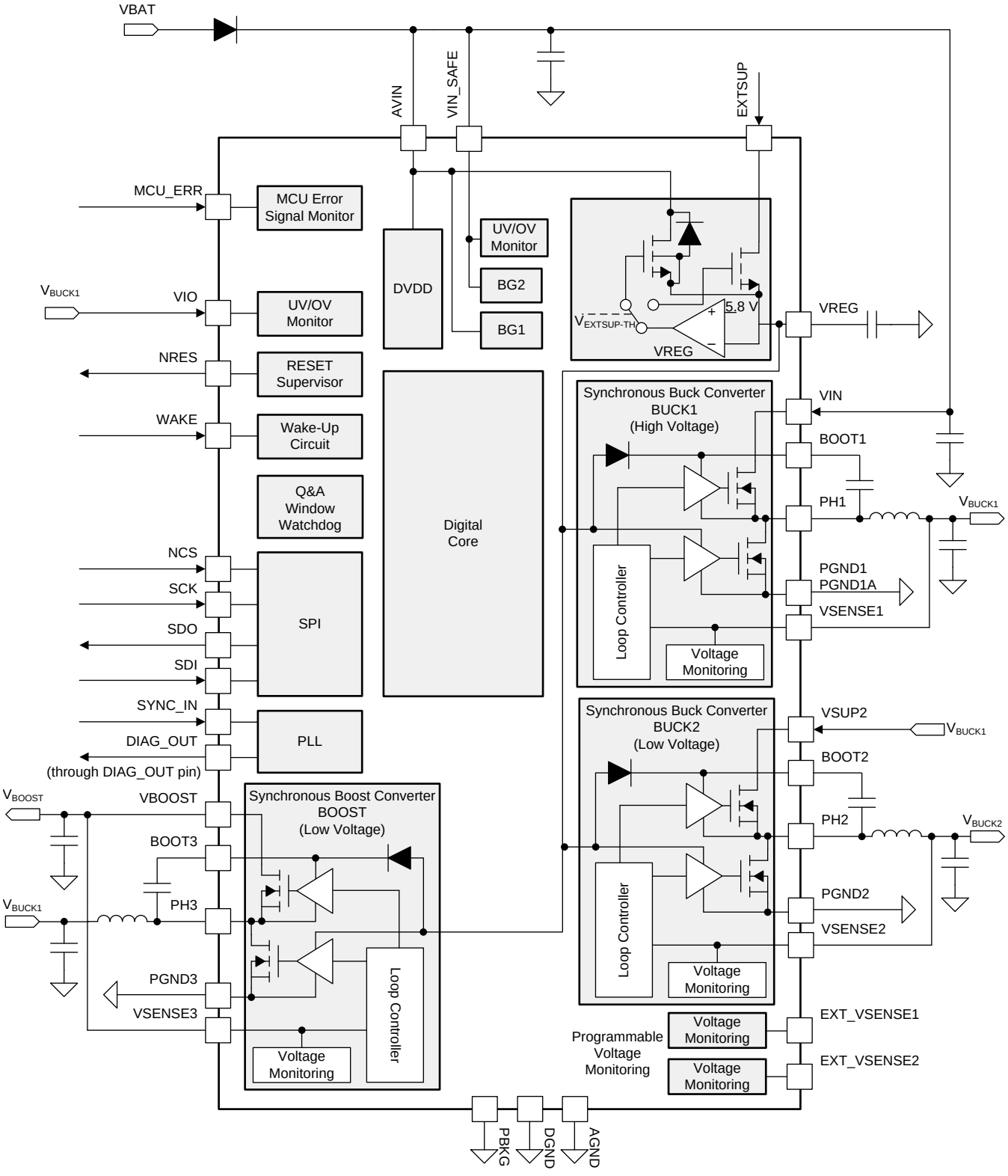
(1) For all available packages, see the orderable addendum at the end of the data sheet.

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ADVANCE INFORMATION

1.3.1 Functional Block Diagram



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Figure 1-1. Device Functional Block Diagram

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2 Revision History

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

DATE	REVISION	NOTES
February 2018	*	Initial release.

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3 Device Option Table

ORDERABLE PART NUMBER	BUCK1	BUCK2	f_{SW} MODULATION	EXT_VMON1 ENABLED AT POWER-UP	EXT_VMON2 ENABLED AT POWER-UP
O313B014QRWGRQ1	3.3 V	1.8 V	Internal	NO	NO
O313B016QRWGRQ1	3.3 V	2.3 V	Internal	NO	NO
O313B092QRWGRQ1	3.3 V	1.25 V	External	NO	NO
O313B096QRWGRQ1	3.3 V	2.3 V	External	NO	NO

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4 Device and Documentation Support

4.1 Receiving Notification of Documentation Updates

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

4.2 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 The TI engineer-to-engineer (E2E) community was 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.

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

4.3 Trademarks

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All other trademarks are the property of their respective owners.

4.4 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.

4.5 Glossary

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

5 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.

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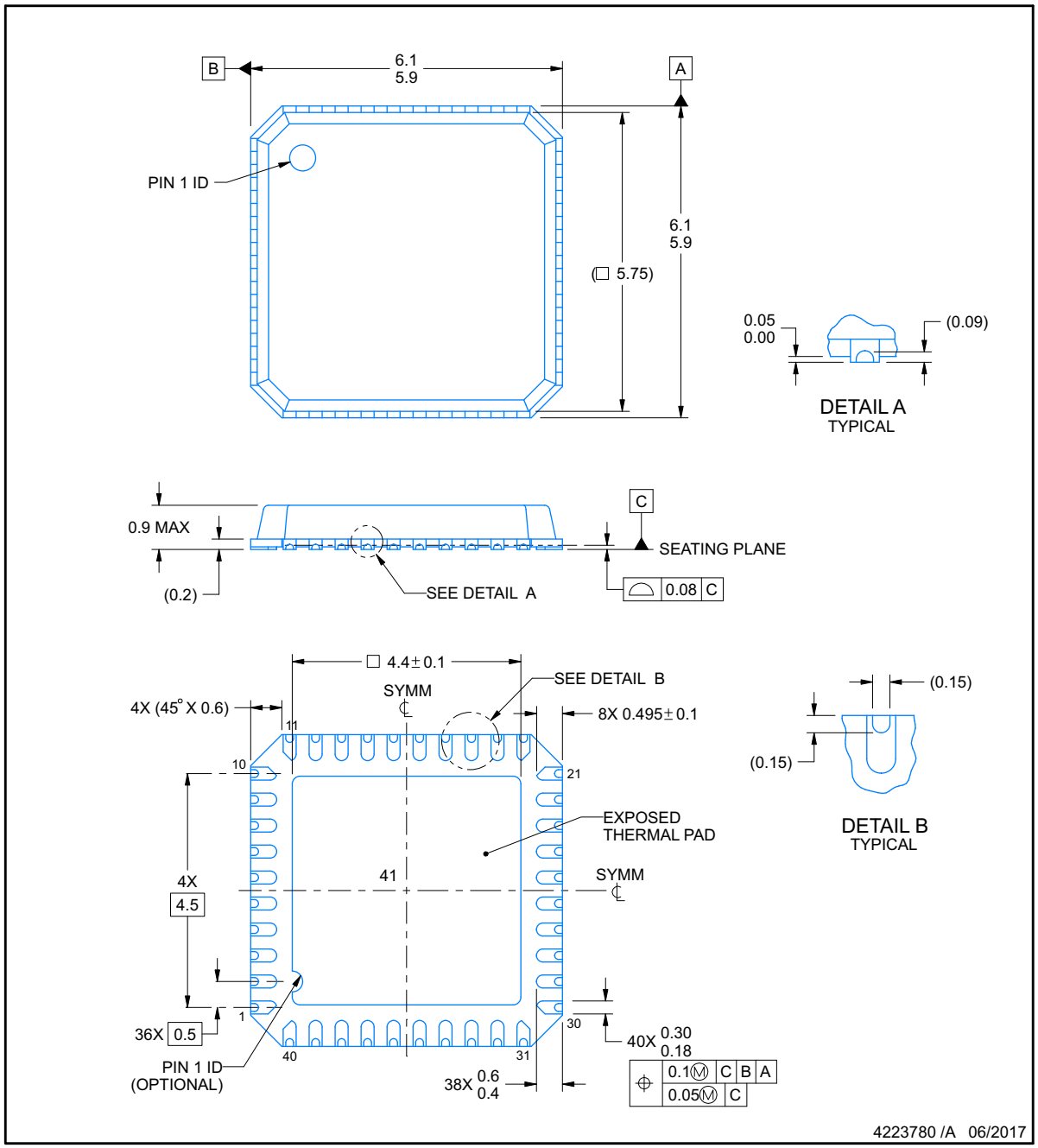
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PACKAGE OUTLINE

RWG0040B

VQFNP - 0.9 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



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. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.

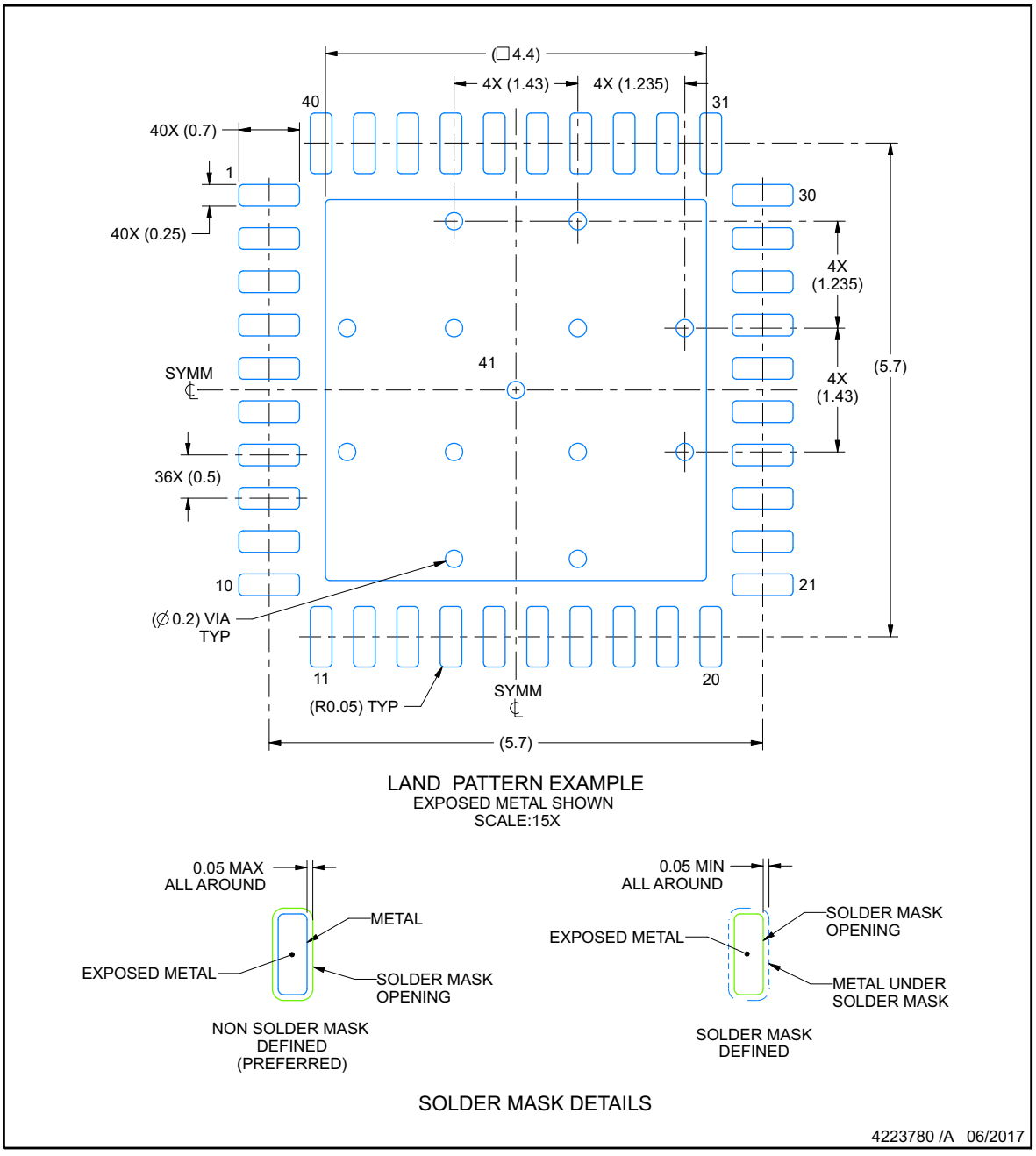
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EXAMPLE BOARD LAYOUT

RWG0040B

VQFNP - 0.9 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



NOTES: (continued)

4. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/slua271).
5. Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It is recommended that vias under paste be filled, plugged or tented.

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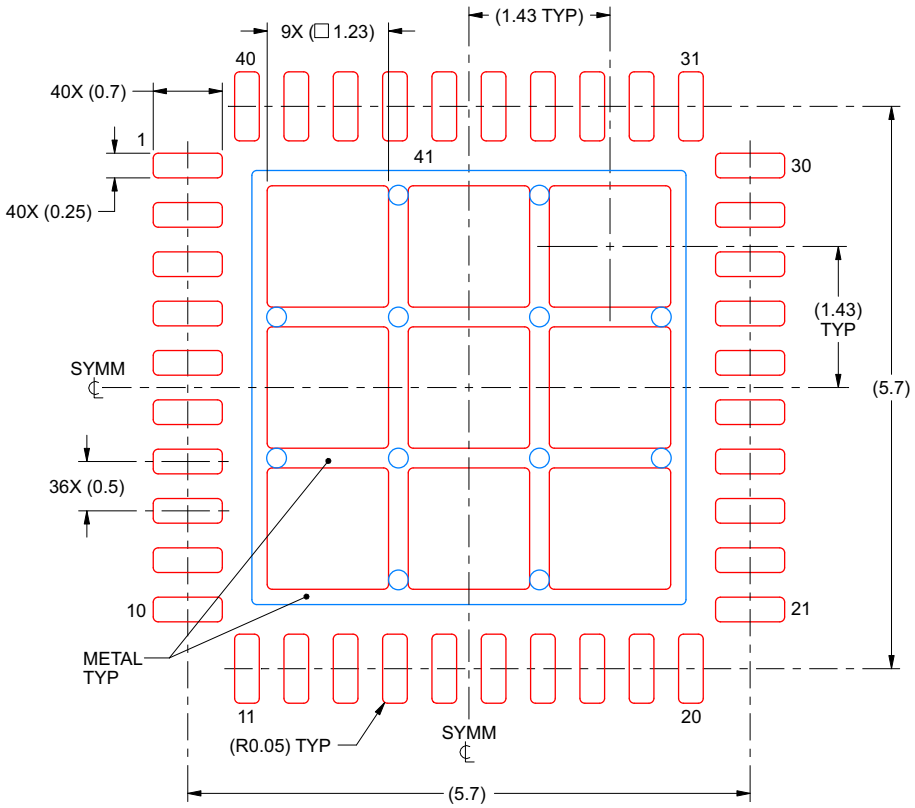
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ADVANCE INFORMATION

EXAMPLE STENCIL DESIGN

RWG0040B — **VQFNP - 0.9 mm max height**

PLASTIC QUAD FLATPACK - NO LEAD



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL

PRINTED SOLDER COVERAGE BY AREA UNDER PACKAGE
PAD 41: 70%
SCALE:15X

4223780 /A 06/2017

NOTES: (continued)

6. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.

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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
O313B014QRWGRQ1	PREVIEW	VQFNP	RWG	40	2000	TBD	Call TI	Call TI	-40 to 125		
PO313B014QRWGRQ1	ACTIVE	VQFNP	RWG	40	2000	TBD	Call TI	Call TI	-40 to 125		Samples

(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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