TEXAS INSTRUMENTS

LM70880-Q1
SNVSCM1 – SEPTEMBER 2023

LM708x0-Q1 80-V, 8-A/6-A/4-A, Automotive, High-Efficiency Buck Converters Optimized for High Power Density

1 Features

- AEC-Q100 qualified for automotive applications:
  - Device temperature grade 1: –40°C to +125°C ambient operating temperature
- Synchronous DC/DC converter with a versatile buck controller and robust power MOSFETs
  - Wide input voltage range: 4.5 V to 80 V
  - 1% accurate, fixed 3.3 V, 5 V, 12 V, or adjustable outputs from 0.8 V to 55 V
  - Dual-phase control enables paralleling two devices for higher current applications
  - Shutdown mode current: 2.3 µA
  - No-load sleep current: 6.5 µA
- Optimized for low EMI requirements
  - Facilitates CISPR 25 Class 5 compliance
  - Pin-selectable ±8% dual-random spread spectrum reduces peak emissions
  - Switching frequency: 200 kHz to 2.2 MHz
  - Pin-configurable AUTO or FPWM operation
- Inherent protection features for robust design
  - Internal hiccup-mode overcurrent protection
  - Enable, power-good, and thermal shutdown
  - Internal or external loop compensation
- 6-mm × 6-mm thermally optimized, RoHS compliant, QFN-29 package with Pb-Free plating

2 Applications

- Industrial: motor drives (Servo/AC), factory automation, off-highway vehicles and eBikes
- Communications: WLAN, AAS and RRU
- Automotive: ADAS, infotainment and cluster
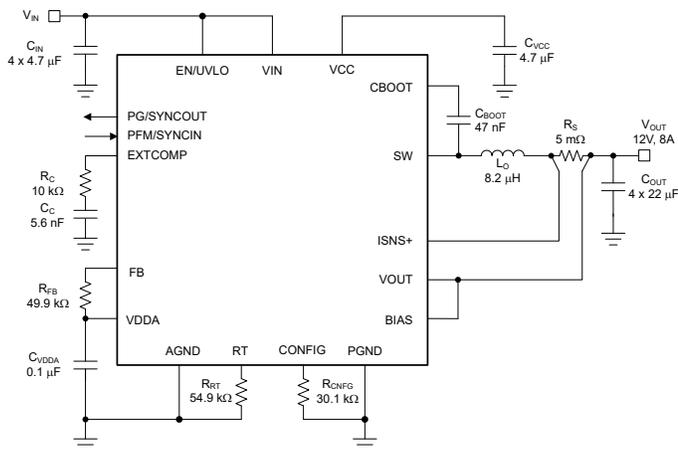
3 Description

The LM70880-Q1 is a compact, easy-to-use, 4.5-V to 80-V, ultra-low I_Q, synchronous step-down DC/DC converter featuring a versatile buck controller and a pair of power MOSFETs designed for delivering of up to 8 A of output current at fixed output voltages of 3.3 V, 5 V, 12 V, or an adjustable output.

The converter uses a peak current-mode control architecture for easy loop compensation, fast transient response, and excellent load and line regulation. A pair of LM70880-Q1 converters can be set up in an interleaved mode (paralleled outputs) with accurate current sharing for applications requiring up to 16 A of output current.

The LM70880-Q1 features a unique Dual Random Spread Spectrum (DRSS) function that combines a low-frequency triangular modulation with a high-frequency cycle-by-cycle random modulation for improved EMI performance across a high range of radio frequency bands.

Device Information

PART NUMBER	PACKAGE[1]	PACKAGE SIZE[2]
LM70880-Q1	RRX (QFN, 29)	6 mm × 6 mm
LM70860-Q1[3]		
LM70840-Q1[3]		

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

(2) The package size (length × width) is a nominal value and includes pins, where applicable.
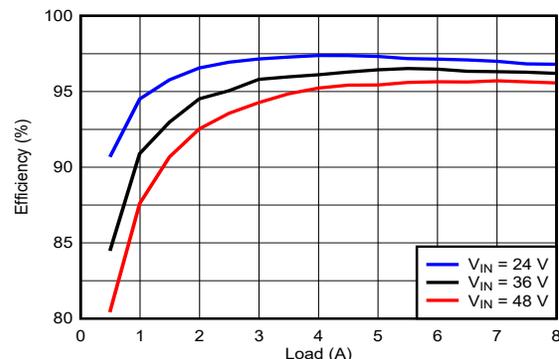
(3) Preview information (not Advance Information)

Figure 3-1. Typical Application Circuit Efficiency
V_{OUT} = 12 V, f_{SW} = 400 kHz

Typical Application Circuit

ADVANCE INFORMATION

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4 Revision History

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

DATE	REVISION	NOTES
September 2023	*	Initial release

ADVANCE INFORMATION

Product Folder Links: *LM70880-Q1*

5 Description (continued)

Additional features of the LM70880-Q1 include user-selectable diode emulation for lower current consumption at light-load conditions, open-drain Power-Good flag for fault reporting and output monitoring, precision enable input, monotonic start-up into prebiased load, integrated VCC bias supply regulator, internal 2.75-ms soft-start time, and thermal shutdown protection with automatic recovery.

The LM70880-Q1 converter comes in a 6-mm × 6-mm thermally-optimized, 29-pin QFN package. The three die-attach pads (VIN, SW, and PGND) improve thermal performance and board level reliability (BLR).

ADVANCE INFORMATION

6 Device and Documentation Support

6.1 Device Support

6.1.1 Development Support

For development support see the following:

- For TI's reference design library, visit TI Designs
- TI Designs:
  - *ADAS 8-Channel Sensor Fusion Hub Reference Design with Two 4-Gbps Quad Deserializers*
  - *Automotive EMI and Thermally Optimized Synchronous Buck Converter Reference Design*
  - *Automotive High Current, Wide V_{IN} Synchronous Buck Controller Reference Design Featuring LM5141-Q1*
  - *25W Automotive Start-Stop Reference Design Operating at 2.2 MHz*
  - *Synchronous Buck Converter for Automotive Cluster Reference Design*
  - *137W Holdup Converter for Storage Server Reference Design*
  - *Automotive Synchronous Buck With 3.3V @ 12.0A Reference Design*
  - *Automotive Synchronous Buck Reference Design*
  - *Wide Input Synchronous Buck Converter Reference Design With Frequency Spread Spectrum*
  - *Automotive Wide V_{IN} Front-end Reference Design for Digital Cockpit Processing Units*
- Technical articles:
  - *High-Density PCB Layout of DC/DC Converters*
  - *Synchronous Buck Controller Solutions Support Wide V_{IN} Performance and Flexibility*
  - *How to Use Slew Rate for EMI Control*

6.2 Documentation Support

6.2.1 Related Documentation

For related documentation see the following:

- User's guides:
  - Texas Instruments, *LM5141-Q1 Synchronous Buck Controller EVM*
  - Texas Instruments, *LM5143-Q1 Synchronous Buck Controller EVM*
  - Texas Instruments, *LM5146-Q1 EVM User's Guide*
  - Texas Instruments, *LM5145 EVM User's Guide*
- Application notes:
  - Texas Instruments, *Improve High-current DC/DC Regulator Performance for Free with Optimized Power Stage Layout Application Report*
  - Texas Instruments, *AN-2162 Simple Success with Conducted EMI from DC-DC Converters*
  - Texas Instruments, *Maintaining Output Voltage Regulation During Automotive Cold-Crank with LM5140-Q1 Dual Synchronous Buck Controller*
- Technical briefs:
  - Texas Instruments, *Reduce Buck Converter EMI and Voltage Stress by Minimizing Inductive Parasitics*
- White papers:
  - Texas Instruments, *An Overview of Conducted EMI Specifications for Power Supplies*
  - Texas Instruments, *An Overview of Radiated EMI Specifications for Power Supplies*
  - Texas Instruments, *Valuing Wide V_{IN}, Low EMI Synchronous Buck Circuits for Cost-driven, Demanding Applications*

6.2.1.1 PCB Layout Resources

- Application notes:
  - Texas Instruments, *Improve High-current DC/DC Regulator Performance for Free with Optimized Power Stage Layout*
  - Texas Instruments, *AN-1149 Layout Guidelines for Switching Power Supplies*
  - Texas Instruments, *AN-1229 Simple Switcher PCB Layout Guidelines*
  - Texas Instruments, *Low Radiated EMI Layout Made SIMPLE with LM4360x and LM4600x*

- Seminars:
  - Texas Instruments, *Constructing Your Power Supply – Layout Considerations*

6.2.1.2 Thermal Design Resources

- Application notes:
  - Texas Instruments, *AN-2020 Thermal Design by Insight, Not Hindsight*
  - *AN-1520 A Guide to Board Layout for Best Thermal Resistance for Exposed Pad Packages*
  - Texas Instruments, *Semiconductor and IC Package Thermal Metrics*
  - Texas Instruments, *Thermal Design Made Simple with LM43603 and LM43602*
  - Texas Instruments, *PowerPAD™Thermally Enhanced Package*
  - Texas Instruments, *PowerPAD Made Easy*
  - Texas Instruments, *Using New Thermal Metrics*

6.3 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.

6.4 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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6.5 Trademarks

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6.6 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.

6.7 Glossary

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

7 Mechanical, Packaging, and Orderable Information

The following pages show 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.

ADVANCE INFORMATION

7.1 Tape and Reel Information

ADVANCE INFORMATION

REEL DIMENSIONS

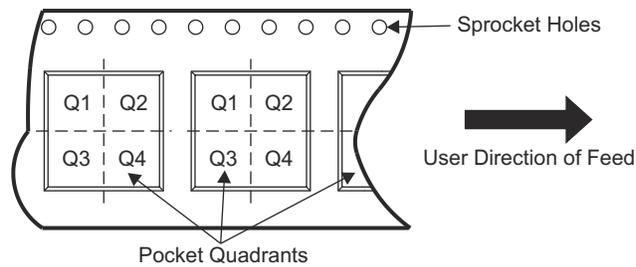**TAPE DIMENSIONS**

A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers
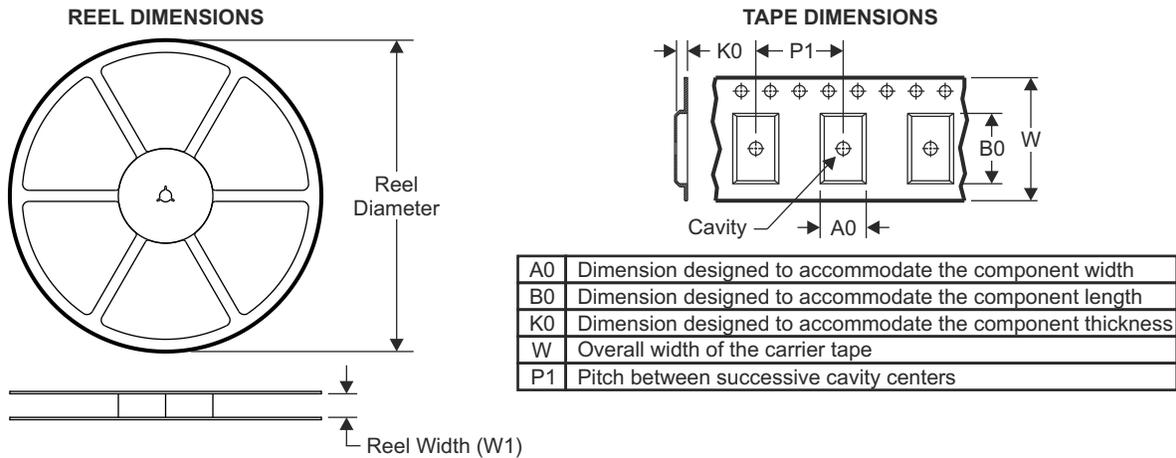
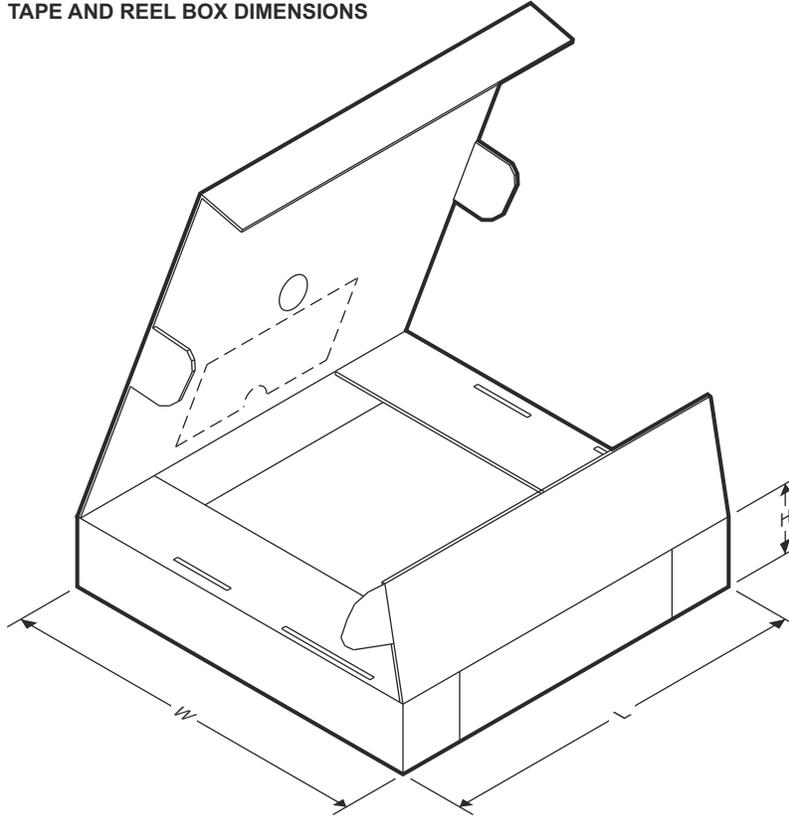**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**

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
PLM70880RRXRQ1	QFN	RRX	29	3000	330.0	12.4	3.8	5.8	1.2	8.0	12.0	Q1

Product Folder Links: *LM70880-Q1*

TAPE AND REEL BOX DIMENSIONS

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
PLM70880RRXRQ1	QFN	RRX	29	3000	367.0	367.0	35.0

ADVANCE INFORMATION

Product Folder Links: LM70880-Q1

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PACKAGE OUTLINE

RRX0029B

VQFN - 1.0 mm max height

PLASTIC QUAD FLATPACK - NO LEAD

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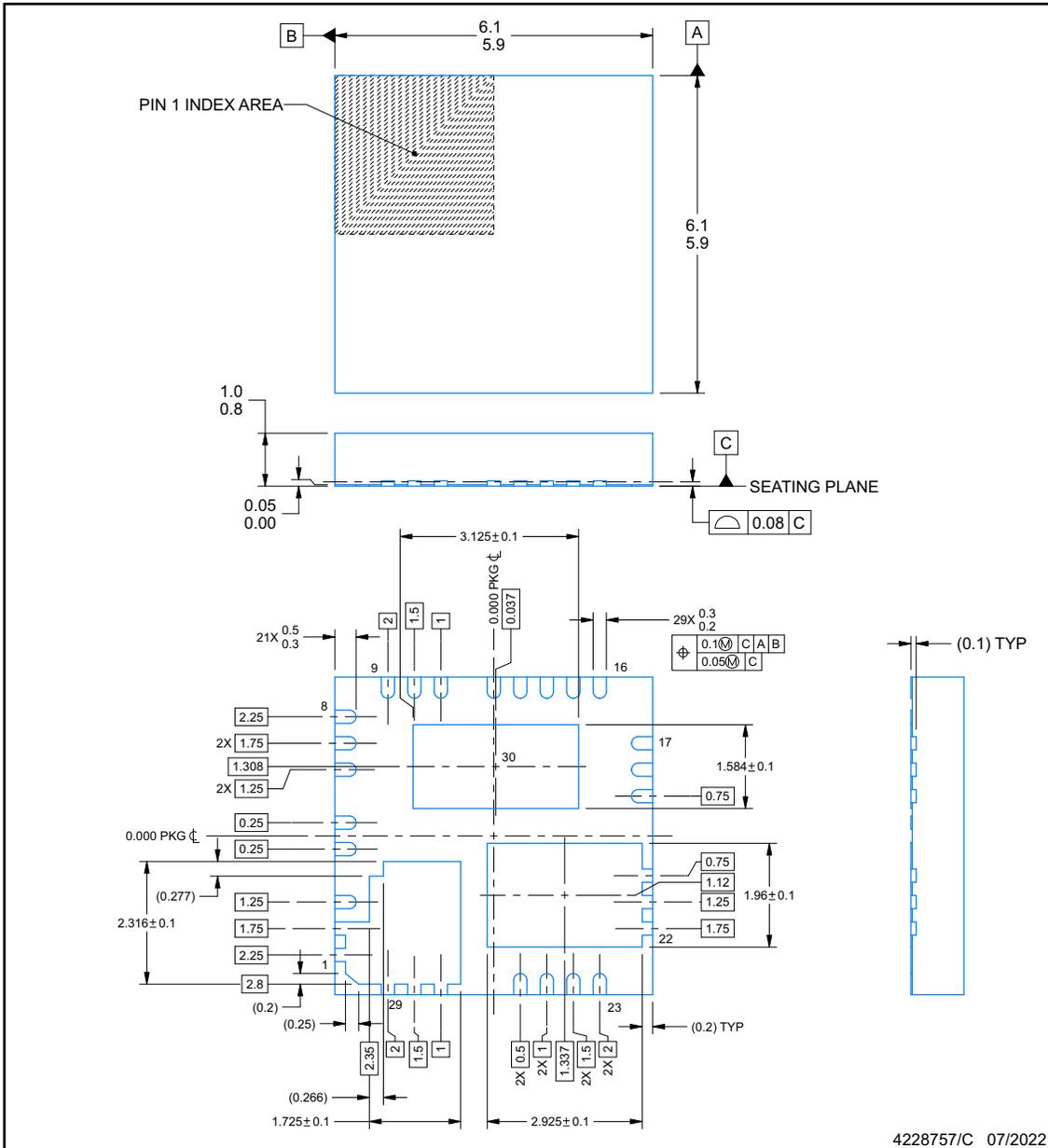
NOTES:

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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Product Folder Links: *LM70880-Q1*

EXAMPLE BOARD LAYOUT

RRX0029B

VQFN - 1.0 mm max height

PLASTIC QUAD FLATPACK - NO LEAD

LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 15X

SOLDER MASK DETAILS

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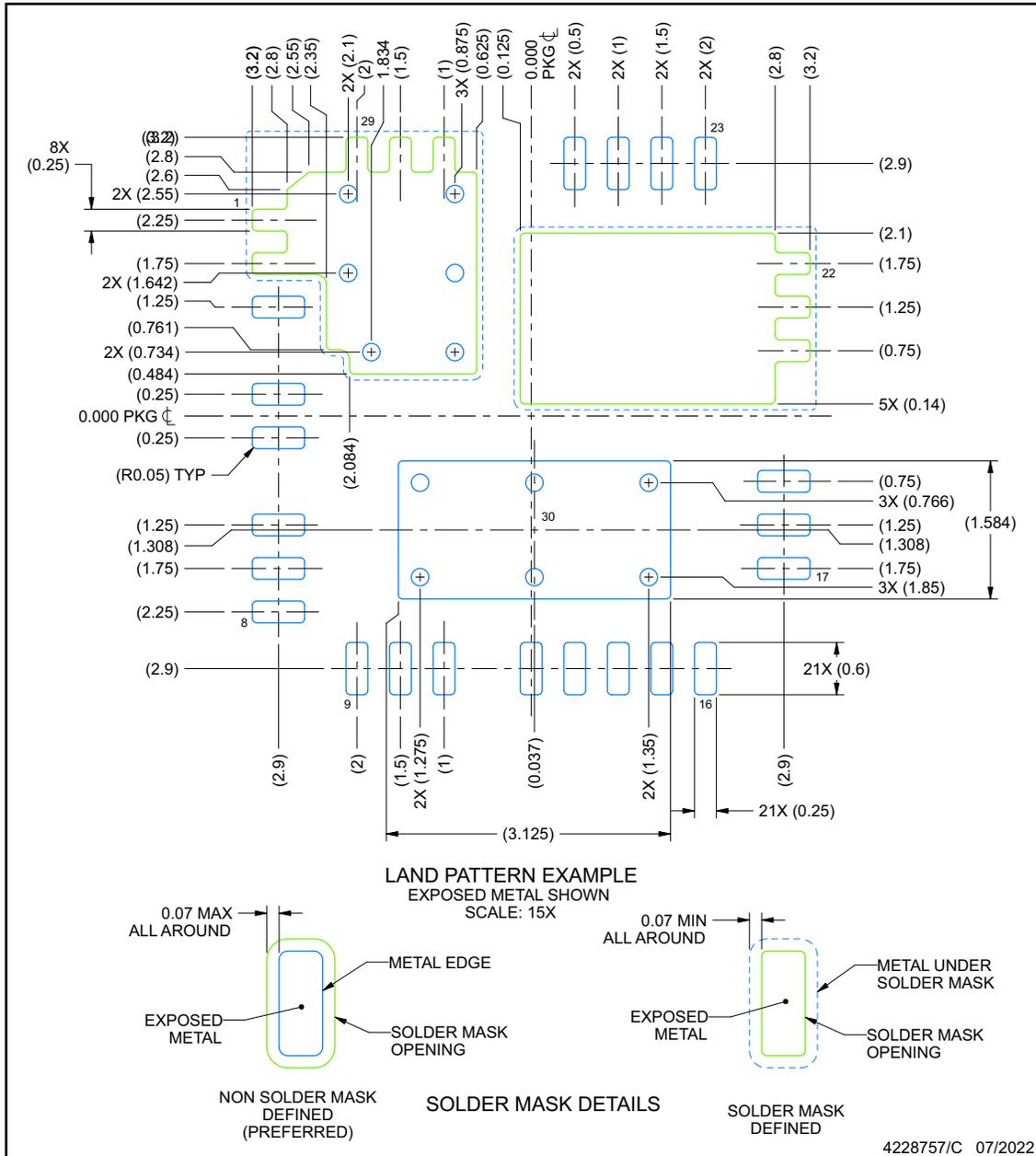
NOTES: (continued)

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.

![Texas Instruments]
www.ti.com

Product Folder Links: *LM70880-Q1*

ADVANCE INFORMATION

EXAMPLE STENCIL DESIGN

RRX0029B

VQFN - 1.0 mm max height

PLASTIC QUAD FLATPACK - NO LEAD

SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE: 15X

4228757/C   07/2022

NOTES: (continued)

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

Submit Document Feedback

Product Folder Links: *LM70880-Q1*

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
PLM70880RRXRQ1	ACTIVE	VQFN	RRX	29	490	TBD	Call TI	Call TI	-40 to 150		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 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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