

BQ25690: Standalone/I²C Controlled, 36V, 1- to 7-Cell Li-Ion, 3A Buck-Boost Bidirectional NVDC Battery Charger with Bypass Mode and USB-PD OTG Output

1 Features

- High integration buck-boost forward (sink) mode charger for 1- to 7-cell Li-Ion batteries supporting USB PD profile with integrated switching MOSFETs and loop compensation
- Highly efficient
 - Programmable switching frequency from 450kHz to 1.2MHz
 - Bypass mode for >98.5% efficiency USB-PD PPS direct battery charging at 20V, 3A
 - Selectable PFM with out-of-audio (OOA) operation for light load efficiency improvement
- Supports a wide range of input sources with 2.5V to 36V operating range and 45V absolute maximum rating
 - Support V_{IN} down to 2.5V with $V_{BAT} > 3.2V$
 - USB-PD input
 - Input voltage dynamic power management (VINDPM) up to 36V to prevent input source overload
 - Optional input current dynamic power management (IINDPM) up-to 3.3A for maximum power limit
- Optional Narrow voltage DC (NVDC) power path management
 - System instant-on with depleted or no battery
 - Battery supplements system when the adapter is fully loaded
- I2C controlled for optimal system performance with resistor-programmable option
 - Hardware selectable default cell count, charge voltage, input and charge current limits
 - 3A charging current with 20mA resolution
- Reverse/OTG (source) mode powers input port from battery
 - 3.5V to 34V reverse output voltage with 20mV resolution to support USB-PD PPS
 - Up-to 3.3A reverse output current regulation with 20mA resolution to support USB-PD PPS
- Low quiescent current
 - TBD μA for battery only operation
 - TBD μA for converter switching
- High accuracy
 - TBD charge voltage regulation
 - TBD input/output current regulation
- Safety
 - Input and battery OVP
 - Thermal regulation and thermal shutdown
 - Converter MOSFETs OCP

- Charging safety timer

2 Applications

- [Video doorbell](#), [Smart home control](#)
- [Data concentrators](#), [Wireless speaker](#), [Appliances](#)
- [Smart trackers](#), [Smart speaker](#)
- [Multiparameter patient monitor](#), [Electrocardiogram \(ECG\)](#), [Ultrasound smart probe](#)

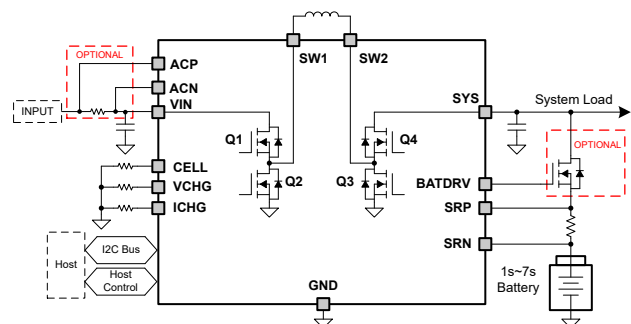
3 Description

The BQ25690 is a fully integrated switch-mode buck-boost charger for 1- to 7 cell Li-ion batteries, Li-polymer batteries. Wide input voltage range from 2.5V to 36V supports applications powered from battery, standard USB-PD adapters and high voltage dedicated DC adapters. The device integrates 4 switching MOSFETs and all the converter loop compensation for small solution size with simple design. It uses NVDC power path management, regulating the system slightly above the battery voltage without dropping below a configurable minimum system voltage. When system power exceeds the input source rating, battery supplement mode supports the system without overloading the input source. The device also supports the full input (sink) and output (reverse or source mode) voltage ranges for USB Type-C and USB power delivery (USB-PD) applications.

Package Information

PART NUMBER	PACKAGE ⁽¹⁾	PACKAGE SIZE ⁽²⁾
PQ25690RBAR	RBA (WQFN, 26)	4.0mm x 3.5mm

- (1) For all available packages, see the orderable addendum at the end of the data sheet.
- (2) The package size (length x width) is a nominal value and includes pins, where applicable.



Simplified Schematic



4 Device and Documentation Support

4.1 Device Support

4.1.1 Third-Party Products Disclaimer

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4.2 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on ti.com. Click on *Notifications* 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.

4.3 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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4.4 Trademarks

TI E2E™ is a trademark of Texas Instruments.
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4.5 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.

4.6 Glossary

[TI Glossary](#) This glossary lists and explains terms, acronyms, and definitions.

5 Revision History

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

DATE	REVISION	NOTES
October 2025	*	Initial Release

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.

6.1 Package Option Addendum

Packaging Information

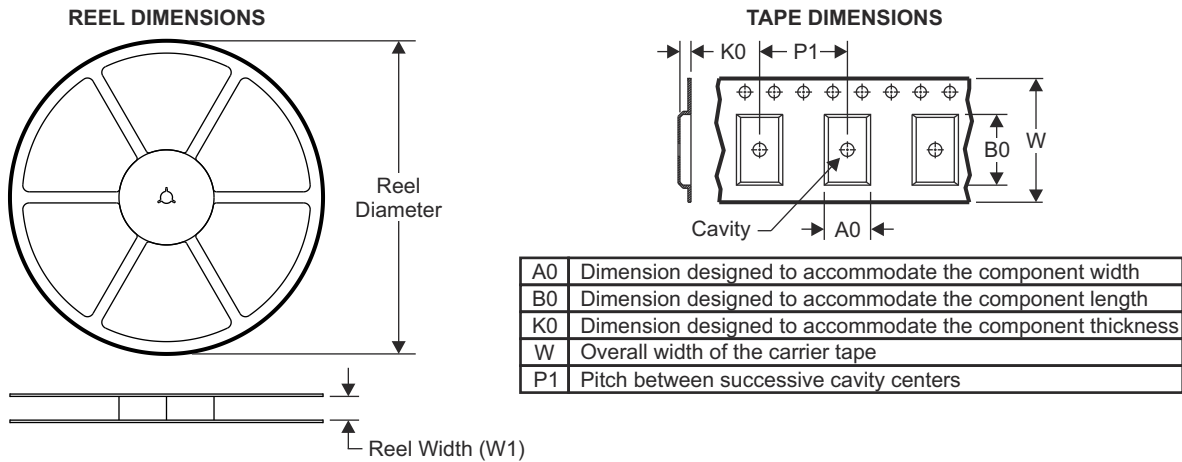
Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish ⁽⁶⁾	MSL Peak Temp ⁽³⁾	Op Temp (°C)	Device Marking ^{(4) (5)}
PQ25690RBAR	Preview	WQFN-HR	RBA	26	3000	RoHS & Green	Matt Tin	MSL1	-40 to 125	P69X

- (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.
PRE_PROD Unannounced device, not in production, not available for mass market, nor on the web, samples not available.
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 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.

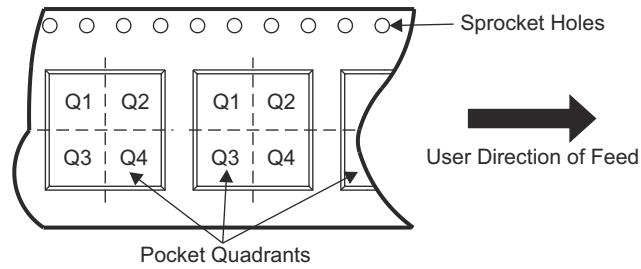
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6.2 Tape and Reel Information



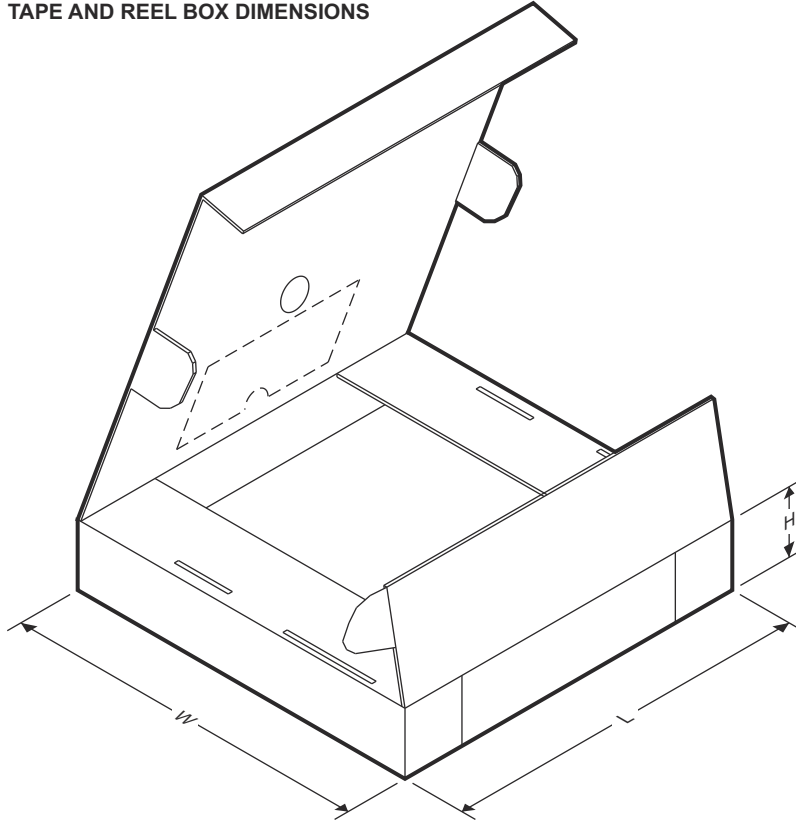
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



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
PQ25690RBAR	WQFN-HR	RBA	26	3000	330	12.4	3.8	4.3	1.5	8.0	12.0	Q2

ADVANCE INFORMATION


TAPE AND REEL BOX DIMENSIONS

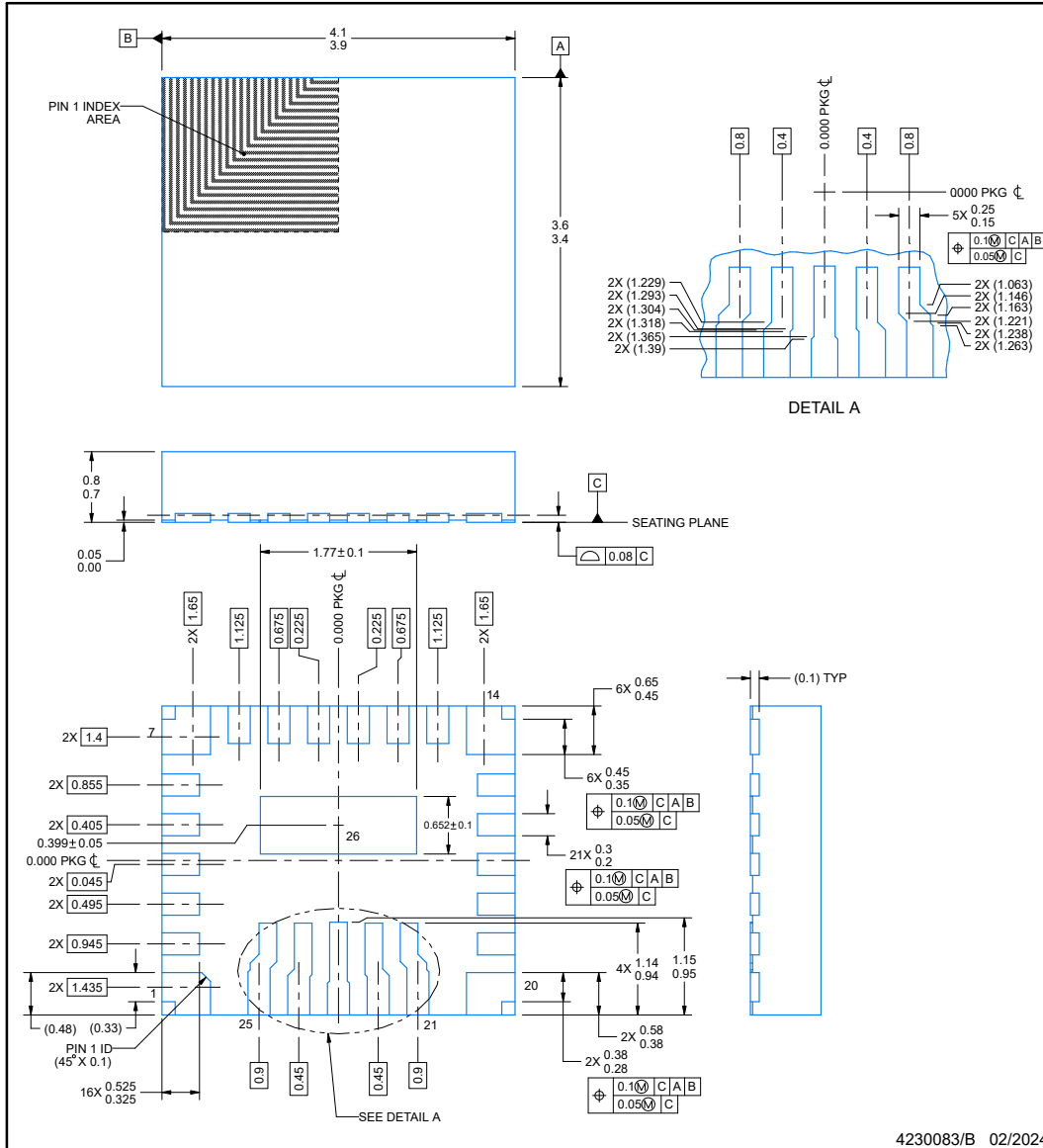


ADVANCE INFORMATION

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
PQ25690RBAR	WQFN-HR	RBA	26	3000	367.0	367.0	35.0

6.3 Mechanical Data

RBA0026A  **PACKAGE OUTLINE**
WQFN-HR - 0.8 mm max height
PLASTIC QUAD FLATPACK - NO LEAD



NOTES:

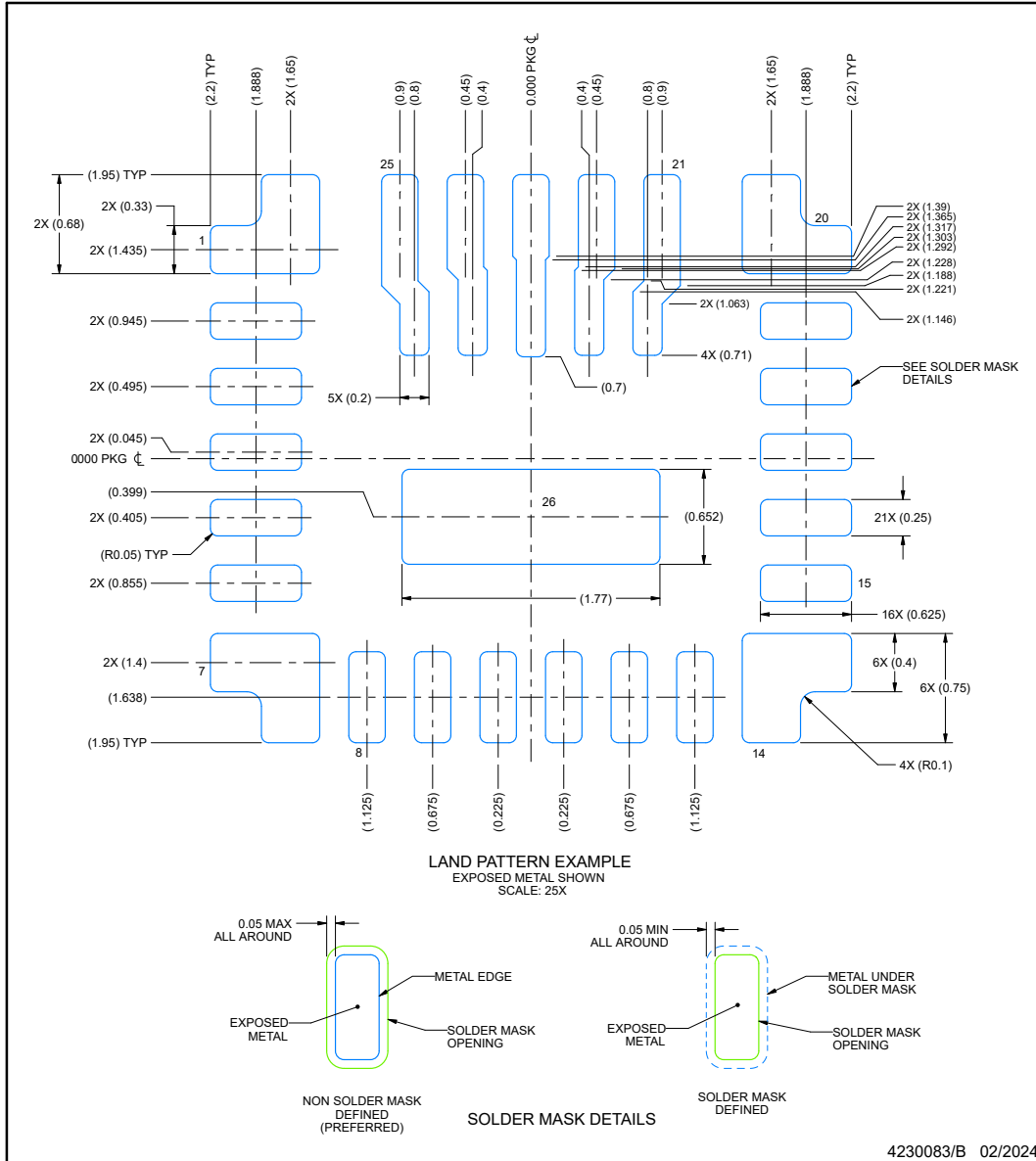
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.

EXAMPLE BOARD LAYOUT

RBA0026A

WQFN-HR - 0.8 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



NOTES: (continued)

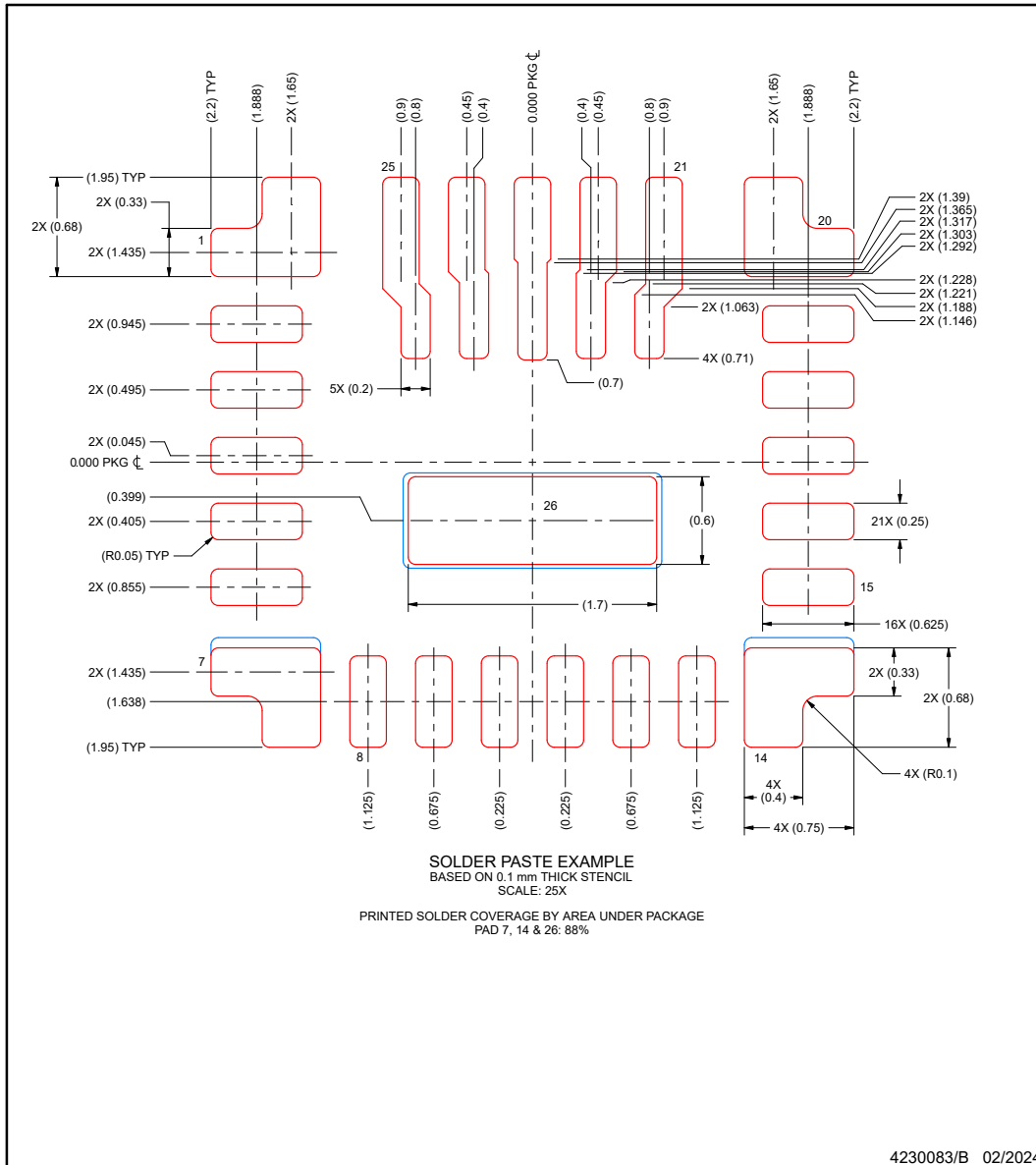
4. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/slua271).
5. Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown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

EXAMPLE STENCIL DESIGN

RBA0026A

WQFN-HR - 0.8 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



NOTES: (continued)

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

ADVANCE INFORMATION

PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package Pins	Package qty Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
PQ25690RBAR	Active	Preproduction	WQFN-HR (RBA) 26	3000 LARGE T&R	-	Call TI	Call TI	125 to -40	

(1) **Status:** For more details on status, see our [product life cycle](#).

(2) **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

(3) **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

(4) **Lead finish/Ball material:** Parts 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.

(5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

(6) **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "-" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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