

BQ79731-Q1 Pack Voltage Current and Isolation Resistance Monitor for HV Automotive BMS Applications

1 Features

- AEC-Q100 qualified -40°C to $+125^{\circ}\text{C}$
- **Functional safety compliant**
 - Documentation to aid ISO 26262 system design
 - Systematic capability up to ASIL D
 - Hardware capability up to ASIL D
- 17 single-ended voltage channels
 - High voltage pack, link, charge measurement accuracy update to 0.2%
 - Pack and cell VI sync to 64 μs
- 2 independent current sense ADCs (BQ79731-Q1)
 - $\pm 0.15\%$ gain error drift
 - Input range = $\pm 275\text{mV}$
- 2 Over current detect comparators (BQ79731-Q1)
 - $\pm 1\%$ accuracy
 - Selectable bi-directional thresholds
 - Programmable OC
- Integrated Coulomb counting (BQ79731-Q1)
- 15 GPIO inputs as IO, I2C, SPI, ADC and temp sense
- Dedicated MOSFET switch drive pins
- Intelligent SPI controller HUB
 - Support multiple SPI peripheral devices
 - HW pin to trigger contactor drivers and Pyro Fuse drivers
- Stackable and register map compatible with BQ7971x-Q1 cell monitors

3 Description

The device can be used to measure divided down high voltage nodes in a battery system. It can measure voltage across Fuse, Contactors and check isolation voltage in a battery junction box (BJB) system. The device has two integrated current sense (BQ79731-Q1) paths supporting low-side shunt resistor. Coulomb counting (BQ79731-Q1) function is available for accurate SOC calculation. There are 15 GPIOs/auxiliary inputs that can be used for HV measurements, thermistor measurements, and driving relays. There are four SW outputs that can be used to drive MOSFET switches in the measurement path. The device can function as a SPI HUB and interface with up to eight separate SPI devices/groups. Over current protection response can be achieved autonomously using HW pins for fast protection in dangerous over current events. The isolated bi-directional daisy chain ports support both capacitor and transformer based isolation. The device can also communicate with MCU over SPI and UART.

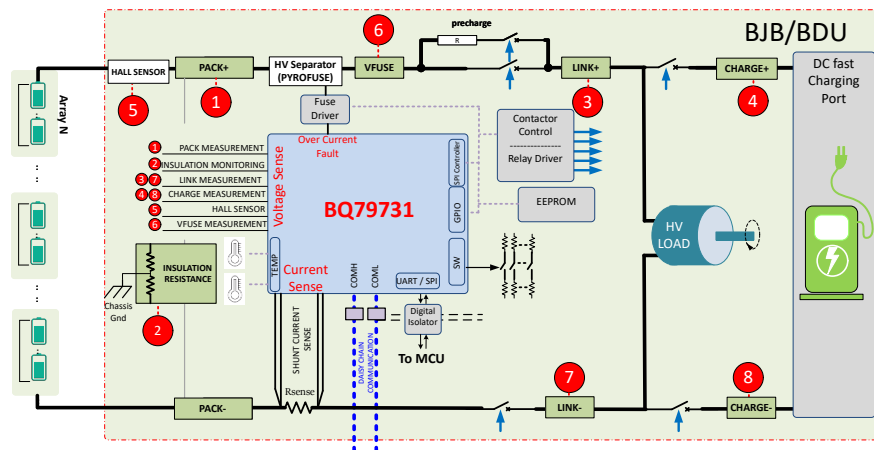
Device Information

PART NUMBER	PACKAGE ⁽¹⁾	BODY SIZE (NOM)
BQ79731-Q1	PHP (HTQFP 48-pin)	7mm × 7mm

(1) For all available packages, see [Section 6](#)

2 Applications

- **Full Electric, Plug-In Hybrid, Hybrid Vehicles**



Simplified System Diagram



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4 Device and Documentation Support

TI offers an extensive line of development tools. Tools and software to evaluate the performance of the device, generate code, and develop solutions are listed below.

4.1 Device Support

4.1.1 Third-Party Products Disclaimer

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4.2 Documentation Support

4.2.1 Related Documentation

4.3 Receiving Notification of Documentation Updates

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

4.4 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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4.5 Trademarks

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4.6 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.

4.7 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.

Changes from Revision * (December 2022) to Revision A (October 2024)	Page
• Changed BQ79731-Q1 from Advance Information to Production Data.....	1
• Updated gain error drift from $\pm 0.25\%$ to $\pm 0.15\%$	1
• Updated title.....	1
• Updated sentence to "Stackable and register map compatible with BQ79721x-Q1 cell monitors".....	1
• Updated sentence to "The device can also communicate with MCU over SPI and UART.".....	1

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

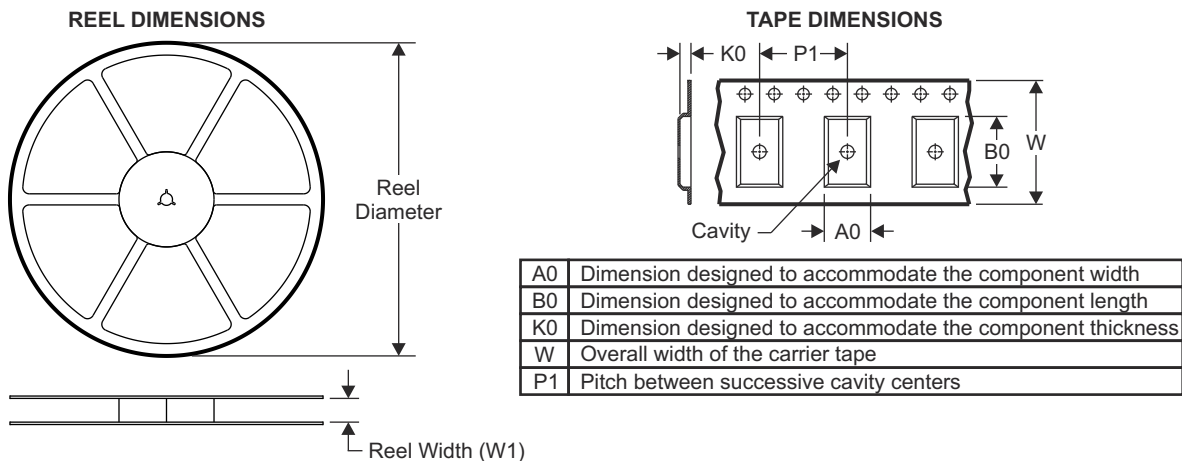
Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish ⁽⁶⁾	MSL Peak Temp ⁽³⁾	Op Temp (°C)	Device Marking ^{(4) (5)}
BQ79731PHPRQ1	ACTIVE	HTQFP	PHP	48	1000	RoHS & Green	NiPdAu	MSL-3-260C-168 HR	-40 to 125C	BQ79731Q

- (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.

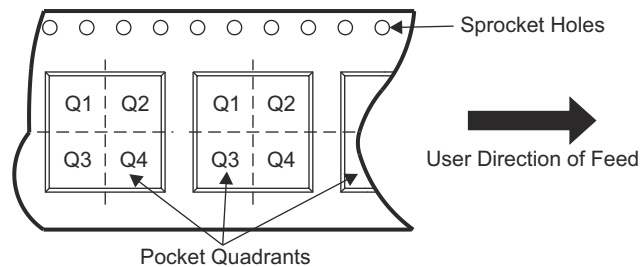
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6.2 Tape and Reel Information

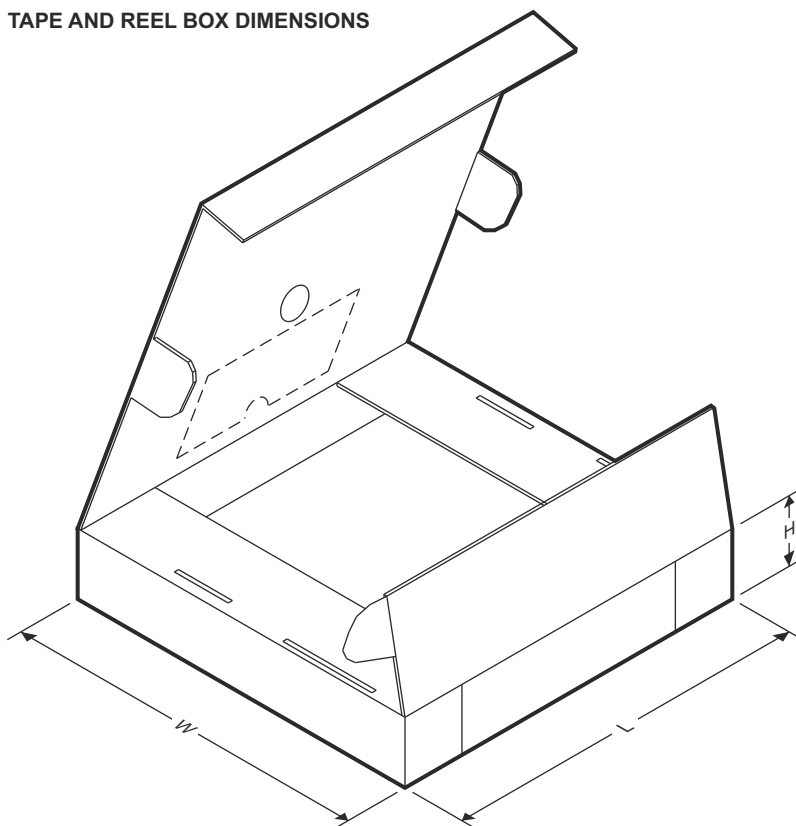


QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



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
BQ79731PHPRQ1	HTQFP	PHP	48	1000	330.0	16.4	9.6	9.6	1.5	12.0	16.0	Q2

TAPE AND REEL BOX DIMENSIONS



Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
BQ79731PHPRQ1	HTQFP	PHP	48	1000	336.6	336.6	31.8

6.3 Mechanical Data

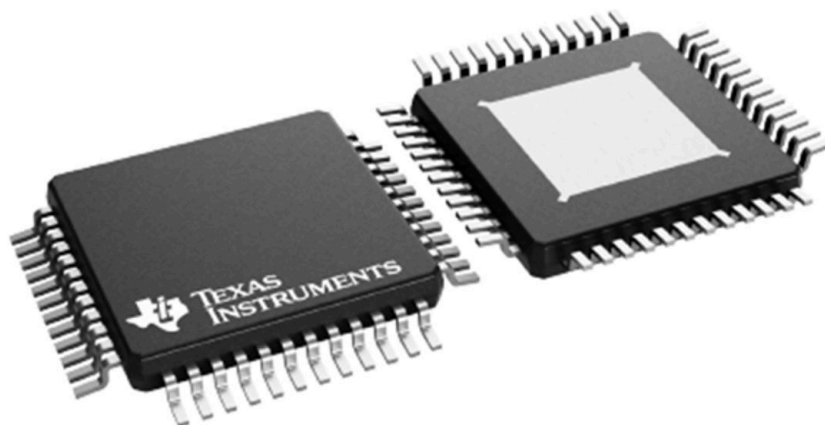
PHP 48

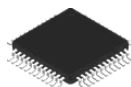
7 x 7, 0.5 mm pitch

TQFP - 1.2 mm max height

QUAD FLATPACK

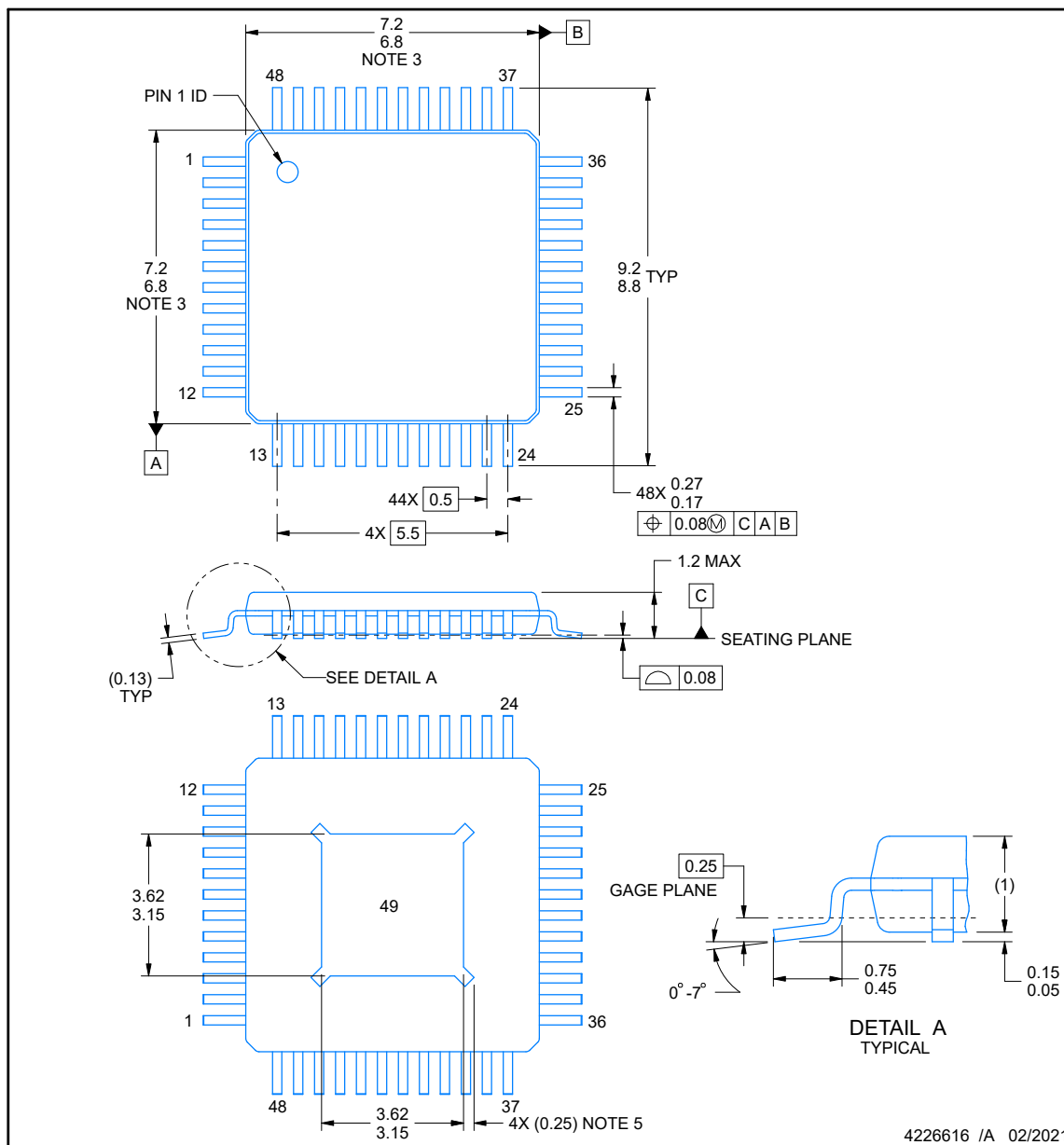
This image is a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.





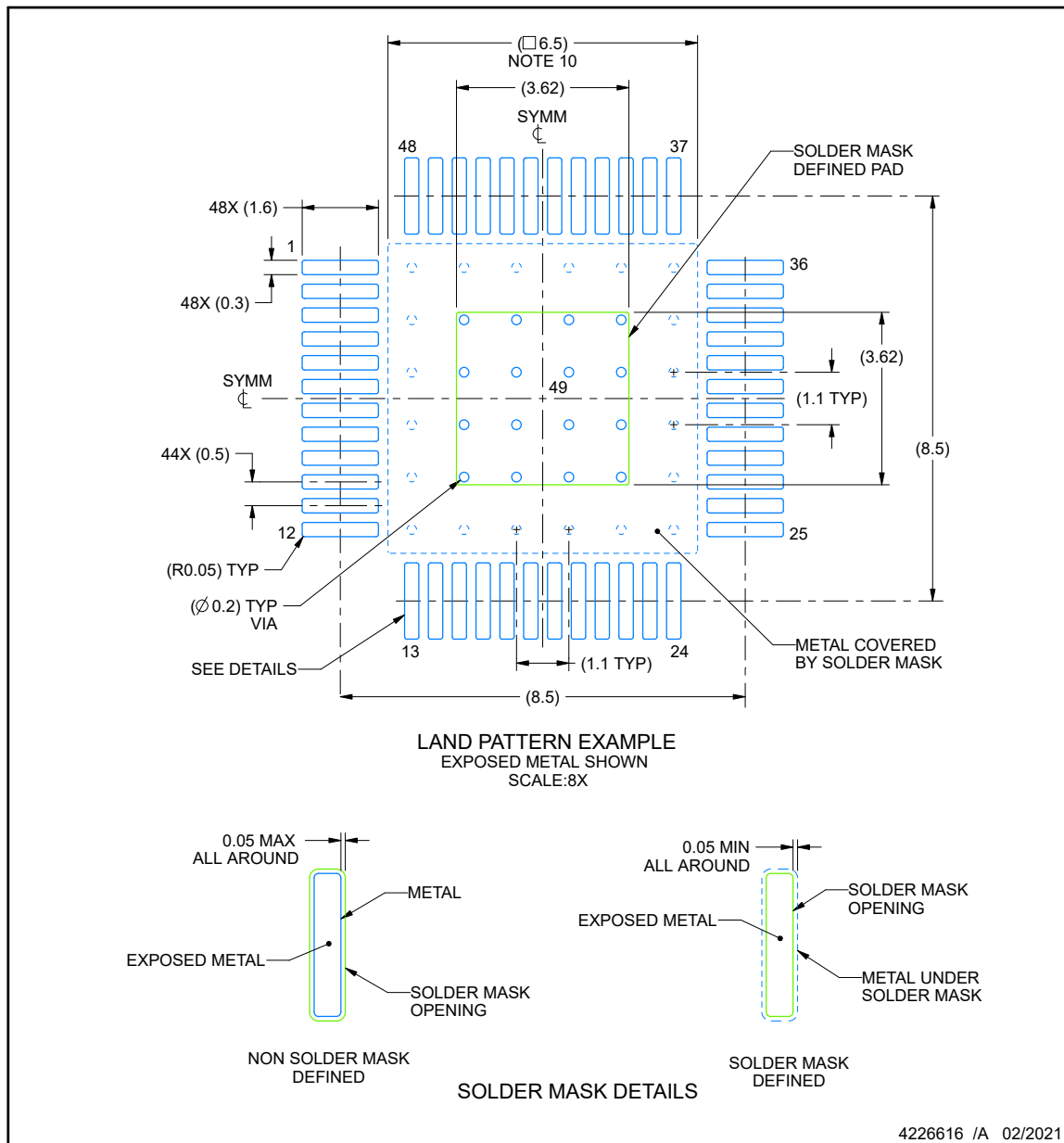
PHP0048E

PACKAGE OUTLINE
PowerPAD™ HTQFP - 1.2 mm max height



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. Reference JEDEC registration MS-026.
5. Feature may not be present.

EXAMPLE BOARD LAYOUT**PHP0048E****PowerPAD™ HTQFP - 1.2 mm max height**

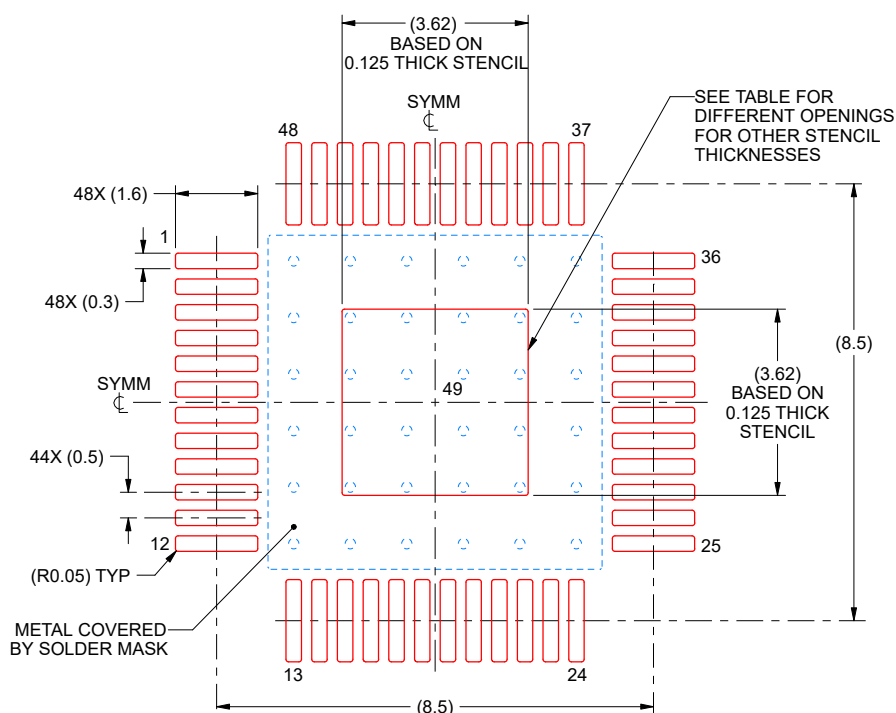
NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.
8. This package is designed to be soldered to a thermal pad on the board. See technical brief, Powerpad thermally enhanced package, Texas Instruments Literature No. SLMA002 (www.ti.com/lit/slma002) and SLMA004 (www.ti.com/lit/slma004).
9. Vias are optional depending on application, refer to device data sheet. It is recommended that vias under paste be filled, plugged or tented.
10. Size of metal pad may vary due to creepage requirement.

EXAMPLE STENCIL DESIGN

PHP0048E

PowerPAD™ HTQFP - 1.2 mm max height



SOLDER PASTE EXAMPLE
EXPOSED PAD
100% PRINTED SOLDER COVERAGE BY AREA
SCALE:8X

STENCIL THICKNESS	SOLDER STENCIL OPENING
0.1	4.05 X 4.05
0.125	3.62 x 3.62 (SHOWN)
0.150	3.30 x 3.30
0.175	3.06 x 3.06

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NOTES: (continued)

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

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)
BQ79731PHPRQ1	Active	Production	HTQFP (PHP) 48	1000 LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 125	BQ79731Q
BQ79731PHPRQ1.A	Active	Production	HTQFP (PHP) 48	1000 LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 125	BQ79731Q

- ⁽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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GENERIC PACKAGE VIEW

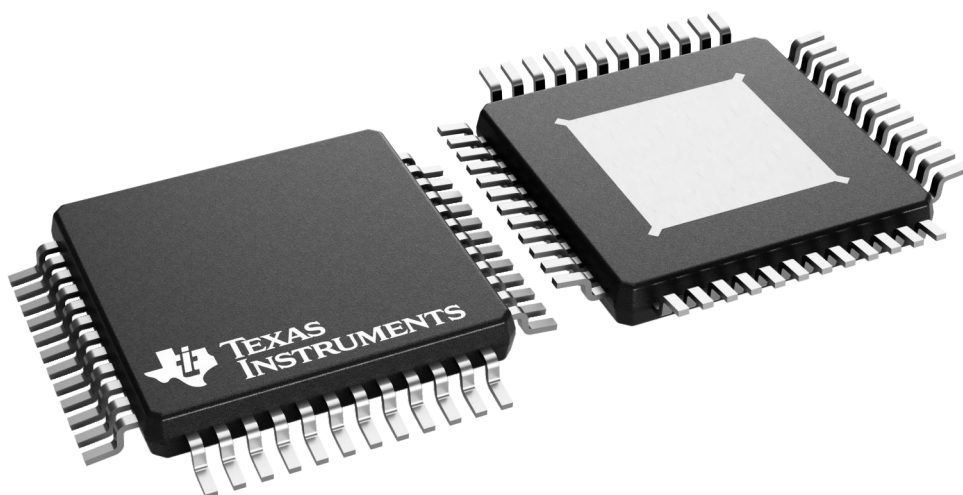
PHP 48

TQFP - 1.2 mm max height

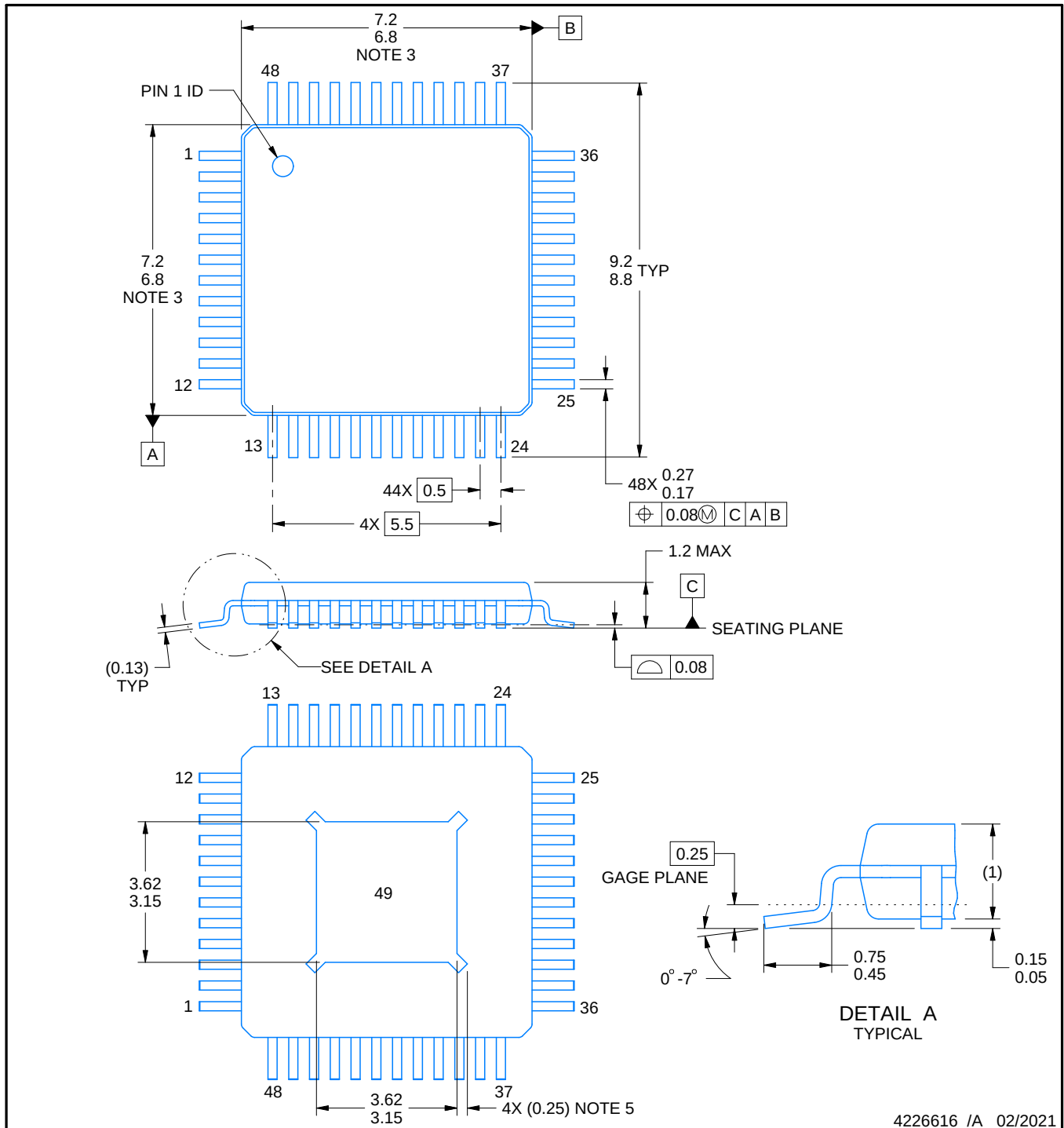
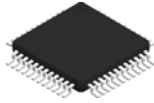
7 x 7, 0.5 mm pitch

QUAD FLATPACK

This image is a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.



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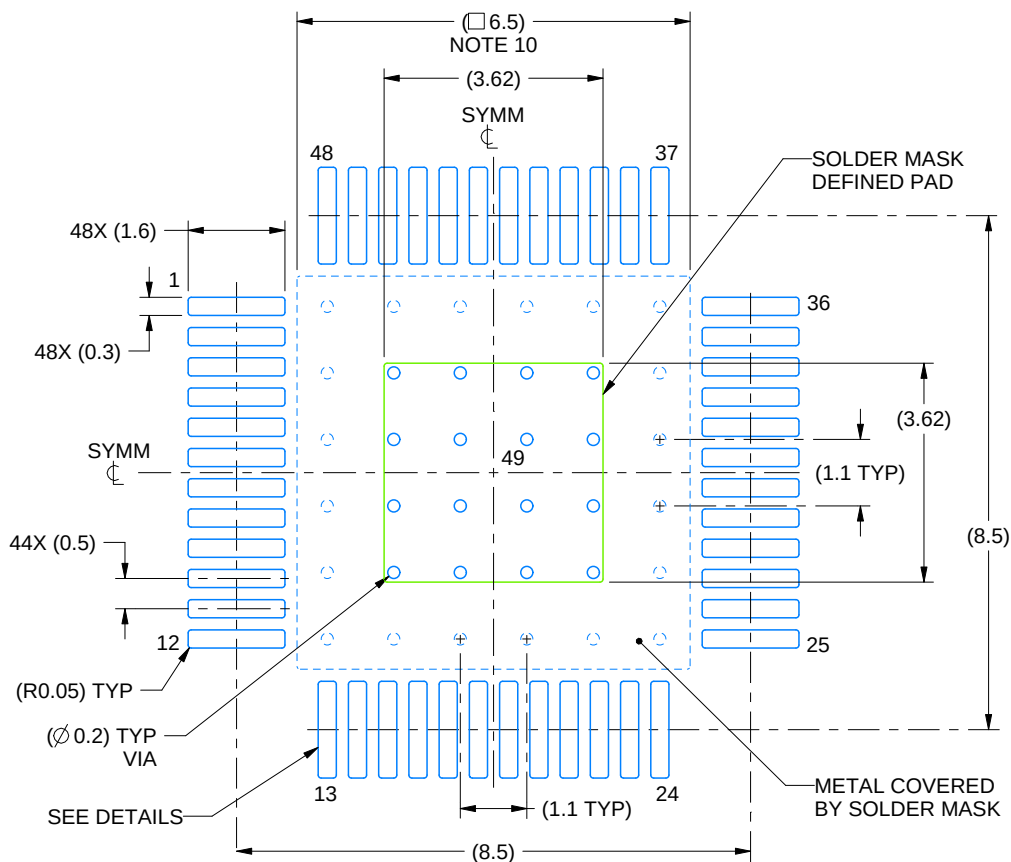
NOTES:

PowerPAD is a trademark of Texas Instruments.

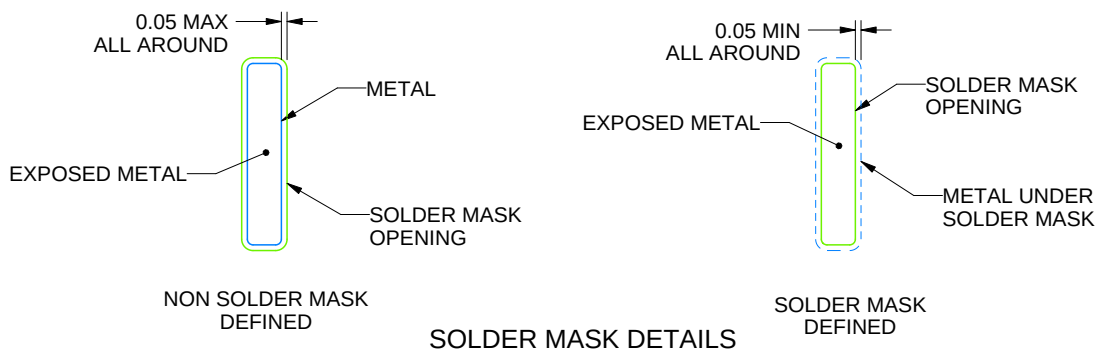
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4. Reference JEDEC registration MS-026.
5. Feature may not be present.

PHP0048E

PowerPAD™ HTQFP - 1.2 mm max height



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:8X



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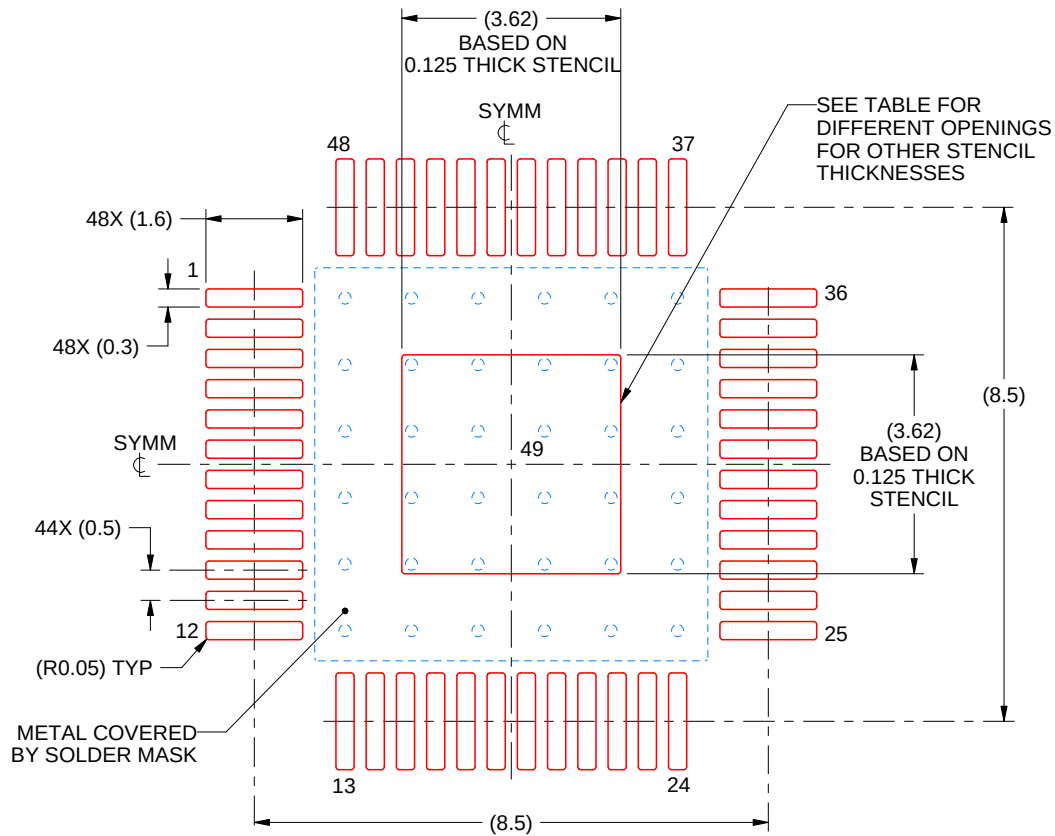
NOTES: (continued)

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EXAMPLE STENCIL DESIGN

PHP0048E

PowerPAD™ HTQFP - 1.2 mm max height



SOLDER PASTE EXAMPLE
EXPOSED PAD
100% PRINTED SOLDER COVERAGE BY AREA
SCALE:8X

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0.150	3.30 x 3.30
0.175	3.06 x 3.06

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NOTES: (continued)

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12. Board assembly site may have different recommendations for stencil design.

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