

TRF4140-Q1 Abstract

Low-Frequency Transceiver for Immobilizer, Passive Start, Passive Entry

1 Device Overview

1.1 Features

- Benefits
 - Full Embedded Sequence Timing Controller Removes All Timing Constraints From the Host Controller
 - Automatic Sequence Repetition for Easy Implementation of Energy-Efficient Polling Systems
 - Separate Transmit and Receive Buffers Reduce Host Controller Performance Requirements
 - Embedded Sequence-Auto-Repeat Enables Low-Power Polling System Without Host Controller Interaction
 - Embedded Half-Duplex (HDX) Protocol Support Enables Flexible and Scalable System Implementation
 - Sine-Wave Controlled Transmitter Stages Enable High-Power Remote Antenna Systems With Cable Lengths of Several Meters and Superior EMC Performance
 - Sequence Preloading With Event-Triggered Execution for Fastest System Reaction Time
- Features
 - Integrated Boost Controller for Wide Supply Voltage Range With Jump Start and Load Dump Protection
 - Antenna Driver With up to 20-V Peak-to-Peak Output Voltage Amplitude and up to 1-A Peak Antenna Current With Sine-Wave or Square-Wave Output
 - Flexible Host Control Interface
 - 4-Wire SPI
 - Configurable I/O Functions to Extend Controller Interface Such as an Interrupt Request Signal
 - Interface Voltage Supply Range From 2.5 V to 5.5 V
 - Ultra-Low Current Consumption in Sleep State
 - Fractional Synthesizer With 10-kHz to 500-kHz Frequency Range With 60-Hz Step Size
 - PSK and ASK Transmitter Stage
 - FSK Receiver and Demodulator
 - Four Programmable Half-Bridge MOSFET Antenna Drivers
 - Pairs of Half-Bridge Antenna Drivers can be Used Together as a Full-Bridge Driver to Double the Possible Output Voltage Amplitude
 - Antenna Current Measurement With 5-Bit Resolution for High Side and Low Side of Antenna Driver Stages
 - Programmable Antenna Driver Output Voltage in Sine-Wave Mode
 - Supply-Controlled Antenna Driver Voltage in Square-Wave Mode
 - Output Stage is Overload Protected for Over-Current and Over-Temperature Conditions
 - Antenna Driver Diagnostics: Short to Ground, Short to Antenna Driver Supply Voltage, and Open-Load Detection
 - Supports On-Off Keying With Data Rates up to 70 kbps for Downlink and Uplink

1.2 Applications

- Car Access
- Immobilizers
- Passive Entry, Passive Start (PEPS)
- RFID Tag Readers (Half Duplex)

- Other Applications Where the Physical Characteristics of Low-Frequency Radio are Beneficial



An IMPORTANT NOTICE at the end of this data sheet addresses availability, warranty, changes, use in safety-critical applications, intellectual property matters and other important disclaimers. PRODUCTION DATA.

1.3 Description

NOTE

This document is an abbreviated version of the full TRF4140-Q1 data sheet. For access to the full data sheet, silicon errata, application report, and other support collateral, [complete the request form](#).

The TRF4140-Q1 low-frequency (LF) transceiver base station device is intended for immobilizer and PEPS systems to communicate with LF transponders, remote keyless entry, and passive entry devices. The antenna driver stage consists of four MOSFET antenna drivers to send modulated LF transmissions and a receiver for detection and demodulation of LF transponder responses. The HDX communication scheme uses frequency shift keying (FSK) as the uplink modulation. The device can drive LF antennas to provide a wake-up and data sequence (PEPS), and it can also receive transponder responses on any or all channels (immobilizer).

The TRF4140-Q1 device needs V_{DD} supply (5 V) for its control blocks and to feed the integrated logic voltage regulator. The antenna driver is supplied separately by V_{DDH} (4 V to 20 V). This voltage can be used to generate a sine-wave output signal for superior EMC performance, which is important for remote antenna applications with several meters of antenna cable.

The TRF4140-Q1 device manages all timings required for a communication sequence without the need for an accurate host controller interaction. In conjunction with transmit and receive FIFOs, the host controller is off-loaded from all timing-critical events, which enables easy host controller process scheduling. In particular, the host controller start-up process for an automotive body control module is tremendously relaxed by this base station device.

The TRF4140-Q1 device supports sequence preloading and sequence execution on external events to start the immobilization process exactly when the key fob is detected. So, delays due to configuration can be avoided in inconvenient time frames.

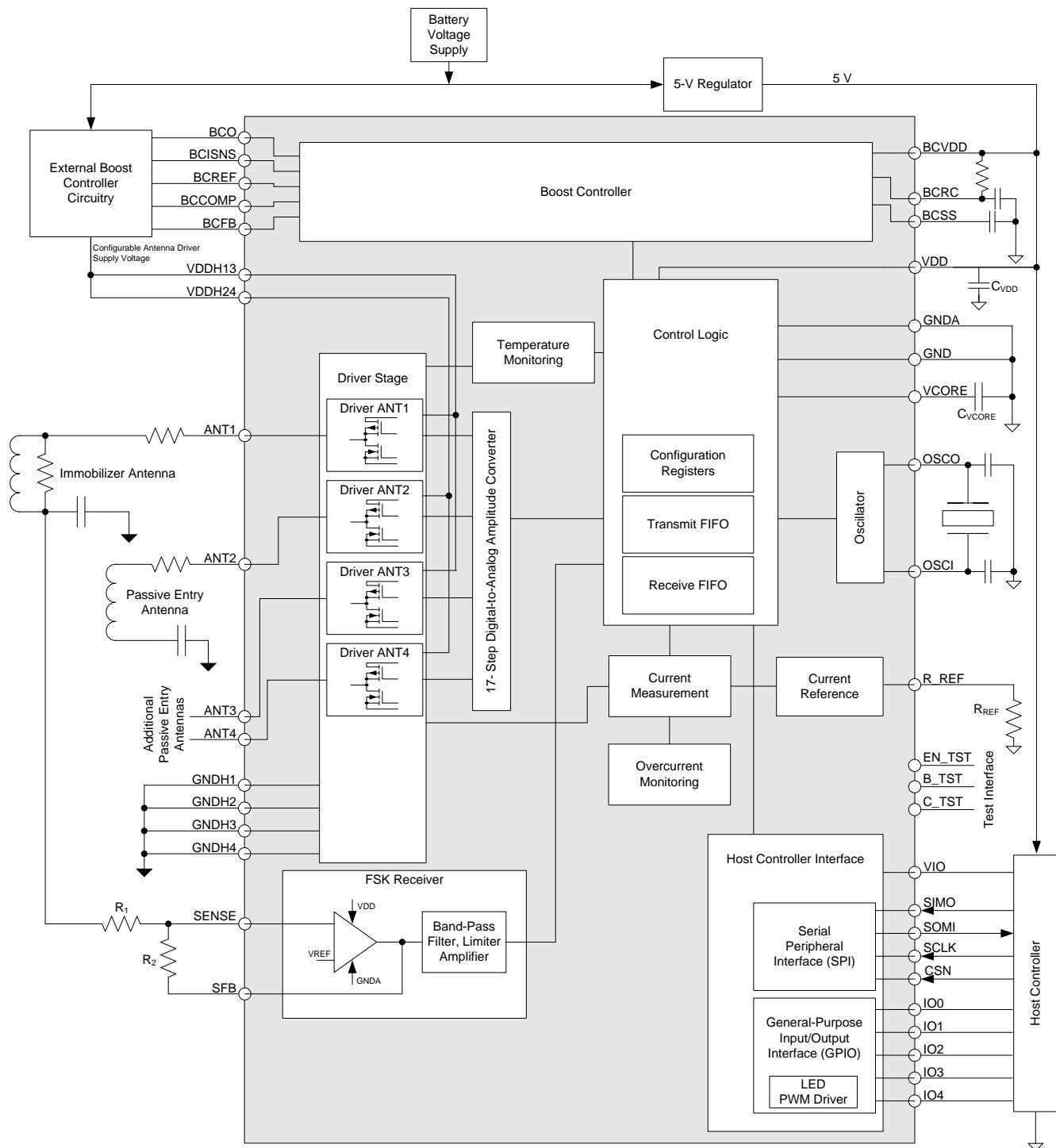
Device Information⁽¹⁾

PART NUMBER	PACKAGE	BODY SIZE
TRF4140QPHNRQ1	HTQFP (48)	7 mm x 7 mm

(1) For more information, see [Section 4, Mechanical, Packaging, and Orderable Information](#).

1.4 Functional Block Diagram

Figure 1-1 shows the functional block diagram and a typical application of TRF4140-Q1 and its function blocks.



BAST_FBD_4ANT

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Figure 1-1. TRF4140-Q1 Block Diagram and Application Example

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2 Revision History

Changes from April 1, 2018 to October 31, 2018

Page

•	Changed Section 4, Mechanical, Packaging, and Orderable Information	6
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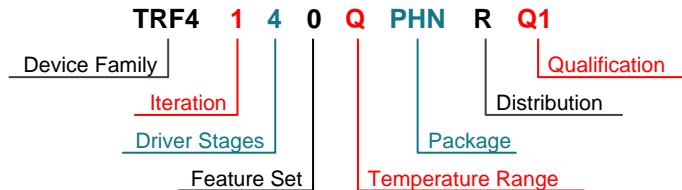
3 Device and Documentation Support

3.1 Getting Started and Next Steps

For more information on the TI NFC/RFID devices and the tools and software that are available to help with your development, visit [Overview for NFC / RFID](#).

3.2 Device Nomenclature

Figure 3-1 provides a legend for reading the complete device name for any family member.



Device Family	TRF4 = LF Transceiver Base Station
Iteration	1 = First Generation TRF4 2 = Second Generation TRF4
Driver Stages	4 = 4 LF Half-Bridge Driver Stages 6 = 6 LF Half-Bridge Driver Stages
Feature Set	0 = FSK Receiver only 1 = FSK and ASK Receiver
Temperature Range	Q = -40°C to 125°C Operation Temperature
Package	See <i>Packaging Information</i> or www.ti.com/package
Distribution	R = Large Reel
Qualification	Q1 = AEC-Q100 Automotive Qualified

Figure 3-1. Device Nomenclature

3.3 Documentation Support

The following documents describe the TRF4140-Q1 device. Copies of these documents are available on the Internet at www.ti.com.

Receiving Notice of Document Updates

To receive notification of documentation updates—including silicon errata—go to the product folder for your device on ti.com (for example, [TRF4140-Q1](#)). In the upper right corner, click the "Alert me" button. This registers you to receive a weekly digest of product information that has changed (if any). For change details, check the revision history of any revised document.

Errata

[TRF4140-Q1 Errata Sheet](#) Describes known design exceptions and related workarounds of this device.

Application Reports

[Using a TRF4xxx Device as an LF Transceiver Base Station](#) Provides a variety of application advice for designing an LF base station with TRF4140-Q1 devices.

[Using a TRF4xxx Device as an LF Transceiver Base Station](#) Provides a variety of application advice for designing an LF base station with TRF4140-Q1 devices.

3.4 Community Resources

The following link connects 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™ Community](#)

TI's Engineer-to-Engineer (E2E) Community. 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.

3.5 Trademarks

E2E is a trademark of Texas Instruments.

3.6 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.

3.7 Export Control Notice

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3.8 Glossary

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

4 Mechanical, Packaging, and Orderable Information

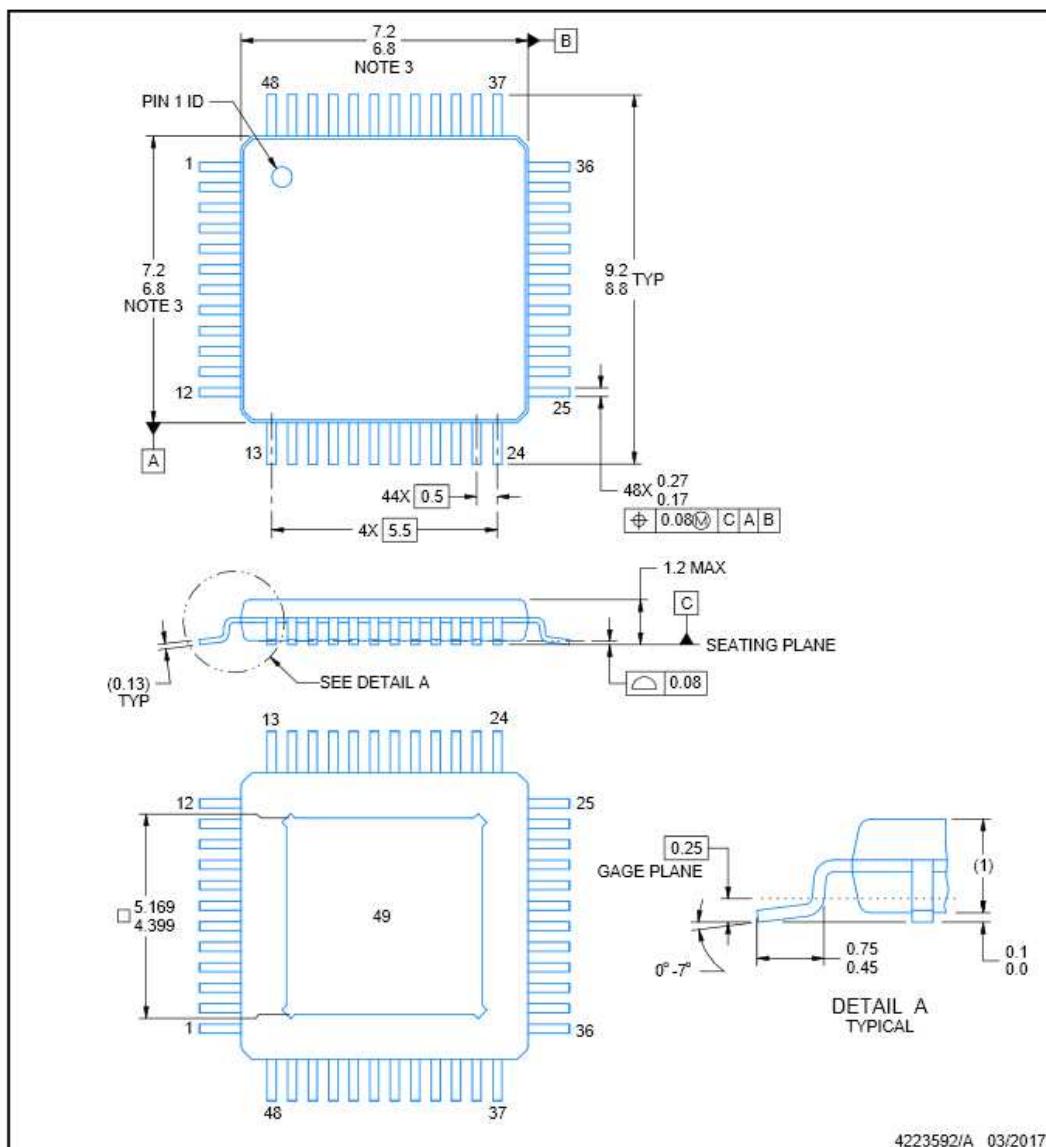
The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

PHN0048G



PACKAGE OUTLINE
PowerPAD™ HTQFP - 1.2 mm max height

PLASTIC QUAD FLATPACK



PowerPAD is a trademark of Texas Instruments.

NOTES:

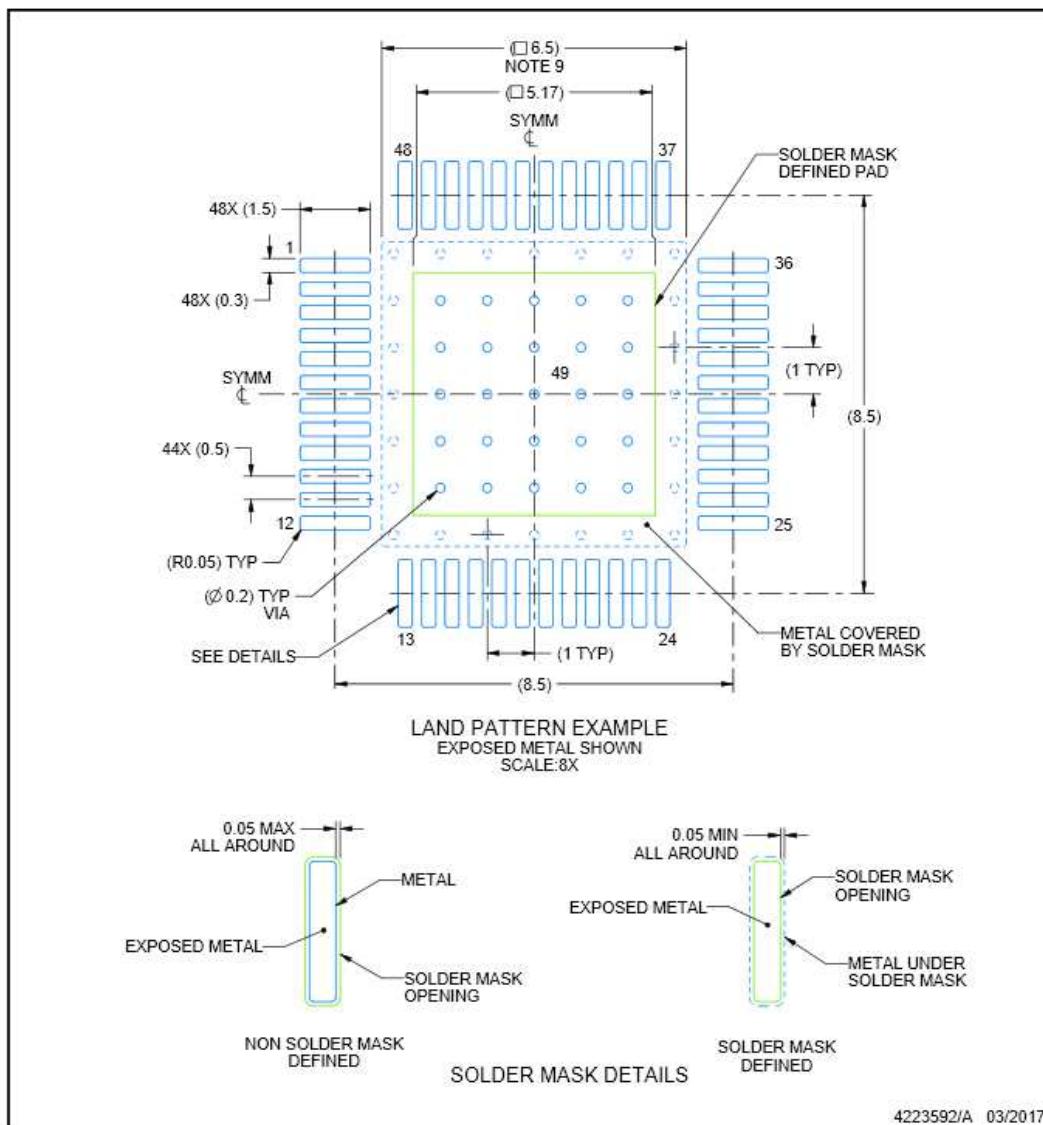
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. Reference JEDEC registration MS-026.

EXAMPLE BOARD LAYOUT

PHN0048G

PowerPAD™ HTQFP - 1.2 mm max height

PLASTIC QUAD FLATPACK

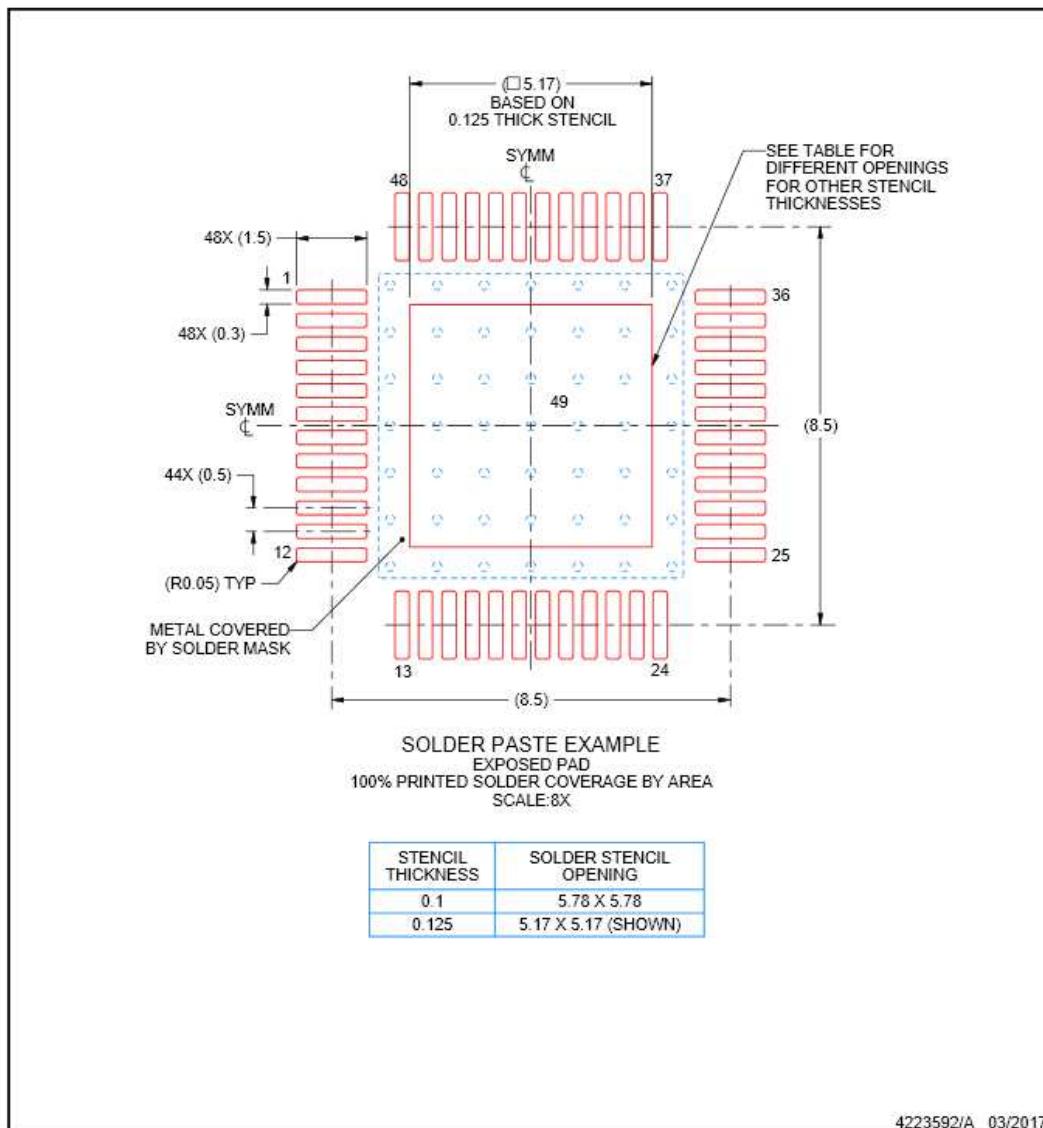


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NOTES: (continued)

5. Publication IPC-7351 may have alternate designs.
6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.
7. 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).
8. Vias are optional depending on application, refer to device data sheet. It is recommended that vias under paste be filled, plugged or tented.
9. Size of metal pad may vary due to creepage requirement.

EXAMPLE STENCIL DESIGN

PHN0048G
PowerPAD™ HTQFP - 1.2 mm max height
PLASTIC QUAD FLATPACK

NOTES: (continued)

10. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
 11. 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)
TRF4140QPHNRQ1	Active	Production	HTQFP (PHN) 48	2000 null	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 125	TRF4140C

⁽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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