TRF4140-Q1 Abstract
Low-Frequency Transceiver for Immobilizer, Passive Start, Passive Entry, and Wireless Charging Systems

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) and Full-Duplex (FDX) 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
  - Supports Wireless Charging Systems for Mobile Devices
- 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
    - 3-Wire SPI
    - 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 and ASK 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 Overcurrent and Overtemperature 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)
- Wireless Power Charging (Qi, WPC, PMA)
- RFID Tag Readers (Full Duplex and Half Duplex)
- Other Applications Where the Physical Characteristics of Low-Frequency Radio are Beneficial

1.3 Description

NOTE

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

The TRF4140 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 and also to support wireless charging. The antenna driver stage consists of several MOSFET antenna drivers to send modulated LF transmissions and a receiver for detection and demodulation of LF transponder responses. The responses can be from either a half-duplex (HDX) transponder or a full-duplex (FDX) transponder. The HDX communication scheme uses frequency shift keying (FSK) as the uplink modulation. The FDX communication scheme uses amplitude shift keying (ASK) as the uplink modulation, also known as load modulation or backscatter 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 device lets the user implement an intelligent system, suitable for wireless power charging (WPC). The WPC system can periodically check the surrounding environment for available devices to be powered while minimizing idle power, monitor all communications from the mobile device being wirelessly powered, and control the output power that is applied to the transmitter coil according to information received from the powered device. The system can manage fault conditions associated with power transfer and can control status signals by using current measurement and LED-capable I/Os to indicate operating modes.

The TRF4140 device needs VDD supply (5 V) for its control blocks and to feed the integrated logic voltage regulator. The antenna driver is supplied separately by VDDH (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 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 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
TRF4140QPHN	HTQFP (48)	7 mm × 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 and its function blocks.

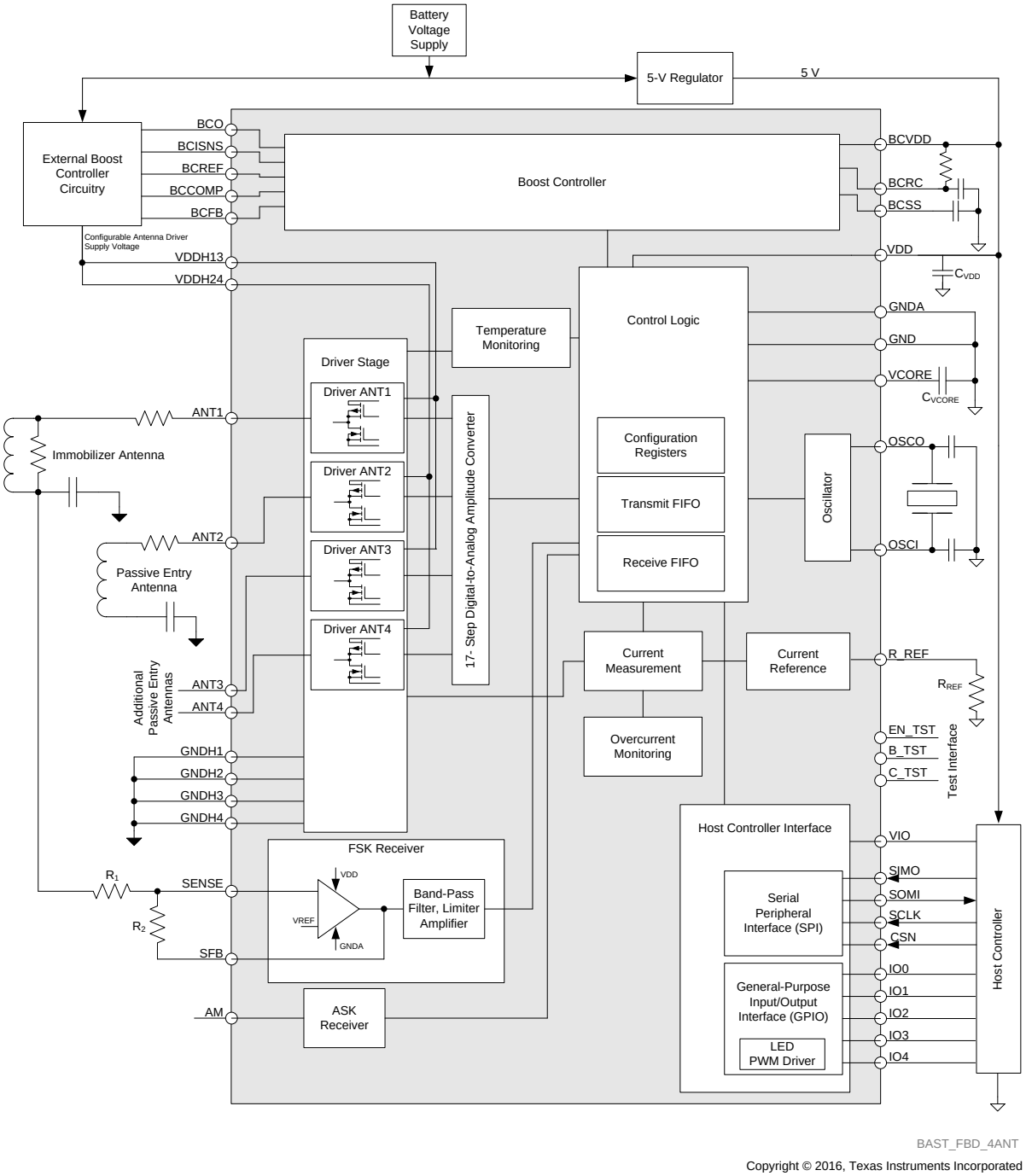


Figure 1-1. TRF4140-Q1 Block Diagram and Application Example

Table of Contents

2 Revision History

Changes from June 1, 2016 to June 27, 2016	Page
• Changed package designator to PHN in *Device Information* table	2

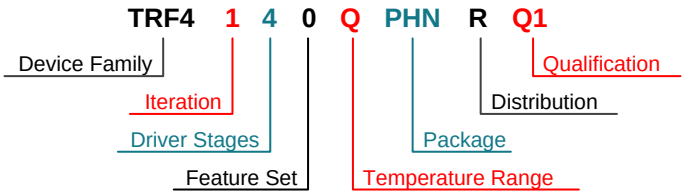
3 Device and Documentation Support

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 *Packaging Information* 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 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 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 or TRF4260 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

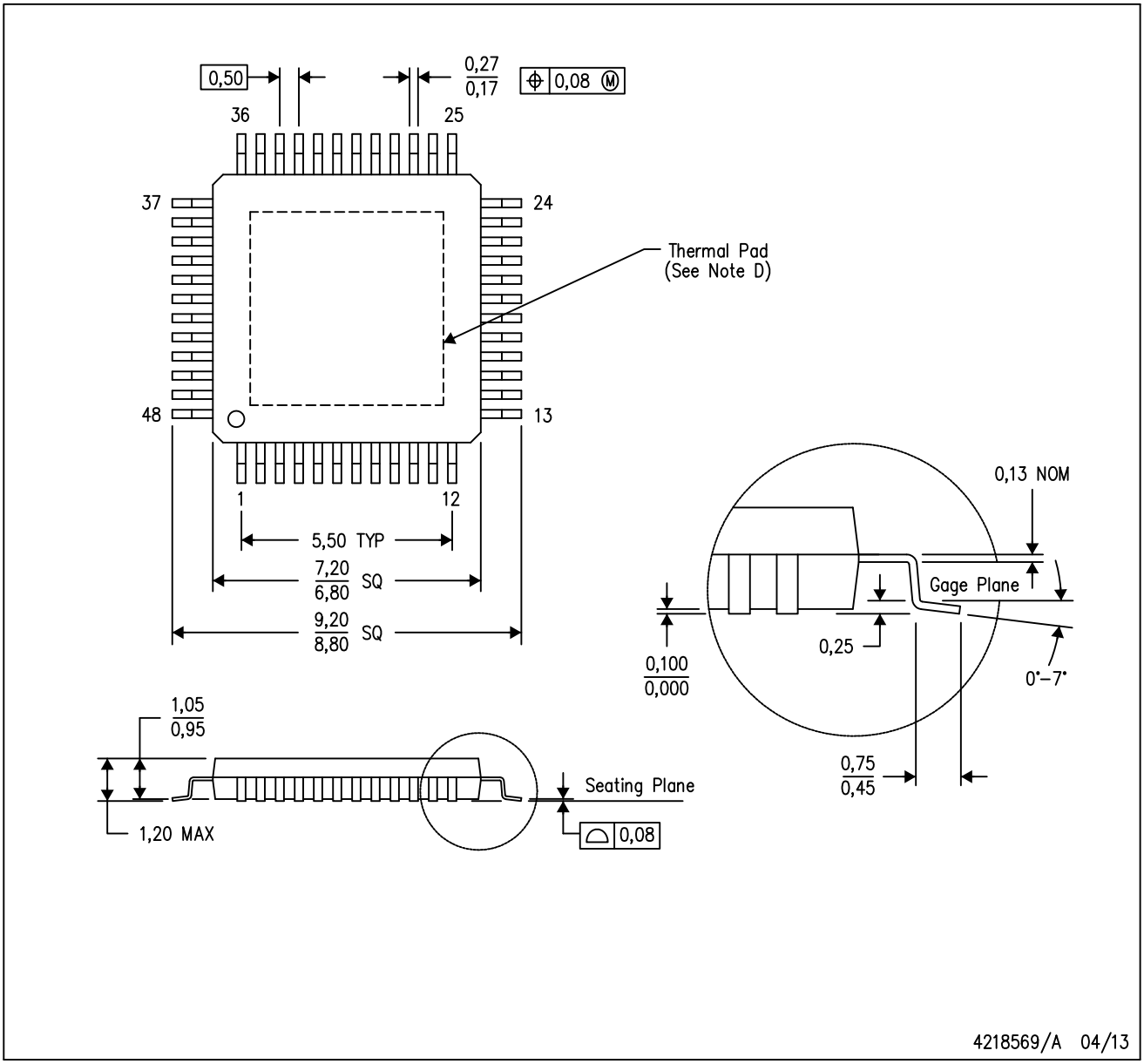
TI Glossary This glossary lists and explains terms, acronyms, and definitions.

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.

Mechanical Data

PHN (S–PQFP–G48) PowerPAD™ PLASTIC QUAD FLATPACK



NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion
D. This package is designed to be soldered to a thermal pad on the board. Refer to Technical Brief, PowerPad Thermally Enhanced Package, Texas Instruments Literature No. SLMA002 for information regarding recommended board layout. This document is available at www.ti.com <http://www.ti.com>.
E. Falls within JEDEC MS–026

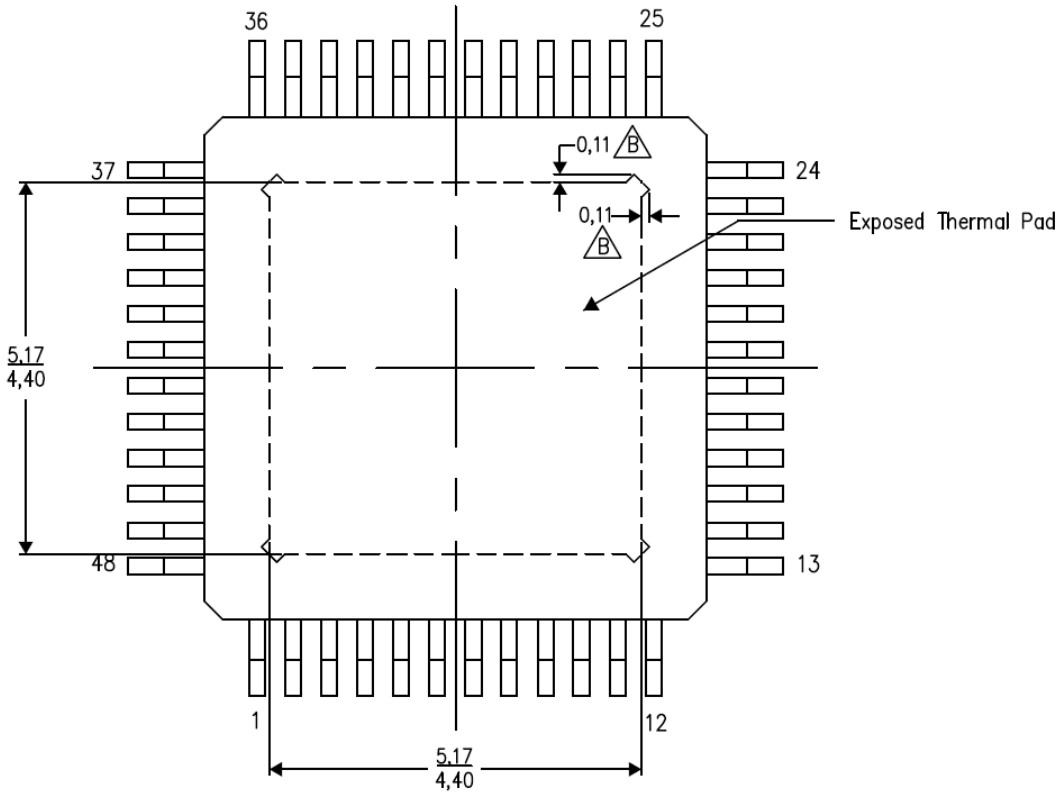
PowerPAD is a trademark of Texas Instruments.

THERMAL INFORMATION

This PowerPAD™ package incorporates an exposed thermal pad that is designed to be attached to a printed circuit board (PCB). The thermal pad must be soldered directly to the PCB. After soldering, the PCB can be used as a heatsink. In addition, through the use of thermal vias, the thermal pad can be attached directly to the appropriate copper plane shown in the electrical schematic for the device, or alternatively, can be attached to a special heatsink structure designed into the PCB. This design optimizes the heat transfer from the integrated circuit (IC).

For additional information on the PowerPAD package and how to take advantage of its heat dissipating abilities, refer to Technical Brief, PowerPAD Thermally Enhanced Package, Texas Instruments Literature No. SLMA002 and Application Brief, PowerPAD Made Easy, Texas Instruments Literature No. SLMA004. Both documents are available at www.ti.com.

The exposed thermal pad dimensions for this package are shown in the following illustration.



Top View

Exposed Thermal Pad Dimensions

4206329–7/N 04/12

NOTE: A. All linear dimensions are in millimeters

B Tie strap features may not be present.

PowerPAD Is a trademark of Texas Instruments

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
TRF4140QPHNRQ1	ACTIVE					Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR	-40 to 125	TRF4140C	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) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://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.
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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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