

Power Controller and Sensor ASIC for Braking Applications

Check for Samples: [TPIC7218-Q1](#)

1 Introduction

The TPIC7218 is an antilock brake controller designed for use in harsh automotive environments, requiring few external components. It has eight high current low-side drivers for use with solenoid valves, four configurable wheel speed sense inputs capable of handling both Intelligent and Active sensors, and high-side gate drivers for controlling two external N-channel MOSFETs for use with a pump motor and master relay. Besides this main functionality, the TPIC7218 also has drivers for warning lamps, a high-side gate driver for controlling an external N-channel MOSFET for use with a relay, K-line driver, and various I/O pins for other common antilock braking needs. The TPIC7218 boosts an internal charge-pump allowing the high-side drivers to use inexpensive N-channel MOSFETs. The digital I/O pins can be configured for both 5 V and 3.3 V levels for easy connection to any microprocessor. The TPIC7218 uses standard SPI protocol for communication.

For the full version of this document, please contact msamktg@list.ti.com.

1.1 Features

- **PWM Low-Side Drivers**
 - 4 PWM Low-Side Driver Outputs
 - Current Limitation
 - Thermal Protection: $T_J = 185^\circ\text{C}$ (Min)
 - Open-Load Detection
 - Energy Capability: 30 mJ at $T_J = 150^\circ\text{C}$
 - Clamp Voltage: 40 V
 - Low R_{DSon} : 0.3 Ω (Max) at $T_J = 150^\circ\text{C}$
- **Digital Low-Side Drivers**
 - 4 Digital Low-Side Driver Outputs
 - Current Limitation
 - Thermal Protection: $T_J = 185^\circ\text{C}$ (Min)
 - Open-Load Detection
 - Energy Capability: 50 mJ at $T_J = 150^\circ\text{C}$
 - Clamp Voltage: 40 V
 - Low R_{DSon} : 0.2 Ω (Max) at $T_J = 150^\circ\text{C}$
- **Dual High-Side Power Drivers**
 - Direct Input Control
 - PWM Capability
 - Load Dump (overvoltage) Detection
 - Programmable over current detection
 - Programmable short-circuit Protection
 - Load Leakage Detection
 - Fault detection over SPI
- **Wheel Speed Sensor Interface**
 - Compatible with Intelligent and Active Wheel Speed Sensors
 - 4 High-Side Switches with Short Circuit Protection
- 4 Low-Side Switches with Short Circuit Protection
- 2 High Voltage Low-Side Output Drivers
- 4 Digital Outputs to Indicate the Speed
- Integrated Data Decoder for Intelligent Wheel Speed Sensors
- **Open-Drain Warning Lamp Drivers**
 - 2 High Voltage Drivers
 - Thermal Protection With Hysteresis
 - Current Limitation
 - $T_J = 185^\circ\text{C}$ (Min)
 - R_{DSon} : 4 Ω at $T_J = 150^\circ\text{C}$
 - Clamp Voltage: 40 V
- **Other Features**
 - K-LINE Transceiver
 - 3.3-V or 5-V Compatible Digital IO
 - Internal 3.3V Regulator
 - Internal Charge Pump
 - 1 Low Voltage open-drain warning lamp driver
 - Full Duplex SPI Interface
 - Watchdog input with open-drain fault reporting for safety
 - "Pb-Free"(1) ASIC
 - Automotive Temperature Range of -40°C to 125°C
 - Qualified based on AEC-Q100 REV G
 - Compliant with CISPR 25 NB Class 5 for Conducted and Radiated Emissions



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

1.2 Description

The TPIC7218 is an antilock braking controller capable of directly driving eight solenoid valves with internal high-current low-side drivers. Low-side drivers configured for digital control do not require external voltage clamps. The TPIC7218 has gate drive capability for two high-side N-Channel MOSFETs that can be used to drive a pump motor and power to all solenoids. The TPIC7218 provides a fault tolerant interface for both Intelligent and Active wheel speed sensors to an external microprocessor. The TPIC218 can be used with either 3.3 or 5.0 V microprocessors and utilizes a standard SPI interface. The TPIC7218 has two internal open-drain warning lamp drivers that can be pulled up to battery voltage, as well as one low voltage driver. An internal state machine monitors a watchdog input and reports faults on a warning lamp pin and SPI register. A K-Line transceiver is also included. A multitude of safety and fault monitoring functionality supervise both system and TPIC7218 circuits. Faults must be polled and reset over SPI. The TPIC7218 is designed for use in harsh automotive environments, capable of withstanding high operating temperatures and electrically noisy signals and power. Short-to-ground, short-to-battery, and open-load conditions are tolerated and monitored. The TPIC7218 also exhibits outstanding Electro-Magnetic Compatibility (EMC) performance.

ORDERING INFORMATION

T_A	PACKAGE ⁽¹⁾		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 125°C	PowerPAD™ S-PQFP – G80	Reel of 1000	TPIC7218QPFRQ1	TPIC7218

- (1) "Pb-Free" is defined to be compliant with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials unless exempt. Where designed to be soldered at high temperatures, TI "Pb-Free" and "RoHS Compliant" products are suitable for use in specified lead-free processes.

PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/ Ball Finish	MSL Peak Temp ⁽³⁾	Samples (Requires Login)
TPIC7218QPFPRQ1	ACTIVE	HTQFP	PFP	80	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR	

⁽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.

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.

Important Information and Disclaimer: The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

TAPE AND REEL 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

TAPE AND REEL INFORMATION

*All dimensions are nominal

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
TPIC7218QPFP RQ1	HTQFP	PFP	80	1000	330.0	24.4	15.0	15.0	1.5	20.0	24.0	Q2

TAPE AND REEL BOX DIMENSIONS



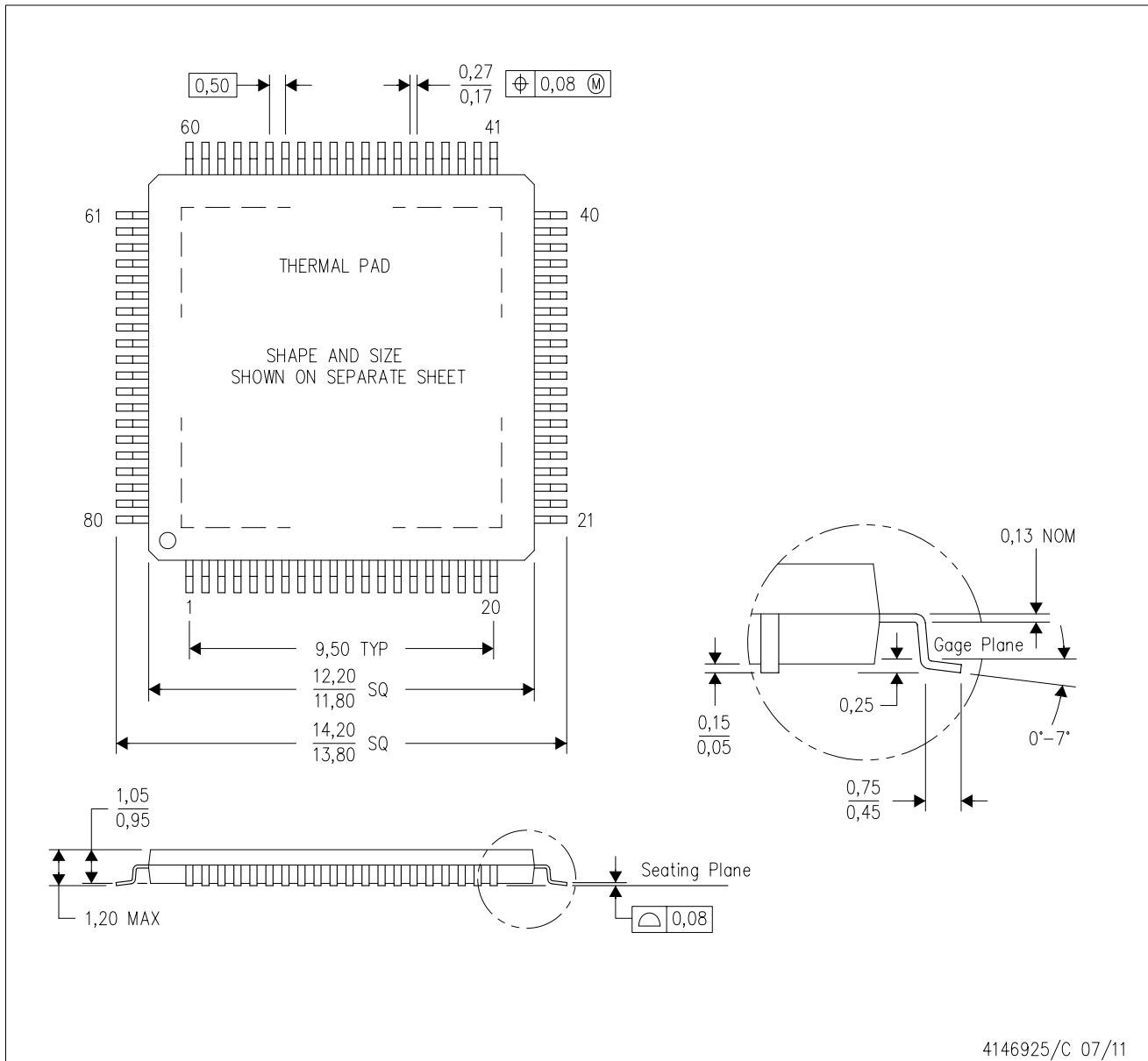
*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TPIC7218QPFPRQ1	HTQFP	PFP	80	1000	367.0	367.0	45.0

MECHANICAL DATA

PFP (S-PQFP-G80)

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. See the additional figure in the Product Data Sheet for details regarding the exposed thermal pad features and dimensions.
 - F. Falls within JEDEC MS-026

PowerPAD is a trademark of Texas Instruments.

THERMAL PAD MECHANICAL DATA

PFP (S-PQFP-G80)

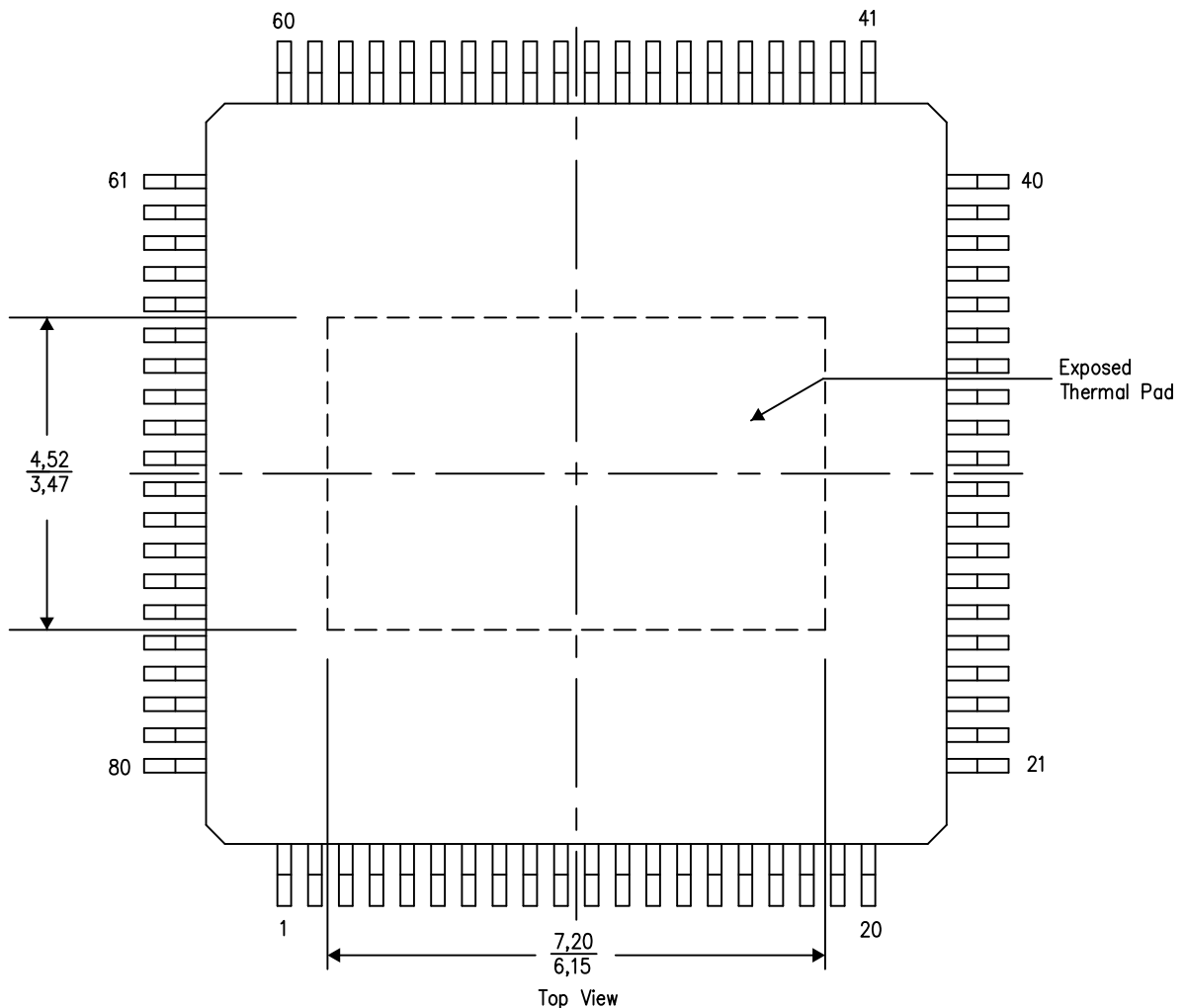
PowerPAD™ PLASTIC QUAD FLATPACK

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.



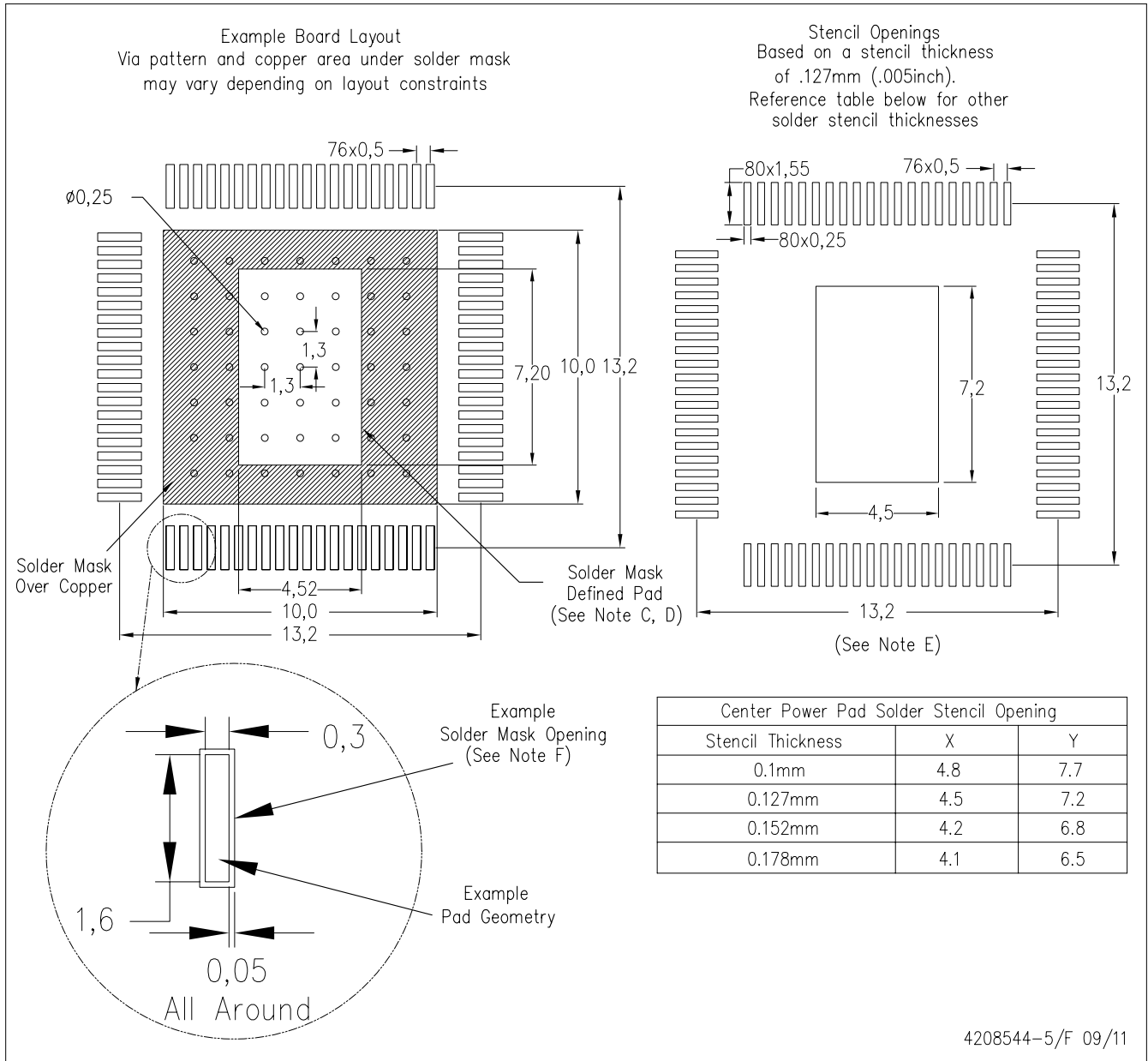
4206327-8/0 07/12

NOTE: A. All linear dimensions are in millimeters

PowerPAD is a trademark of Texas Instruments

PFP (S-PQFP-G80)

PowerPAD™ PLASTIC QUAD FLATPACK



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Customers should place a note on the circuit board fabrication drawing not to alter the center solder mask defined pad.
 - 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, SLMA004, and also the Product Data Sheets for specific thermal information, via requirements, and recommended board layout. These documents are available at www.ti.com <<http://www.ti.com>>. Publication IPC-SM-7351 is recommended for alternate designs.
 - E. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Example stencil design based on a 50% volumetric metal load solder paste. Refer to IPC-7525 for other stencil recommendations.
 - F. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.
- PowerPAD is a trademark of Texas Instruments.

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46C and to discontinue any product or service per JESD48B. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI's terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers' products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers' products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components which meet ISO/TS16949 requirements, mainly for automotive use. Components which have not been so designated are neither designed nor intended for automotive use; and TI will not be responsible for any failure of such components to meet such requirements.

Products

Audio	www.ti.com/audio
Amplifiers	amplifier.ti.com
Data Converters	dataconverter.ti.com
DLP® Products	www.dlp.com
DSP	dsp.ti.com
Clocks and Timers	www.ti.com/clocks
Interface	interface.ti.com
Logic	logic.ti.com
Power Mgmt	power.ti.com
Microcontrollers	microcontroller.ti.com
RFID	www.ti-rfid.com
OMAP Mobile Processors	www.ti.com/omap
Wireless Connectivity	www.ti.com/wirelessconnectivity

Applications

Automotive and Transportation	www.ti.com/automotive
Communications and Telecom	www.ti.com/communications
Computers and Peripherals	www.ti.com/computers
Consumer Electronics	www.ti.com/consumer-apps
Energy and Lighting	www.ti.com/energy
Industrial	www.ti.com/industrial
Medical	www.ti.com/medical
Security	www.ti.com/security
Space, Avionics and Defense	www.ti.com/space-avionics-defense
Video and Imaging	www.ti.com/video

TI E2E Community e2e.ti.com