

Quad-Channel Driver for Airbag Deployment

Check for Samples: [TPIC71004-Q1](#)

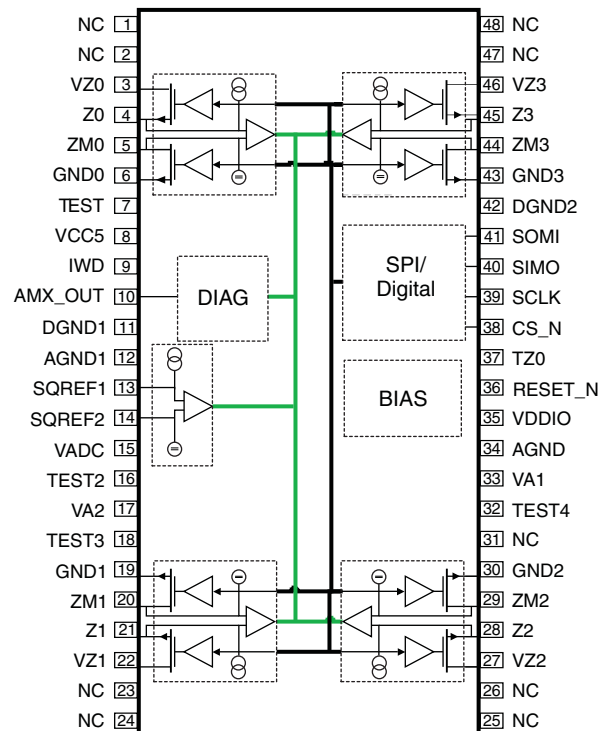
FEATURES

- Quad-Channel Squib Drivers for Airbag Application
- Loop Diagnostics Monitor and Reporting
- Two Logic Inputs Providing Independent Safety Logic for Enabling/Disabling Deployment
- Four Independent Thermally Protected High-Side Drivers That can Source Deployment or Diagnostic Current Level to Each Squib Load
- Four Independent Avalanche Voltage and Thermally Protected Low-Side Drivers That Can Sink Deployment or Diagnostic Current Level From Each Squib Load
- Each Output Capable of 1.2 A/1.75 A Firing Current for Typical 2 ms/0.5 ms
- SPI Slave Interface for Serial Bus Communication with Parity Check
- Firing VZx Voltage Range 10 V to 35 V, Transients up to 40 V
- Programmable Firing Time up to 8.2 ms
- Common Load Current Settings for All Deployment Loops, Using Registers
- Individual Firing Current Timer Limit Set for Each Deployment Loop, Using Registers
- Firing Current Timer to Monitor Firing Current Over Deployment Time for Each Deployment Loop
- Independent Switch Control for Both High- and Low-Side Switches
- Diagnostic Mode for Fault Checking
- Internal Fault Monitoring for Safe Operation
- A Multiplex-able Output Buffer for Analog Voltage Measurements
- Use of External Clamping devices on Squib Pins is Not Required to Protect the Deployment ASIC Against Substrate Injection Effects During Deployment Due to Dynamic Shorts to Ground

- An External Pin Connection to the Microprocessor ADC Supply for Ratio-metric Squib Resistance Measurement
- 40-V Pin Capability on All Pins (Except GNDx, AGND, DGND, VCC5, VDDIO, AMX_OUT)
- Operating Ambient Temperature Range: -40°C to 105°C
- Thermally Enhanced 48-Pin TSSOP DCA PowerPad™ Package

APPLICATIONS

- Squib Drivers for Airbag Application



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.

PowerPad is a trademark of Texas Instruments.

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of the Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

DESCRIPTION

The TPIC71004-Q1 is a quad channel squib driver for airbags deployment in automotive applications. Each channel consists of a high side and a low side switch with independent control logic for protection against inadvertent deployment. Both the high and the low side switches have internal current limits, over-temperature protection.

The IC registers are used for four channel configuration, control and status monitoring. To prevent inadvertent deployment, the high and the low side switches will be turned on only if the proper configuration sequence is used and multiple inputs to the deploy controller logic are at the correct level. The registers are programmed using a serial communications interface.

The maximum on time for each channel is limited by programmable Firing Time Out Timer to prevent excessive power dissipation. In addition, a current limit register is used to program the maximum current through the switches during a deployment. The current limitation on the low side switch is larger than the corresponding high side switch. During deployment, the low side switch will be full enhanced and operate with RDS_ON mode and the high side switch will be in current regulation mode.

The implemented diagnostic functions monitor deployment ASIC pin voltages to provide High Side switch test, Low Side switch test, squib resistance measurements, squib leakage measurement to battery, ground and between any squib channels. Furthermore, the squib leakage measurement is provided for both Zx and ZMx pins and does not require the squib load to be present to operate properly. Diagnostic information is communicated through the AMX_OUT pin (for analog signals) and SPI mapped status registers (for status signals latched in digital core).

The high-side and low-side squib drivers have a diagnostic level current limit and a deployment level current limit. The default current limit for high-side and low-side squib drivers is the diagnostic level current limit. The high-side switch deployment current limit for all high-side drivers can be set to either 1.2 A min or 1.75 A min (see [Table 1](#)) through SPI mapped registers, device EEPROM settings (see [Table 2](#)). The low-side switch deployment current limit is not programmable and is fixed to a level greater than the high-side driver current limit. The ON time duration for each individual squib driver can be programmed through SPI mapped registers.

The deployment sequence requires a specific set of software commands combined with external hardware enable logic lines (TZ0=H, IWD=L) to provide deployment capability. The turn-on sequence of the high-side driver and low-side drivers is software controlled via SPI commands, but the turn-off procedure is automatically provided by the deployment ASIC. After the programmed ON time duration has been achieved, the high-side switch is deactivated first then followed by the low-side driver deactivation by approximately 100µsec.

The RESET_N is an active low input reset signal. This input will be released high by the power supply unit and/or the µC once the external voltage supplies are within the specified limits. The external microcontroller is required to configure and control device through the serial communication interface. Reliable software is critical for the system operation.

Table 1. Potential Deployment Settings for Typical Firing Current

FIRING VOLTAGE	MAXIMUM AVERAGE FIRING VOLTAGE BETWEEN VZx AND Zx PINS TO ACHIEVE DEPLOYMENT	TYPICAL FIRING CURRENT	DWELL (FIRING) TIME ⁽¹⁾
35 V	32.56 V	1.2 A	2 ms
35 V	35.0 V	1.75 A	0.5 ms

(1) For programming desired dwell (firing) time.

Extended deployment duration activates the over temperature protection circuit and terminates deployment. If short-to-ground condition occurs during deployment, 35V firing voltage is completely dropped across the HS_FET: therefore, thermal shut down protection kicks in to protect the device.

Table 2. Potential Deployment Settings for Maximum Firing Current

FIRING VOLTAGE	MAXIMUM AVERAGE FIRING VOLTAGE BETWEEN VZx AND Zx PINS TO ACHIEVE DEPLOYMENT	MAX FIRING CURRENT ⁽¹⁾	DWELL (FIRING) TIME ⁽²⁾
35 V	30 V	2.6 A (for 1.75 A current setting)	0.7 ms
35 V	31 V	2.0 A (for 1.2 A current setting)	2.0 ms

(1) The max firing current levels are set through device EEPROM setting

(2) For programming desired dwell (firing) time

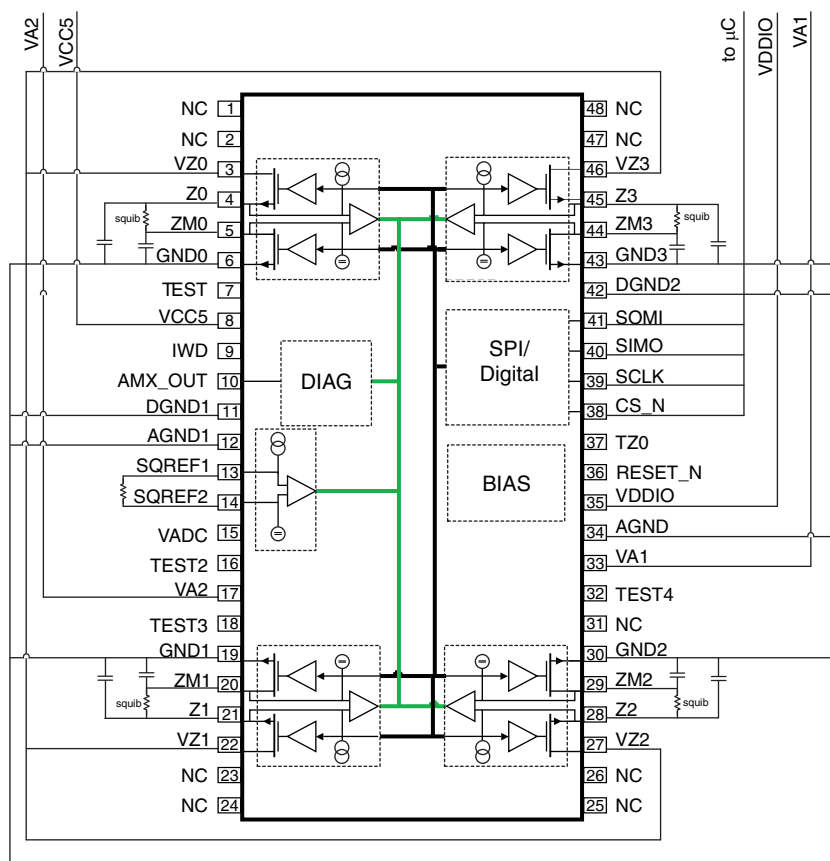
For the full version of this document, please contact msamktg@list.ti.com.

ORDERING INFORMATION

T _A	PACKAGE ⁽¹⁾	ORDERABLE PART NUMBER	TOP-SIDE MARKING
-40°C to 125°C	HTSSOP – DCA	Tape and reel	TPIC71004

(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.

Functional Block Diagram



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)
TPIC71004TDCARQ1	ACTIVE	HTSSOP	DCA	48	2000	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.

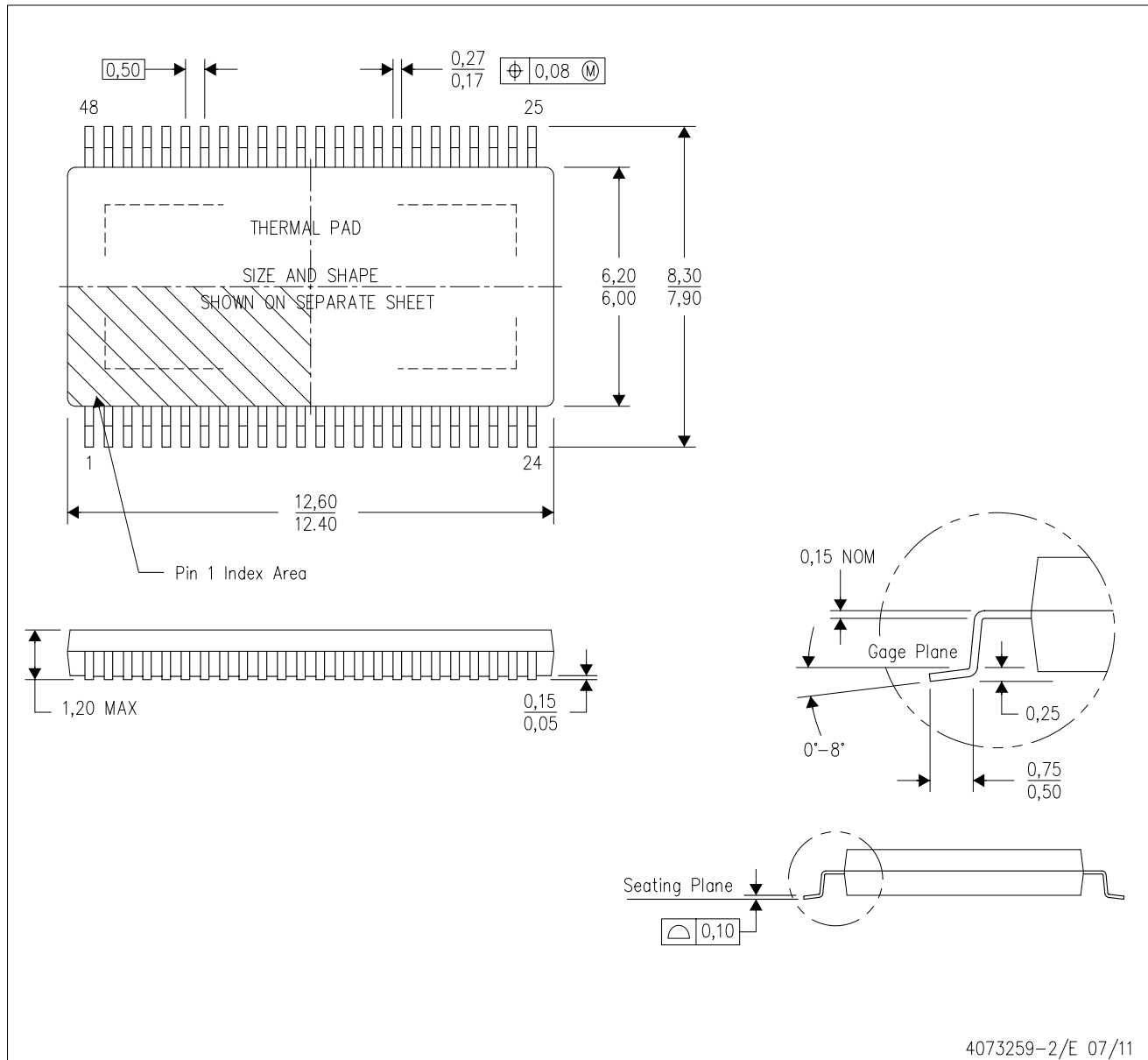
Important Information and Disclaimer: The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. 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.

MECHANICAL DATA

DCA (R-PDSO-G48)

PowerPAD™ PLASTIC SMALL-OUTLINE



- NOTES:
- All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
 - This drawing is subject to change without notice.
 - Body dimensions do not include mold flash or protrusion not to exceed 0,15.
 - 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>>.
 - See the additional figure in the Product Data Sheet for details regarding the exposed thermal pad features and dimensions.
 - Falls within JEDEC MO-153

PowerPAD is a trademark of Texas Instruments.

THERMAL PAD MECHANICAL DATA

DCA (R-PDSO-G48)

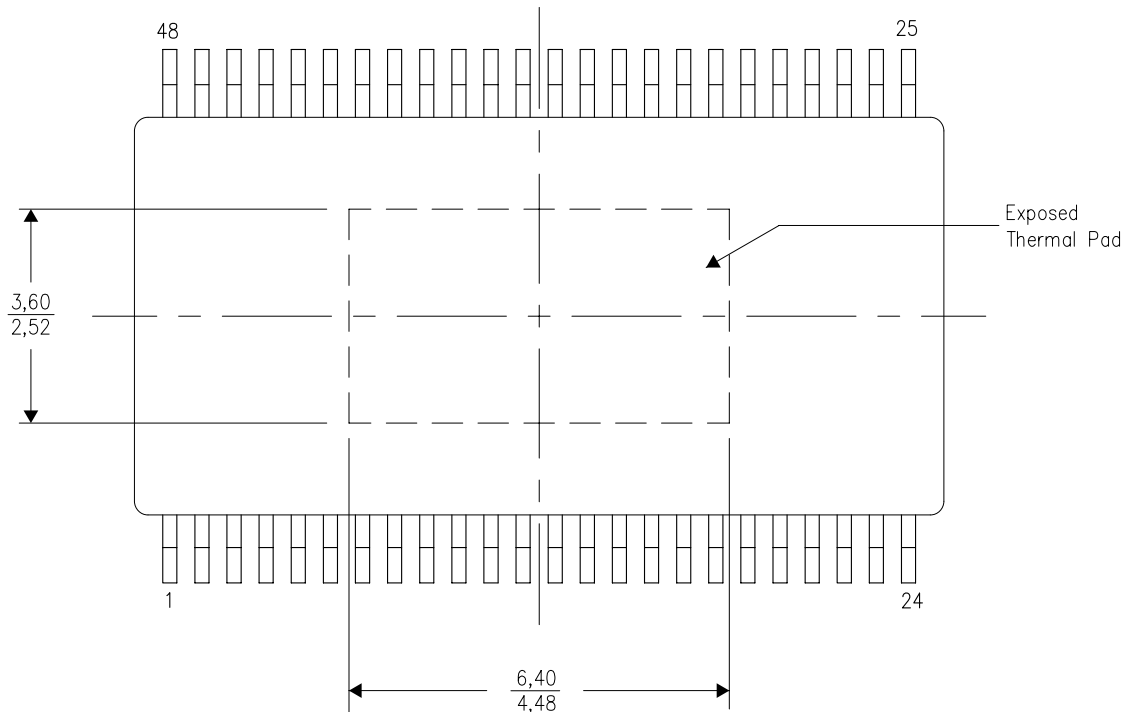
PowerPAD™ PLASTIC SMALL OUTLINE

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.

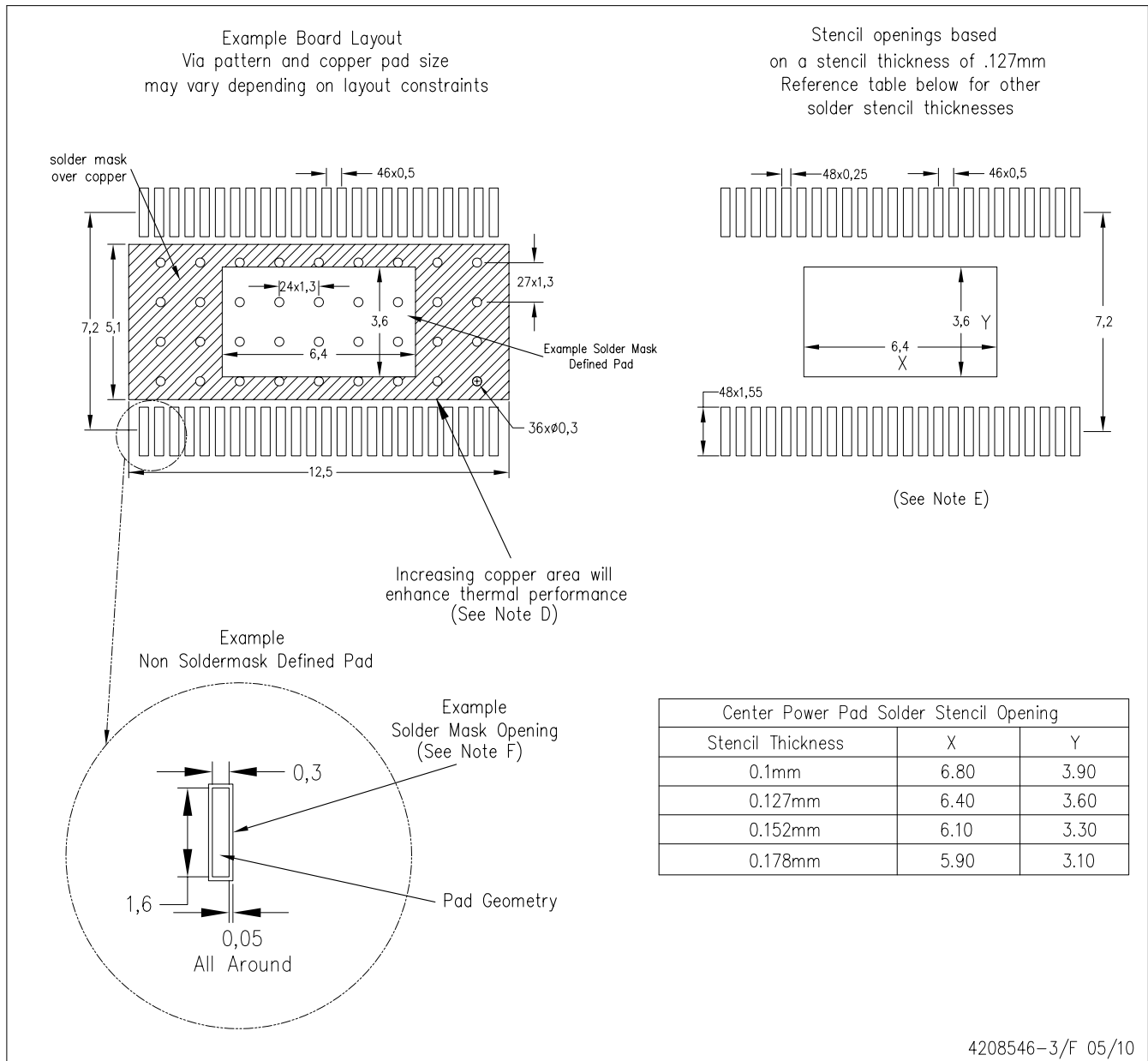
The exposed thermal pad dimensions for this package are shown in the following illustration.



4206320-4/N 10/11

NOTE: A. All linear dimensions are in millimeters

PowerPAD is a trademark of Texas Instruments.



- NOTES:
- All linear dimensions are in millimeters.
 - This drawing is subject to change without notice.
 - Customers should place a note on the circuit board fabrication drawing not to alter the center solder mask defined pad.
 - 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-7351 is recommended for alternate designs.
 - 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.
 - Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

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

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

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI 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 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. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

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

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

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

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
Transportation and Automotive	www.ti.com/automotive
Video and Imaging	www.ti.com/video

TI E2E Community Home Page

e2e.ti.com

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2011, Texas Instruments Incorporated