CSD18504Q5A 40V N-Channel NexFET™ Power MOSFET

1 Features

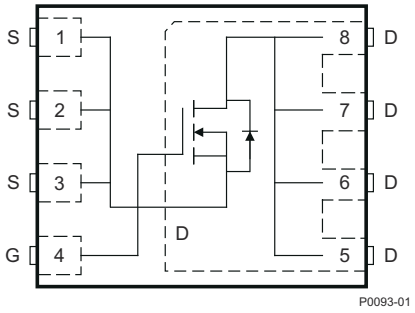
- Ultra-low Q_g and Q_{gd}
- Low thermal resistance
- Avalanche rated
- Logic level
- Pb free terminal plating
- RoHS compliant
- Halogen free
- SON 5mm × 6mm plastic package

2 Applications

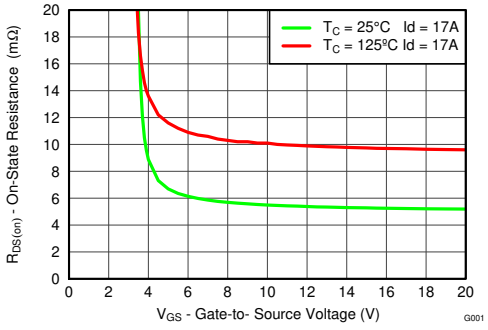
- DC-DC conversion
- Secondary side synchronous rectifier
- Battery motor control

3 Description

This 5.3mΩ, SON 5mm × 6mm, 40V NexFET™ power MOSFET is designed to minimize losses in power conversion applications.



Top View



$R_{DS(on)}$ vs V_{GS}

Product Summary

T_A = 25°C		TYPICAL VALUE		UNIT
V_{DS}	Drain-to-Source Voltage	40		V
Q_g	Gate Charge Total (4.5V)	7.7		nC
Q_{gd}	Gate Charge Gate-to-Drain	2.4		nC
$R_{DS(on)}$	Drain-to-Source On-Resistance	V_{GS} = 4.5V	7.5	mΩ
		V_{GS} = 10V	5.3	mΩ
$V_{GS(th)}$	Threshold Voltage	1.9		V

Ordering Information (1)

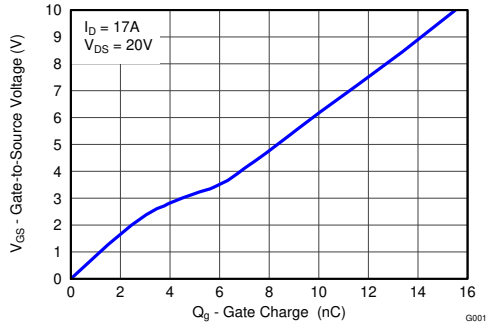
Device	Qty	Media	Package	Ship
CSD18504Q5A	2500	13-Inch Reel	SON 5mm × 6mm Plastic Package	Tape and Reel
CSD18504Q5AT	250	7-Inch Reel		

(1) For all available packages, see the orderable addendum at the end of the data sheet.

Absolute Maximum Ratings

T_A = 25°C		VALUE	UNIT
V_{DS}	Drain-to-Source Voltage	40	V
V_{GS}	Gate-to-Source Voltage	±20	V
I_D	Continuous Drain Current (Package limited)	50	A
	Continuous Drain Current (Silicon limited), T_C = 25°C	75	
	Continuous Drain Current(1)	15	
I_{DM}	Pulsed Drain Current(2)	275	A
P_D	Power Dissipation(1)	3.1	W
	Power Dissipation, T_C = 25°C	77	
T_J, T_{stg}	Operating Junction and Storage Temperature Range	–55 to 150	°C
E_{AS}	Avalanche Energy, single pulse I_D = 43A, L = 0.1mH, R_G = 25Ω	92	mJ

(1) Typical $R_{\theta JA}$ = 40°C/W on a 1-inch^2 , 2oz. Cu pad on a 0.06-inch thick FR4 PCB.
(2) Max $R_{\theta JC}$ = 2.0 °C/W, pulse duration ≤100µs, duty cycle ≤1%



Gate Charge

Table of Contents

4 Specifications

4.1 Electrical Characteristics

(T_A = 25°C unless otherwise stated)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
STATIC CHARACTERISTICS						
BV_{DSS}	Drain-to-Source Voltage	V_{GS} = 0V, I_D = 250µA	40			V
I_{DSS}	Drain-to-Source Leakage Current	V_{GS} = 0V, V_{DS} = 32V			1	µA
I_{GSS}	Gate-to-Source Leakage Current	V_{DS} = 0V, V_{GS} = 20V			100	nA
$V_{GS(th)}$	Gate-to-Source Threshold Voltage	V_{DS} = V_{GS}, I_D = 250µA	1.5	1.9	2.4	V
$R_{DS(on)}$	Drain-to-Source On-Resistance	V_{GS} = 4.5V, I_D = 17A		7.5	9.8	mΩ
		V_{GS} = 10V, I_D = 17A		5.3	6.6	mΩ
g_{fs}	Transconductance	V_{DS} = 20V, I_D = 17A		71		S
DYNAMIC CHARACTERISTICS						
C_{iss}	Input Capacitance	V_{GS} = 0V, V_{DS} = 20V, f = 1MHz		1380	1656	pF
C_{oss}	Output Capacitance			310	372	pF
C_{rss}	Reverse Transfer Capacitance			8	9.6	pF
R_G	Series Gate Resistance			1.4	2.8	Ω
Q_g	Gate Charge Total (4.5V)	V_{DS} = 20V, I_D = 17A		7.7	9.2	nC
Q_g	Gate Charge Total (10V)			16	19	
Q_{gd}	Gate Charge Gate-to-Drain			2.4		nC
Q_{gs}	Gate Charge Gate-to-Source			3.2		nC
$Q_{g(th)}$	Gate Charge at V_{th}			2.2		nC
Q_{oss}	Output Charge	V_{DS} = 20V, V_{GS} = 0V		21		nC
$t_{d(on)}$	Turn On Delay Time	V_{DS} = 20V, V_{GS} = 10V, I_{DS} = 17A, R_G = 0Ω		3.2		ns
t_r	Rise Time			6.8		ns
$t_{d(off)}$	Turn Off Delay Time			12		ns
t_f	Fall Time			2		ns
DIODE CHARACTERISTICS						
V_{SD}	Diode Forward Voltage	I_{SD} = 17A, V_{GS} = 0V		0.8	1	V
Q_{rr}	Reverse Recovery Charge	V_{DS}= 20V, I_F = 17A, di/dt = 300A/µs		39		nC
t_{rr}	Reverse Recovery Time			28		ns

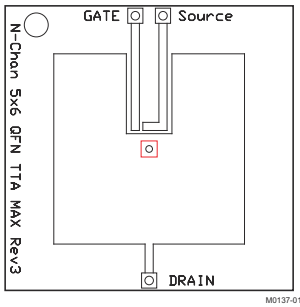
4.2 Thermal Information

(T_A = 25°C unless otherwise stated)

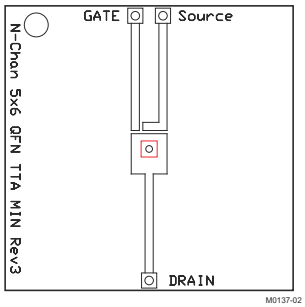
THERMAL METRIC		MIN	TYP	MAX	UNIT
$R_{\theta JC}$	Junction-to-Case Thermal Resistance(1)			2.0	°C/W
$R_{\theta JA}$	Junction-to-Ambient Thermal Resistance(1) (2)			50	

(1) $R_{\theta JC}$ is determined with the device mounted on a 1-inch^2 (6.45cm^2), 2oz. (0.071mm thick) Cu pad on a 1.5-inches × 1.5-inches (3.81cm × 3.81cm), 0.06-inch (1.52mm) thick FR4 PCB. $R_{\theta JC}$ is specified by design, whereas $R_{\theta JA}$ is determined by the user's board design.

(2) Device mounted on FR4 material with 1-inch^2 (6.45cm^2), 2oz. (0.071mm thick) Cu.



Max $R_{\theta JA}$ = 50°C/W when mounted on 1 inch^2 (6.45cm^2) of 2oz. (0.071mm thick) Cu.



Max $R_{\theta JA}$ = 125°C/W when mounted on a minimum pad area of 2oz. (0.071mm thick) Cu.

4.3 Typical MOSFET Characteristics

(T_A = 25°C unless otherwise stated)

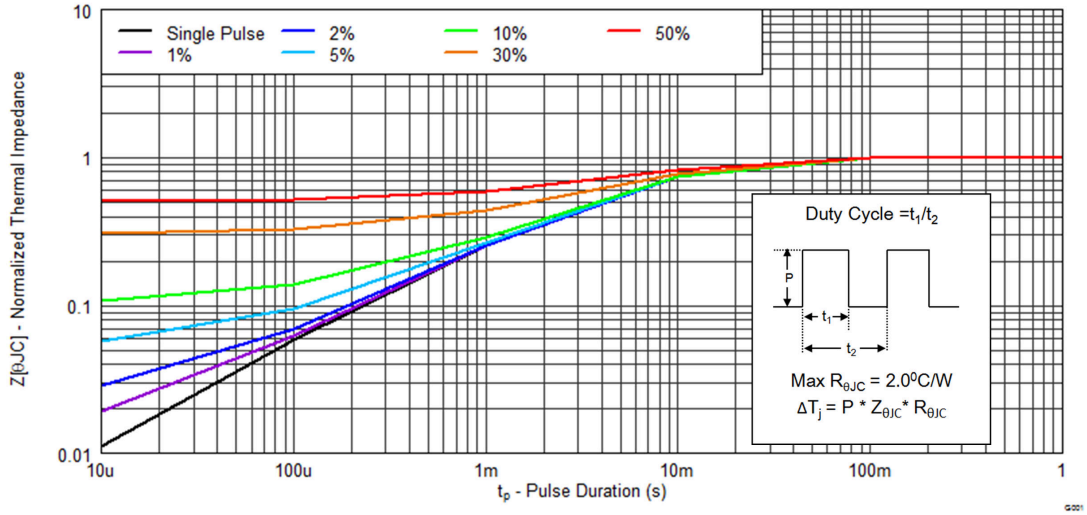


Figure 4-1. Transient Thermal Impedance

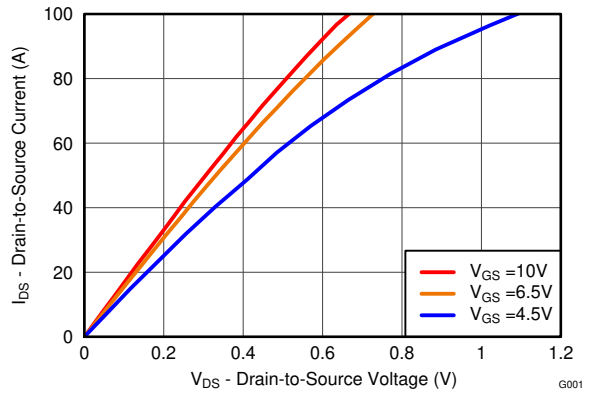


Figure 4-2. Saturation Characteristics

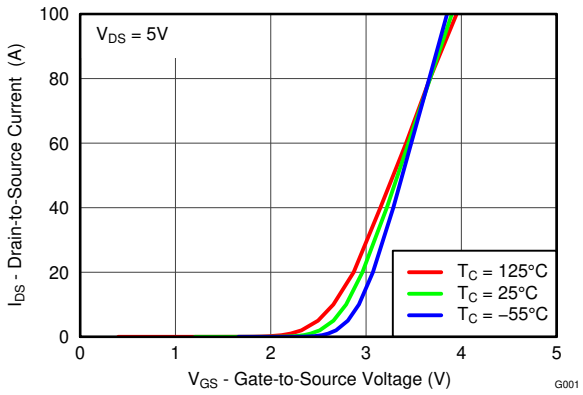


Figure 4-3. Transfer Characteristics

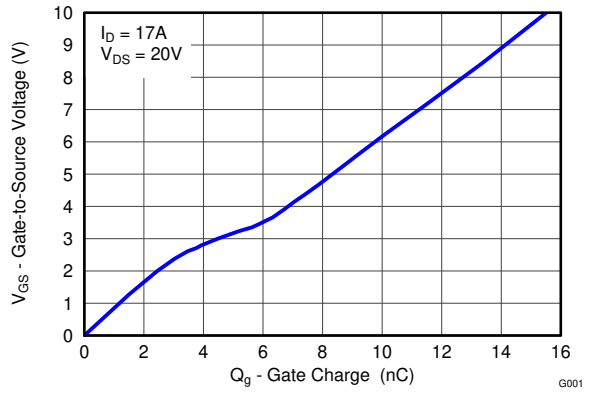


Figure 4-4. Gate Charge

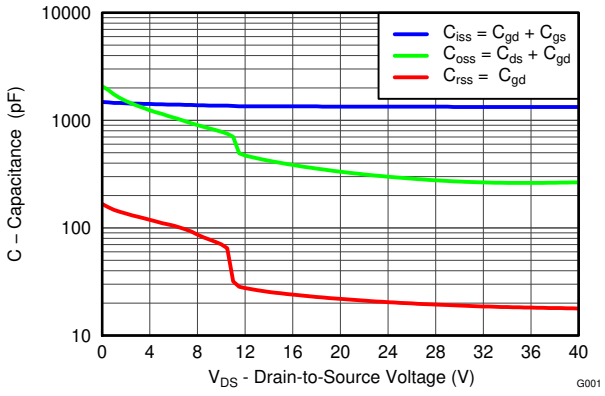


Figure 4-5. Capacitance

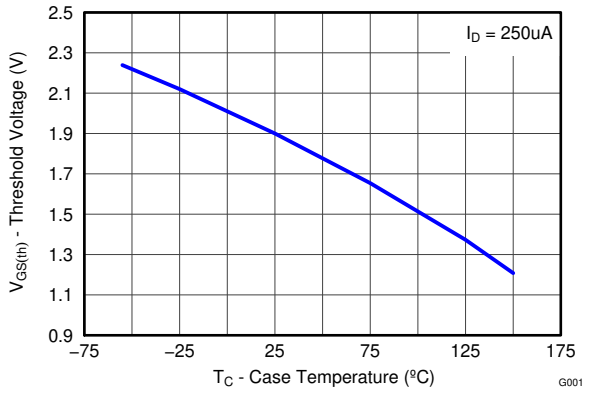


Figure 4-6. Threshold Voltage vs Temperature

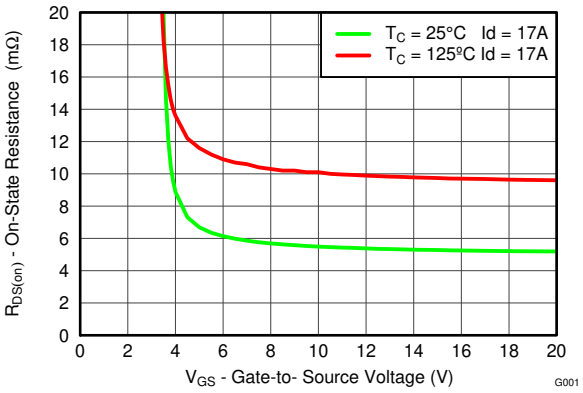


Figure 4-7. On-State Resistance vs Gate-to-Source Voltage

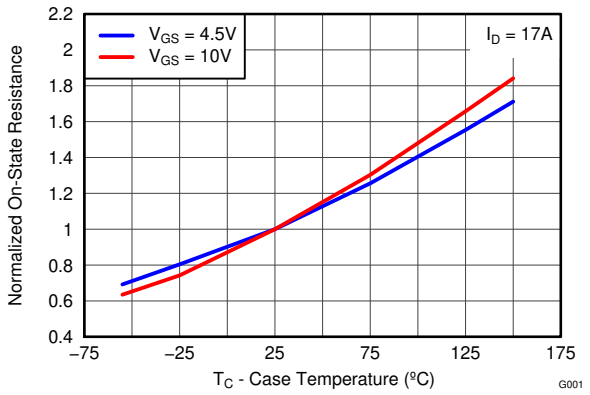


Figure 4-8. Normalized On-State Resistance vs Temperature

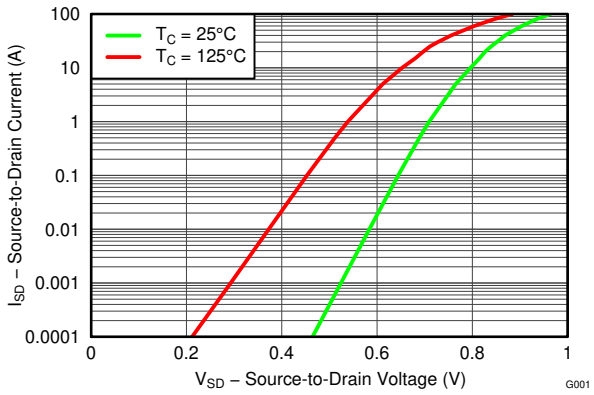


Figure 4-9. Typical Diode Forward Voltage

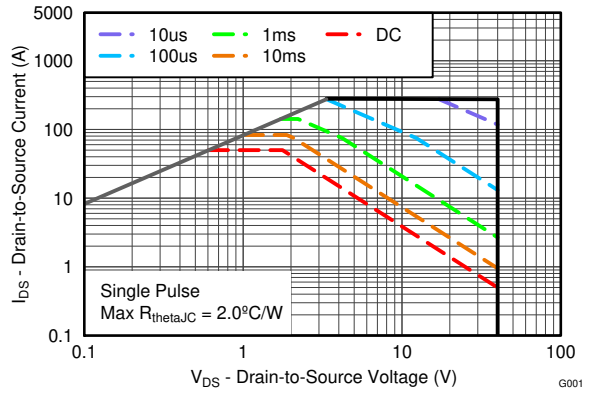


Figure 4-10. Maximum Safe Operating Area

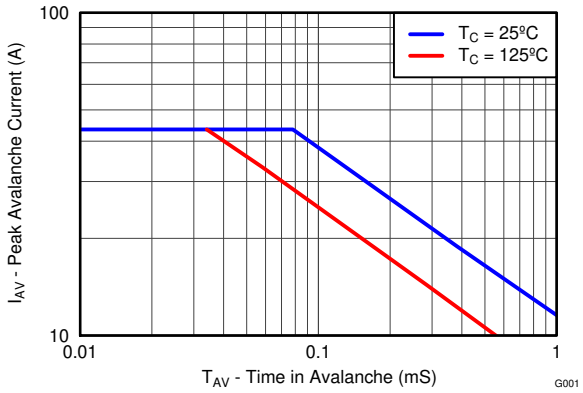


Figure 4-11. Single Pulse Unclamped Inductive Switching

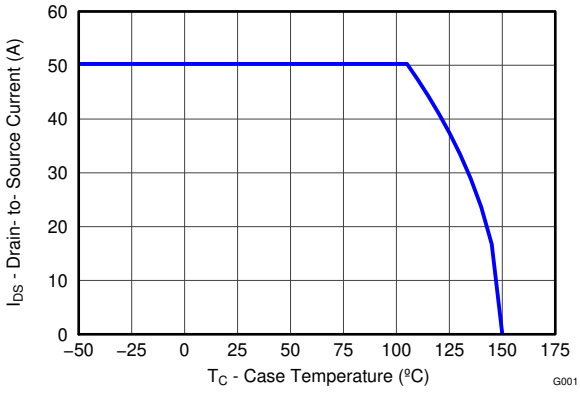


Figure 4-12. Maximum Drain Current vs Temperature

5 Device and Documentation Support

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5.2 Documentation Support

5.2.1 Related Documentation

5.3 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on 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.

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5.6 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.

5.7 Glossary

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

6 Revision History

Changes from Revision E (August 2014) to Revision F (January 2025)	Page
• Updated the numbering format for tables, figures, and cross-references throughout the document	1

Changes from Revision D (August 2014) to Revision E (August 2014)	Page
• Increased pulsed current to 275A	1
• Updated the SOA in Figure 4-10	4

Changes from Revision C (May 2013) to Revision D (August 2014)	Page
• Added 7-inch reel to Ordering Information table	1
• Added parameter for power dissipation with case temperature held to 25°C	1
• Updated pulsed current conditions	1
• Updated Figure 4-1 to a normalized $R_{\theta JC}$ curve	4

Changes from Revision B (November 2012) to Revision C (May 2013)	Page
• Updated Mechanical stencil	9

Changes from Revision A (October 2012) to Revision B (November 2012)	Page
• Changed the $R_{DS(on)}$ vs V_{GS} and Gate Charge graphs	1
• Changed $R_{\theta JA}$ Max value From: 51 To: 50°C/W	3
• Changed the Typical MOSFET Characteristics section	4

Changes from Revision * (June 2012) to Revision A (October 2012)	Page
• Changed the Transconductance TYP value From: 63S To: 71S	3
• Changed the Turn On and Turn Off Delay Time, Rise and Fall Time Test Conditions From: I_{DS} = 17A, R_G = 2Ω To: I_{DS} = 17A, R_G = 0Ω	3
• Changed the Q_{rr} Reverse Recovery Charge TYP value From: 18nC To: 39nC	3

7 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.

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
CSD18504Q5A	ACTIVE	VSONP	DQJ	8	2500	RoHS-Exempt & Green	SN	Level-1-260C-UNLIM	-55 to 150	CSD18504	Samples
CSD18504Q5AT	ACTIVE	VSONP	DQJ	8	250	RoHS-Exempt & Green	SN	Level-1-260C-UNLIM	-55 to 150	CSD18504	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) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".
RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.
Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

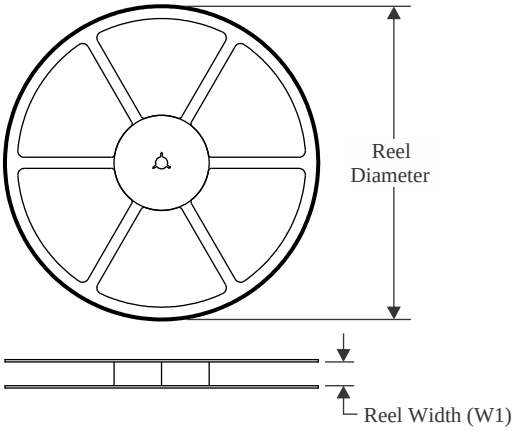
(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(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.

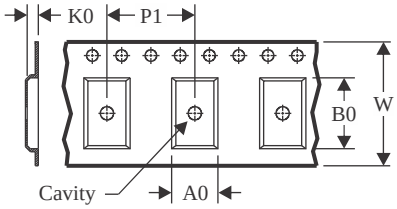
(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

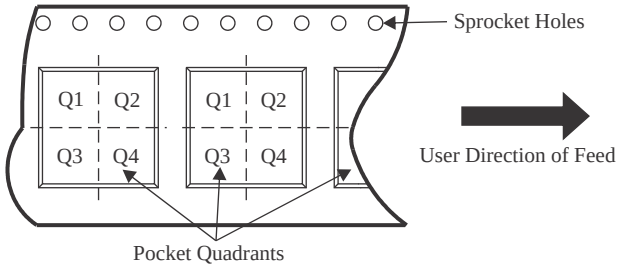


TAPE DIMENSIONS



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

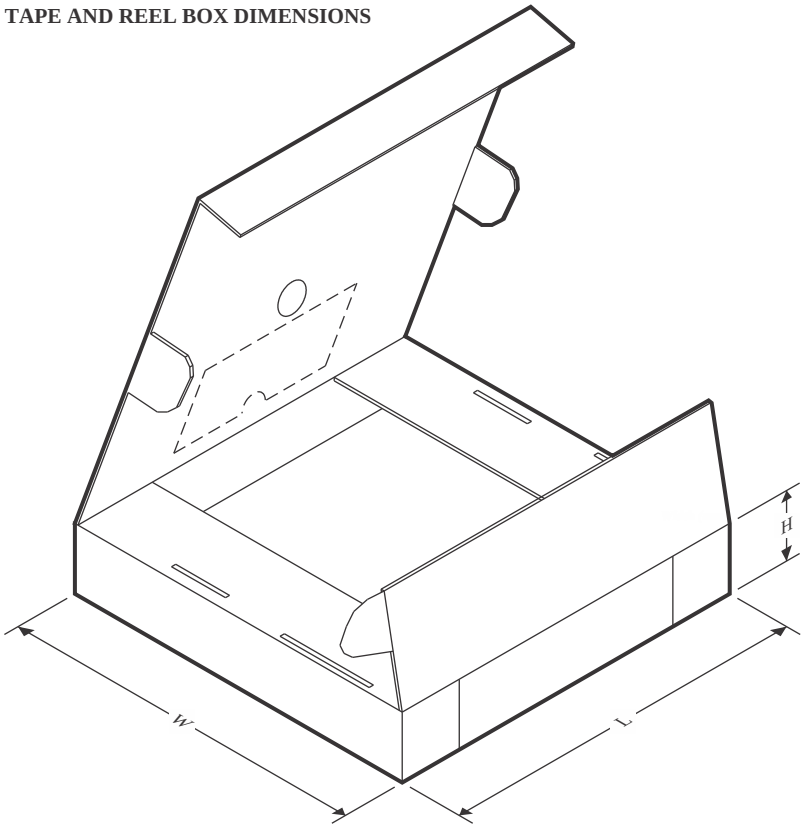
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

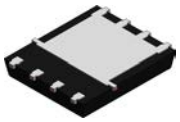
Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
CSD18504Q5A	VSONP	DQJ	8	2500	330.0	12.4	6.3	5.3	1.2	8.0	12.0	Q1
CSD18504Q5AT	VSONP	DQJ	8	250	180.0	12.4	6.3	5.3	1.2	8.0	12.0	Q1

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
CSD18504Q5A	VSONP	DQJ	8	2500	340.0	340.0	38.0
CSD18504Q5AT	VSONP	DQJ	8	250	190.0	190.0	30.0

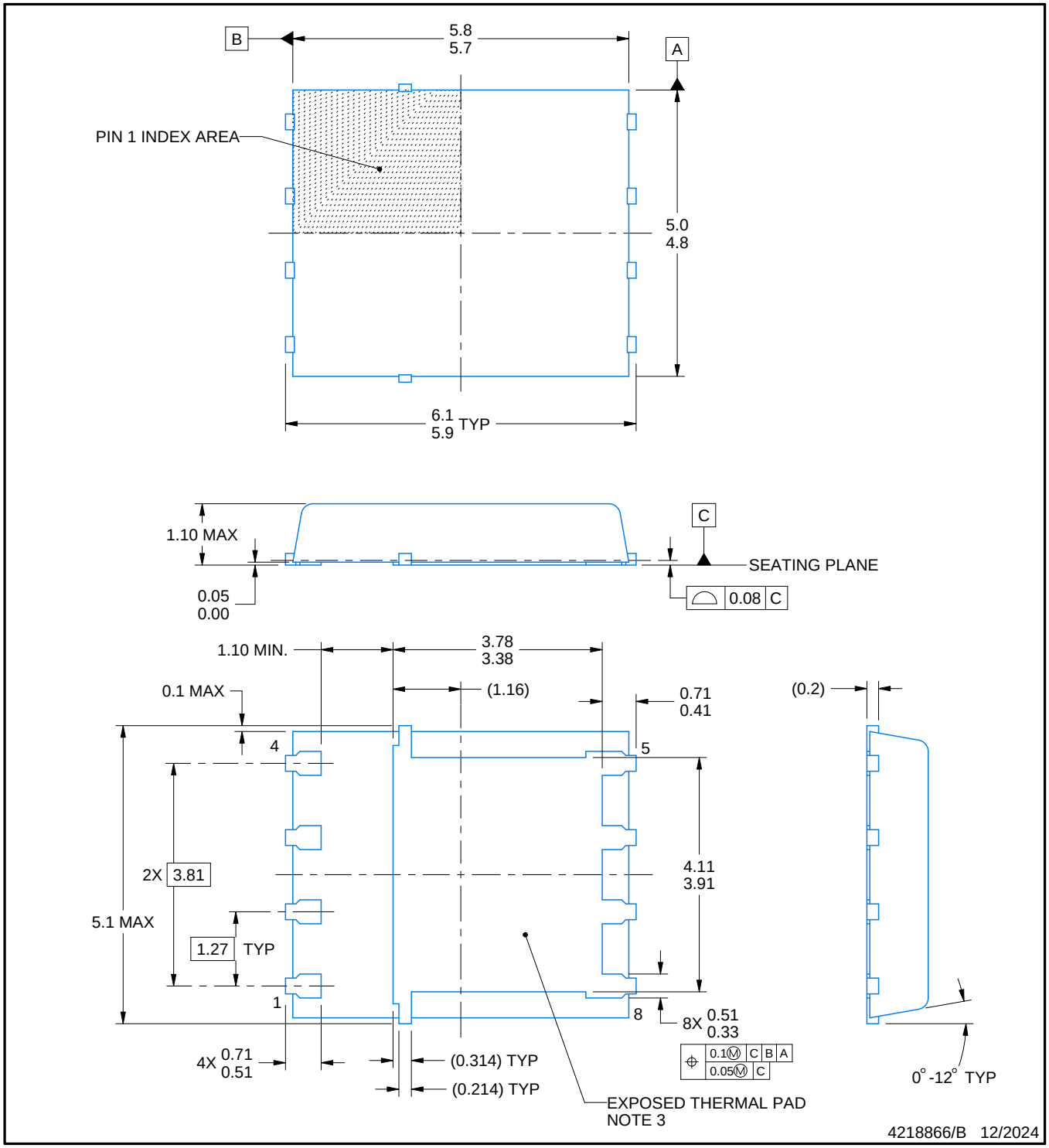


PACKAGE OUTLINE

DQJ0008A

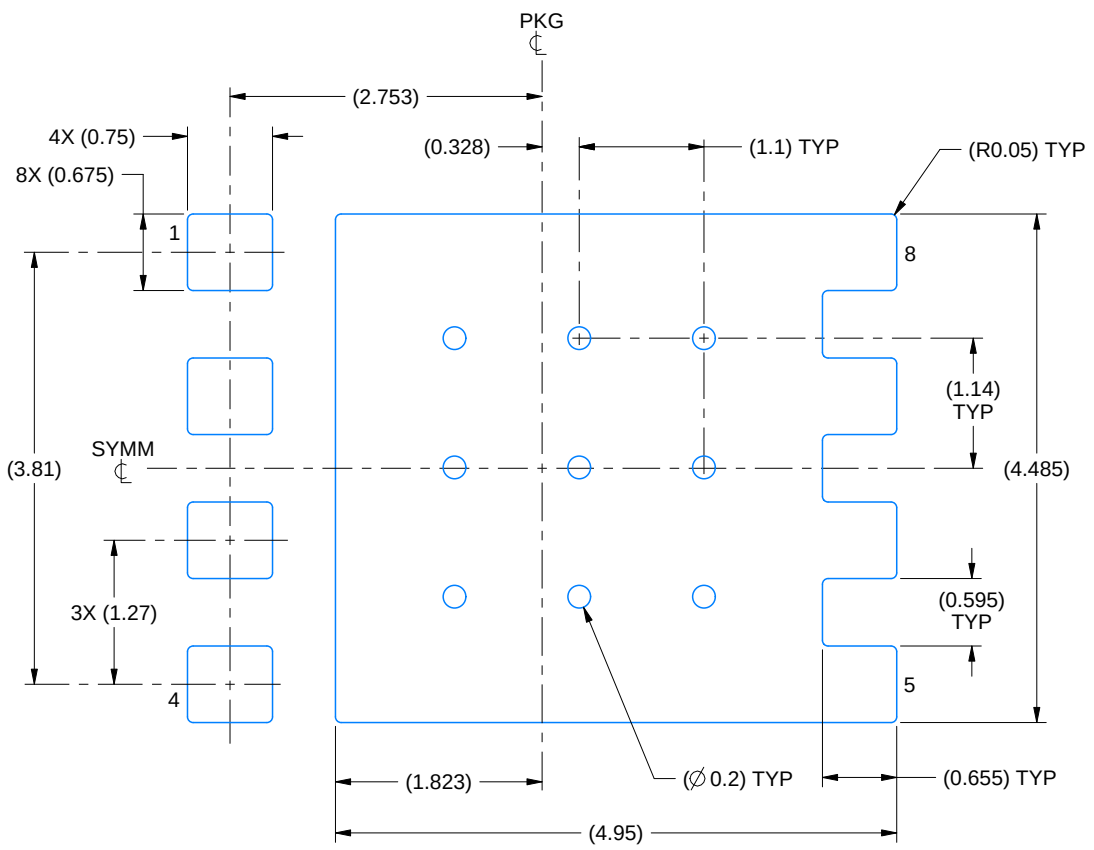
VSONP - 1.1 mm max height

PLASTIC SMALL OUTLINE - NO LEAD

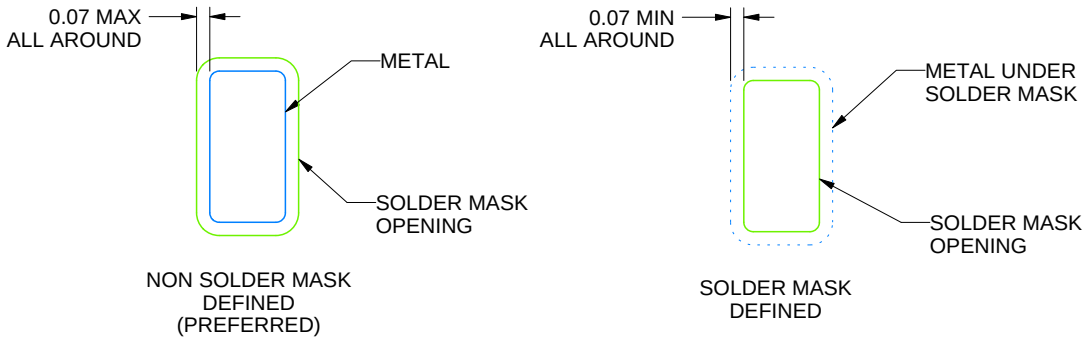


NOTES:

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. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.
4. Metalized features are supplier options and may not be on the package.
5. All dimensions do not include mold flash or protrusions.



LAND PATTERN EXAMPLE
SOLDER MASK DEFINED
SCALE: 15X



SOLDER MASK DETAILS

4218866/B 12/2024

NOTES: (continued)

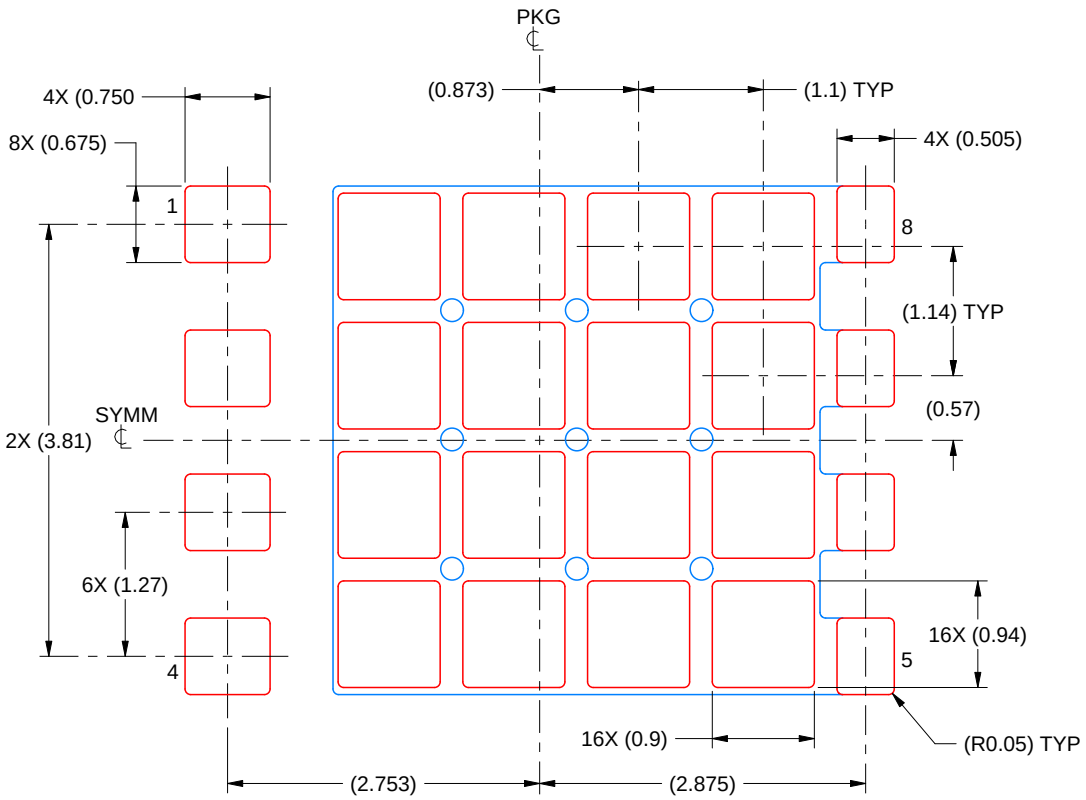
6. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/slua271).
7. Vias are optional depending on application, refer to device data sheet. If some or all are implemented, recommended via locations are shown.

EXAMPLE STENCIL DESIGN

DQJ0008A

VSONP - 1.1 mm max height

PLASTIC SMALL OUTLINE - NO LEAD



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL

EXPOSED PAD:
70% PRINTED SOLDER COVERAGE BY AREA UNDER PACKAGE
SCALE: 15X

4218866/B 12/2024

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.

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