CSD88539ND Dual 60 V N-Channel NexFET™ Power MOSFETs

1 Features

- Ultra-Low Q_g and Q_{gd}
- Avalanche Rated
- Pb Free
- RoHS Compliant
- Halogen Free

2 Applications

- Half Bridge for Motor Control
- Synchronous Buck Converter

3 Description

This dual SO-8, 60 V, 23 mΩ NexFET™ power MOSFET is designed to serve as a half bridge in low-current motor control applications.

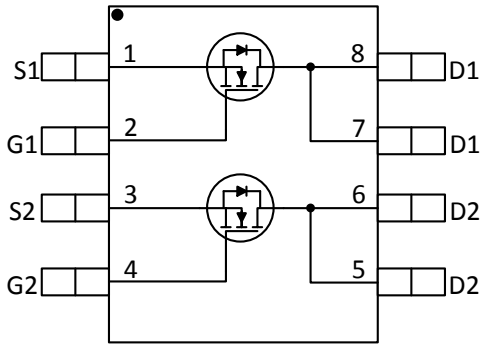


Figure 3-1. Top View

Product Summary

T_A = 25°C		TYPICAL VALUE		UNIT
V_{DS}	Drain-to-Source Voltage	60		V
Q_g	Gate Charge Total (10 V)	7.2		nC
Q_{gd}	Gate Charge Gate to Drain	1.1		nC
$R_{DS(on)}$	Drain-to-Source On Resistance	V_{GS} = 6 V	27	mΩ
		V_{GS} = 10 V	23	mΩ
$V_{GS(th)}$	Threshold Voltage	3.0		V

Ordering Information(1)

Device	Qty	Media	Package	Ship
CSD88539ND	2500	13-Inch Reel	SO-8 Plastic Package	Tape and Reel
CSD88539NDT	250	7-Inch Reel		

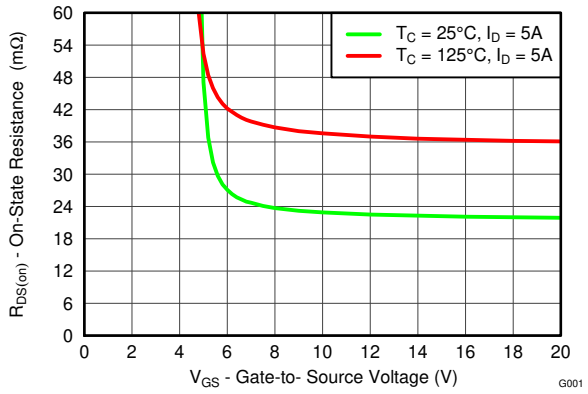
(1) For all available packages, see the orderable addendum at the end of the data sheet.

Absolute Maximum Ratings

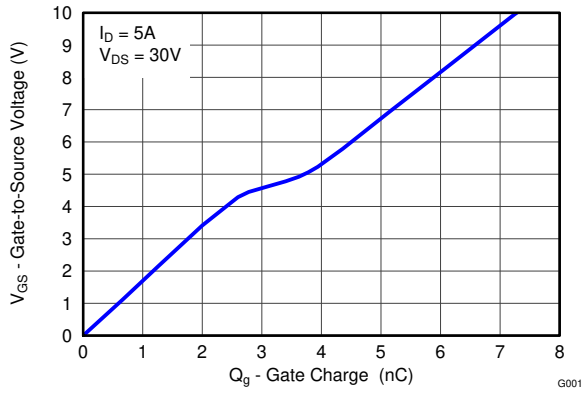
T_A = 25°C		VALUE	UNIT
V_{DS}	Drain-to-Source Voltage	60	V
V_{GS}	Gate-to-Source Voltage	±20	V
I_D	Continuous Drain Current (Package limited)	15	A
	Continuous Drain Current (Silicon limited), T_C = 25°C	11.7	
	Continuous Drain Current(1)	6.3	
I_{DM}	Pulsed Drain Current (2)	46	A
P_D	Power Dissipation(1)	2.1	W
T_J, T_{STG}	Operating Junction and Storage Temperature Range	–55 to 150	°C
E_{AS}	Avalanche Energy, single pulse I_D = 22 A, L = 0.1 mH, R_G = 25 Ω	24	mJ

(1) Typical $R_{\theta JA}$ = 60°C/W on a 1-inch², 2-oz. Cu pad on a 0.06-inch thick FR4 PCB

(2) Pulse duration ≤300 µs, duty cycle ≤2%



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



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} = 0 V, I_D = 250 µA	60			V
I_{DSS}	Drain-to-Source Leakage Current	V_{GS} = 0 V, V_{DS} = 48 V			1	µA
I_{GSS}	Gate-to-Source Leakage Current	V_{DS} = 0 V, V_{GS} = 20 V			100	nA
$V_{GS(th)}$	Gate-to-Source Threshold Voltage	V_{DS} = V_{GS}, I_D = 250 µA	2.6	3.0	3.6	V
$R_{DS(on)}$	Drain-to-Source On Resistance	V_{GS} = 6 V, I_D = 5 A		27	34	mΩ
		V_{GS} = 10 V, I_D = 5 A		23	28	mΩ
g_{fs}	Transconductance	V_{DS} = 30 V, I_D = 5 A		19		S
DYNAMIC CHARACTERISTICS						
C_{iss}	Input Capacitance	V_{GS} = 0 V, V_{DS} = 30 V, f = 1 MHz		570	741	pF
C_{oss}	Output Capacitance			70	91	pF
C_{rss}	Reverse Transfer Capacitance			2.0	2.6	pF
R_G	Series Gate Resistance			6.6	13.2	Ω
Q_g	Gate Charge Total (10 V)	V_{DS} = 30 V, I_D = 5 A		7.2	9.4	nC
Q_{gd}	Gate Charge Gate to Drain			1.1		nC
Q_{gs}	Gate Charge Gate to Source			2.7		nC
$Q_{g(th)}$	Gate Charge at V_{th}			1.8		nC
Q_{oss}	Output Charge	V_{DS} = 30 V, V_{GS} = 0 V		9.6		nC
$t_{d(on)}$	Turn On Delay Time	V_{DS} = 30 V, V_{GS} = 10 V, I_{DS} = 5 A, R_G = 0 Ω		5		ns
t_r	Rise Time			9		ns
$t_{d(off)}$	Turn Off Delay Time			14		ns
t_f	Fall Time			4		ns
DIODE CHARACTERISTICS						
V_{SD}	Diode Forward Voltage	I_{SD} = 5 A, V_{GS} = 0 V		0.8	1	V
Q_{rr}	Reverse Recovery Charge	V_{DS}= 30 V, I_F = 5A, di/dt = 300A/µs		37		nC
t_{rr}	Reverse Recovery Time			21		ns

4.2 Thermal Information

(T_A = 25°C unless otherwise stated)

THERMAL METRIC		MIN	TYP	MAX	UNIT
$R_{\theta JL}$	Junction-to-Lead Thermal Resistance(1)			20	°C/W
$R_{\theta JA}$	Junction-to-Ambient Thermal Resistance(1) (2)			75	

(1) $R_{\theta JC}$ is determined with the device mounted on a 1-inch^2 (6.45-cm^2), 2-oz. (0.071-mm thick) Cu pad on a 1.5-inch × 1.5-inch (3.81-cm × 3.81-cm), 0.06-inch (1.52-mm) 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 (6.45-cm^2), 2-oz. (0.071-mm thick) Cu.

4.3 Typical MOSFET Characteristics

(T_A = 25°C unless otherwise stated)

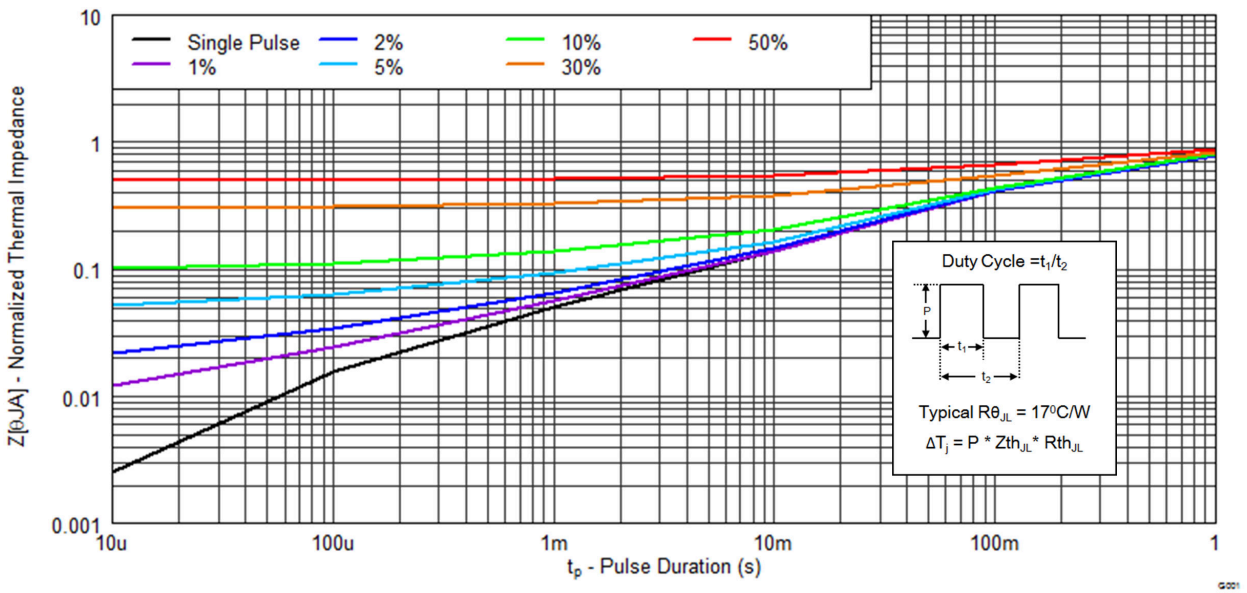


Figure 4-1. Transient Thermal Impedance

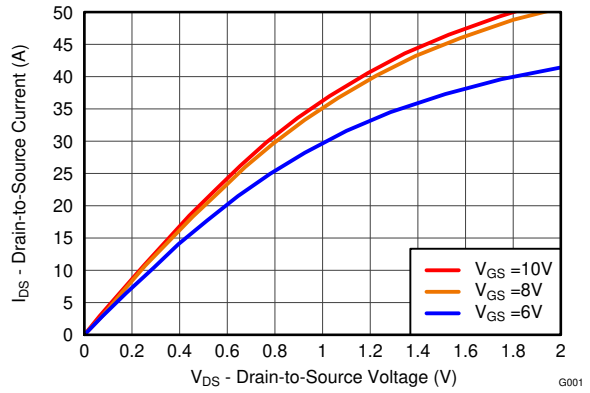


Figure 4-2. Saturation Characteristics

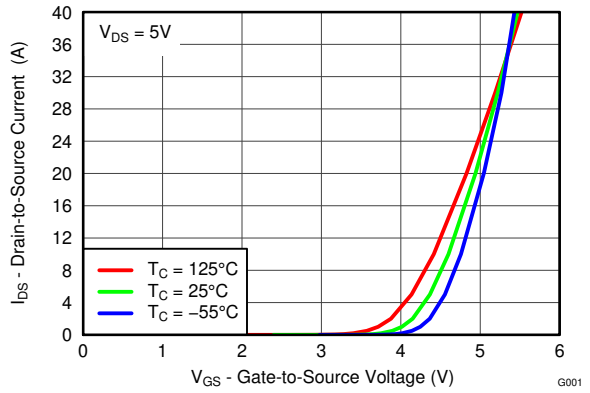


Figure 4-3. Transfer Characteristics

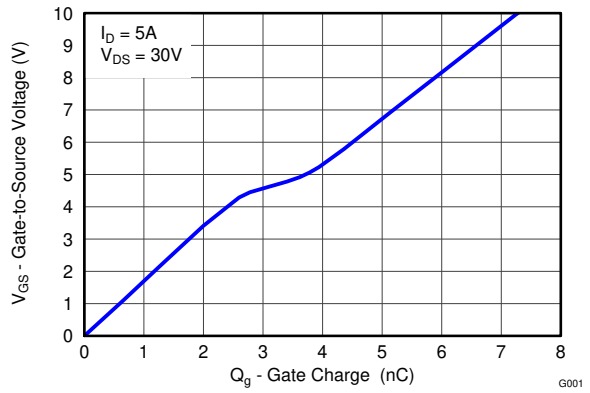


Figure 4-4. Gate Charge

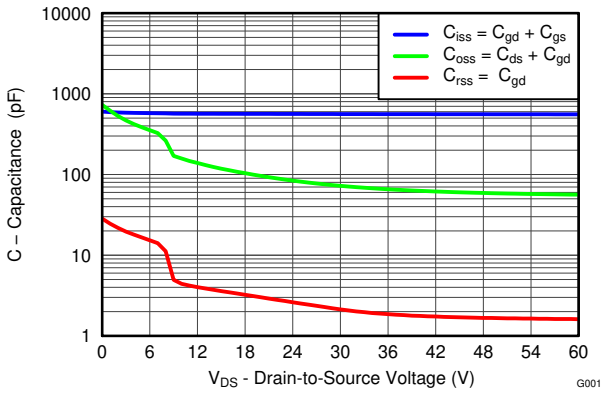


Figure 4-5. Capacitance

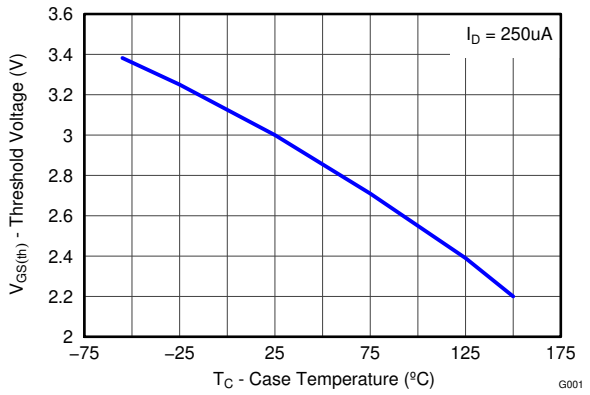


Figure 4-6. Threshold Voltage vs Temperature

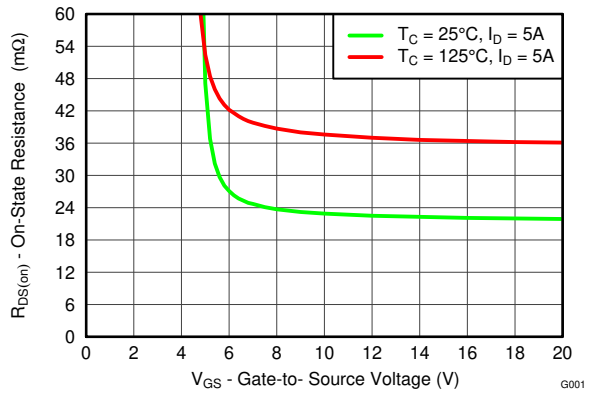


Figure 4-7. On-State Resistance vs Gate-to-Source Voltage

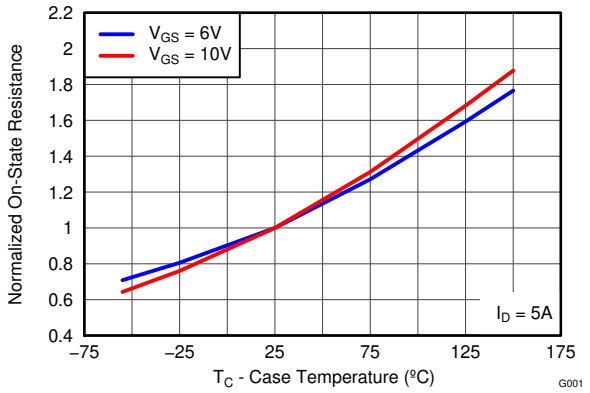


Figure 4-8. Normalized On-State Resistance vs Temperature

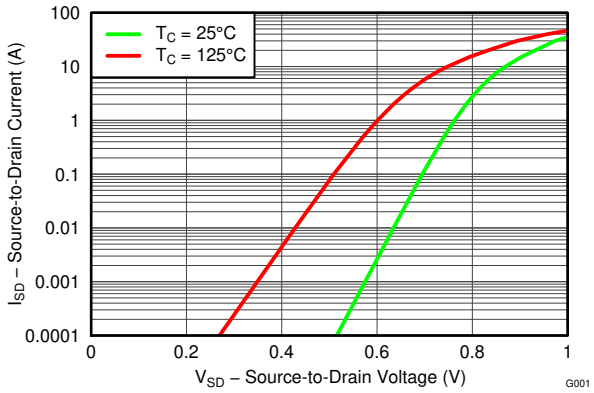


Figure 4-9. Typical Diode Forward Voltage

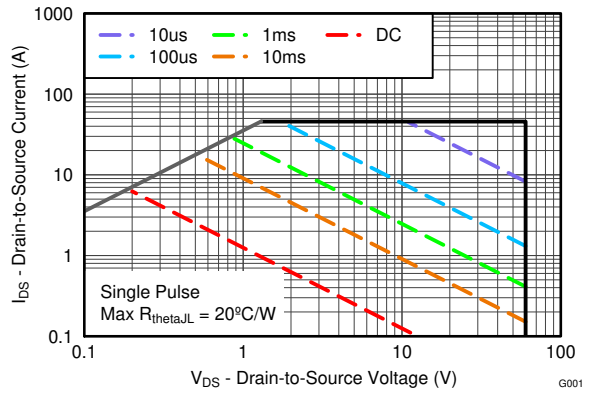


Figure 4-10. Maximum Safe Operating Area

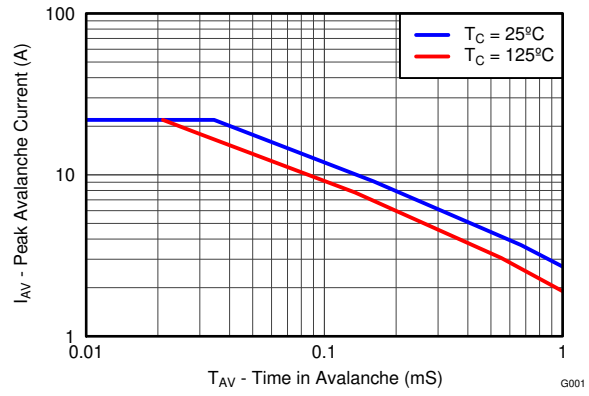


Figure 4-11. Single Pulse Unclamped Inductive Switching

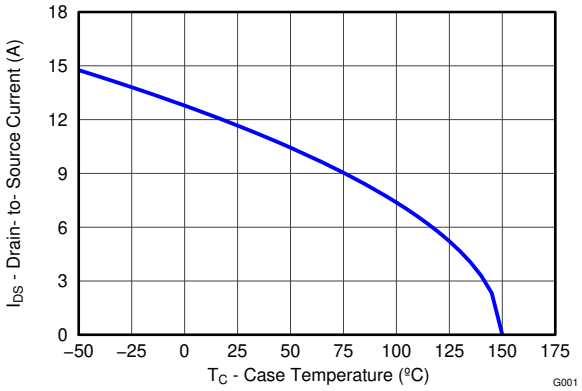


Figure 4-12. Maximum Drain Current vs Temperature

5 Device and Documentation Support

5.1 Trademarks

NexFET™ is a trademark of Texas Instruments.
All trademarks are the property of their respective owners.

5.2 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.

6 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Revision * (February 2014) to Revision A (December 2023)	Page
• Updated the numbering format for tables, figures, and cross-references throughout the document	1

7 Mechanical Data

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
CSD88539ND	ACTIVE	SOIC	D	8	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 150	88539N	Samples
CSD88539NDT	ACTIVE	SOIC	D	8	250	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 150	88539N	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.

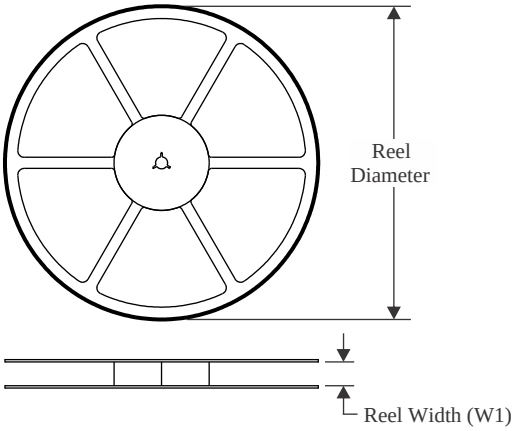
(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(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.

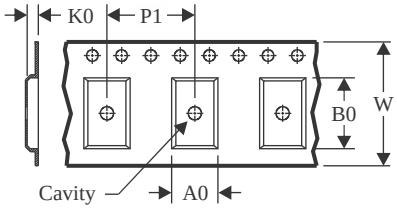
(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

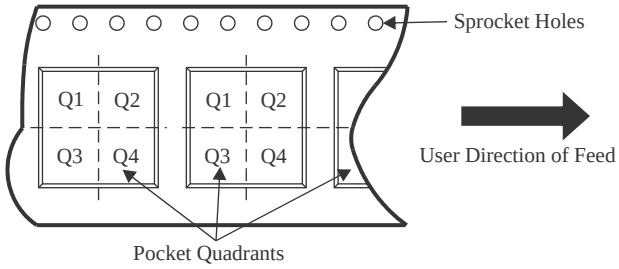


TAPE DIMENSIONS



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

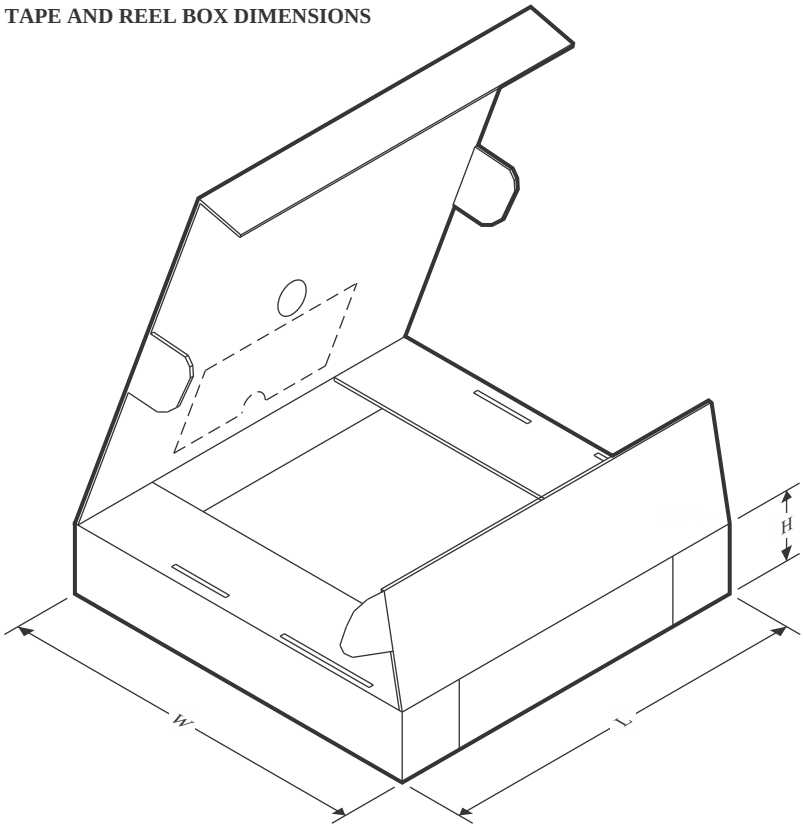
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

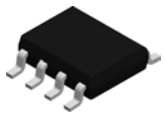
Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
CSD88539NDT	SOIC	D	8	250	178.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
CSD88539NDT	SOIC	D	8	250	180.0	180.0	79.0

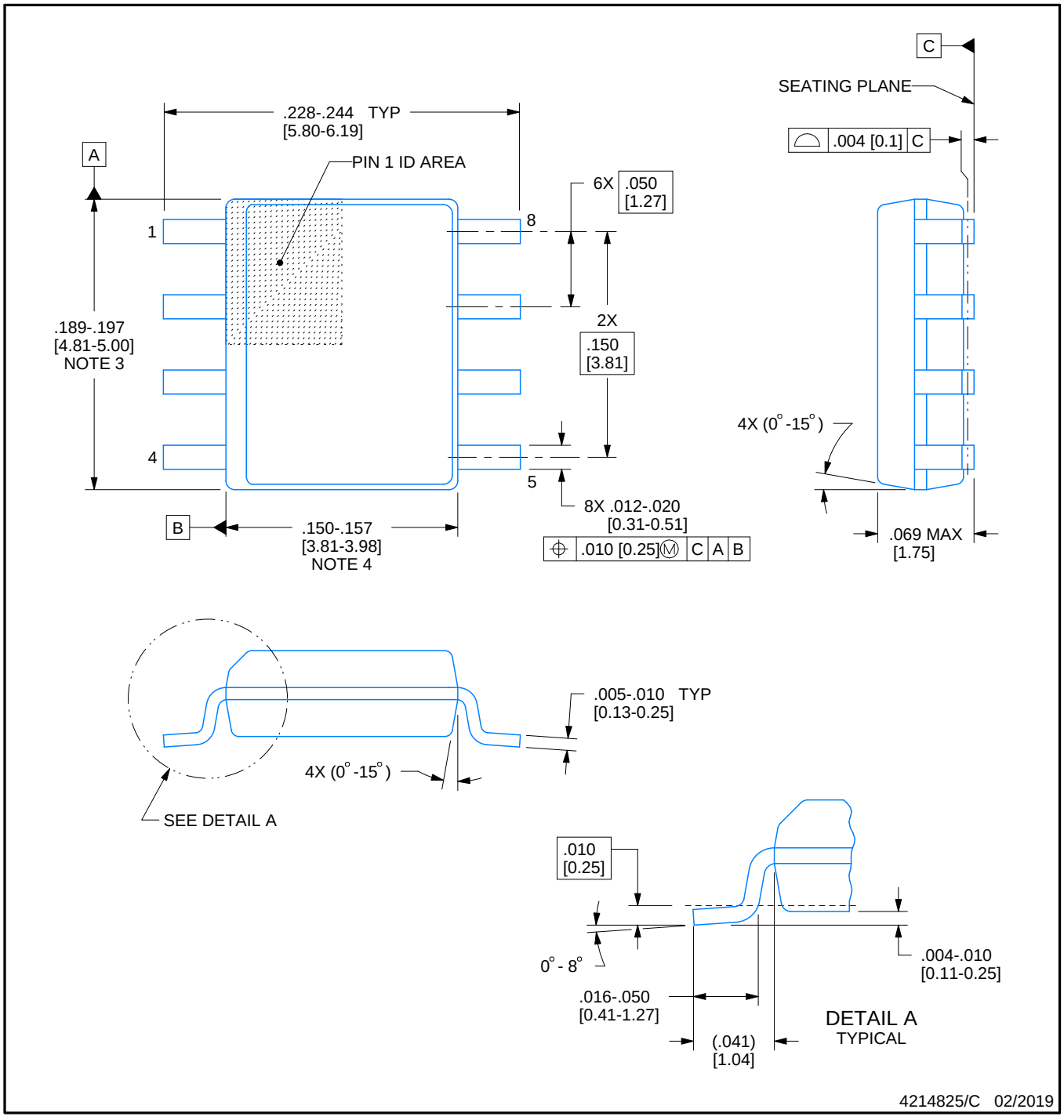


PACKAGE OUTLINE

D0008A

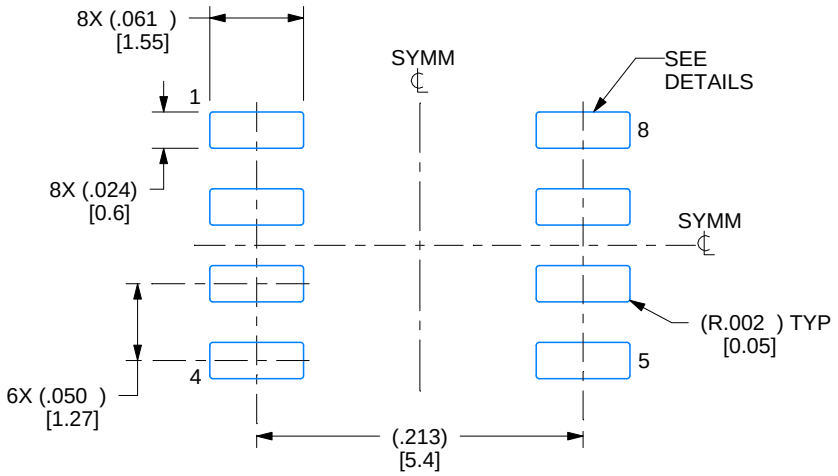
SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT

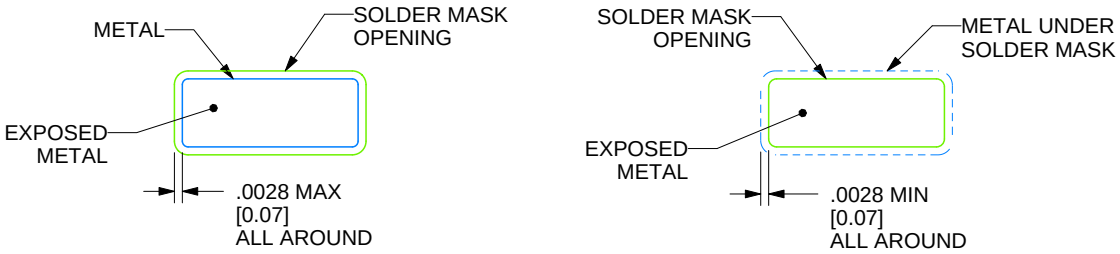


NOTES:

1. Linear dimensions are in inches [millimeters]. Dimensions in parenthesis are for reference only. Controlling dimensions are in inches. 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 .006 [0.15] per side.
4. This dimension does not include interlead flash.
5. Reference JEDEC registration MS-012, variation AA.



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:8X



SOLDER MASK DETAILS

4214825/C 02/2019

NOTES: (continued)

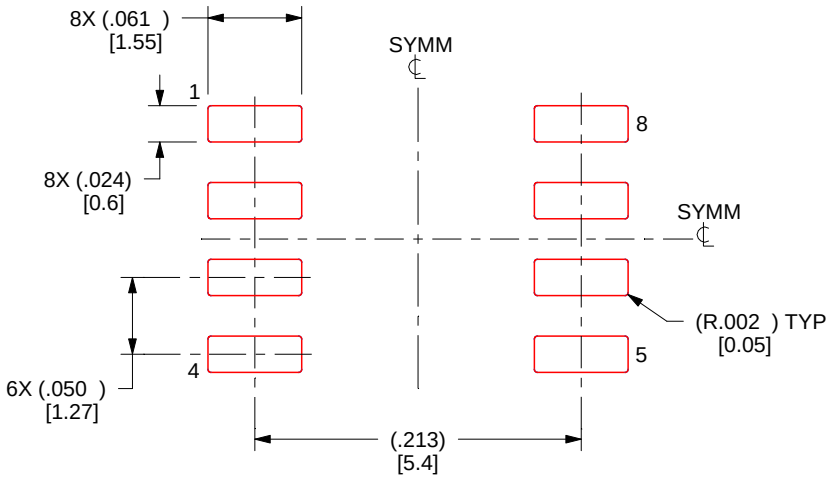
6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

D0008A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



SOLDER PASTE EXAMPLE
BASED ON .005 INCH [0.125 MM] THICK STENCIL
SCALE:8X

4214825/C 02/2019

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

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