CSD23280F3 –12-V P-Channel FemtoFET™ MOSFET

1 Features

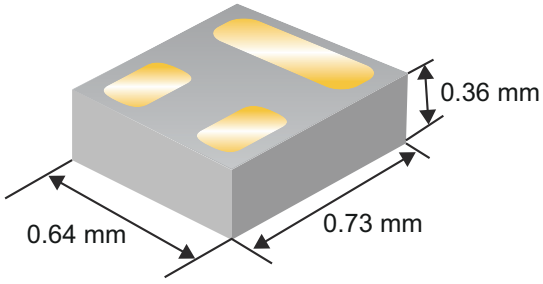
- Low On-Resistance
- Ultra-Low Q_g and Q_{gd}
- High-operating drain current
- Ultra-small footprint
  - 0.73 mm × 0.64 mm
- Ultra-low profile
  - 0.36-mm max height
- Integrated ESD protection diode
  - Rated > 4-kV HBM
  - Rated > 2-kV CDM
- Lead and halogen free
- RoHS compliant

2 Applications

- Optimized for load switch applications
- Optimized for general purpose switching applications
- Battery applications
- Handheld and mobile applications

3 Description

This –12-V, 97-mΩ, P-Channel FemtoFET™ MOSFET is designed and optimized to minimize the footprint in many handheld and mobile applications. This technology is capable of replacing standard small signal MOSFETs while providing a substantial reduction in footprint size.



Typical Part Dimensions

Product Summary

T_A = 25°C		TYPICAL VALUE		UNIT
V_{DS}	Drain-to-Source Voltage	–12		V
Q_g	Gate Charge Total (4.5 V)	0.95		nC
Q_{gd}	Gate Charge Gate-to-Drain	0.068		nC
$R_{DS(on)}$	Drain-to-Source On-Resistance	V_{GS} = –1.5 V	230	mΩ
		V_{GS} = –1.8 V	180	
		V_{GS} = –2.5 V	129	
		V_{GS} = –4.5 V	97	
$V_{GS(th)}$	Threshold Voltage	–0.65		V

Device Information(1)

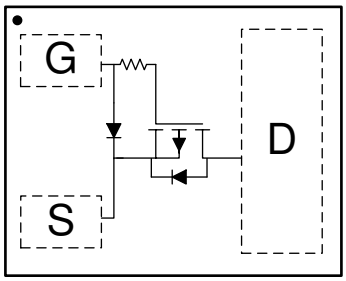
DEVICE	QTY	MEDIA	PACKAGE	SHIP
CSD23280F3	3000	7-Inch Reel	Femto 0.73-mm × 0.64-mm Land Grid Array (LGA)	Tape and Reel
CSD23280F3T	250			

(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	–12	V
V_{GS}	Gate-to-Source Voltage	–6	V
I_D	Continuous Drain Current(1)	2.9	A
	Continuous Drain Current(2)	1.8	
I_{DM}	Pulsed Drain Current(1) (3)	11.4	A
P_D	Power Dissipation(1)	1.4	W
	Power Dissipation(2)	0.5	
$V_{(ESD)}$	Human-Body Model (HBM)	4000	V
	Charged-Device Model (CDM)	2000	
T_J, T_{stg}	Operating Junction, Storage Temperature	–55 to 150	°C

(1) Typical $R_{\theta JA}$ = 90°C/W on 1-in^2 (6.45-cm^2), 2-oz (0.071-mm) thick Cu pad on a 0.06-in (1.52-mm) thick FR4 PCB
(2) Typical $R_{\theta JA}$ = 255°C/W on min Cu board
(3) Pulse duration ≤ 100 µs, duty cycle ≤ 1%.



Top View

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4 Revision History

Changes from Revision A (August 2017) to Revision B (February 2022) **Page**

- Changed ultra-low profile bullet from 0.35 mm to 0.36 mm in height.... 1
- Added max Cu currents and power dissipation limits 1
- Added min Cu footnote 1
- Updated ultra-low profile image height from 0.35 mm to 0.36 mm.... 1
- Changed ultra-low profile image height from 0.35 mm to 0.36 mm.... 8
- Added FemtoFET Surface Mount Guide note.... 9

Changes from Revision * (April 2016) to Revision A (August 2017) **Page**

- Added the *Section 6.1* section in *Section 6* 7
- Updated the *Section 7.3* 9

5 Specifications

5.1 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_{DS} = –250 µA	–12			V
I_{DSS}	Drain-to-source leakage current	V_{GS} = 0 V, V_{DS} = –9.6 V			–50	nA
I_{GSS}	Gate-to-source leakage current	V_{DS} = 0 V, V_{GS} = –5 V			–25	nA
$V_{GS(th)}$	Gate-to-source threshold voltage	V_{DS} = V_{GS}, I_{DS} = –250 µA	–0.40	–0.65	–0.95	V
$R_{DS(on)}$	Drain-to-source on-resistance	V_{GS} = –1.5 V, I_{DS} = –0.1 A		230	399	mΩ
		V_{GS} = –1.8 V, I_{DS} = –0.4 A		180	250	
		V_{GS} = –2.5 V, I_{DS} = –0.4 A		129	165	
		V_{GS} = –4.5 V, I_{DS} = –0.4 A		97	116	
g_{fs}	Transconductance	V_{DS} = –1.2 V, I_{DS} = –0.4 A		3		S
DYNAMIC CHARACTERISTICS						
C_{iss}	Input capacitance	V_{GS} = 0 V, V_{DS} = –6 V, f = 1 MHz		180	234	pF
C_{oss}	Output capacitance			73	95	pF
C_{rss}	Reverse transfer Capacitance			8.5	11.1	pF
R_G	Series gate resistance			9		Ω
Q_g	Gate charge total (4.5 V)	V_{DS} = –6 V, I_{DS} = –0.4 A		0.95	1.23	nC
Q_{gd}	Gate charge gate-to-drain			0.068		nC
Q_{gs}	Gate charge gate-to-source			0.30		nC
$Q_{g(th)}$	Gate charge at V_{th}			0.15		nC
Q_{oss}	Output charge	V_{DS} = –6 V, V_{GS} = 0 V		1.07		nC
$t_{d(on)}$	Turnon delay time	V_{DS} = –6 V, V_{GS} = –4.5 V, I_{DS} = –0.4 A, R_G = 0 Ω		8		ns
t_r	Rise time			4		ns
$t_{d(off)}$	Turnoff delay time			21		ns
t_f	Fall time			8		ns
DIODE CHARACTERISTICS						
V_{SD}	Diode forward voltage	I_{SD} = –0.4 A, V_{GS} = 0 V		–0.73	–1.0	V

5.2 Thermal Information

T_A = 25°C (unless otherwise stated)

THERMAL METRIC		TYPICAL VALUES	UNIT
$R_{\theta JA}$	Junction-to-ambient thermal resistance(1)	90	°C/W
	Junction-to-ambient thermal resistance(2)	255	

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

5.3 Typical MOSFET Characteristics

T_A = 25°C (unless otherwise stated)

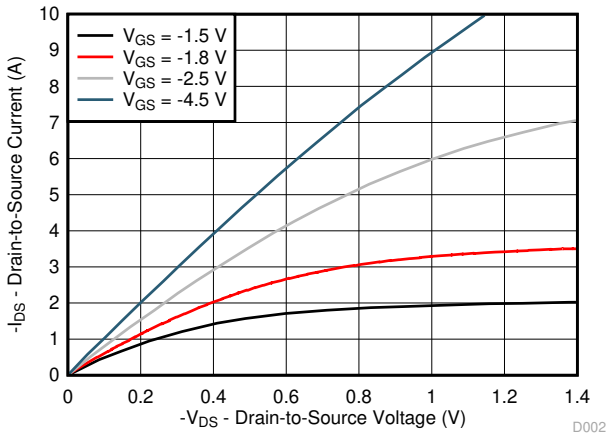
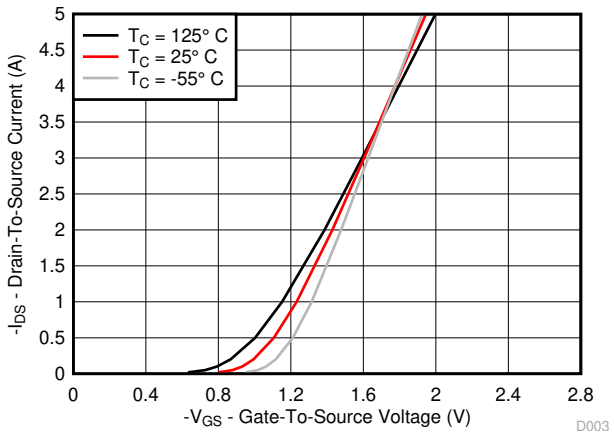


Figure 5-1. Saturation Characteristics



V_{DS} = –5 V

Figure 5-2. Transfer Characteristics

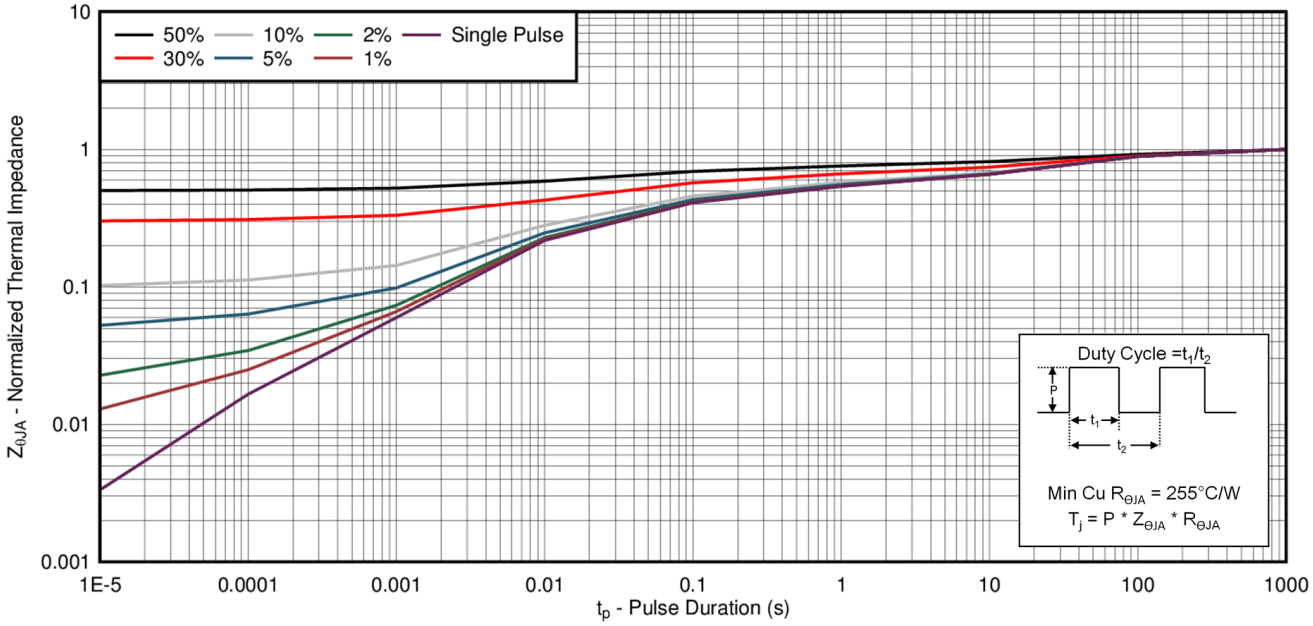
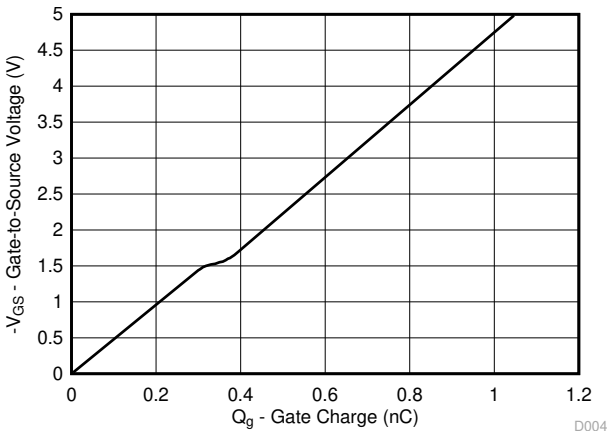


Figure 5-3. Transient Thermal Impedance



V_{DS} = –6 V I_D = –0.4 A

Figure 5-4. Gate Charge

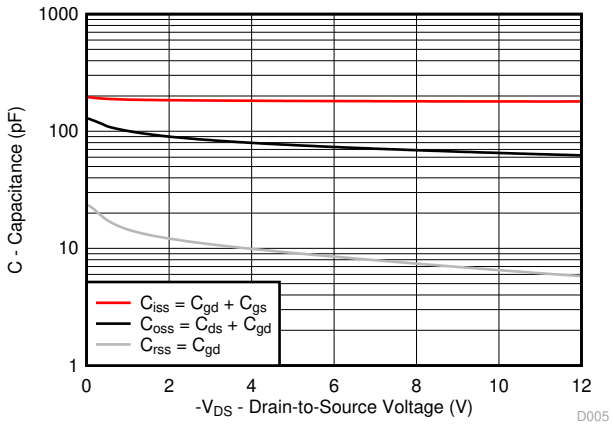
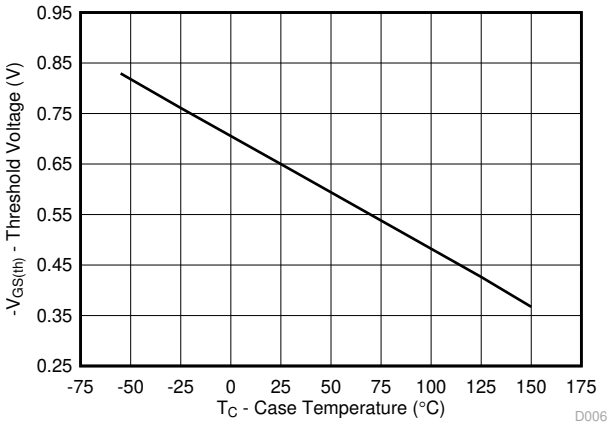


Figure 5-5. Capacitance



I_D = –250 µA

Figure 5-6. Threshold Voltage vs Temperature

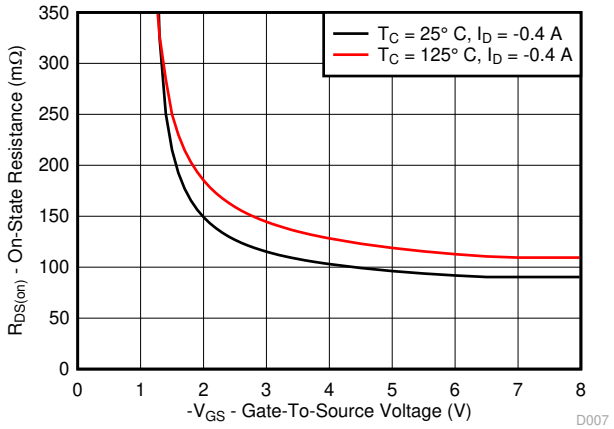
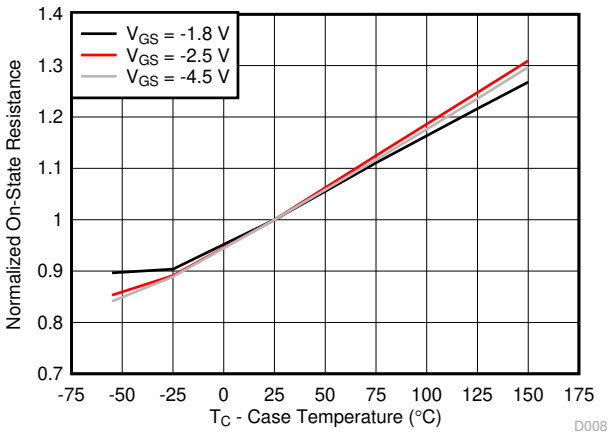


Figure 5-7. On-State Resistance vs Gate-to-Source Voltage



V_{GS} = –4.5 V I_D = –0.4 A

Figure 5-8. Normalized On-State Resistance vs Temperature

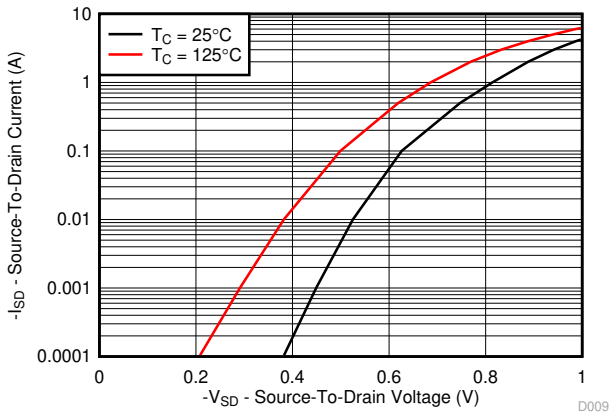
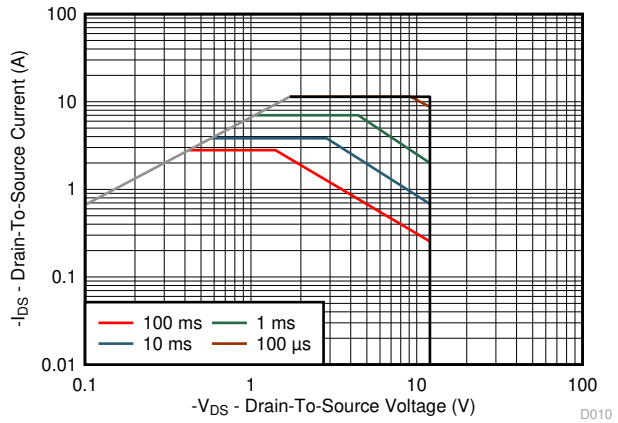


Figure 5-9. Typical Diode Forward Voltage



Single pulse, max $R_{\theta JA}$ = 255°C/W

Figure 5-10. Maximum Safe Operating Area

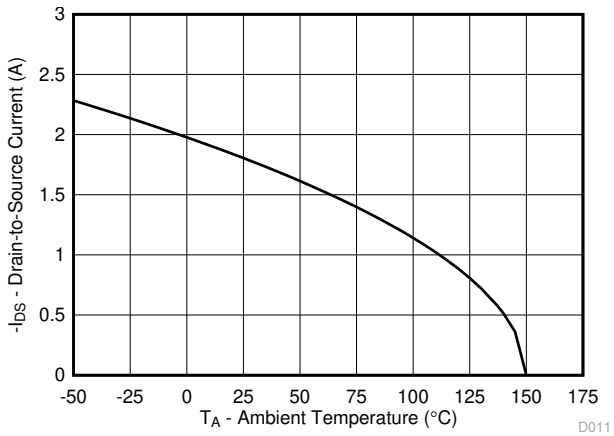


Figure 5-11. Maximum Drain Current vs Temperature

6 Device and Documentation Support

6.1 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on ti.com. In the upper right corner, click on *Alert me* 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.

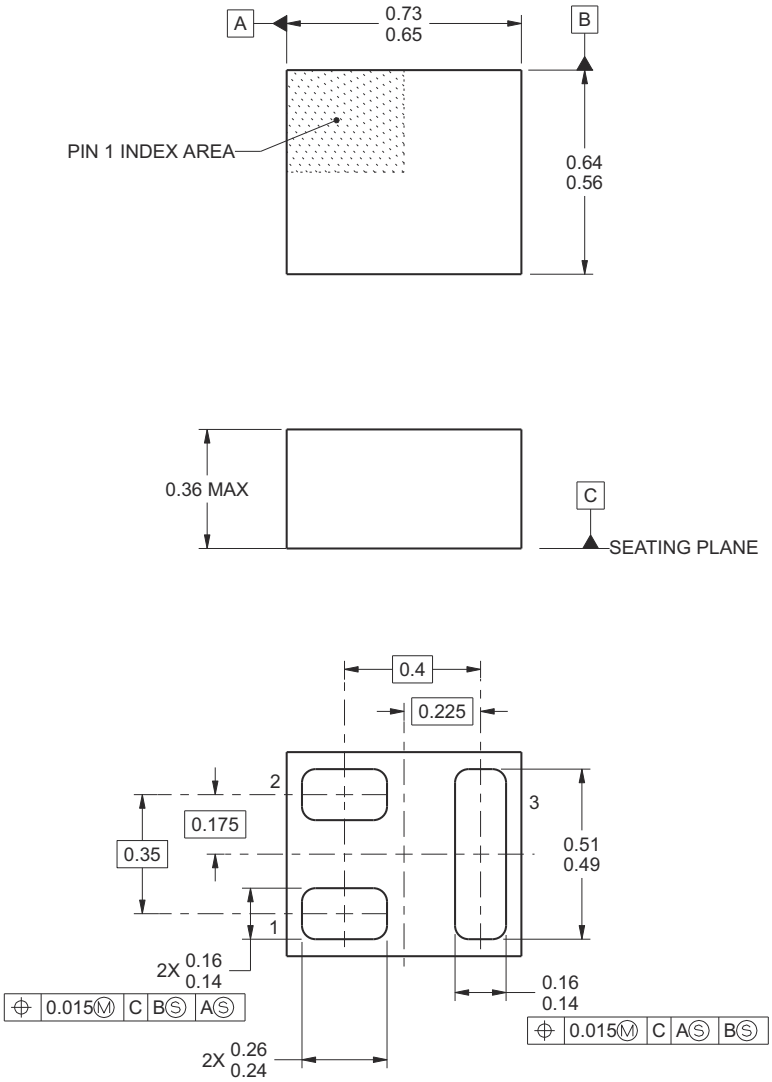
6.2 Trademarks

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

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.

7.1 Mechanical Dimensions

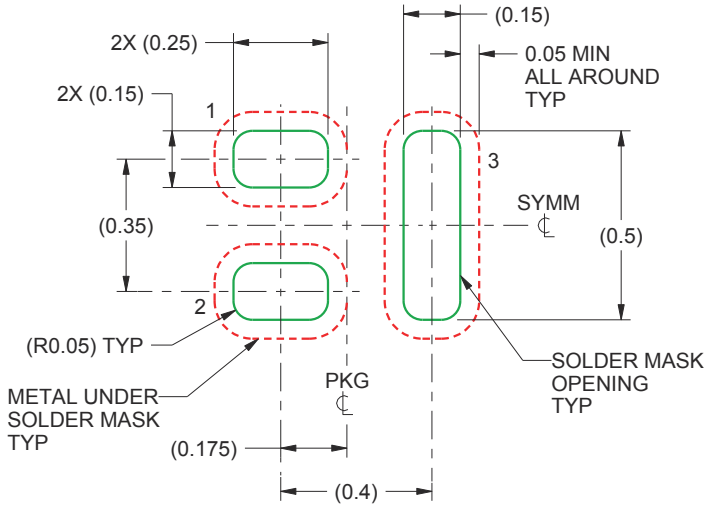


A. All linear dimensions are in millimeters (dimensions and tolerancing per AME T14.5M-1994).
B. This drawing is subject to change without notice.
C. This package is a lead-free solder land design.

Table 7-1. Pin Configuration

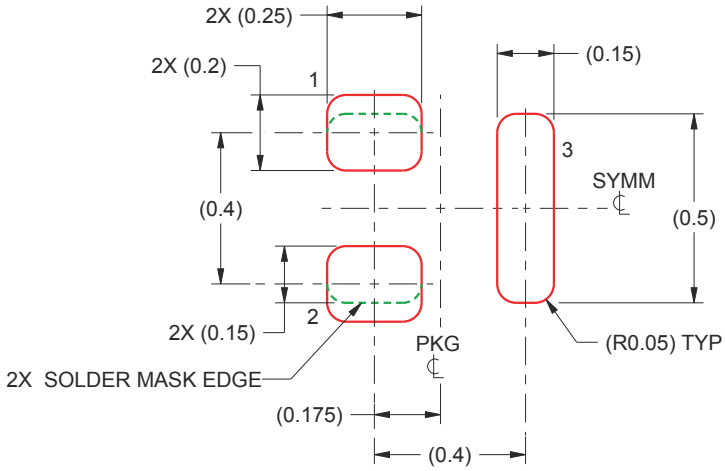
POSITION	DESIGNATION
Pin 1	Gate
Pin 2	Source
Pin 3	Drain

7.2 Recommended Minimum PCB Layout



A. All dimensions are in millimeters.
B. For more information, see *FemtoFET Surface Mount Guide* (SLRA003D).

7.3 Recommended Stencil Pattern



A. All dimensions are in millimeters.

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
CSD23280F3	ACTIVE	PICOSTAR	YJM	3	3000	RoHS & Green	NIAU	Level-1-260C-UNLIM	-55 to 150	5	Samples
CSD23280F3T	ACTIVE	PICOSTAR	YJM	3	250	RoHS & Green	NIAU	Level-1-260C-UNLIM	-55 to 150	5	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.

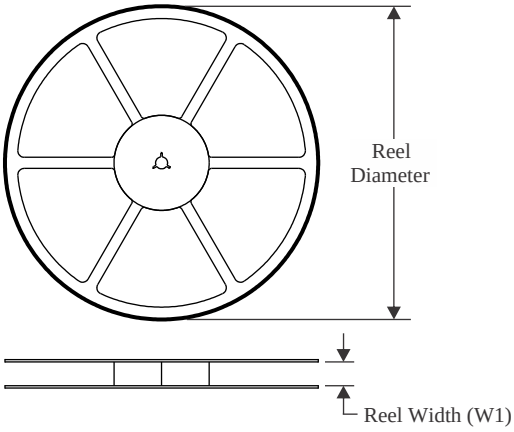
(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(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.

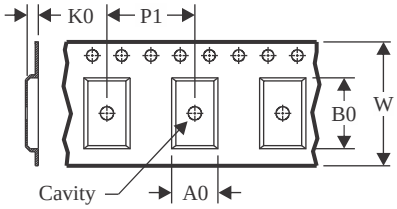
(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

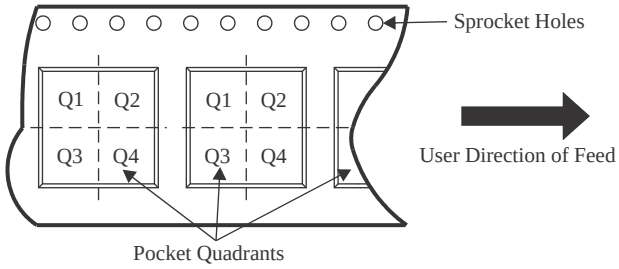


TAPE DIMENSIONS



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

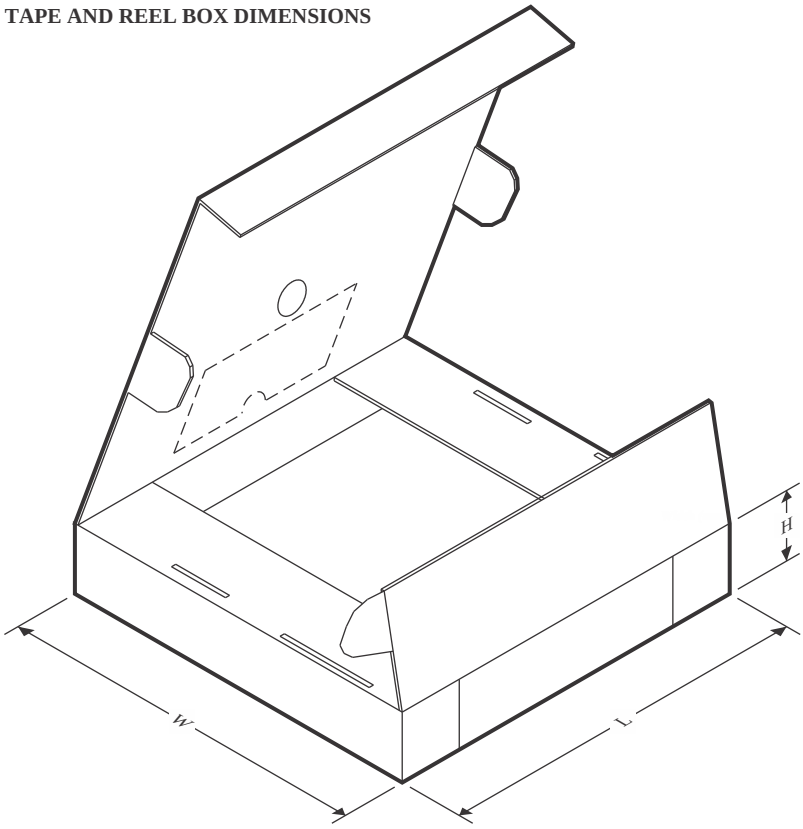
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
CSD23280F3	PICOSTAR	YJM	3	3000	180.0	8.4	1.94	0.79	0.44	4.0	8.0	Q2
CSD23280F3T	PICOSTAR	YJM	3	250	180.0	8.4	1.94	0.79	0.44	4.0	8.0	Q2

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
CSD23280F3	PICOSTAR	YJM	3	3000	182.0	182.0	20.0
CSD23280F3T	PICOSTAR	YJM	3	250	182.0	182.0	20.0

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