



CSD25501F3 –20-V P-Channel FemtoFET™ MOSFET

1 Features

- Low On-Resistance
- Ultra-Low Q_g and Q_{gd}
- Ultra-Small Footprint
 - 0.7 mm × 0.6 mm
- Low Profile
 - 0.22-mm Max Height
- Integrated ESD Protection Diode
- Lead and Halogen Free
- RoHS Compliant

2 Applications

- Optimized for Load Switch Applications
- Battery Applications
- Handheld and Mobile Applications

3 Description

This –20-V, 64-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. The integrated 10-kΩ clamp resistor (R_C) allows the gate voltage (V_{GS}) to be operated above the maximum internal gate oxide value of –6 V depending on duty cycle. The gate leakage (I_{GSS}) through the diode increases as V_{GS} is increased above –6 V.

Product Summary

$T_A = 25^\circ\text{C}$		TYPICAL VALUE	UNIT
V_{DS}	Drain-to-Source Voltage	–20	V
Q_g	Gate Charge Total (–4.5 V)	1.02	nC
Q_{gd}	Gate Charge Gate-to-Drain	0.09	nC
$R_{DS(on)}$	Drain-to-Source On-Resistance	$V_{GS} = -1.8\text{ V}$	120
		$V_{GS} = -2.5\text{ V}$	86
		$V_{GS} = -4.5\text{ V}$	64
$V_{GS(th)}$	Threshold Voltage	–0.75	V

Device Information⁽¹⁾

DEVICE	QTY	MEDIA	PACKAGE	SHIP
CSD25501F3	3000	7-Inch Reel	Femto	Tape and Reel
CSD25501F3T	250		0.73-mm × 0.64-mm Land Grid Array (LGA)	

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

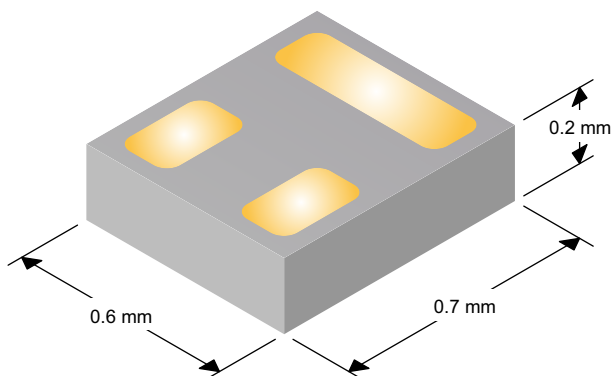
Absolute Maximum Ratings

$T_A = 25^\circ\text{C}$ (unless otherwise stated)		VALUE	UNIT
V_{DS}	Drain-to-Source Voltage	–20	V
V_{GS}	Gate-to-Source Voltage	–20	V
I_D	Continuous Drain Current ⁽¹⁾	–3.6	A
I_{DM}	Pulsed Drain Current ⁽¹⁾⁽²⁾	–13.6	A
P_D	Power Dissipation ⁽¹⁾	500	mW
$V_{(ESD)}$	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 $R_{\theta JA} = 255^\circ\text{C/W}$ mounted on FR4 material with minimum Cu mounting area.

(2) Pulse duration ≤ 100 μs, duty cycle ≤ 1%.

Typical Part Dimensions



Top View

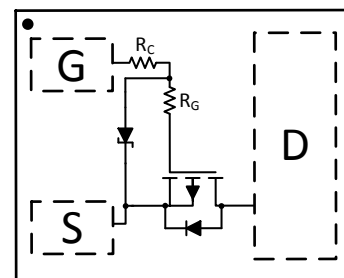


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4 Revision History

DATE	REVISION	NOTES
October 2017	*	Initial release.

5 Specifications

5.1 Electrical Characteristics

 $T_A = 25^\circ\text{C}$ (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	−20			V
I _{DSS}	Drain-to-source leakage current	V _{GS} = 0 V, V _{DS} = −16 V	−50			nA
I _{GSS}	Gate-to-source leakage current	V _{DS} = 0 V, V _{GS} = −6 V	−50			nA
		V _{DS} = 0 V, V _{GS} = −16 V	−1			mA
V _{GS(th)}	Gate-to-source threshold voltage	V _{DS} = V _{GS} , I _{DS} = −250 μA	−0.45	−0.75	−1.05	V
R _{DS(on)}	Drain-to-source on-resistance	V _{GS} = −1.8 V, I _{DS} = −0.1 A	120			260
		V _{GS} = −2.5 V, I _{DS} = −0.4 A	86			125
		V _{GS} = −4.5 V, I _{DS} = −0.4 A	64			76
g _{fs}	Transconductance	V _{DS} = −2 V, I _{DS} = −0.4 A	3.4			S
DYNAMIC CHARACTERISTICS						
C _{iss}	Input capacitance	V _{GS} = 0 V, V _{DS} = −10 V, f = 100 kHz	295		385	pF
C _{oss}	Output capacitance		70		91	pF
C _{rss}	Reverse transfer capacitance		4.1		5.3	pF
R _G	Series gate resistance		33			Ω
R _C	Series clamp resistance		10,000			Ω
Q _g	Gate charge total (−4.5 V)	V _{DS} = −10 V, I _{DS} = −0.4 A	1.02		1.33	nC
Q _{gd}	Gate charge gate-to-drain		0.09			nC
Q _{gs}	Gate charge gate-to-source		0.45			nC
Q _{g(th)}	Gate charge at V _{th}		0.36			nC
Q _{oss}	Output charge	V _{DS} = −10 V, V _{GS} = 0 V	1.8			nC
t _{d(on)}	Turnon delay time	V _{DS} = −10 V, V _{GS} = −4.5 V, I _{DS} = −0.4 A, R _G = 0 Ω	474			ns
t _r	Rise time		428			ns
t _{d(off)}	Turnoff delay time		1154			ns
t _f	Fall time		945			ns
DIODE CHARACTERISTICS						
V _{SD}	Diode forward voltage	I _{SD} = −0.4 A, V _{GS} = 0 V	−0.73	−0.95		V
Q _{rr}	Reverse recovery charge	V _{DS} = −10 V, I _F = −0.4 A, di/dt = 200 A/μs	3.0			nC
t _{rr}	Reverse recovery time		7.4			ns

5.2 Thermal Information

 $T_A = 25^\circ\text{C}$ (unless otherwise stated)

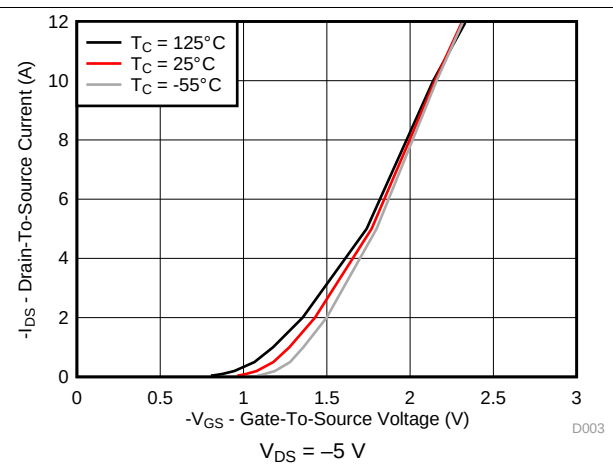
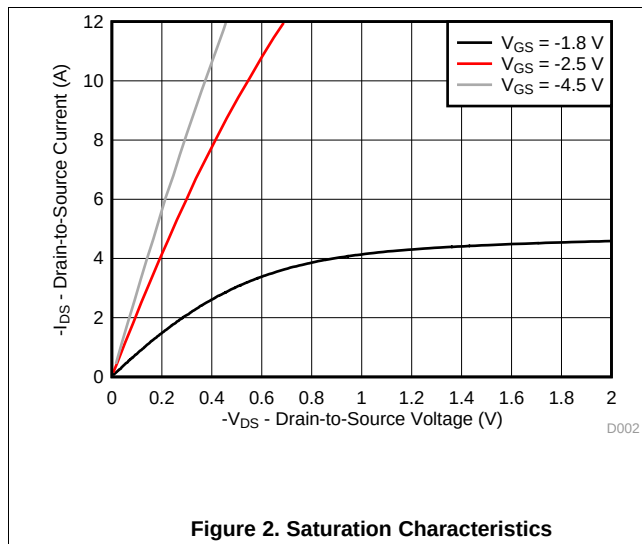
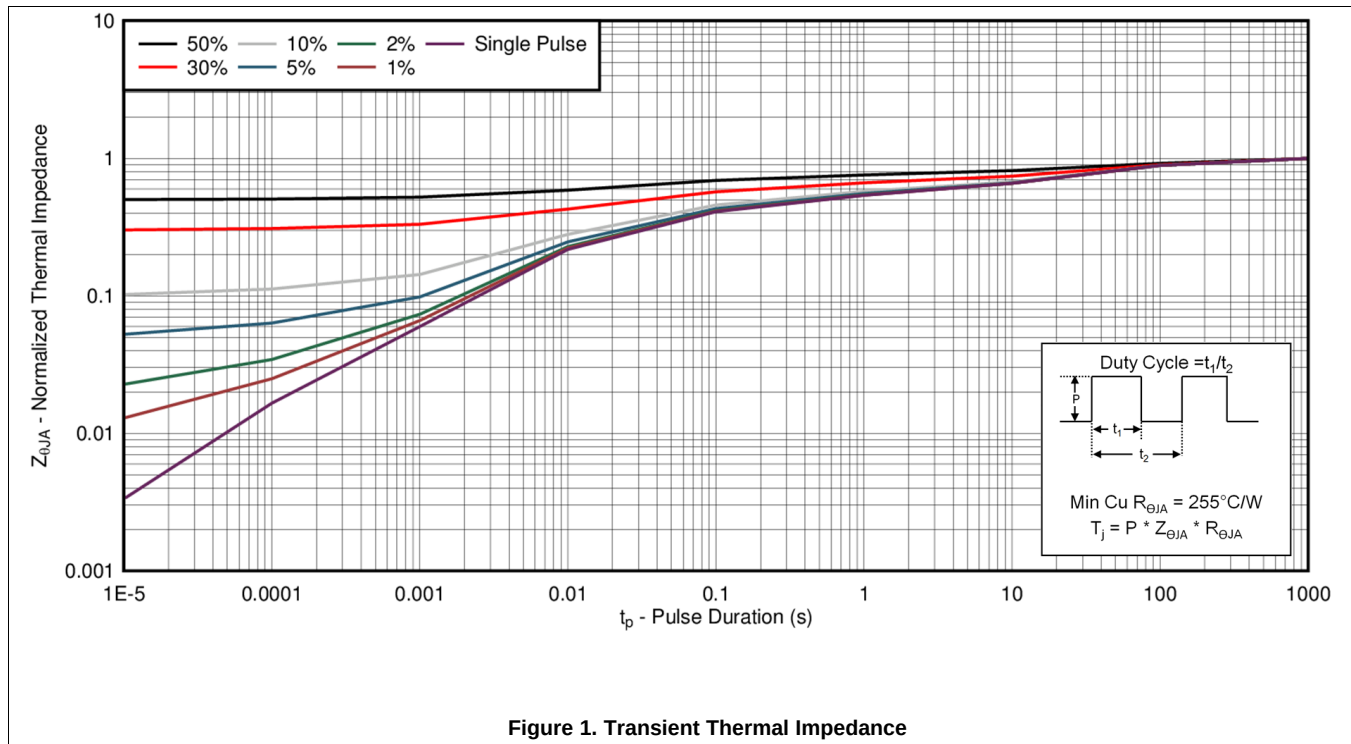
THERMAL METRIC		TYPICAL VALUES	UNIT
$R_{\theta JA}$	Junction-to-ambient thermal resistance ⁽¹⁾	90	$^\circ\text{C}/\text{W}$
	Junction-to-ambient thermal resistance ⁽²⁾	255	$^\circ\text{C}/\text{W}$

(1) Device mounted on FR4 material with 1-in² (6.45-cm²), 2-oz (0.071-mm) thick Cu.

(2) Device mounted on FR4 material with minimum Cu mounting area.

5.3 Typical MOSFET Characteristics

$T_A = 25^\circ\text{C}$ (unless otherwise stated)



Typical MOSFET Characteristics (continued)

$T_A = 25^\circ\text{C}$ (unless otherwise stated)

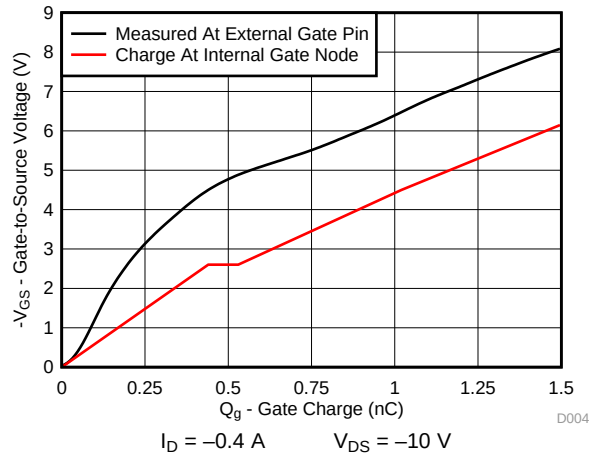


Figure 4. Gate Charge

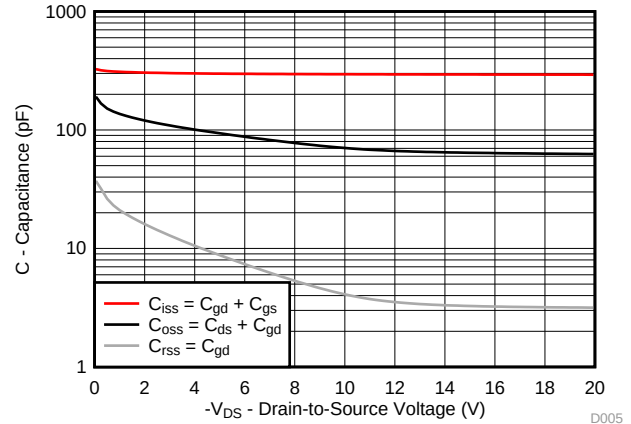


Figure 5. Capacitance

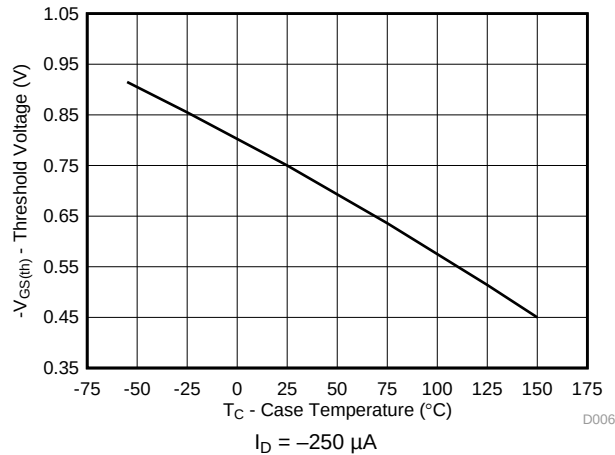


Figure 6. Threshold Voltage vs Temperature

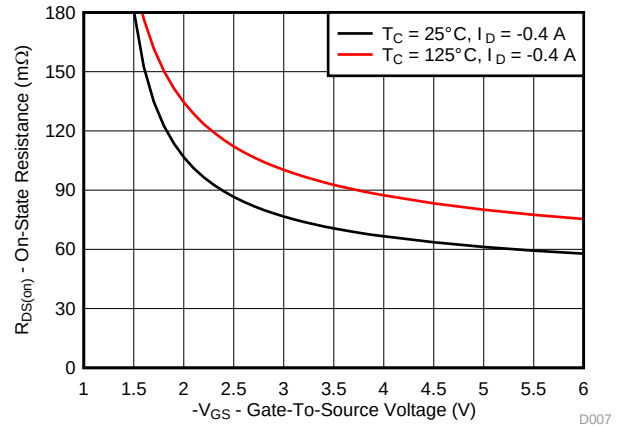


Figure 7. On-State Resistance vs Gate-to-Source Voltage

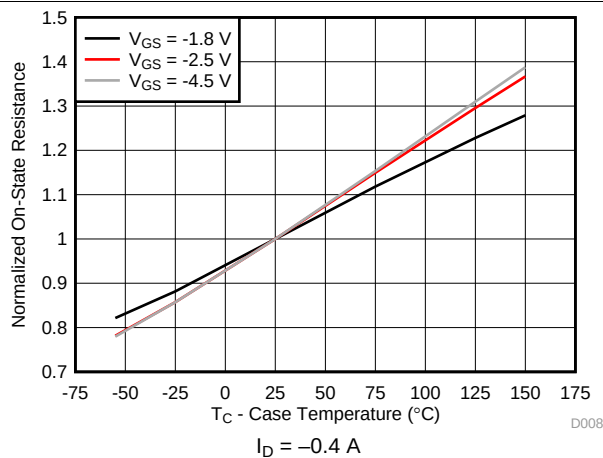


Figure 8. Normalized On-State Resistance vs Temperature

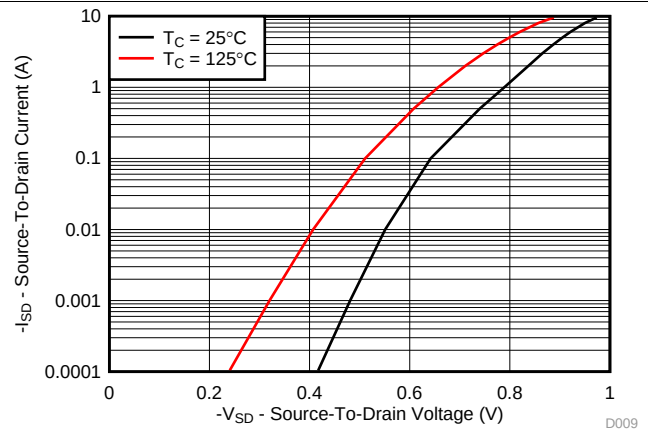
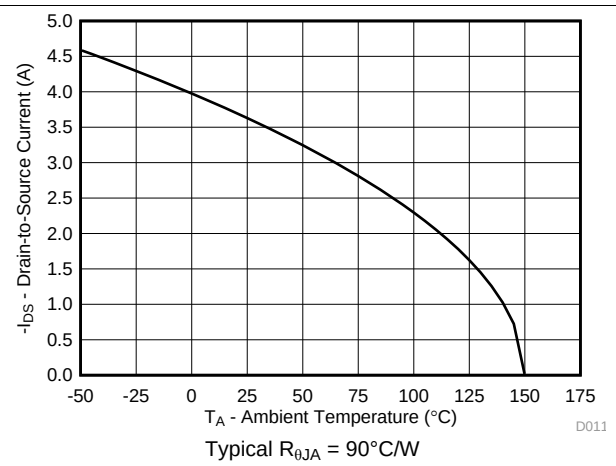
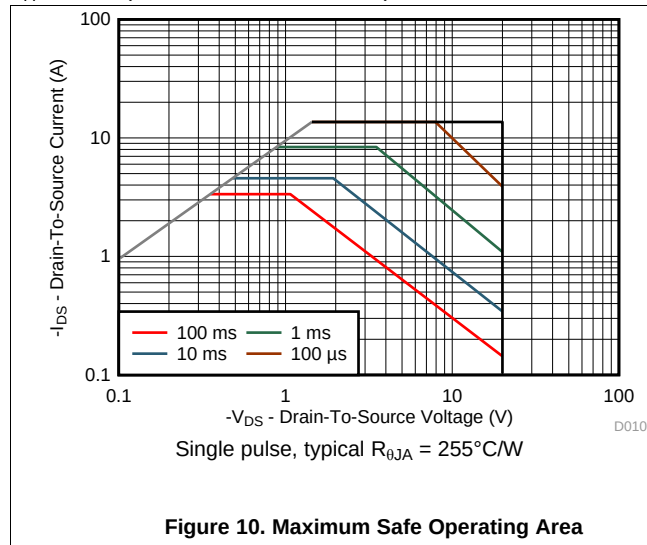


Figure 9. Typical Diode Forward Voltage

Typical MOSFET Characteristics (continued)

$T_A = 25^\circ\text{C}$ (unless otherwise stated)



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 Community Resources

The following links connect to TI community resources. Linked contents are provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's [Terms of Use](#).

TI E2E™ Online Community *TI's Engineer-to-Engineer (E2E) Community*. Created to foster collaboration among engineers. At e2e.ti.com, you can ask questions, share knowledge, explore ideas and help solve problems with fellow engineers.

Design Support *TI's Design Support* Quickly find helpful E2E forums along with design support tools and contact information for technical support.

6.3 Trademarks

FemtoFET, E2E are trademarks of Texas Instruments.
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6.4 Electrostatic Discharge Caution



These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

6.5 Glossary

[SLYZ022](#) — *TI Glossary*.

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

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/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
CSD25501F3	ACTIVE	PICOSTAR	YJN	3	3000	Green (RoHS & no Sb/Br)	Call TI	Level-1-260C-UNLIM	-55 to 150	V	Samples
CSD25501F3T	ACTIVE	PICOSTAR	YJN	3	250	Green (RoHS & no Sb/Br)	Call TI	Level-1-260C-UNLIM	-55 to 150	V	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.

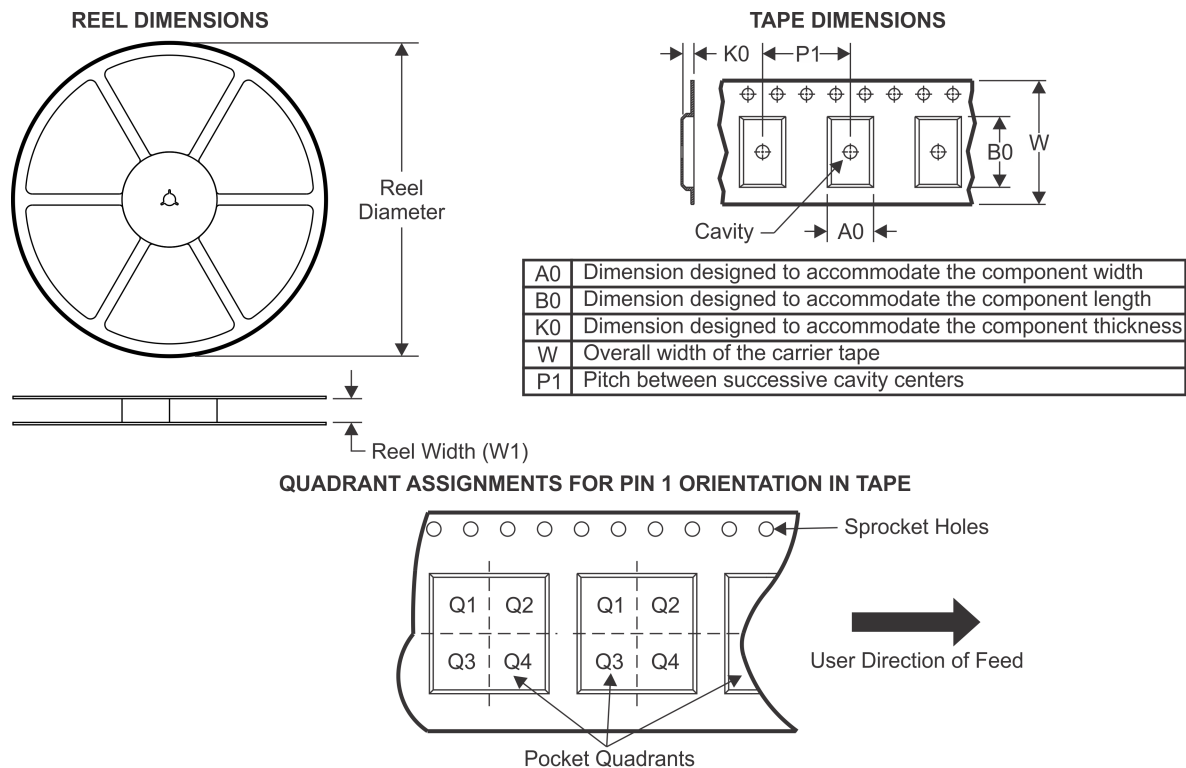
(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

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

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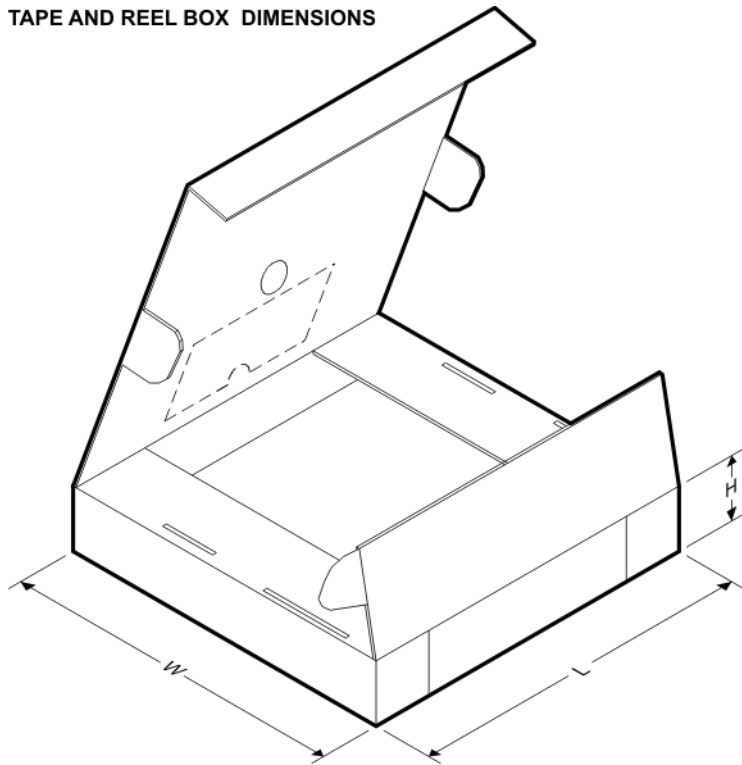
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TAPE AND REEL INFORMATION


*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
CSD25501F3	PICOST AR	YJN	3	3000	180.0	8.4	0.7	0.79	0.31	4.0	8.0	Q2
CSD25501F3T	PICOST AR	YJN	3	250	180.0	8.4	0.7	0.79	0.31	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)
CSD25501F3	PICOSTAR	YJN	3	3000	182.0	182.0	20.0
CSD25501F3T	PICOSTAR	YJN	3	250	182.0	182.0	20.0

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