

20V, P-Channel NexFET™ Power MOSFETs

Check for Samples: [CSD25481F4](#)

FEATURES

- Ultra Low On Resistance
- Ultra Low Q_g and Q_{gd}
- High Operating Drain Current
- Ultra Small Footprint (0402 Case Size)
 - 1.0 mm x 0.6 mm
- Ultra Low Profile
 - 0.35 mm Max Height
- Integrated ESD Protection Diode
 - Rated > 4kV HBM
 - Rated > 2kV CDM
- Pb Free Terminal Plating and Hallogen Free
- RoHS Compliant

APPLICATIONS

- Optimized for Load Switch Applications
- Optimized for General Purpose Switching Applications
- Battery Applications
- Handheld and Mobile Applications

DESCRIPTION

This 90mΩ, 20V P-Channel FemtoFET™ MOSFET has been 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 at least a 60% reduction in footprint size.

PRODUCT SUMMARY

V_{DS}	Drain to Source Voltage	-20	V
Q_g	Gate Charge Total (-4.5V)	913	pC
Q_{gd}	Gate Charge Gate to Drain	153	pC
$R_{DS(on)}$	Drain to Source On Resistance	$V_{GS} = -1.8V$	395 mΩ
		$V_{GS} = -2.5V$	145 mΩ
		$V_{GS} = -4.5V$	90 mΩ
$V_{GS(th)}$	Threshold Voltage	-0.95	V

ORDERING INFORMATION

Device	Qty	Media	Package	Ship
CSD25481F4	3,000	7-Inch Reel	Femto(0402) 1.0mm x 0.6mm Land Grid Array (LGA)	Tape and Reel
CSD25481F4R	18,000	13-Inch Reel		

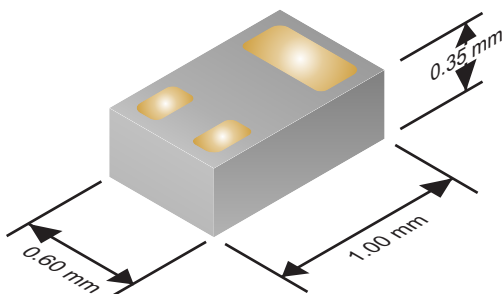
ABSOLUTE MAXIMUM RATINGS

$T_A = 25^\circ\text{C}$ unless otherwise stated		VALUE	UNIT
V_{DS}	Drain to Source Voltage	-20	V
V_{GS}	Gate to Source Voltage	-12	V
I_D	Continuous Drain Current ⁽¹⁾	-2.5	A
I_{DM}	Pulsed Drain Current ⁽²⁾	-10	A
P_D	Power Dissipation ⁽¹⁾	500	mW
ESD Rating	Human Body Model (HBM)	4	kV
	Charged Device Model (CDM)	2	kV
T_J, T_{STG}	Operating Junction and Storage Temperature Range	-55 to 150	°C

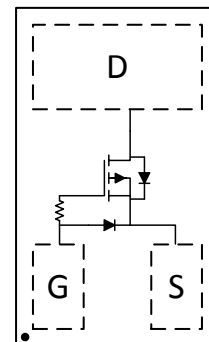
(1) Typical $R_{\theta JA} = 85^\circ\text{C/W}$ on 1-inch² (6.45-cm²), 2-oz. (0.071-mm thick) Cu pad on a 0.06-inch (1.52-mm) thick FR4 PCB.

(2) Pulse duration $\leq 300\mu\text{s}$, duty cycle $\leq 2\%$

Typical Part Dimensions



Top View



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.

FemtoFET 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.



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.

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} = 0V, I _{DS} = -250μA	-20			V
I _{DSS}	Drain to Source Leakage Current	V _{GS} = 0V, V _{DS} = -16V	-1			μA
I _{GSS}	Gate to Source Leakage Current	V _{DS} = 0V, V _{GS} = -12V	-100			nA
V _{GS(th)}	Gate to Source Threshold Voltage	V _{DS} = V _{GS} , I _{DS} = -250μA	-0.70	-0.95	-1.20	V
R _{DS(on)}	Drain to Source On Resistance	V _{GS} = -1.8V, I _{DS} = -0.1A		395	800	mΩ
		V _{GS} = -2.5V, I _{DS} = -0.5A		145	174	mΩ
		V _{GS} = -4.5V, I _{DS} = -0.5A		90	105	mΩ
		V _{GS} = -8V, I _{DS} = -0.5A		75	88	mΩ
g _{fs}	Transconductance	V _{DS} = -10V, I _{DS} = -0.5A		3.3		S
Dynamic Characteristics						
C _{iss}	Input Capacitance	V _{GS} = 0V, V _{DS} = -10V, f = 1MHz		189		pF
C _{oss}	Output Capacitance			78		pF
C _{rss}	Reverse Transfer Capacitance			5.5		pF
R _G	Series Gate Resistance	V _{DS} = -10V, I _{DS} = -0.5A		20		Ω
Q _g	Gate Charge Total (4.5V)			913		pC
Q _{gd}	Gate Charge Gate to Drain			153		pC
Q _{gs}	Gate Charge Gate to Source			240		pC
Q _{g(th)}	Gate Charge at V _{th}			116		pC
Q _{oss}	Output Charge	V _{DS} = -10V, V _{GS} = 0V		1030		pC
t _{d(on)}	Turn On Delay Time	V _{DS} = 0V, V _{GS} = -4.5V, I _{DS} = -0.5A, R _G = 2Ω		4.1		ns
t _r	Rise Time			3.6		ns
t _{d(off)}	Turn Off Delay Time			16.9		ns
t _f	Fall Time			6.7		ns
Diode Characteristics						
V _{SD}	Diode Forward Voltage	I _{SD} = -0.5A, V _{GS} = 0V		-0.75		V
Q _{rr}	Reverse Recovery Charge	V _{DS} = -10V, I _F = -0.5A, di/dt = 100A/μs		1,010		pC
t _{rr}	Reverse Recovery Time			7.5		ns

THERMAL CHARACTERISTICS

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

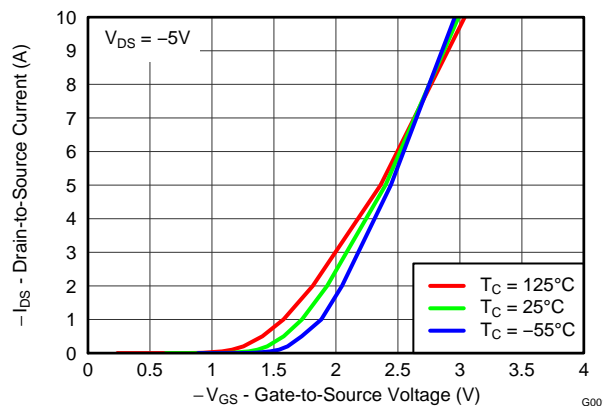
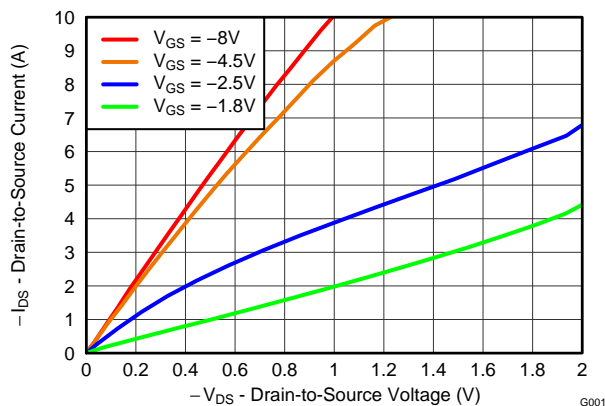
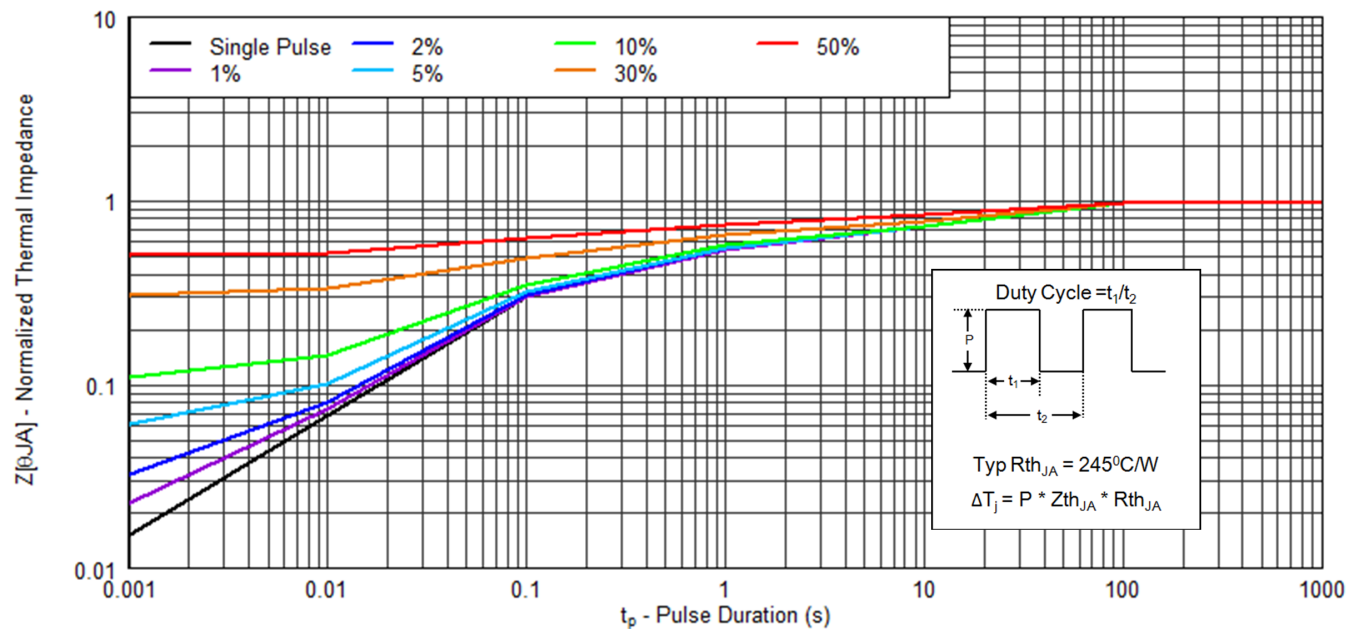
PARAMETER		Typical Values	UNIT
$R_{\theta JA}$	Thermal Resistance Junction to Ambient ⁽¹⁾	85	$^\circ\text{C/W}$
	Thermal Resistance Junction to Ambient ⁽²⁾	245	$^\circ\text{C/W}$

(1) Device mounted on FR4 material with 1-inch² (6.45-cm²), 2-oz. (0.071-mm thick) Cu.

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

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)

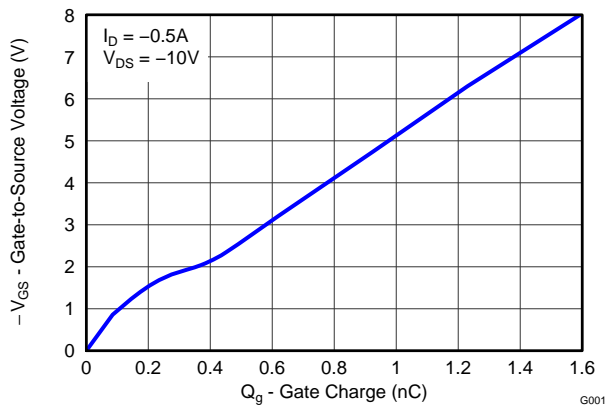


Figure 4. Gate Charge

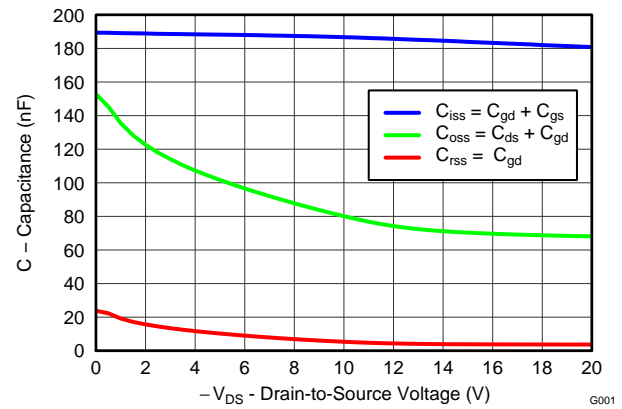


Figure 5. Capacitance

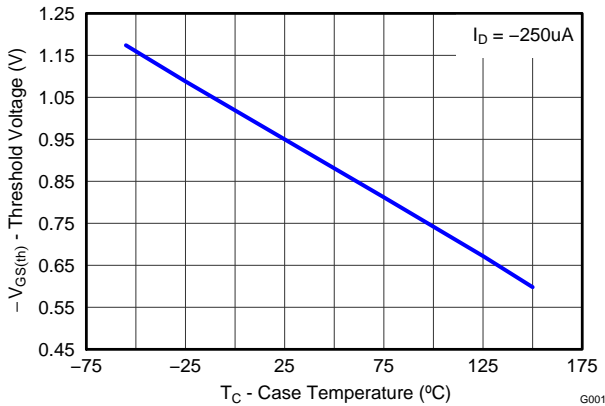


Figure 6. Threshold Voltage vs. Temperature

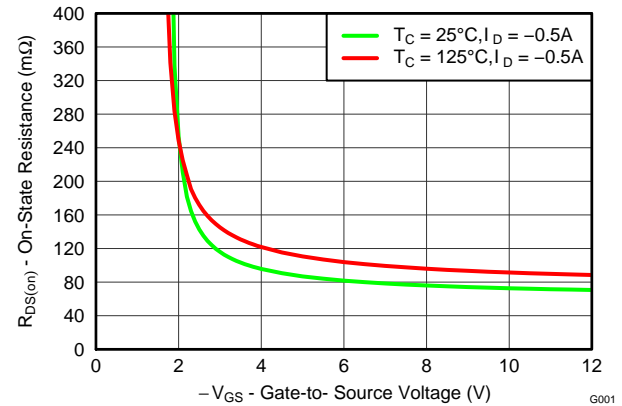


Figure 7. On-State Resistance vs. Gate-to-Source Voltage

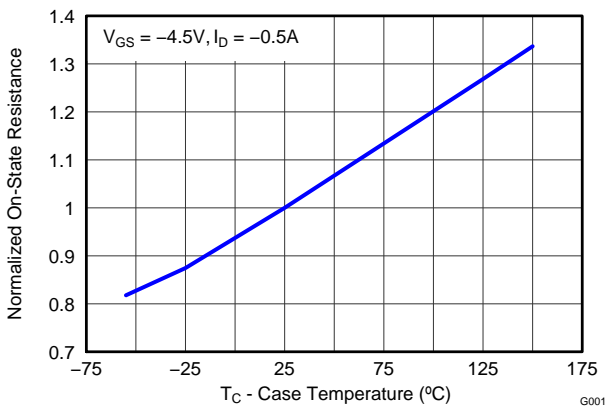


Figure 8. Normalized On-State Resistance vs. Temperature

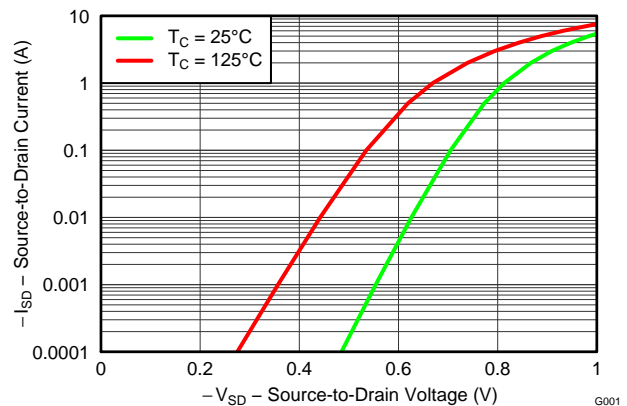


Figure 9. Typical Diode Forward Voltage

TYPICAL MOSFET CHARACTERISTICS (continued)

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

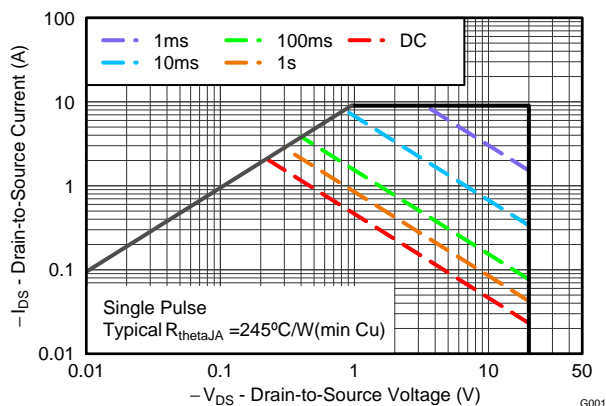


Figure 10. Maximum Safe Operating Area

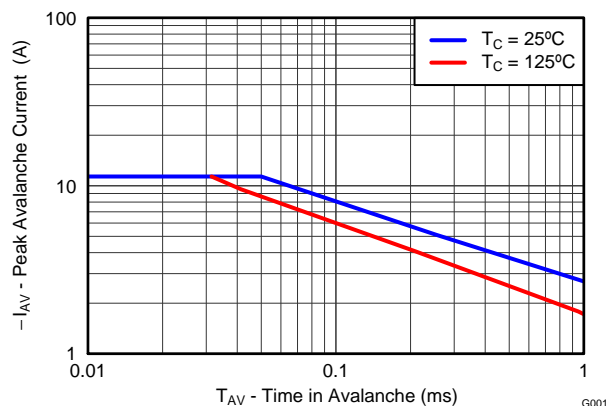


Figure 11. Single Pulse Unclamped Inductive Switching

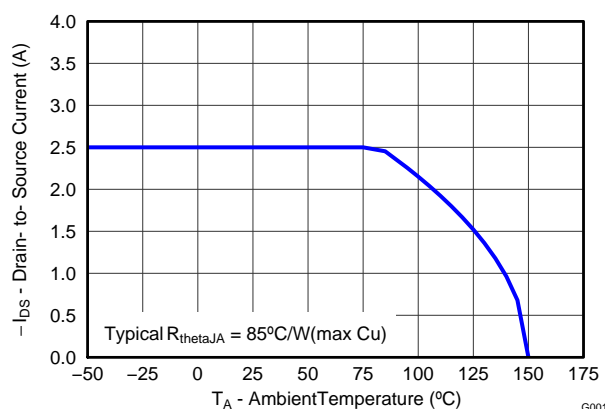
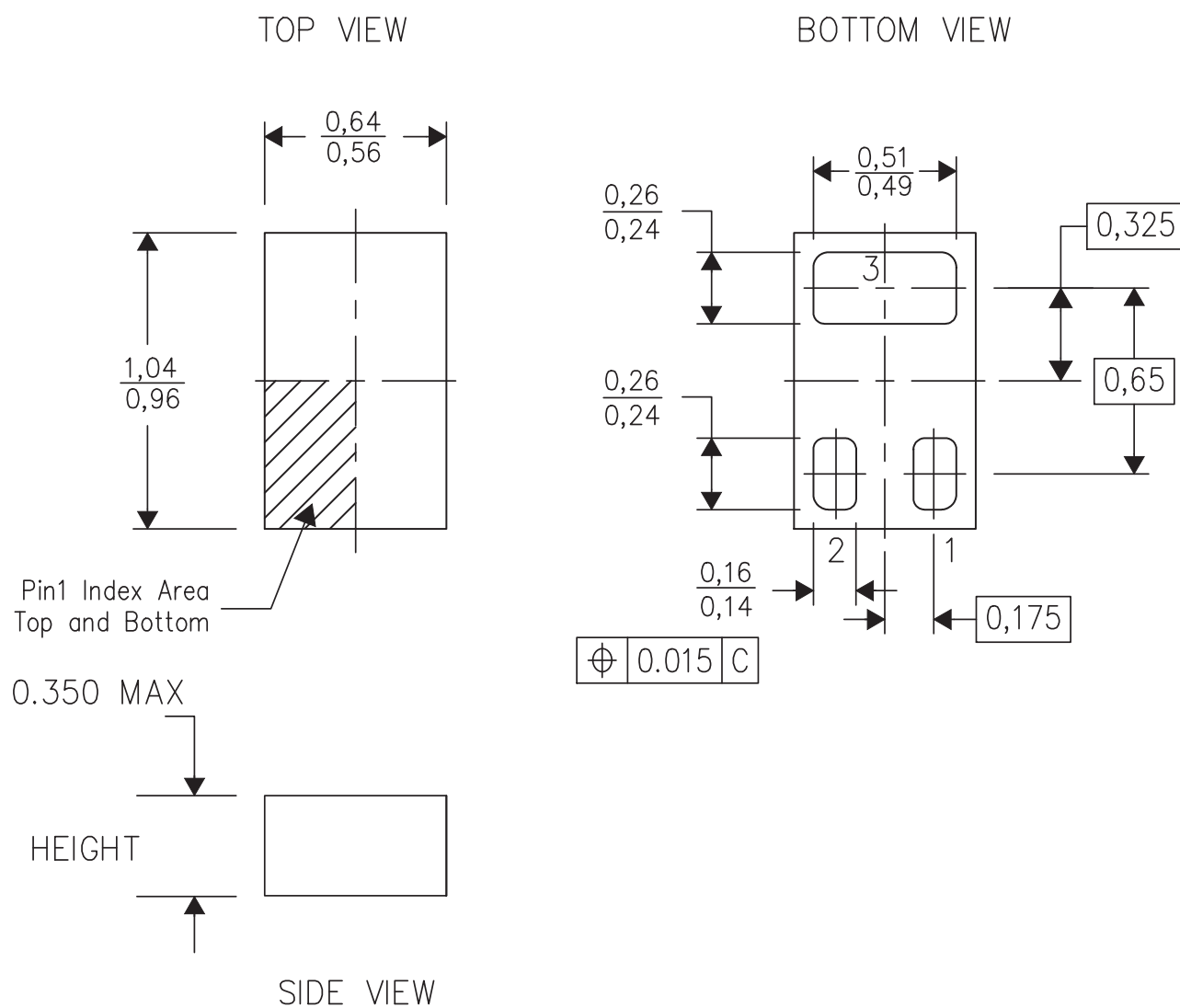


Figure 12. Maximum Drain Current vs. Temperature

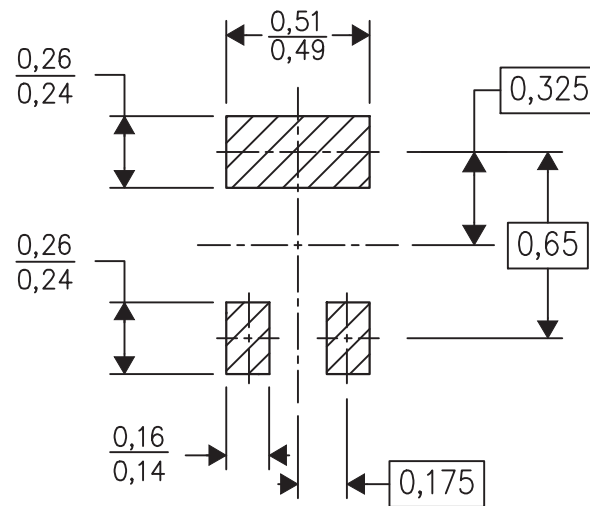
MECHANICAL DATA**0402 Mechanical Dimensions**

- (1) All linear dimensions are in millimeters (dimensions and tolerancing per AME T14.5M-1994)
- (2) This drawing is subject to change without notice
- (3) This package is a PB-Free solder land design

Table 1. Pin Configuration

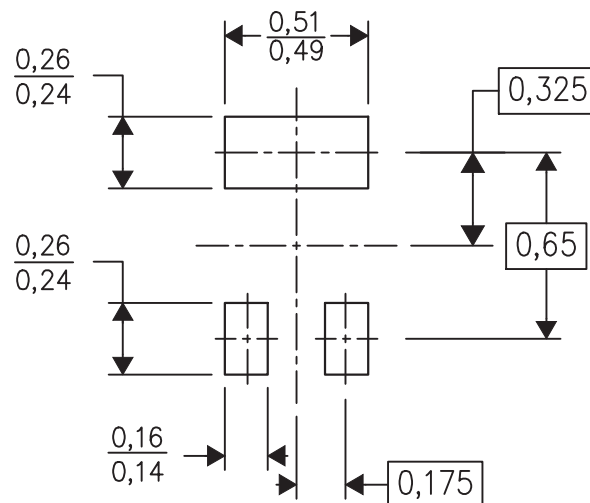
Position	Designation
Pin 1	Gate
Pin 2	Source
Pin 3	Drain

Recommended Minimum PCB Layout



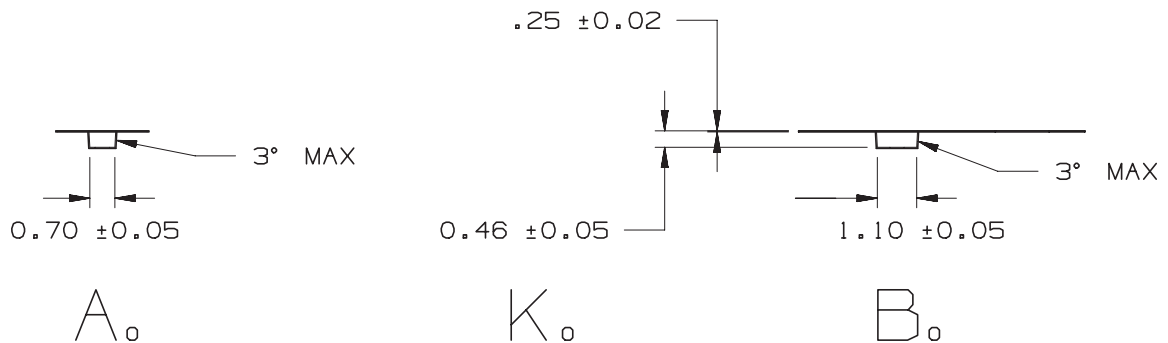
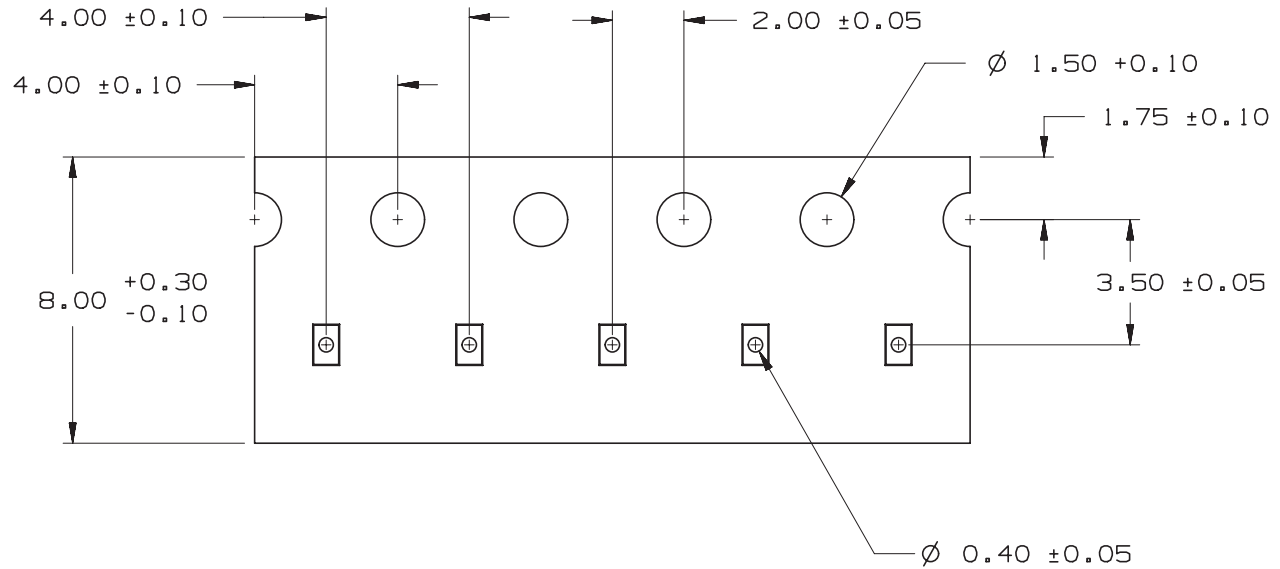
(1) All dimensions are in millimeters.

Recommended Stencil Pattern



(1) All dimensions are in millimeters.

CSD17381F4 Embossed Carrier Tape Dimensions



- (1) Pin 1 will be oriented in the top right quadrant of the tape enclosure (Quadrant 2), closest to the carrier tape sprocket holes.

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
CSD25481F4	ACTIVE	PICOSTAR	YJC	3	3000	Green (RoHS & no Sb/Br)	Call TI	Level-1-250C-UNLIM	-40 to 85	CS	Samples
CSD25481F4R	PREVIEW	PICOSTAR	YJC	3	18000	TBD	Call TI	Call TI	-40 to 85		

(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.

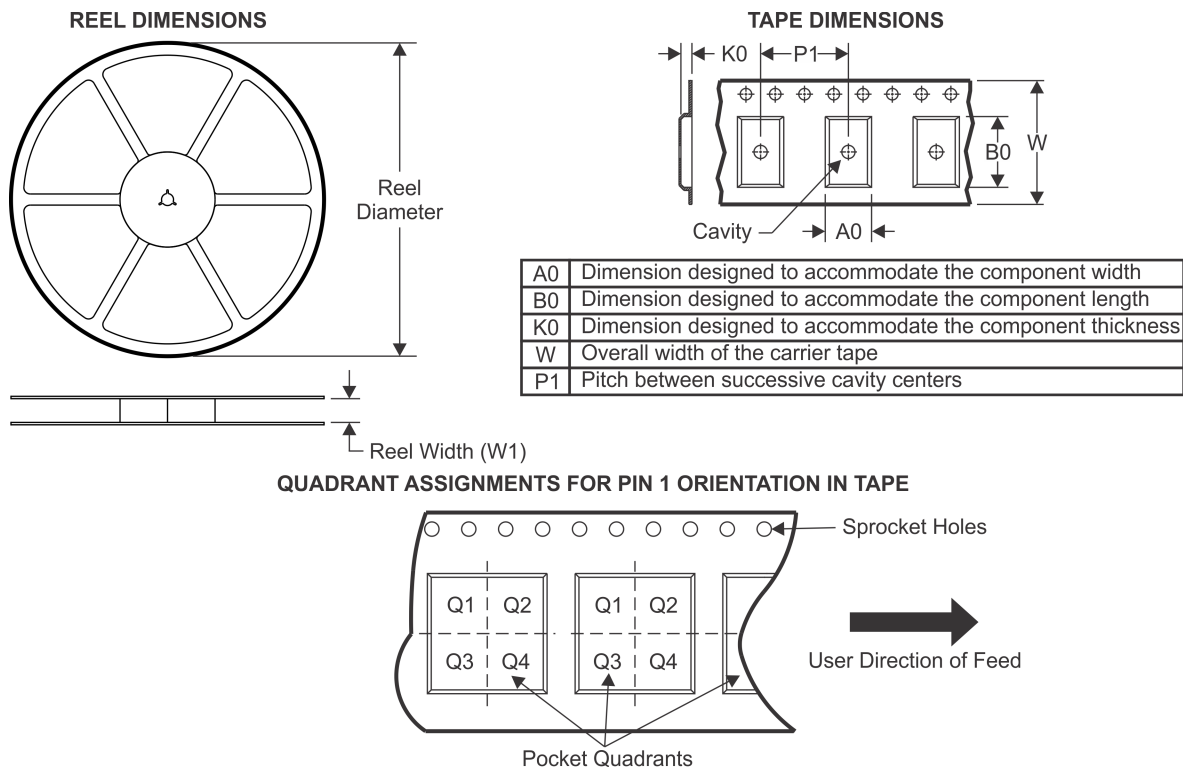
(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(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.

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.

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
CSD25481F4	PICOST AR	YJC	3	3000	180.0	8.4	0.7	1.1	0.46	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)
CSD25481F4	PICOSTAR	YJC	3	3000	210.0	185.0	35.0

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

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

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

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license 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 significant portions 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. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

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

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

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 Applications Processors	www.ti.com/omap
Wireless Connectivity	www.ti.com/wirelessconnectivity

Applications

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

TI E2E Community

e2e.ti.com