CSD13381F4 12 V N-Channel FemtoFET™ MOSFET

1 Features

- Low On-Resistance
- Low Q_g and Q_{gd}
- Low Threshold Voltage
- Ultra-Small Footprint (0402 Case Size)
  - 1.0 mm × 0.6 mm
- Ultra-Low Profile
  - 0.35 mm Height
- Integrated ESD Protection Diode
  - Rated >4 kV HBM
  - Rated >2 kV CDM
- Lead and Halogen Free
- RoHS Compliant

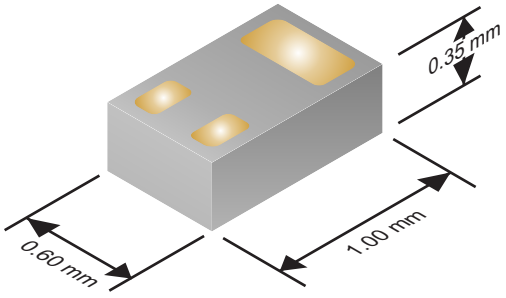
2 Applications

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

3 Description

This 140 mΩ, 12 V N-channel FemtoFET™ MOSFET technology 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 at least a 60% 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)	1060		pC
Q_{gd}	Gate Charge Gate-to-Drain	140		pC
$R_{DS(on)}$	Drain-to-Source On-Resistance	V_{GS} = 1.8 V	310	mΩ
		V_{GS} = 2.5 V	170	mΩ
		V_{GS} = 4.5 V	140	mΩ
$V_{GS(th)}$	Threshold Voltage	0.85		V

Ordering Information(1)

Device	Qty	Media	Package	Ship
CSD13381F4	3000	7-Inch Reel	Femto (0402) 1.0 mm x 0.6 mm SMD Lead Less	Tape and Reel
CSD13381F4T	250			

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

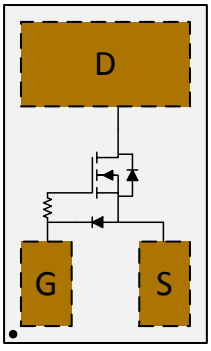
Absolute Maximum Ratings

T_A = 25°C unless otherwise stated		VALUE	UNIT
V_{DS}	Drain-to-Source Voltage	12	V
V_{GS}	Gate-to-Source Voltage	8	V
I_D	Continuous Drain Current, T_A = 25°C(1)	2.1	A
I_{DM}	Pulsed Drain Current, T_A = 25°C(2)	7	A
I_G	Continuous Gate Clamp Current	35	mA
	Pulsed Gate Clamp Current(2)	350	
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
E_{AS}	Avalanche Energy, single pulse I_D = 7.4 A, L = 0.1 mH, R_G = 25 Ω	2.7	mJ

(1) Typical $R_{\theta JA}$ = 90°C/W on 1 inch^2 (6.45 cm^2), 2 oz. (0.071 mm thick) Cu pad on a 0.06 inch (1.52 mm) thick FR4 PCB.

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

Top View



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4 Revision History

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

Changes from Revision B (February 2014) to Revision C — **Page**

- Corrected timing V_{DS} to read 6 V ... 3

Changes from Revision A (November 2013) to Revision B — **Page**

- Added I_G parameter ... 1
- Lowered I_{DSS} limit ... 3
- Lowered I_{GSS} limit ... 3

Changes from Original (July 2013) to Revision A — **Page**

- Updated device ordering information ... 1
- Changed test voltage conditions ... 3
- Changed Figure 4 Gate Charge graph ... 5

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			100	nA
I_{GSS}	Gate-to-Source Leakage Current	V_{DS} = 0 V, V_{GS} = 4 V			50	nA
$V_{GS(th)}$	Gate-to-Source Threshold Voltage	V_{DS} = V_{GS}, I_{DS} = 250 µA	0.65	0.85	1.10	V
$R_{DS(on)}$	Drain-to-Source On-Resistance	V_{GS} = 1.8 V, I_{DS} =0.5 A		310	400	mΩ
		V_{GS} = 2.5 V, I_{DS} =0.5 A		170	225	mΩ
		V_{GS} = 4.5 V, I_{DS} = 0.5 A		140	180	mΩ
g_{fs}	Transconductance	V_{DS} = 6 V, I_{DS} = 0.5 A		3.2		S
DYNAMIC CHARACTERISTICS						
C_{iss}	Input Capacitance	V_{GS} = 0 V, V_{DS} = 6 V, f = 1 MHz		155	200	pF
C_{oss}	Output Capacitance			47	62	pF
C_{rss}	Reverse Transfer Capacitance			2.5	3.3	pF
R_G	Series Gate Resistance			23		Ω
Q_g	Gate Charge Total (4.5 V)	V_{DS} = 6 V, I_{DS} = 0.5 A		1060	1400	pC
Q_{gd}	Gate Charge Gate-to-Drain			140		pC
Q_{gs}	Gate Charge Gate-to-Source			230		pC
$Q_{g(th)}$	Gate Charge at V_{th}			155		pC
Q_{oss}	Output Charge	V_{DS} = 6 V, V_{GS} = 0 V		1120		pC
$t_{d(on)}$	Turn On Delay Time	V_{DS} = 6 V, V_{GS} = 4.5 V, I_{DS} = 0.5 A,R_G = 2 Ω		3.7		ns
t_r	Rise Time			1.5		ns
$t_{d(off)}$	Turn Off Delay Time			11.0		ns
t_f	Fall Time			3.8		ns
DIODE CHARACTERISTICS						
V_{SD}	Diode Forward Voltage	I_{SD} = 0.5 A, V_{GS} = 0 V		0.73	0.9	V
Q_{rr}	Reverse Recovery Charge	V_{DS}= 6 V, I_F = 0.5 A, di/dt = 300 A/µs		1550		pC
t_{rr}	Reverse Recovery Time			6		ns

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)	250	

(1) Device mounted on FR4 material with 1 inch^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)

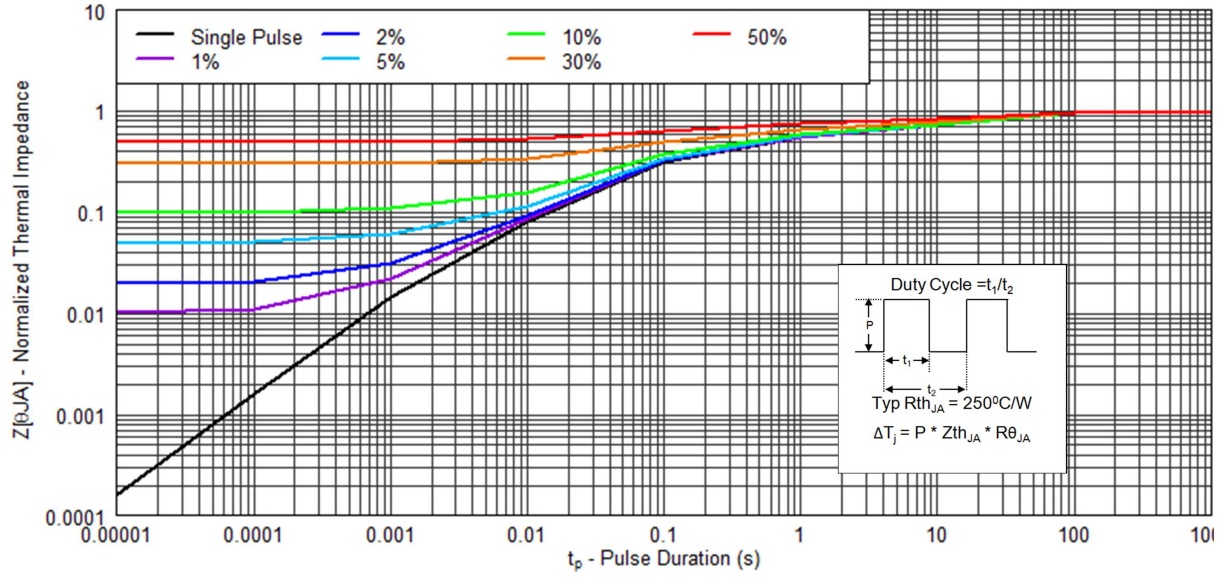

Figure 1. Transient Thermal Impedance

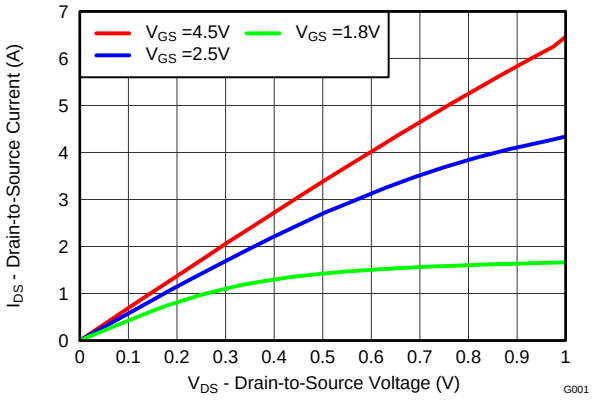

Figure 2. Saturation Characteristics

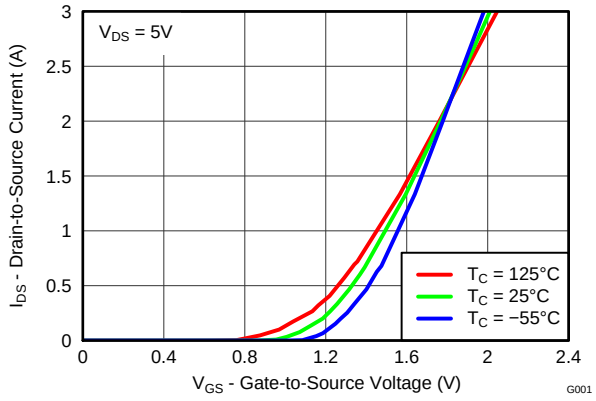

Figure 3. Transfer Characteristics

Typical MOSFET Characteristics (continued)

(T_A = 25°C unless otherwise stated)

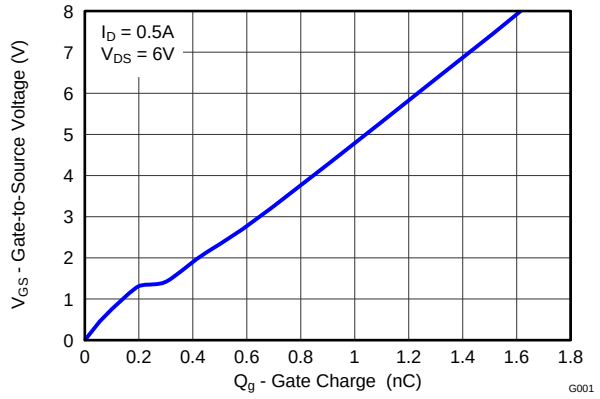

Figure 4. Gate Charge

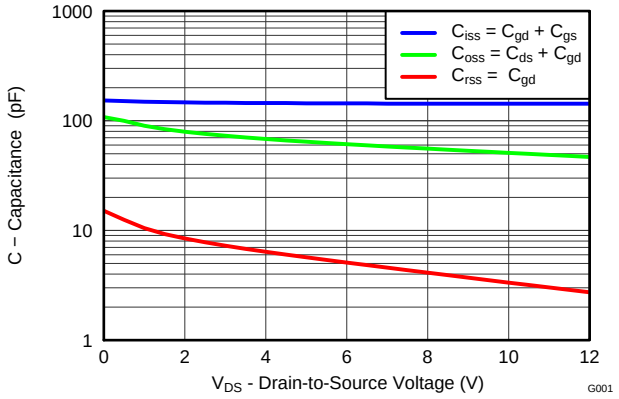

Figure 5. Capacitance

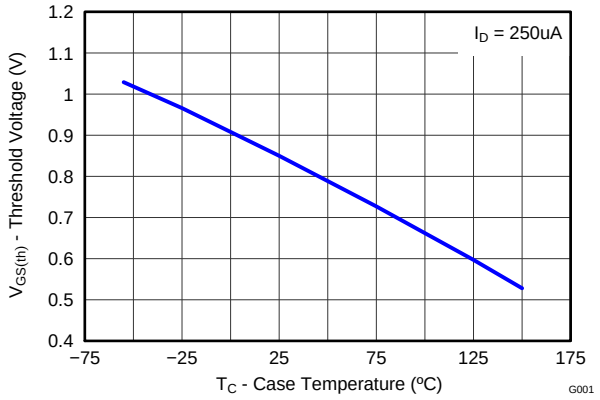

Figure 6. Threshold Voltage vs Temperature

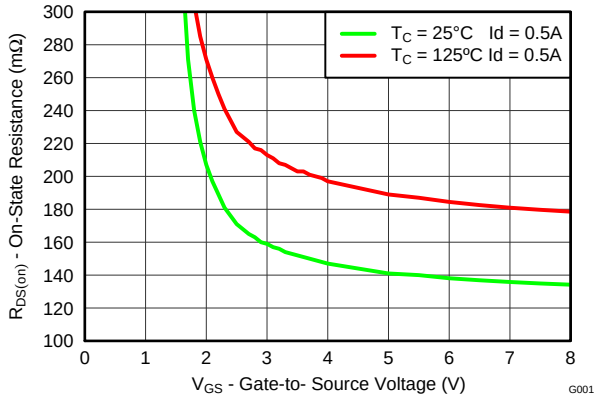

Figure 7. On-State Resistance vs Gate-to-Source Voltage

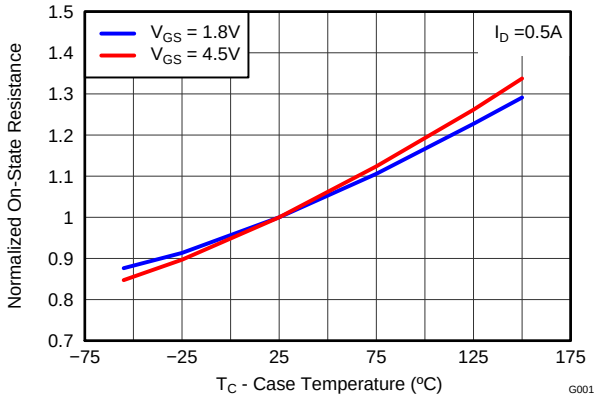

Figure 8. Normalized On-State Resistance vs Temperature

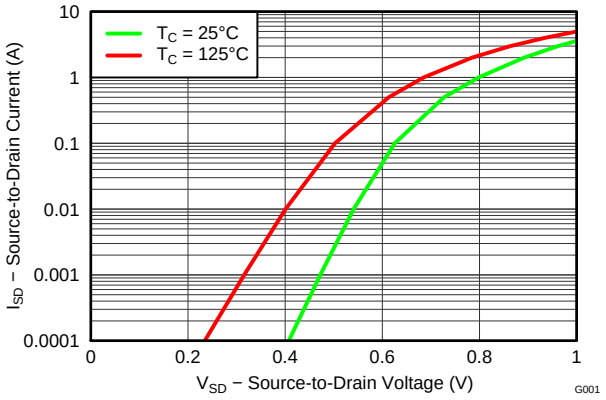

Figure 9. Typical Diode Forward Voltage

Typical MOSFET Characteristics (continued)

(T_A = 25°C unless otherwise stated)

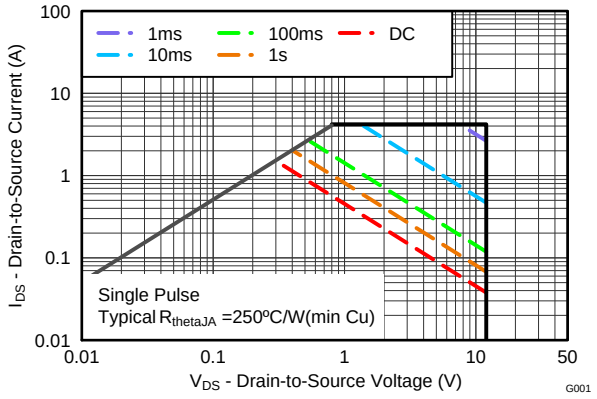

Figure 10. Maximum Safe Operating Area (SOA)

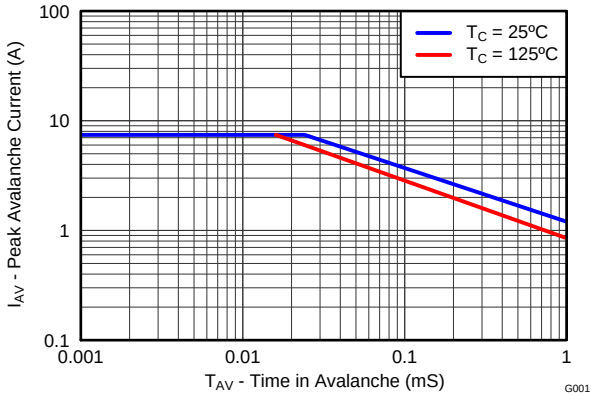

Figure 11. Single Pulse Unclamped Inductive Switching

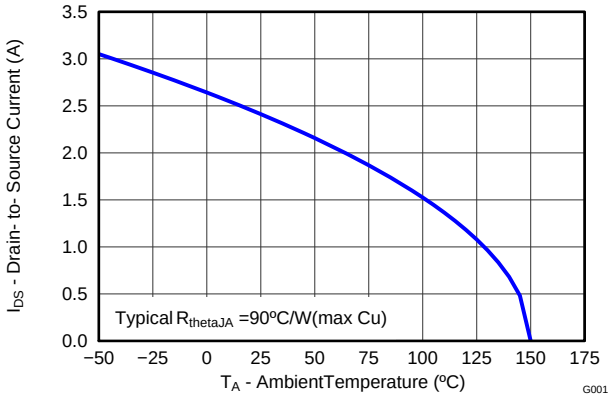

Figure 12. Maximum Drain Current vs Temperature

6 Device and Documentation Support

6.1 Trademarks

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6.2 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.

6.3 Glossary

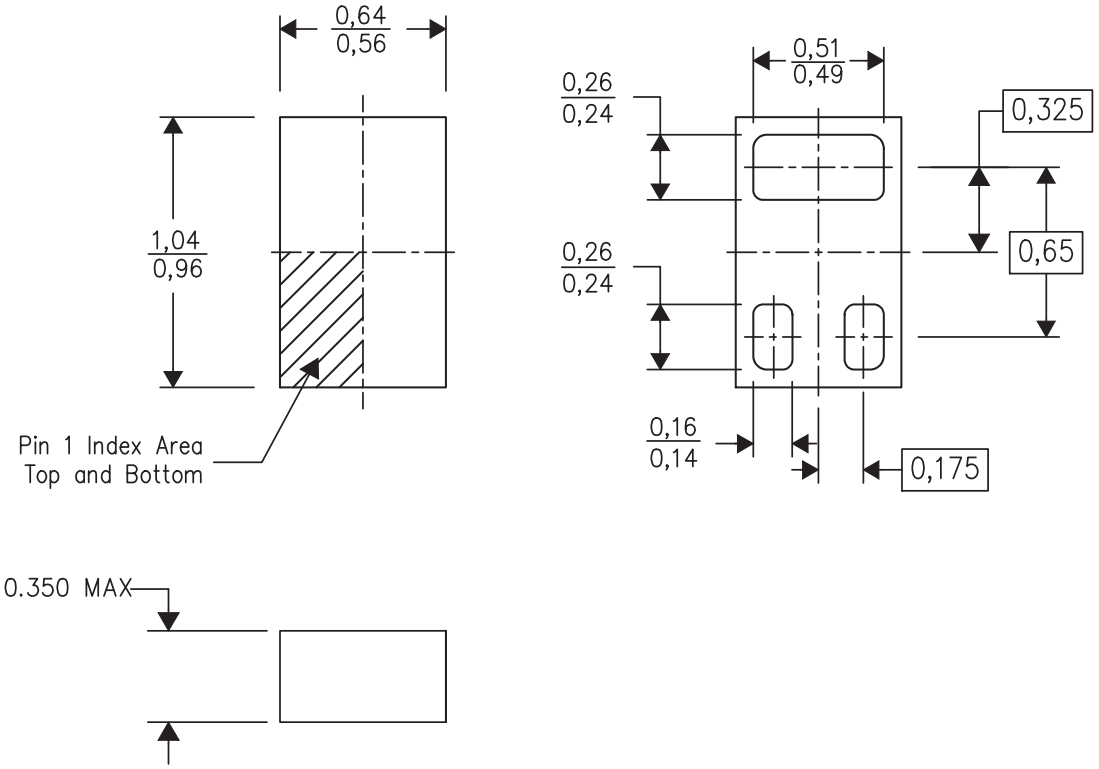
SLYZ022 — *TI Glossary*.

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

7 Mechanical Data

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

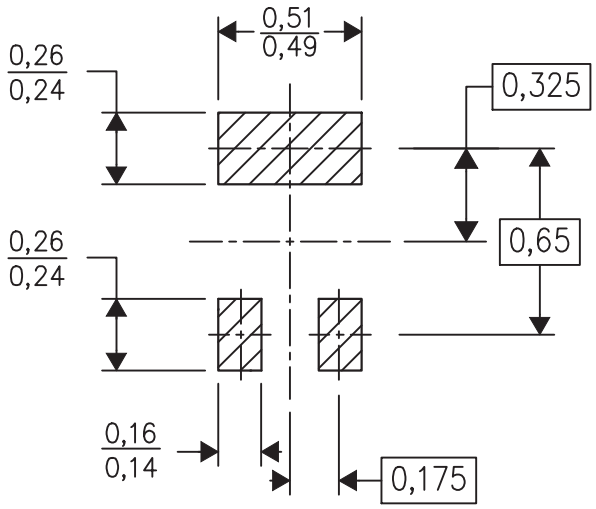


(1) All linear dimensions are in millimeters (dimensions and tolerancing per AME T14.5M-1994).

(2) This drawing is subject to change without notice.

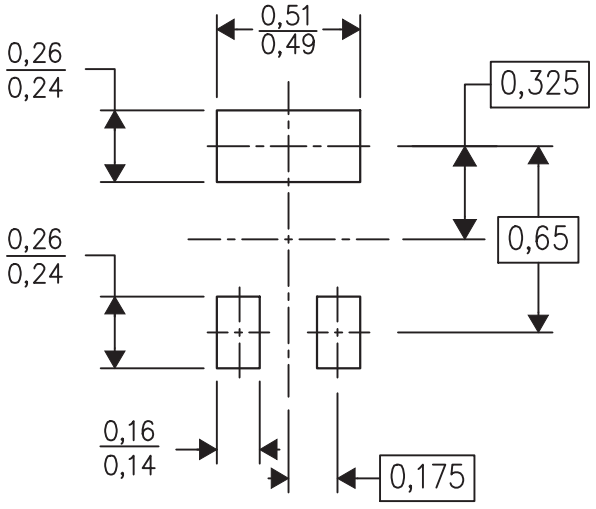
(3) This package is a PB-free solder land design.

7.2 Recommended Minimum PCB Layout



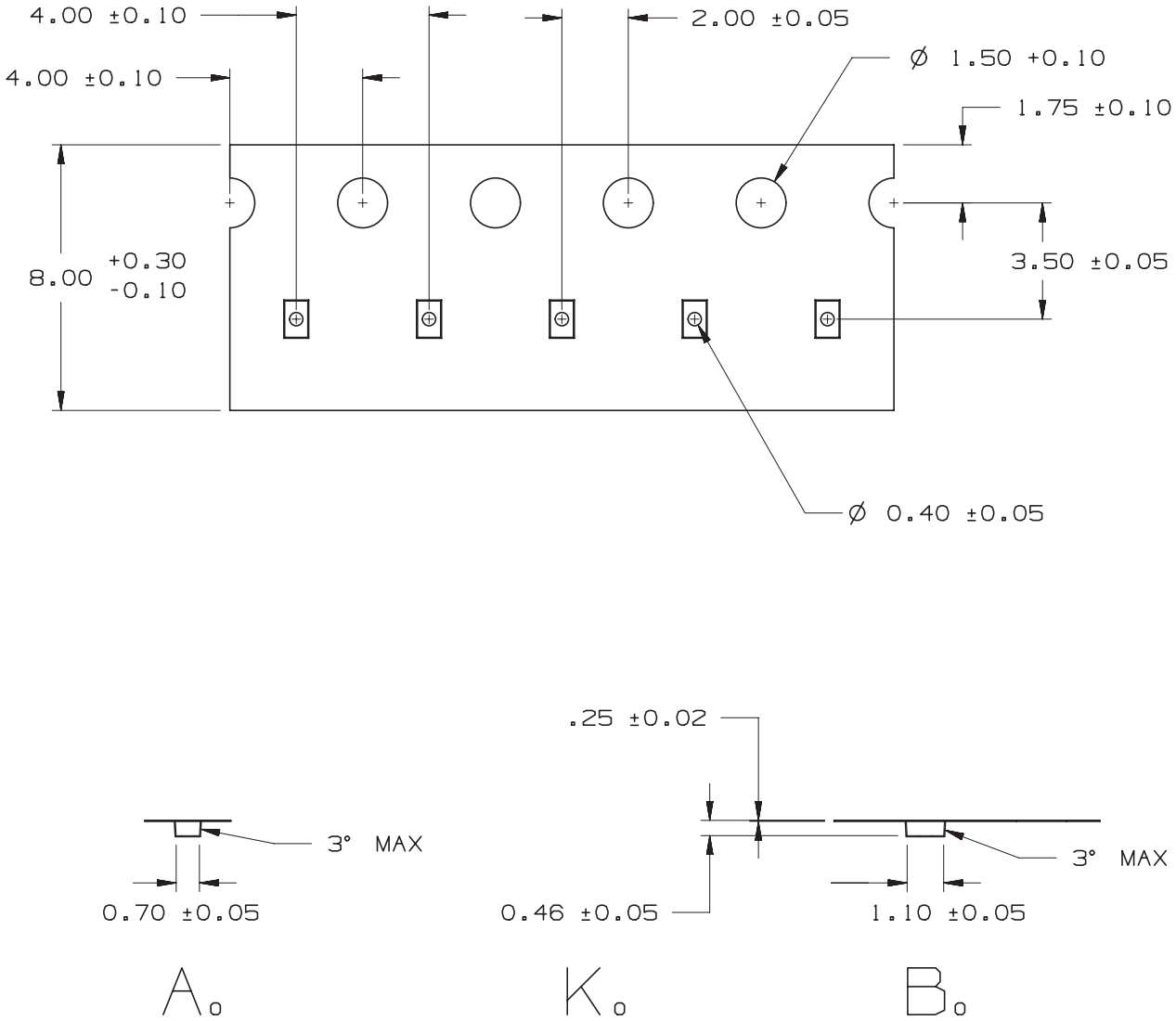
(1) All dimensions are in millimeters.

7.3 Recommended Stencil Pattern



(1) All dimensions are in millimeters.

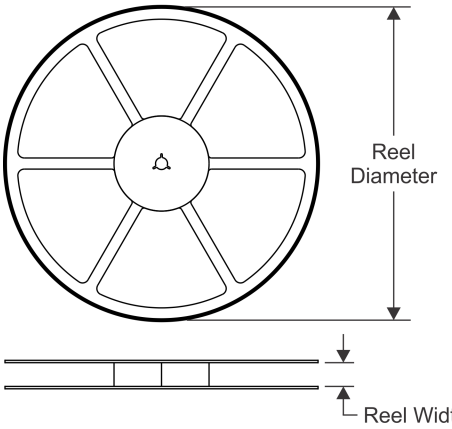
7.4 CSD13381F4 Embossed Carrier Tape Dimensions



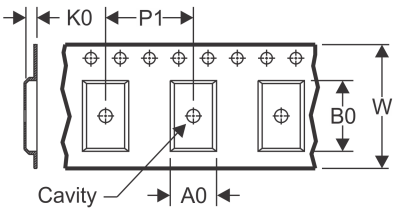
(1) Pin 1 is oriented in the top-right quadrant of the tape enclosure (quadrant 2), closest to the carrier tape sprocket holes.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

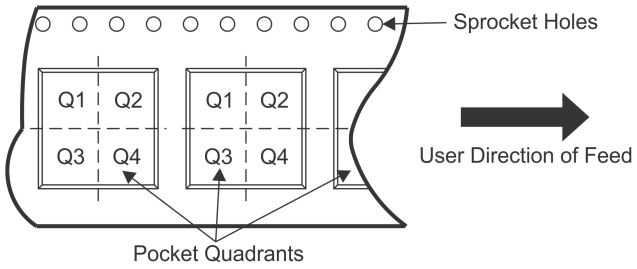


TAPE DIMENSIONS



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

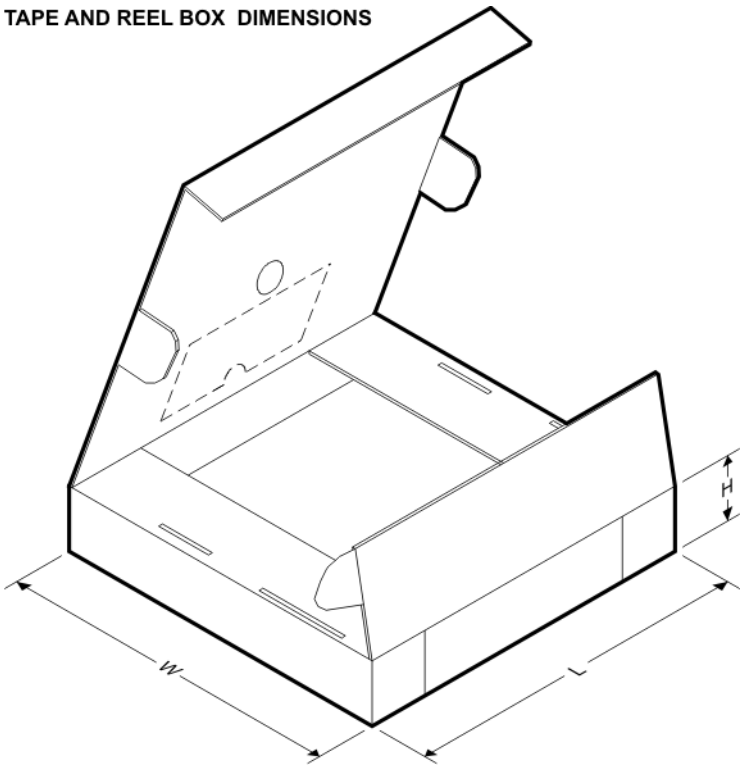
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
CSD13381F4	PICOSTAR	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)
CSD13381F4	PICOSTAR	YJC	3	3000	182.0	182.0	17.0

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