

CSD17381F4 30-V N-Channel FemtoFET™ MOSFET

1 Features

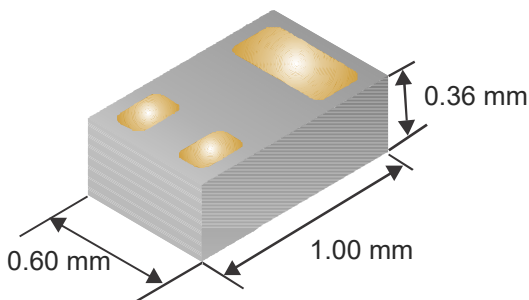
- Ultra-low on-resistance
- Ultra-low Q_g and Q_{gd}
- Low threshold voltage
- Ultra-small footprint (0402 case size)
 - 1.0 mm × 0.6 mm
- Ultra-low profile
 - 0.36 mm height
- Integrated ESD protection diode
 - Rated >4 kV HBM
 - Rated >2 kV CDM
- Lead and halogen free
- RoHS compliant

2 Applications

- Optimized for load switch applications
- Optimized for general purpose switching applications
- Single-cell battery applications
- Handheld and mobile applications

3 Description

This 90 mΩ, 30 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 Dimensions

Product Summary

$T_A = 25^\circ\text{C}$		TYPICAL VALUE	UNIT
V_{DS}	Drain-to-source voltage	30	V
Q_g	Gate charge total (4.5 V)	1040	pC
Q_{gd}	Gate charge gate-to-drain	133	pC
$R_{DS(on)}$	Drain-to-source on-resistance	$V_{GS} = 1.8\text{ V}$	160 mΩ
		$V_{GS} = 2.5\text{ V}$	110 mΩ
		$V_{GS} = 4.5\text{ V}$	90 mΩ
$V_{GS(th)}$	Threshold voltage	0.85	V

Ordering Information

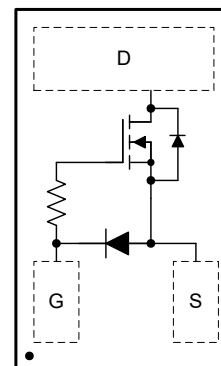
DEVICE ⁽¹⁾	QTY	MEDIA	PACKAGE	SHIP
CSD17381F4	3000	7-Inch reel	Femto (0402) 1.0 mm × 0.6 mm SMD Lead Less	Tape and reel
CSD17381F4T	250			

- (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	30	V
V_{GS}	Gate-to-source voltage	12	V
I_D	Continuous drain current, $T_A = 25^\circ\text{C}$ ⁽¹⁾	3.1	A
I_{DM}	Pulsed Drain Current, $T_A = 25^\circ\text{C}$ ⁽²⁾	12	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 $I_D = 7.4\text{ A}$, $L = 0.1\text{ mH}$, $R_G = 25\ \Omega$	2.7	mJ

- (1) Typical $R_{\theta JA} = 90^\circ\text{C/W}$ 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 ≤ 100 μs, duty cycle ≤ 1%.



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 F (October 2021) to Revision G (January 2022) Page

- Changed height dimension from "0.35 mm" to "0.36 mm" *Features* 1
- Changed height dimension from "0.35 mm" to "0.36 mm" in *Typical Dimensions* 1
- Changed height dimension from "0.35 mm" to "0.36 mm" in *Mechanical Dimensions* 8

Changes from Revision E (December 2017) to Revision F (October 2021) Page

- Updated the numbering format for tables, figures, and cross-references throughout the document..... 1
- Changed footnote to refer to correct support document..... 9

Changes from Revision D (August 2014) to Revision E (December 2017) Page

- Changed Pulsed Drain Current value From: 10 A To: 12 A in the *Absolute Maximum Ratings* table. 1
- Change Note 2 From: Pulse duration $\leq 300 \mu\text{s}$, duty cycle $\leq 2\%$ To: Pulse duration $\leq 100 \mu\text{s}$, duty cycle $\leq 1\%$. 1
- Updated [Figure 5-1](#). 4
- Updated [Figure 5-10](#) with newly measured data. 4
- Updated all mechanical drawings, increased the size of the pads in [Section 7.3](#) 8

5 Specifications

5.1 Electrical Characteristics

(T_A = 25°C unless otherwise stated)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
STATIC CHARACTERISTICS						
B _V DSS	Drain-to-Source Voltage	V _{GS} = 0 V, I _{DS} = 250 μA	30			V
I _{DSS}	Drain-to-Source Leakage Current	V _{GS} = 0 V, V _{DS} = 24 V			100	nA
I _{GSS}	Gate-to-Source Leakage Current	V _{DS} = 0 V, V _{GS} = 10 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		160	250	mΩ
		V _{GS} = 2.5 V, I _{DS} = 0.5 A		110	143	mΩ
		V _{GS} = 4.5 V, I _{DS} = 0.5 A		90	117	mΩ
		V _{GS} = 8 V, I _{DS} = 0.5 A		84	109	mΩ
g _{fs}	Transconductance	V _{DS} = 15 V, I _{DS} = 0.5 A		4.8		S
DYNAMIC CHARACTERISTICS						
C _{iss}	Input Capacitance	V _{GS} = 0 V, V _{DS} = 15 V, f = 1 MHz		150	195	pF
C _{oss}	Output Capacitance			44	57	pF
C _{rss}	Reverse Transfer Capacitance			2.2	2.9	pF
R _G	Series Gate Resistance			23		Ω
Q _g	Gate Charge Total (4.5 V)	V _{DS} = 15 V, I _{DS} = 0.5 A		1040	1350	pC
Q _{gd}	Gate Charge Gate-to-Drain			133		pC
Q _{gs}	Gate Charge Gate-to-Source			226		pC
Q _{g(th)}	Gate Charge at V _{th}			150		pC
Q _{oss}	Output Charge		V _{DS} = 15 V, V _{GS} = 0 V		1110	
t _{d(on)}	Turn On Delay Time	V _{DS} = 15 V, V _{GS} = 4.5 V, I _{DS} = 0.5 A, R _G = 2 Ω		3.4		ns
t _r	Rise Time			1.4		ns
t _{d(off)}	Turn Off Delay Time			10.8		ns
t _f	Fall Time			3.6		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} = 15 V, I _F = 0.5 A, di/dt = 300 A/μs		1500		pC
t _{rr}	Reverse Recovery Time			5.6		ns

5.2 Thermal Information

(T_A = 25°C unless otherwise stated)

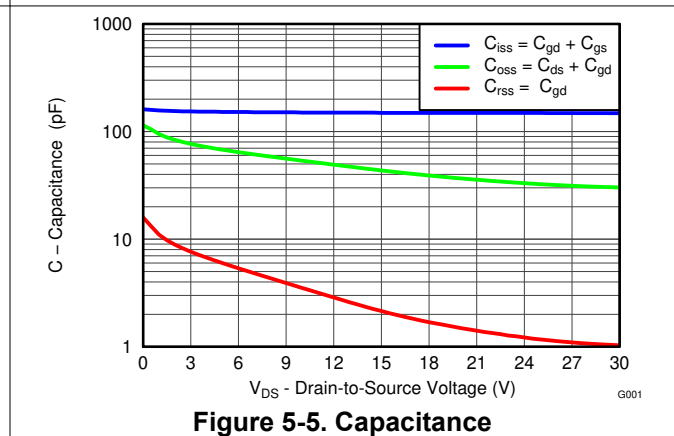
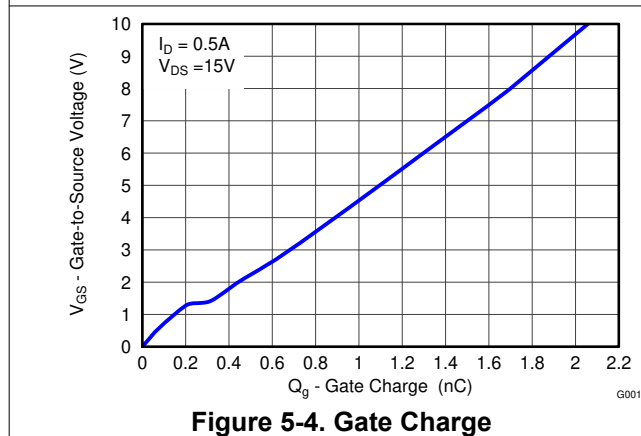
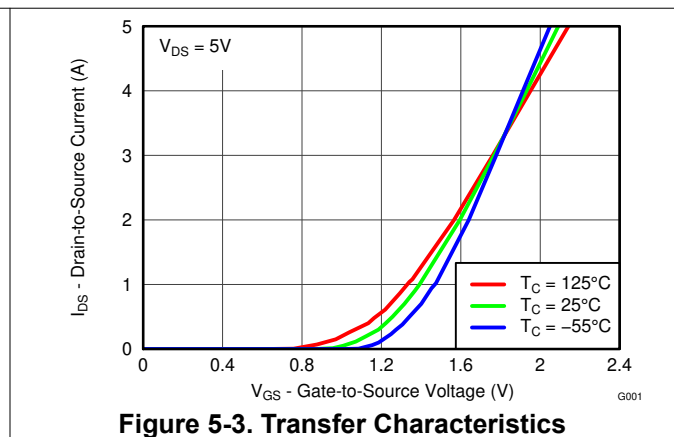
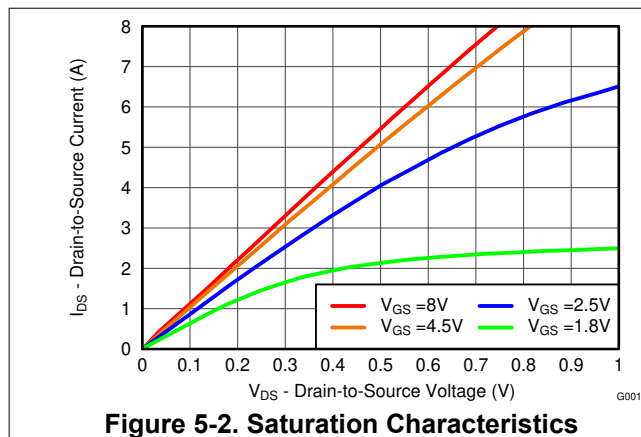
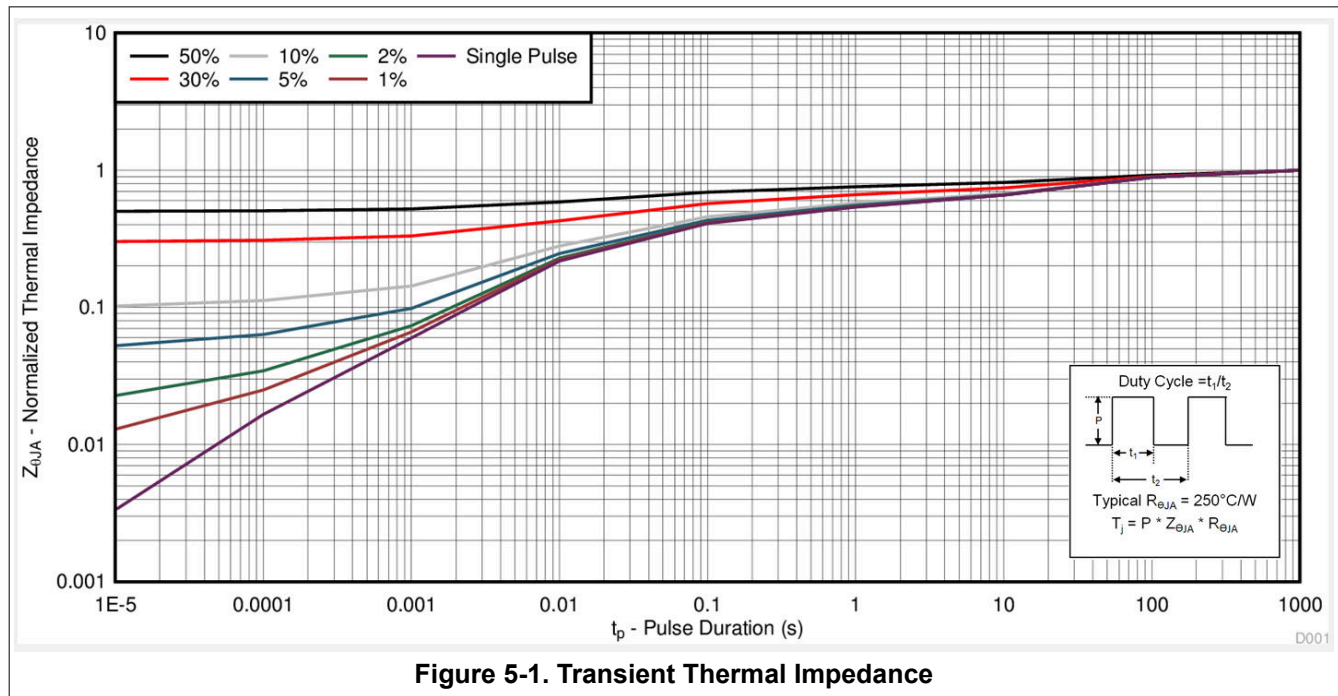
THERMAL METRIC		TYPICAL VALUES	UNIT
R _{θJA}	Junction-to-Ambient Thermal Resistance ⁽¹⁾	90	°C/W
	Junction-to-Ambient Thermal Resistance ⁽²⁾	250	

(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.

5.3 Typical MOSFET Characteristics

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



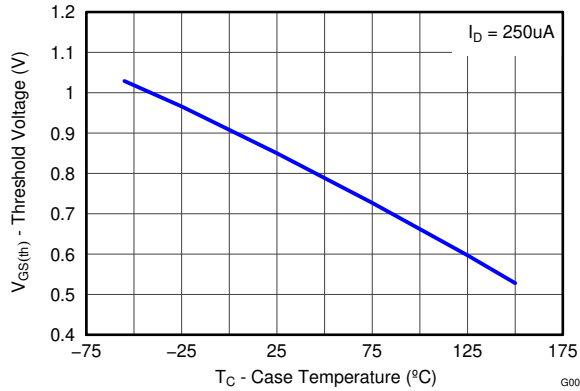


Figure 5-6. Threshold Voltage vs Temperature

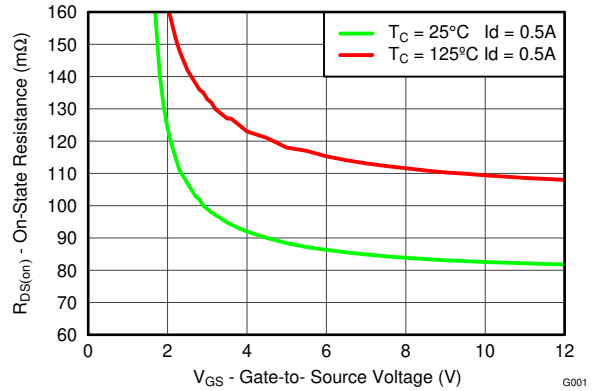


Figure 5-7. On-State Resistance vs Gate-to-Source Voltage

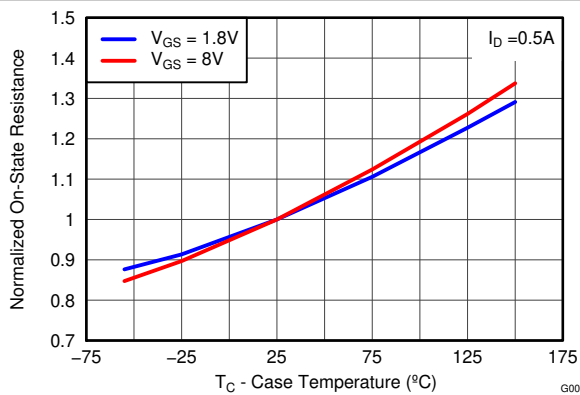


Figure 5-8. Normalized On-State Resistance vs Temperature

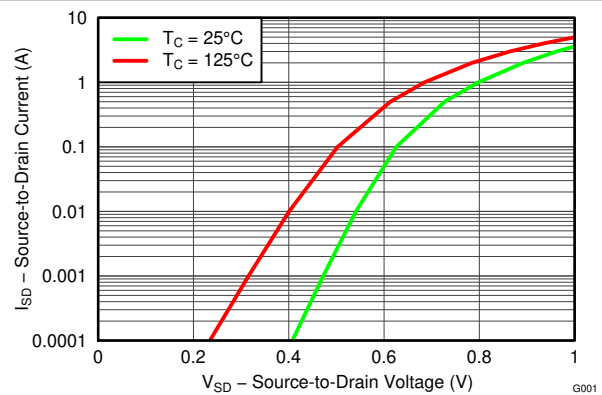


Figure 5-9. Typical Diode Forward Voltage

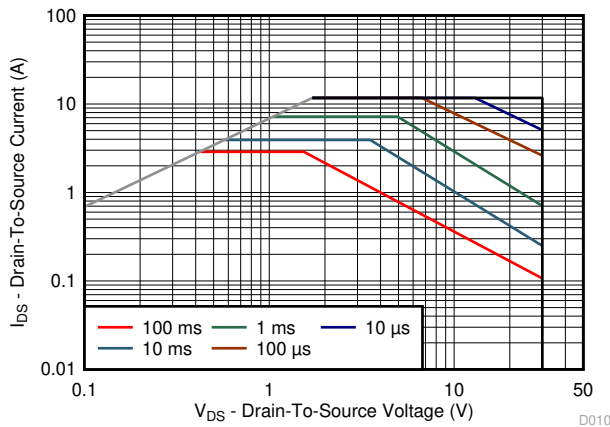


Figure 5-10. Maximum Safe Operating Area

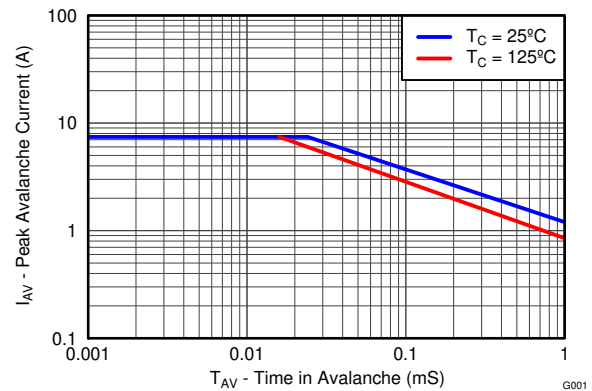


Figure 5-11. Single Pulse Unclamped Inductive Switching

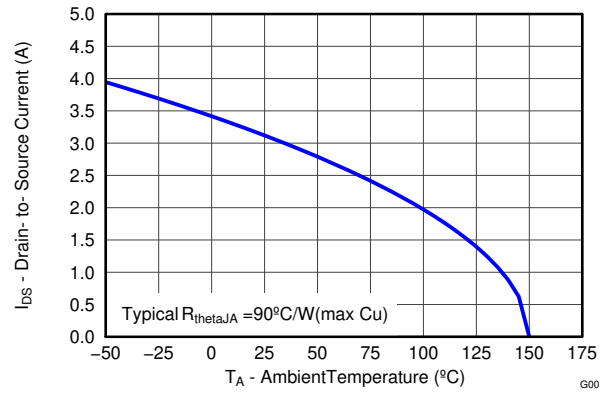


Figure 5-12. Maximum Drain Current vs Temperature

6 Device and Documentation Support

6.1 Support Resources

[TI E2E™ support forums](#) are an engineer's go-to source for fast, verified answers and design help — straight from the experts. Search existing answers or ask your own question to get the quick design help you need.

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6.2 Trademarks

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6.3 Electrostatic Discharge Caution



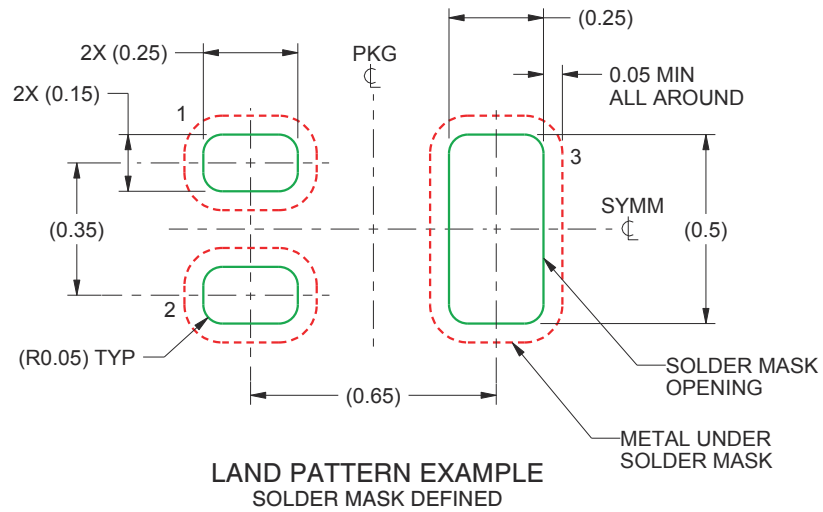
This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

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.

6.4 Glossary

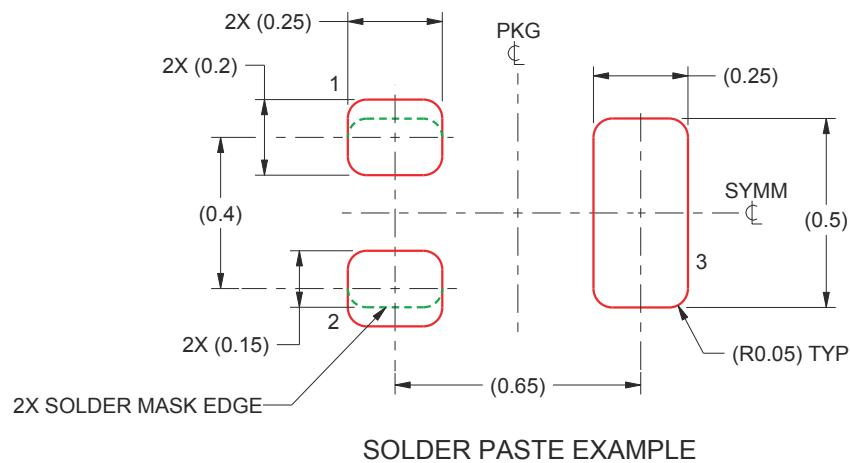
[TI Glossary](#) This glossary lists and explains terms, acronyms, and definitions.

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.
- B. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.

PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package Pins	Package qty Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
CSD17381F4	Active	Production	PICOSTAR (YJC) 3	3000 LARGE T&R	Yes	NIAU	Level-1-260C-UNLIM	-55 to 150	CQ
CSD17381F4.B	Active	Production	PICOSTAR (YJC) 3	3000 LARGE T&R	Yes	NIAU	Level-1-260C-UNLIM	-55 to 150	CQ
CSD17381F4T	Active	Production	PICOSTAR (YJC) 3	250 SMALL T&R	Yes	NIAU	Level-1-260C-UNLIM	-55 to 150	CQ
CSD17381F4T.B	Active	Production	PICOSTAR (YJC) 3	250 SMALL T&R	Yes	NIAU	Level-1-260C-UNLIM	-55 to 150	CQ

(1) **Status:** For more details on status, see our [product life cycle](#).

(2) **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

(3) **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

(4) **Lead finish/Ball material:** Parts 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.

(5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

(6) **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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TAPE AND REEL INFORMATION

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
CSD17381F4	PICOSTAR	YJC	3	3000	180.0	8.4	0.7	1.1	0.46	4.0	8.0	Q2
CSD17381F4T	PICOSTAR	YJC	3	250	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)
CSD17381F4	PICOSTAR	YJC	3	3000	182.0	182.0	20.0
CSD17381F4T	PICOSTAR	YJC	3	250	182.0	182.0	20.0

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