

Silicon Carbide (SiC) Cascode JFET – EliteSiC, Power N-Channel, TO247-4, 750 V, 23 mohm

UJ4C075023K4S

Description

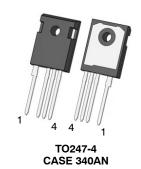
The UJ4C075023K4S is a 750 V, 23 m Ω G4 SiC FET. It is based on a unique 'cascode' circuit configuration, in which a normally-on SiC JFET is is co-packaged with a Si MOSFET to produce a normally-off SiC FET device. The device's standard gate-drive characteristics allows for a true "drop-in replacement" to Si IGBTs, Si FETs, SiC MOSFETs or Si superjunction devices. Available in the TO-247-4L package, this device exhibits ultra-low gate charge and exceptional reverse recovery characteristics, making it ideal for switching inductive loads and any application requiring standard gate drive.

Features

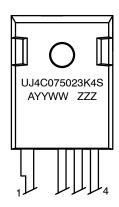
- On-resistance $R_{DS(on)}$: 23 m Ω (typ)
- Operating Temperature: 175 °C (max)
- Excellent Reverse Recovery: Q_{rr} = 105 nC
- Low Body Diode V_{FSD}: 1.23 V
- Low Gate Charge: Q_G = 37.8 nC
- Threshold Voltage V_{G(th)}: 4.8 V (typ) Allowing 0 to 15 V Drive
- Low Intrinsic Capacitance
- ESD Protected: HBM Class 2 and CDM Class C3
- TO-247-4L Package for Faster Switching, Clean Gate Waveforms
- This Device is Pb-Free, Halogen Free and is RoHS Compliant

Typical Applications

- EV Charging
- PV Inverters
- Switch Mode Power Supplies
- Power Factor Correction Modules
- Motor Drives
- Induction Heating



MARKING DIAGRAM



UJ4C075023K4S

Specific Device CodeAssembly Location

YY

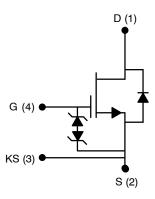
= Year

WW ZZZ

1

= Work Week = Lot Code

PIN CONNECTIONS



ORDERING INFORMATION

See detailed ordering and shipping information on page 11 of this data sheet.

MAXIMUM RATINGS

Parameter	Symbol	Test Conditions	Value	Unit
Drain-source Voltage	V _{DS}		750	V
Gate-source Voltage	V_{GS}	DC	-20 to +20	V
		AC (f > 1 Hz)	-25 to +25	
Continuous Drain Current (Note 1)	I _D	T _C = 25 °C	66	Α
		T _C = 100 °C	49	
Pulsed Drain Current (Note 2)	I _{DM}	T _C = 25 °C	196	Α
Single Pulsed Avalanche Energy (Note 3)	E _{AS}	L = 15 mH, I _{AS} = 3 A	67	mJ
SiC FET dv/dt Ruggedness	dv/dt	V _{DS} ≤ 500 V	150	V/ns
Power Dissipation	P _{tot}	T _C = 25 °C	306	W
Maximum Junction Temperature	T _{J, max}		175	°C
Operating and Storage Temperature	T _J , T _{STG}		-55 to 175	°C
Max. Lead Temperature for Soldering, 1/8" from Case for 5 seconds	TL		250	°C

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

- 1. Limited by $T_{J, max}$. 2. Pulse width t_p limited by $T_{J, max}$. 3. Starting $T_J = 25$ °C.

THERMAL CHARACTERISTICS

Parameter	Symbol	Test Conditions	Min	Тур	Max	Unit
Thermal Resistance, Junction-to-Case	$R_{\theta JC}$		-	0.38	0.49	°C/W

ELECTRICAL CHARACTERISTICS ($T_J = +25$ °C unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Тур	Max	Unit	
TYPICAL PERFORMANCE - STATIC							
Drain-source Breakdown Voltage	BV _{DS}	$V_{GS} = 0 \text{ V}, I_D = 1 \text{ mA}$	750	-	-	V	
Total Drain Leakage Current	I _{DSS}	$V_{DS} = 750 \text{ V}, V_{GS} = 0 \text{ V}, T_J = 25 ^{\circ}\text{C}$	-	2	30	μΑ	
		V _{DS} = 750 V, V _{GS} = 0 V, T _J = 175°C	-	15	-		
Total Gate Leakage Current	I _{GSS}	$V_{DS} = 0 \text{ V, } T_J = 25 \text{ °C,} $ $V_{GS} = -20 \text{ V / } +20 \text{ V}$	_	6	±20	μΑ	
Drain-source On-resistance	R _{DS(on)}	V _{GS} = 12 V, I _D = 40 A, T _J = 25°C	=	23	29	mΩ	
		V _{GS} = 12 V, I _D = 40 A, T _J = 125°C	-	39	-		
		V _{GS} = 12 V, I _D = 40 A, T _J = 175°C	-	50	-		
Gate Threshold Voltage	V _{G(th)}	V _{DS} = 5 V, I _D = 10 mA	4	4.8	6	V	
Gate Resistance	R_{G}	f = 1 MHz, open drain	_	4.5	_	Ω	
TYPICAL PERFORMANCE - REVERSE DIO	DE						
Diode Continuous Forward Current (Note 1)	IS	T _C = 25 °C	_	-	66	Α	
Diode Pulse Current (Note 2)	I _{S, pulse}	T _C = 25 °C	-	-	196	Α	
Forward Voltage	V_{FSD}	V_{GS} = 0 V, I_S = 20 A, T_J = 25 °C	-	1.23	1.39	V	
		$V_{GS} = 0 \text{ V, } I_{S} = 20 \text{ A, } T_{J} = 175 ^{\circ}\text{C}$	-	1.45	-		
Reverse Recovery Charge	Q _{rr}	$V_{DS} = 400 \text{ V}, I_S = 40 \text{ A}, V_{GS} = 0 \text{ V},$	_	105	_	nC	
Reverse Recovery Time	t _{rr}	$R_{G~EXT}$ = 5 Ω , di/dt = 3100 A/ μ s, T_{J} = 25 °C	=	12	-	ns	
Reverse Recovery Charge	Q _{rr}	$V_{DS} = 400 \text{ V}, I_S = 40 \text{ A}, V_{GS} = 0 \text{ V},$	-	112	-	nC	
Reverse Recovery Time	t _{rr}	$R_{G~EXT}$ = 5 Ω, di/dt = 3100 A/μs, T_{J} = 150 °C	_	13	_	ns	

ELECTRICAL CHARACTERISTICS (T_J = +25 °C unless otherwise specified) (continued)

Parameter	Symbol	Test Conditions	Min	Тур	Max	Unit
TYPICAL PERFORMANCE - DYNAMIC		•				
Input Capacitance	C _{iss}	V _{DS} = 400 V, V _{GS} = 0 V,	_	1400	_	pF
Output Capacitance	C _{oss}	f = 100 kHz	-	93	-	1
Reverse Transfer Capacitance	C _{rss}	1	-	2.5	-	1
Effective Output Capacitance, Energy Related	C _{oss(er)}	V _{DS} = 0 V to 400 V, V _{GS} = 0 V	-	116	-	pF
Effective Output Capacitance, Time Related	C _{oss(tr)}	1	-	232	-	1
C _{OSS} Stored Energy	E _{oss}	V _{DS} = 400 V, V _{GS} = 0 V	-	9.3	-	Lμ
Total Gate Charge	Q_{G}	V _{DS} = 400 V, I _D = 40 A,	-	37.8	-	nC
Gate-drain Charge	Q_{GD}	V _{GS} = 0 V to 15 V	-	8	-	
Gate-source Charge	Q _{GS}	1	-	11.8	-	1
Turn-on Delay Time	t _{d(on)}	(Note 4) and (Note 5)	-	16	-	ns
Rise Time	t _r	V _{DS} = 400 V, I _D = 40 A, Gate Driver = 0 V to +15 V,	-	27	-	
Turn-off Delay Time	t _{d(off)}	Turn-on $R_{G,EXT} = 1 \Omega$,	_	28	-	
Fall Time	t _f	Turn-off $R_{G,EXT} = 5 \Omega$, Inductive Load, FWD: Same	_	8	-	
Turn-on Energy Including R _S Energy	E _{ON}	Device with V_{GS} = 0 V and R_G = 5 Ω , RC Snubber: R_S = 10 Ω and C_S = 200 pF, T_J = 25 °C	_	237	-	μJ
Turn-off Energy Including R _S Energy	E _{OFF}		-	50	-	
Total Switching Energy	E _{TOTAL}		-	287	-	
Snubber R _S Energy During Turn-on	E _{RS_ON}		-	4.9	-	
Snubber R _S Energy During Turn-off	E _{RS_OFF}		-	17	-	
Turn-on Delay Time	t _{d(on)}	(Note 4) and (Note 5)	-	19	-	ns
Rise Time	t _r	V _{DS} = 400 V, I _D = 40 A, Gate Driver = 0 V to +15 V,	-	24	-	
Turn-off Delay Time	t _{d(off)}	Turn-on $R_{G,EXT} = 1 \Omega$,	-	29	-	
Fall Time	t _f	Turn-off $R_{G,EXT} = 5 \Omega$, Inductive Load, FWD: Same	-	10	-	
Turn-on Energy Including R _S Energy	E _{ON}	Device with $V_{GS} = 0$ V and $R_{G} = 5 \Omega$, RC Snubber:	_	288	-	μJ
Turn-off Energy Including R _S Energy	E _{OFF}	$R_S = 10 \Omega$ and $C_S = 200 pF$,	-	60	-	
Total Switching Energy	E _{TOTAL}	T _J = 150 °C	-	348	-	
Snubber R _S Energy During Turn-on	E _{RS_ON}	1	-	4	-	1
Snubber R _S Energy During Turn-off	E _{RS_OFF}	1	-	18	-	
Turn-on Delay Time	t _{d(on)}	(Note 6)	-	17	-	ns
Rise Time	t _r	V_{DS} = 400 V, I_D = 40 A, Gate Driver = 0 V to +15 V, Turn-on $R_{G,EXT}$ = 1 Ω , Turn-off $R_{G,EXT}$ = 5 Ω , Inductive Load,	-	25	-	
Turn-off Delay Time	t _{d(off)}		-	22	-	
Fall Time	t _f		-	7	-	
Turn-on Energy Including R _S Energy	E _{ON}	FWD: UJ3D06520TS, RC snubber: $R_S = 10 \Omega$ and	-	167	-	μJ
Turn-off Energy Including R _S Energy	E _{OFF}	$C_S = 200 \text{ pF}, T_J = 25 ^{\circ}\text{C}$	-	40	_	
Total Switching Energy	E _{TOTAL}		-	207	-	
Snubber R _S Energy During Turn-on	E _{RS_ON}		-	4.3	-	
Snubber R _S Energy During Turn-off	E _{RS OFF}]	-	26	-	

ELECTRICAL CHARACTERISTICS ($T_J = +25$ °C unless otherwise specified) (continued)

Parameter	Symbol	Test Conditions	Min	Тур	Max	Unit
TYPICAL PERFORMANCE - DYNAMIC						
Turn-on Delay Time	t _{d(on)}	(Note 6)	_	17	_	ns
Rise Time	t _r	V _{DS} = 400 V, I _D = 40 A, Gate Driver = 0 V to +15 V,	_	22	-	
Turn-off Delay Time	t _{d(off)}	Turn-on $R_{G,EXT} = 1 \Omega$,	_	23	_	
Fall Time	t _f	Turn-off $R_{G,EXT}$ = 5 Ω , Inductive Load,	_	8	-	
Turn-on Energy Including R _S Energy	E _{ON}	FWD: UJ3D06520TS, RC snubber: $R_S = 10 \Omega$ and	_	183	_	μJ
Turn-off Energy Including R _S Energy	E _{OFF}	$C_S = 200 \text{ pF, } T_J = 150 \text{ °C}$	_	58	_	
Total Switching Energy	E _{TOTAL}		_	241	_	
Snubber R _S Energy During Turn-on	E _{RS_ON}	1	_	4	-	
Snubber R _S Energy During Turn-off	E _{RS_OFF}	1	-	22	_	

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

- 4. Measured with the switching test circuit in Figure 35.
- 5. The switching energies (turn-on energy, turn-off energy and total energy) presented in this table include the device RC snubber energy losses.
- 6. Measured with the switching test circuit in Figure 36.

TYPICAL PERFORMANCE DIAGRAMS

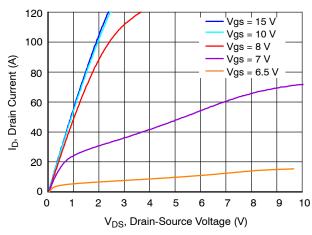


Figure 1. Typical Output Characteristics at $T_J = -55~^{\circ}\text{C}, \, t_p < 250~\mu\text{s}$

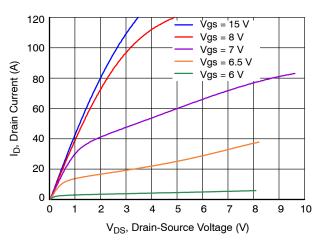


Figure 2. Typical Output Characteristics at $T_J = 25$ °C, $t_p < 250~\mu s$

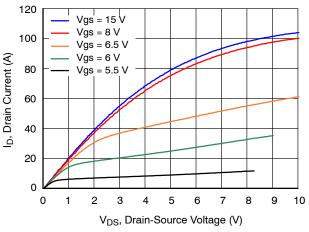


Figure 3. Typical Output Characteristics at $$T_{J}=175~^{\circ}\text{C},\,t_{p}<250~\mu\text{s}$$

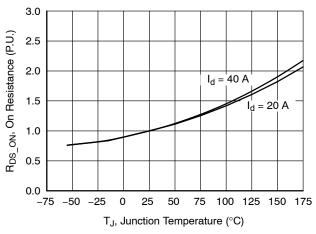


Figure 4. Normalized On-Resistance vs. Temperature at $V_{GS} = 12 \text{ V}$

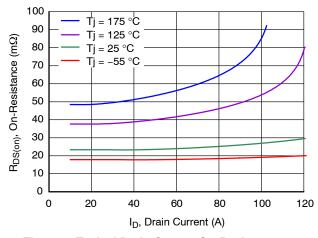


Figure 5. Typical Drain-Source On-Resistances at V_{GS} = 12 V

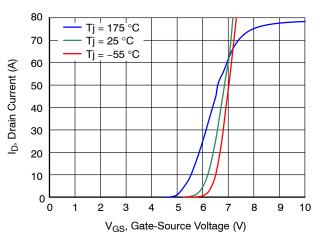


Figure 6. Typical Transfer Characteristics at $V_{DS} = 5 \text{ V}$

TYPICAL PERFORMANCE DIAGRAMS

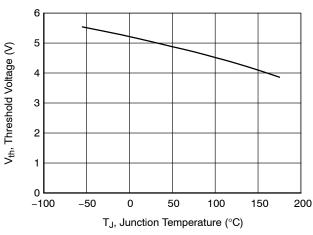


Figure 7. Threshold Voltage vs. Junction Temperature at V_{DS} = 5 V and I_{D} = 10 mA

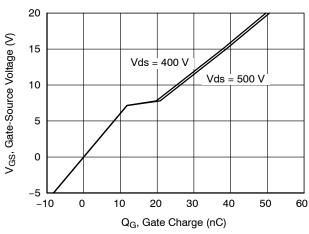


Figure 8. Typical Gate Charge I_D = 40 A

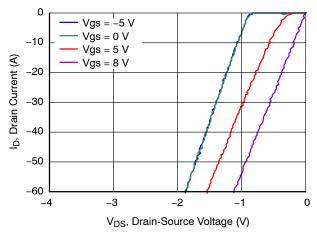


Figure 9. 3^{rd} Quadrant Characteristics at $T_J = -55$ °C

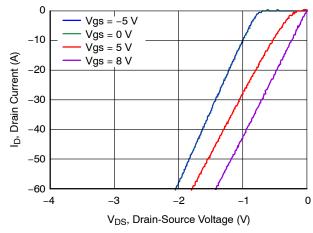


Figure 10. 3^{rd} Quadrant Characteristics at $T_J = 25$ °C

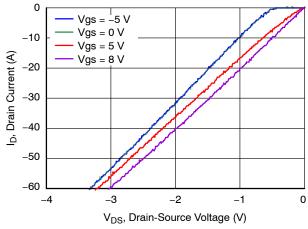


Figure 11. 3^{rd} Quadrant Characteristics at $T_J = 175$ °C

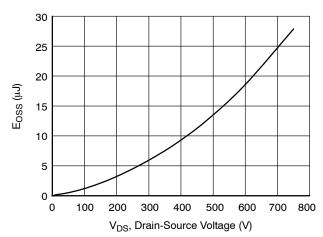


Figure 12. Typical Stored Energy in C_{OSS} at $V_{GS} = 0 \text{ V}$

TYPICAL PERFORMANCE DIAGRAMS

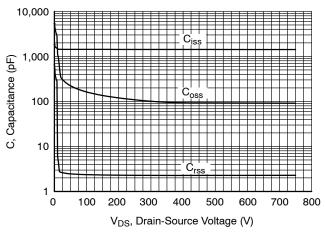


Figure 13. Typical Capacitances at f = 100 kHz and V_{GS} = 0 V

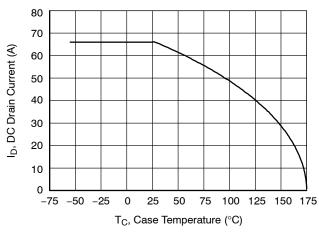


Figure 14. DC Drain Current Derating

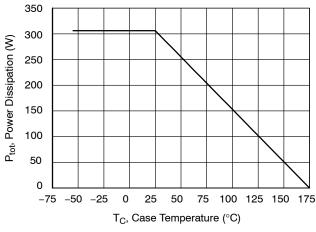


Figure 15. Total Power Dissipation

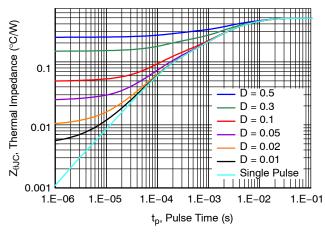


Figure 16. Maximum Transient Thermal Impedance

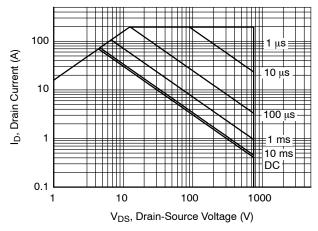


Figure 17. Safe Operation Area at T_C = 25 °C, D = 0, Parameter t_p

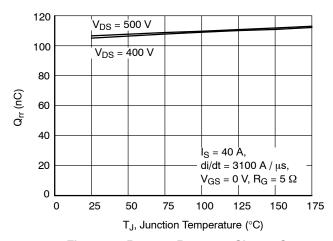


Figure 18. Reverse Recovery Charge Q_{rr} vs. Junction Temperature

TYPICAL PERFORMANCE DIAGRAMS (CONTINUED)

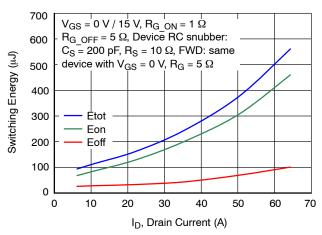


Figure 19. Clamped Inductive Switching Energy vs. Drain Current at V_{DS} = 400 V and T_J = 25 °C

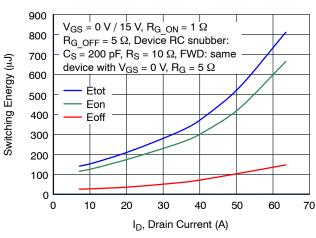


Figure 20. Clamped Inductive Switching Energy vs. Drain Current at $V_{DS} = 500 \text{ V}$ and $T_{J} = 25 \,^{\circ}\text{C}$

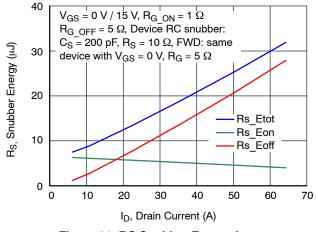


Figure 21. RC Snubber Energy Loss vs. Drain Current at V_{DS} = 400 V and T_{J} = 25 °C

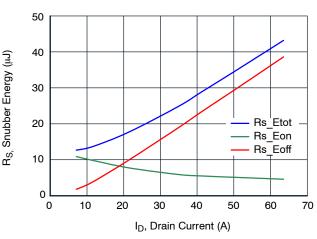


Figure 22. RC Snubber Energy Loss vs. Drain Current at V_{DS} = 500 V and T_J = 25 °C

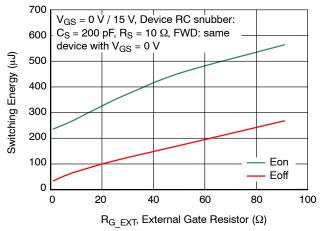


Figure 23. Clamped Inductive Switching Energies vs. External Gate Resistor at V_{DS} = 400 V, I_{D} = 40 A and $T_{\rm J}$ = 25 °C

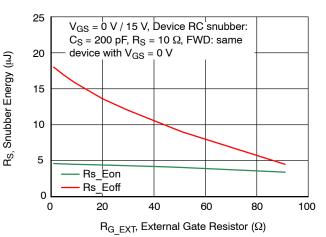


Figure 24. RC Snubber Energy Losses vs. External Gate Resistor at V_{DS} = 400 V, I_{D} = 40 A and T_{J} = 25 °C

TYPICAL PERFORMANCE DIAGRAMS (CONTINUED)

Snubber Energy (μJ)

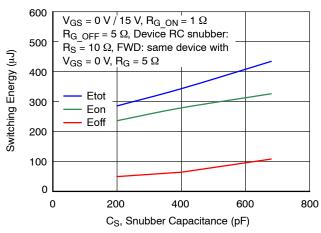


Figure 25. Clamped Inductive Switching Energy vs. Snubber Capacitance C_S at V_{DS} = 400 V, I_D = 40 A and $T_{.l}$ = 25 °C

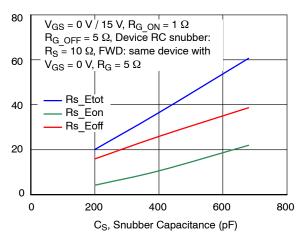


Figure 26. RC Snubber Energy Losses vs. Snubber Capacitance C_S at V_{DS} = 400 V, I_D = 40 A, and T_J = 25 °C

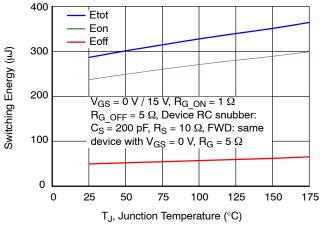


Figure 27. Clamped Inductive Switching Energy vs. Junction Temperature at V_{DS} = 400 V and I_{D} = 40 A

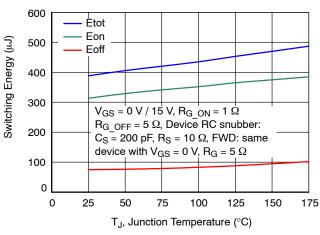


Figure 28. Clamped Inductive Switching Energy vs. Junction Temperature at V_{DS} = 500 V and I_{D} = 40 A

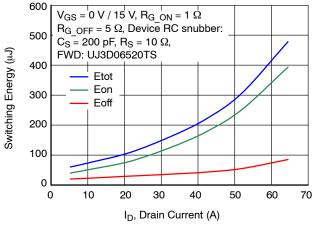


Figure 29. Clamped Inductive Switching Energies vs. Drain Current at V_{DS} = 400 V and T_J = 25 °C

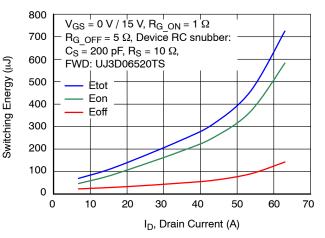


Figure 30. Clamped Inductive Switching Energies vs. Drain Current at $V_{DS} = 500 \text{ V}$ and $T_J = 25 \,^{\circ}\text{C}$

TYPICAL PERFORMANCE DIAGRAMS (CONTINUED)

Snubber Energy (μJ)

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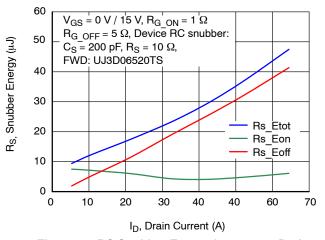


Figure 31. RC Snubber Energy Losses vs. Drain Current at V_{DS} = 400 V and T_{J} = 25 °C

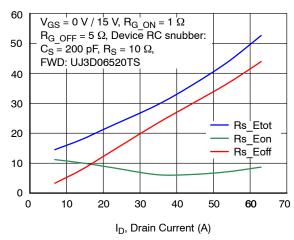


Figure 32. RC Snubber Energy Losses vs. Drain Current at V_{DS} = 500 V and T_J = 25 °C

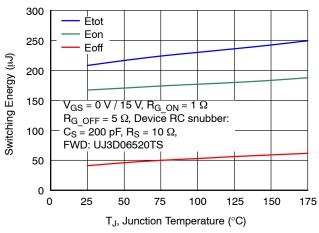


Figure 33. Clamped Inductive Switching Energies vs. Junction Temperature at V_{DS} = 400 V and I_{D} = 40 A

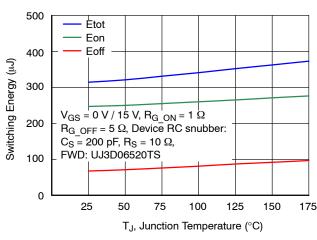


Figure 34. Clamped Inductive Switching Energies vs. Junction Temperature at $V_{DS} = 500 \text{ V}$ and $I_D = 40 \text{ A}$

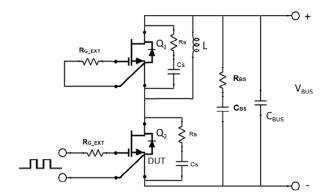


Figure 35. Schematic of the Half-Bridge Mode Switching Test Circuit. Note, a Bus RC Snubber (R_{BS} = 2.5 Ω , C_{BS} = 100 nF) is Used to Reduce the Power Loop High Frequency Oscillations

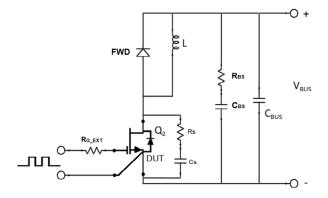


Figure 36. Schematic of the Chopper Mode Switching Test Circuit. Note, a Bus RC Snubber (R_{BS} = 2.5 Ω , C_{BS} = 100 nF) is Used to Reduce the Power Loop High Frequency Oscillations

APPLICATIONS INFORMATION

SiC FETs are enhancement-mode power switches formed by a high-voltage SiC depletion-mode JFET and a low-voltage silicon MOSFET connected in series. The silicon MOSFET serves as the control unit while the SiC JFET provides high voltage blocking in the off state. This combination of devices in a single package provides compatibility with standard gate drivers and offers superior performance in terms of low on-resistance ($R_{DS(on)}$), output capacitance (C_{oss}), gate charge (Q_G), and reverse recovery charge (Q_{rr}) leading to low conduction and switching losses. The SiC FETs also provide excellent reverse conduction capability eliminating the need for an external anti-parallel diode.

Like other high performance power switches, proper PCB layout design to minimize circuit parasitics is strongly recommended due to the high dv/dt and di/dt rates. An external gate resistor is recommended when the FET is

working in the diode mode in order to achieve the optimum reverse recovery performance. For more information on SiC FET operation, see www.onsemi.com.

A snubber circuit with a small $R_{(G)}$, or gate resistor, provides better EMI suppression with higher efficiency compared to using a high $R_{(G)}$, value. There is no extra gate delay time when using the snubber circuitry, and a small $R_{(G)}$, will better control both the turn-off $V_{(DS)}$ peak spike and ringing duration, while a high $R_{(G)}$ will damp the peak spike but result in a longer delay time. In addition, the total switching loss when using a snubber circuit is less than using high $R_{(G)}$, while greatly reducing $E_{(OFF)}$ from mid-to-full load range with only a small increase in $E_{(ON)}$. Efficiency will therefore improve with higher load current. For more information on how a snubber circuit will improve overall system performance, visit the **onsemi** website at www.onsemi.com.

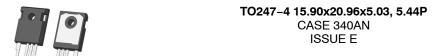
ORDERING INFORMATION

Part Number	Marking	Package	Shipping
UJ4C075023K4S	UJ4C075023K4S	TO247-4	600 Units / Tube

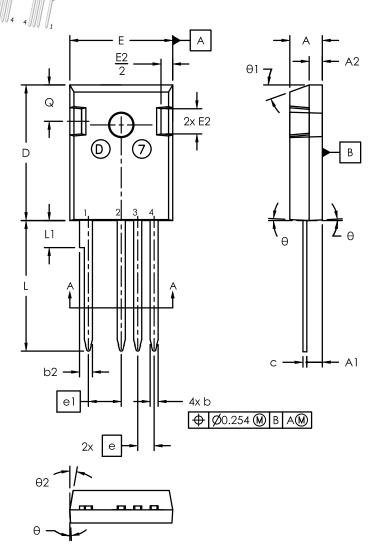
REVISION HISTORY

Revision	Description of Changes	Date
С	Acquired the original Qorvo JFET Division Data Sheet and updated the main document title to comply with onsemi standards for SiC products.	1/15/2025
3	Converted the Data Sheet to onsem i format.	6/10/2025





DATE 20 JUN 2025



♦ Ø0.635 M	BAM
ØP \	r □2
\$	-
ØP1 4 3 2	
	E1

SYM	millimeters				
317/1	MIN	NOM	MAX		
Α	4.70	5.03	5.31		
A1	2.21	2.40	2.59		
A2	1.50	2.03	2.49		
b	0.99	1.20	1.40		
b2	1.65	2.03	2.39		
С	0.38	0.60	0.89		
D	20.80	20.96	21.46		
D1	13.08	1	1		
D2	0.51	1.19	1.35		
Е	15.49	15.90	16.26		
e		2.54 BSC			
el		5.08 BSC			
E1	13.46	_	-		
E2	3.43	3.89	5.20		
Ш	19.81	20.17	20.32		
L1	ı	-	4.50		
ØP	3.40	3.60	3.80		
ØP1	7.06	7.19	7.39		
Q S	5.38	5.62	6.20		
	6.17 BSC				
θ	3°				
θ1	20°				
θ2	10°				

NOTE:

- 1. Dimensioning and tolerancing as per ASME Y14.5 2018
- 2. Controlling dimension: millimeters
- 3. Package Outline in compliance with JEDEC standard var.
- 4. Dimensions D & E does not include mold flash.
- 5. ØP to have max draft angle of 1.7° to the top with max. hole diameter of 3.91mm.
- 5. Through Hole diameter value = End Hole diameter
- 6. PCB Through Hole pattern as per IPC-2221/IPC-2222

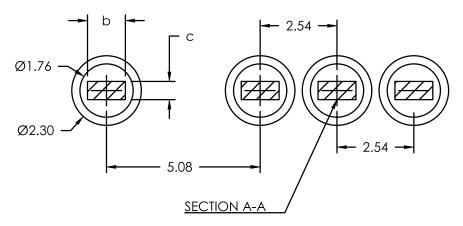
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DATE 20 JUN 2025

RECOMMENDED PCB THROUGH HOLE



NOTE: LAND PATTERN AND THROUGH HOLE DIMENSIONS SERVE ONLY AS AN INITIAL GUIDE. END-USER PCB DESIGN RULES AND TOLERANCES SHOULD ALWAYS PREVAIL.

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DESCRIPTION:	TO247-4 15.90x20.96x5.03	, 5.44P	PAGE 2 OF 2

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