





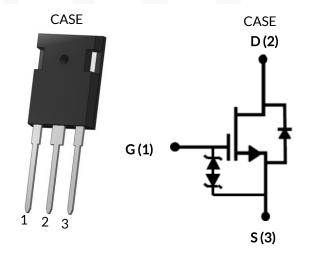








# UJ4C075018K3S



Part Number	Package	Marking
UJ4C075018K3S	TO-247-3L	UJ4C075018K3S









# 750V-18m $\Omega$ SiC FET

Rev. A. October 2020

#### Description

The UJ4C075018K3S is a 750V,  $18m\Omega$  G4 SiC FET. It is based on a unique 'cascode' circuit configuration, in which a normally-on SiC JFET 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-247-3L 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  $R_{DS(on)}$ :  $18m\Omega$  (typ)
- Operating temperature: 175°C (max)
- Excellent reverse recovery: Q<sub>rr</sub> = 102nC
- ◆ Low body diode V<sub>FSD</sub>: 1.14V
- ◆ Low gate charge: Q<sub>G</sub> = 37.8nC
- ◆ Threshold voltage V<sub>G(th)</sub>: 4.8V (typ) allowing 0 to 15V drive
- Low intrinsic capacitance
- ESD protected, HBM class 2

#### Typical applications

- EV charging
- PV inverters
- Switch mode power supplies
- Power factor correction modules
- Motor drives
- Induction heating













# **Maximum Ratings**

Parameter	Symbol	Test Conditions	Value	Units
Drain-source voltage	$V_{DS}$		750	V
Gate-source voltage	$V_{GS}$	DC	-20 to +20	V
Continuous drain current <sup>1</sup>		T <sub>C</sub> = 25°C	81	Α
Continuous drain current	I <sub>D</sub>	T <sub>C</sub> = 100°C	60	Α
Pulsed drain current <sup>2</sup>	I <sub>DM</sub>	T <sub>C</sub> = 25°C	205	Α
Single pulsed avalanche energy <sup>3</sup>	E <sub>AS</sub>	L=15mH, I <sub>AS</sub> =3.6A	97.2	mJ
Power dissipation	P <sub>tot</sub>	T <sub>C</sub> = 25°C	385	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	T <sub>L</sub>		250	°C

- 1. Limited by  $T_{J,max}$
- 2. Pulse width t<sub>p</sub> limited by T<sub>J,max</sub>
- 3. Starting  $T_J = 25$ °C

#### **Thermal Characteristics**

Parameter	Symbol	Test Conditions		Value		Units
Parameter	Зуппон	rest Conditions	Min	Тур	Max	Offits
Thermal resistance, junction-to-case	$R_{\theta JC}$			0.3	0.39	°C/W













# Electrical Characteristics (T<sub>J</sub> = +25°C unless otherwise specified)

# Typical Performance - Static

Parameter	Symbol	Symbol Test Conditions		Units		
raiametei	Syllibol		Min	Тур	Max	Units
Drain-source breakdown voltage	BV <sub>DS</sub>	$V_{GS}$ =0V, $I_D$ =1mA	750			V
Total drain leakage current		V <sub>DS</sub> =750V, V <sub>GS</sub> =0V, T <sub>J</sub> =25°C		1.3	125	^
Total drain leakage current	I <sub>DSS</sub>	V <sub>DS</sub> =750V, V <sub>GS</sub> =0V, T <sub>J</sub> =175°C		20		μΑ
Total gate leakage current	I <sub>GSS</sub>	V <sub>DS</sub> =0V, T <sub>J</sub> =25°C, V <sub>GS</sub> =-20V / +20V		4.7	± 20	μА
		$V_{GS}$ =12V, $I_{D}$ =20A, $T_{J}$ =25°C		18	23	
Drain-source on-resistance	R <sub>DS(on)</sub>	V <sub>GS</sub> =12V, I <sub>D</sub> =20A, T <sub>J</sub> =125°C		31		mΩ
		$V_{GS}$ =12V, $I_{D}$ =20A, $T_{J}$ =175°C		41		
Gate threshold voltage	$V_{G(th)}$	$V_{DS}$ =5V, $I_{D}$ =10mA	4	4.8	6	V
Gate resistance	$R_{G}$	f=1MHz, open drain		4.5		Ω

# Typical Performance - Reverse Diode

Parameter	Symbol	Test Conditions		Value		Units
rai ailletei	Symbol Test Conditions	rest Conditions	Min	Тур	Max	Offics
Diode continuous forward current <sup>1</sup>	I <sub>S</sub>	T <sub>C</sub> =25°C			81	Α
Diode pulse current <sup>2</sup>	I <sub>S,pulse</sub>	T <sub>C</sub> =25°C			205	Α
Forward voltage	$V_{FSD}$	V <sub>GS</sub> =0V, I <sub>F</sub> =20A, T <sub>J</sub> =25°C		1.14	1.46	V
For war u voitage	* F3D	V <sub>GS</sub> =0V, I <sub>F</sub> =20A, T <sub>J</sub> =175°C		1.35		
Reverse recovery charge	$Q_{rr}$	$V_{DS}$ =400V, $I_{S}$ =50A, $V_{GS}$ =-0V, $R_{G\_EXT}$ =50 $\Omega$		102		nC
Reverse recovery time	t <sub>rr</sub>	di/dt=1300A/μs, Τ <sub>J</sub> =25°C		25		ns
Reverse recovery charge	Q <sub>rr</sub>	$V_{DS}$ =400V, $I_{S}$ =50A, $V_{GS}$ =-0V, $R_{G\_EXT}$ =50 $\Omega$		109		nC
Reverse recovery time	t <sub>rr</sub>	di/dt=1300A/μs, Τ <sub>J</sub> =150°C		27		ns













# Typical Performance - Dynamic

Parameter	Cl	Took Conditions	Value			Units
	Symbol	Test Conditions	Min	Тур	Max	Units
Input capacitance	$C_{iss}$	V <sub>DS</sub> =100V, V <sub>GS</sub> =0V		1422		
Output capacitance	$C_{oss}$	f=100kHz		217		pF
Reverse transfer capacitance	$C_{rss}$	1-100KHZ		2		
Effective output capacitance, energy related	$C_{oss(er)}$	$V_{DS}$ =0V to 400V, $V_{GS}$ =0V		150		pF
Effective output capacitance, time related	$C_{oss(tr)}$	$V_{DS}$ =0V to 400V, $V_{GS}$ =0V		280		pF
C <sub>OSS</sub> stored energy	$E_{oss}$	V <sub>DS</sub> =400V, V <sub>GS</sub> =0V		12		μЈ
Total gate charge	$Q_{G}$	\/ -400\/   -504		37.8		nC
Gate-drain charge	$Q_{GD}$			8		
Gate-source charge	$Q_{GS}$	V <sub>GS</sub> – 0 V to 13 V		11.8		
Turn-on delay time	$t_{d(on)}$	Note 4		13		ns
Rise time	$t_r$	V <sub>DS</sub> =400V, I <sub>D</sub> =50A,		56		
Turn-off delay time	t <sub>d(off)</sub>	$V_{DS}\text{=}400\text{V}, I_{D}\text{=}50\text{A},$ $V_{GS}\text{=}0\text{V to }15\text{V}$ $Note 4,$ $V_{DS}\text{=}400\text{V}, I_{D}\text{=}50\text{A},$ $Gate Driver = 0\text{V to }+15\text{V},$ $Turn\text{-}on R_{G,EXT}\text{=}1\Omega,$ $Turn\text{-}off R_{G,EXT}\text{=}50\Omega$ $Inductive Load,$ $FWD: same device with V_{GS}$		139		
Fall time	t <sub>f</sub>	- 7		21		
Turn-on energy	E <sub>ON</sub>	-,		615		
Turn-off energy	E <sub>OFF</sub>	FWD: same device with V <sub>GS</sub>		518		μЈ
Total switching energy	$E_TOTAL$	$= 0V, R_G = 50\Omega, T_J = 25$ °C		1133		
Turn-on delay time	t <sub>d(on)</sub>	Note 4,		13		
Rise time	t <sub>r</sub>	V <sub>DS</sub> =400V, I <sub>D</sub> =50A,		62		ne
Turn-off delay time	t <sub>d(off)</sub>	Gate Driver = 0V to +15V,		147		ns
Fall time	t <sub>f</sub>	Turn-on $R_{G,EXT}$ =1 $\Omega$ , Turn-off $R_{G,EXT}$ =50 $\Omega$		22		
Turn-on energy	E <sub>ON</sub>	Inductive Load,		670		
Turn-off energy	E <sub>OFF</sub>	FWD: same device with V <sub>GS</sub>		573		μJ
Total switching energy	E <sub>TOTAL</sub>	= 0V, $R_G = 50\Omega$ , $T_J = 150$ °C		1243		

<sup>4.</sup> Measured with the half-bridge mode switching test circuit in Figure 28.













# Typical Performance - Dynamic (continued)

Note 5,   Note 6,   Note	Doromotor	Cymahal	Tast Conditions Value		ue		
Note 5,   Note 6,   Not	Parameter	Symbol	rest Conditions	Min	Тур	Max	Units
Turn-off delay time	Turn-on delay time	$t_{d(on)}$			13		
Turn-off delay time	Rise time	t <sub>r</sub>			61		nc
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	Turn-off delay time	$t_{d(off)}$			33		115
Turn-off energy including $R_S$ energy $E_{OFF}$ and $C_{SI}=3000F$ , $R_S=10\Omega$ and $C_{SI}=3000F$ , $T_J=25^{\circ}C$ and $T$	Fall time	t <sub>f</sub>			17		
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Turn-on energy including $R_S$ energy	E <sub>ON</sub>			696		
Total switching energy         E TOTAL Enougher Resembly of the properties of the prop	Turn-off energy including $R_S$ energy	E <sub>OFF</sub>			217		
Sinubber R <sub>s</sub> energy during turn-off $E_{RS_sOFF}$ 8           Furn-on delay time $t_{d(on)}$ 15           Rise time $t_r$ $V_{DS}=400V, I_D=50A, Gate$ 36           Furn-off delay time $t_r$ $V_{DS}=400V, I_D=50A, Gate$ 36           Fall time $t_r$ $V_{DS}=400V, I_D=50A, Gate$ 18           Furn-on energy including R <sub>S</sub> energy $E_{ON}$ FWD: same device with V <sub>GS</sub> 744           Furn-off energy including R <sub>S</sub> energy $E_{OFF}$ FWD: same device with V <sub>GS</sub> 744           For all switching energy $E_{TOTAL}$ $E_{TOTAL}$ $E_{TOTAL}$ $E_{TOTAL}$ Sinubber R <sub>S</sub> energy during turn-on $E_{RS_s,OFF}$ $E_{TOTAL}$ $E$	Total switching energy	E <sub>TOTAL</sub>			913		μJ
Turn-on delay time $t_{d(on)}$ Note 5, Vos=400V, I <sub>D</sub> =50A, Gate Driver = 0V to +15V, R <sub>G,EXT</sub> =1Ω, inductive Load, Furn-on energy including R <sub>S</sub> energy         To Note 5, Vos=400V, I <sub>D</sub> =50A, Gate Driver = 0V to +15V, R <sub>G,EXT</sub> =1Ω, inductive Load, Furn-on energy including R <sub>S</sub> energy         To Note 5, Vos=400V, I <sub>D</sub> =50A, Gate Driver = 0V to +15V, R <sub>G,EXT</sub> =1Ω, inductive Load, Furn-on energy including R <sub>S</sub> energy         To Note 5, Vos=400V, I <sub>D</sub> =50A, Gate Driver = 0V to +15V, R <sub>G,EXT</sub> =1Ω, and R <sub>G</sub> =1Ω, RC snubber: R <sub>S</sub> =10Ω and C <sub>S1</sub> =300pF, T <sub>J</sub> =150°C         36         Driver = 0V to +15V, R <sub>G,EXT</sub> =1Ω, and R <sub>G,EX</sub>	Snubber R <sub>S</sub> energy during turn-on	E <sub>RS_ON</sub>	T <sub>J</sub> =25°C		4		
Rise time	Snubber R <sub>S</sub> energy during turn-off	E <sub>RS_OFF</sub>			8		
Furn-off delay time $t_{d(off)}$ $V_{DS}=400V, I_{D}=50A, Gate Driver = 0V to +15V, R_{GLXT}=120, inductive Load, PWD: same device with V_{OS}=100 and V_{OS}=100 an$	Turn-on delay time	t <sub>d(on)</sub>			15		
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	Rise time	t <sub>r</sub>	· ·		64		
Fall time $ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	Turn-off delay time	t <sub>d(off)</sub>			36		TIS
Turn-off energy during turn-off energy e	Fall time	t <sub>f</sub>	-		18		1
Total switching energy $E_{OFF}$ and $E_{CS}=10\Omega$ and $E_{SS}=10\Omega$ and $E$	Turn-on energy including R <sub>S</sub> energy	E <sub>ON</sub>			744		
Total switching energy $E_{TOTAL}$ Snubber $R_S$ energy during turn-on Snubber $R_S$ energy during turn-off Fall time $E_{RS,ON}$ $E_{RS,ON}$ $C_{S1}=300pF$ , $T_J=150^{\circ}C$ 973 $4$ $\mu J$ Snubber $R_S$ energy during turn-off Ease time $E_{RS,ON}$ $E_{RS}$ and $E_{RS,ON}$ $E_{RS}$ and $E_{RS,ON}$ Fall timeNote 6, $V_{DS}=400V, I_D=50A, Gate$ $E_{AU}$ Turn-off delay time $E_{AU}$ $E_{AU}$ Turn-on energyNote 6, $E_{AU}$ Turn-on $E_{AU}$ Turn-off $E_{AU}$ Turn-of	Turn-off energy including R <sub>S</sub> energy	E <sub>OFF</sub>	,		229		
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	Total switching energy	E <sub>TOTAL</sub>			973		μ
Turn-on delay time $t_{d(on)}$ Note 6, V <sub>DS</sub> =400V, I <sub>D</sub> =50A, Gate         14         Note 6, V <sub>DS</sub> =400V, I <sub>D</sub> =50A, Gate         54         ns           Turn-off delay time $t_{d(off)}$ Driver =0V to +15V, Turn-on R <sub>G,EXT</sub> =1Ω, Turn-on R <sub>G,EXT</sub> =1Ω, Turn-off R <sub>G,EXT</sub> =50Ω Inductive Load, FWD: UJ3D06530TS Turn-off energy         21         21           Turn-off energy         E <sub>OFF</sub> FWD: UJ3D06530TS Turn-on delay time         549         μJ           Total switching energy         E <sub>TOTAL</sub> Note 6, V <sub>DS</sub> =400V, I <sub>D</sub> =50A, Gate         14         Note 6, V <sub>DS</sub> =400V, I <sub>D</sub> =50A, Gate         59         Driver =0V to +15V, Turn-on R <sub>G,EXT</sub> =1Ω, Turn-on R <sub>G,EXT</sub> =1Ω, Turn-on R <sub>G,EXT</sub> =1Ω, Turn-on R <sub>G,EXT</sub> =1Ω, Turn-on R <sub>G,EXT</sub> =50Ω Inductive Load,	Snubber R <sub>S</sub> energy during turn-on	E <sub>RS_ON</sub>	T <sub>J</sub> =150°C		4		
Rise time $t_r$ Note 6, V <sub>DS</sub> =400V, I <sub>D</sub> =50A, Gate Driver =0V to +15V, Turn-on R <sub>G,EXT</sub> =1Ω, Turn-on energy $t_f$ $t_{f}$	Snubber R <sub>S</sub> energy during turn-off	E <sub>RS_OFF</sub>			8		
Rise time $t_r$ $V_{DS}$ =400V, $I_D$ =50A, Gate         54         ns           Turn-off delay time $t_{d(off)}$ Turn-off $R_{G,EXT}$ =1Ω,         139         ns           Turn-on energy $E_{ON}$ Turn-off $R_{G,EXT}$ =50Ω         619         10           Turn-off energy $E_{OFF}$ FWD: UJ3D06530TS         549         μJ           Total switching energy $E_{TOTAL}$ Note 6,         1168           Turn-on delay time $t_r$ $V_{DS}$ =400V, $I_D$ =50A, Gate         59         ns           Turn-off delay time $t_r$ Driver =0V to +15V, Turn-on $R_{G,EXT}$ =1Ω, Turn-on $R_{G,EXT}$ =50Ω Inductive Load,         140<	Turn-on delay time	t <sub>d(on)</sub>	Note 6		14		
Turn-off delay time $t_{d(off)}$ Driver =0V to +15V, $t_{d(off)}$ Turn-on $R_{G,EXT}=1\Omega$ , $t_{f}$ Turn-on $R_{G,EXT}=50\Omega$ Inductive Load, $t_{f}$ Turn-off energy $t_{f}$ Turn-off energy $t_{f}$ Turn-on delay time $t_{f}$ Turn-on delay time $t_{f}$ Turn-off delay time $t_{f}$ Turn-off delay time $t_{f}$ Turn-off $t_{f}$ Turn-on $t_{f}$ R <sub>G,EXT</sub> =50Ω Inductive Load, $t_{f}$ Turn-on $t_{f}$ Turn-off $t_{f}$ Turn-off $t_{f}$ Turn-off $t_{f}$ Turn-on energy $t_{f}$ Turn-on $t_{f}$ Turn-on $t_{f}$ Turn-on $t_{f}$ Turn-on $t_{f}$ Turn-on $t_{f}$ Turn-on $t_{f}$ Turn-off $t_{f}$ Turn-off $t_{f}$ Turn-off energy $t_{f}$ Turn-off $t_{f}$	Rise time	t <sub>r</sub>			54		
Turn-on energy $E_{ON}$ $E_{ON}$ $E_{OFF}$ $E_{ON}$ $E_{OFF}$ $E_{ON}$ $E_{OFF}$ $E_{$	Turn-off delay time	t <sub>d(off)</sub>			139		- ns
Turn-on energy $E_{ON}$ Inductive Load, FWD: UJ3D06530TS619Turn-off energy $E_{OFF}$ FWD: UJ3D06530TS549 $\mu$ Total switching energy $E_{TOTAL}$ $E_{TOTAL}$ 1168Turn-on delay time $E_{ON}$ Note 6, VDS=400V, ID=50A, Gate Driver =0V to +15V, Turn-on RG,EXT=1Ω, Turn-off RG,EXT=50Ω Inductive Load, FWD: UJ3D06530TS140Turn-off energy $E_{OFF}$ Inductive Load, FWD: UJ3D06530TS24Turn-off energy $E_{OFF}$ FWD: UJ3D06530TS611 $\mu$	Fall time				21		
Turn-off energy $E_{OFF}$ FWD: UJ3D06530TS $T_J=25^{\circ}C$ 549 1168μJTurn-on delay time $t_{d(on)}$ Note 6, $V_{DS}=400V$ , $I_D=50A$ , Gate14Rise time $t_r$ Driver =0V to +15V, Turn-onf delay time140Fall time $t_f$ Turn-off $R_{G,EXT}=1\Omega$ , Turn-off $R_{G,EXT}=50\Omega$ Inductive Load,24Turn-off energy $E_{OFF}$ FWD: UJ3D06530TS665Turn-off energy $E_{OFF}$ FWD: UJ3D06530TS611 $\mu$ J	Turn-on energy	E <sub>ON</sub>			619		
Turn-on delay time $\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Turn-off energy	E <sub>OFF</sub>			549		μJ
Rise time $ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	Total switching energy	E <sub>TOTAL</sub>	T <sub>J</sub> =25°C		1168		
Rise time $ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	Turn-on delay time	t <sub>d(on)</sub>	Note 6.		14		
Turn-off delay time $t_{d(off)}$ Driver =0V to +15V, Turn-on R <sub>G,EXT</sub> = 1Ω, Turn-on energy     140       Fall time $t_f$ Turn-off R <sub>G,EXT</sub> = 50Ω Inductive Load, FWD: UJ3D06530TS     665       Turn-off energy $E_{OFF}$ FWD: UJ3D06530TS     611 $\mu$ J	Rise time	t <sub>r</sub>			59		
Turn-off $R_{G,EXT}$ = $50\Omega$ $E_{ON}$ Turn-off $R_{G,EXT}$ = $50\Omega$ $E_{OFF}$ Turn-off energy $E_{OFF}$ Turn-off $R_{G,EXT}$ = $150$ °C $E_{OFF}$ Turn-off $R_{G,EXT}$ = $150$ °C $E_{OFF}$ Turn-off $R_{G,EXT}$ = $150$ °C $E_{OFF}$	Turn-off delay time	$t_{d(off)}$	Driver =0V to +15V, Turn-on $R_{G,EXT}$ =1 $\Omega$ ,		140		ns
Turn-on energy $E_{ON}$ Inductive Load, $665$ Turn-off energy $E_{OFF}$ FWD: UJ3D06530TS $T_{e}=150^{\circ}\text{C}$	Fall time	t <sub>f</sub>			24		
Turn-off energy $E_{OFF}$ FWD: UJ3D06530TS 611 $\mu$ J	Turn-on energy	E <sub>ON</sub>	Inductive Load, FWD: UJ3D06530TS		665		
T.=150°C	Turn-off energy	E <sub>OFF</sub>			611		μJ
	Total switching energy				1276		

<sup>5.</sup> Measured with the chopper mode switching test circuit in Figure 30.

<sup>6.</sup> Measured with the chopper mode switching test circuit in Figure 29.





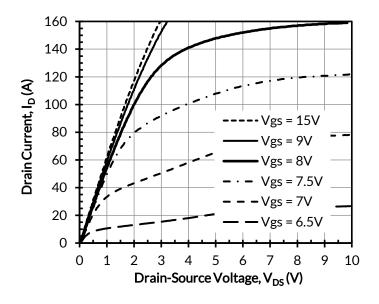








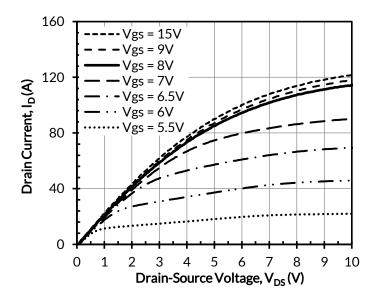
#### **Typical Performance Diagrams**



160 120 Drain Current, I<sub>D</sub> (A) - Vgs = 15V Vgs = 9V80 Vgs = 8VVgs = 7V- Vgs = 6.5V 40 Vgs = 6V 0 0 1 2 3 5 10 Drain-Source Voltage, V<sub>DS</sub> (V)

Figure 1. Typical output characteristics at  $T_J$  = - 55°C, tp < 250 $\mu$ s

Figure 2. Typical output characteristics at  $T_J = 25$ °C, tp < 250 $\mu$ s



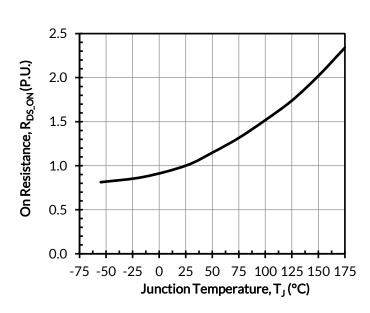


Figure 3. Typical output characteristics at  $T_J$  = 175°C, tp < 250 $\mu$ s

Figure 4. Normalized on-resistance vs. temperature at  $V_{GS}$  = 12V and  $I_{D}$  = 50A



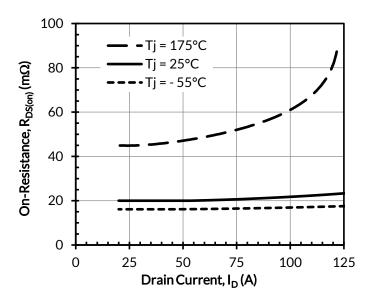












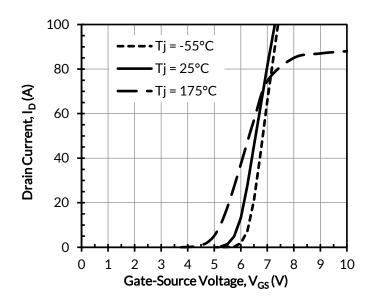
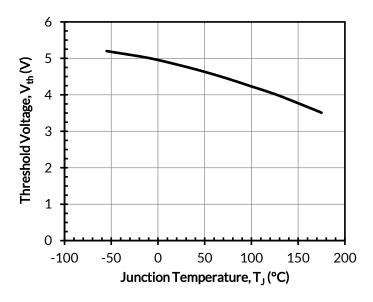


Figure 5. Typical drain-source on-resistances at  $V_{GS}$  = 12V

Figure 6. Typical transfer characteristics at  $V_{DS}$  = 5V



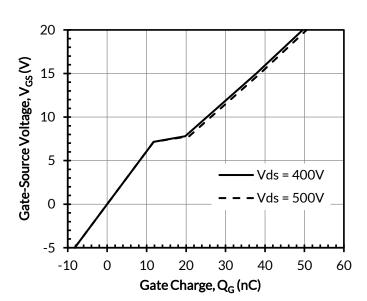


Figure 7. Threshold voltage vs. junction temperature at  $V_{DS}$  = 5V and  $I_{D}$  = 10mA

Figure 8. Typical gate charge at  $I_D = 50A$ 













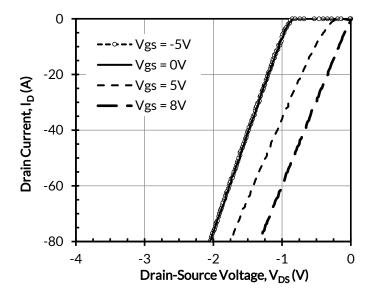


Figure 9. 3rd quadrant characteristics at  $T_J$  = -55°C

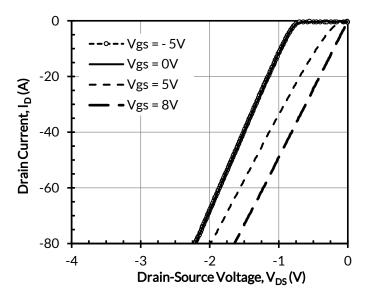


Figure 10. 3rd quadrant characteristics at T<sub>J</sub> = 25°C

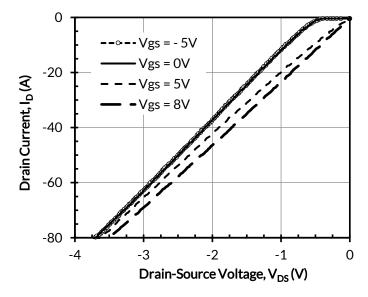


Figure 11. 3rd quadrant characteristics at  $T_J$  = 175°C

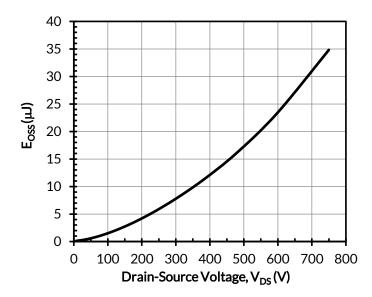


Figure 12. Typical stored energy in  $C_{OSS}$  at  $V_{GS} = 0V$ 



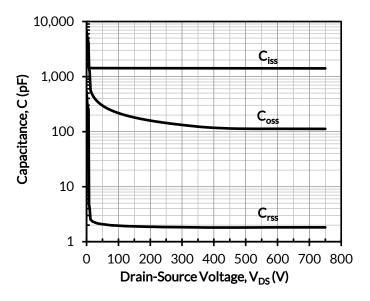








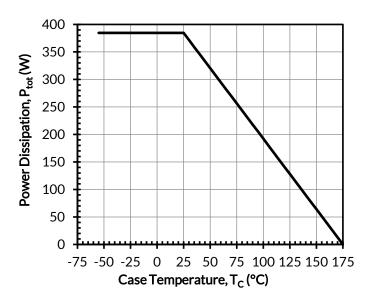




100 (8) 80 -75 -50 -25 0 25 50 75 100 125 150 175 Case Temperature, T<sub>C</sub> (°C)

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

Figure 14. DC drain current derating



1 Thermal Impedance,  $Z_{\theta JC}$  (°C/W) 0.1 D = 0.5D = 0.3**-** D = 0.1 0.01 **-** D = 0.05 ···· D = 0.02 -D = 0.01Single Pulse 0.001 1.E-06 1.E-05 1.E-04 1.E-03 1.E-02 1.E-01 Pulse Time, t<sub>p</sub> (s)

Figure 15. Total power dissipation

Figure 16. Maximum transient thermal impedance













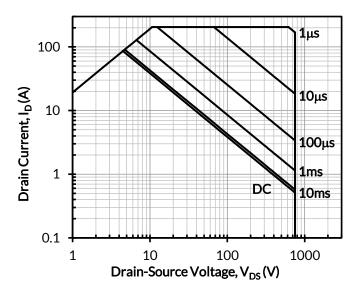


Figure 17. Safe operation area at  $T_C$  = 25°C, D = 0, Parameter  $t_D$ 

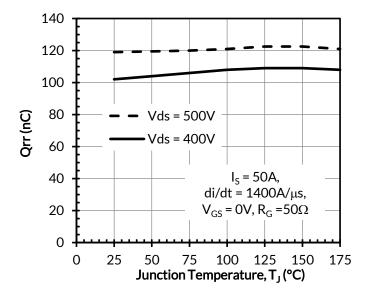


Figure 18. Reverse recovery charge Qrr vs. junction temperature

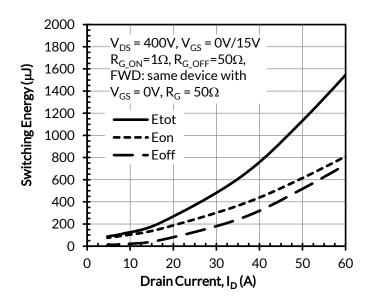


Figure 19. Clamped inductive switching energy vs. drain current at  $V_{DS}$  = 400V and  $T_J$  = 25°C

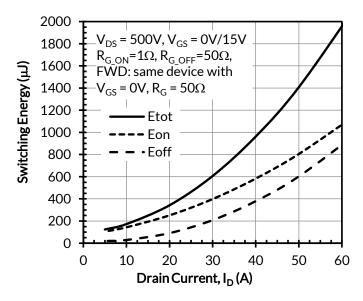


Figure 20. Clamped inductive switching energy vs. drain current at  $V_{DS}$  = 500V and  $T_J$  = 25°C



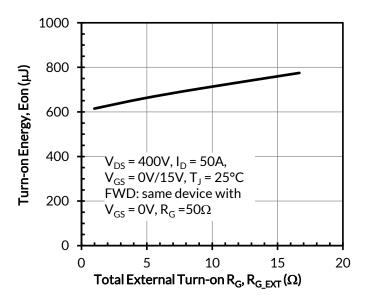








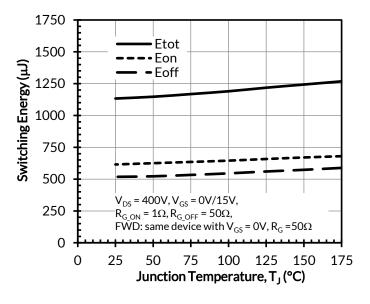




800 Furn-Off Energy, Eoff (μJ) 600 400  $V_{DS} = 400V, I_{D} = 50A,$  $V_{GS} = 0V/15V, T_J = 25^{\circ}C$ 200 FWD: same device with  $V_{GS} = 0V, R_{G} = 50\Omega$ 0 20 0 40 60 80 100 Total External Turn-off  $R_G$ ,  $R_{G,EXT}(\Omega)$ 

Figure 21. Clamped inductive switching turn-on energy vs.  $R_{G,EXT\_ON}$ 

Figure 22. Clamped inductive switching turn-off energy vs.  $R_{\text{G,EXT\_OFF}}$ 



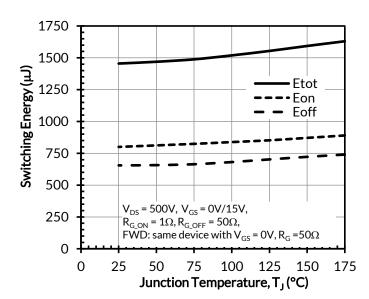


Figure 23. Clamped inductive switching energy vs. junction temperature at  $V_{DS}$  =400V and  $I_{D}$  = 50A

Figure 24. Clamped inductive switching energy vs. junction temperature at  $V_{DS}$  = 500V and  $I_D$  = 50A



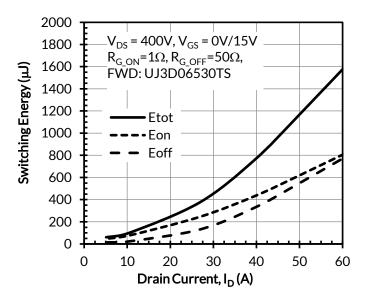








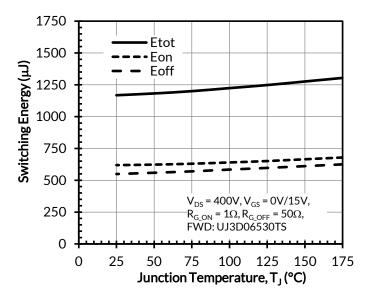




 $V_{DS} = 500V, V_{GS} = 0V/15V$  $R_{G\_ON}$ =1 $\Omega$ ,  $R_{G\_OFF}$ =50 $\Omega$ , Switching Energy (µJ) FWD: UJ3D06530TS Etot Eoff Drain Current, I<sub>D</sub> (A)

Figure 24. Clamped inductive switching energy vs. drain current at  $V_{DS}$  = 400V and  $T_J$  = 25°C

Figure 25. Clamped inductive switching energy vs. drain current at  $V_{DS}$  = 500V and  $T_J$  = 25°C



Switching Energy (μJ) Etot • Eon Eoff  $V_{DS} = 500V, V_{GS} = 0V/15V,$  $R_{G ON} = 1\Omega, R_{G OFF} = 50\Omega,$ FWD: UJ3D06530TS Junction Temperature, T<sub>J</sub> (°C)

Figure 26. Clamped inductive switching energy vs. junction temperature at  $V_{DS}$  =400V and  $I_{D}$  = 50A

Figure 27. Clamped inductive switching energy vs. junction temperature at  $V_{DS}$  = 500V and  $I_D$  = 50A













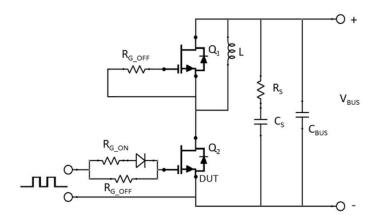


Figure 28. Schematic of the half-bridge mode switching test circuit. Note, a bus RC snubber ( $R_S$  =  $2.5\Omega$ ,  $C_S$ =100nF) is used to reduce the power loop high frequency oscillations.

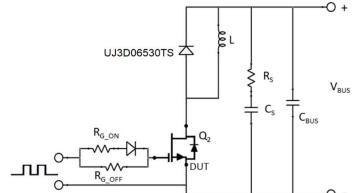


Figure 29. Schematic of the chopper mode switching test circuit. Note, a bus RC snubber ( $R_S$  = 2.5 $\Omega$ ,  $C_S$ =100nF) is used to reduce the power loop high frequency oscillations.

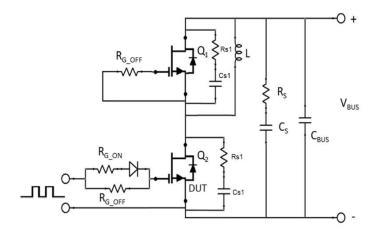


Figure 30. Schematic of the half-bridge mode switching test circuit with device RC snubbers ( $R_{s1}$  = 10 $\Omega$ ,  $C_{s1}$  = 300pF) and a bus RC snubber ( $R_{S}$  = 2.5 $\Omega$ ,  $C_{S}$ =100nF).













#### **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.unitedsic.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 UnitedSiC website at www.unitedsic.com

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