

40mΩ, 1200V Silicon Carbide Power MOSFET

GENERAL DESCRIPTION

- ◆ 3rd generation SiC MOSFET technology
- ◆ High blocking voltage with low on-resistance
- ◆ High-speed switching with low capacitance
- ◆ Fast intrinsic diode with low reverse recovery

BENEFIT

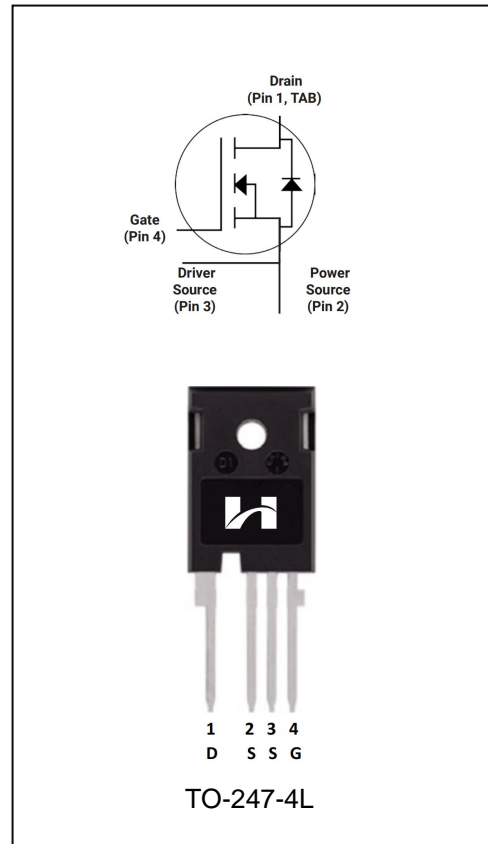
- ◆ Reduce switching losses and minimize gate ringing
- ◆ Higher system efficiency
- ◆ High Temperature Application
- ◆ Hard Switching Higher Reliability

APPLICATIONS

- ◆ High voltage DC / DC converters
- ◆ Switched mode power supplies
- ◆ Motor Drives

Features

- ◆ $V_{DS}=1200V, I_D=55A$
- ◆ $R_{DS(on)}$
TYP:40mΩ@ $V_{GS}= 20V$



ORDERING INFORMATION

Part No.	Package	Marking	Material	Packing
SC3K040120	TO-247-4L	SC3K040120	Pb free	Tube

ABSOLUTE MAXIMUM RATINGS (T_C=25°C unless otherwise noted)

Characteristics	Symbol	Test conditions	Value	Unit	
Drain-Source Voltage	V _{DSmax}	V _{GS} =0V, I _D =100uA	1200	V	
Gate-Source Voltage (dynamic)	V _{GSmax}	AC(f>1Hz)	-10/+25		
Gate-Source Voltage (static)	V _{GSop}	Static	-5/+20		
Continuous Drain Current:	I _D	V _{GS} =20V	T _C =25°C	55	A
			T _C =100°C	39	
Pulsed Drain Current:	I _{D(pulse)}	T _C =25°C	117		
Short Circuit Capability	tsc	V _{DD} =800V, V _{GS} =20V	3	uS	
Short Circuit Capability	I _{DS}	V _{DD} =800V, V _{GS} =20V	600	A	
Total power dissipation	P _D	T _C =25°C	300	W	
Operating Junction Temperature	T _j	--	-55 to 175	°C	
Storage Temperature	T _{stg}	--	-55 to 150		

THERMAL CHARACTERISTICS

Characteristics	Symbol	MAX	Unit
Thermal Resistance, Junction-to-Case	R _{θJC}	0.5	°C/W

ELECTRICAL CHARACTERISTICS

Characteristics	Symbol	Test conditions	Min.	Typ.	Max.	Unit	
Drain-Source Breakdown Voltage	V _{(BR)DSS}	V _{GS} =0V, I _D =100μA	1200	--	--	V	
Gate Threshold Voltage	V _{GS(th)}	V _{DS} =V _{GS} I _D =10mA	T _j =25°C	1.8	3.5		3.9
			T _j =150°C	--	2.6		--
			T _j =175°C	--	2.5		--
Zero Gate Voltage Drain Current	I _{DSS}	V _{DS} =1200V, V _{GS} =0V	--	--	100	uA	
Gate-Source Leakage Current	I _{GSS}	V _{GS} =20V, V _{DS} =0V	--	--	200	nA	
Gate-Source Leakage Current	I _{GSS}	V _{GS} =-5V, V _{DS} =0V	--	--	-200		
Drain-Source On-State Resistance	R _{DS(on)}	V _{GS} =20V I _D =40A	T _j =25°C	--	40	44	mΩ
			T _j =150°C	--	61	--	
			T _j =175°C	--	69	--	
Transconductance	g _{fs}	V _{GS} =20V I _D =40A	T _j =25°C	--	22	--	S
			T _j =150°C	--	20	--	
			T _j =175°C	--	19	--	
Internal gate input resistance	R _{g(int)}	f=1MHz, I _D =0A		2		Ω	
Input capacitance	C _{iss}	V _{DS} =1000V V _{GS} =0V f=1MHz	--	2920	--	pF	
Output capacitance	C _{oss}		--	151	--		
Reverse transfer capacitance	C _{rss}		--	8.6	--		
Total gate charge	Q _g	V _{DS} =800V V _{GS} =-5V/20V I _D =40A	--	143.6	--	nC	
Gate-source charge	Q _{gs}		--	40.2	--		
Gate-drain charge	Q _{gd}		--	74.5	--		

Characteristics	Symbol	Test conditions	Min.	Typ.	Max.	Unit
Turn-On Switching Energy	E _{ON}	V _{DS} =800V, V _{GS} =-5V/20V I _D =40A, R _{G(ext)} =1.5 Ω L=450μH	--	596	--	μJ
Turn-Off Switching Energy	E _{OFF}		--	451	--	
Turn-On Delay Time	t _{d(on)}	V _{DS} =800V V _{GS} =-5V/20V I _D =40A, R _{G(ext)} =1.5 Ω L=450μH	--	23.1	--	nS
Rise Time	t _r		--	33.6	--	
Turn-Off Delay Time	t _{d(off)}		--	35.8	--	
Fall Time	t _f		--	19.5	--	
Avalanche Capability	E _{AS}	V _{DD} =100V, V _{GS} =20V L=2mH	--	669	--	mJ
	I _{AV}		--	26	--	A

REVERSE DIODE RATINGS AND CHARACTERISTICS

Characteristics	Symbol	Test conditions	Min.	Typ.	Max.	Unit	
Continuous Diode Forward Current	I _S	V _{GS} =-5V	--	70	--	A	
Diode Forward Voltage	V _{SD}	V _{GS} =-5V I _{SD} =20A	T _j =25°C	--	3.9	--	V
			T _j =150°C	--	3.5	--	
			T _j =175°C	--	3.4	--	
Reverse Recovery time	t _{rr}	V _{GS} =-5V, I _{SD} =40A V _R =800V dif/dt=4000A/μs		21.6		nS	
Reverse Recovery Charge	Q _{rr}			369.4		nC	
Peak Reverse Recovery Current	I _{rrm}			31		A	

Typical Performance Characteristics

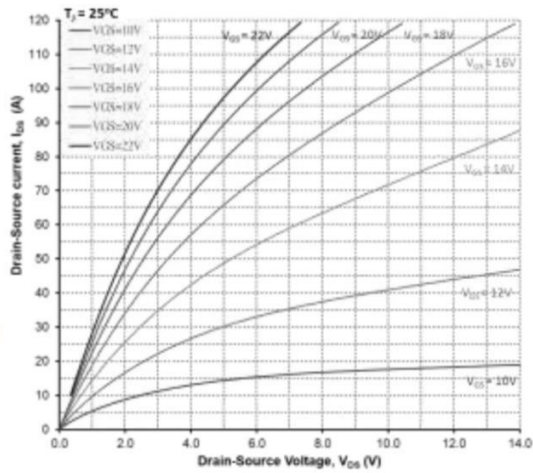


Figure 1. Output Characteristics, $T_J = 25^\circ\text{C}$

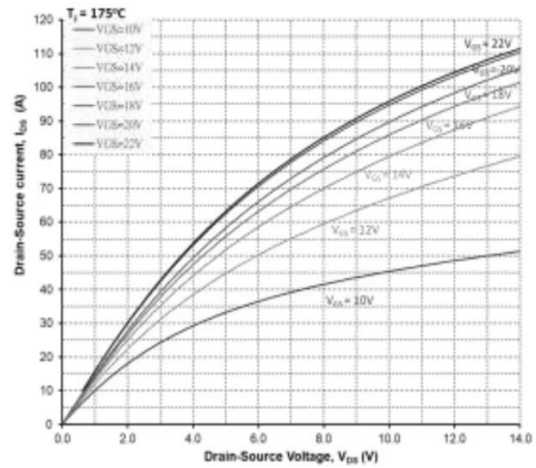


Figure 2. Output Characteristics, $T_J = 175^\circ\text{C}$

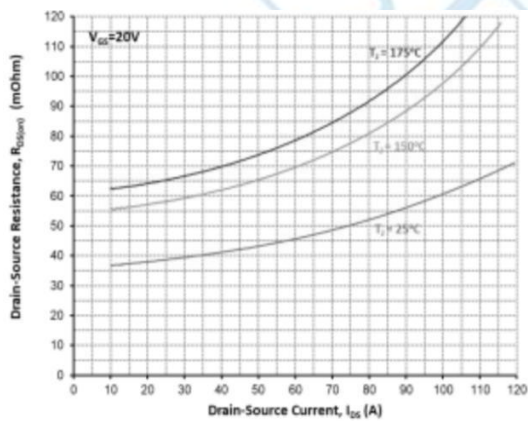


Figure 3. On-Resistance vs. Drain Current For Various Temperatures

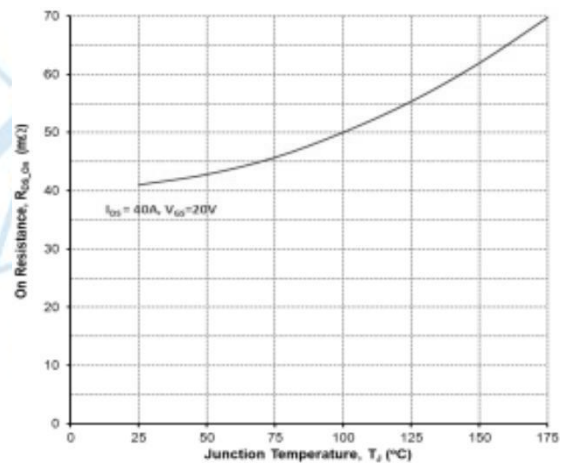


Figure 4. On-Resistance vs. Temperature

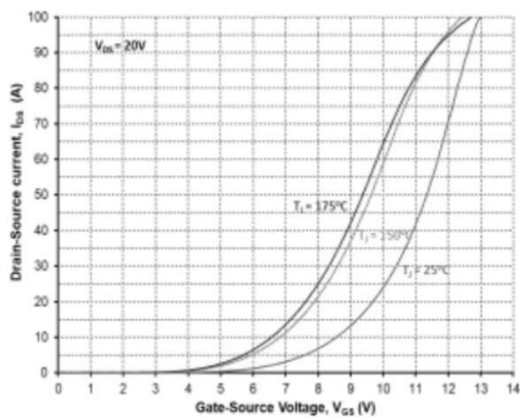


Figure 5. Transfer Characteristic For Various Junction Temperatures

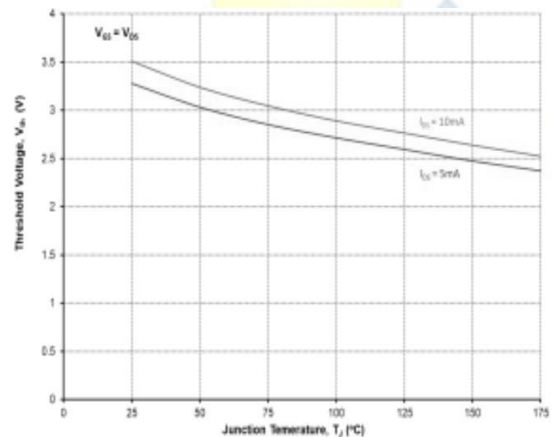


Figure 6. Threshold Voltage vs. Temperature

Typical Performance Characteristics

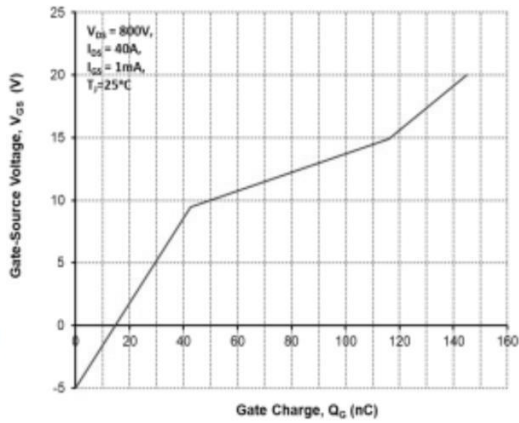


Figure 7. Gate Charge Characteristics

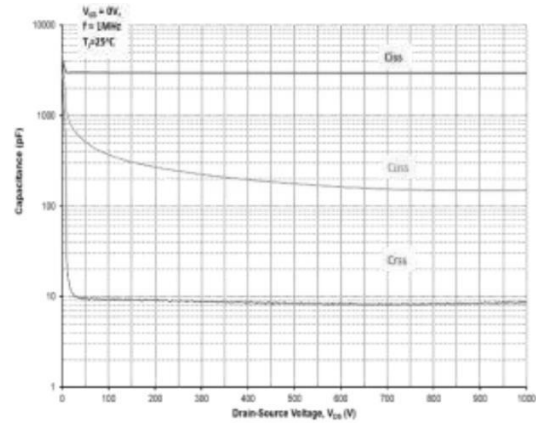


Figure 8. Capacitances vs. Drain-Source Voltage (0-1000V)

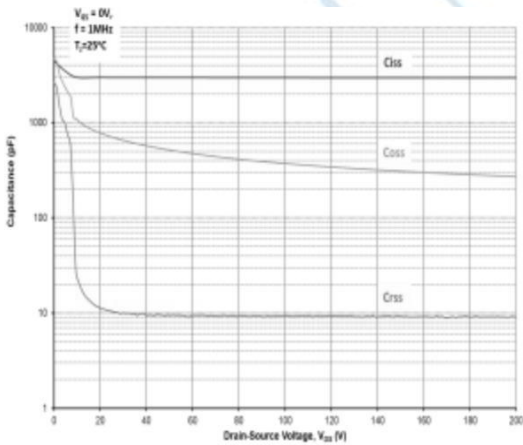


Figure 9. Capacitances vs. Drain-Source Voltage (0-200V)

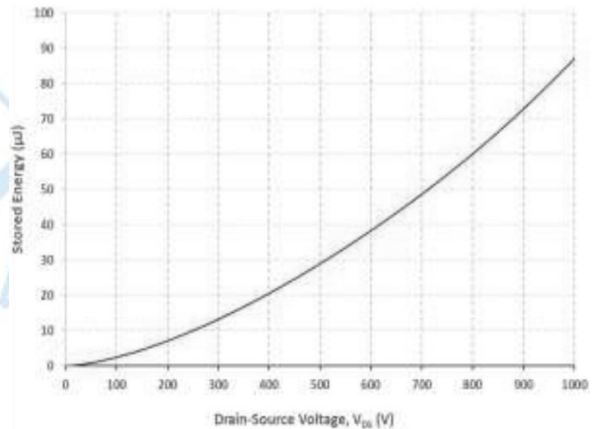


Figure 10. Output Capacitor Stored Energy

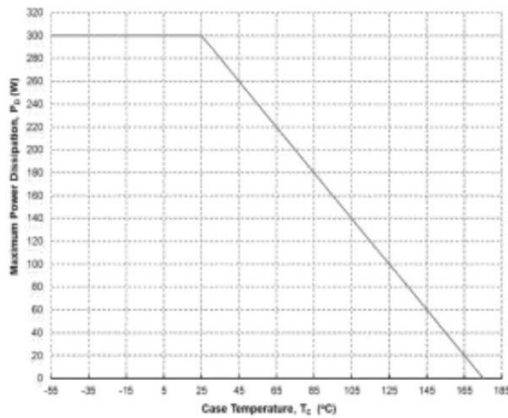


Figure 11. Maximum Power Dissipation Derating vs. Case Temperature

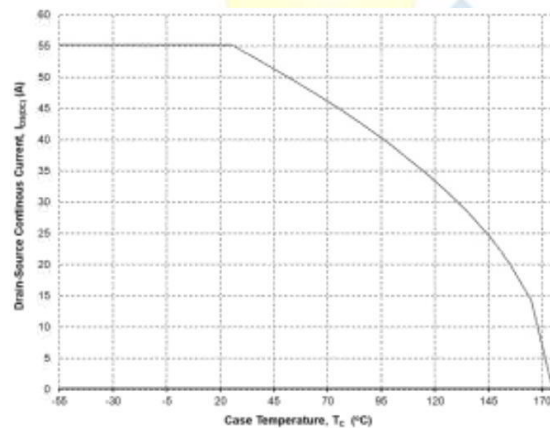


Figure 12. Continuous Drain Current Derating vs. Case Temperature

Typical Performance Characteristics

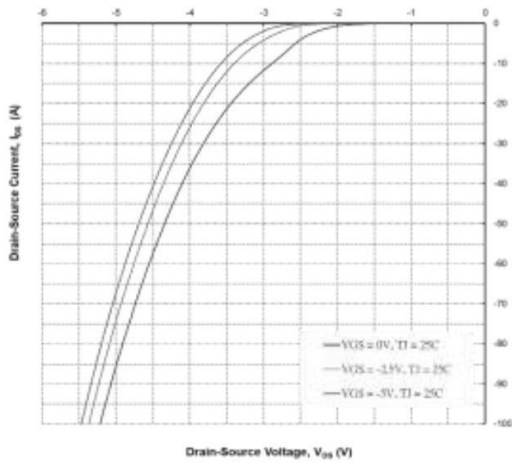


Figure 13. Body Diode Characteristics @ 25°C

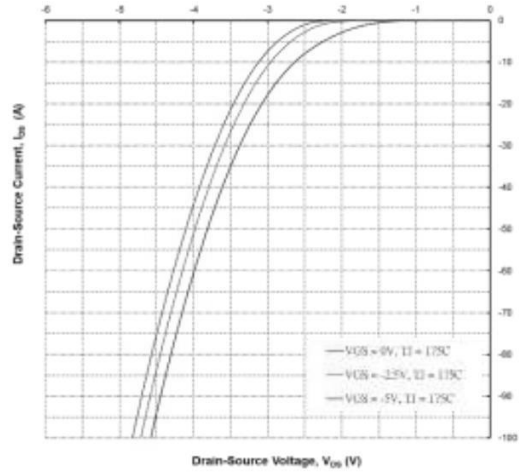


Figure 14. Body Diode Characteristics @ 175°C

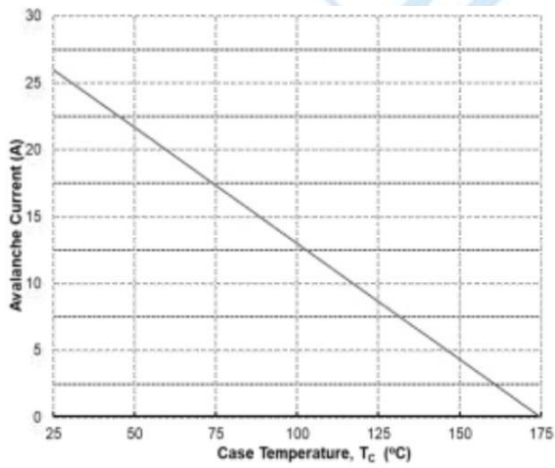


Figure 15. Single Avalanche vs. Temperature

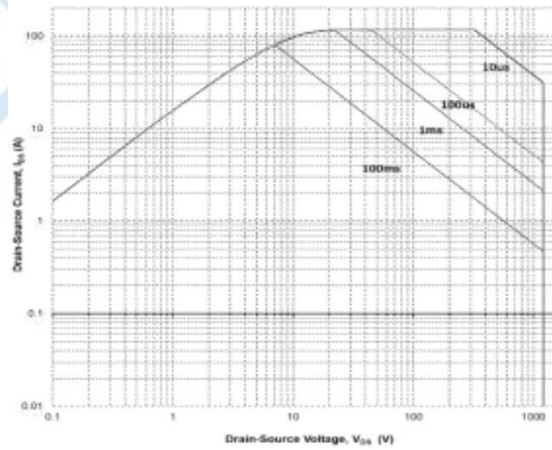
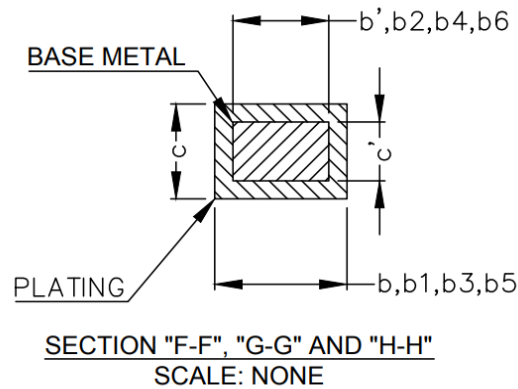
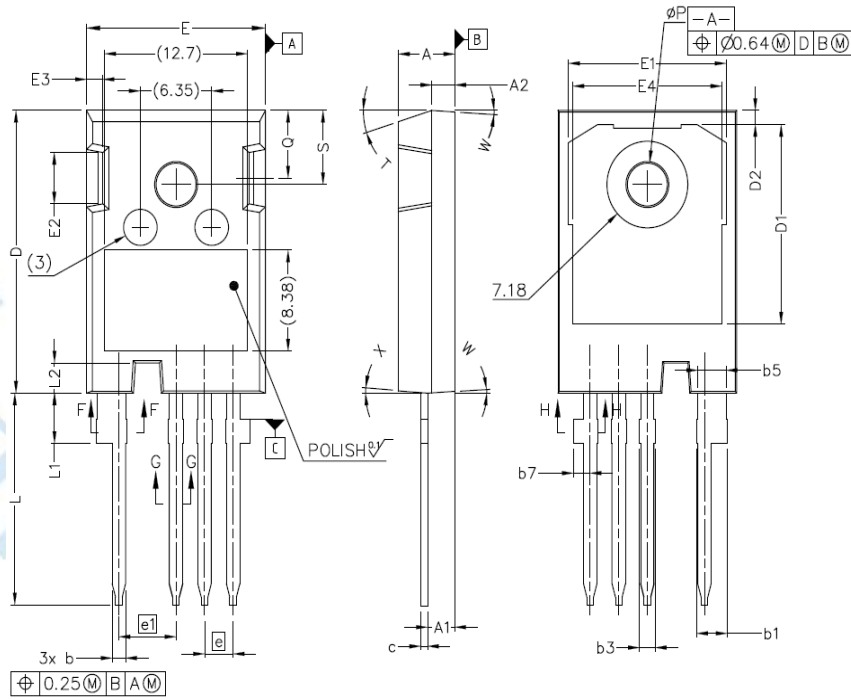


Figure 16. Safe Operating Area

Package Dimensions of TO-247-4L



SYMBOL	MILLIMETERS		SYMBOL	MILLIMETERS		SYMBOL	MILLIMETERS	
	MIN	MAX		MIN	MAX		MIN	MAX
A	4.83	5.21	A1	2.29	2.54	A2	1.91	2.16
b'	1.07	1.28	b	1.07	1.33	b1	2.39	2.94
b2	2.39	2.84	b3	1.07	1.60	b4	1.07	1.50
b5	2.39	2.69	b6	2.39	2.64	B7	1.3	1.7
C'	0.55	0.65	c	0.55	0.68	D	23.30	23.60
D1	16.25	17.65	D2	0.95	1.25	E	15.75	16.13
E1	13.10	14.15	E2	3.68	5.10	E3	1.00	1.90
E4	12.38	13.43	e1	5.08BSC		N	4	
e	2.54BSC		X	4° REF		T	17.5° REF	
L1	3.97	4.37	L2	2.35	2.65	ΦP	3.51	3.65
Q	5.49	6.00	S	6.04	6.30	L	17.31	17.82
W	3.5° REF							

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