

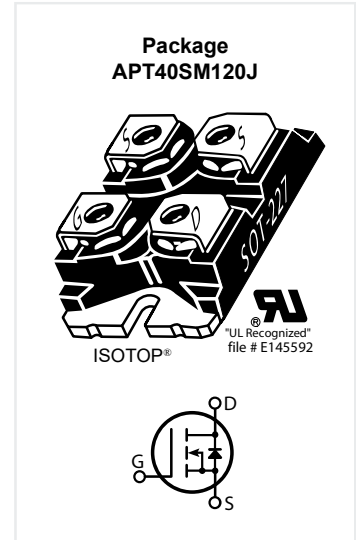
APT40SM120J

1200V, 32A, 80mΩ

Silicon Carbide N-Channel Power MOSFET

DESCRIPTION

Silicon carbide (SiC) power MOSFET product line from Microsemi increase your performance over silicon MOSFET and silicon IGBT solutions while lowering your total cost of ownership for high-voltage applications.



FEATURES / TYPICAL APPLICATIONS

SiC MOSFET Features:

- Low capacitances and low gate charge
- Fast switching speed due to low internal gate resistance (ESR)
- Stable operation at high junction temperature, $T_j(\text{max}) = +175\text{C}$
- Fast and reliable body diode
- Superior avalanche ruggedness

SiC MOSFET Benefits:

- High efficiency to enable lighter/compact system
- Simple to drive and easy to parallel
- Improved thermal capabilities and lower switching losses
- Eliminates the need of external Free Wheeling Diode
- Lower system cost of ownership

Applications:

- PV inverter, converter and industrial motor drives
- Smart grid transmission & distribution
- Induction heating, and welding
- H/EV powertrain and EV charger
- Power supply and distribution

MAXIMUM RATINGS

Symbol	Parameter	Ratings	Unit
V_{DSS}	Drain Source Voltage	1200	V
I_{D}	Continuous Drain Current @ $T_c = 25^\circ\text{C}$	32	A
	Continuous Drain Current @ $T_c = 100^\circ\text{C}$	22	
I_{DM}	Pulsed Drain Current ^①	99	
V_{GS}	Gate-Source Voltage	-10 to +25	V
P_{D}	Total Power Dissipation @ $T_c = 25^\circ\text{C}$	165	W
	Linear Derating Factor	1.1	W/°C

THERMAL AND MECHANICAL CHARACTERISTICS

Symbol	Characteristic	Min	Typ	Max	Unit
$R_{\theta\text{JC}}$	Junction to Case Thermal Resistance			0.91	°C/W
T_j	Operating Junction Temperature	-55		175	°C
T_{stg}	Storage Junction Temperature Range	-55		150	
W_{T}	Package Weight			1.03	oz
Torque	Mounting Torque (SOT-227 Package), 6-32 or M3 screw		5	10	in·lbf
			.56	1.13	N·m

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STATIC CHARACTERISTICS

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
$V_{(BR)DSS}$	Drain-Source Breakdown Voltage	$V_{GS} = 0V, I_D = 1mA$	1200			V
$R_{DS(on)}$	Drain-Source On Resistance ^②	$V_{GS} = 20V, I_D = 20A$		80	100	mΩ
$V_{GS(th)}$	Gate-Source Threshold Voltage	$V_{GS} = V_{DS}, I_D = 1mA$	1.7	3.0		V
$\Delta V_{GS(th)}/\Delta T_J$	Threshold Voltage Temperature Coefficient			-4.8		mV/°C
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 1200V$ $V_{GS} = 0V$			100	μA
		$T_J = 25^\circ C$ $T_J = 125^\circ C$			500	
I_{GSS}	Gate-Source Leakage Current	$V_{GS} = +20V / -10V$			±100	nA

$T_J = 25^\circ C$ unless otherwise specified

DYNAMIC CHARACTERISTICS

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
C_{iss}	Input Capacitance	$V_{GS} = 0V, V_{DD} = 1000V$ $f = 1MHz$		2085		pF
C_{rss}	Reverse Transfer Capacitance			25		
C_{oss}	Output Capacitance			115		
Q_g	Total Gate Charge	$V_{GS} = 0/20V$ $V_{DD} = 800V$ $I_D = 20A$		130		nC
Q_{gs}	Gate-Source Charge			19		
Q_{gd}	Gate-Drain Charge			35		
$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 800V$ $V_{GS} = 0/20V$ $I_D = 20A$ $R_G = 0.7 \Omega$ ^③ $L = 115 \mu H$ $T_C = 25^\circ C$ Freewheeling Diode = APT10SCE120B		10		ns
t_r	Current Rise Time			6		
$t_{d(off)}$	Turn-Off Delay Time			32		
t_f	Current Fall Time			16		
E_{on2}	Turn-On Switching Energy ^④				225	
E_{off}	Turn-Off Switching Energy			50		
$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 800V$ $V_{GS} = 0/20V$ $I_D = 20A$ $R_G = 0.7 \Omega$ ^③ $L = 115 \mu H$ $T_C = 150^\circ C$ Freewheeling Diode = APT10SCE120B		8		ns
t_r	Current Rise Time			6		
$t_{d(off)}$	Turn-Off Delay Time			36		
t_f	Current Fall Time			17		
E_{on2}	Turn-On Switching Energy ^④				225	
E_{off}	Turn-Off Switching Energy			60		
ESR	Equivalent Series Resistance	$f = 1MHz, 25mV, \text{Drain Short}$		1.2		Ω
SCWT	Short Circuit Withstand Time	$V_{DS} = 960V, V_{GS} = 20V, T_C = 25^\circ C$		5		μS
E_{AS}	Avalanche Energy, Single Pulse	$V_{DS} = 145V, V_{GS} = 20V, I_D = 20A, T_C = 25^\circ C$		2500		mJ

Source-Drain Diode Characteristics

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V_{SD}	Diode Forward Voltage	$I_{SD} = 20A, V_{GS} = 0V$		3.8		V
t_{rr}	Reverse Recovery Time	$I_{SD} = 20A, V_{DD} = 800V$ $di/dt = -1000A/\mu s$		90		ns
Q_{rr}	Reverse Recovery Charge				265	nC
I_{rrm}	Reverse Recovery Current				7.8	A

$T_J = 25^\circ C$ unless otherwise specified

① Repetitive Rating: Pulse width and case temperature limited by maximum junction temperature

② Pulse test: Pulse Width < 380μs, duty cycle < 2%.

③ R_G is total gate resistance including internal gate driver impedance.

④ E_{on2} includes energy of APT10SCD120B free wheeling diode.

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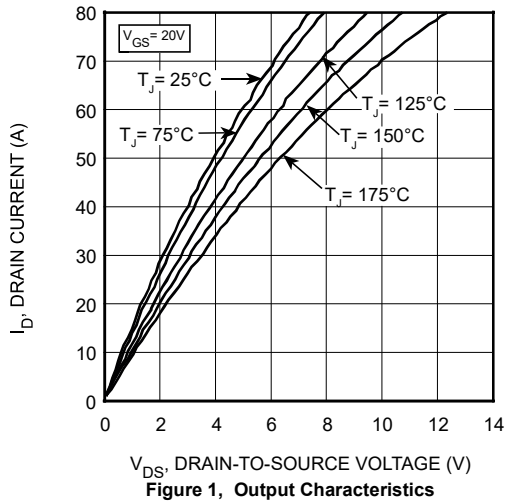


Figure 1, Output Characteristics

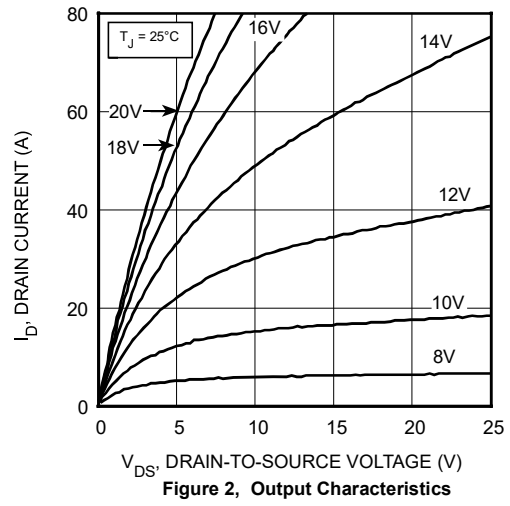


Figure 2, Output Characteristics

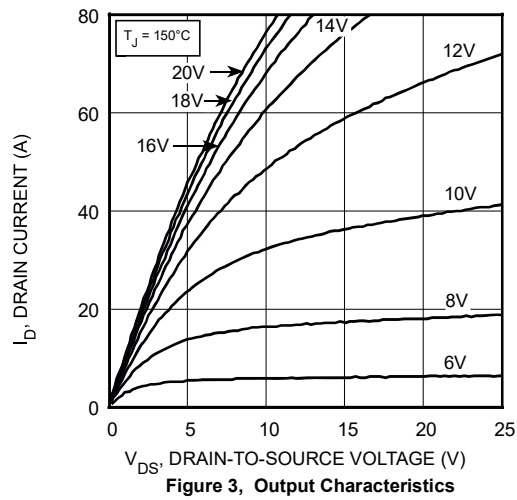


Figure 3, Output Characteristics

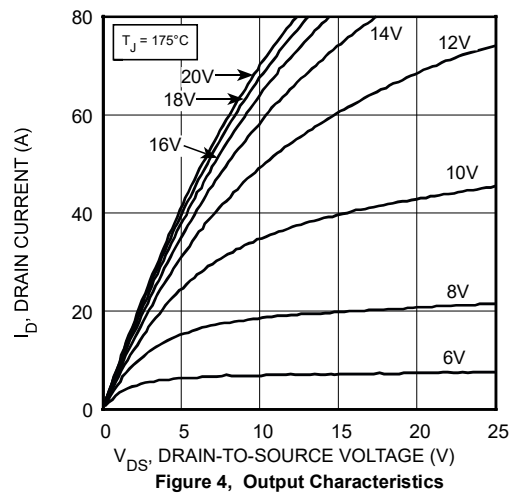


Figure 4, Output Characteristics

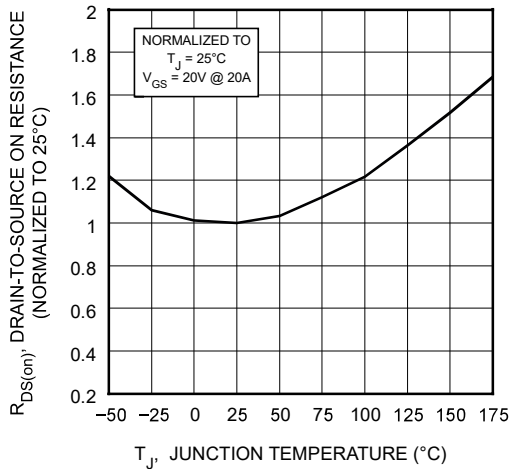


Figure 5, $R_{DS(on)}$ vs Junction Temperature

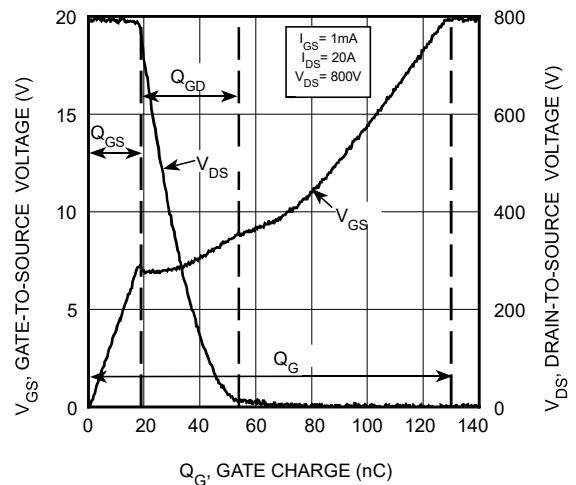


Figure 6, Gate Charge Characteristics

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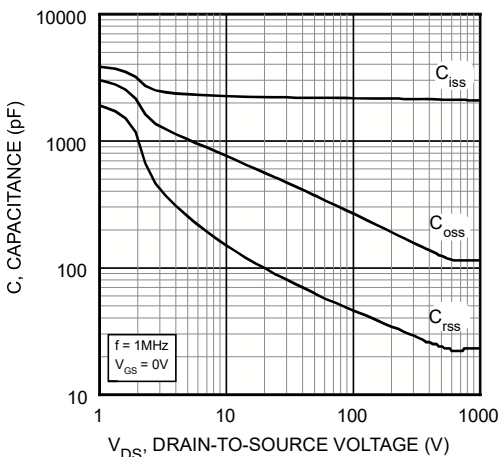


Figure 7, Capacitance vs Drain-to-Source Voltage

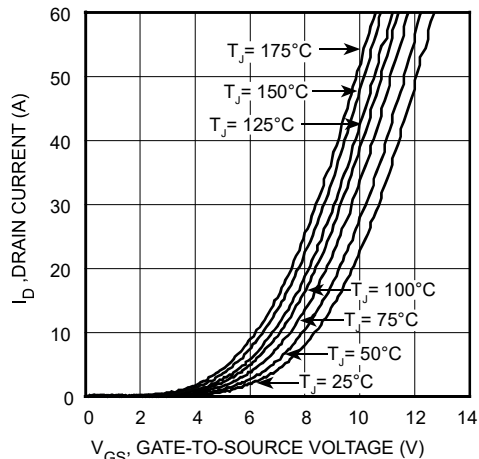


Figure 8, Output Characteristics I_D vs V_{GS} Temperature

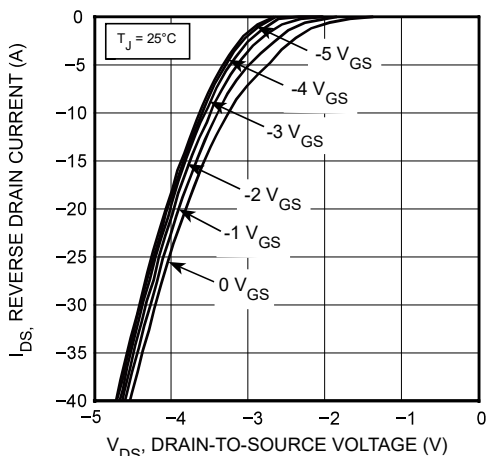


Figure 9, Reverse Drain Current vs Drain-to-Source Voltage Third Quadrant Conduction

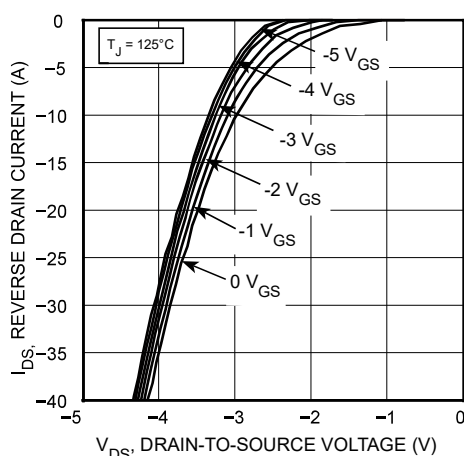


Figure 10, Reverse Drain Current vs Drain-to-Source Voltage Third Quadrant Conduction

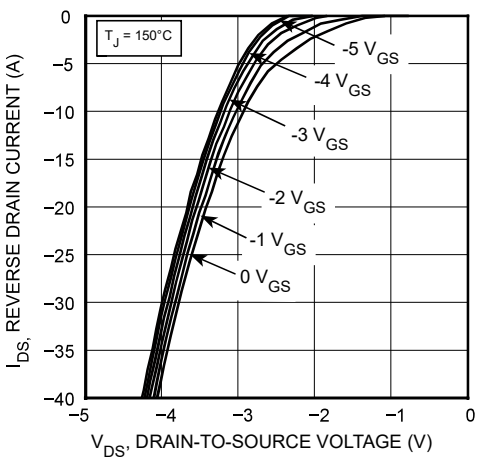


Figure 11, Reverse Drain Current vs Drain-to-Source Voltage Third Quadrant Conduction

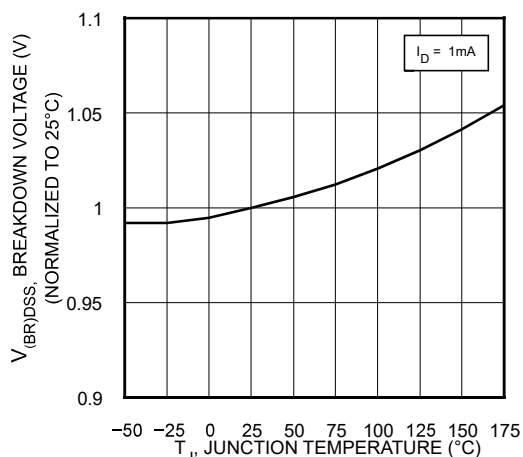


Figure 12, Breakdown Voltage vs Temperature

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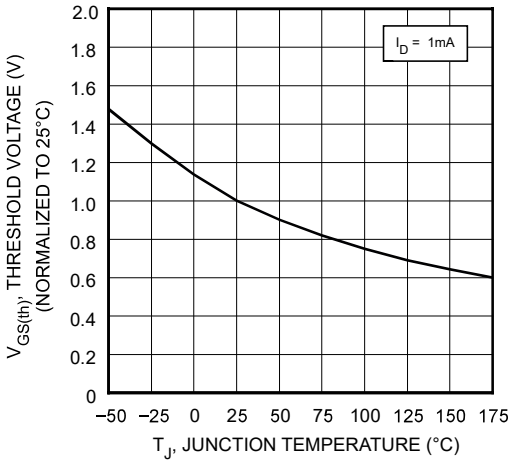


Figure 13, Threshold Voltage vs Temperature

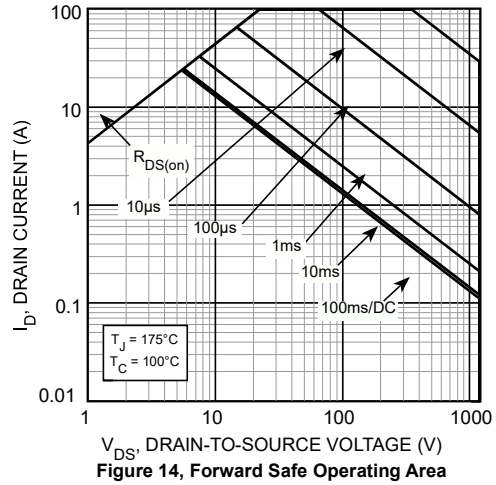


Figure 14, Forward Safe Operating Area

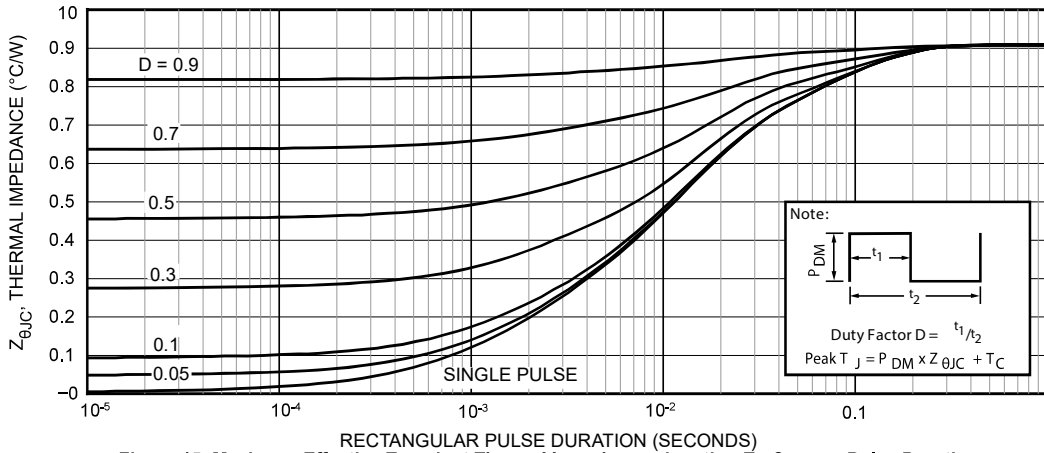
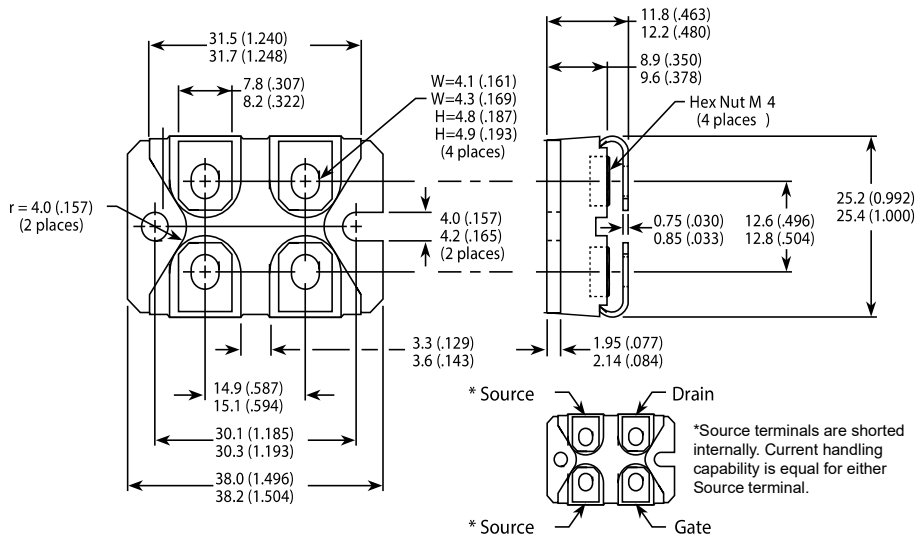


Figure 15, Maximum Effective Transient Thermal Impedance, Junction-To-Case vs Pulse Duration

SOT-227 (ISOTOP®) Package Outline



Dimensions in Millimeters (Inches)

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