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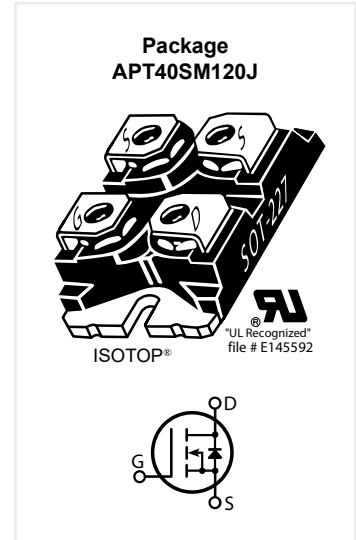
# APT40SM120J

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 <sup>①</sup>	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
$R_{\theta JC}$	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 <sup>②</sup>	$V_{GS} = 20V, I_D = 20A$		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	$V_{DD} = 800V$ $V_{GS} = 0/20V$ $I_D = 20A$ $R_G = 0.7 \Omega$ <sup>③</sup> $L = 115 \mu H$ $T_C = 25^\circ C$ 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 <sup>④</sup>				225	
$E_{off}$	Turn-Off Switching Energy			50		
$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 800V$ $V_{GS} = 0/20V$ $I_D = 20A$ $R_G = 0.7 \Omega$ <sup>③</sup> $L = 115 \mu H$ $T_C = 150^\circ C$ 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 <sup>④</sup>				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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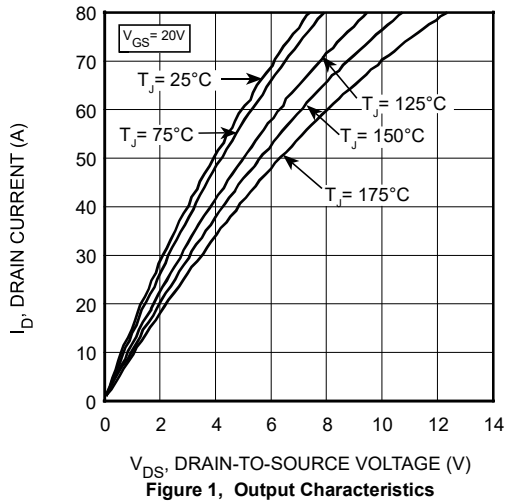


Figure 1, Output Characteristics

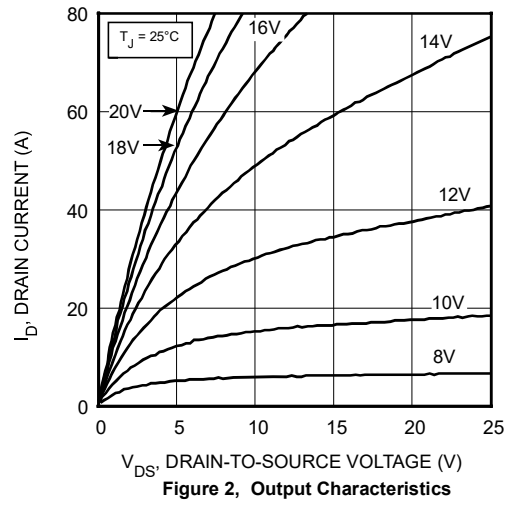


Figure 2, Output Characteristics

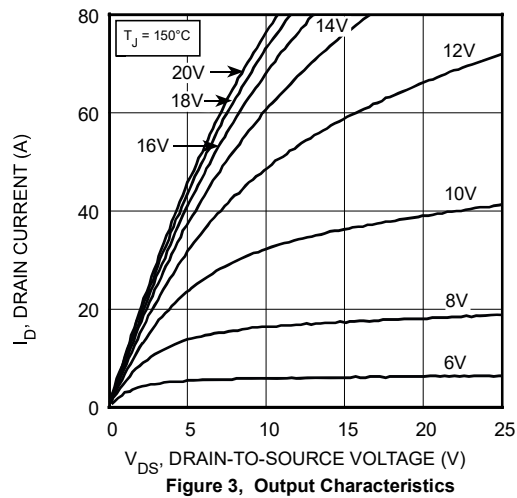


Figure 3, Output Characteristics

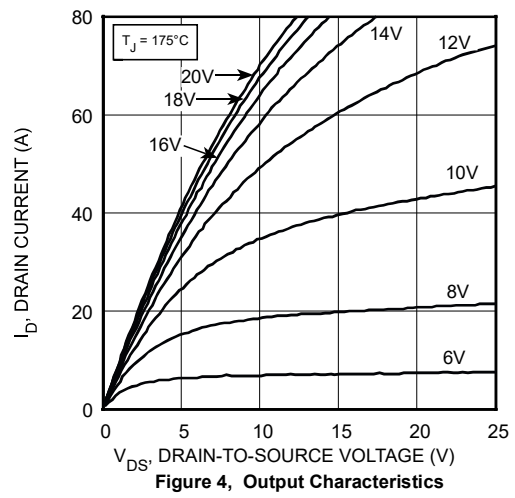


Figure 4, Output Characteristics

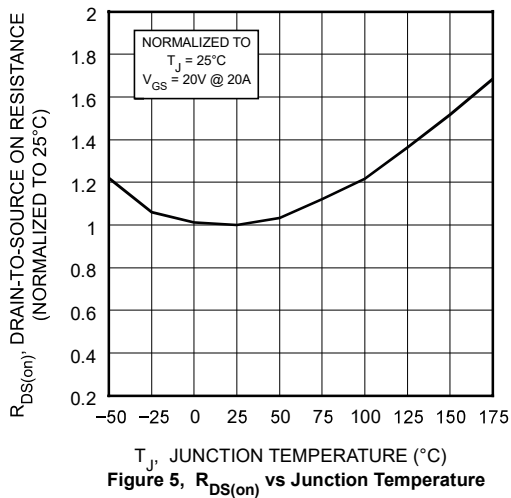


Figure 5,  $R_{DS(on)}$  vs Junction Temperature

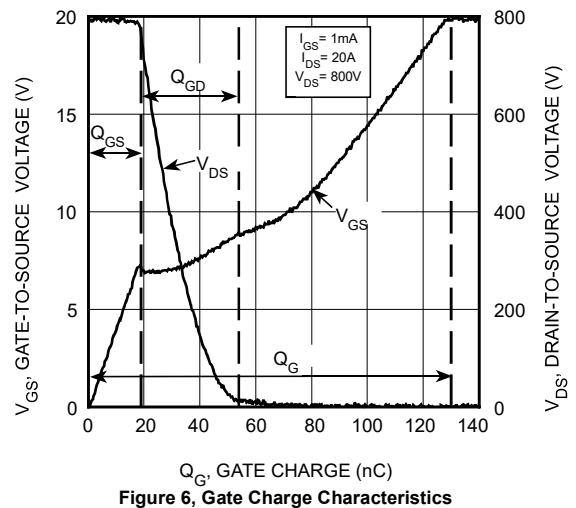


Figure 6, Gate Charge Characteristics

# APT40SM120J

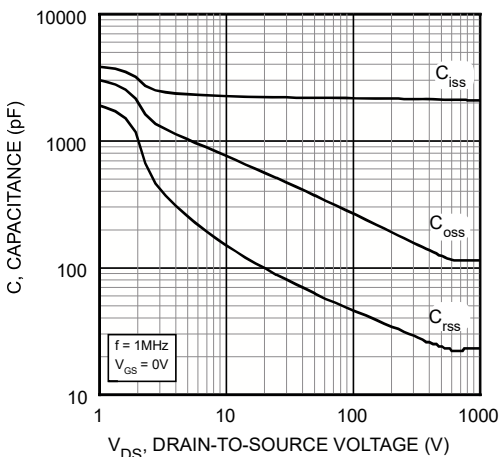


Figure 7, Capacitance vs Drain-to-Source Voltage

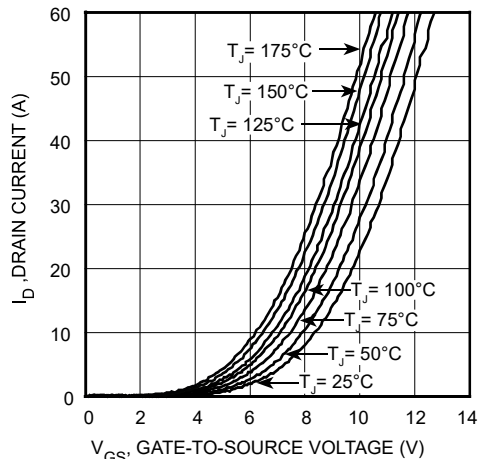


Figure 8, Output Characteristics  $I_D$  vs  $V_{GS}$  Temperature

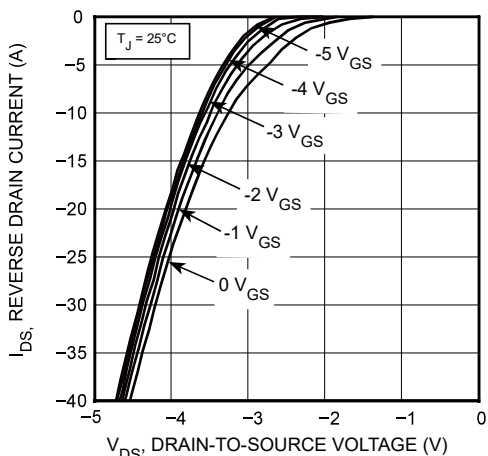


Figure 9, Reverse Drain Current vs Drain-to-Source Voltage Third Quadrant Conduction

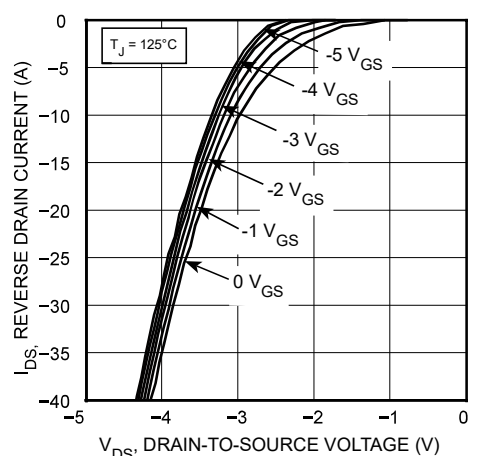


Figure 10, Reverse Drain Current vs Drain-to-Source Voltage Third Quadrant Conduction

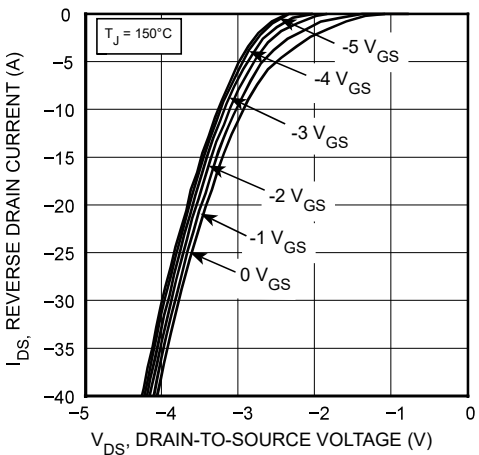


Figure 11, Reverse Drain Current vs Drain-to-Source Voltage Third Quadrant Conduction

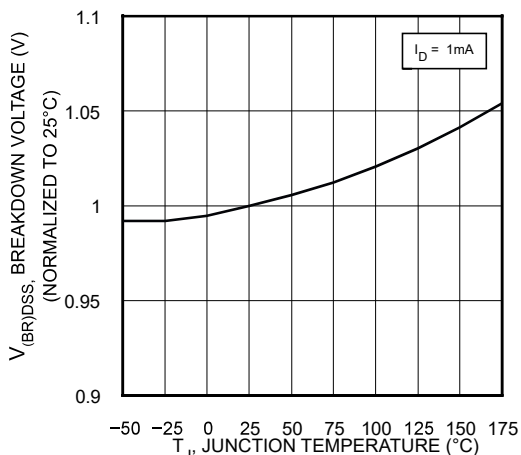


Figure 12, Breakdown Voltage vs Temperature

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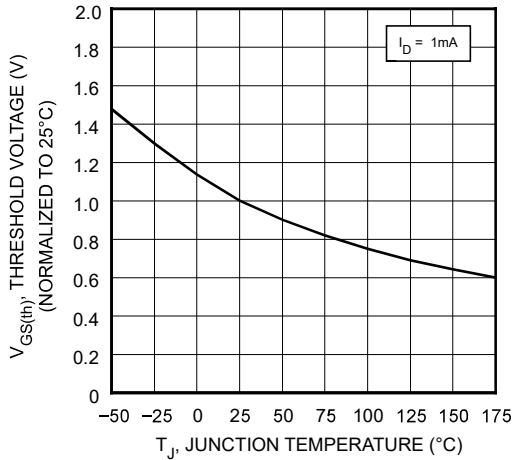


Figure 13, Threshold Voltage vs Temperature

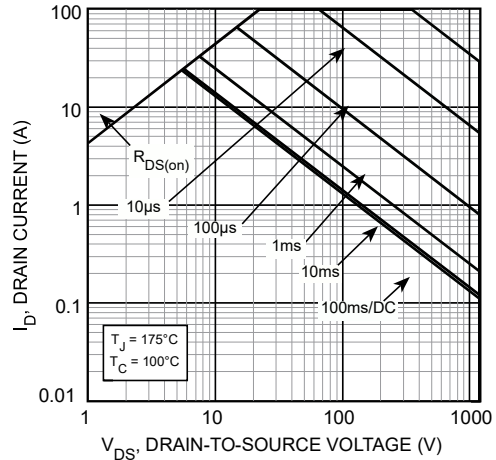


Figure 14, Forward Safe Operating Area

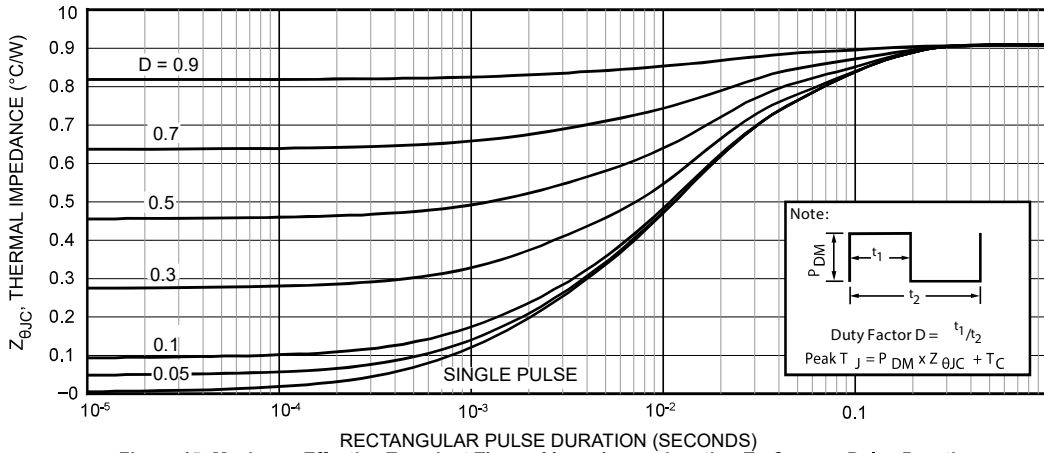
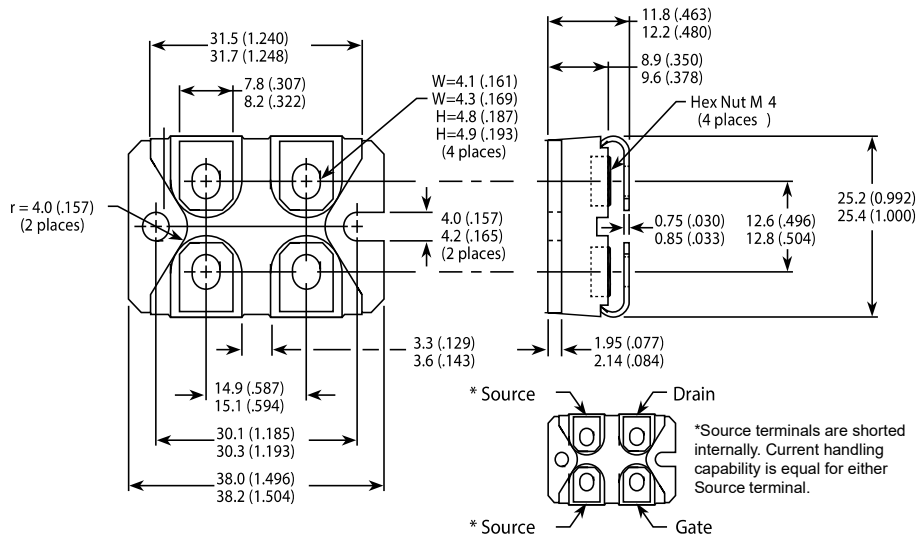


Figure 15, Maximum Effective Transient Thermal Impedance, Junction-To-Case vs Pulse Duration

## SOT-227 (ISOTOP®) Package Outline



Dimensions in Millimeters (Inches)

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