

# APT70SM70B

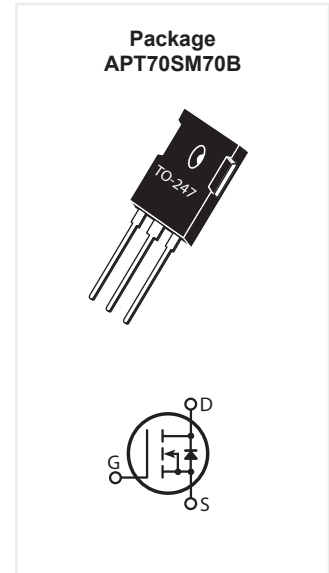
PRELIMINARY

700V, 58A, 75mΩ

## Silicon Carbide N-Channel Power MOSFET

### DESCRIPTION

Silicon carbide power MOSFET solutions with Microsemi-proprietary passivation technology provides maximum SiC benefits over silicon MOSFET solutions that include higher energy conversion efficiency with 10x higher breakdown field resistance resulting in lower RDS(on); lower switching losses due to temperature-independent switching behavior for stable high temperature performance and 2x higher electron saturation; improved system cooling with 3x higher band gap energy to operate at higher junction temperatures; and higher current capabilities with 3x higher thermal conductivity for higher power density. Faster switching frequencies combined with the above characteristics provide higher efficiency, lower power losses for power topologies that lower total cost of ownership with higher reliability and efficiency, lower passive and system costs, and smaller heat sinks.



### FEATURES / TYPICAL APPLICATIONS

- Ultra Low sensitivity of  $R_{DS(on)}$  to temperature
- Fast switching with low EMI/RFI
- Low Switching Energy
- Low  $R_{DS(on)}$  Temperature Coefficient For Improved Efficiency
- Ultra Low Gate Resistance
- RoHS compliant
- PFC and other boost converter
- Buck Converter
- Two Switch forward (asymmetrical)
- Single Switch forward
- Flyback
- Inverters

### MAXIMUM RATINGS

Symbol	Parameter	Ratings	Unit
$V_{DSS}$	Drain Source Voltage	700	V
$I_D$	Continuous Drain Current @ $T_c = 25^\circ\text{C}$	58	A
	Continuous Drain Current @ $T_c = 100^\circ\text{C}$	41	
$I_{DM}$	Pulsed Drain Current <sup>①</sup>	137	
$V_{GS}$	Gate-Source Voltage	-10 to +25	V
$P_D$	Total Power Dissipation @ $T_c = 25^\circ\text{C}$	300	W
	Linear Derating Factor	2.0	W/°C

### THERMAL AND MECHANICAL CHARACTERISTICS

Symbol	Characteristic	Min	Typ	Max	Unit
$R_{\theta JC}$	Junction to Case Thermal Resistance		0.35	0.5	°C/W
$T_j$	Operating Junction Temperature	-55		175	°C
$T_{stg}$	Storage Junction Temperature Range	-55		150	
$T_L$	Soldering Temperature for 10 Seconds (1.6mm from case)			260	
Torque	Mounting Torque (TO-247 Package), 6-32 or M3 screw			10	in·lbf
				1.1	N·m

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## STATIC CHARACTERISTICS

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
$V_{(BR)DSS}$	Drain-Source Breakdown Voltage	$V_{GS} = 0V, I_D = 1mA$	700			V
$R_{DS(on)}$	Drain-Source On Resistance <sup>②</sup>	$V_{GS} = 20V, I_D = 30A$		75	90	mΩ
$V_{GS(th)}$	Gate-Source Threshold Voltage	$V_{GS} = V_{DS}, I_D = 1mA$	1.7	2.5		V
$\Delta V_{GS(th)}/\Delta T_J$	Threshold Voltage Temperature Coefficient			-4.9		mV/°C
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 700V$ $V_{GS} = 0V$	$T_J = 25^\circ C$		100	μA
			$T_J = 150^\circ C$		250	
$I_{GSS}$	Gate-Source Leakage Current	$V_{GS} = +20V / -10V$			±100	nA
ESR	Equivalent Series Resistance	$f = 1MHz, 25mV, \text{Drain Short}$		0.97		Ω

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

## DYNAMIC CHARACTERISTICS

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
$C_{iss}$	Input Capacitance	$V_{GS} = 0V, V_{DD} = 700V$ $f = 1MHz$		1935		pF
$C_{rss}$	Reverse Transfer Capacitance			45		
$C_{oss}$	Output Capacitance			240		
$Q_g$	Total Gate Charge	$V_{GS} = 0/20V$ $V_{DD} = 466V$ $I_D = 30A$		120		nC
$Q_{gs}$	Gate-Source Charge			20		
$Q_{gd}$	Gate-Drain Charge			34		
$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 466V$ $V_{GS} = 0/20V$ $I_D = 30A$ $R_G = 3.0 \Omega$ <sup>③</sup> $L = 115 \mu H$ $T_c = 25^\circ C$ Freewheeling Diode = APT10SCE65B		11		ns
$t_r$	Current Rise Time			9		
$t_{d(off)}$	Turn-Off Delay Time			34		
$t_f$	Current Fall Time			20		
$E_{on2}$	Turn-On Switching Energy <sup>④</sup>			291		
$E_{off}$	Turn-Off Switching Energy		122			
$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 466V$ $V_{GS} = 0/20V$ $I_D = 30A$ $R_G = 3.0 \Omega$ <sup>③</sup> $L = 115 \mu H$ $T_c = 150^\circ C$ Freewheeling Diode = APT10SCE65B		10		ns
$t_r$	Current Rise Time			9		
$t_{d(off)}$	Turn-Off Delay Time			37		
$t_f$	Current Fall Time			24		
$E_{on2}$	Turn-On Switching Energy <sup>④</sup>			257		
$E_{off}$	Turn-Off Switching Energy		135			

### Source-Drain Diode Characteristics

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
$V_{SD}$	Diode Forward Voltage	$I_{SD} = 30A, V_{GS} = 0V$		4.45		V
$t_{rr}$	Reverse Recovery Time	$I_{SD} = 30A, V_{DD} = 466V$ $di/dt = -1000A/\mu s$		66		ns
$Q_{rr}$	Reverse Recovery Charge			320		nC
$I_{rrm}$	Reverse Recovery Current			10		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 external gate resistance including internal gate driver impedance.  
 ④  $E_{on2}$  includes energy of APT10SCE65B free wheeling diode.

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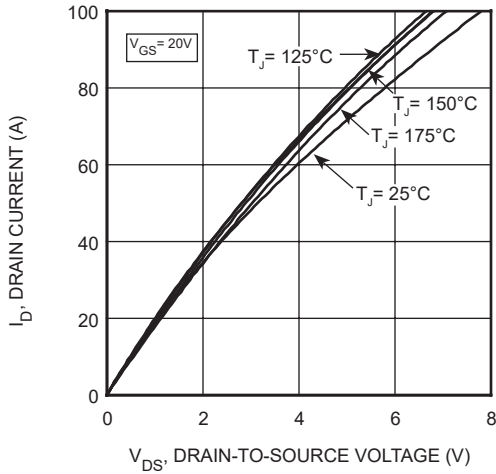


Figure 1, Output Characteristics

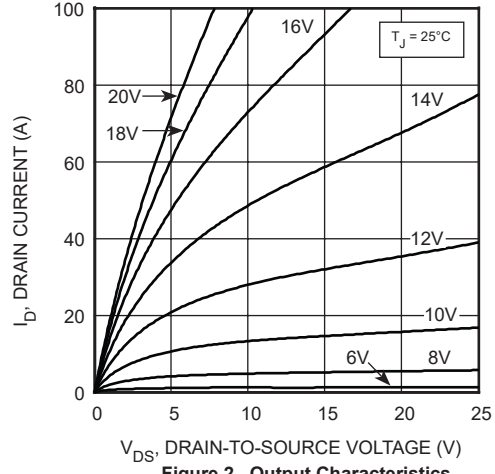


Figure 2, Output Characteristics

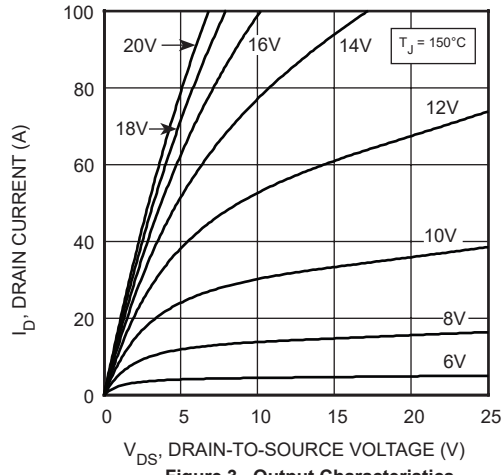


Figure 3, Output Characteristics

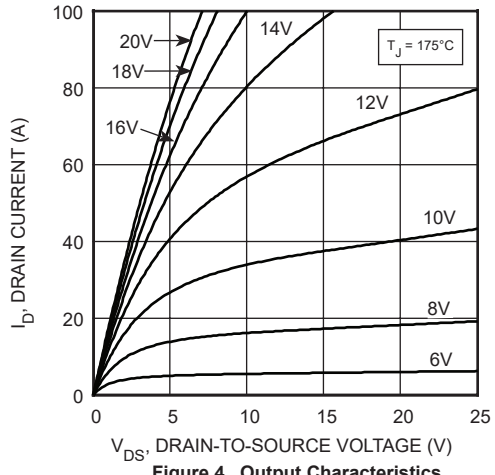


Figure 4, Output Characteristics

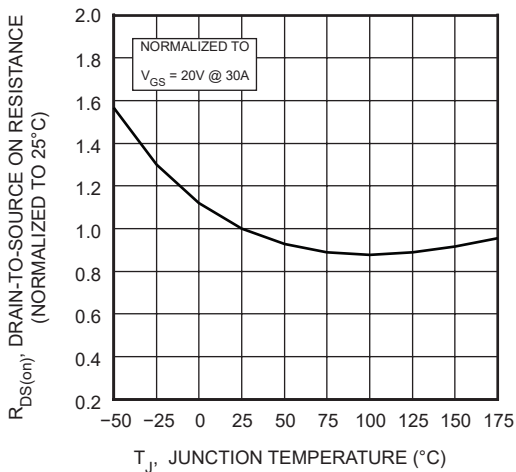


Figure 5,  $R_{DS(on)}$  vs Junction Temperature

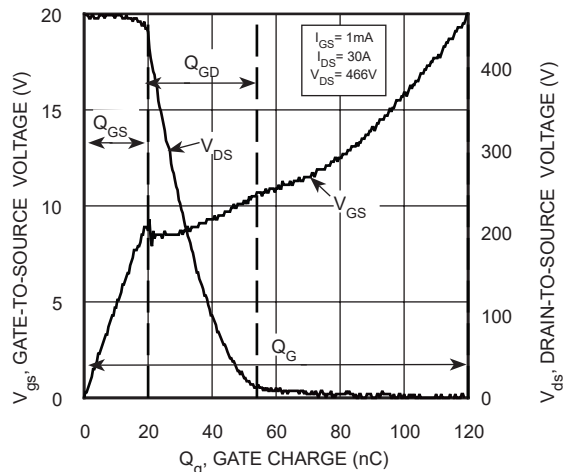


Figure 6, Gate Charge Characteristics

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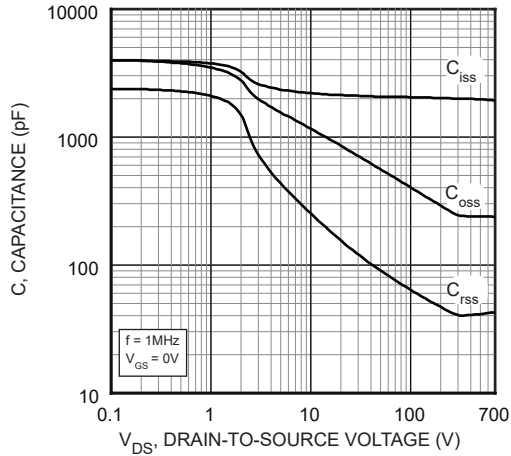


Figure 7, Capacitance vs Drain-to-Source Voltage

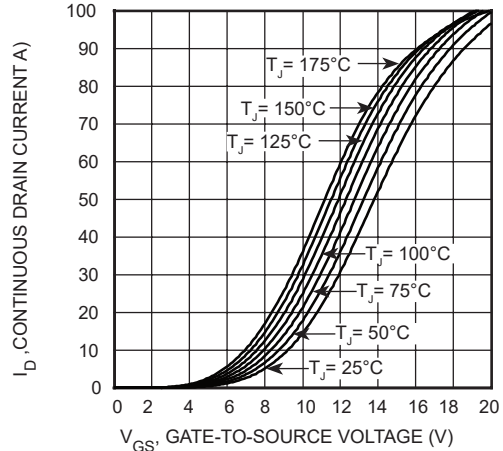


Figure 8, Output Characteristics  $I_D$  vs  $V_{GS}$  Temperature

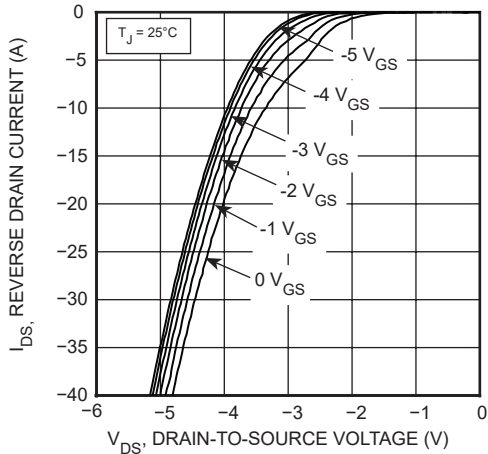


Figure 9, Reverse Drain Current vs Drain-to-Source Voltage Third Quadrant Conduction

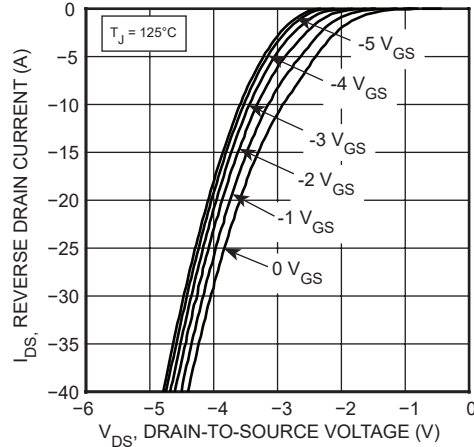


Figure 10, Reverse Drain Current vs Drain-to-Source Voltage Third Quadrant Conduction

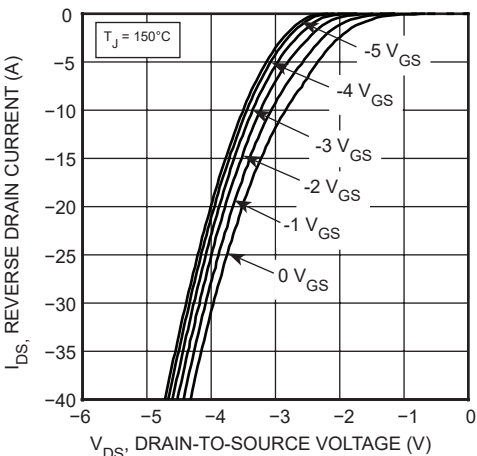


Figure 11, Reverse Drain Current vs Drain-to-Source Voltage Third Quadrant Conduction

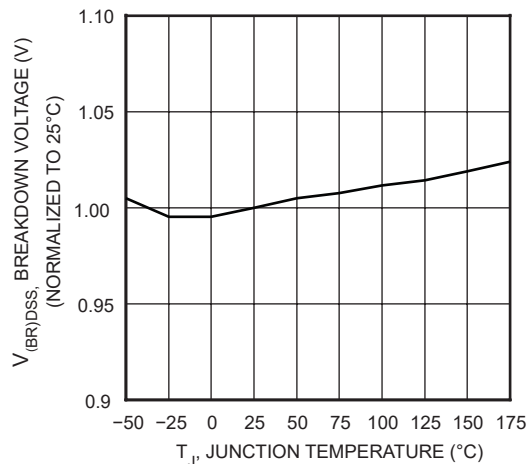


Figure 12, Breakdown Voltage vs Temperature

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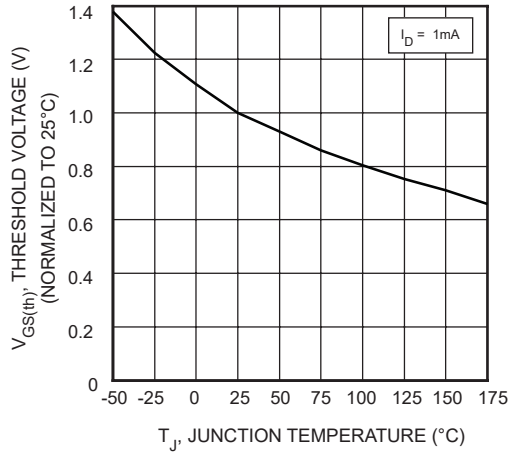


Figure 13, Threshold Voltage vs Temperature

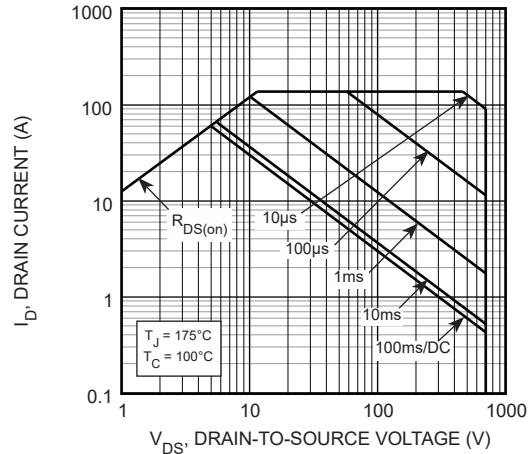


Figure 14, Forward Safe Operating Area

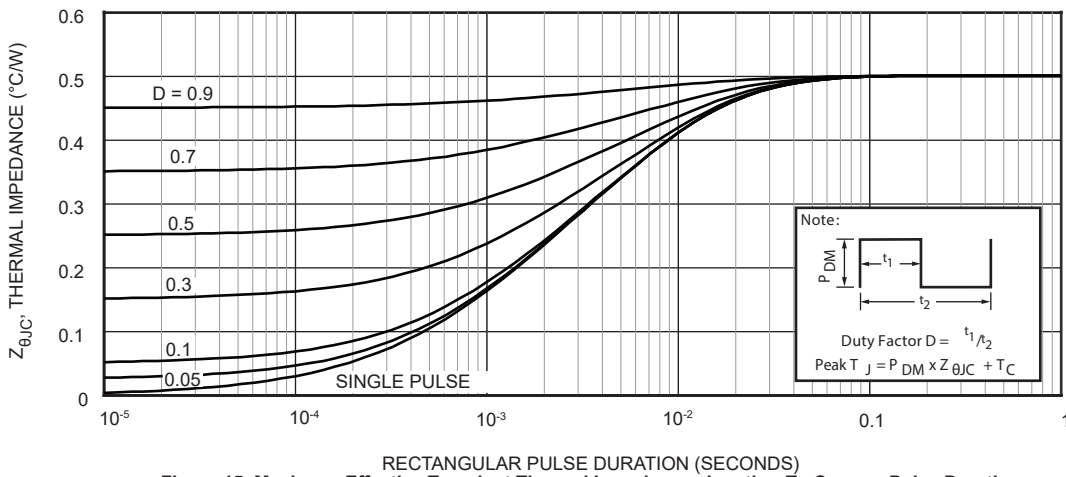
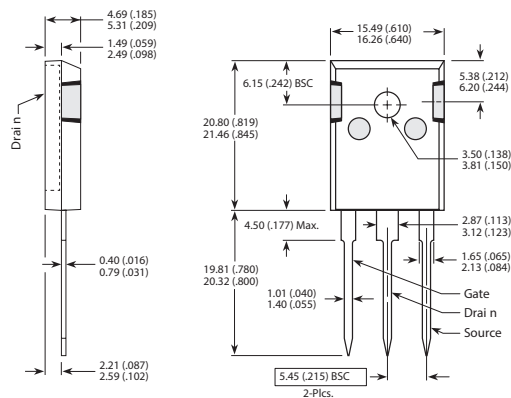


Figure 15, Maximum Effective Transient Thermal Impedance, Junction-To-Case vs Pulse Duration

## TO-247 (B) Package Outline



Dimensions in Millimeters (Inches)

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