

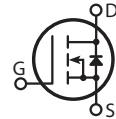
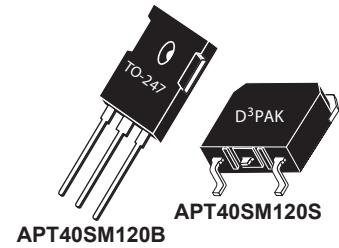
## Silicon Carbide Power MOSFET

### FEATURES

- Fast switching with low EMI/RFI
- Low Switching Energy
- Low  $R_{DS(on)}$  Temperature Coefficient For Improved Efficiency
- Low gate charge
- Short Circuit Withstand Rated
- RoHS compliant

### TYPICAL APPLICATIONS

- PFC and other boost converter
- Buck converter
- Two switch forward (asymmetrical bridge)
- Single switch forward
- Flyback
- Inverters



### Maximum Ratings

Symbol	Parameter	Ratings	Unit
$V_{DSS}$	Drain Source Voltage	1200	V
$I_D$	Continuous Drain Current @ $T_c = 25^\circ\text{C}$	41	A
	Continuous Drain Current @ $T_c = 100^\circ\text{C}$	29	
$I_{DM}$	Pulsed Drain Current <sup>①</sup>	100	
$V_{GS}$	Gate-Source Voltage	-10 to +25	V
SCWT	Short Circuit Withstand Time: $V_{DD} = 960\text{V}$ , $V_{GS} = 20\text{V}$ , $T_c = 25^\circ\text{C}$	8	$\mu\text{s}$
$P_D$	Total Power Dissipation @ $T_c = 25^\circ\text{C}$	273	W
	Linear Derating Factor	1.82	W/ $^\circ\text{C}$

### Thermal and Mechanical Characteristics

Symbol	Characteristic	Min	Typ	Max	Unit
$R_{\theta JC}$	Junction to Case Thermal Resistance			0.55	$^\circ\text{C}/\text{W}$
$T_J, T_{STG}$	Operating and Storage Junction Temperature Range	-55		175	$^\circ\text{C}$
$T_L$	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

### Static Characteristics

$T_J = 25^\circ\text{C}$  unless otherwise specified

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
$V_{BR(DSS)}$	Drain-Source Breakdown Voltage	$V_{GS} = 0\text{V}$ , $I_D = 1\text{mA}$	1200			V
$\Delta V_{BR(DSS)}/\Delta T_J$	Breakdown Voltage Temperature Coefficient	Reference to $25^\circ\text{C}$ , $I_D = 1\text{mA}$		0.250		V/ $^\circ\text{C}$
$R_{DS(on)}$	Drain-Source On Resistance <sup>②</sup>	$V_{GS} = 20\text{V}$ , $I_D = 20\text{A}$		80	100	m $\Omega$
$V_{GS(th)}$	Gate-Source Threshold Voltage	$V_{GS} = V_{DS}$ , $I_D = 1\text{mA}$	1.7	3.0		V
$\Delta V_{GS(th)}/\Delta T_J$	Threshold Voltage Temperature Coefficient				-6	
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 1200\text{V}$ $V_{GS} = 0\text{V}$	$T_J = 25^\circ\text{C}$	1	100	$\mu\text{A}$
			$T_J = 125^\circ\text{C}$		500	
$I_{GSS}$	Gate-Source Leakage Current	$V_{GS} = +20\text{V} / -10\text{V}$			$\pm 100$	nA
ESR	Equivalent Series Resistance	$f = 1\text{MHz}$ , 25mV, Drain Short		1.3		$\Omega$

## Dynamic Characteristics

 $T_J = 25^\circ\text{C}$  unless otherwise specified

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
$C_{iss}$	Input Capacitance	$V_{GS} = 0V, V_{DD} = 1000V$ $f = 1MHz$		2560		pF
$C_{rss}$	Reverse Transfer Capacitance			20		
$C_{oss}$	Output Capacitance			120		
$Q_g$	Total Gate Charge	$V_{GS} = 0/20V$ $V_{DD} = 800V$ $I_D = 20A$		130		nC
$Q_{gs}$	Gate-Source Charge			30		
$Q_{gd}$	Gate-Drain Charge			60		
$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 800V$ $V_{GS} = 20V$ $I_D = 20A$ $R_G = 0.7 \Omega$ ③		10		ns
$t_r$	Current Rise Time			10		
$t_{d(off)}$	Turn-Off Delay Time			40		
$t_f$	Current Fall Time			25		
$E_{on2}$	Turn-On Switching Energy ④	$L = 115 \mu H$ $T_c = 25^\circ C$		435		$\mu J$
$E_{off}$	Turn-Off Switching Energy			130		
$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 800V$ $V_{GS} = 20V$ $I_D = 20A$ $R_G = 0.7 \Omega$ ③		10		ns
$t_r$	Current Rise Time			10		
$t_{d(off)}$	Turn-Off Delay Time			45		
$t_f$	Current Fall Time			30		
$E_{on2}$	Turn-On Switching Energy ④		$L = 115 \mu H$ $T_c = 150^\circ C$		405	
$E_{off}$	Turn-Off Switching Energy			140		

## Source-Drain Diode Characteristics

 $T_J = 25^\circ\text{C}$  unless otherwise specified

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
$V_{SD}$	Diode Forward Voltage	$I_{SD} = 20A, T_J = 25^\circ C, V_{GS} = 0V$		3.9		V
$t_{rr}$	Reverse Recovery Time	$I_{SD} = 20A, V_{DD} = 800V$ $di/dt = 100A/\mu s, T_J = 25^\circ C$		140		ns
$Q_{rr}$	Reverse Recovery Charge			115		nC
$I_{rrm}$	Reverse Recovery Current			2.0		A

- ① Repetitive Rating: Pulse width and case temperature limited by maximum junction temperature.  
 ② Pulse test: Pulse Width < 380 $\mu s$ , duty cycle < 2%.  
 ③  $R_G$  is total gate resistance including internal gate driver impedance (MIC4452).  
 ④ Free wheeling diode APT10SCD120B.

TYPICAL PERFORMANCE CURVES

APT40SM120B\_S

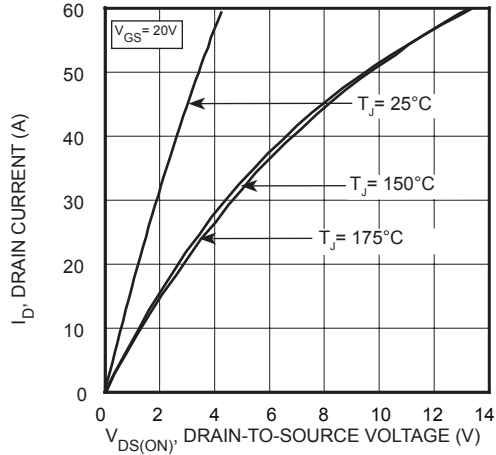


Figure 1, Output Characteristics

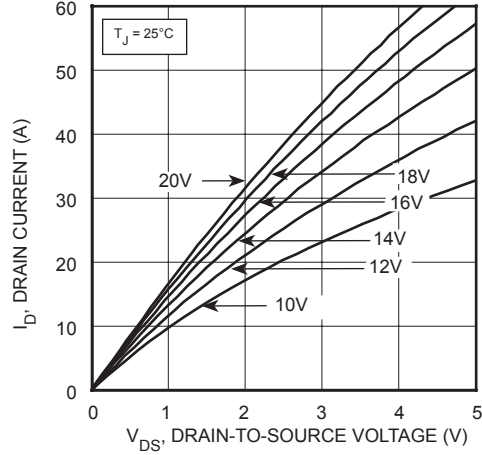


Figure 2, Output Characteristics

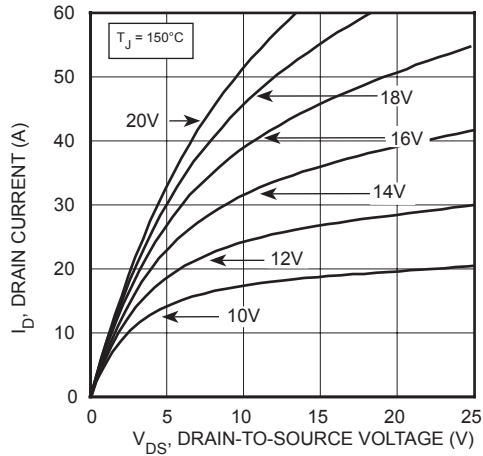


Figure 3, Output Characteristics

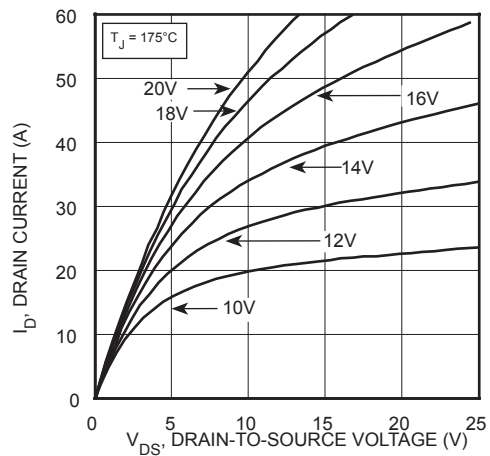


Figure 4, Output Characteristics

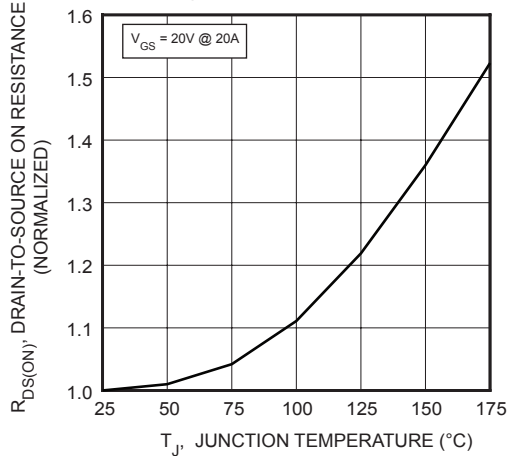


Figure 5,  $R_{DS(ON)}$  vs Junction Temperature

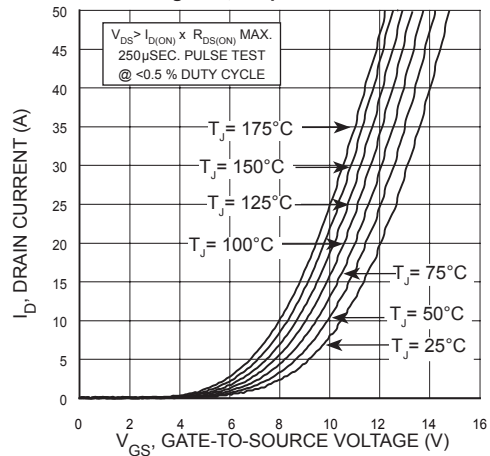


Figure 6, Transfer Characteristics

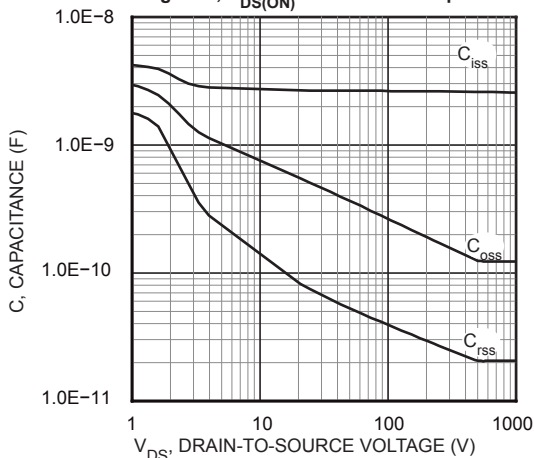


Figure 7, Capacitance vs Drain-to-Source Voltage

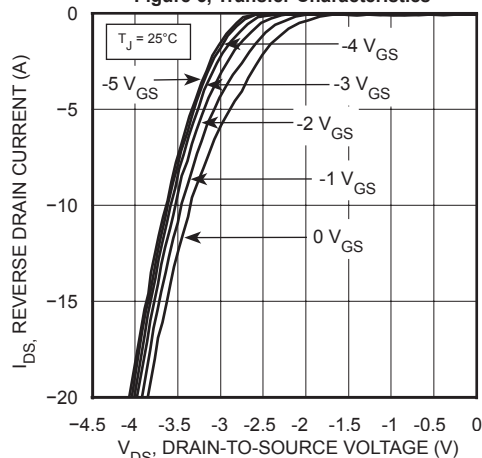


Figure 8, Reverse Drain Current vs Drain-to-Source Voltage

TYPICAL PERFORMANCE CURVES

APT40SM120B\_S

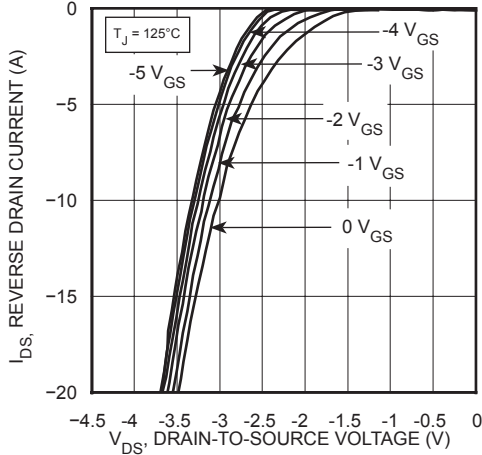


Figure 9, Reverse Drain Current vs Drain-to-Source Voltage

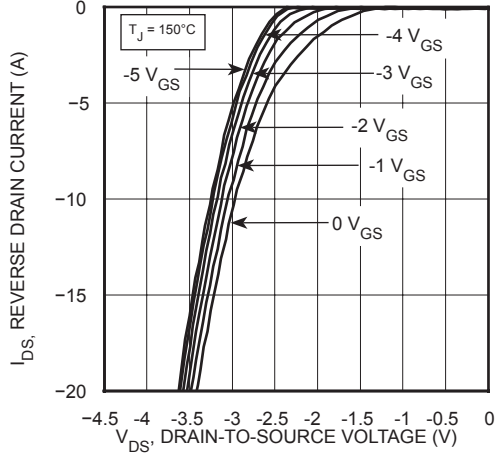


Figure 10, Reverse Drain Current vs Drain-to-Source Voltage

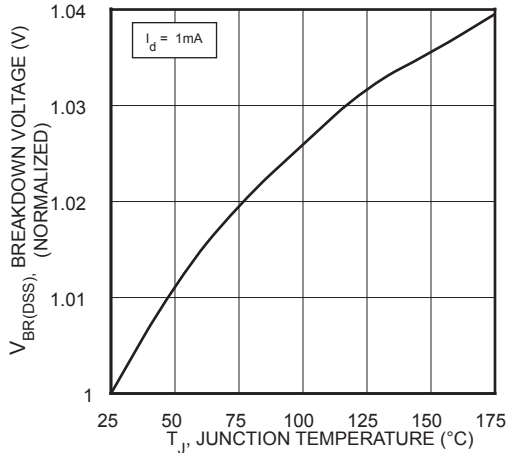


Figure 11, Breakdown Voltage vs Temperature

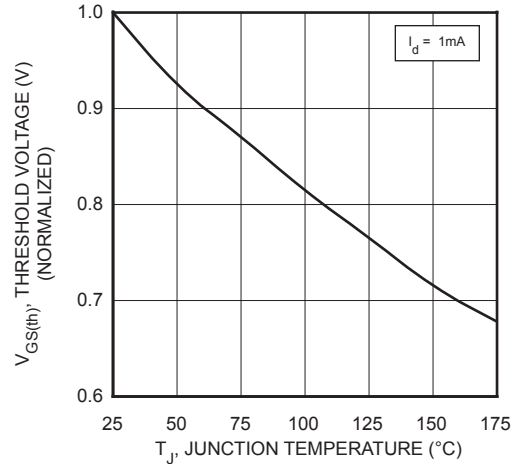


Figure 12, Threshold Voltage vs Temperature

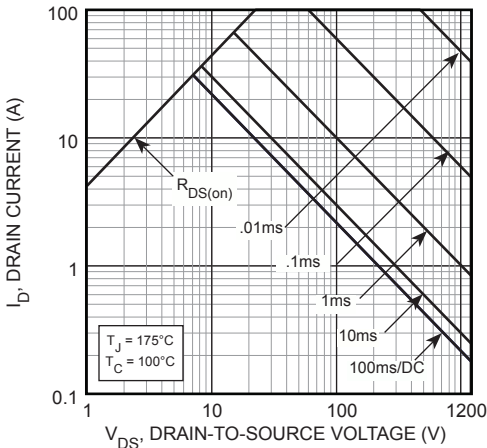


Figure 13, Forward Safe Operating Area

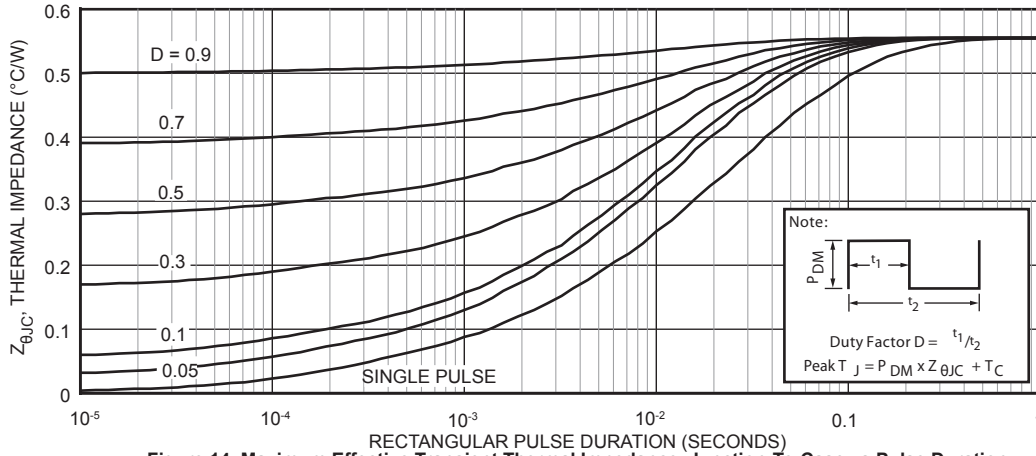
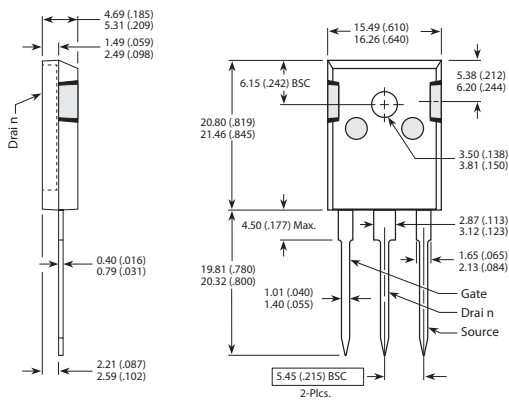


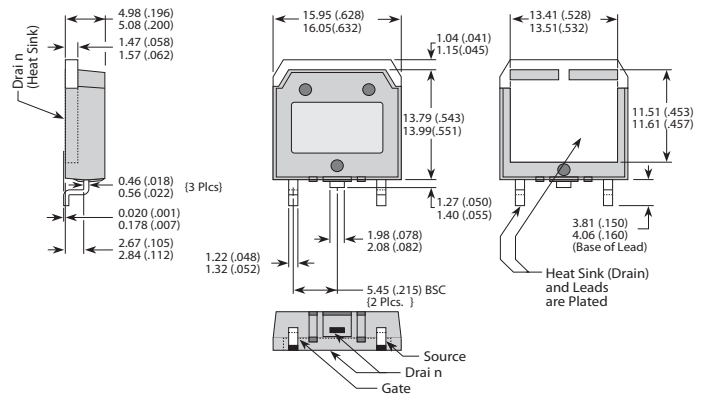
Figure 14, Maximum Effective Transient Thermal Impedance, Junction-To-Case vs Pulse Duration

**TO-247 (B) Package Outline**

① SAC: Tin, Silver, Copper



**D<sup>3</sup>PAK (S) Package Outline**



Dimensions in Millimeters (Inches)

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