# Silicon Carbide N-Channel Power MOSFET

FEATURES

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

TYPICAL APPLICATIONS

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

APT80SM120S

APT80SM120B
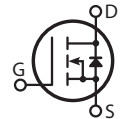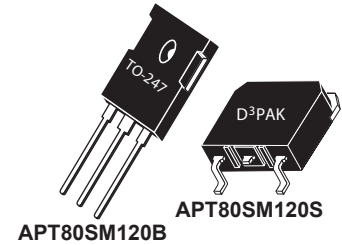
Maximum Ratings

Symbol	Parameter	Ratings	Unit
V_{DSS}	Drain Source Voltage	1200	V
I_D	Continuous Drain Current @ T_C = 25°C	80	A
	Continuous Drain Current @ T_C = 100°C	55	
I_{DM}	Pulsed Drain Current①	190	
V_{GS}	Gate-Source Voltage	-10 to +25	V
P_D	Total Power Dissipation @ T_C = 25°C	625	W/°C
	Linear Derating Factor	4.17	

Thermal and Mechanical Characteristics

Symbol	Characteristic	Min	Typ	Max	Unit
$R_{\theta JC}$	Junction to Case Thermal Resistance		0.2	0.24	°C/W
T_J, T_{STG}	Operating and Storage Junction Temperature Range	-55		175	°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°C unless otherwise specified

Symbol	Parameter	Test Conditions		Min	Typ	Max	Unit
$V_{BR(DSS)}$	Drain-Source Breakdown Voltage	V_{GS} = 0V, I_D = 1mA		1200			V
$\Delta V_{BR(DSS)}/\Delta T_J$	Breakdown Voltage Temperature Coefficient	Reference to 25°C, I_D = 1mA			0.26		V/°C
$R_{DS(on)}$	Drain-Source On Resistance②	V_{GS} = 20V, I_D = 40A			40	55	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				-4.3		mV/°C
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = 1200V V_{GS} = 0V	T_J = 25°C			100	µA
			T_J = 150°C			250	
I_{GSS}	Gate-Source Leakage Current	V_{GS} = +20V / -10V				±100	nA
ESR	Equivalent Series Resistance	f = 1MHz, 25mV, Drain Short			0.76		Ω

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
C_{iss}	Input Capacitance	V_{GS} = 0V, V_{DD} = 1000V f = 1MHz		4600		pF
C_{rss}	Reverse Transfer Capacitance			34		
C_{oss}	Output Capacitance			250		
E_{oss}	Typical Output Capacitance Stored Energy	V_{GS} = 0V, V_{DD} = 1000V f = 1MHz		133		µJ
$C_{o(er)}$	Effective Output Capacitance			266		pF
Q_g	Total Gate Charge	V_{GS} = 0/20V V_{DD}= 800V I_D = 40A		235		nC
Q_{gs}	Gate-Source Charge			40		
Q_{gd}	Gate-Drain Charge			50		
$t_{d(on)}$	Turn-On Delay Time	V_{DD} = 800V V_{GS} = 0/20V I_D = 40A R_G = 0.7 Ω ③ L = 115 µH T_c = 25°C		13		ns
t_r	Current Rise Time			9		
$t_{d(off)}$	Turn-Off Delay Time			42		
t_f	Current Fall Time			19		
E_{on2}	Turn-On Switching Energy④			720		µJ
E_{off}	Turn-Off Switching Energy			175		
$t_{d(on)}$	Turn-On Delay Time	V_{DD} = 800V V_{GS} = 0/20V I_D = 40A R_G = 0.7 Ω ③ L = 115 µH T_c = 150°C		11		ns
t_r	Current Rise Time			9		
$t_{d(off)}$	Turn-Off Delay Time			48		
t_f	Current Fall Time			22		
E_{on2}	Turn-On Switching Energy④			710		µJ
E_{off}	Turn-Off Switching Energy			200		

Source-Drain Diode Characteristics T_J = 25°C unless otherwise specified

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V_{SD}	Diode Forward Voltage	I_{SD} = 40A, T_J = 25°C, V_{GS} = 0V		3.75		V
t_{rr}	Reverse Recovery Time	I_{SD} = 40A, V_{DD} = 800V dI/dt = -100A/µs, T_J = 25°C		245		ns
Q_{rr}	Reverse Recovery Charge			250		nC
I_{rrm}	Reverse Recovery Current			2.7		A

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.
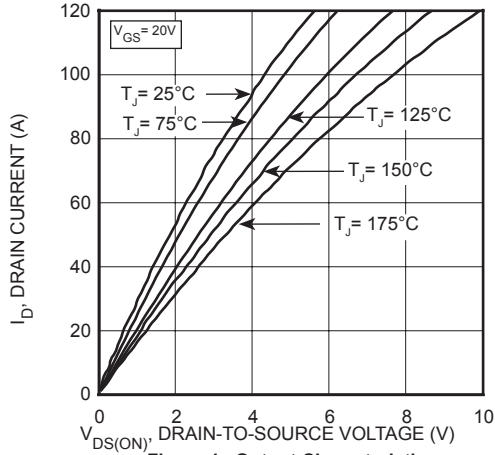
④ Free wheeling diode APT20SCD120B.

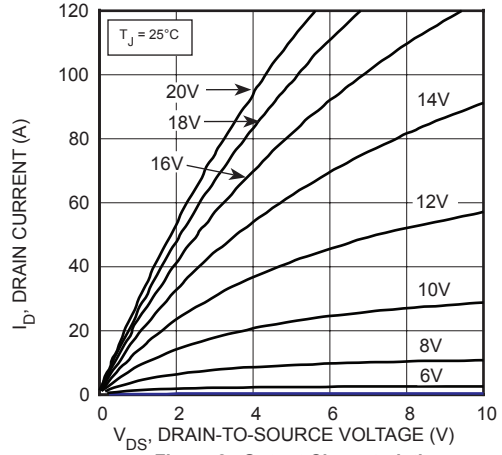Figure 1, Output Characteristics

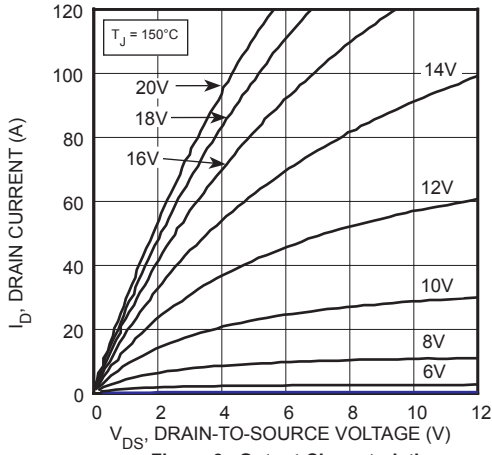Figure 2, Output Characteristics

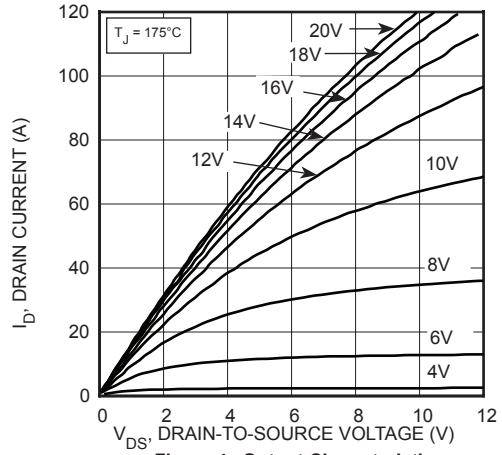Figure 3, Output Characteristics
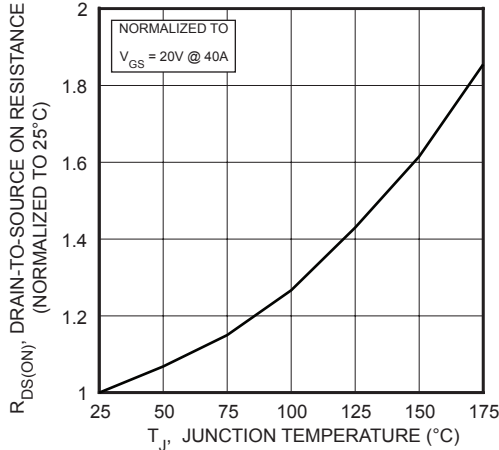

Figure 4, Output Characteristics

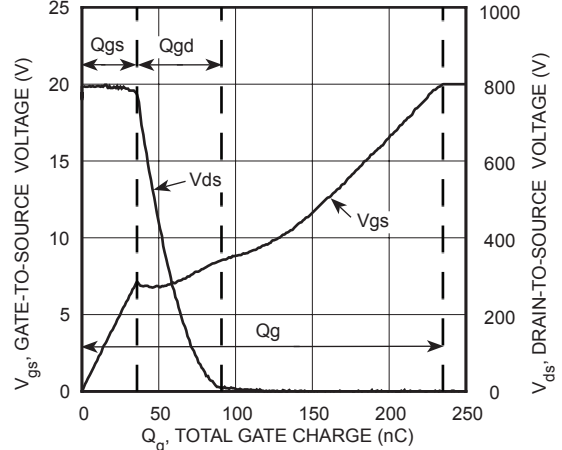Figure 5, $R_{DS(ON)}$ vs Junction Temperature

Figure 6, Gate Charge vs Gate-to-Source Voltage

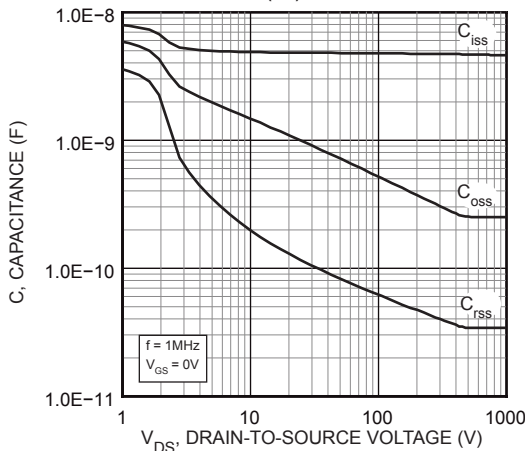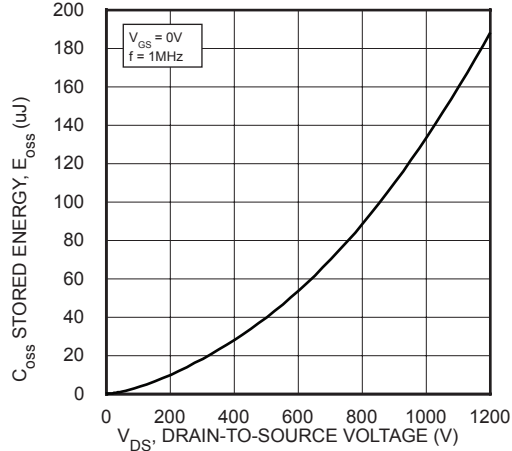Figure 7, Capacitance vs Drain-to-Source Voltage

Figure 8, Typical Output Cpacitance Stored Energy, E_{oss}

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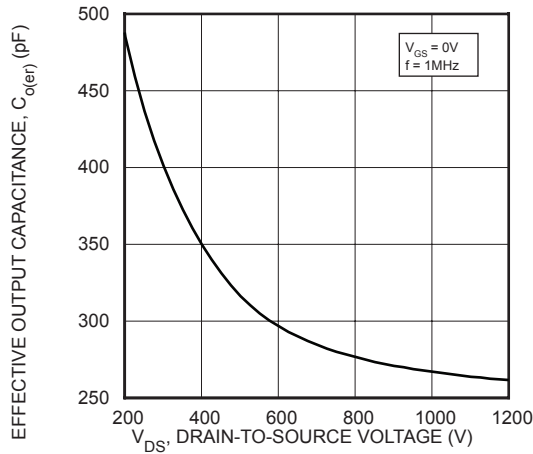
Figure 9, Effective Output Capacitance, C$_{o(er)}$
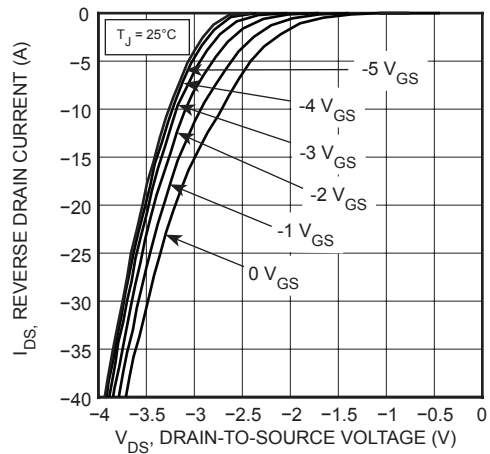
Figure 10, Reverse Drain Current vs Drain-to-Source Voltage
Third Quadrant Conduction
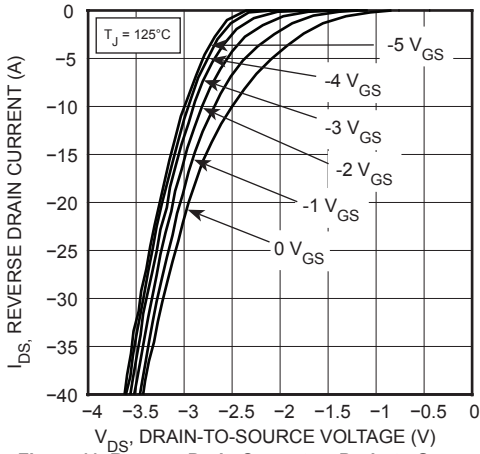
Figure 11, Reverse Drain Current vs Drain-to-Source Voltage
Third Quadrant Conduction
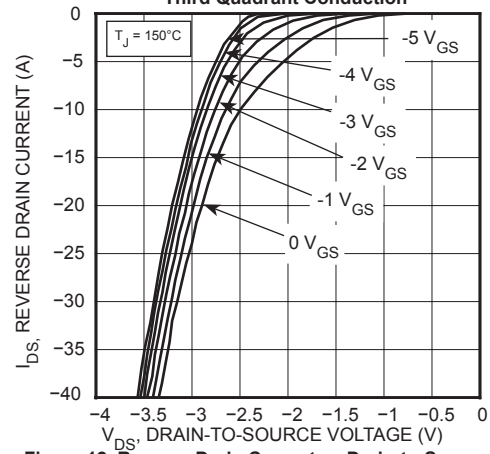
Figure 12, Reverse Drain Current vs Drain-to-Source Voltage
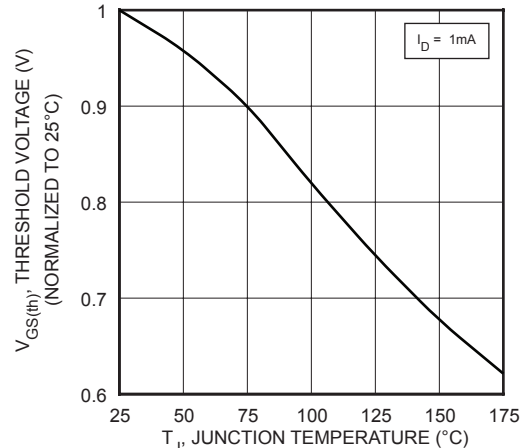**Third Quadrant Conduction**
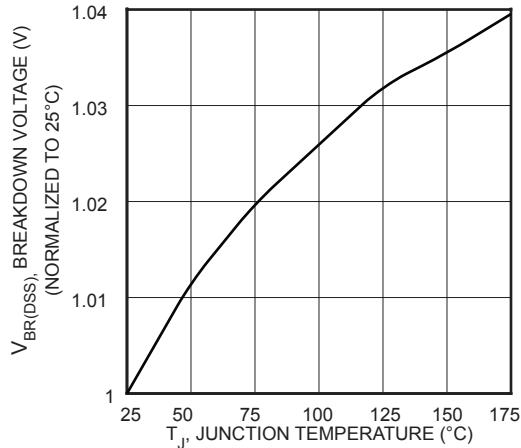
Figure 13, Breakdown Voltage vs Temperature
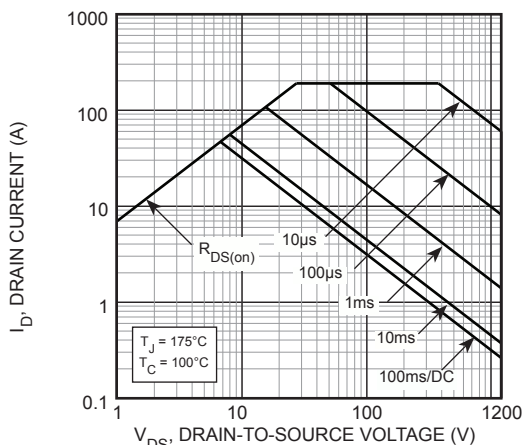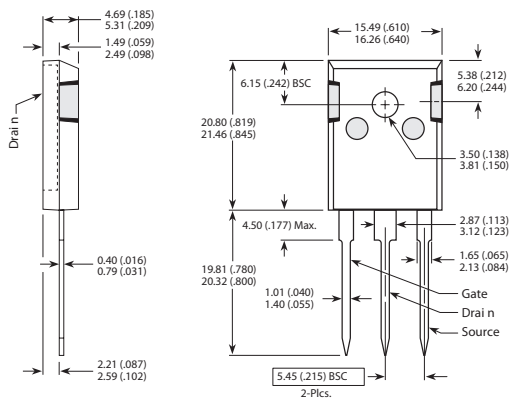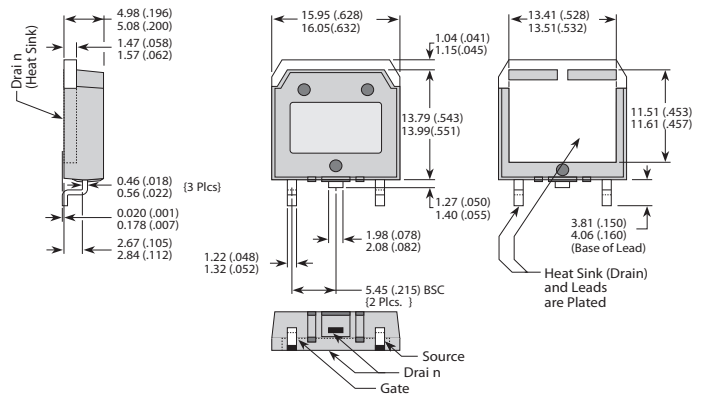
Figure 14, Threshold Voltage vs Temperature

Figure 15, Forward Safe Operating Area

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$Z_{\theta JC}$, THERMAL IMPEDANCE (°C/W)

D = 0.9

0.7

0.5

0.3

0.1

0.05

SINGLE PULSE

Note:

P_{DM}

t_1

t_2

Duty Factor D = t_1/t_2

Peak T_J = P_{DM} x $Z_{\theta JC}$ + T_C

RECTANGULAR PULSE DURATION (SECONDS)

Figure 16, Maximum Effective Transient Thermal Impedance, Junction-To-Case vs Pulse Duration

TO-247 (B) Package Outline

4.69 (.185)
5.31 (.209)

1.49 (.059)
2.49 (.098)

Drain

15.49 (.610)
16.26 (.640)

6.15 (.242) BSC

20.80 (.819)
21.46 (.845)

5.38 (.212)
6.20 (.244)

3.50 (.138)
3.81 (.150)

4.50 (.177) Max.

2.87 (.113)
3.12 (.123)

1.65 (.065)
2.13 (.084)

19.81 (.780)
20.32 (.800)

1.01 (.040)
1.40 (.055)

Gate
Drain
Source

0.40 (.016)
0.79 (.031)

2.21 (.087)
2.59 (.102)

5.45 (.215) BSC
2-Plcs.

D³PAK (S) Package Outline

4.98 (.196)
5.08 (.200)

Drain
(Heat Sink)

1.47 (.058)
1.57 (.062)

15.95 (.628)
16.05 (.632)

1.04 (.041)
1.15 (.045)

13.79 (.543)
13.99 (.551)

13.41 (.528)
13.51 (.532)

11.51 (.453)
11.61 (.457)

0.46 (.018)
0.56 (.022)   {3 Plcs}

0.020 (.001)
0.178 (.007)

2.67 (.105)
2.84 (.112)

1.22 (.048)
1.32 (.052)

1.98 (.078)
2.08 (.082)

1.27 (.050)
1.40 (.055)

3.81 (.150)
4.06 (.160)
(Base of Lead)

Heat Sink (Drain)
and Leads
are Plated

5.45 (.215) BSC
{2 Plcs. }

Source
Drain
Gate

Dimensions in Millimeters (Inches)

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Disclaimer: