

High Temperature Silicon Carbide Power MOSFET

N-Channel Enhancement Mode

1200 V / 50 A / 80 mΩ

FEATURES

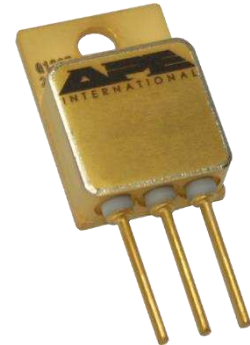
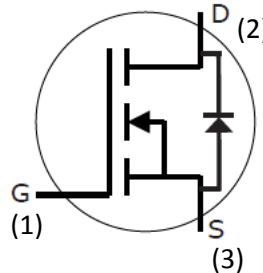
- High temperature: $T_{C(max)} = 225\text{ °C}$, $T_{J(max)} = 225\text{ °C}$
- AS9100:Rev. C-certified manufacturing, traceable throughout value chain
- < 20 ns switching, enables high system efficiency
- Hermetic seal; flux-free packaging; high reliability
- Backside isolation

HIGH TEMPERATURE APPLICATIONS

- Downhole tools
- High efficiency DC/DC converters & motor drives
- Aerospace: Military & Commercial
- Smart grid/grid-tie distributed generation
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COMPANION PARTS

- Silicon Carbide Schottky Diodes, APE HT-0122, APE HT-0123
- Low-Temperature Single-Channel Gate Driver, APE ITGD1-0021
- Mil-Temperature Dual-Channel Gate Driver, APE MTGD2-2011
- High-Temperature Dual-Channel Gate Driver, APE HTGD2-0031



TO-254 Package 1 2 3
G D S

Absolute Maximum Ratings¹ ($T_J = 25\text{ °C}$ unless otherwise specified)

Symbol	Parameter	Condition(s)	Value	Units
V_{DSS}	Drain-source voltage		1200	V
V_{GSS}	Gate-source voltage		-5 to 25	V
I_D	Continuous drain current ²	$V_{GS} = 20\text{ V}$, $T_C = 25\text{ °C}$	50	A
		$V_{GS} = 20\text{ V}$, $T_C = 100\text{ °C}$	40 ³	
		$V_{GS} = 20\text{ V}$, $T_C = 200\text{ °C}$	18 ³	
I_{DM}	Peak pulsed drain current ¹	Pulse width t_p limited by $T_{J(max)}$; $T_J = 25\text{ °C}$, $t_p = 1\text{ ms}$	90	A
E_{AS}	Single-pulse avalanche energy	$I_D = 20\text{ A}$, $V_{DD} = 50\text{ V}$, $L = 9.5\text{ mH}$	2.2	J
E_{AR}	Repetitive avalanche energy	t_{AR} limited by $T_{J(max)}$	1.5	J
I_{AR}	Repetitive avalanche current	$I_D = 20\text{ A}$, $V_{DD} = 50\text{ V}$, $L = 3\text{ mH}$; t_{AR} limited by $T_{J(max)}$	20	A
P_{tot}	Power dissipation ¹	$T_C = 25\text{ °C}$	200 ³	W
		$T_C = 100\text{ °C}$	125 ³	
		$T_C = 200\text{ °C}$	25 ³	
T_J	Operating junction temperature		-50 to 225 ³	°C
T_{stg}	Storage temperature		-50 to 225 ³	°C
V_{isol}	Insulation test voltage	AC, 1 min.	TBD	V
		AC, 1 s.	TBD	V

¹ Obtained from Cree Inc. CPMF-1200-S080B Rev. A datasheet

² Assumes a thermal resistance junction to case of $\leq 1.0\text{ °C/W}$

³ Data obtained through APEI experimentation and/or calculation

SiC MOSFET Electrical Characteristics¹ (T_J = 25 °C unless otherwise specified)							
Symbols	Parameter	Condition(s)	Values			Units	
			Min.	Typical	Max.		
V _{(BR)DSS}	Drain-source breakdown voltage	V _{GS} = 0 V, I _D = 100 μA	1200	-	-	V	
V _{GS(th)}	Gate-source threshold voltage ⁴	V _{DS} = V _{GS} , I _D = 1 mA	-	2.5	-	V	
		V _{DS} = V _{GS} , I _D = 1 mA, T _J = 225 °C ³	-	1.6	-		
I _{DSS}	Zero gate voltage drain current	V _{DS} = 1200 V, V _{GS} = 0 V	-	1	100	μA	
		V _{DS} = 1200 V, V _{GS} = 0 V, T _J = 225 °C ³	-	-	2000		
I _{GSS}	Gate-source leakage current	V _{GS} = 20 V, V _{DS} = 0 V	-	-	250	nA	
R _{DS(on)}	Drain-source on-resistance	V _{GS} = 20 V, I _D = 20 A	-	80	110	mΩ	
		V _{GS} = 20 V, I _D = 20 A, T _J = 225 °C ³	-	190	260		
g _{fs}	Transconductance	V _{GS} = 20 V, I _D = 20 A	-	7.3	-	S	
		V _{GS} = 20 V, I _D = 20 A, T _J = 225 °C ³	-	TBD	-		
C _{iss}	Input capacitance	V _{GS} = 0 V	-	1915	-	pF	
C _{oss}	Output capacitance	V _{DS} = 800 V	-	120	-	pF	
C _{rss}	Reverse transfer capacitance	f = 1 MHz V _{AC} = 25 mV	-	13	-	pF	
t _{d(on)}	Turn-on delay time	V _{DD} = 800 V, V _{GS} = -2 to 20 V I _D = 20 A R _{G(ext)} = 6.8 Ω, L = 856 μH Per JEDEC24 p. 27	-	17.2	-	ns	
t _{rv}	Rise time		-	13.6	-	ns	
t _{d(off)}	Turn-off delay time		-	62	-	ns	
t _{fv}	Fall time		-	35.6	-	ns	
E _{on}	Turn-On switching loss		-	-	530	-	μJ
			-	-	410 ⁵	-	
E _{off}	Turn-Off switching loss		-	-	320	-	μJ
		-	-	345 ⁵	-		
R _G	Internal gate resistance	V _{GS} = 0 V, f = 1 MHz, V _{AC} = 25 mV	-	5	-	Ω	

SiC Inverse Body Diode Electrical Characteristics^{1,6} (T_J = 25 °C unless otherwise specified)						
Symbols	Parameter	Condition(s)	Values			Units
			Min.	Typical	Max.	
V _{SD}	Diode forward voltage	V _{GS} = -5 V, I _F = 10 A	-	3.5	-	V
		V _{GS} = -2 V, I _F = 10 A	-	3.1	-	
t _{rr}	Reverse recovery time	V _{GS} = -5 V, I _F = 20 A	-	220	-	ns
Q _{rr}	Reverse recovery charge	V _R = 800 V	-	142	-	nC
I _{rrm}	Peak reverse recovery current	di _F /dt = 100 A/μs	-	2.3	-	A

⁴ The recommended on-state V_{GS} is +20 V and the recommended off-state V_{GS} is between 0 V and -5 V

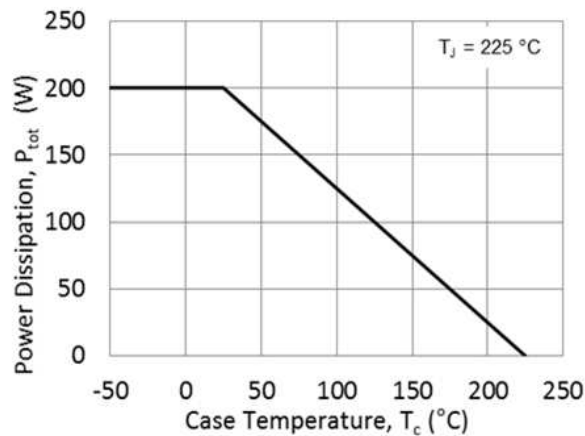
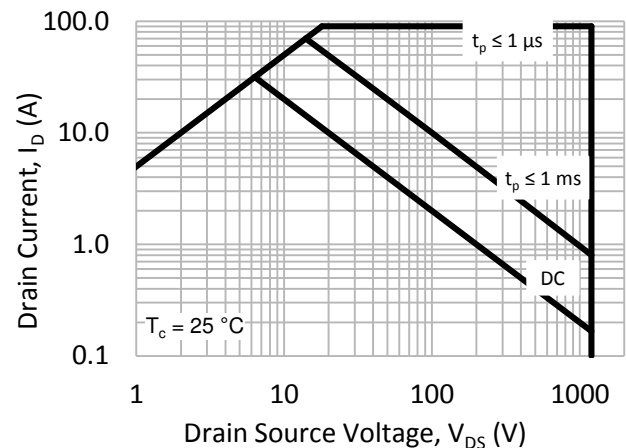
⁵ 150 °C

⁶ APEI recognizes the end user's ultimate responsibility for determining the appropriateness of use and effectiveness of the SiC inverse body diode for freewheeling capability in their specific application. APEI recommends that the end user bypass the SiC inverse body diode during operation. Increased performance may be achieved by using other APEI products found in the Companion Parts section of this datasheet.

SiC MOSFET Gate Charge Electrical Characteristics ¹ ($T_J = 25\text{ }^\circ\text{C}$ unless otherwise specified)						
Symbols	Parameter	Condition(s)	Values			Units
			Min.	Typical	Max.	
Q_{gs}	Gate to source charge	$V_{DD} = 800\text{ V}$, $V_{GS} = 0$ to 20 V	-	23.8	-	nC
Q_{gd}	Gate to drain charge	$I_D = 20\text{ A}$	-	43.1	-	nC
Q_g	Gate charge total	Per JEDEC24, p. 27	-	90.8	-	nC

Thermal Characteristics ($T_J = 25\text{ }^\circ\text{C}$ unless otherwise specified)						
Symbols	Parameter	Condition(s)	Values			Units
			Min.	Typical	Max.	
$R_{\theta(J-C)}$	Thermal resistance junction-case	Calculated at $200\text{ }^\circ\text{C}$	-	TBD	1.0	$^\circ\text{C/W}$

Mechanical Characteristics ($T_J = 25\text{ }^\circ\text{C}$ unless otherwise specified)						
Symbols	Parameter	Condition(s)	Values			Units
			Min.	Typical	Max.	
w	Weight		-	9.0	-	g
M_s	Mounting torque	6-32 steel screw, Al heat sink	-	0.78	1.04	N-m

TYPICAL PERFORMANCE CURVES

 Fig. 1 - Maximum power dissipation P_{tot} versus case temperature T_c

 Fig. 2 - Maximum safe operating area (SOA) $I_D = f(V_{DS})$

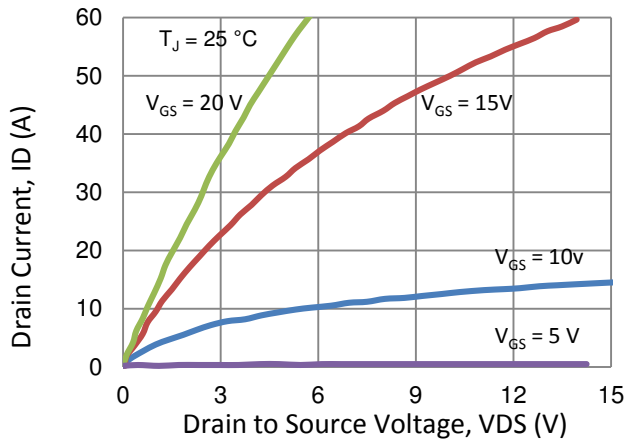
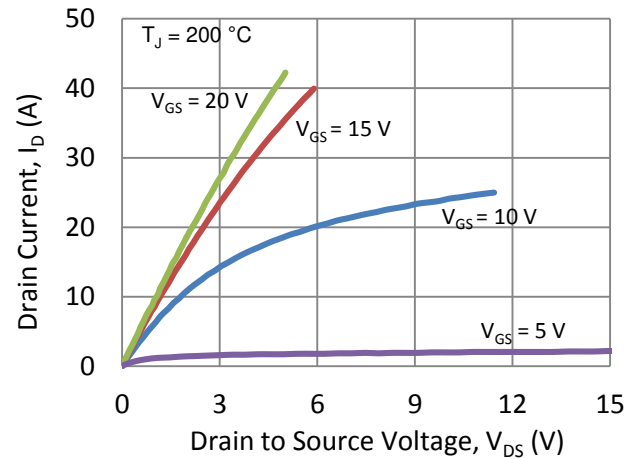
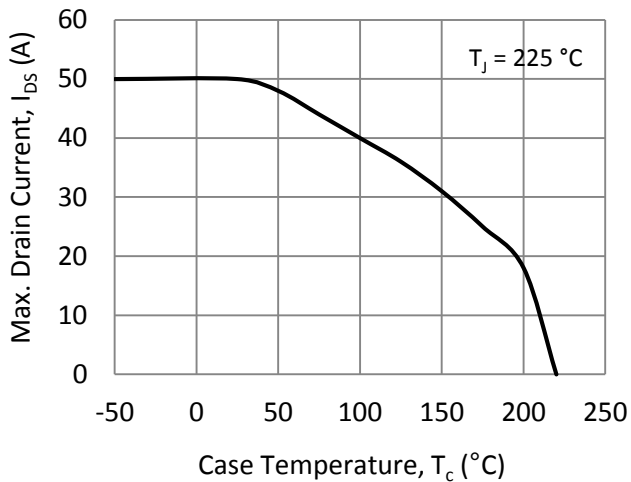
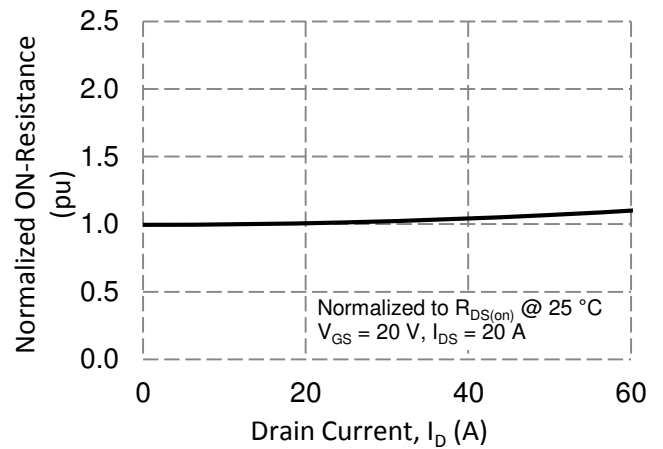

 Fig. 3 - Forward output characteristic $I_D = f(V_{DS})$, $25\text{ }^\circ\text{C}$

 Fig. 4 - Forward output characteristic $I_D = f(V_{DS})$, $200\text{ }^\circ\text{C}$

 Fig. 5 - Drain current derating versus case temperature T_C


Fig. 6 - ON-resistance versus drain current and gate-source voltage

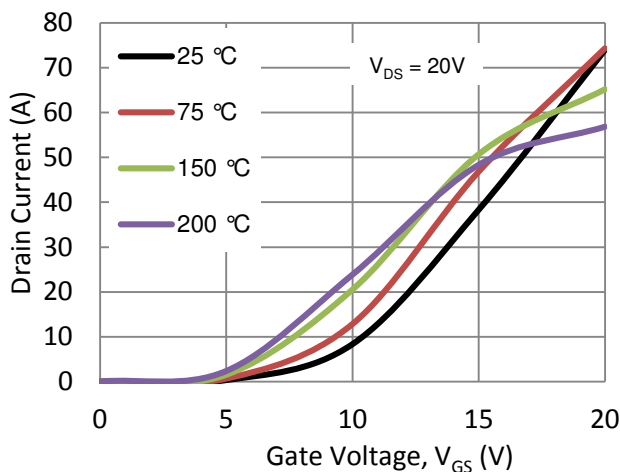
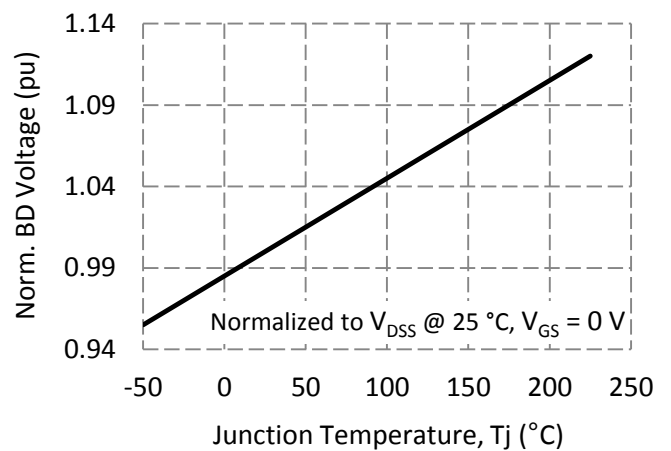
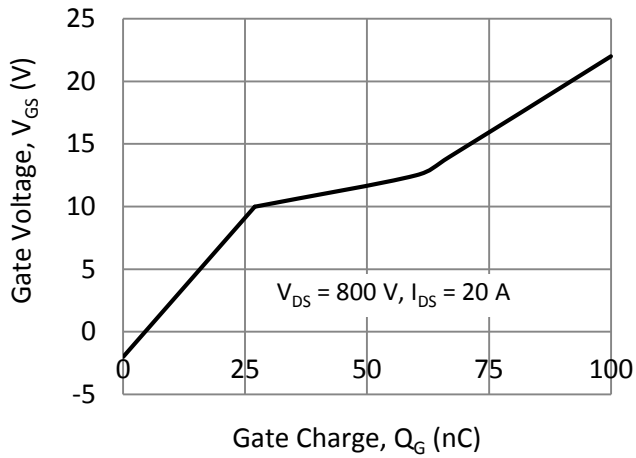
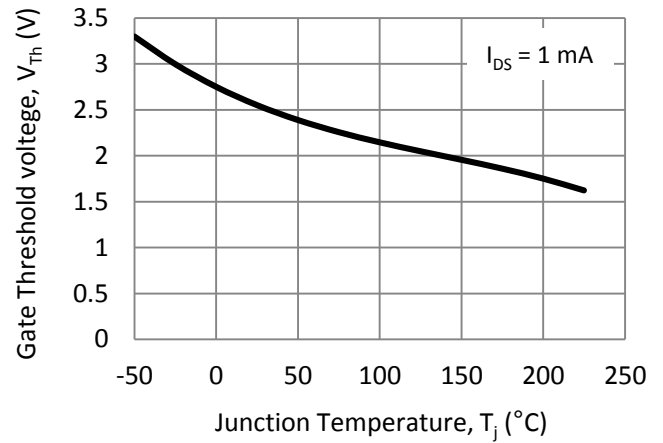
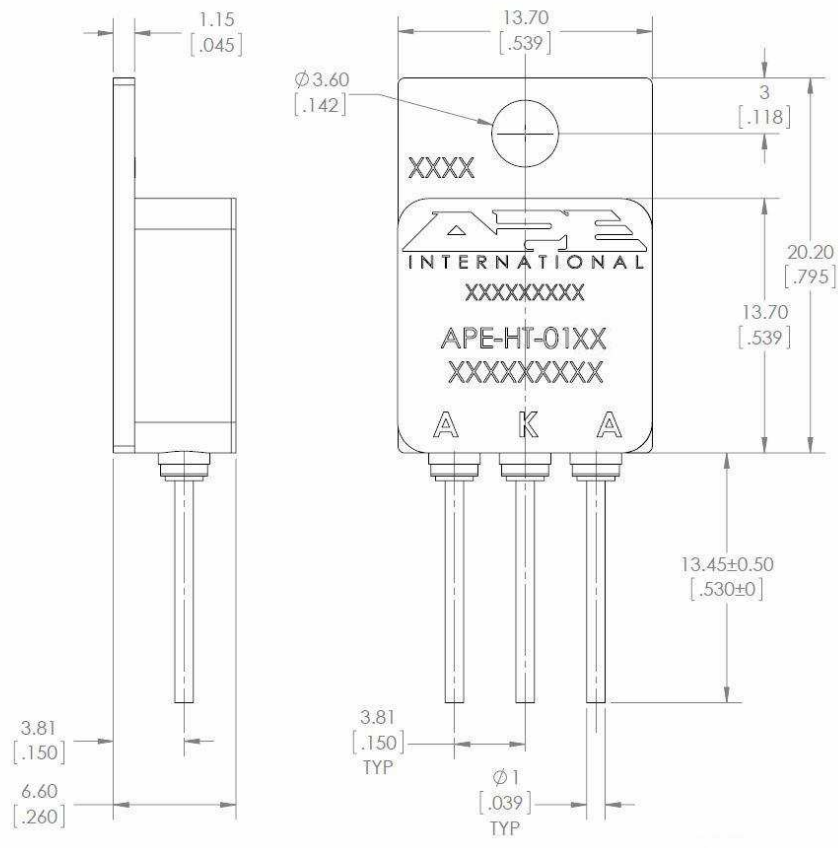


Fig. 7 - Transconductance versus temperature


 Fig. 8 - Drain-source breakdown voltage versus junction temperature T_J


 Fig. 9 - Gate charge characteristic $V_{GS} = f(Q_G)$

 Fig. 10 - Gate-source threshold voltage versus junction temperature T_J
PACKAGE DIMENSIONS

All dimensions shown are in inches [millimeters]



PART NUMBER	PACKAGE	MARKING
APE HT-0121	TO-254	Q120709001



PRELIMINARY

APE HT-0121

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