APEI

PRELIMINARY

APE HT-0111-A

High Temperature Silicon Carbide Power MOSFET

N-Channel Enhancement Mode

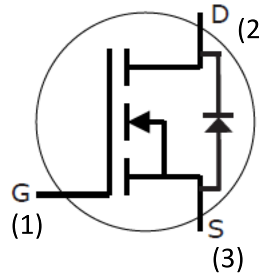
1200 V / 45 A / 80 mΩ

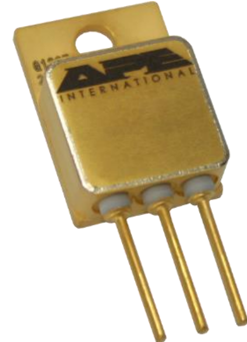
FEATURES

- High temperature: $T_{C(max)}$ = 225 °C, $T_{J(max)}$ = 225 °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





TO-254 Package	1	2	3
	G	D	S

COMPANION PARTS

- Silicon Carbide Schottky Diodes, APE HT-0112, APE HT-0122
- 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

Absolute Maximum Ratings[1] **(T_J = 25 °C unless otherwise specified)**

Symbol	Parameter	Condition(s)	Value	Units
V_{DSS}	Drain-source voltage		1200	V
V_{GSS}	Gate-source voltage		-6 to 22	V
I_D	Continuous drain current[2]	V_{GS} = 20 V, T_C = 25 °C	45	A
		V_{GS} = 20 V, T_C = 100 °C	36	
		V_{GS} = 20 V, T_C = 200 °C	16	
I_{DM}	Peak pulsed drain current[1]	Pulse width t_p limited by $T_{J(max)}$; T_J = 25 °C, t_p = 1 ms	TBD	A
E_{AS}	Single-pulse avalanche energy		TBD	J
E_{AR}	Repetitive avalanche energy		TBD	J
I_{AR}	Repetitive avalanche current		TBD	A
P_{tot}	Power dissipation[1]	T_C = 25 °C	200[2]	W
		T_C = 100 °C	125[2]	
		T_C = 200 °C	25[2]	
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 Rohm Co., Ltd. S2301 TCST Rev. 0 datasheet

[2] Assumes a thermal resistance junction to case of ≤ 1.0 °C/W

[3] Data obtained through APEI experimentation and/or calculation

SiC MOSFET Electrical Characteristics[1] (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 = 1 mA	1200	-	-	V
$V_{GS(th)}$	Gate-source threshold voltage[4]	V_{DS} = V_{GS}, I_D = 4.4 mA	1.6	-	4.0	V
		T_J = 225 °C	-	TBD	-	
I_{DSS}	Zero gate voltage drain current	V_{DS} = 1200 V, V_{GS} = 0 V	-	-	10	µA
I_{GSS}	Gate-source leakage current	V_{GS} = 22 V, V_{DS} = 0 V	-	-	100	nA
$R_{DS(on)}$	Drain-source on-resistance	V_{GS} = 18 V, I_D = 10 A	-	80	111	mΩ
		T_J = 225 °C	-	TBD	-	
g_{fs}	Transconductance	V_{DS} = 10 V, I_D = 10 A	-	3.7	-	S
		T_J = 225 °C	-	TBD	-	
C_{iss}	Input capacitance	V_{GS} = 0 V V_{DS} = 800 V f = 1 MHz	-	2080	-	pF
C_{oss}	Output capacitance		-	77	-	pF
C_{rss}	Reverse transfer capacitance		-	16	-	pF
$t_{d(on)}$	Turn-on delay time	V_{DD} = 400 V, V_{GS} = 18 V I_D = 10 A $R_{G(ext)}$ = 0 Ω, R_L = 40 Ω	-	35	-	ns
t_{rv}	Rise time		-	36	-	ns
$t_{d(off)}$	Turn-off delay time		-	76	-	ns
t_{fv}	Fall time		-	22	-	ns
E_{on}	Turn-On switching loss		-	TBD	-	µJ
			-	TBD	-	
E_{off}	Turn-Off switching loss		-	TBD	-	µJ
			-	TBD	-	

SiC Inverse Body Diode Electrical Characteristics[1,5] (T_J = 25 °C unless otherwise specified)						
Symbols	**Parameter**	**Condition(s)**	**Values**			**Units**
			Min.	**Typical**	**Max.**	
V_{SD}	Diode forward voltage	V_{GS} = -3 V, I_F = 10 A	-	4.5	-	V
t_{rr}	Reverse recovery time	V_{GS} = 0 V, I_F = 10 A V_R = 800 V di_F/dt = 400 µA/µs	-	TBD	-	ns
Q_{rr}	Reverse recovery charge		-	120	-	nC
I_{rrm}	Peak reverse recovery current		-	TBD	-	A

[4] The recommended on-state VGS is +20 V and the recommended off-state VGS is between 0 V and -5 V

[5] 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. 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 °C unless otherwise specified)						
Symbols	**Parameter**	**Condition(s)**	**Values**			**Units**
			Min.	**Typical**	**Max.**	
Q_{gs}	Gate to source charge	V_{DD} = 400 V, V_{GS} = 18 V	-	27	-	nC
Q_{gd}	Gate to drain charge	I_D = 10 A	-	31	-	nC
Q_g	Gate charge total	R_L = 40 Ω	-	106	-	nC

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

Mechanical Characteristics (T_J = 25 °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

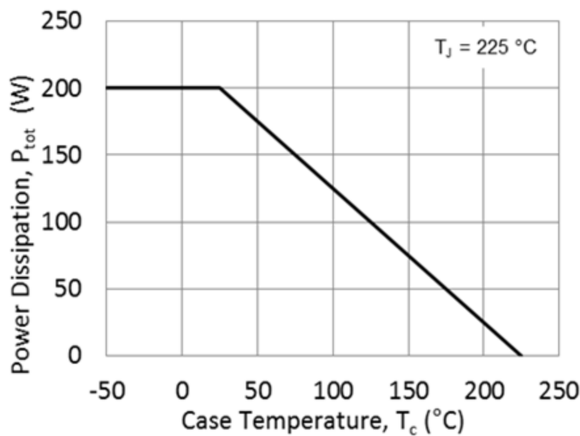


Fig. 1 - Maximum power dissipation Ptot versus case temperature Tc

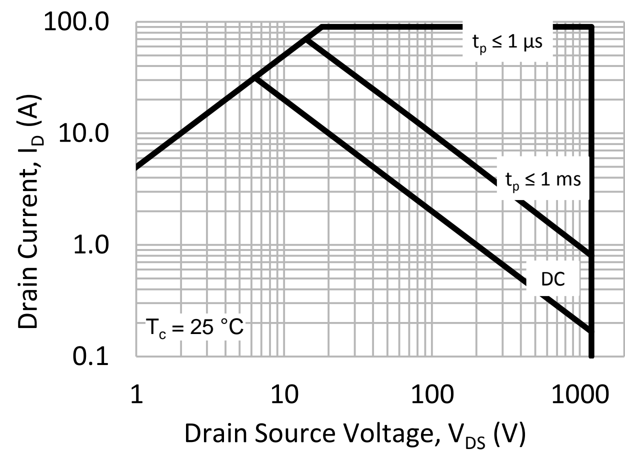


Fig. 2 - Maximum safe operating area (SOA) ID = f(VDS)

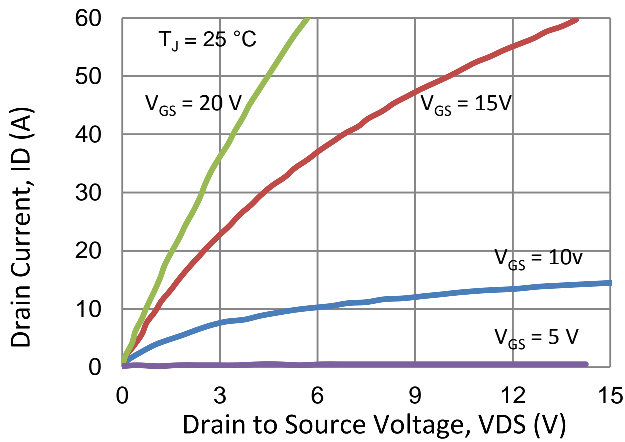


Fig. 3 Forward output characteristic ID = f(VDS), 25 °C

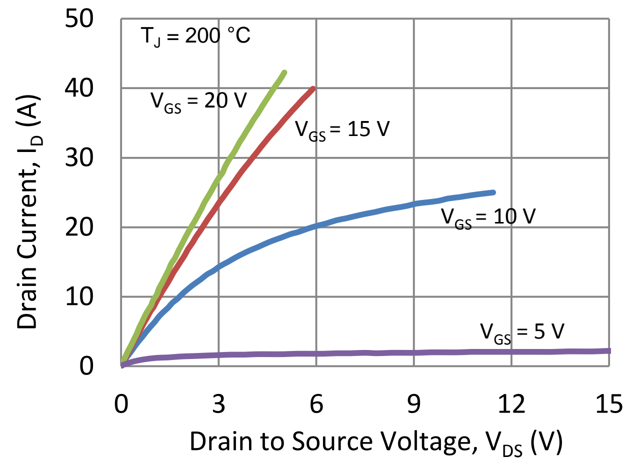


Fig. 4 - Forward output characteristic ID = f(VDS), 200 °C

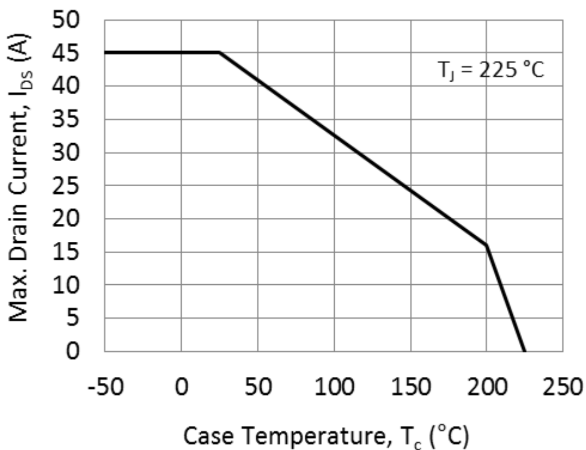


Fig. 5 - Drain current derating versus case temperature TC

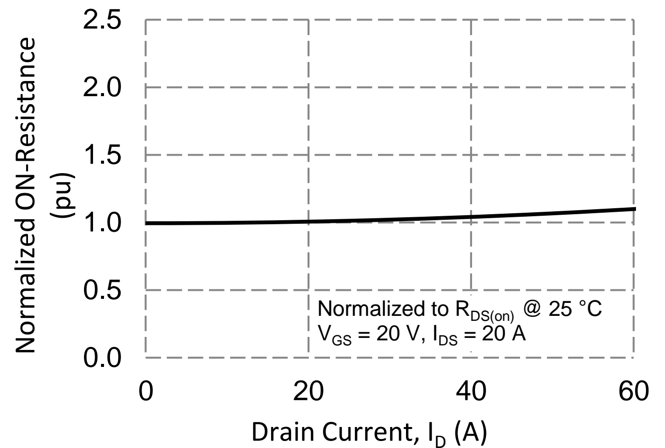


Fig. 6 - ON-resistance versus drain current and gate-source voltage

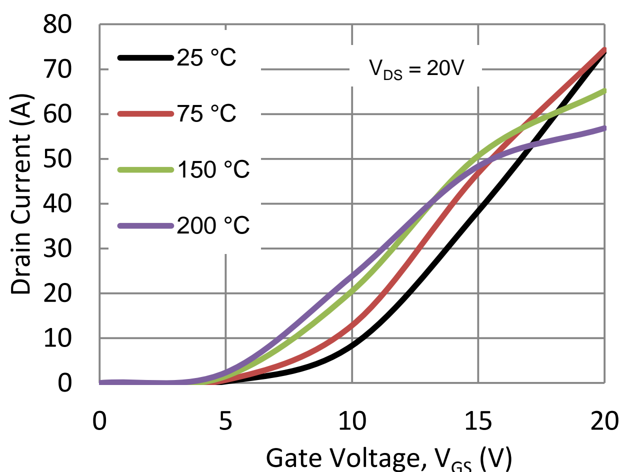


Fig. 7 - Transconductance versus temperature

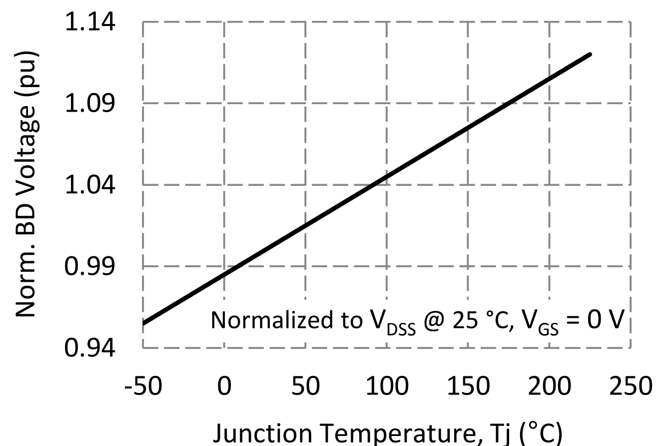


Fig. 8 - Drain-source breakdown voltage versus junction temperature T_J

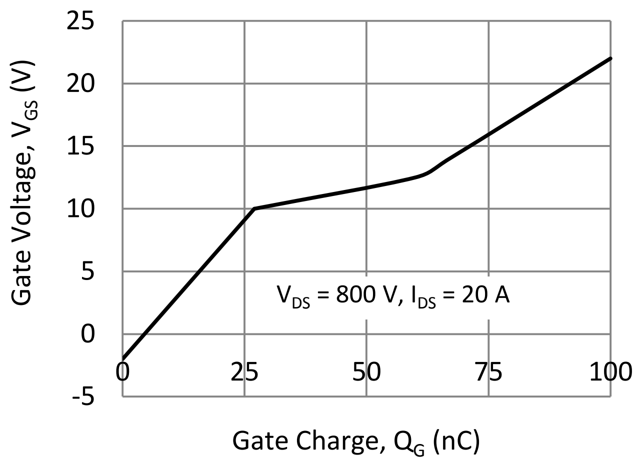


Fig. 9 - Gate charge characteristic $V_{GS} = f(Q_G)$

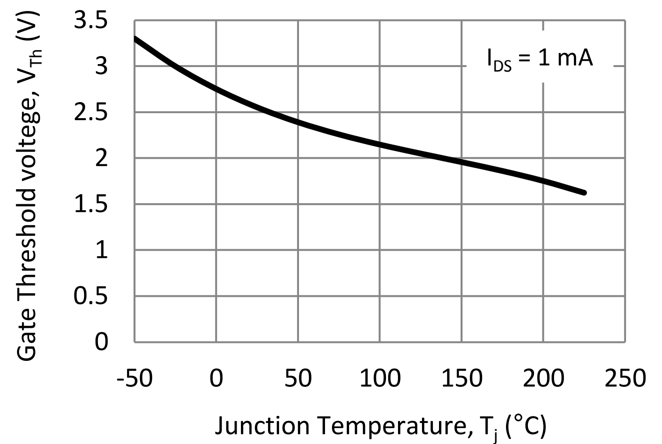
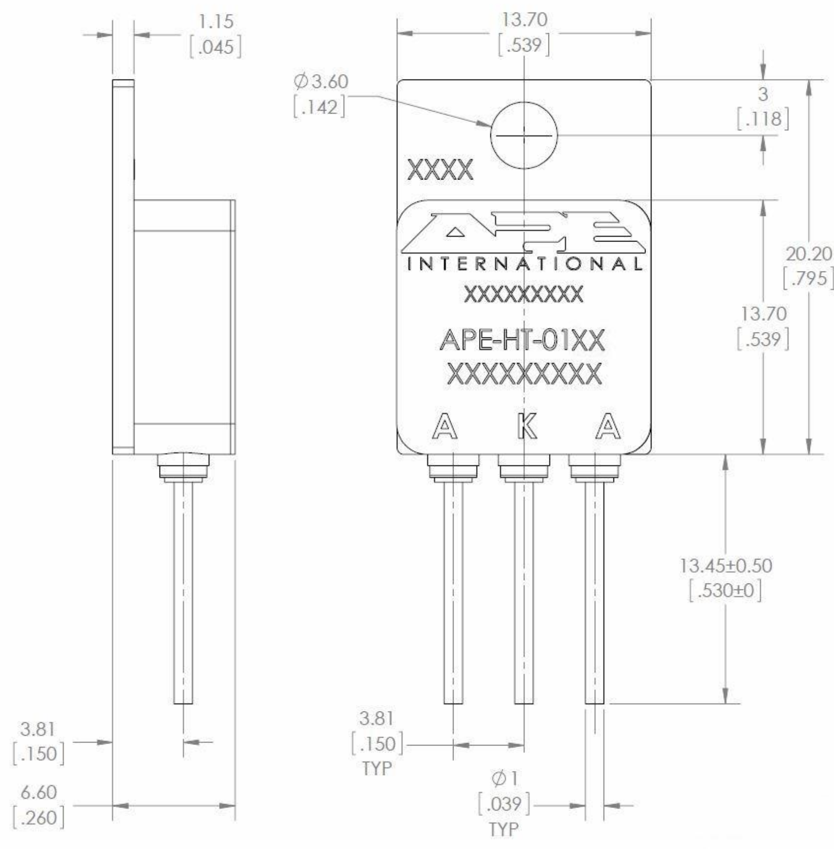


Fig. 10 - Gate-source threshold voltage versus junction temperature T_J

PACKAGE DIMENSIONS

All dimensions shown are in inches [millimeters]



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