

1200V Silicon Carbide Power MOSFET

Features

- Revolutionary semiconductor material Silicon Carbide
- High blocking voltage with low on-resistance
- High-speed switching with very low switching losses
- High-speed and high robust intrinsic body diode
- Optimized package with separate driver source pin

Product Summary

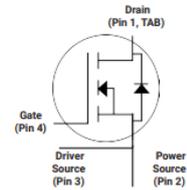
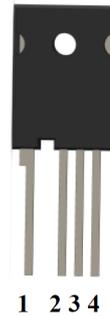


BVDSS	R _{DS(on)}	I _D
1200V	35mΩ	70A

Applications

- EV OBC and DC/DC converter
- EV compressor controller
- EV charger
- UPS / Solar inverter
- Energy storage system
- Welding machine
- Test power supply
- Battery formation power supply

TO247-4L Pin Configuration



Maximum Ratings For MOSFET (T_{VJ}= 25°C unless otherwise specified)

Symbol	Parameter	Value	Unit	Testing Conditions
V _{DSS}	Drain-Source Voltage	1200	V	
I _D	Continuous DC Drain Current for R _{th(j-c,typ.)} , Limited by T _{VJ(max)}	70	A	T _C = 25 °C
		50		T _C = 100°C
I _{DM}	Peak Drain Current, tp Limited by T _{VJ(max)}	137	A	T _C = 25 °C
V _{GS, max}	Gate-Source Max Voltage	-10/22	V	
V _{GS, op}	Gate-Source Operate Voltage	-5/18	V	
E _{AS}	Single Pulse Avalanche Energy	335	mJ	L=0.5mH, I _{AS} =37.5 A, V _{DD} =50V, V _{GS} =18V
P _{tot}	Power Dissipation for R _{th(j-c,typ.)}	308	W	T _C = 25°C

Package Values

Symbol	Parameter	Min.	Typ.	Max.	Unit	Testing Conditions
R _{th(j-c)}	MOSFET/Body Diode Junction-Case Thermal Resistance		0.49	0.58	K/W	
T _{VJ} , T _{STG}	Operating Junction and Storage Temperature	-55		175	°C	
T _{SOLD}	Soldering Temperature, Wave Soldering only Allowed at Leads 1.6mm from Case for 10s		260		°C	
M	M3 screw, Maximum of mounting processes: 3			1	Nm	

MOSFET Characteristics ($T_{VJ} = 25^{\circ}\text{C}$ unless otherwise specified)

Symbol	Parameters	Min	Typ	Max	Unit	Testing Conditions
$V_{(BR)DSS}$	Drain-Source Breakdown Voltage	1200			V	$I_D = 100 \mu\text{A}$
$V_{GS(th)}$	Gate Threshold Voltage		3.2		V	$V_{DS} = V_{GS}, I_D = 8.8 \text{ mA}$
			2.2			
I_{DSS}	Drain-Source Leakage Current		0.1	20	μA	$V_{GS} = 0 \text{ V}, V_{DS} = 1200 \text{ V}$
			1			
I_{GSS}	Gate-Source Leakage Current			250	nA	$V_{GS} = 22 \text{ V}, V_{DS} = 0 \text{ V}$
I_{SGS}	Source-Gate Leakage Current			250	nA	$V_{GS} = -10 \text{ V}, V_{DS} = 0 \text{ V}$
$R_{DS(on)}$	Drain-Source On-State Resistance		31.5		m Ω	$V_{GS} = 18 \text{ V}, I_D = 35 \text{ A}$
			52.0			
g_{fs}	Transconductance		18.5		S	$V_{DS} = 10 \text{ V}, I_D = 35 \text{ A}$
$R_{G(int)}$	Internal Gate Resistance		2.2		Ω	$f = 1\text{MHz}, V_{AC} = 25 \text{ mV}$
C_{iss}	Input Capacitance		2259		pF	$V_{GS} = 0 \text{ V}, V_{DS} = 800 \text{ V}, f = 1\text{MHz}$
C_{oss}	Output Capacitance		99		pF	
C_{rss}	Reverse Transfer Capacitance		5		pF	
Q_{GS}	Gate to Source Charge		36		nC	$V_{GS} = -5 \text{ V} / +18 \text{ V}, V_{DD} = 800 \text{ V}, I_D = 35 \text{ A}$
Q_{GD}	Gate to Drain Charge		8		nC	
Q_G	Total Gate Charge		93		nC	

Dynamic MOSFET Characteristics ($T_{VJ} = 25^{\circ}\text{C}$ unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit	Testing Conditions
$t_{d(on)}$	Turn-On Delay Time		10.3		ns	$T_{VJ} = 25^{\circ}\text{C}$
			10.5			$T_{VJ} = 175^{\circ}\text{C}$
t_r	Rise Time		10.5		ns	$T_{VJ} = 25^{\circ}\text{C}$
			13.9			$T_{VJ} = 175^{\circ}\text{C}$
$t_{d(off)}$	Turn-Off Delay Time		20.7		ns	$T_{VJ} = 25^{\circ}\text{C}$
			23.2			$T_{VJ} = 175^{\circ}\text{C}$
t_f	Fall Time		6.3		ns	$T_{VJ} = 25^{\circ}\text{C}$
			5.5			$T_{VJ} = 175^{\circ}\text{C}$
E_{on}	Turn-On Switching Loss		215		μJ	$T_{VJ} = 25^{\circ}\text{C}$
			273			$T_{VJ} = 175^{\circ}\text{C}$
E_{off}	Turn-Off Switching Loss		10.5		μJ	$T_{VJ} = 25^{\circ}\text{C}$
			9			$T_{VJ} = 175^{\circ}\text{C}$
E_{tot}	Total Switching Energy		225.5		μJ	$T_{VJ} = 25^{\circ}\text{C}$
			282			$T_{VJ} = 175^{\circ}\text{C}$

Note: E_{on}/E_{off} result is with body diode.

Maximum Ratings For Body Diode ($T_{VJ} = 25^{\circ}\text{C}$ unless otherwise specified)

Symbol	Parameter	Value	Unit	Testing Conditions
V_{DSS}	Drain-Source Voltage	1200	V	
I_S	Continuous DC Source Current, Limited by $T_{VJ(max)}$	58	A	$T_C = 25^{\circ}\text{C}$
		32	A	$T_C = 100^{\circ}\text{C}$
I_{SM}	Peak Reverse Drain Current, tp Limited by $T_{VJ(max)}$	137	A	$T_C = 25^{\circ}\text{C}$

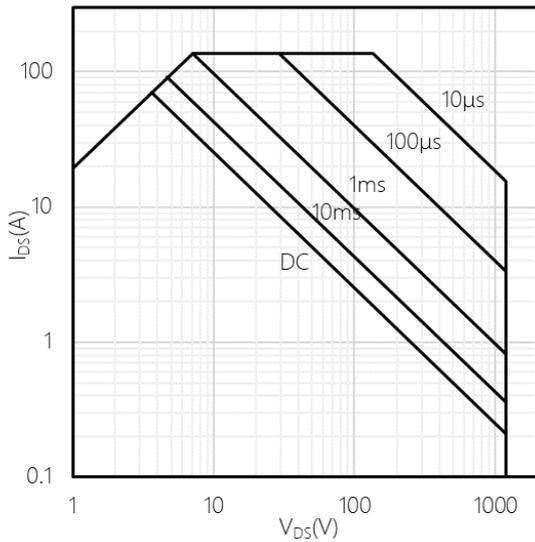
Body Diode Characteristics ($T_{VJ} = 25^{\circ}\text{C}$ unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit	Testing Conditions	
V_{SD}	Body Diode Forward Voltage		4.2		V	$V_{GS} = -5\text{ V}, I_{SD} = 17.5\text{ A}$	$T_{VJ} = 25^{\circ}\text{C}$
			3.6				$T_{VJ} = 175^{\circ}\text{C}$
I_{rrm}	Peak Reverse Recovery Current		31		A		$T_{VJ} = 25^{\circ}\text{C}$
			41				$T_{VJ} = 175^{\circ}\text{C}$
Q_{rr}	Reverse Recovery Charge		259		nC	$V_{DS} = 800\text{ V}, V_{GS} = -5\text{ V},$ $I_{SD} = 35\text{ A}, di/dt = 3.1$	$T_{VJ} = 25^{\circ}\text{C}$
			895				$T_{VJ} = 175^{\circ}\text{C}$
t_{rr}	Reverse Recovery Time		15.5		ns	$kA/\mu s$	$T_{VJ} = 25^{\circ}\text{C}$
			35				$T_{VJ} = 175^{\circ}\text{C}$
E_{rr}	Reverse Recovery Energy		21		μJ		$T_{VJ} = 25^{\circ}\text{C}$
			215				$T_{VJ} = 175^{\circ}\text{C}$

Typical Performance

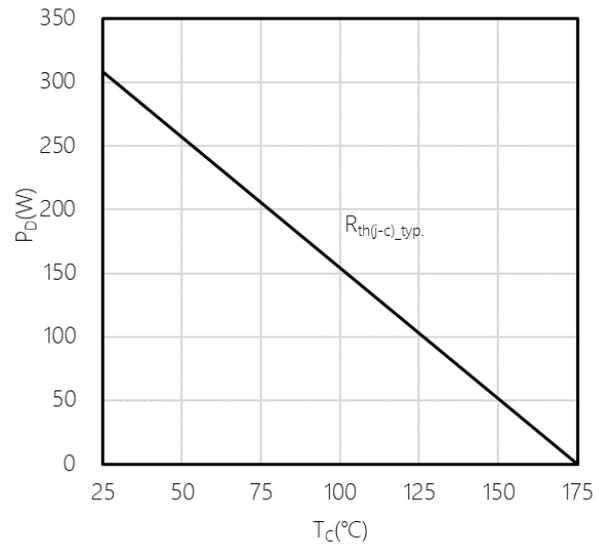
Safe operating area (SOA)

$R_{th(j-c)} = 0.58 \text{ } ^\circ\text{C/W}$, Single Pulse, $T_{vj} = 25^\circ\text{C}$



Power dissipation as a function of case temperature limited by bond wire

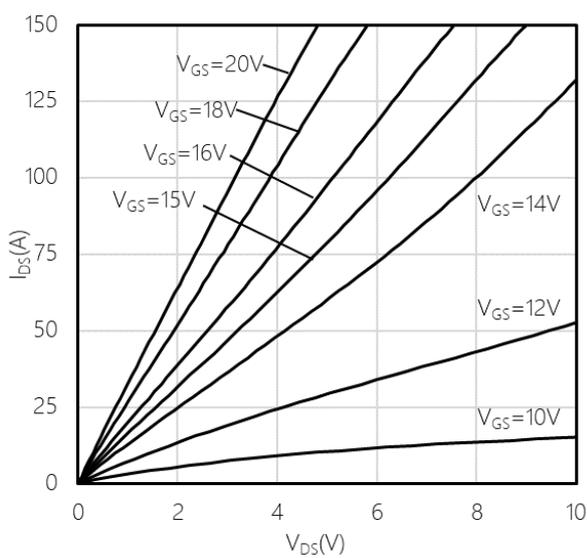
$P_D = f(T_c)$



Typical output characteristic, V_{GS} as parameter

$I_{DS} = f(V_{DS})$

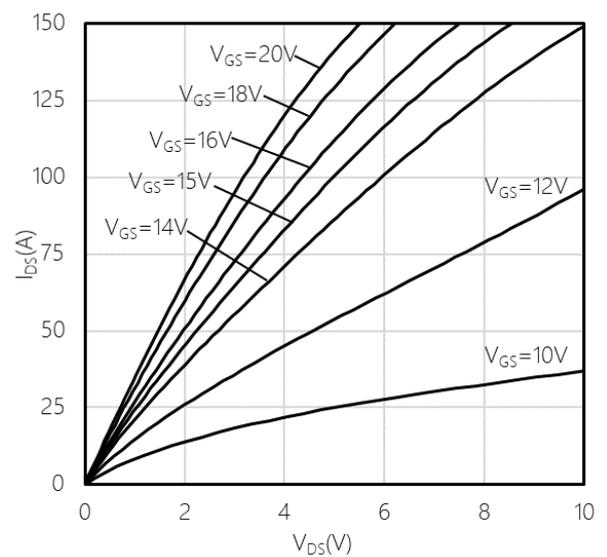
$T_{vj} = -55^\circ\text{C}$



Typical output characteristic, V_{GS} as parameter

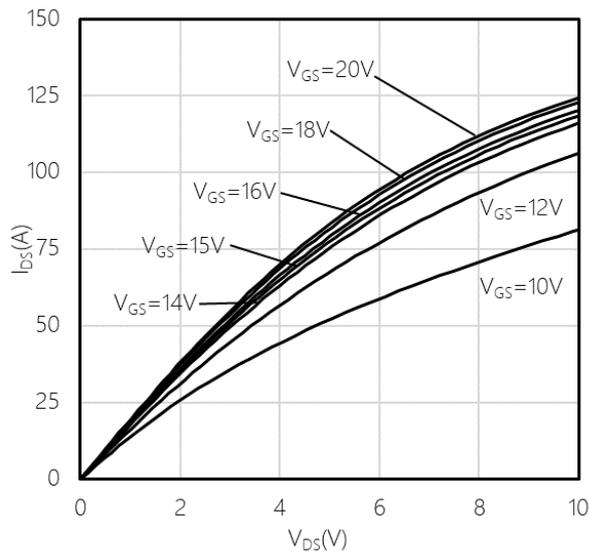
$I_{DS} = f(V_{DS})$

$T_{vj} = 25^\circ\text{C}$

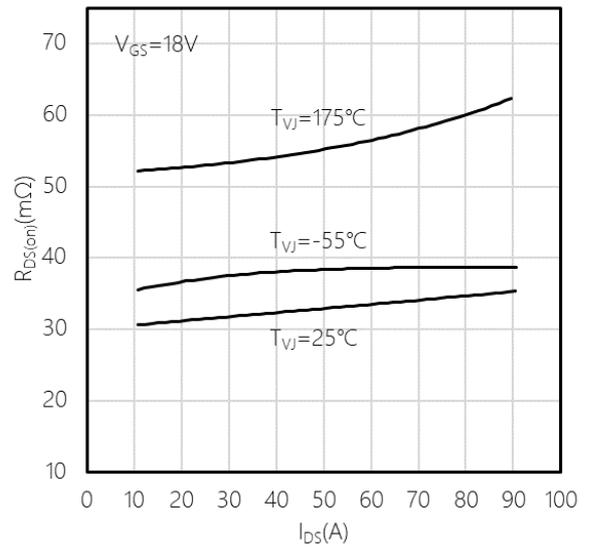


Typical output characteristic, V_{GS} as parameter

$I_{DS} = f(V_{DS})$
 $T_{VJ} = 175^{\circ}\text{C}$

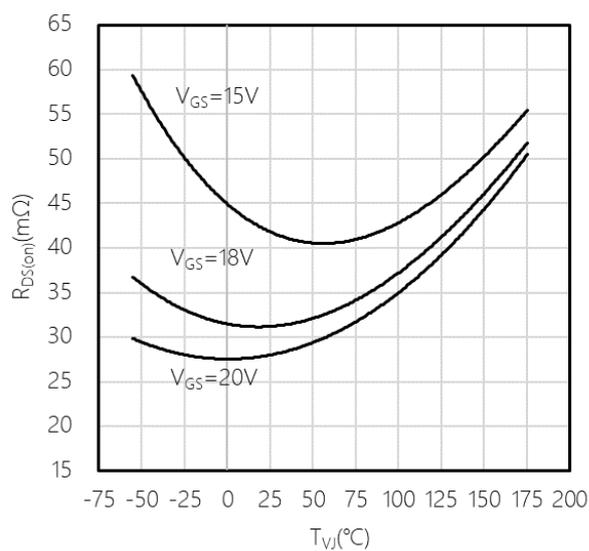


Typical on-state resistance as a function of drain current



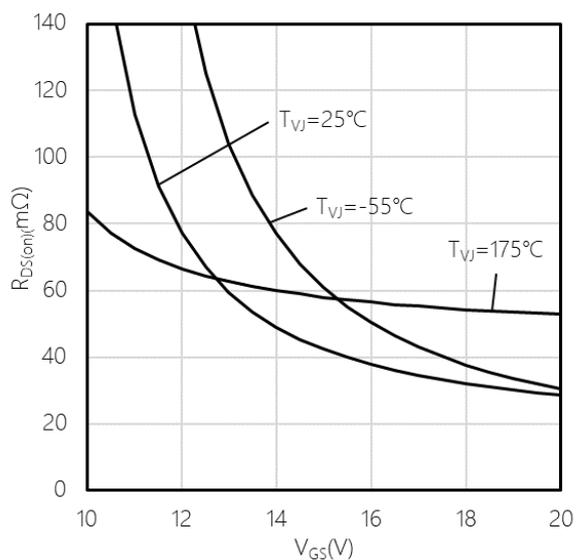
Typical on-state resistance as a function of temperature

$R_{DS(on)} = f(T_{VJ}), I_{DS} = 35\text{A}$



Typical on-state resistance as a function of V_{GS}

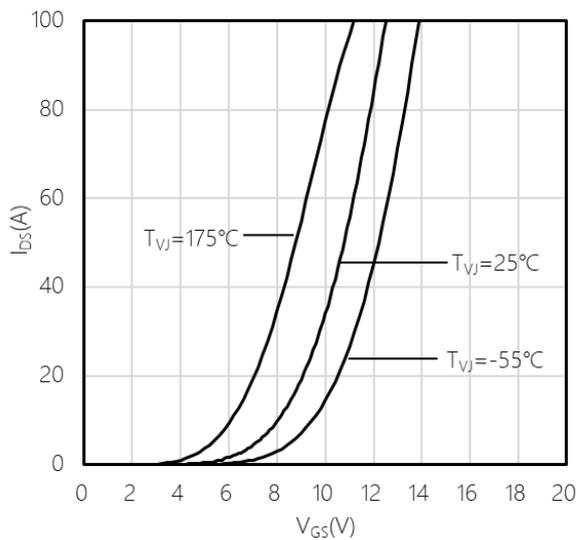
$R_{DS(on)} = f(V_{GS})$
 $I_{DS} = 35\text{A}$



Typical transfer characteristic

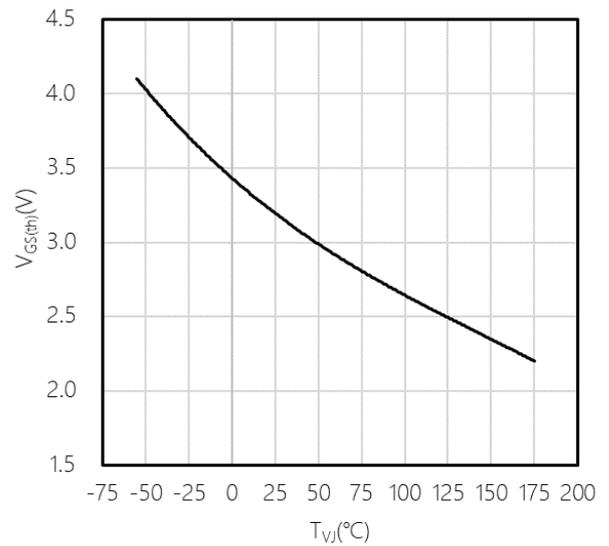
$I_{DS} = f(V_{GS})$

$V_{DS} = 10\text{ V}$



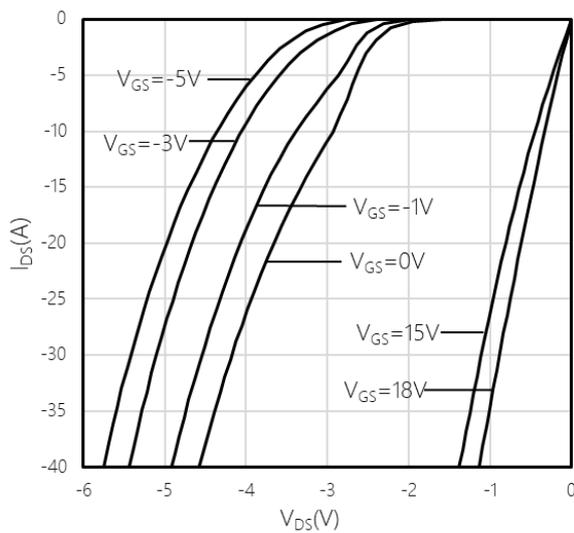
Typical gate-source threshold voltage as a function of junction temperature

$V_{GS(th)} = f(T_{VJ}), I_{DS} = 8.8\text{ mA}$



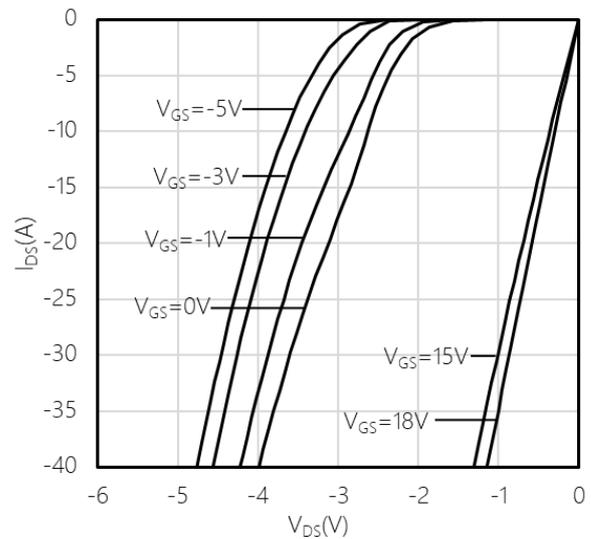
Typical reverse drain current as function of reverse drain voltage, V_GS as parameter

$I_{DS} = f(V_{DS}), T_{VJ} = -55\text{ °C}$



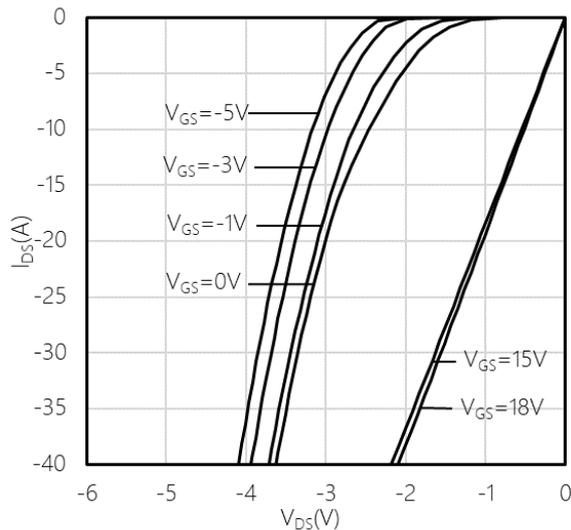
Typical reverse drain current as function of reverse drain voltage, V_GS as parameter

$I_{DS} = f(V_{DS}), T_{VJ} = 25\text{ °C}$



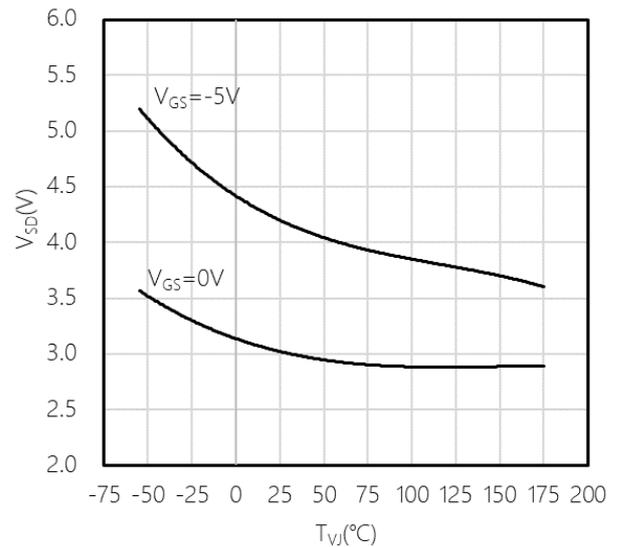
Typical reverse drain current as function of reverse drain voltage, V_{GS} as parameter

$I_{DS} = f(V_{DS}), T_{VJ} = 175\text{ }^{\circ}\text{C}$



Typical reverse drain voltage as function of junction temperature

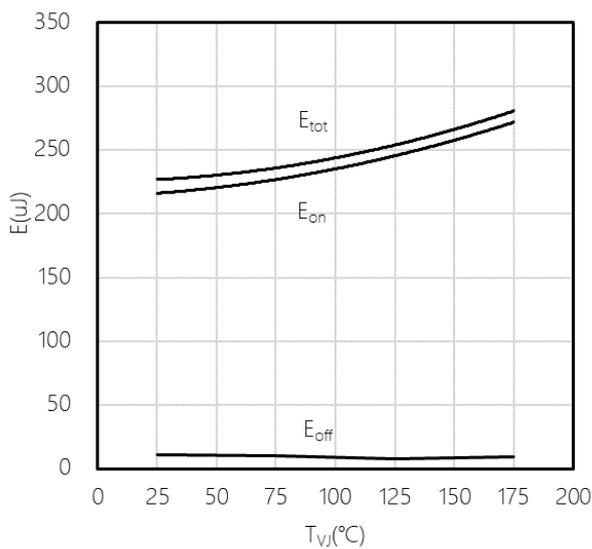
$V_{SD} = f(T_{VJ}), I_{SD} = 17.5\text{ A}$



Typical switching energy as a function of junction temperature, 2nd device own body diode: $V_{GS} = -5\text{ V}$

$E = f(T_{VJ})$

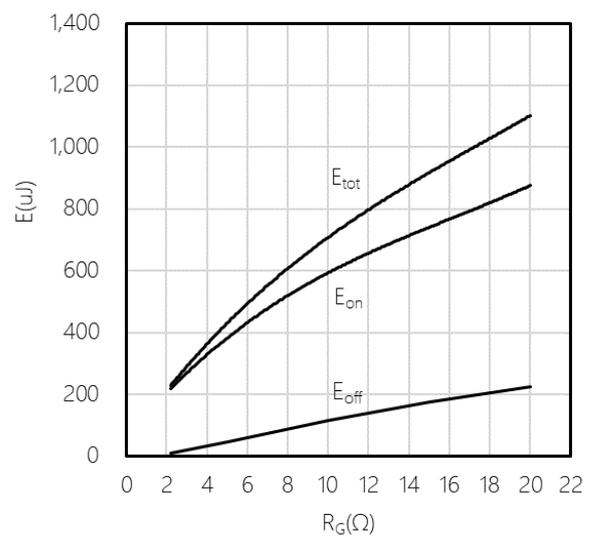
$V_{DS} = 800\text{ V}, R_{G(ext)} = 2.2\text{ }\Omega, V_{GS} = -5\text{ V} / +18\text{ V}, I_{DS} = 35\text{ A}$



Typical switching energy losses as a function of gate resistance, 2nd device own body diode: $V_{GS} = -5\text{ V}$

$E = f(R_{G(ext)})$

$V_{GS} = -5/18\text{ V}, I_{DS} = 35\text{ A}, T_{VJ} = 25\text{ }^{\circ}\text{C}, V_{DS} = 800\text{ V}$

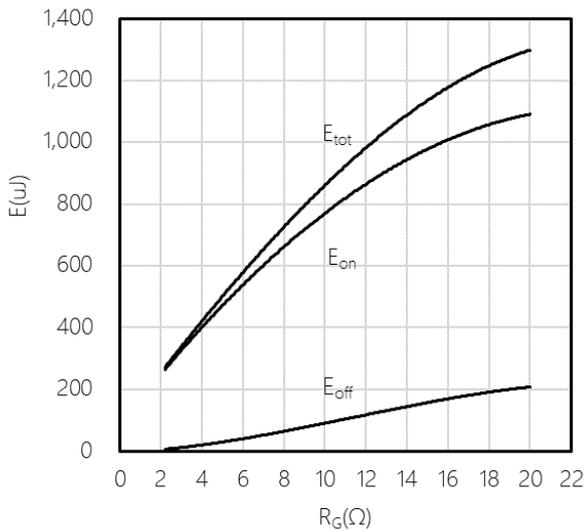


1200V Silicon carbide Power MOSFET

Typical switching energy losses as a function of gate resistance, 2nd device own body diode: $V_{GS} = -5\text{ V}$

$E = f(R_{G(ext)})$

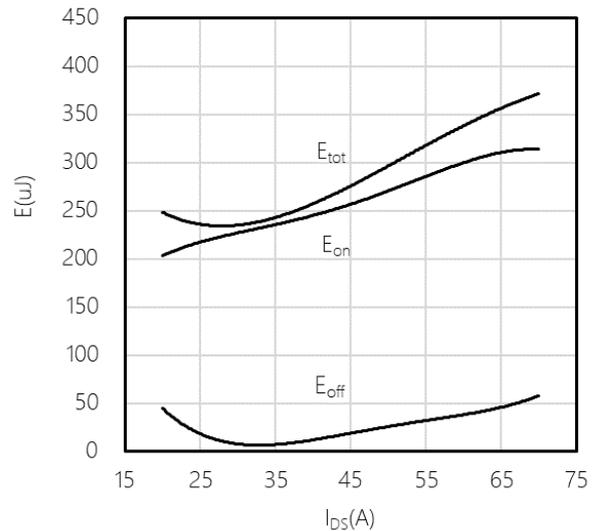
$V_{GS} = -5/18\text{ V}$, $I_{DS} = 35\text{ A}$, $T_{VJ} = 175\text{ }^\circ\text{C}$, $V_{DS} = 800\text{ V}$



Typical switching energy losses as a function of I_{DS} , 2nd device own body diode: $V_{GS} = -5\text{ V}$

$E = f(I_{DS})$

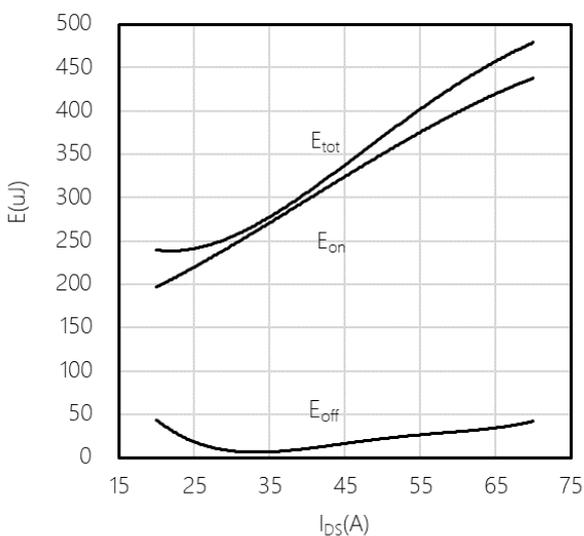
$V_{GS} = -5/18\text{ V}$, $R_{G(ext)} = 2.2\text{ }\Omega$, $T_{VJ} = 25\text{ }^\circ\text{C}$, $V_{DS} = 800\text{ V}$



Typical switching energy losses as a function of I_{DS} , 2nd device own body diode: $V_{GS} = -5\text{ V}$

$E = f(I_{DS})$

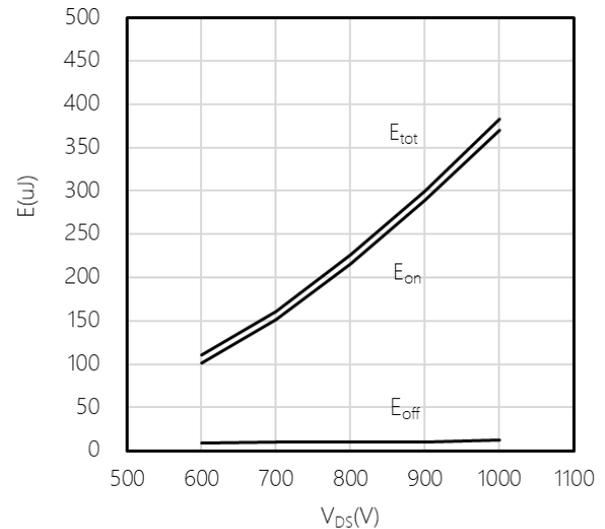
$V_{GS} = -5/18\text{ V}$, $R_{G(ext)} = 2.2\text{ }\Omega$, $T_{VJ} = 175\text{ }^\circ\text{C}$, $V_{DS} = 800\text{ V}$



Typical switching energy losses as a function of V_{DS} , 2nd device own body diode: $V_{GS} = -5\text{ V}$

$E = f(V_{DS})$

$V_{GS} = -5/18\text{ V}$, $R_{G(ext)} = 2.2\text{ }\Omega$, $T_{VJ} = 25\text{ }^\circ\text{C}$, $I_{DS} = 35\text{ A}$



Typical switching energy losses as a function of V_{DS} ,

2nd device own body diode: $V_{GS} = -5\text{ V}$

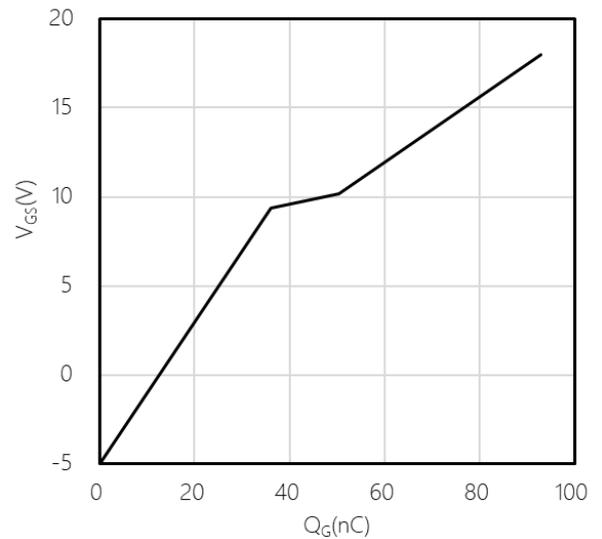
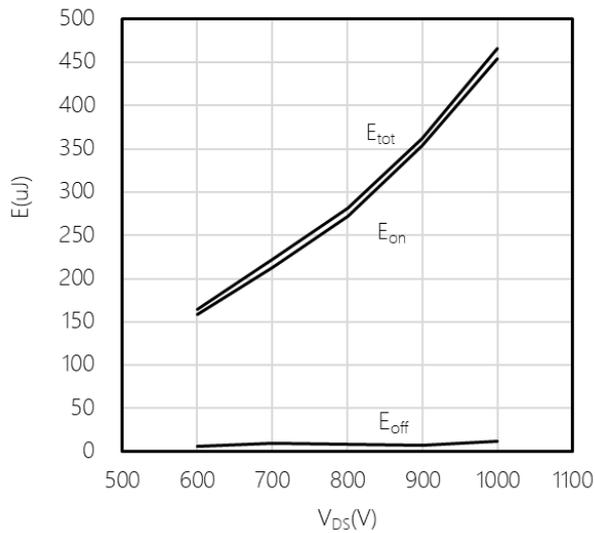
$E = f(V_{DS})$

$V_{GS} = -5/18\text{ V}$, $R_{G(ext)} = 2.2\ \Omega$, $T_{VJ} = 175\ ^\circ\text{C}$, $I_{DS} = 35\text{ A}$

Typical gate charge

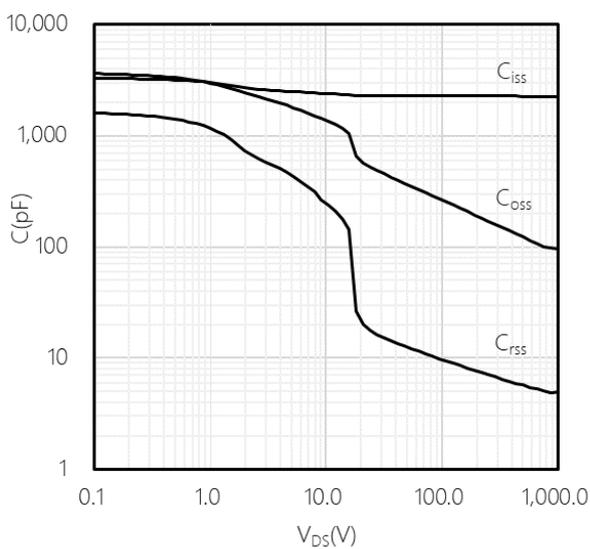
$V_{GS} = f(Q_G)$, $I_{DS} = 35\text{ A}$, $V_{DS} = 800\text{ V}$

turn-on pulse



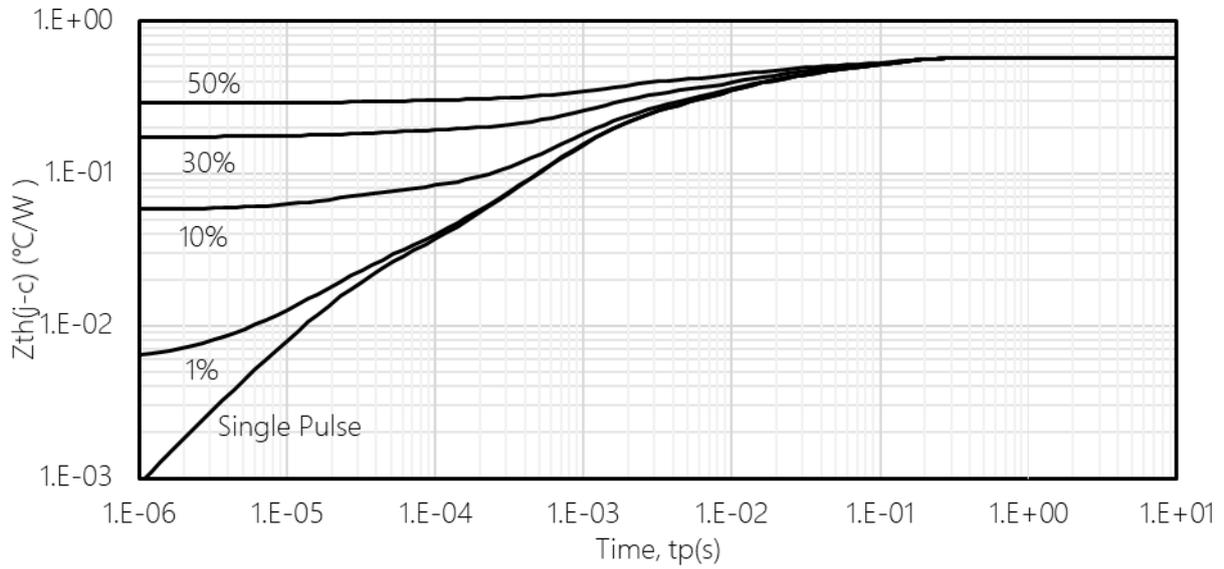
Typical capacitance as a function of drain-source voltage

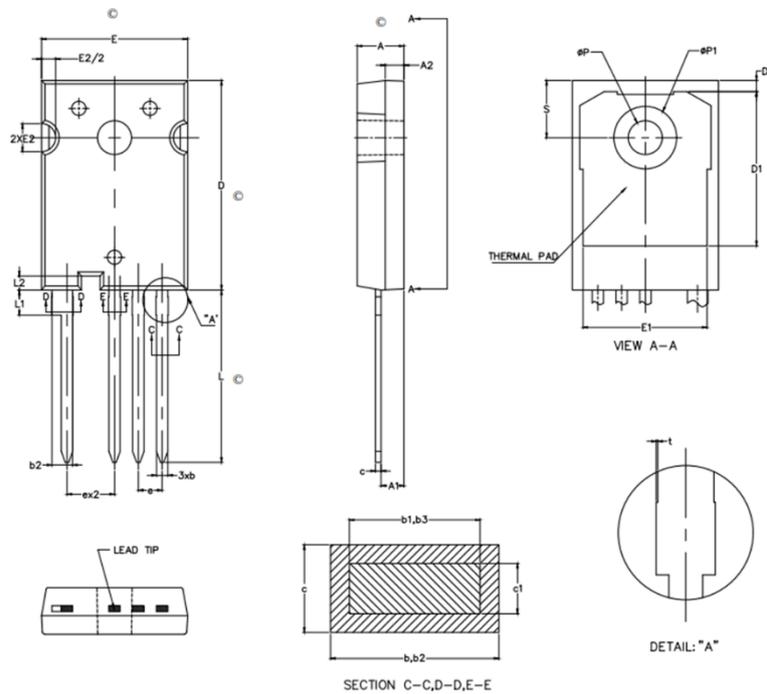
$C = f(V_{DS})$, $V_{GS} = 0\text{ V}$, $f = 1\text{ MHz}$



Transient thermal resistance (MOSFET)

$(Z_{th(j-c,max)} = f(t_p), \text{Parameter } D = t_p/T$



Package Dimensions


Symbols	Dimensions			
	Mm		Inch	
	MIN.	MAX.	MIN.	MAX.
A	4.90	5.10	0.193	0.201
A1	2.31	2.51	0.091	0.099
A2	1.90	2.10	0.075	0.083
b	1.16	1.26	0.046	0.050
b1	1.15	1.22	0.045	0.048
b2	2.16	2.26	0.085	0.089
b3	2.15	2.22	0.085	0.087
c	0.59	0.66	0.023	0.026
c1	0.58	0.62	0.023	0.024
D	22.40	22.60	0.882	0.890
D1	16.15	16.75	0.640	0.663
D2	1.22	1.53	0.041	0.053
E	15.75	15.90	0.620	0.626
E1	13.26	—	0.552	—
E2	2.90	3.10	0.114	0.122
e	2.54BSC		0.1BSC	
L	18.30	18.60	0.720	0.732
L1	—	2.80	—	0.110
L2	—	1.50	—	0.059
φP	3.50	3.70	0.138	0.146
φP1	—	7.40	—	0.291
S	6.22	6.42	0.238	0.246
t	0.00	0.15	0.000	0.006