

750V 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

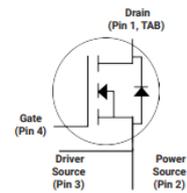
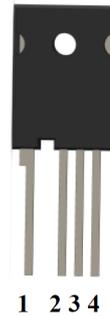


BVDSS	RDSON	ID
750V	60mΩ	43A

Applications

- Motor Drives
- EV battery chargers
- Solar energy system
- Power Supply
- Power Conversion System

TO247-4L Pin Configuration



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

Symbol	Parameter	Value	Unit	Testing Conditions
V_{DSS}	Drain-Source Voltage	750	V	
I_D	Continuous DC Drain Current for $R_{th(j-c,typ.)}$, Limited by $T_{VJ(max)}$	43	A	$T_C = 25^{\circ}\text{C}$
		30		$T_C = 100^{\circ}\text{C}$
I_{DM}	Peak Drain Current, tp Limited by $T_{VJ(max)}$	79	A	$T_C = 25^{\circ}\text{C}$
$V_{GS,max}$	Gate-Source Max Voltage	-10/22	V	
$V_{GS,op}$	Gate-Source Operate Voltage	-5/18	V	
E_{AS}	Single Pulse Avalanche Energy	135	mJ	$L=0.5\text{ mH}$, $I_{AS}=23\text{ A}$, $V_{DD}=50\text{ V}$, $V_{GS}=18\text{ V}$
P_{tot}	Power Dissipation for $R_{th(j-c,typ.)}$	185	W	$T_C = 25^{\circ}\text{C}$

Package Values

Symbol	Parameter	Min.	Typ.	Max.	Unit	Testing Conditions
$R_{th(j-c)}$	MOSFET/Body Diode Junction-Case Thermal Resistance		0.81	1.03	K/W	
T_{VJ}, T_{STG}	Operating Junction and Storage Temperature	-55		175	$^{\circ}\text{C}$	
T_{SOLD}	Soldering Temperature, Wave Soldering only Allowed at Leads 1.6mm from Case for 10s		260		$^{\circ}\text{C}$	
M	M3 screw, Maximum of mounting processes: 3		1	1	Nm	

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

Symbol	Parameter	Min.	Typ.	Max.	Unit	Testing Conditions
$V_{(BR)DSS}$	Drain-Source breakdown voltage	750			V	$I_D = 100 \mu\text{A}$
$V_{GS(th)}$	Gate Threshold Voltage	2.5	3.1	3.4	V	$V_{DS} = V_{GS}, I_D = 4.5 \text{ mA}$
I_{DSS}	Drain-Source Leakage Current		0.1	20	μA	$V_{GS} = 0 \text{ V}, V_{DS} = 1200 \text{ V}$
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		56 80	60	m Ω	$V_{GS} = 18 \text{ V}, I_D = 15 \text{ A}$
g_{fs}	Transconductance		9.1		S	$V_{DS} = 10 \text{ V}, I_D = 15 \text{ A}$
$R_{G(int)}$	Internal Gate Resistance		2.9		Ω	$f = 1\text{MHz}, V_{AC} = 25 \text{ mV}$
C_{iss}	Input Capacitance		1161		pF	$V_{GS} = 0 \text{ V}, V_{DS} = 800 \text{ V}, f = 1\text{MHz}$
C_{oss}	Output Capacitance		79		pF	
C_{rss}	Reverse Transfer Capacitance		4		pF	$V_{GS} = -5 \text{ V} / +18 \text{ V}, V_{DD} = 800 \text{ V}, I_D = 15 \text{ A}$
Q_{GS}	Gate to Source Charge		17		nC	
Q_{GD}	Gate to Drain Charge		4		nC	
Q_G	Total Gate Charge		45		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		6.3 6.1		ns	$V_{GS} = -5 \text{ V} / +18 \text{ V},$ $L=200\mu\text{H}$
t_r	Rise Time		7.9 6.0		ns	
$t_{d(off)}$	Turn-Off Delay Time		16.9 19.3		ns	$V_{DD} = 500 \text{ V}, I_D = 12.5 \text{ A},$ $R_{G(on)} = 2.2 \Omega, R_{G(off)} = 2.2$
t_f	Fall Time		9.5 9.9		ns	
E_{on}	Turn-On Switching Loss		52.6 43.8		μJ	Ω
E_{off}	Turn-Off Switching Loss		1.6 0.9		μJ	
E_{tot}	Total Switching Energy		54.2 44.7		μJ	

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	750	V	
I_S	Continuous DC Source Current, Limited by $T_{VJ(max)}$	32 18	A	$T_C = 25^{\circ}\text{C}$ $T_C = 100^{\circ}\text{C}$
I_{SM}	Peak Reverse Drain Current, tp Limited by $T_{VJ(max)}$	79	A	$T_C = 25^{\circ}\text{C}$

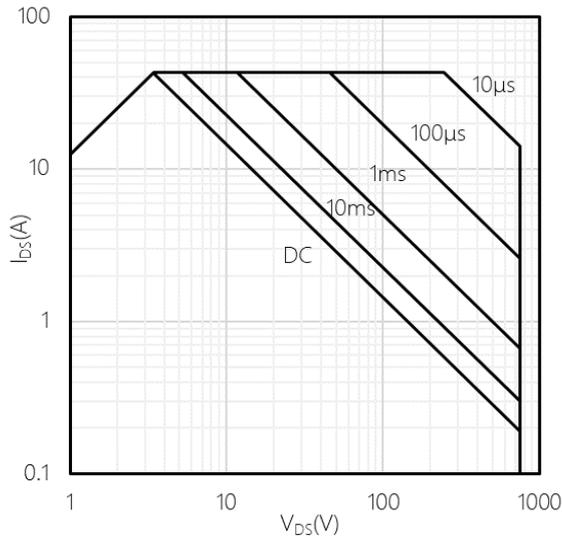
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Body Diode Characteristics ($T_{VJ} = 25^{\circ}\text{C}$ unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit	Testing Conditions	
V_{SD}	Body Diode Forward Voltage		4.2		V	$V_{GS} = -5\text{ V}, I_{SD} = 12.5\text{ A}$	$T_{VJ} = 25^{\circ}\text{C}$
			3.6				$T_{VJ} = 175^{\circ}\text{C}$
I_{rrm}	Peak Reverse Recovery Current		30		A	$V_{DS} = 500\text{ V}, V_{GS} = -5\text{ V},$ $I_{SD} = 12.5\text{ A}, di/dt = 4$ $\text{kA}/\mu\text{s}$	$T_{VJ} = 25^{\circ}\text{C}$
			33				$T_{VJ} = 175^{\circ}\text{C}$
Q_{rr}	Reverse Recovery Charge		186		nC		$T_{VJ} = 25^{\circ}\text{C}$
			306				$T_{VJ} = 175^{\circ}\text{C}$
t_{rr}	Reverse Recovery Time		12		ns		$T_{VJ} = 25^{\circ}\text{C}$
			16				$T_{VJ} = 175^{\circ}\text{C}$
E_{rr}	Reverse Recovery Energy		23		μJ	$T_{VJ} = 25^{\circ}\text{C}$	
			45			$T_{VJ} = 175^{\circ}\text{C}$	

Typical Performances

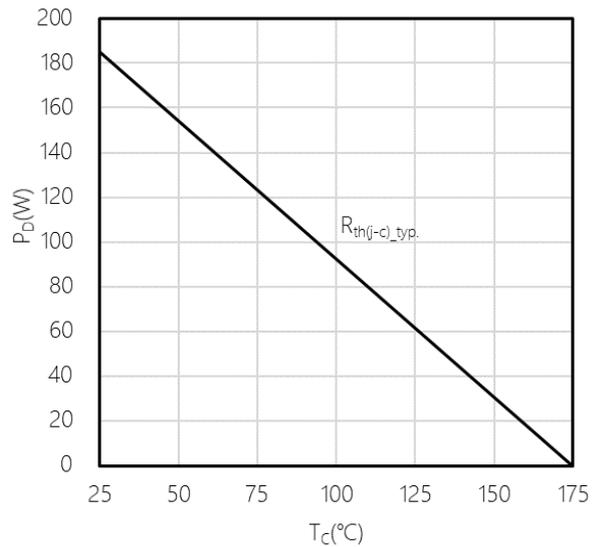
Safe operating area (SOA)

$R_{th(j-c)} = 1.03 \text{ }^\circ\text{C/W}$, Single Pulse, $T_{vj} = 25^\circ\text{C}$



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

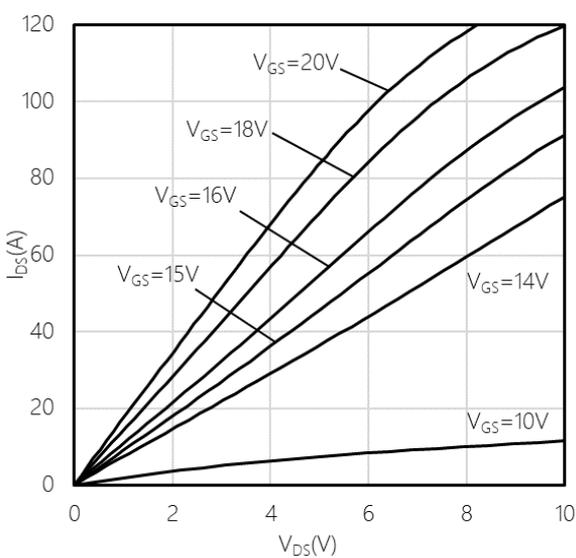
$P_D = f(T_C)$



Typical output characteristic, V_{GS} as parameter

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

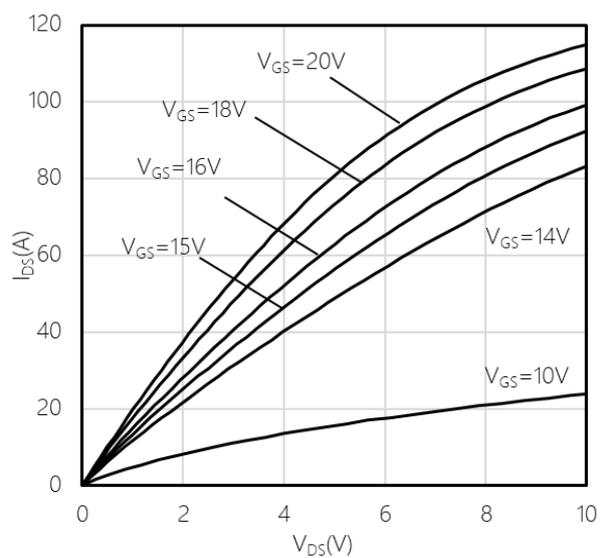
$T_{vj} = -55^\circ\text{C}$



Typical output characteristic, V_{GS} as parameter

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

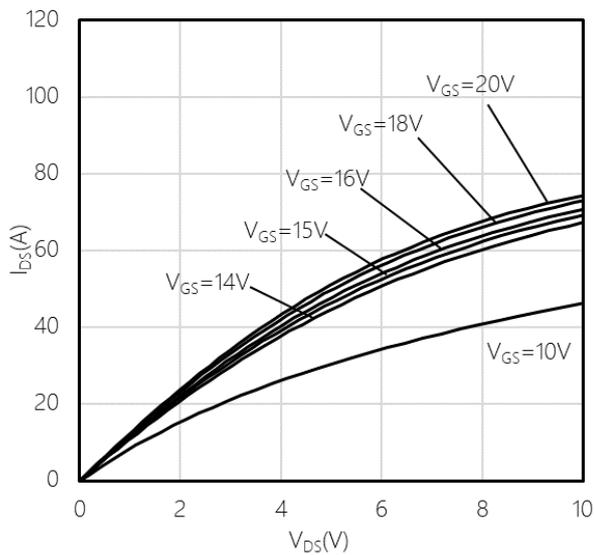
$T_{vj} = 25^\circ\text{C}$



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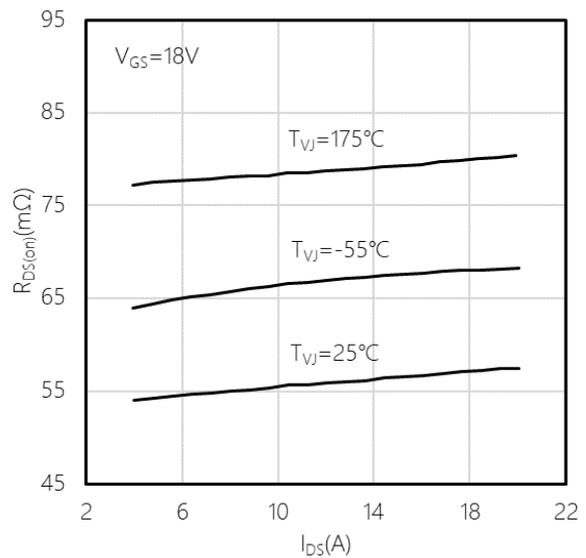
Typical output characteristic, V_{GS} as parameter

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



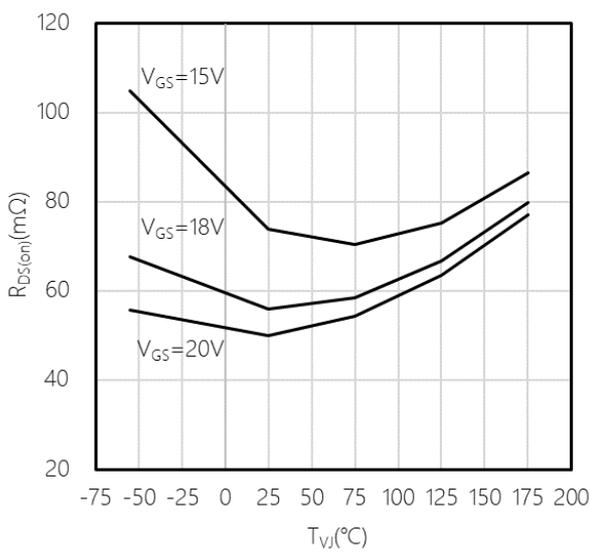
Typical on-state resistance as a function of drain current

$R_{DS(on)} = f(I_{DS}), V_{GS} = 18\text{V}$



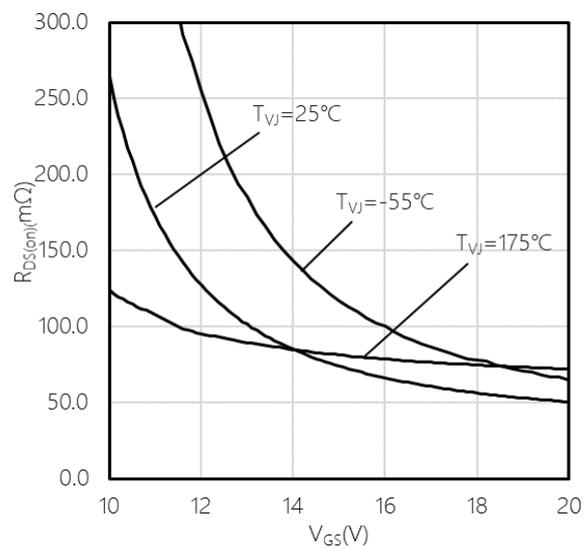
Typical on-state resistance as a function of temperature

$R_{DS(on)} = f(T_{VJ}), I_{DS} = 12.5\text{A}$



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

$R_{DS(on)} = f(V_{GS})$
 $I_{DS} = 12.5\text{A}$

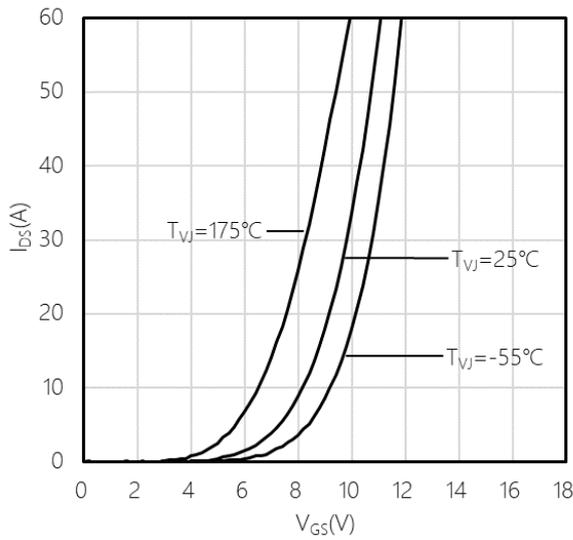


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Typical transfer characteristic

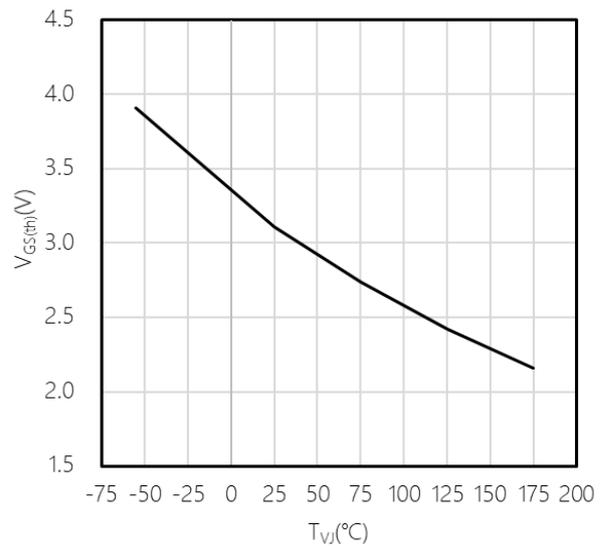
$I_{DS} = f(V_{GS})$

$V_{DS} = 20\text{ V}$



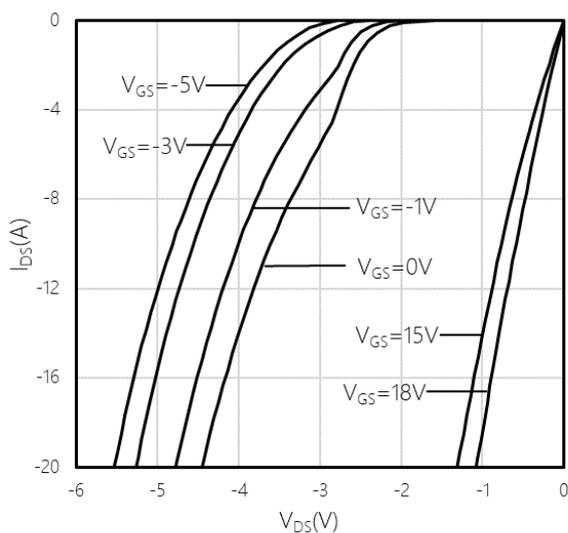
Typical gate-source threshold voltage as a function of junction temperature

$V_{GS(th)} = f(T_{VJ}), I_{DS} = 3.8\text{ mA}$



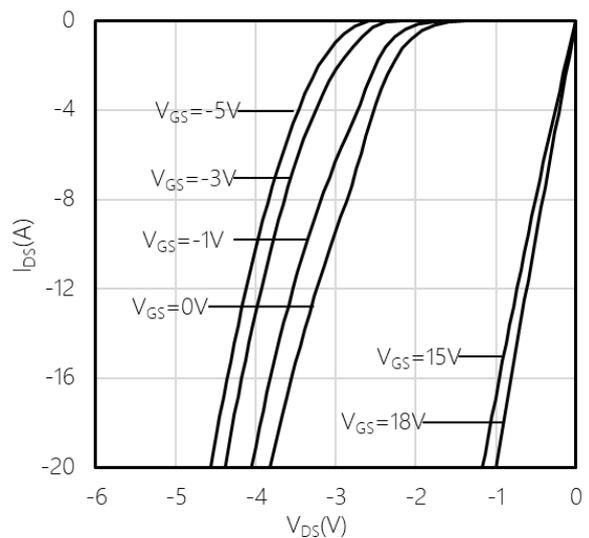
Typical reverse drain current as function of reverse drain voltage, V_{GS} as parameter

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



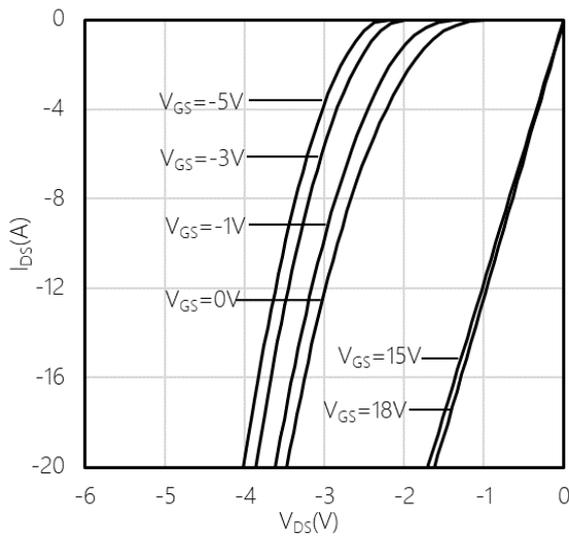
Typical reverse drain current as function of reverse drain voltage, V_{GS} as parameter

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



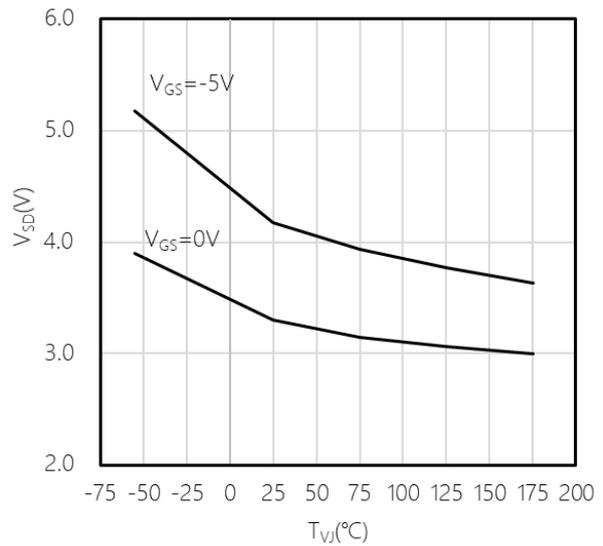
Typical reverse drain current as function of reverse drain voltage, V_{GS} as parameter

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



Typical reverse drain voltage as function of junction temperature

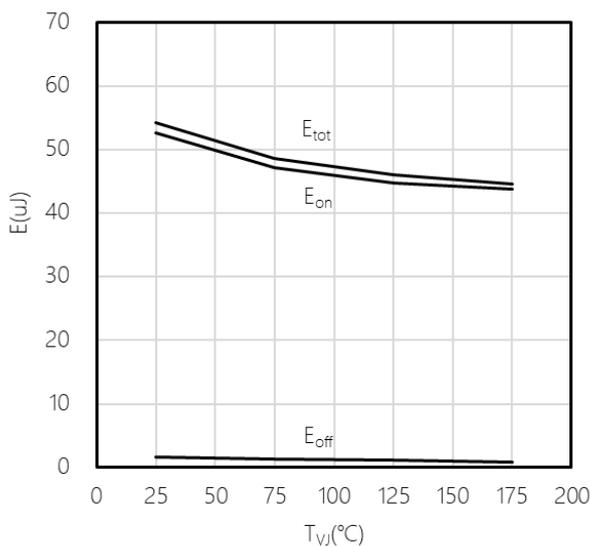
$V_{SD} = f(T_{VJ}), I_{SD} = 12.5\text{ A}$



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

$E = f(T_{VJ})$

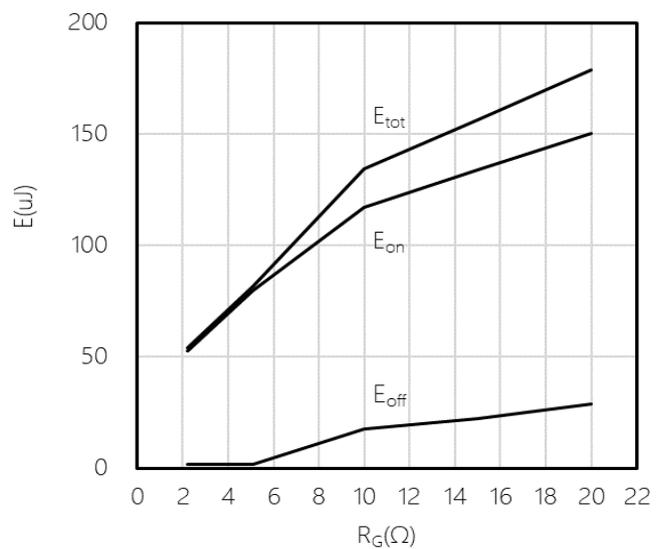
$V_{DS} = 500\text{ V}, R_{G(ext)} = 2.2\text{ }\Omega, V_{GS} = -5\text{ V} / +18\text{ V}, I_{DS} = 12.5\text{ A}$



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

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

$V_{GS} = -5/18\text{ V}, I_{DS} = 12.5\text{ A}, T_{VJ} = 25\text{ }^{\circ}\text{C}, V_{DS} = 500\text{ V}$

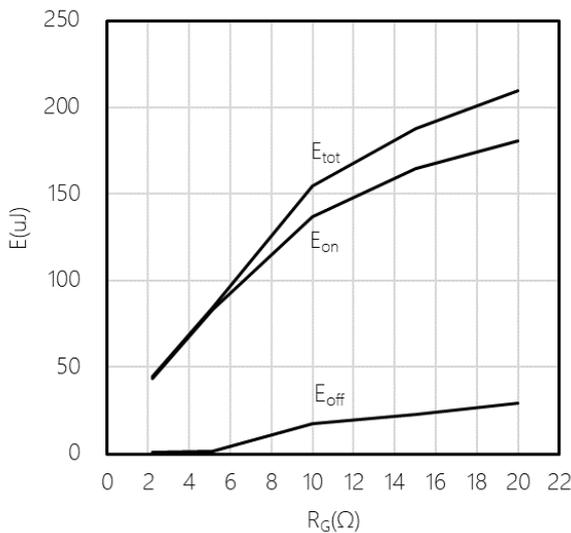


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Typical switching energy losses as a function of gate resistance, 2nd device own body diode: $V_{GS} = -5\text{ V}$

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

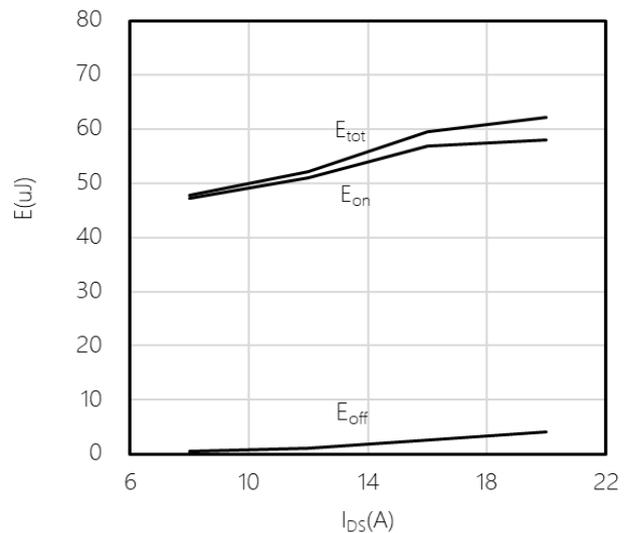
$V_{GS} = -5/18\text{ V}$, $I_{DS} = 12.5\text{ A}$, $T_{VJ} = 175\text{ }^\circ\text{C}$, $V_{DS} = 500\text{ V}$



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

$E = f(I_{DS})$

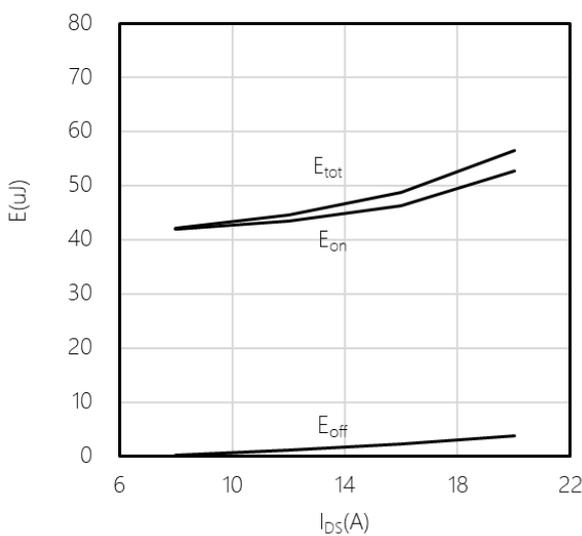
$V_{GS} = -5/18\text{ V}$, $R_{G(ext)} = 2.2\text{ } \Omega$, $T_{VJ} = 25\text{ }^\circ\text{C}$, $V_{DS} = 500\text{ V}$



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

$E = f(I_{DS})$

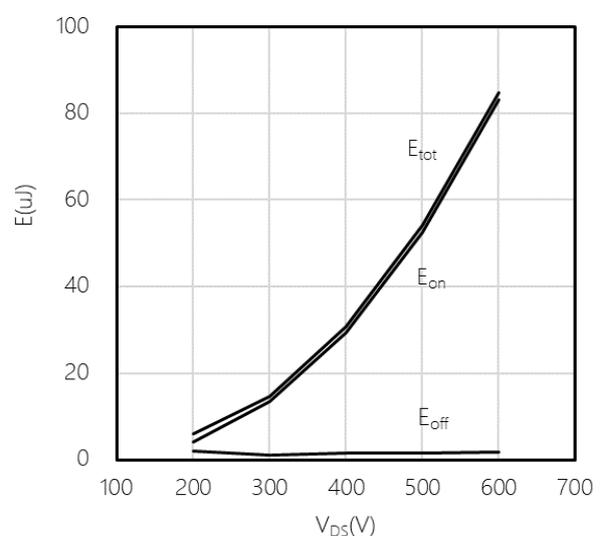
$V_{GS} = -5/18\text{ V}$, $R_{G(ext)} = 2.2\text{ } \Omega$, $T_{VJ} = 175\text{ }^\circ\text{C}$, $V_{DS} = 12.5\text{ V}$



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

$E = f(V_{DS})$

$V_{GS} = -5/18\text{ V}$, $R_{G(ext)} = 2.2\text{ } \Omega$, $T_{VJ} = 25\text{ }^\circ\text{C}$, $I_{DS} = 12.5\text{ A}$



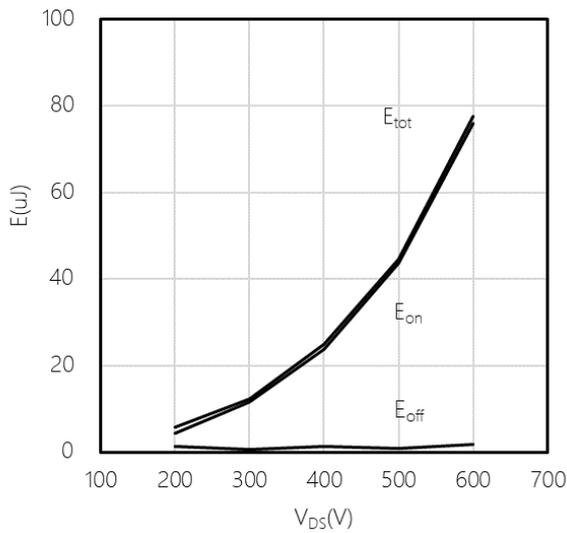
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Typical switching energy losses as a function of V_{DS} ,

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

$E = f(V_{DS})$

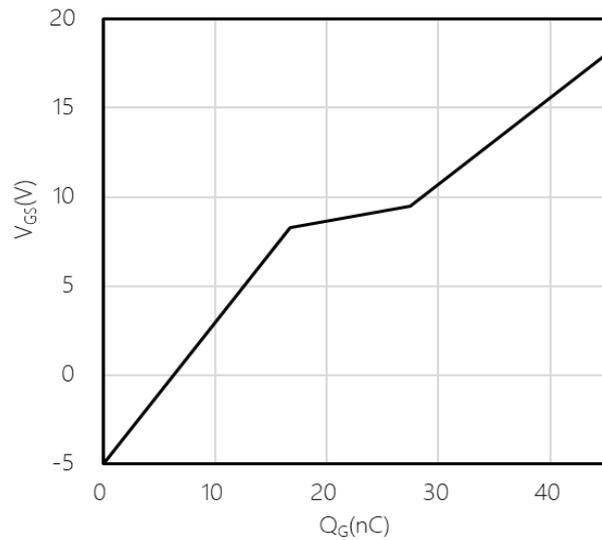
$V_{GS} = -5/18\text{ V}$, $R_{G(ext)} = 2.2\ \Omega$, $T_{VJ} = 175\ ^\circ\text{C}$, $I_{DS} = 12.5\text{ A}$



Typical gate charge

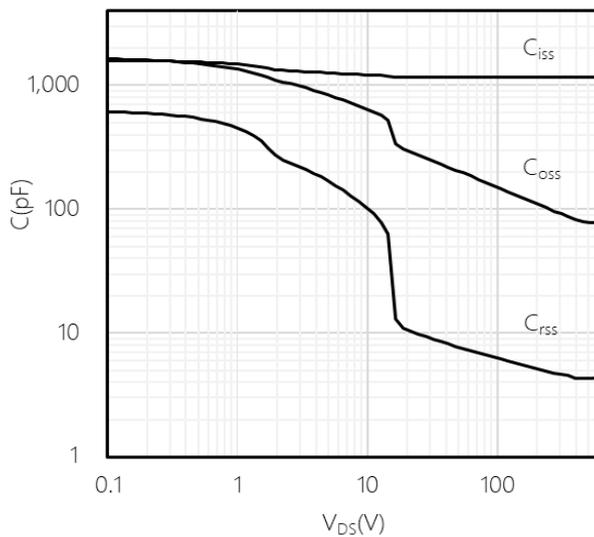
$V_{GS} = f(Q_G)$, $I_{DS} = 12.5\text{ A}$, $V_{DS} = 500\text{ V}$

turn-on pulse



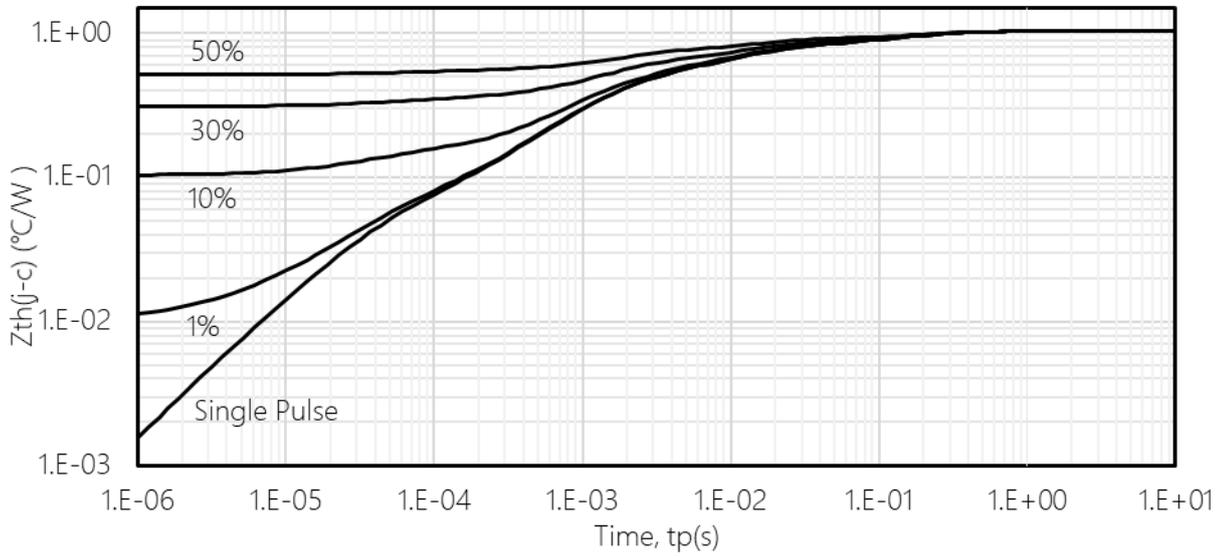
Typical capacitance as a function of drain-source voltage

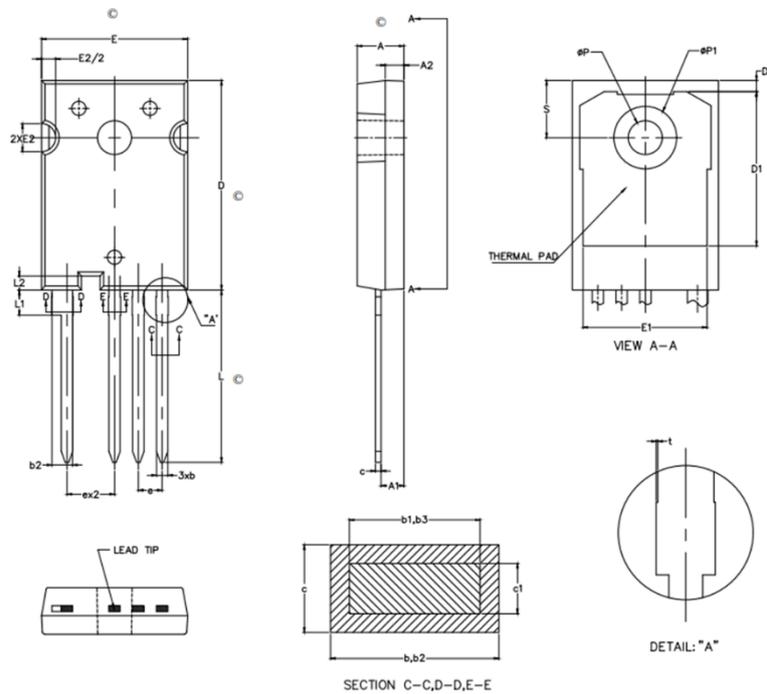
$C = f(V_{DS})$, $V_{GS} = 0\text{ V}$, $f = 1\text{ MHz}$



Transient thermal resistance (MOSFET)

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



750V Silicon Carbide Power MOSFET
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