650V 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

Product Summary

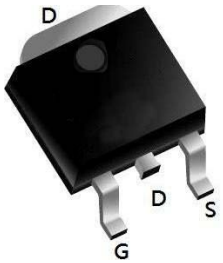
Green

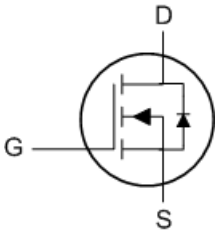
BVDSS	RDSON	ID
650V	180mΩ	19.5A

Applications

- LED Driver
- PD charger
- PC adapter
- Air-condictioning
- E-bike charger

TO252-3L Pin Configuration





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

Symbol	Parameter	Value	Unit	Testing Conditions
V_{DSS}	Drain-Source Voltage	650	V	
I_D	Continuous DC Drain Current for $R_{th(j-c,typ.)}$, Limited by $T_{VJ(max)}$	19.5	A	T_C = 25 ℃
		13.5		Tc = 100℃
I_{DM}	Peak Drain Current, tp Limited by $T_{VJ(max)}$	34	A	T_C = 25 ℃
$V_{GS, max}$	Gate-Source Max Voltage	-10/22	V	
$V_{GS, op}$	Gate-Source Operate Voltage	0/15	V	
E_{AS}	Single Pulse Avalanche Energy	33.4	mJ	L=0.5mH, I_{AS}=11.5A, V_{DD}=50V, V_{GS}=15V
P_{tot}	Power Dissipation for $R_{th(j-c,typ.)}$	76	W	T_C = 25℃

Package Values

Symbol	Parameter	Min.	Typ.	Max.	Unit	Testing Conditions
$R_{th(j-c)}$	MOSFET/Body Diode Junction-Case Thermal Resistance		1.98	2.37	K/W	
T_{VJ}, T_{STG}	Operating Junction and Storage Temperature	-55		175	℃	
T_{SOLD}	Soldering Temperature, Wave Soldering only Allowed at Leads 1.6mm from Case for 10s		260		℃	

MOSFET Characteristics (T_{VJ}= 25˚C unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit	Testing Conditions	
$V_{(BR)DSS}$	Drain-Source Breakdown Voltage	650			V	I_D = 100 μA	
$V_{GS(th)}$	Gate Threshold Voltage	3.2	3.9	5.0	V	V_{DS} = V_{GS}, I_D = 10 mA	T_{VJ} = 25 ℃
			2.8				T_{VJ} = 175 ℃
I_{DSS}	Drain-Source Leakage Current		0.1	20	μA	V_{GS} = 0 V, V_{DS} = 650 V	T_{VJ} = 25 ℃
			5				T_{VJ} = 175 ℃
I_{GSS}	Gate-Source Leakage Current			250	nA	V_{GS} = 22 V, V_{DS} = 0 V	T_{VJ} = 25 ℃
I_{SGS}	Source-Gate Leakage Current			250	nA	V_{GS} = -10 V, V_{DS} = 0 V	T_{VJ} = 25 ℃
$R_{DS(on)}$	Drain-Source On-State Resistance		180	215	mΩ	V_{GS} = 15 V, I_D = 7 A	T_{VJ} = 25 ℃
			164				T_{VJ} = 175 ℃
g_{fs}	Transconductance		4.3		S	V_{DS} = 20 V, I_D = 7 A	
$R_{G(int)}$	Internal Gate Resistance		31		Ω	f = 1MHz, V_{AC} = 25 mV	
C_{iss}	Input Capacitance		418		pF	V_{GS} = 0 V, V_{DS} = 650 V, f = 1MHz	
C_{oss}	Output Capacitance		33		pF		
C_{rss}	Reverse Transfer Capacitance		4.3		pF		
Q_{GS}	Gate to Source Charge		5.5		nC	V_{GS} = 0 /15 V, V_{DD} = 400 V, I_D = 7 A	
Q_{GD}	Gate to Drain Charge		2.6		nC		
Q_G	Total Gate Charge		15.3		nC		

Dynamic MOSFET Characteristics (T_{VJ}= 25˚C unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit	Testing Conditions	
$t_{d(on)}$	Turn−On Delay Time		29.2		ns	V_{GS} = 0/15 V, L=600 μH V_{DD} = 400 V, I_D = 7 A, $R_{G(on)}$ = 2.2 Ω, $R_{G(off)}$ = 2.2 Ω	T_{VJ} = 25 ℃
			27.6				T_{VJ} = 175 ℃
t_r	Rise Time		11.7		ns		T_{VJ} = 25 ℃
			10.8				T_{VJ} = 175 ℃
$t_{d(off)}$	Turn−Off Delay Time		46.1		ns		T_{VJ} = 25 ℃
			43.1				T_{VJ} = 175 ℃
t_f	Fall Time		16.5		ns		T_{VJ} = 25 ℃
			13.3				T_{VJ} = 175 ℃
E_{on}	Turn−On Switching Loss		67.8		μJ		T_{VJ} = 25 ℃
			67.5				T_{VJ} = 175 ℃
E_{off}	Turn−Off Switching Loss		15.0		μJ		T_{VJ} = 25 ℃
			10.5				T_{VJ} = 175 ℃
E_{tot}	Total Switching Energy		82.8		μJ		T_{VJ} = 25 ℃
			78.0				T_{VJ} = 175 ℃

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

Maximum Ratings For Body Diode (T_{VJ}= 25˚C unless otherwise specified)

Symbol	Parameter	Value	Unit	Testing Conditions
V_{DSS}	Drain-Source Voltage	650	V	
I_S	Continuous DC Source Current, Limited by $T_{VJ(max)}$	13.5	A	T_C = 25 ℃
		7.7	A	T_C = 100 ℃
I_{SM}	Peak Reverse Drain Current, tp Limited by $T_{VJ(max)}$	29.5	A	T_C = 25 ℃

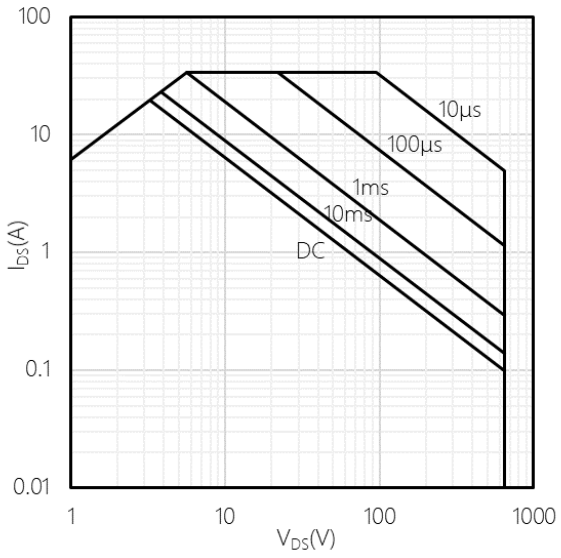
Body Diode Characteristics (T_{VJ}= 25˚C unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit	Testing Conditions	
V_{SD}	Body Diode Forward Voltage		3.3		V	V_{GS} = 0 V, I_{SD} = 3.5 A	T_{VJ} = 25 ℃
			2.8				T_{VJ} = 175 ℃
I_{rrm}	Peak Reverse Recovery Current		6.9		A	V_{DS} = 400 V, V_{GS} = 0 V, I_{SD} =7 A, di/dt = 2 kA/μs	T_{VJ} = 25 ℃
			5.8				T_{VJ} = 175 ℃
Q_{rr}	Reverse Recovery Charge		68		nC		T_{VJ} = 25 ℃
			82				T_{VJ} = 175 ℃
t_{rr}	Reverse Recovery Time		26		ns		T_{VJ} = 25 ℃
			27				T_{VJ} = 175 ℃
E_{rr}	Reverse Recovery Energy		5.0		μJ		T_{VJ} = 25 ℃
			7.2				T_{VJ} = 175 ℃

Typical Performances

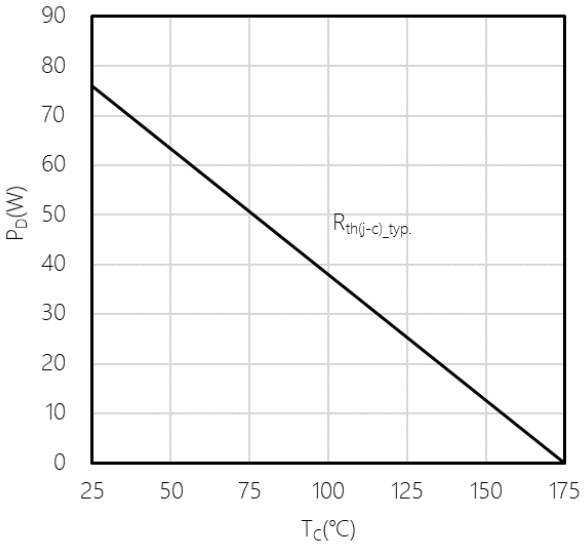
Safe operating area (SOA)

$R_{th(j-c)}$ =2.37 °C/W, Single Pulse, T_{VJ} = 25°C



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

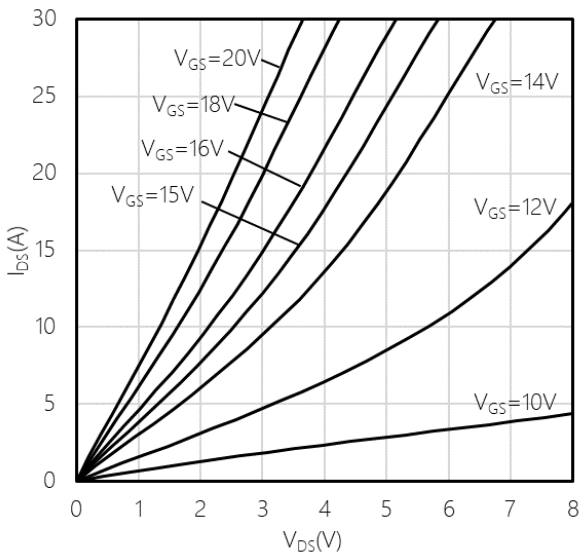
$P_D = f(T_C)$



Typical output characteristic, V_{GS} as parameter

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

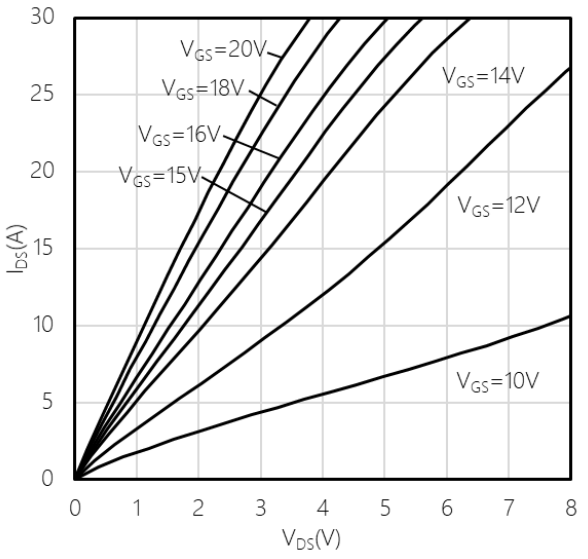
T_{VJ} = -55 ℃



Typical output characteristic, V_{GS} as parameter

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

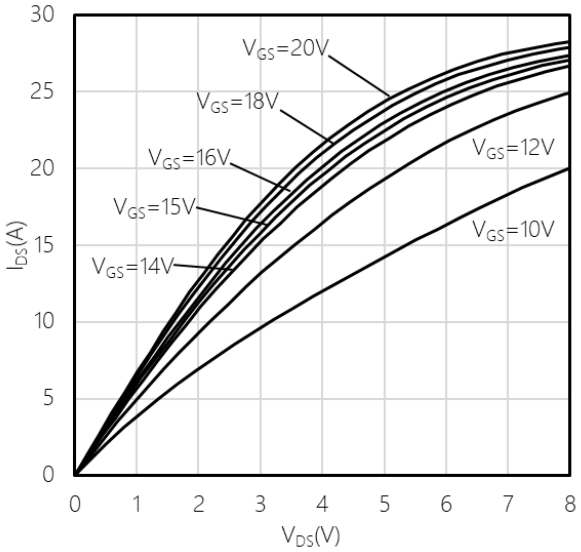
T_{VJ} = 25 ℃



Typical output characteristic, V_{GS} as parameter

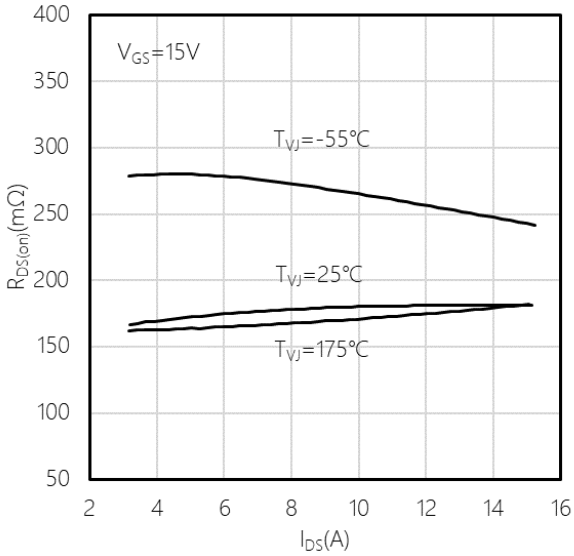
$I_{DS} = f(V_{DS})$

T_{VJ} = 175℃



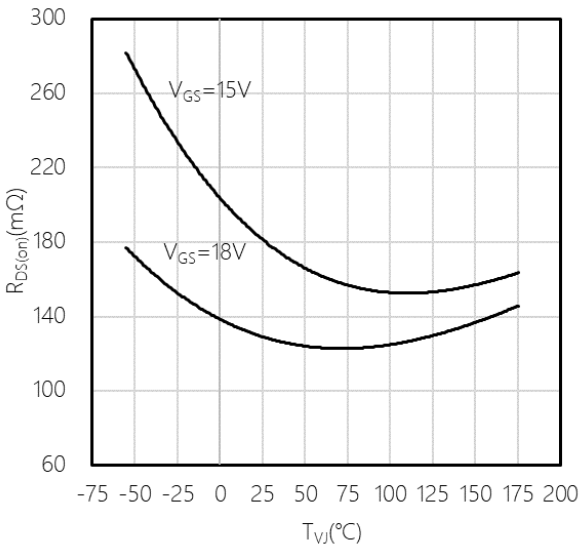
Typical on-state resistance as a function of drain current

$R_{DS(on)} = f(I_{DS})$, V_{GS} = 15V



Typical on-state resistance as a function of temperature

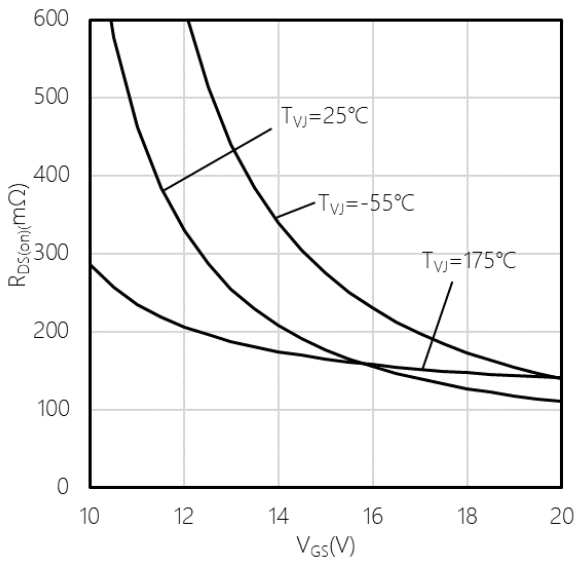
$R_{DS(on)} = f(T_{VJ})$, I_{DS} =7 A



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

$R_{DS(on)} = f(V_{GS})$

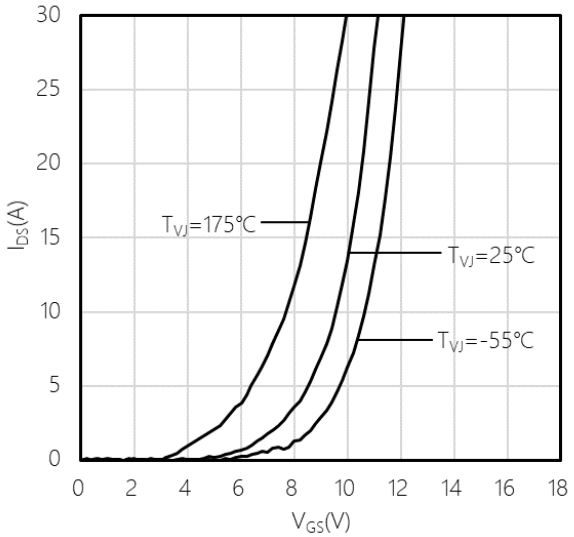
I_{DS} =7 A



Typical transfer characteristic

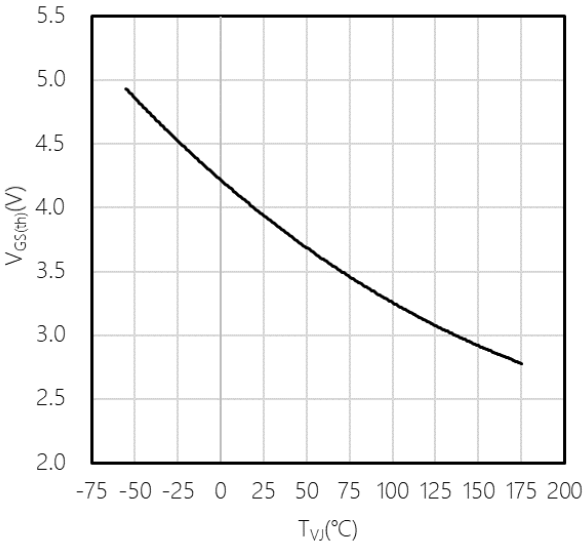
I_{DS} = f(V_{GS})

V_{DS}= 20 V



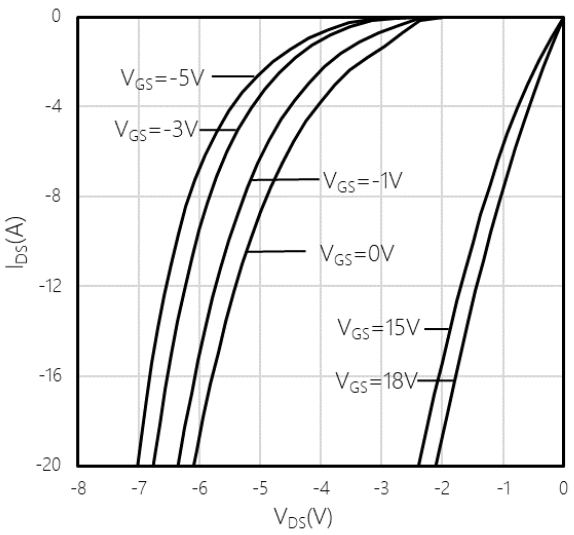
Typical gate-source threshold voltage as a function of junction temperature

$V_{GS(th)}$ = f(T_{VJ}), I_{DS} = 10 mA



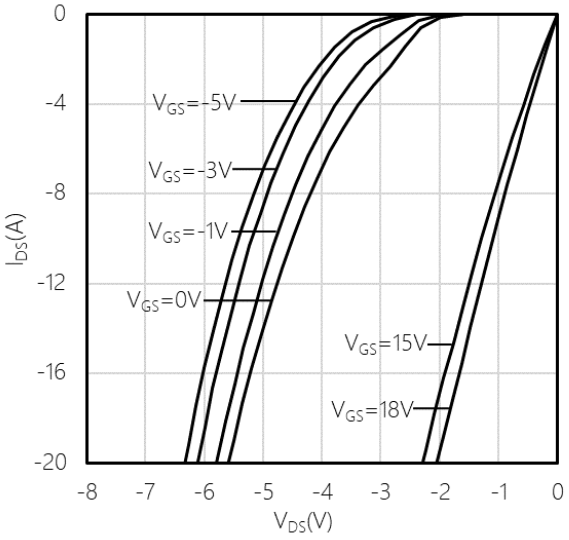
Typical reverse drain current as function of reverse drain voltage, V_{GS} as parameter

I_{DS} = f(V_{DS}), T_{VJ} = -55 °C



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

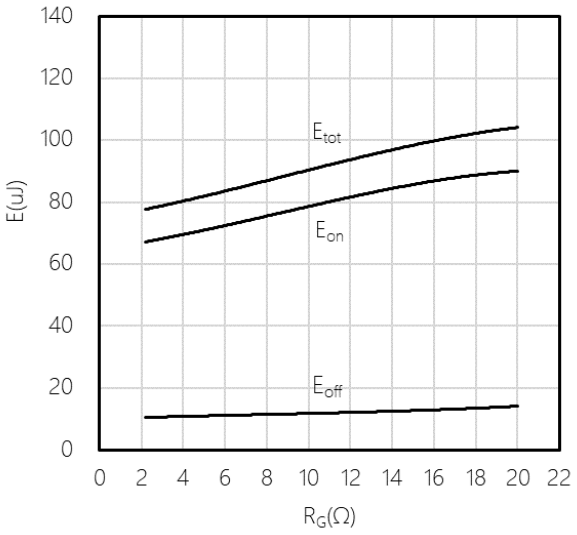
I_{DS} = f(V_{DS}), T_{VJ} = 25 °C



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

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

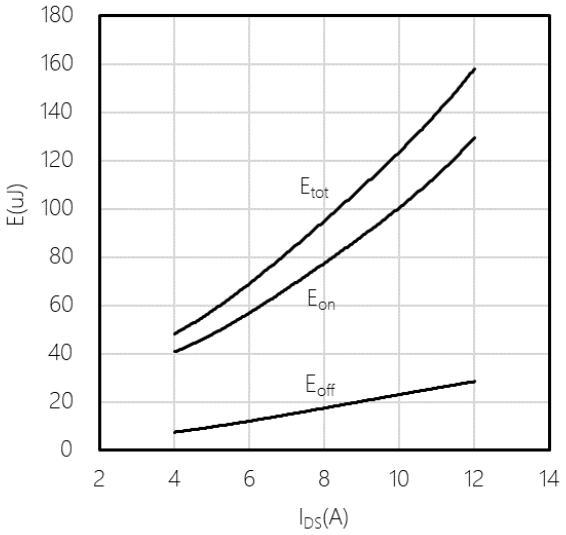
V_{GS} = 0/15 V, I_{DS} = 7 A, T_{VJ} = 175 °C, V_{DS} = 400 V



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

E = f(I_{DS})

V_{GS} = 0/15 V, $R_{G(ext)}$ = 2.2 Ω, T_{VJ} = 25 °C, V_{DS} = 400 V



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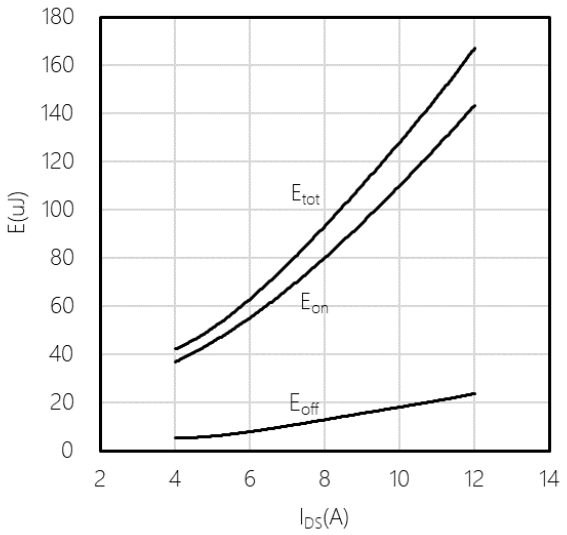

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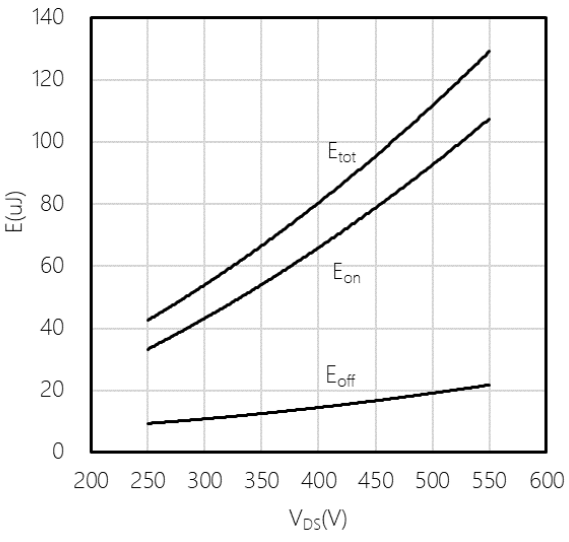
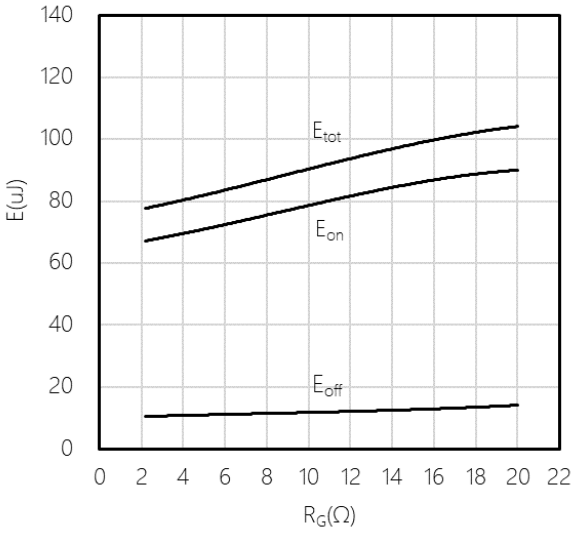
V_{GS} = 0/15 V, $R_{G(ext)}$ = 2.2 Ω, T_{VJ} = 25 °C, I_{DS} = 7 A



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

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

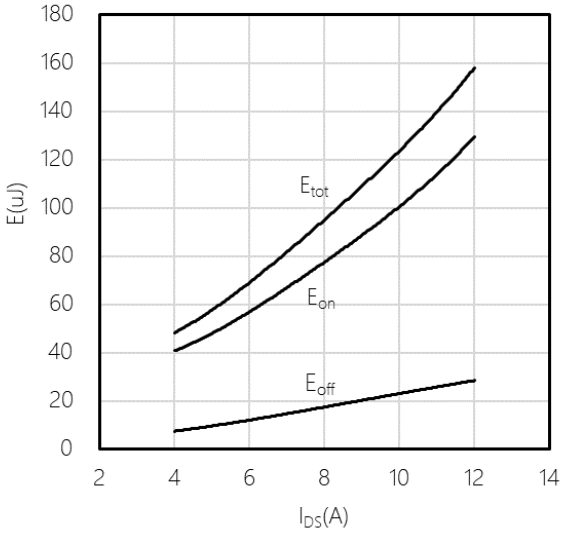
V_{GS} = 0/15 V, I_{DS} = 7 A, T_{VJ} = 175 °C, V_{DS} = 400 V



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

E = f(I_{DS})

V_{GS} = 0/15 V, $R_{G(ext)}$ = 2.2 Ω, T_{VJ} = 25 °C, V_{DS} = 400 V



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

E = f(I_{DS})

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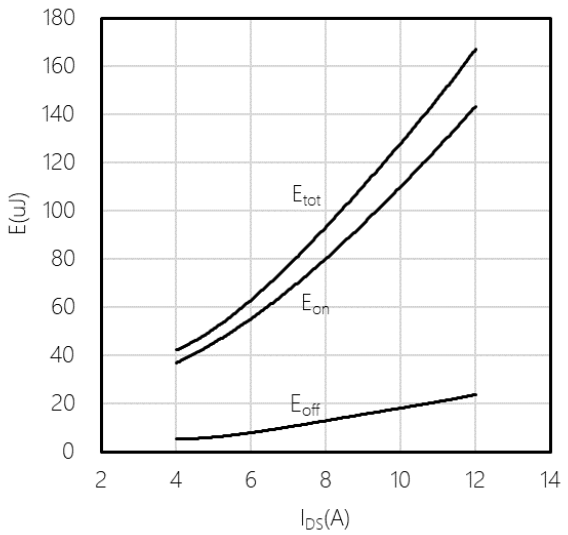

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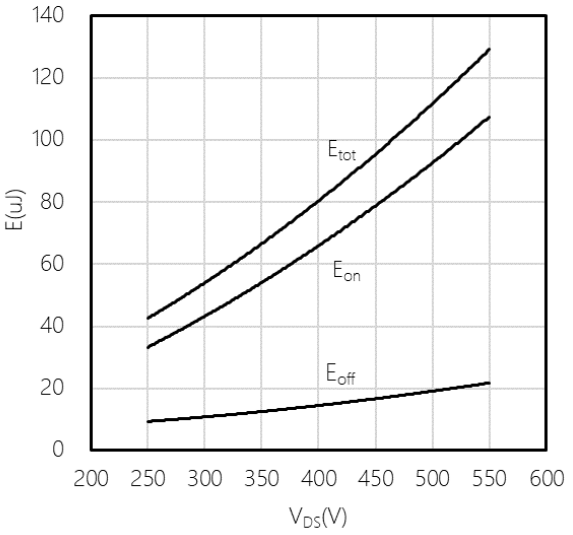

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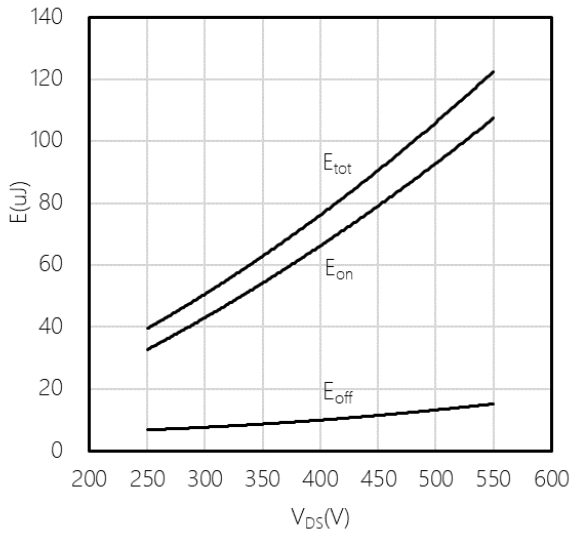
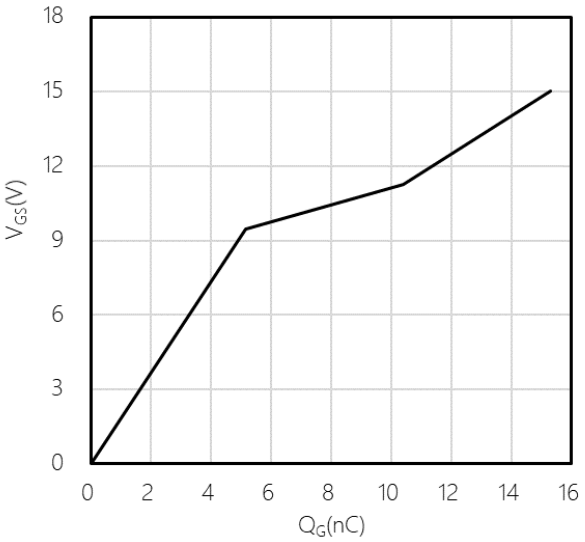


Typical gate charge

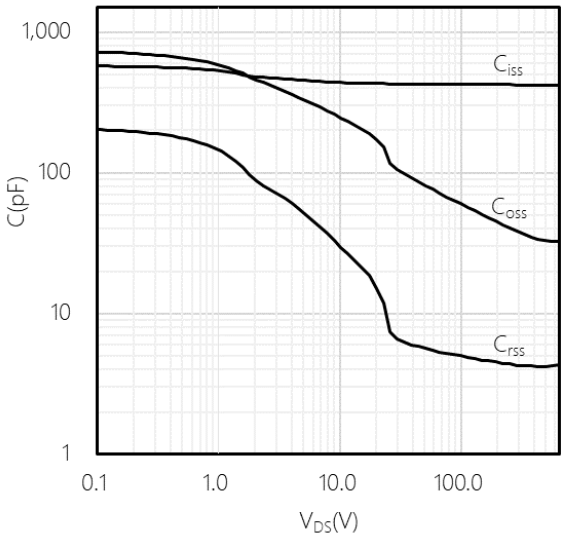
V_{GS} =f(Q_G), I_{DS} = 7A, V_{DS} = 400V

turn-on pulse



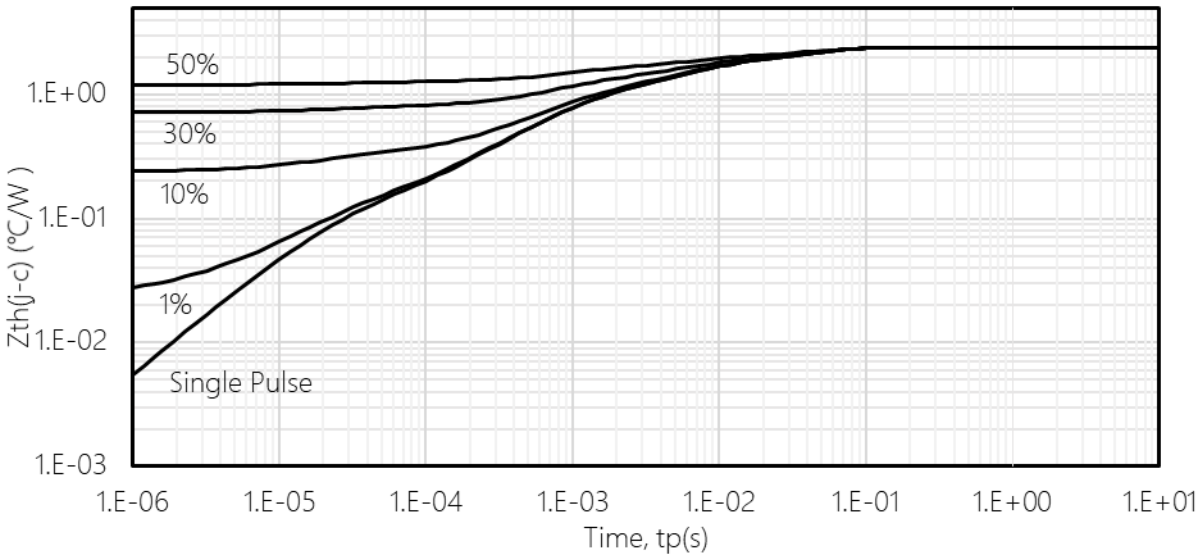
Typical capacitance as a function of drain-source voltage

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

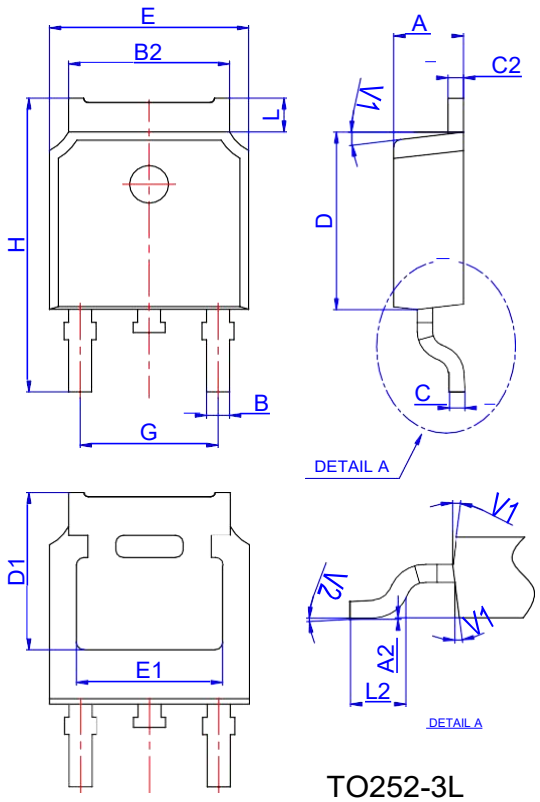


Transient thermal resistance (MOSFET)

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



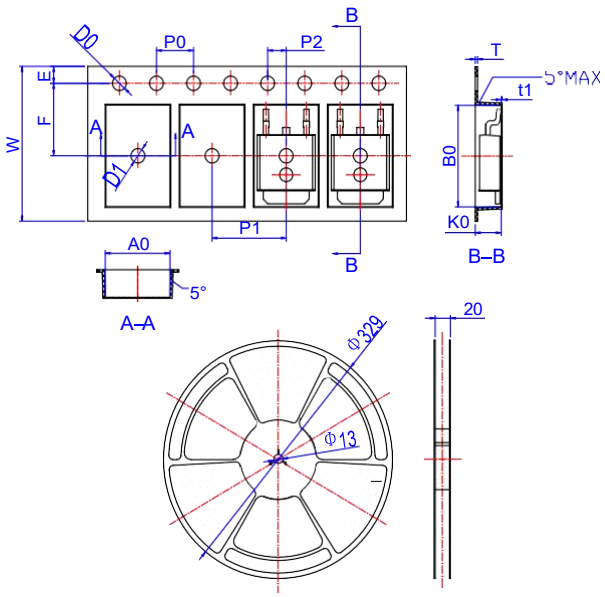
Package Dimensions



TO252-3L

Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	2.10		2.50	0.083		0.098
A2	0		0.10	0		0.004
B	0.66		0.86	0.026		0.034
B2	5.18		5.48	0.202		0.216
C	0.40		0.60	0.016		0.024
C2	0.44		0.58	0.017		0.023
D	5.90		6.30	0.232		0.248
D1	5.30REF			0.209REF		
E	6.40		6.80	0.252		0.268
E1	4.63			0.182		
G	4.47		4.67	0.176		0.184
H	9.50		10.70	0.374		0.421
L	1.09		1.21	0.043		0.048
L2	1.35		1.65	0.053		0.065
V1		7°			7°	
V2	0°		6°	0°		6°

Reel Specification-TO252-3L



Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
W	15.90	16.00	16.10	0.626	0.630	0.634
E	1.65	1.75	1.85	0.065	0.069	0.073
F	7.40	7.50	7.60	0.291	0.295	0.299
D0	1.40	1.50	1.60	0.055	0.059	0.063
D1	1.40	1.50	1.60	0.055	0.059	0.063
P0	3.90	4.00	4.10	0.154	0.157	0.161
P1	7.90	8.00	8.10	0.311	0.315	0.319
P2	1.90	2.00	2.10	0.075	0.079	0.083
A0	6.85	6.90	7.00	0.270	0.271	0.276
B0	10.45	10.50	10.60	0.411	0.413	0.417
K0	2.68	2.78	2.88	0.105	0.109	0.113
T	0.24		0.27	0.009		0.011
t1	0.10			0.004		
10P0	39.80	40.00	40.20	1.567	1.575	1.583