

Silicon Carbide Enhancement Mode MOSFET

Features

- High blocking voltage with low $R_{ds(on)}$
- High frequency operation with low Capacitance
- Simple to drive and easy to parallel
- Robust body diode with low Q_{rr}
- 100% Avalanche Tested

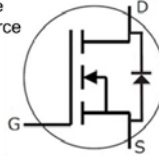
Benefits

- Superior robustness and system reliability
- Higher system efficiency
- Easier paralleling without thermal runaway
- Capable of high temperature application
- Faster and more efficient switching

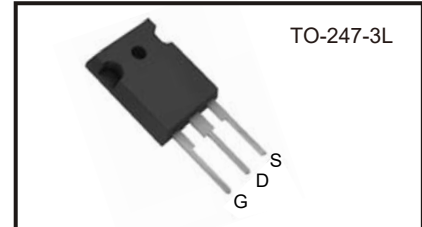
Applications

- EV motor drives
- EV/HEV charging station
- Energy storage and Battery charging
- High voltage DC-DC converters
- Solar / Wind Inverters
- UPS and PFC

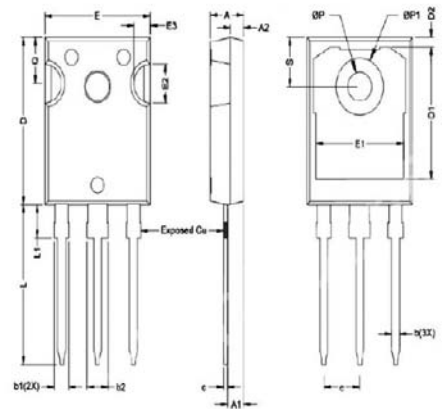
D : Drain
G : Gate
S : Source



V_{DSS}	650V
$I_D(@25^{\circ}C)$	110A
$R_{DS(ON) typ.}$	21m Ω



Package Dimensions



Unit : mm

Absolute Maximum Ratings

($T_c = 25^{\circ}C$ unless otherwise specified)

Parameter	Symbol	Ratings	Unit
Drain-Source Voltage $V_{GS}=0V$ $I_D=100\mu A$	V_{DS}	650	V
Gate-Source Voltage (dynamic) AC ($f > 1$ Hz, duty cycle < 1%, pulse width < 200ns)	V_{GS}	-9/+23	V
Gate-Source Voltage (static)	$V_{GS(op)}$	-4/+18	V
Drain Current-Continuous $V_{GS}=18V @ T_c=25^{\circ}C$ $V_{GS}=18V @ T_c=100^{\circ}C$	I_D	110 78	A
Pulse Drain Current	$I_{D,pulse}$	241	A
Power Dissipation	P_D	326	W
Storage Temperature Range	T_{STG}	-55 to +175	$^{\circ}C$
Operating Junction Temperature Range	T_J	-55 to +175	$^{\circ}C$
Soldering Temperature	T_L	260	$^{\circ}C$
Avalanche Capability, single pulse * $V_{DD}=100V$ $V_{GS}=10V$ $L=1mH$	I_{AV}	50	A
Avalanche Capability, single pulse** $V_{DD}=100V$ $V_{GS}=10V$ $L=1mH$	E_{AV}	1250	mJ

* 100% tested in 60% rating

** 100% tested in 36% rating

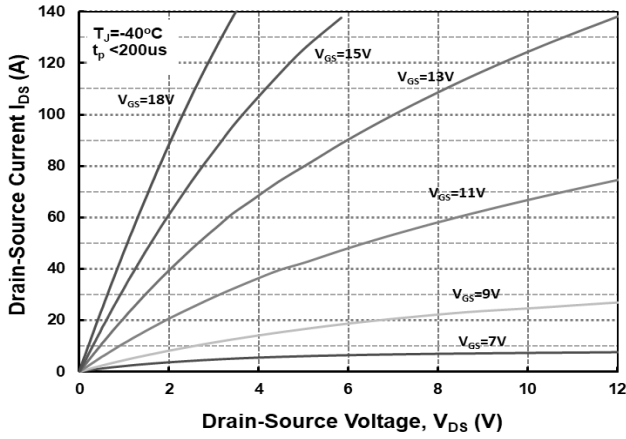
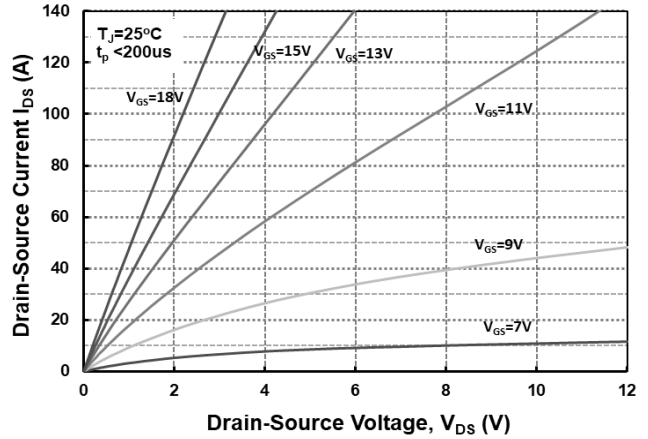
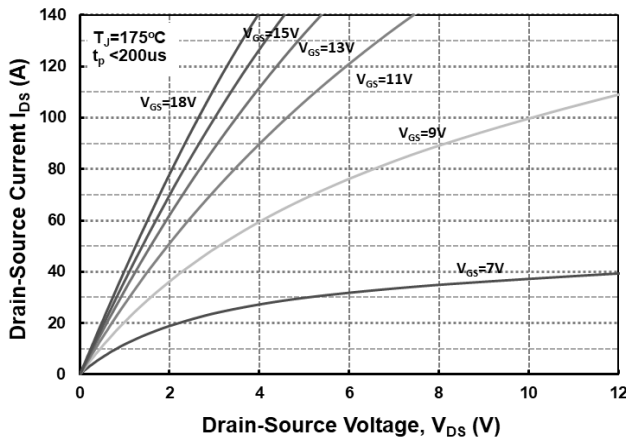
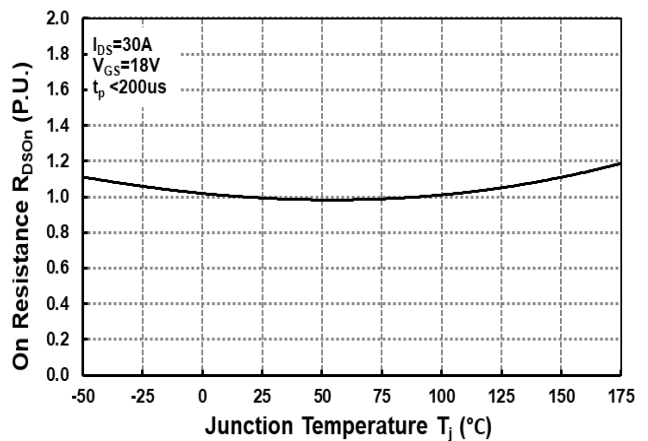
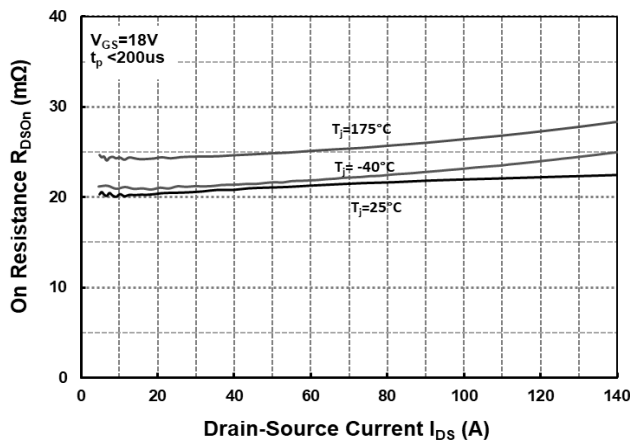
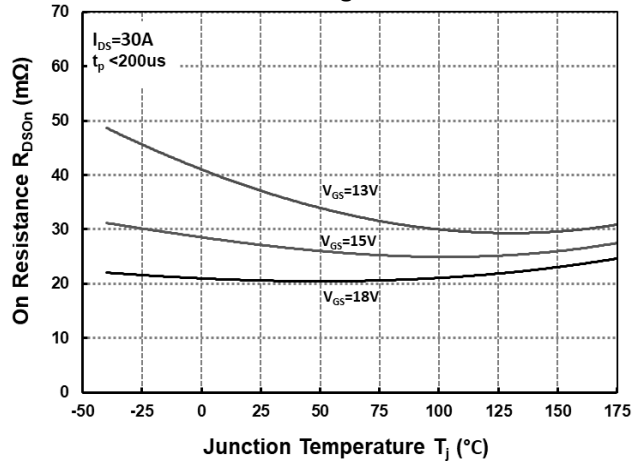
DIM	MILIMETERS		
	MIN	TYP.	MAX
A	4.82	5.02	5.22
A1	2.21	2.41	2.61
A2	1.8	2	2.2
b	0.95	1.2	1.45
b1	1.95	2.2	2.45
b2	2.95	3.2	3.45
c	0.35	0.6	0.85
D	20.75	20.95	21.15
D1	16.3	16.55	16.8
D2	0.99	1.19	1.39
E	15.74	15.94	16.14
E1	13.01	13.26	13.51
E2	4.71	4.91	5.11
E3	2.26	2.46	2.66
e	5.44 BSC.		
L	19.82	20.07	20.32
L1	3.94	4.19	4.44
P	3.41	3.61	3.81
P1	6.94	7.19	7.44
Q	5.59	5.79	5.99
S	5.97	6.17	6.37

Electrical Characteristics @ T_c =25°C (unless otherwise specified)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit	
OFF Characteristics							
Drain-Source Breakdown Voltage	BV _{DSS}	V _{GS} =0V, I _D =0.1mA	650	-	-	V	
Zero Gate Voltage Drain Current	I _{DSS}	V _{DS} =650V V _{GS} =0V	T _J =25°C	-	0.5	60	μA
			T _J =175°C	-	5	200	
Gate-Source Leakage Current	I _{GSS}	V _{GS} =18V, V _{DS} =0V	-	5	100	nA	
		V _{GS} =-4V, V _{DS} =0V	-100	-5	-		
ON Characteristics							
Gate Threshold Voltage	V _{GS(th)}	V _{DS} =V _{GS} , I _D =10mA	T _J =25°C	2.4	2.9	3.6	V
			T _J =175°C	-	2.2	-	
Drain-Source On-State Resistance	R _{DS(on)}	V _{GS} =18V, I _D =30A	T _J =25°C	-	21	27	mΩ
			T _J =175°C	-	25	-	
Transconductance	g _{fs}	V _{DS} =20V, I _D =30A	T _J =25°C	-	25	-	S
			T _J =175°C	-	23	-	
Internal Gate Resistance	R _{G(int.)}	f=1MHz, I _D =0A	-	1.2	-	Ω	
Dynamic Characteristics							
Input Capacitance	C _{iss}	V _{DS} =400V V _{GS} =0V f=1MHz V _{AC} =25mV	-	2420	-	pF	
Output Capacitance	C _{oss}		-	189	-		
Reverse Transfer Capacitance	C _{rss}		-	8	-		
Coss Stored Energy	E _{oss}		-	18	-		μJ
Turn-On Switching Energy	E _{on}	V _{DS} =400V, V _{GS} =-4/+18V I _D =30A, R _{G(ext)} =2.0Ω L=200μH	-	202	-	μJ	
Turn-Off Switching Energy	E _{off}		-	63	-		
Switching Characteristics							
Turn-On Delay Time	t _{d(on)}	V _{DS} =400V, V _{GS} =-4/+18V I _D =30A, R _{G(ext)} =2.0Ω L=200μH	-	17	-	ns	
Rise Time	t _r		-	14	-		
Turn-Off Delay Time	t _{d(off)}		-	30	-		
Fall Time	t _f		-	5	-		
Total Gate Charge	Q _g	V _{DS} =400V V _{GS} =-4/+18V I _D =30A	-	113	-	nC	
Gate to Source Charge	Q _{gs}		-	32	-		
Gate to Drain Charge	Q _{gd}		-	27	-		
Body Diode Characteristics							
Inverse Diode Forward Voltage	V _{SD}	V _{GS} =0V, I _{SD} =20A	T _J =25°C	-	3.2	-	V
Inverse Diode Forward Voltage			T _J =175°C	-	2.9	-	V
Continuous Diode Forward Current	I _S	V _{GS} =-4V, T _J =25°C	-	60	-	A	
Reverse Recovery Time	T _{rr}	I _{SD} =30A, V _{GS} =-4V	-	41	-	ns	
Reverse Recovery Charge	Q _{rr}	V _R =400V, R _{G(ext)} =20Ω	-	369	-	nC	
Peak Reverse Recovery Current	I _{rrm}	L=200μH, dif/dt=1420A/μs	-	14	-	A	
Thermal Resistance							
Thermal Resistance, Junction-to-Case	Rθ _{JC}		-	0.46	0.55	°C/W	

*** Turn-off with -4V gate bias is highly recommended

Typical Performance

Fig 1. Output Characteristics, $T_J = -40^\circ\text{C}$

Fig 2. Output Characteristics, $T_J = 25^\circ\text{C}$

Fig 3. Output Characteristics, $T_J = 175^\circ\text{C}$

Fig 4. Normalized On-Resistance vs. Temperature

Fig 5. On-Resistance vs. Drain Current for Various Temperatures

Fig 6. On-Resistance vs. Temperature for Various Gate Voltage


Typical Performance

Fig 7. Transfer Characteristic for Various Junction Temperatures

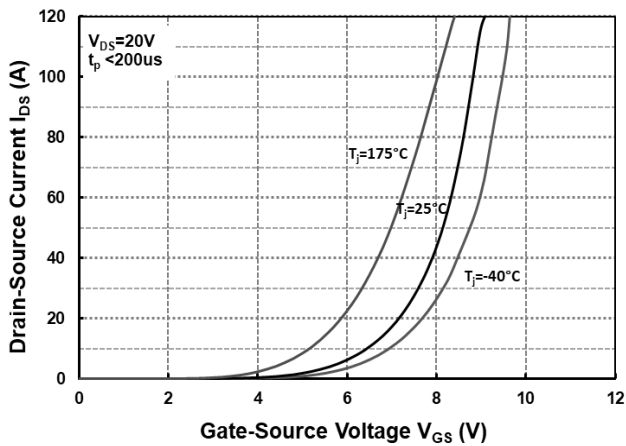


Fig 8. Body Diode Characteristics @ -40°C

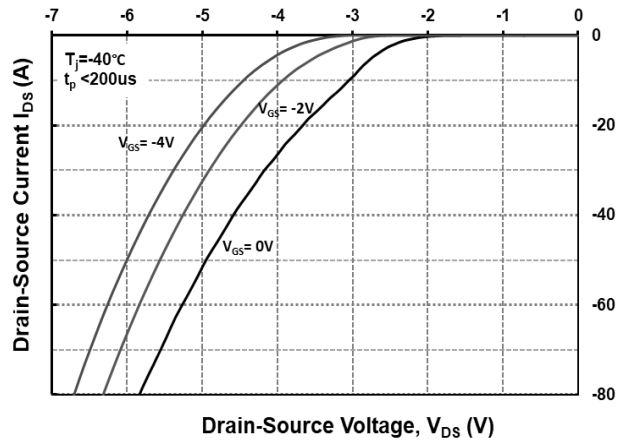


Fig 9. Body Diode Characteristics @ 25°C

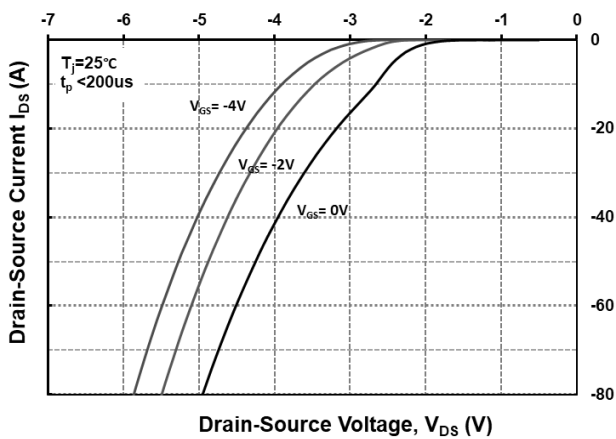


Fig 10. Body Diode Characteristics @ 175°C

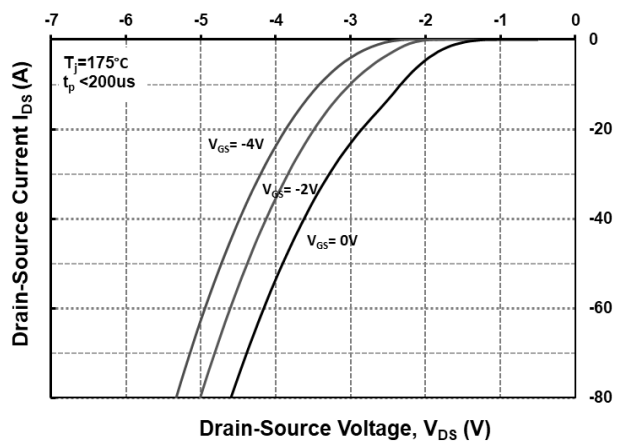


Fig 11. Threshold Voltage vs. Temperature

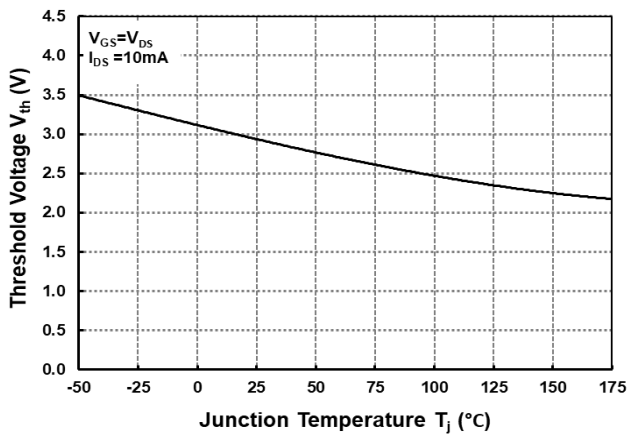
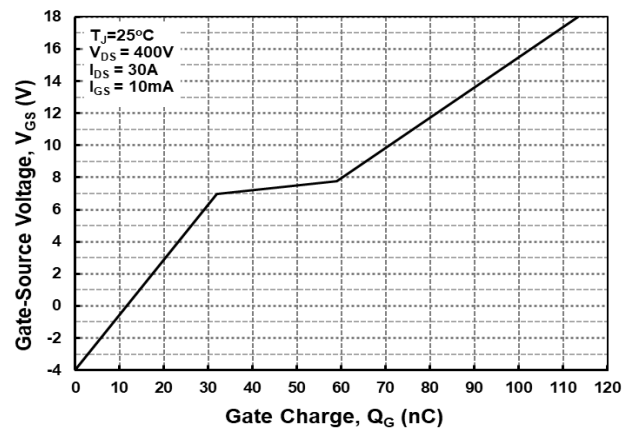
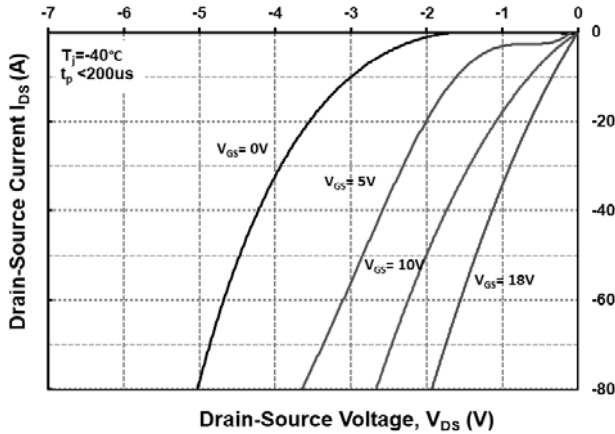
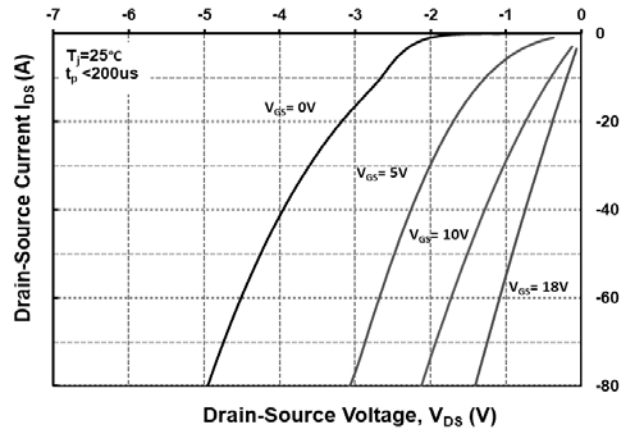
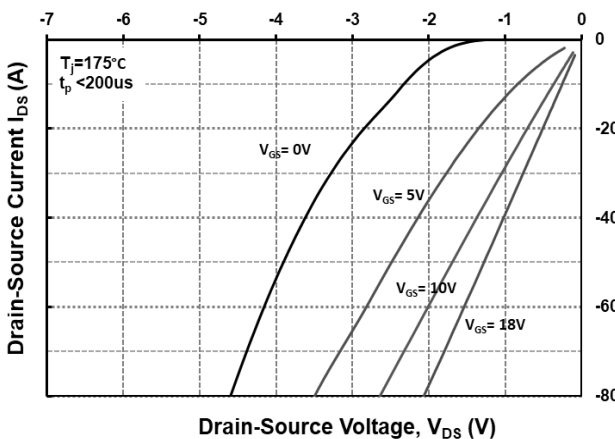
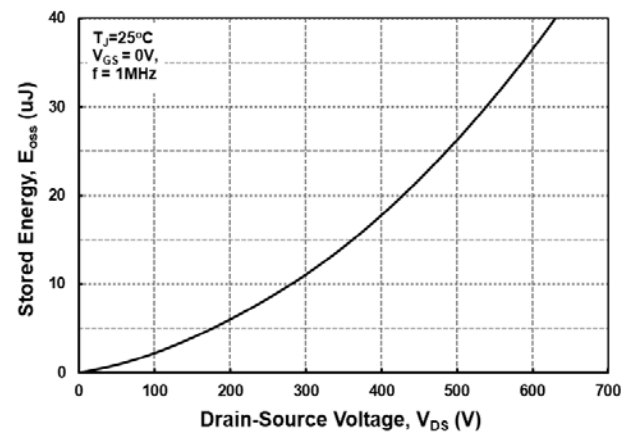
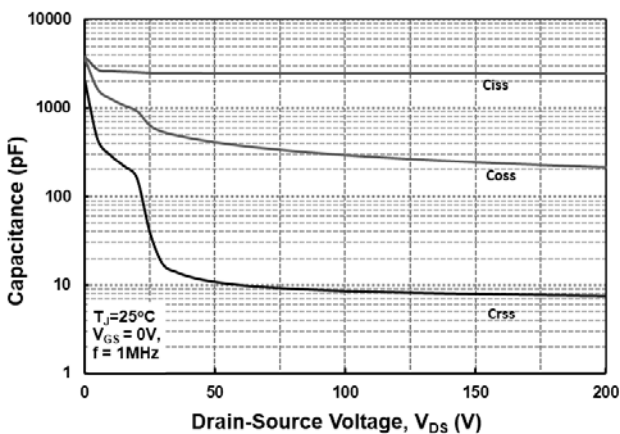
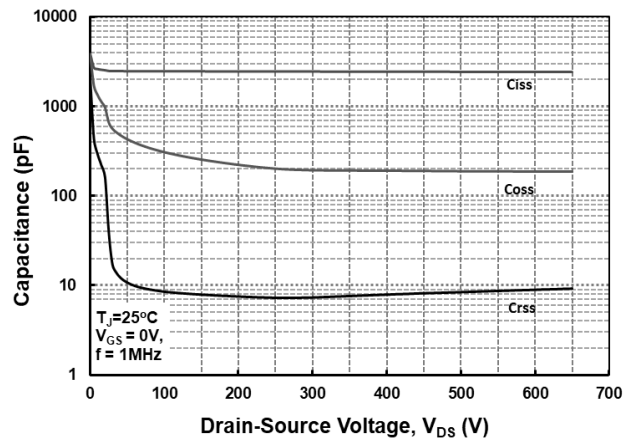


Fig 12. Gate Charge Characteristics



Typical Performance

Fig 13. 3rd Quadrant Characteristics @ -40°C

Fig 14. 3rd Quadrant Characteristics @ 25°C

Fig 15. 3rd Quadrant Characteristics @ 175°C

Fig 16. Output Capacitor Stored Energy

Fig 17. Capacitances vs. Drain-Source Voltage (0-200V)

Fig 18. Capacitances vs. Drain-Source Voltage (0-650V)


Typical Performance

Fig 19. Continuous Drain Current Derating vs. Case Temperature

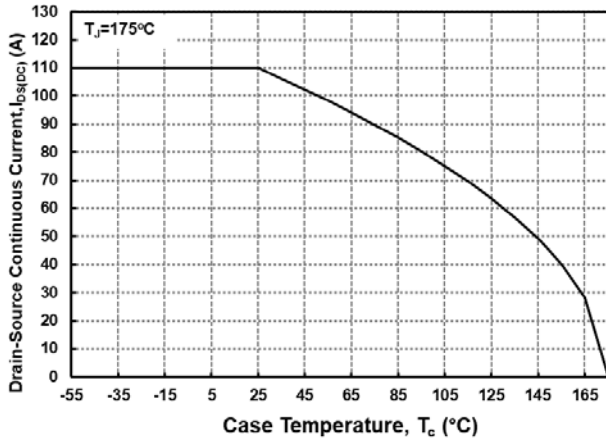


Fig 20. Maximum Power Dissipation Derating vs. Case Temperature

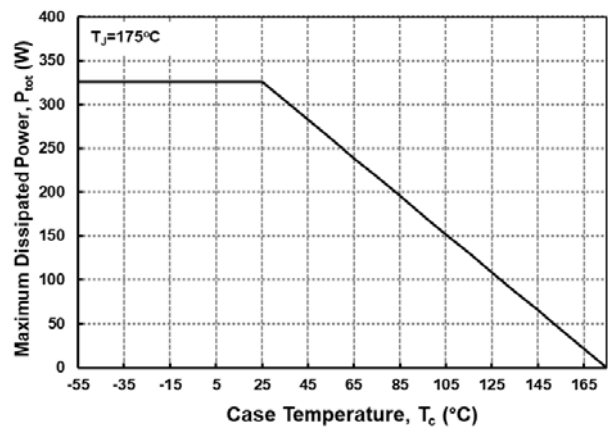


Fig 21. Transient Thermal Impedance (Junction-Case)

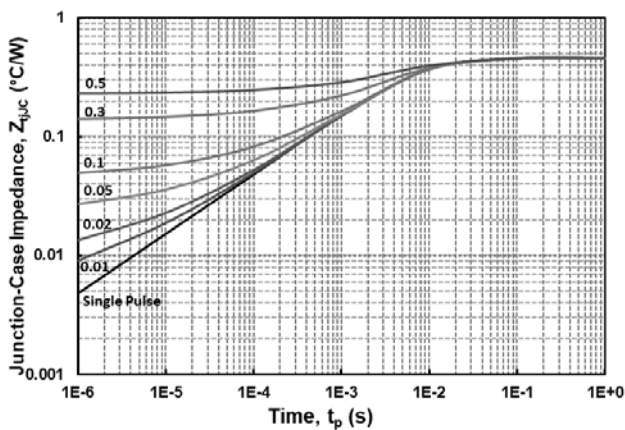


Fig 22. Safe Operating Area

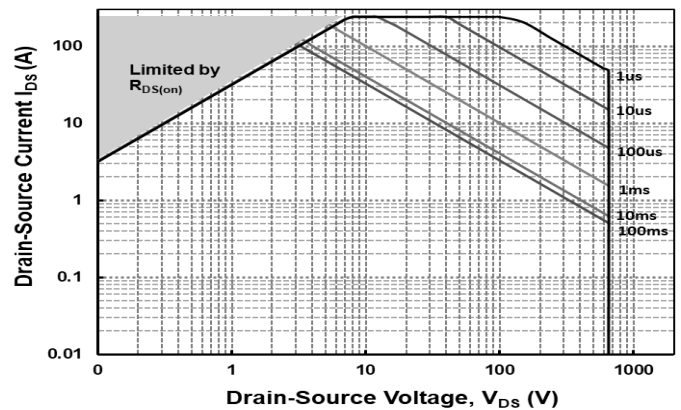


Fig 23. Clamped Inductive Switching Energy vs Drain Current ($V_{DD} = 400V$)

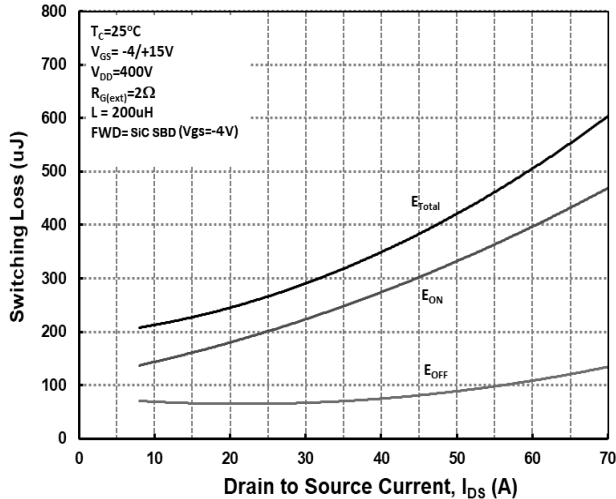
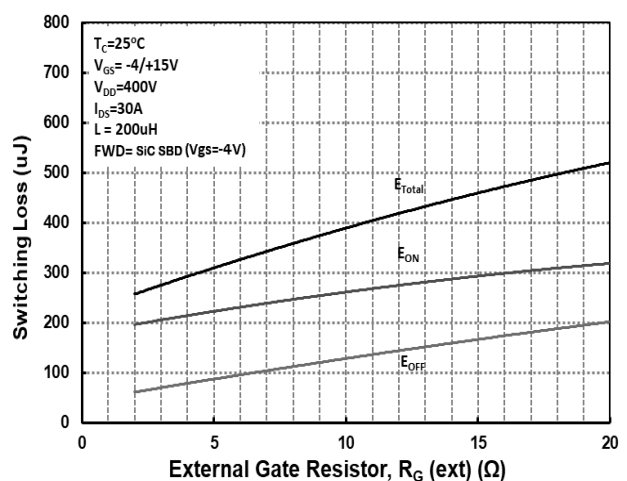
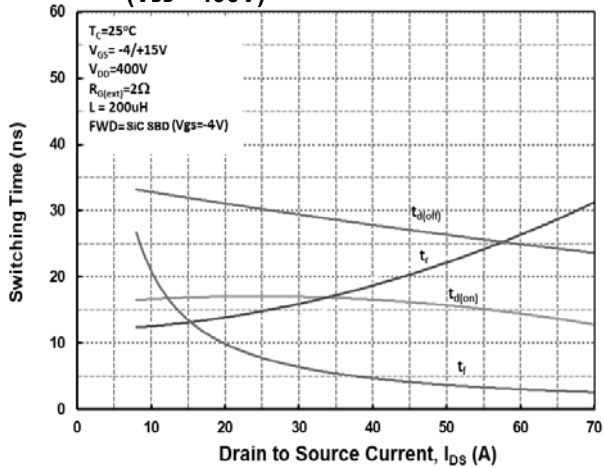
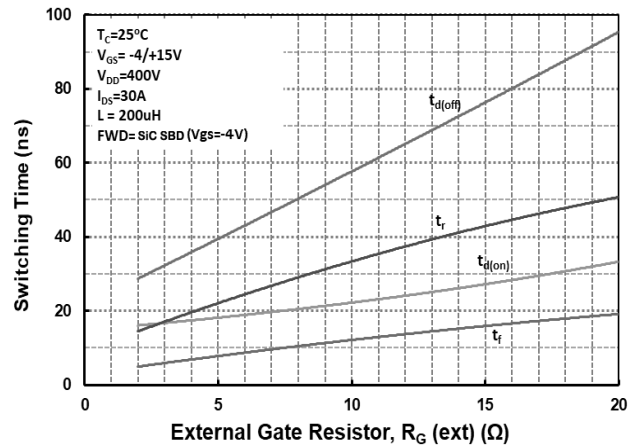


Fig 24. Clamped Inductive Switching Energy vs External Gate Resistor $R_{G(ext)}$



Typical Performance
**Fig 25. Switching Times vs Drain Current
($V_{DD} = 400V$)**

Fig 26. Switching Times vs External Gate Resistor $R_{G(ext)}$


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