CAS300M12BM2
1.2kV, 5.0 mΩ All-Silicon Carbide Half-Bridge Module

Z-FET™ MOSFET and Z-Rec™ Diode

V_{DS}	= 1.2 kV
$E_{sw,Total@300A}$	= 12.0 mJ
$R_{DS(on)}$	= 5.0 mΩ

Module Features

- Ultra Low Loss
- High-Frequency Operation
- Zero Reverse Recovery Current from Diode
- Zero Turn-off Tail Current from MOSFET
- Normally-off, fail-safe device operation
- Ease of paralleling
- Copper baseplate and aluminum nitride insulator

Package 62 mm x 106 mm x 30 mm

System Benefits

- Enables compact and lightweight systems
- High efficiency operation
- Mitigates over-voltage protection
- Reduces thermal requirements
- Enables simplified topologies

Applications

- Induction Heating
- Motor Drives
- Solar and Wind Inverters
- UPS and SMPS
- Traction

Part Number	Package	Marking
CAS300M12BM2	Half Bridge Module	CAS300M12BM2

Maximum Ratings (T_C = 25°C unless otherwise specified)

Symbol	Parameter	Value	Unit	Test Conditions	Note
V_{DSmax}	Drain – Source Voltage	1.2	kV		
V_{GSmax}	Gate – Source Voltage	-10/+25	V	Absolute maximum values	
V_{GSop}	Gate – Source Voltage	-5/+20	V	Recommended operational values	
I_D	Continuous Drain Current	404	A	V_{GS} = 20 V, T_C = 25 °C	Fig 20
		285	A	V_{GS} = 20 V, T_C = 90 °C	
I_{Dpulse}	Pulsed Drain Current	1500	A	Pulse width t_P = 200 µs repetition rate limited by $T_{J(max)}$, T_C = 25°C	
T_{Jmax}	Junction Temperature	150	°C		
T_C T_{stg}	Case and Storage Temperature Range	-40 to +125	°C		
P_{tot}	Maximum Power Dissipation	1660	W	T_C = 25 °C, T_J = 150 °C	
V_{isol}	Case Isolation Voltage	4.0	kV	AC, 50 Hz, 1 min	
L_{stray}	Stray Inductance	14	nH	Measured between terminals 2 and 3	
M	Mounting Torque	5	Nm	To heatsink and terminals	
G	Weight	300	g		
	Clearance Distance	12	mm	Terminal to terminal	
	Creepage Distance	30	mm	Terminal to terminal	
		40	mm	Terminal to baseplate	

Electrical Characteristics (T_C = 25°C unless otherwise specified)

Symbol	Parameter	Value			Unit	Test Conditions	Notes
		Min	Typ	Max			
$V_{(BR)DSS}$	Drain – Source Breakdown Voltage	1.2			kV	V_{GS} = 0 V, I_{DS} = 1 mA	
$V_{GS(th)}$	Gate Threshold Voltage	2.0	2.3		V	V_{DS} = 10 V, I_{DS} = 15 mA	Fig 11
I_{DSS}	Zero Gate Voltage Drain Current		500	2000	µA	V_{DS} = 1.2 kV, V_{GS} = 0 V	
			1000			V_{DS} = 1.2 kV, V_{GS} = 0 V T_J = 150 °C	
I_{GSS}	Gate-Source Leakage Current		1	100	nA	V_{GS} = 20 V, V_{DS} = 0 V	
$R_{DS(on)}$	Drain-Source On-State Resistance		5.0	5.7	mΩ	V_{GS} = 20 V, I_{DS} = 300 A	Fig 4, 5 and 6
			8.6	9.8		V_{GS} = 20 V, I_{DS} = 300 A, T_J = 150 °C	
g_{fs}	Transconductance		94.8		S	V_{DS} = 20 V, I_{DS} = 300 A	Fig 7
			93.3			V_{DS} = 20 V, I_{DS} = 300 A, T_J = 150 °C	
C_{ISS}	Input Capacitance		11.7		nF	V_{DS} = 600 V f = 200 kHz, V_{AC} = 25 mV	Fig 17, 18
C_{OSS}	Output Capacitance		2.55				
C_{RSS}	Reverse Transfer Capacitance		0.07				
$t_{d(on)}$	Turn-On Delay Time		76			VDD = 600 V, VGS = -5/20 V ID = 300 A, RG(ext) = 2.5 Ω, Timing relative to VDS Per IEC60747-8-4 pg 83 Inductive Load	Fig 24
t_r	Rise Time		68				
$t_{d(off)}$	Turn-Off Delay Time		168				
t_f	Fall Time		43				
E_{ON}	Turn-On Switching Energy		6.05		mJ	V_{DS} = 600 V, V_{GS} = -5 / 20 V I_{DS} = 300 A, R_G = 2.5 Ω, Inductive Load	Fig 25
E_{OFF}	Turn-Off Switching Energy		5.95				

Free-Wheeling Diode Characteristics

Symbol	Parameter	Value			Unit	Test Conditions	Notes
		Min	Typ	Max			
V_{SD}	Diode Forward Voltage		1.7	2.0	V	I_{SD} = 300 A, T_J = 25°C, V_{GS} = 0 V	Fig 8, 9 and 10
			2.2	2.5	V	I_{SD} = 300 A, T_J = 150°C, V_{GS} = 0 V	
Q_C	Total Capacitive Charge		3.2		µC		

Note: The reverse recovery is purely capacitive.

Gate Charge Characteristics

Symbol	Parameter	Value			Unit	Test Conditions	Notes
		Min	Typ	Max			
Q_{GS}	Gate to Source Charge		166		nC	V_{DS} = 800 V, V_{GS} = -5 /+ 20 V I_{DS} = 300 Amps Per JEDEC24 pg 27	Fig 12
Q_{GD}	Gate to Drain Charge		475				
Q_G	Total Gate Charge		1025				
R_G	Internal Gate Resistance		3.0		Ω	f = 200 kHz, V_{AC} = 25 mV	

Thermal Characteristics

Symbol	Parameter	Value			Unit	Test Conditions	Notes
		Min	Typ	Max			
$R_{\theta JCM}$	Thermal Resistance Junction to Case for MOSFET		0.070	0.075	°C/W	T_C = 90 °C, T_j =150 °C P_{dis} = P_{max}	Fig 17
$R_{\theta JCD}$	Thermal Resistance Junction to Case for Diode		0.073	0.076			Fig 18

Typical Performance

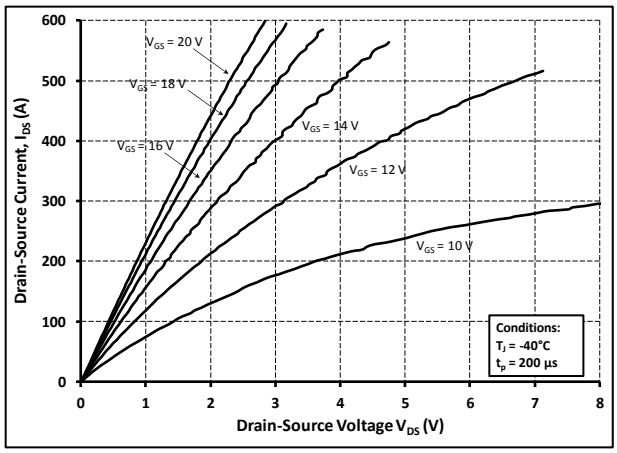


Fig 1. Typical Output Characteristics T_J = -40 °C

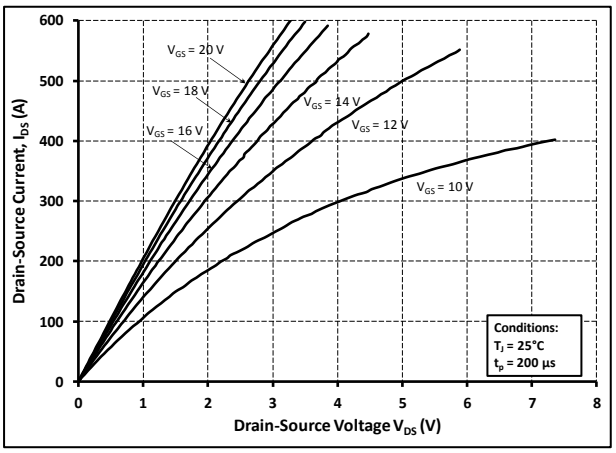


Fig 2. Typical Output Characteristics T_J = 25 °C

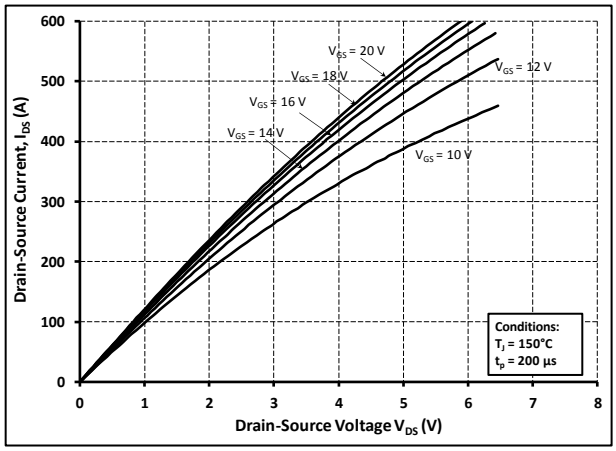


Fig 3. Typical Output Characteristics T_J = 150 °C

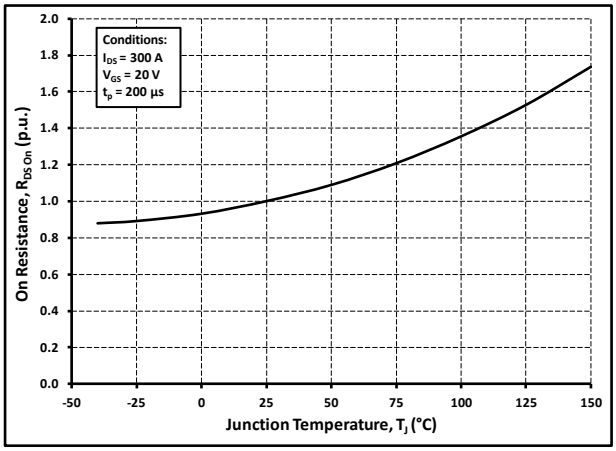


Fig 4. Normalized On-Resistance vs. Temperature

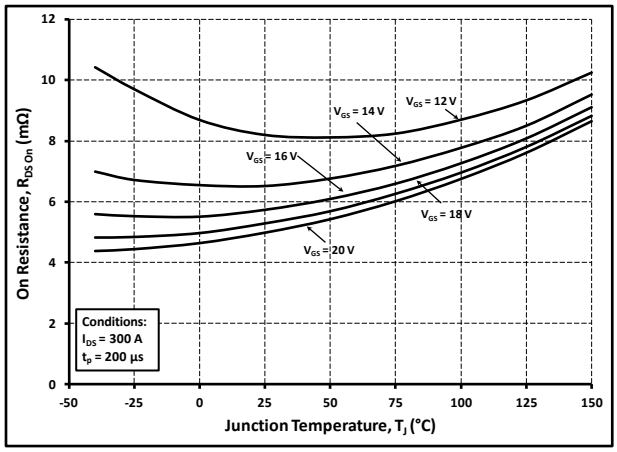


Fig 5. Typical On-Resistance vs. Temperature and Gate Voltage

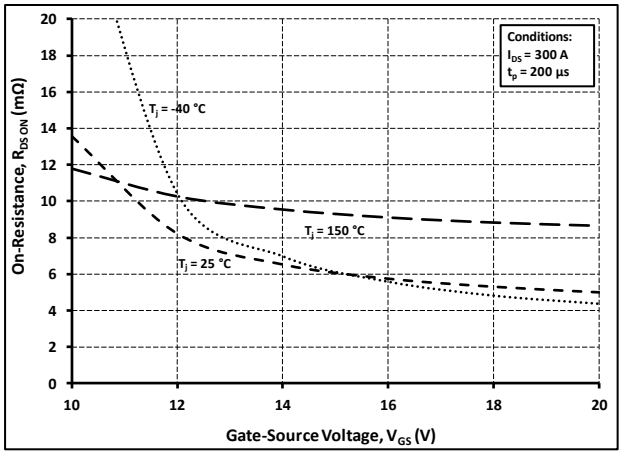


Fig 6. Typical On-Resistance vs. Gate Voltage

Typical Performance

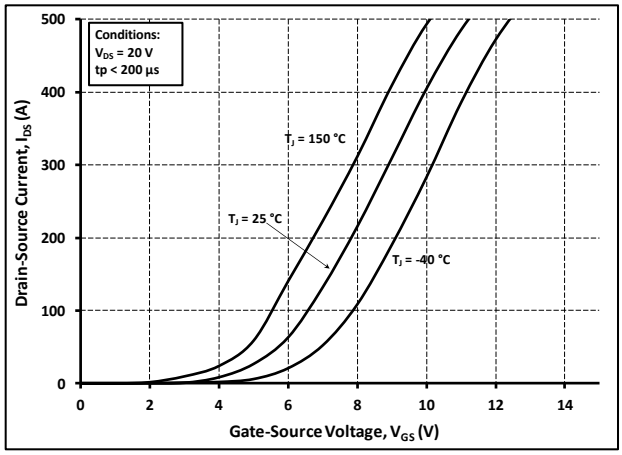


Fig 7. Typical Transfer Characteristic For Various Temperatures

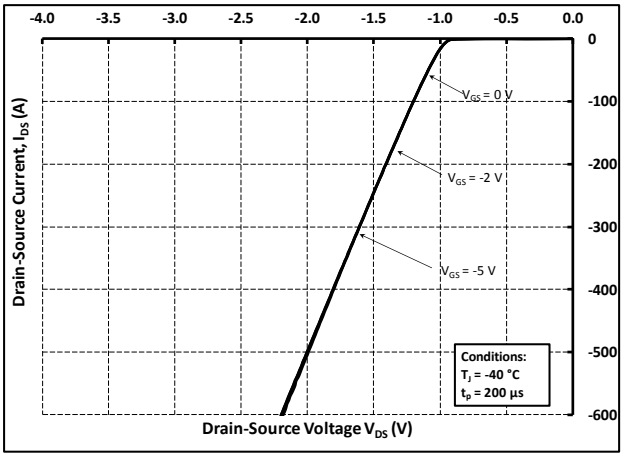


Fig 8. Typical Diode Behavior T_J = -40 °C

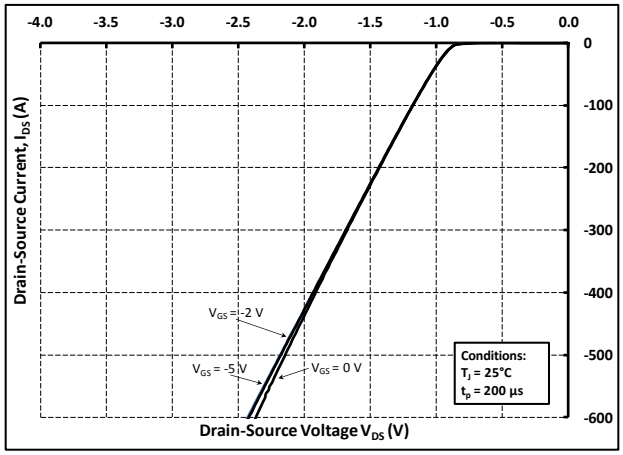


Fig 9. Typical Diode Behavior T_J = 25 °C

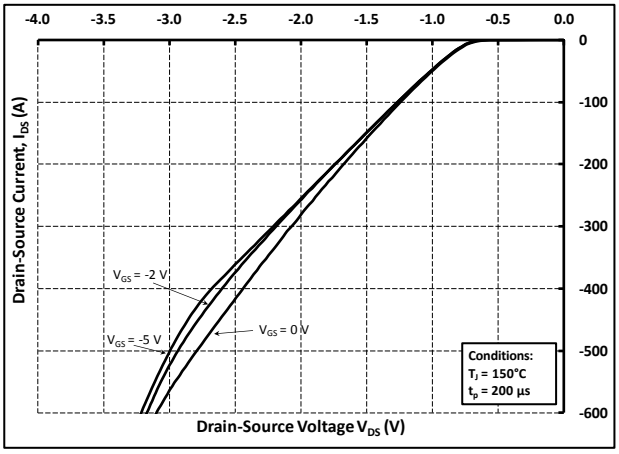


Fig 10. Typical Diode Behavior T_J = 150 °C

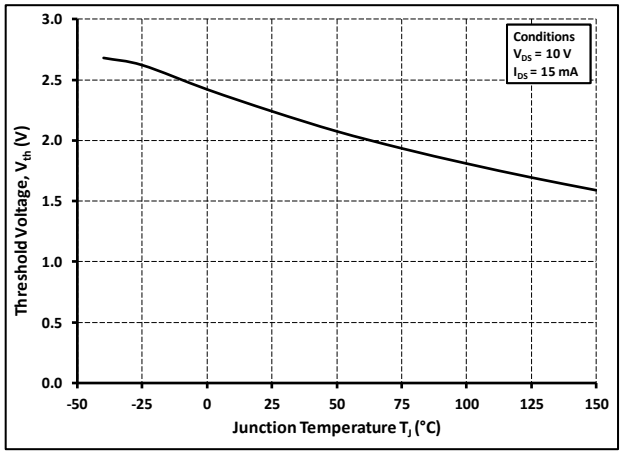


Fig 11. Typical Threshold Voltage vs. Temperature

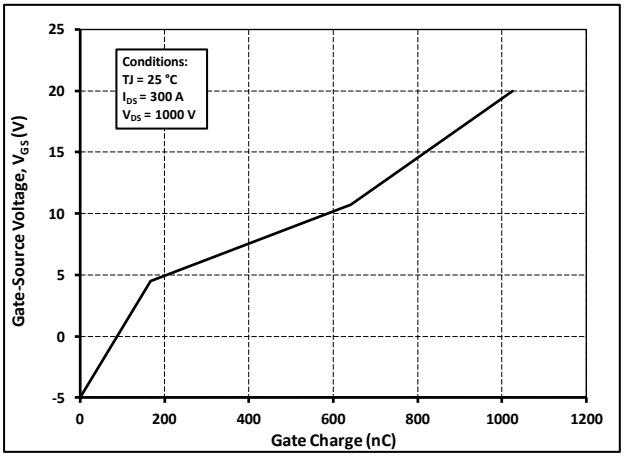


Fig 12. Typical Gate Charge

Typical Performance

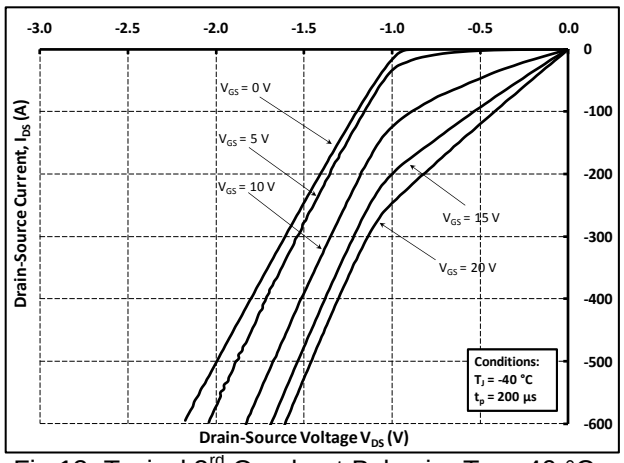


Fig 13. Typical 3rd Quadrant Behavior T_J = -40 °C

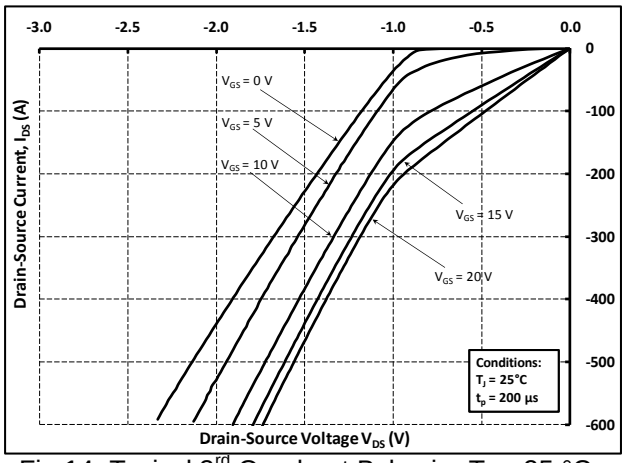


Fig 14. Typical 3rd Quadrant Behavior T_J = 25 °C

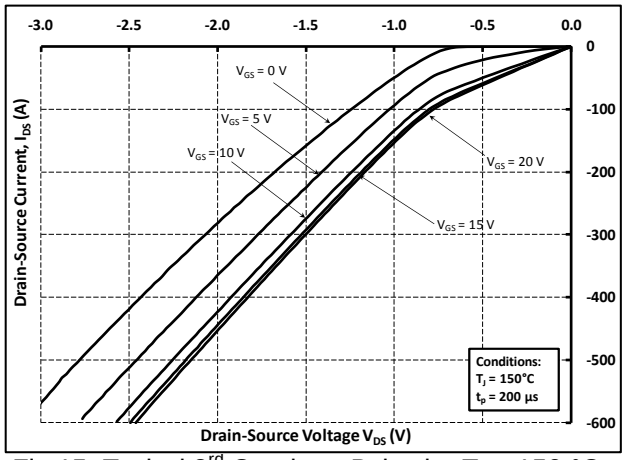


Fig 15. Typical 3rd Quadrant Behavior T_J = 150 °C

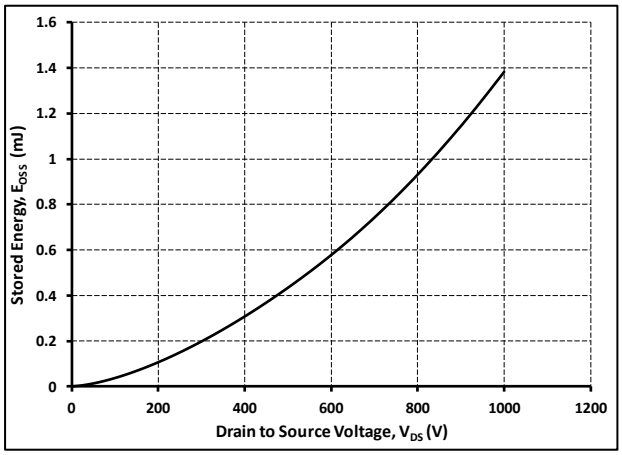


Fig 16. Typical Output Capacitor Stored Energy

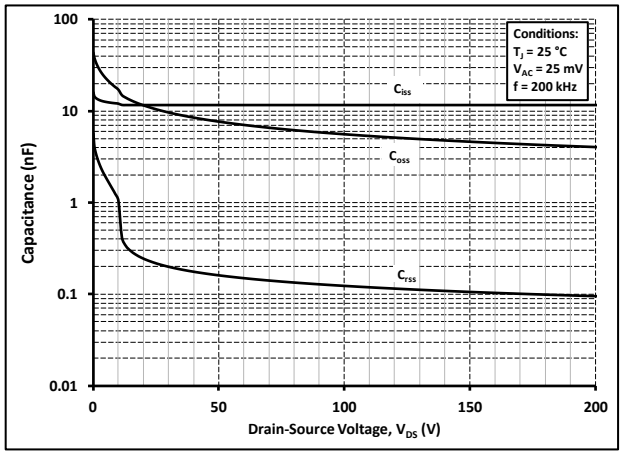


Fig 17. Typical Capacitances vs. Drain-Source Voltage. (0-200V)

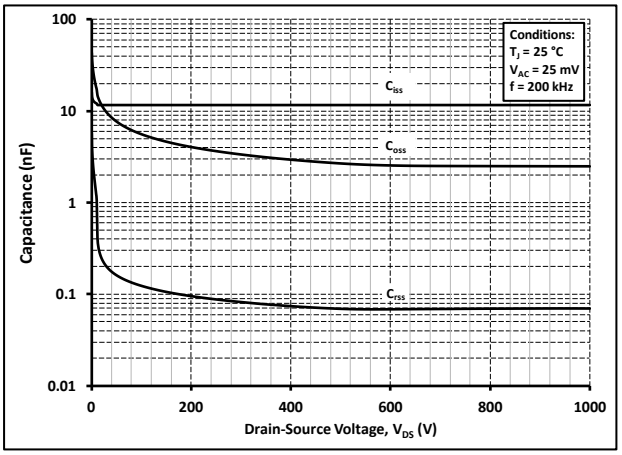


Fig 18. Typical Capacitances vs. Drain-Source Voltage. (0-1000V)

Typical Performance

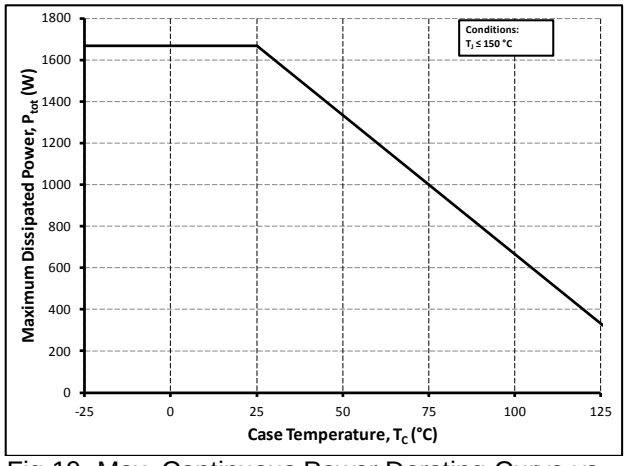


Fig 19. Max. Continuous Power Derating Curve vs. Case Temperature.

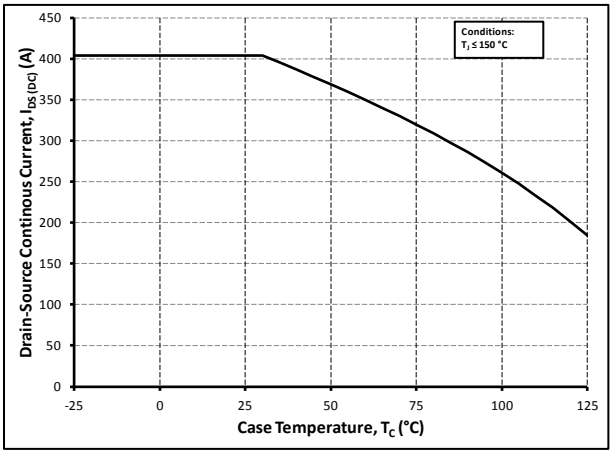


Fig 20. Max. Continuous Current Derating Curve vs. Case Temperature

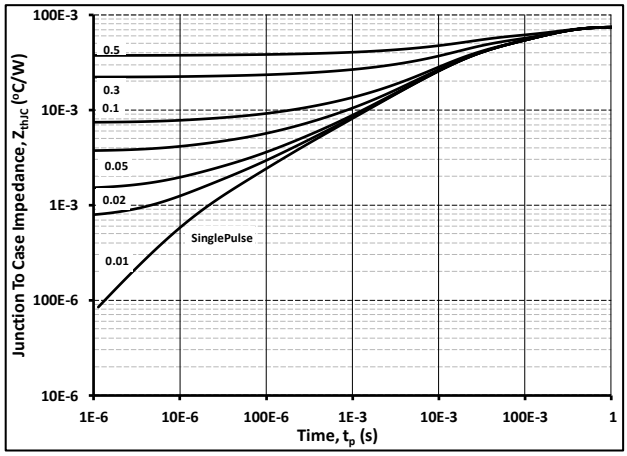


Fig 21. Typical Transient Thermal Impedance - MOSFET

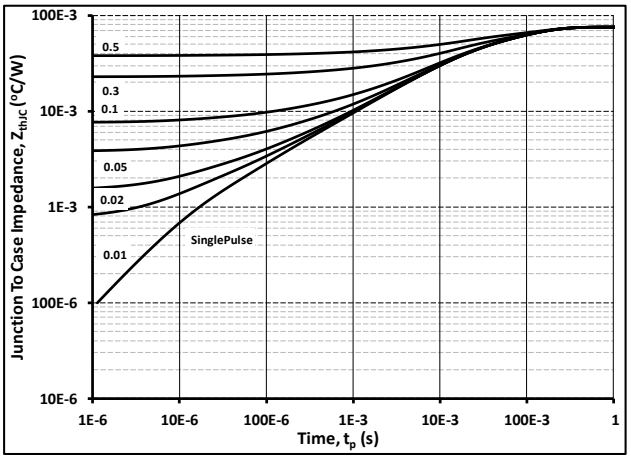


Fig 22. Typical Transient Thermal Impedance - DIODE

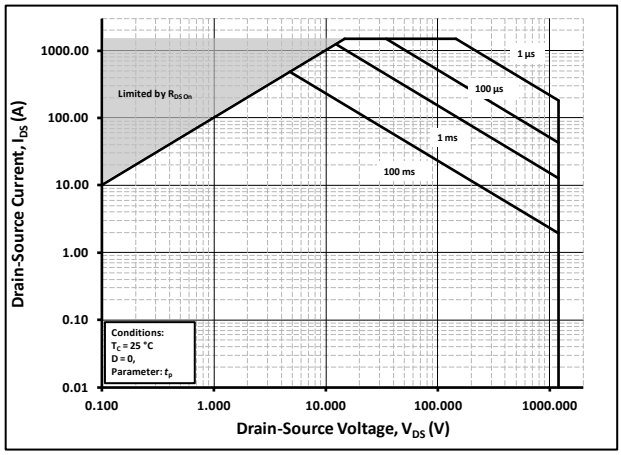


Fig 23. MOSFET Safe Operating Area

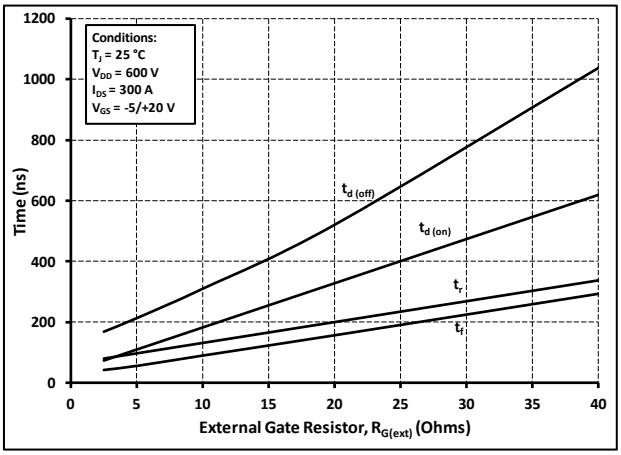


Fig 24. Typical Inductive Switching Time vs Gate Resistance (V_{DD} = 600V, I_D = 300A)

Typical Performance

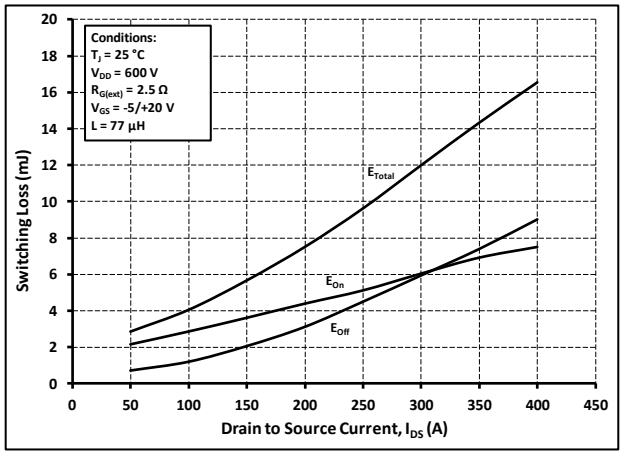


Fig 25. Typical Clamped Inductive Switching Energy vs Drain Current (V_{DD} = 600V)

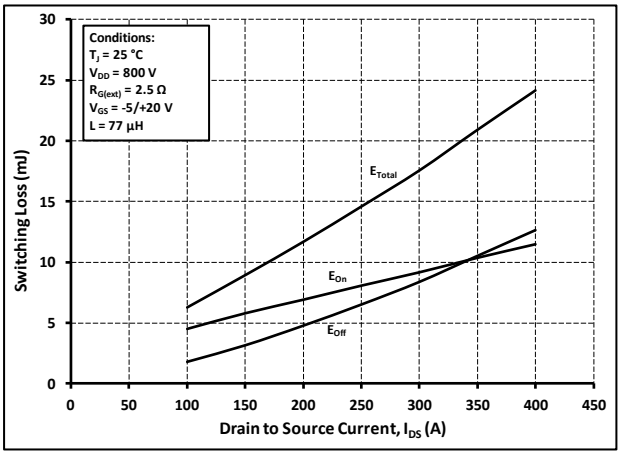


Fig 26. Typical Clamped Inductive Switching Energy vs Drain Current (V_{DD} = 800V)

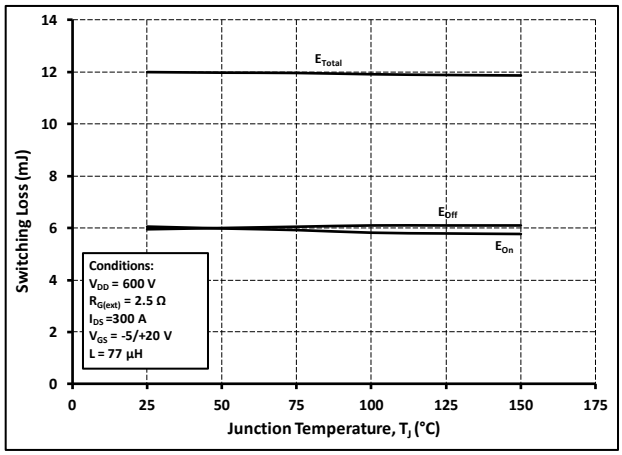


Fig 27. Typical Switching Loss vs. Temperature

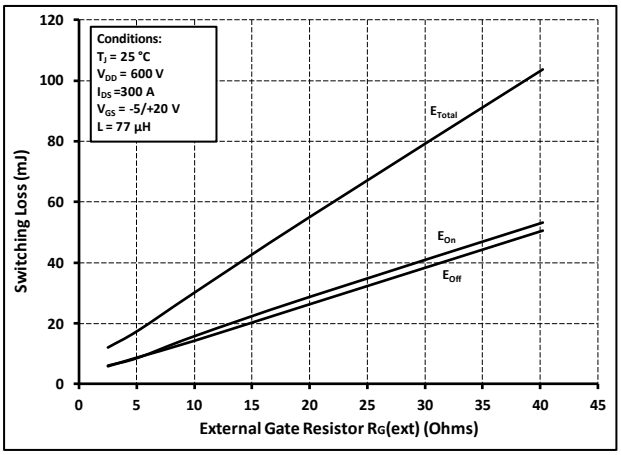
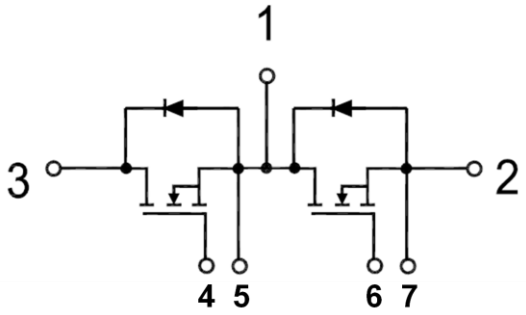


Fig 28. Typical Switching Loss vs. Gate Resistance

Schematic



Mechanical Characteristics (in mm)