CAS300M12BM2

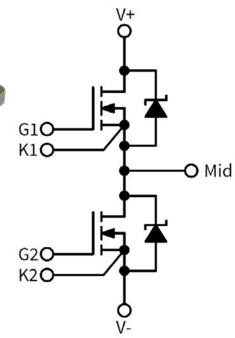
1200 V, 300 A All-Silicon Carbide
High Performance, Switching Optimized, Half-Bridge Module

V_{DS}	1200 V
I_{DS}	300 A

Technical Features

- Industry Standard 62mm Footprint
- Ultra Low Loss , High-Frequency Operation
- Zero Reverse Recovery from Diodes
- Zero Turn-off Tail Current from MOSFET
- Normally-off, Fail-safe Device Operation
- Copper Baseplate and Aluminum Nitride Insulator

Package 61.4 mm X 106.4 mm X 30 mm



Applications

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

System Benefits

- 62mm Form Factor Enables System Retrofit
- Increased System Efficiency, due to Low Switching & Conduction Losses of SiC

Maximum Parameters (Verified By Design)

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions	Note
$V_{DS\,max}$	Drain-Source Voltage			1200	V		
$V_{GS\,max}$	Gate-Source Voltage, Maximum Value	-10		+25	V	Transient, <100 ns	Fig. 32
$V_{GS\,op}$	Gate-Source Voltage, Recommended Op. Value	-5		+20	V	Static	Fig. 32
I_{DS}	DC Continuous Drain Current		498		A	V_{GS} = 20 V, T_C = 25 ˚C, $T_{VJ} \le$ 150 ˚C	Fig. 20
			345		A	V_{GS} = 20 V, T_C = 90 ˚C, $T_{VJ} \le$ 150 ˚C	
I_{SD}	DC Source-Drain Current		876		A	V_{GS} = 20 V, T_C = 25 ˚C, $T_{VJ} \le$ 150 ˚C	
I_F	Schottky Diode DC Forward Current		547		A	V_{GS} = - 5 V, T_C = 25 ˚C, $T_{VJ} \le$ 150 ˚C	
$I_{DS\,(pulsed)}$	Maximum Pulsed Drain-Source Current			1500	A	V_{GS} = 20 V; T_C = 25 ˚C; t_{Pmax} limited by T_{VJmax}	
$I_{F\,(pulsed)}$	Maximum Pulsed Diode Current			1500	A	V_{GS} = -5 V; T_C = 25 ˚C; t_{Pmax} limited by T_{VJmax}	
$T_{VJ\,op}$	Maximum Virtual Junction Temperature under Switching Conditions	-40		150	°C		

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

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions	Note
$V_{(BR)DSS}$	Drain-Source Breakdown Voltage	1200			V	V_{GS} = 0 V, T_{VJ} = -40 °C	
$V_{GS(th)}$	Gate Threshold Voltage	2.0	2.9	4.0	V	V_{DS} = V_{GS}, I_D = 90 mA	
			2.4		V	V_{DS} = V_{GS}, I_D = 90 mA, T_{VJ} = 150 °C	
I_{DSS}	Zero Gate Voltage Drain Current		600	2000	μA	V_{GS} = 0 V, V_{DS} = 1200 V	
I_{GSS}	Gate-Source Leakage Current		0.06	3.6	μA	V_{GS} = 20 V, V_{DS} = 0 V	
$R_{DS(on)}$	Drain-Source On-State Resistance (Devices Only)		4.17	5.67	mΩ	V_{GS} = 20 V, I_D = 300 A	Fig. 2 Fig. 3
			7.20		mΩ	V_{GS} = 20 V, I_D = 300 A, T_{VJ} = 150 °C	
g_{fs}	Transconductance		160		S	V_{DS}= 20 V, I_{DS}= 300 A	Fig. 4
			160		S	V_{DS}= 20 V, I_{DS}= 300 A, T_{VJ} = 150 °C	
E_{On}	Turn-On Switching Energy, T_{VJ} = 25 °C T_{VJ} = 125 °C T_{VJ} = 175 °C		3.4 3.0 2.9		mJ	V_{DS} = 600 V, I_D = 300 A, V_{GS} = -5 V/+20 V, $R_{G(ext)}$ = 0.0 Ω, L= 22.2 μH	Fig. 11 Fig. 13
E_{Off}	Turn-Off Switching Energy, T_{VJ} = 25 °C T_{VJ} = 125 °C T_{VJ} = 175 °C		3.4 3.4 3.5		mJ		
$R_{G(int)}$	Internal Gate Resistance		3.0		Ω	V_{AC} = 25 mV, f = 100 kHz	
C_{iss}	Input Capacitance		19.5		nF	V_{GS} = 0 V, V_{DS} = 800 V, V_{AC} = 25 mV, f = 100 kHz	Fig. 9
C_{oss}	Output Capacitance		2.54		nF		
C_{rss}	Reverse Transfer Capacitance		113		pF		
Q_{GS}	Gate to Source Charge		166		nC	V_{DS} = 800 V, V_{GS} = -5 V/+20 V I_D = 300 A Per IEC60747-8-4 pg 21	
Q_{GD}	Gate to Drain Charge		475		nC		
Q_G	Total Gate Charge		1025		nC		
$R_{th\ JC}$	FET Thermal Resistance, Junction to Case		0.070	0.075	°C/W		Fig. 17

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

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions	Note
V_F	Diode Forward Voltage		1.6		V	V_{GS} = -5 V, I_F = 300 A	Fig. 7
			2.1			V_{GS} = -5 V, I_F = 300 A, T_{VJ} = 150 °C	
t_{rr}	Reverse Recovery Time		27		ns	V_{GS} = -5 V, I_{SD} = 300 A, V_R = 600 V di_F/dt = 22 A/ns, T_{VJ} = 150 °C	Fig. 31
Q_{RR}	Reverse Recovery Charge		4.9		µC		
I_{RRM}	Peak Reverse Recovery Current		-310		A		
E_{rr}	Diode Energy T_{VJ} = 25 °C T_{VJ} = 125 °C T_{VJ} = 150 °C		2.04 2.17 2.18		mJ	V_{DS} = 600 V, I_D = 300A, V_{GS} = -5 V/20 V, $R_{G(ext)}$ = 0.0 Ω, L= 22.2 µH	Fig. 14 Note 1
$R_{th\ JC}$	Diode Thermal Resistance, Junction to Case		0.073	0.076	°C/W		Fig. 18

Note 1 SiC Schottky diodes do not have reverse recovery energy but still contribute capacitive energy.

Module Physical Characteristics

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions
$R_{1\text{-}3}$	Package Resistance, M1		0.60		mΩ	T_C = 125 °C, Note 2
$R_{1\text{-}2}$	Package Resistance, M2		0.51			T_C = 125 °C, Note 2
L_{Stray}	Stray Inductance		11.1		nH	Between Terminals 3 and 2
T_C	Case Temperature	-40		125	°C	
W	Weight		300		g	
M_S	Mounting Torque	4	5	5.5	N-m	Baseplate, M6-1.0 bolts
		4	5	5.5		Power Terminals, M6-1.0 bolts
V_{isol}	Case Isolation Voltage	5			kV	AC, 50 Hz, 1 min
	Clearance Distance	9			mm	Terminal to Terminal
		30				Terminal to Baseplate
	Creepage Distance	30				Terminal to Terminal
		40				Terminal to Baseplate

Note 2 Total Effective Resistance (Per Switch Position) = MOSFET $R_{DS(on)}$ + Switch Position Package Resistance.

Typical Performance

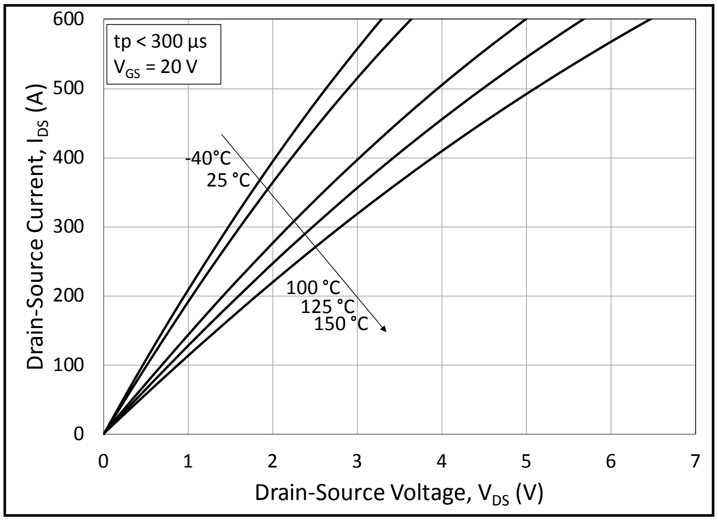


Figure 1. Output Characteristics for Various Junction Temperatures

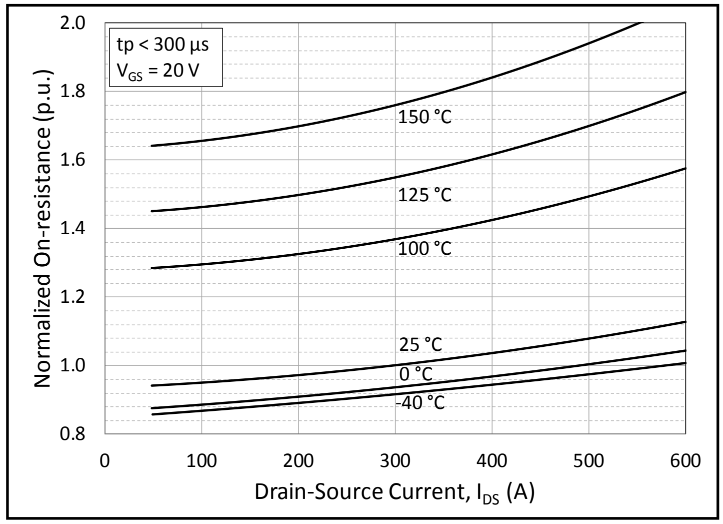


Figure 2. Normalized On-State Resistance vs. Drain Current for Various Junction Temperatures

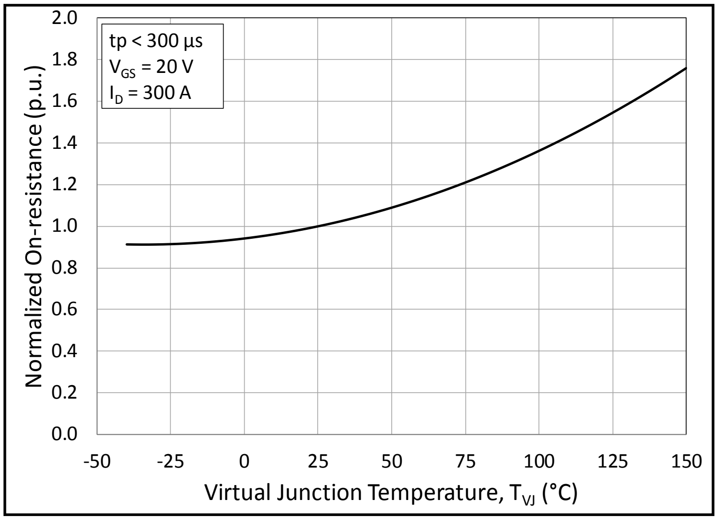


Figure 3. Normalized On-State Resistance vs. Junction Temperature

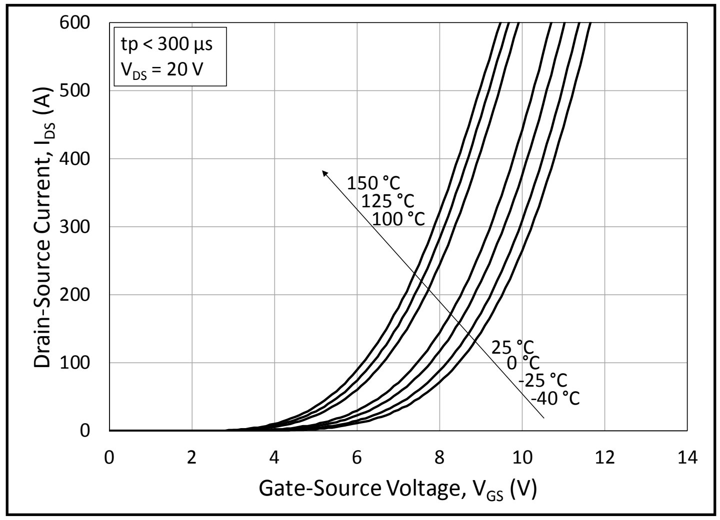


Figure 4. Transfer Characteristic for Various Junction Temperatures

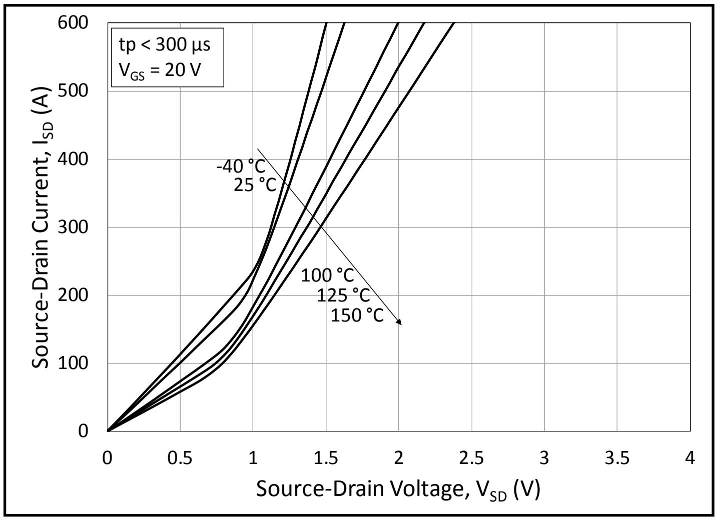


Figure 5. 3rd Quadrant Characteristic vs. Junction Temperatures at V_{GS} = 20 V

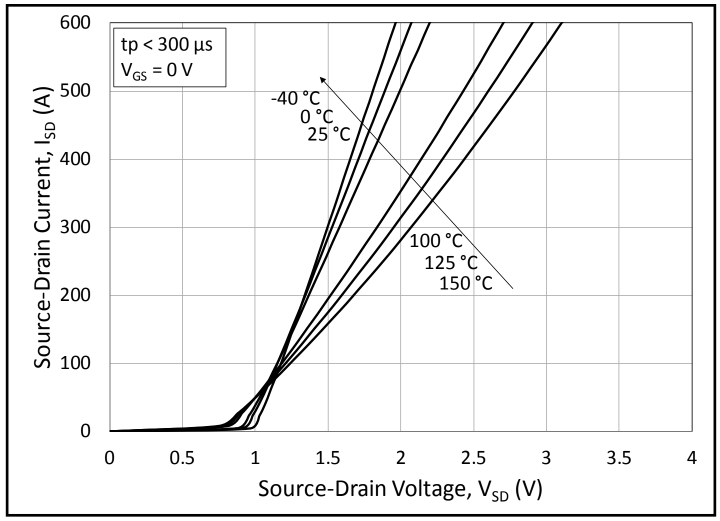


Figure 6. 3rd Quadrant Characteristic vs. Junction Temperatures at V_{GS} = 0V (Diode)

Typical Performance

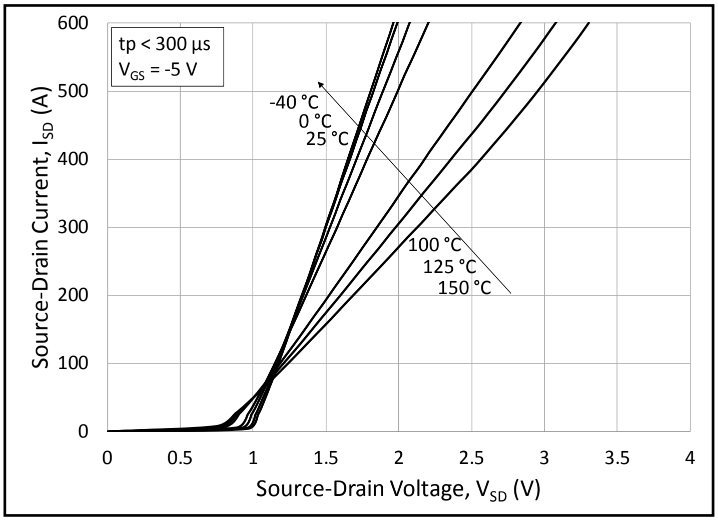


Figure 7. 3rd Quadrant Characteristic vs. Junction Temperatures at V_{GS} = - 5 V (Diode)

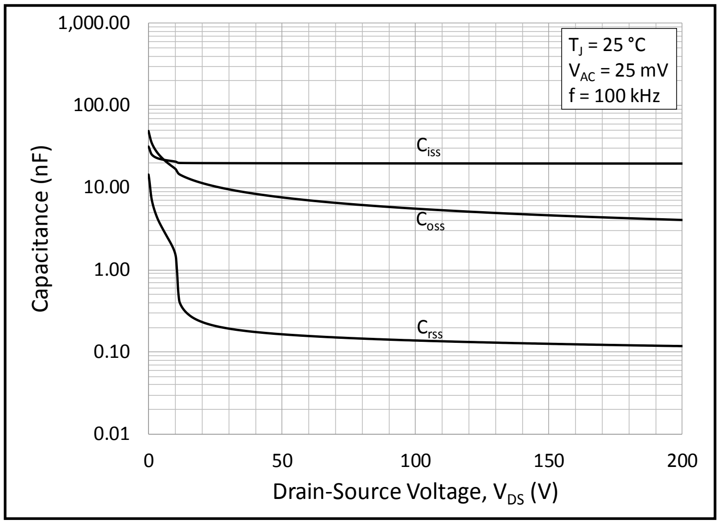


Figure 8. Typical Capacitances vs. Drain to Source Voltage (0 - 200V)

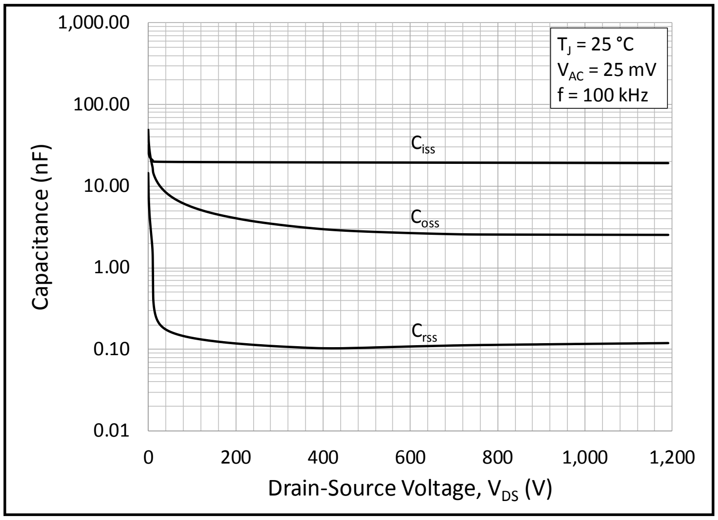


Figure 9. Typical Capacitances vs. Drain to Source Voltage (0 - 1200V)

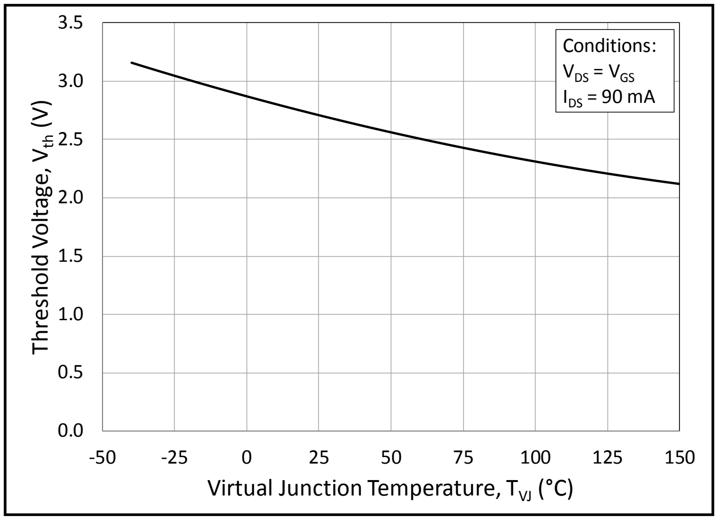


Figure 10. Threshold Voltage vs. Junction Temperature

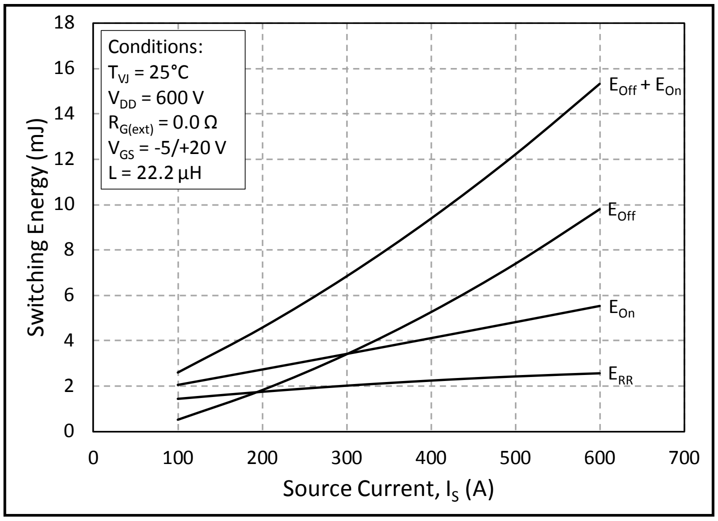


Figure 11. Switching Energy vs. Drain Current (V_{DS} = 600 V)

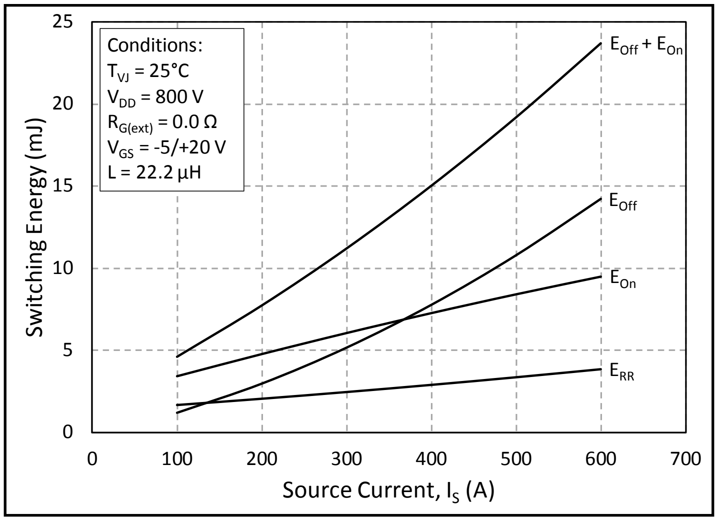


Figure 12. Switching Energy vs. Drain Current (V_{DS} = 800 V)

Typical Performance

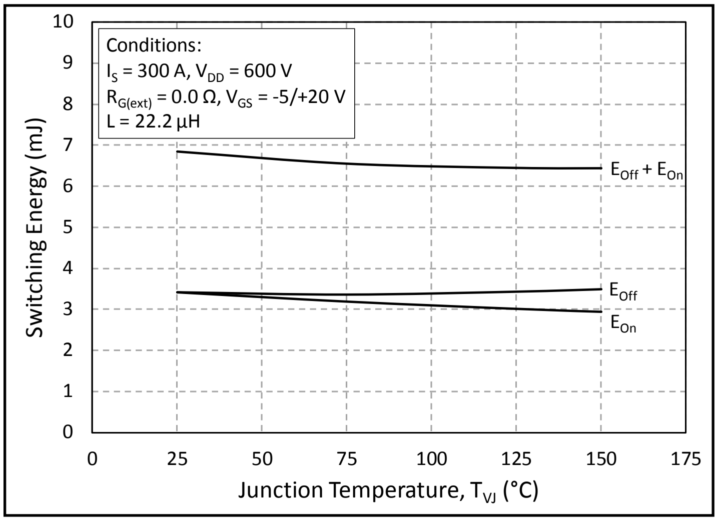


Figure 13. MOSFET Switching Energy vs. Junction Temperature

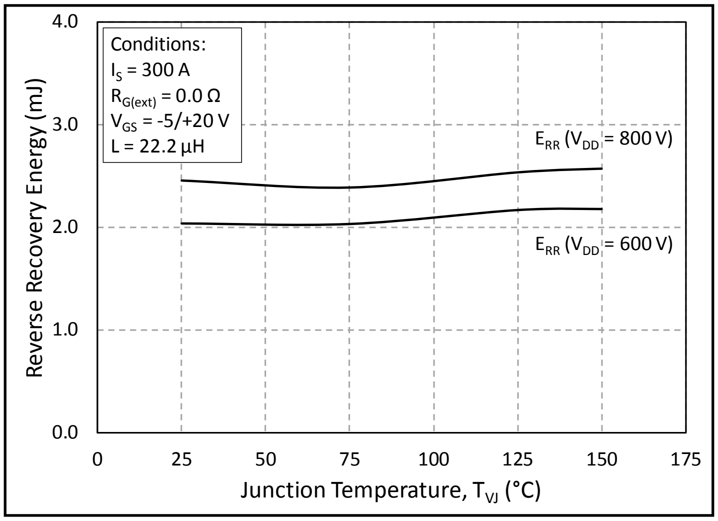


Figure 14. Reverse Recovery Energy vs. Junction Temperature

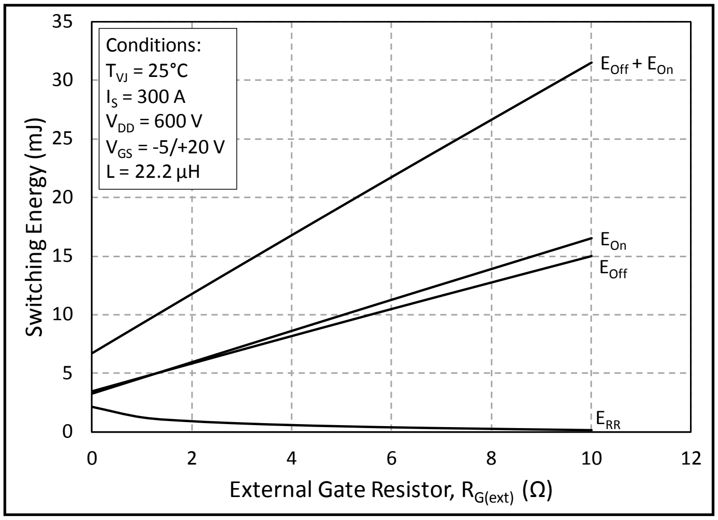


Figure 15. MOSFET Switching Energy vs. External Gate Resistance

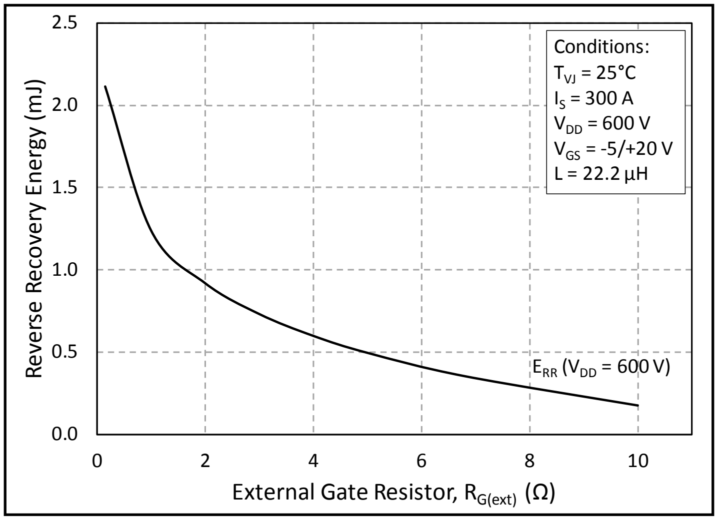


Figure 16. Reverse Recovery Energy vs. External Gate Resistance

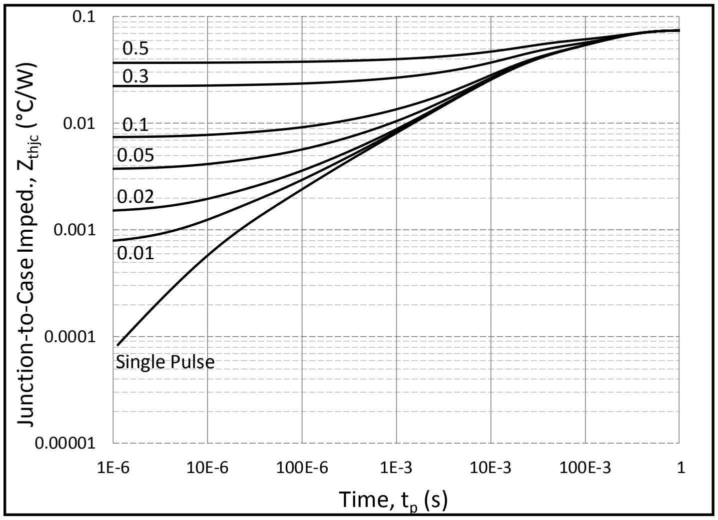


Figure 17. MOSFET Junction to Case Transient Thermal Impedance, $Z_{th\ JC}$ (°C/W)

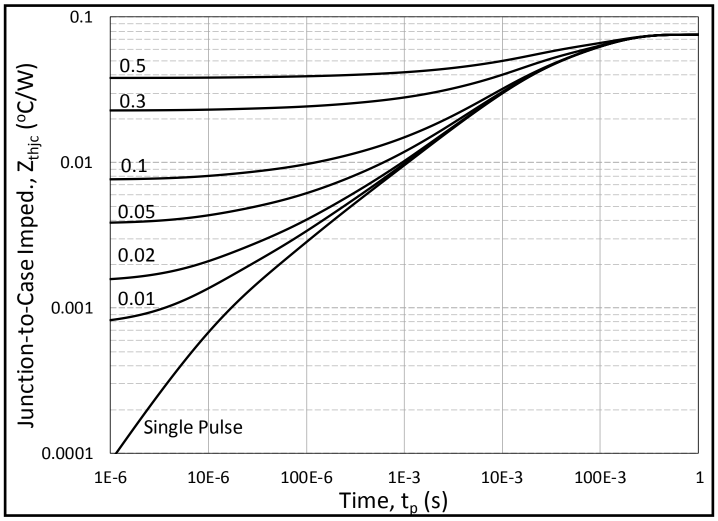


Figure 18. Diode Junction to Case Transient Thermal Impedance, $Z_{th\ JC}$ (°C/W)

Typical Performance

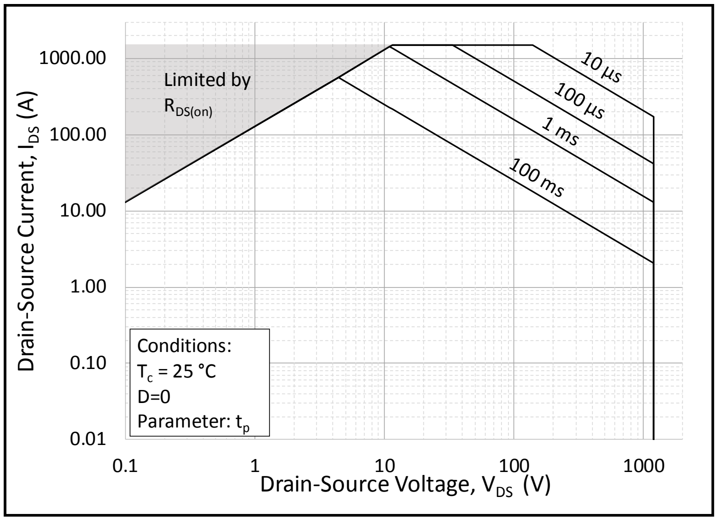


Figure 19. Forward Bias Safe Operating Area (FBSOA)

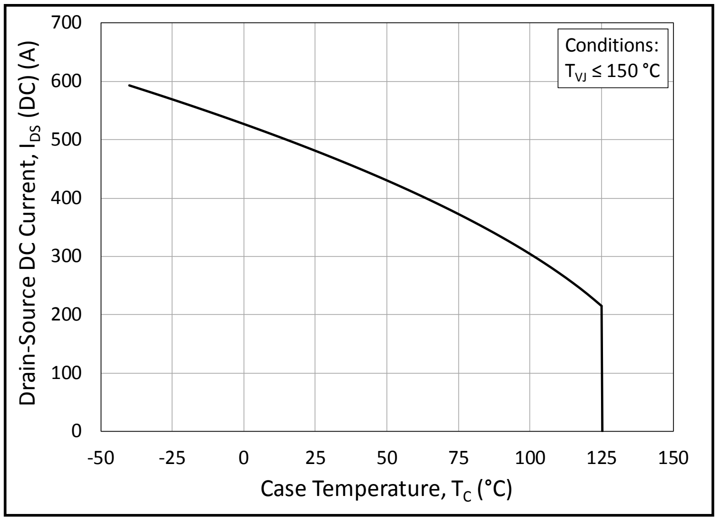


Figure 20. Continuous Drain Current Derating vs. Case Temperature

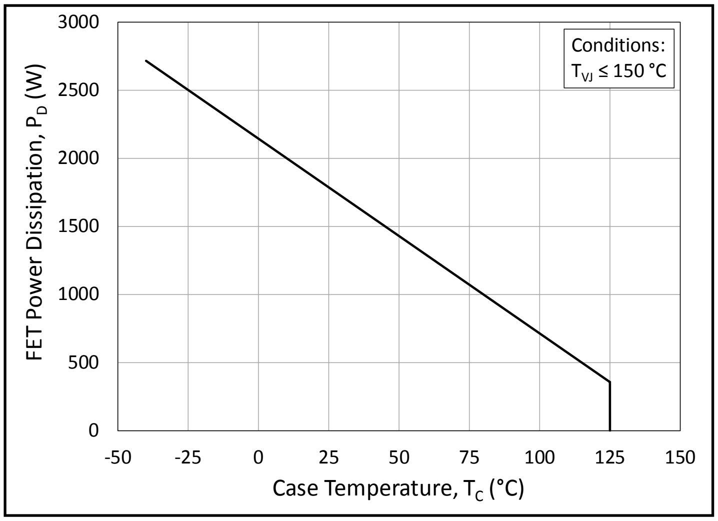


Figure 21. Maximum Power Dissipation Derating vs. Case Temperature

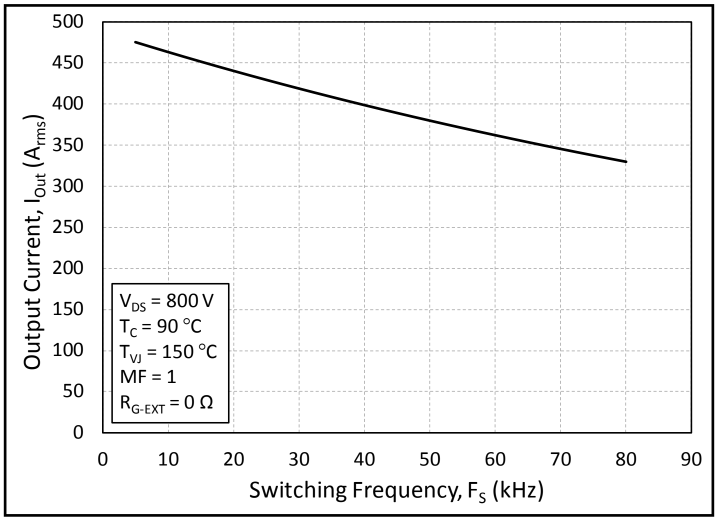


Figure 22. Typical Output Current Capability vs. Switching Frequency (Inverter Application)

Timing Characteristics

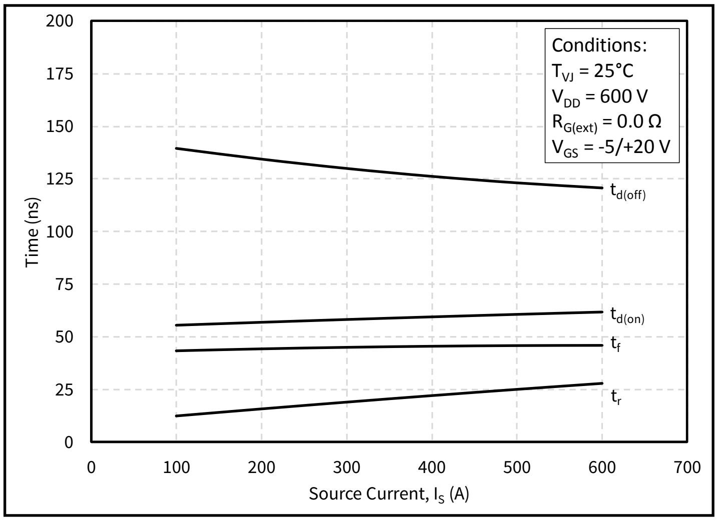


Figure 23. Timing vs. Source Current

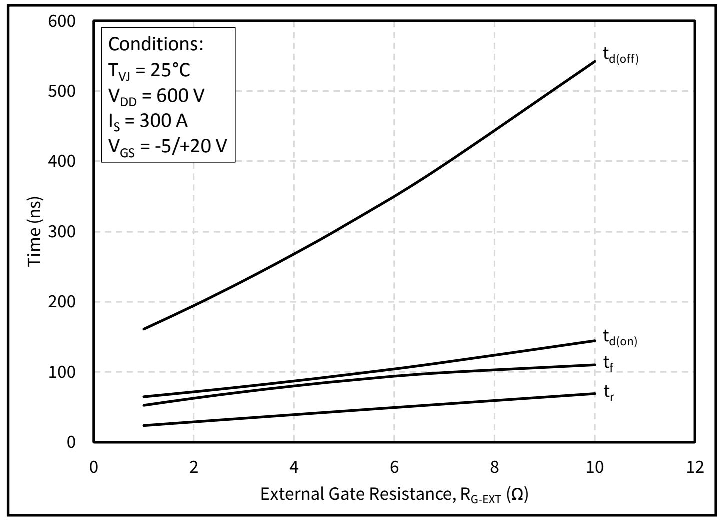


Figure 24. Timing vs. External Gate Resistance

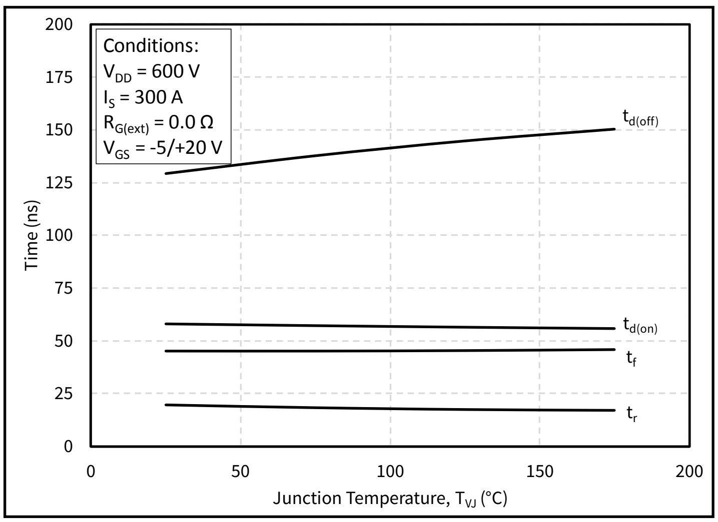


Figure 25. Timing vs. Junction Temperature

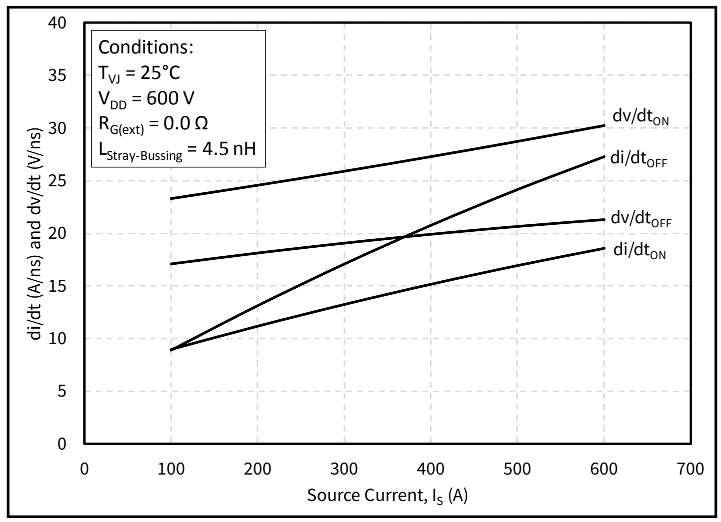


Figure 26. dv/dt and di/dt vs. Source Current

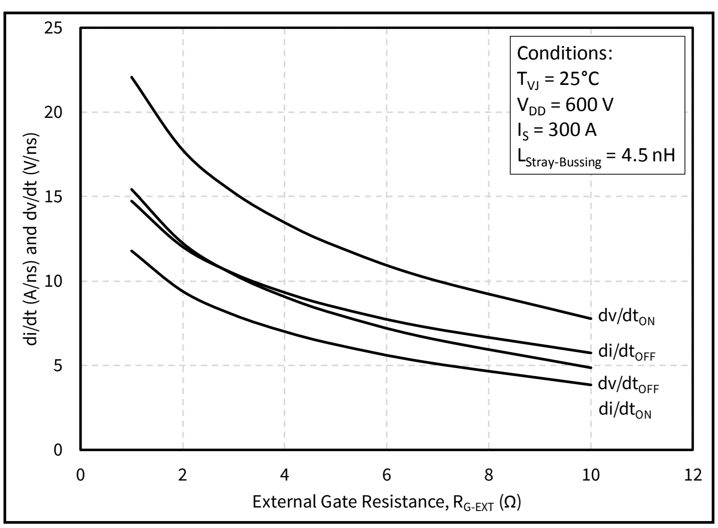


Figure 27. dv/dt and di/dt vs. External Gate Resistance

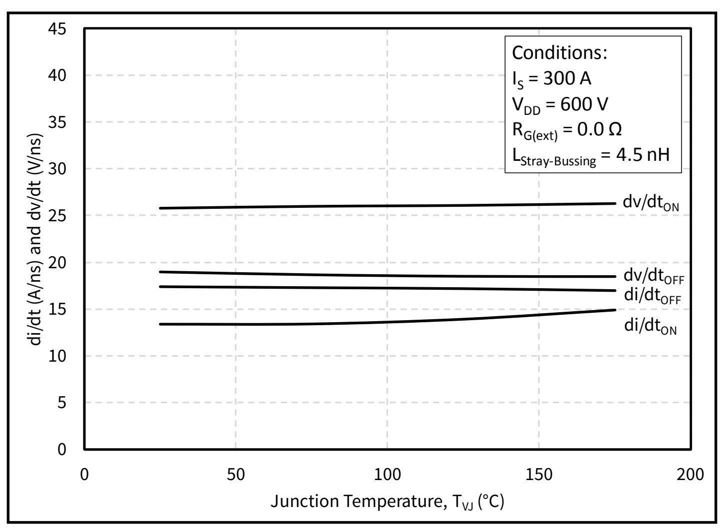


Figure 28. dv/dt and di/dt vs. Junction Temperature

Definitions

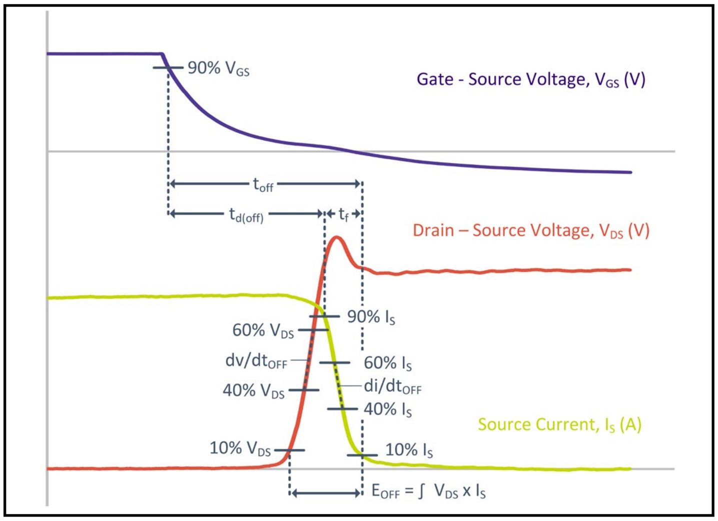


Figure 29. Turn-off Transient Definitions

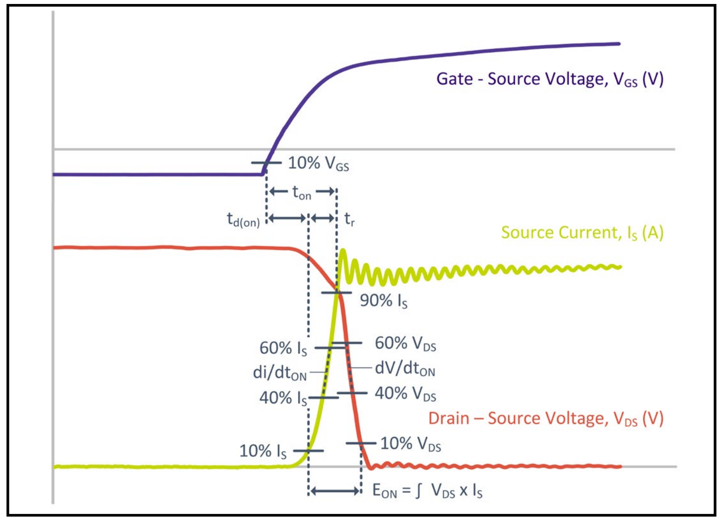


Figure 30. Turn-on Transient Definitions

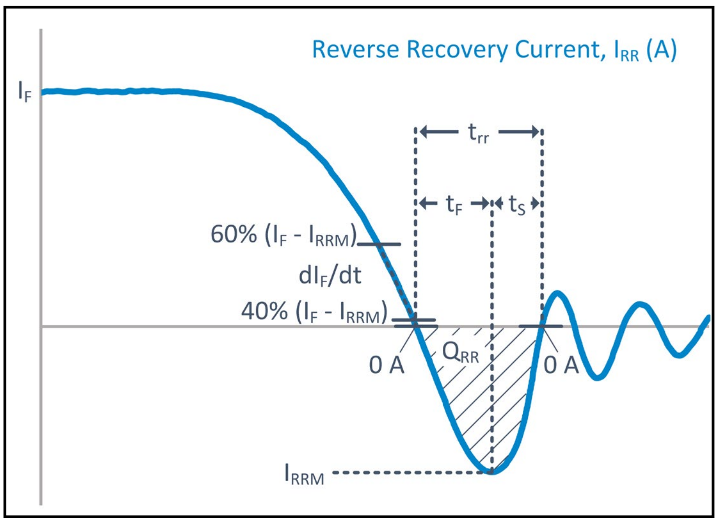


Figure 31. Reverse Recovery Definitions

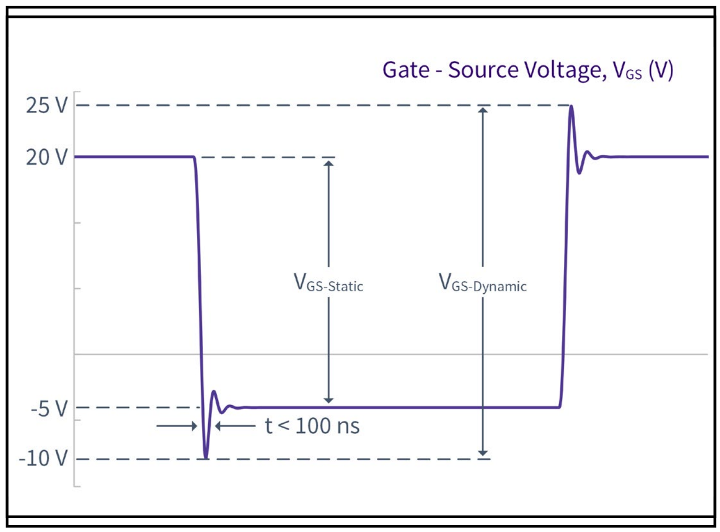
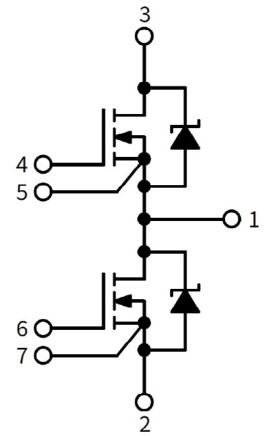
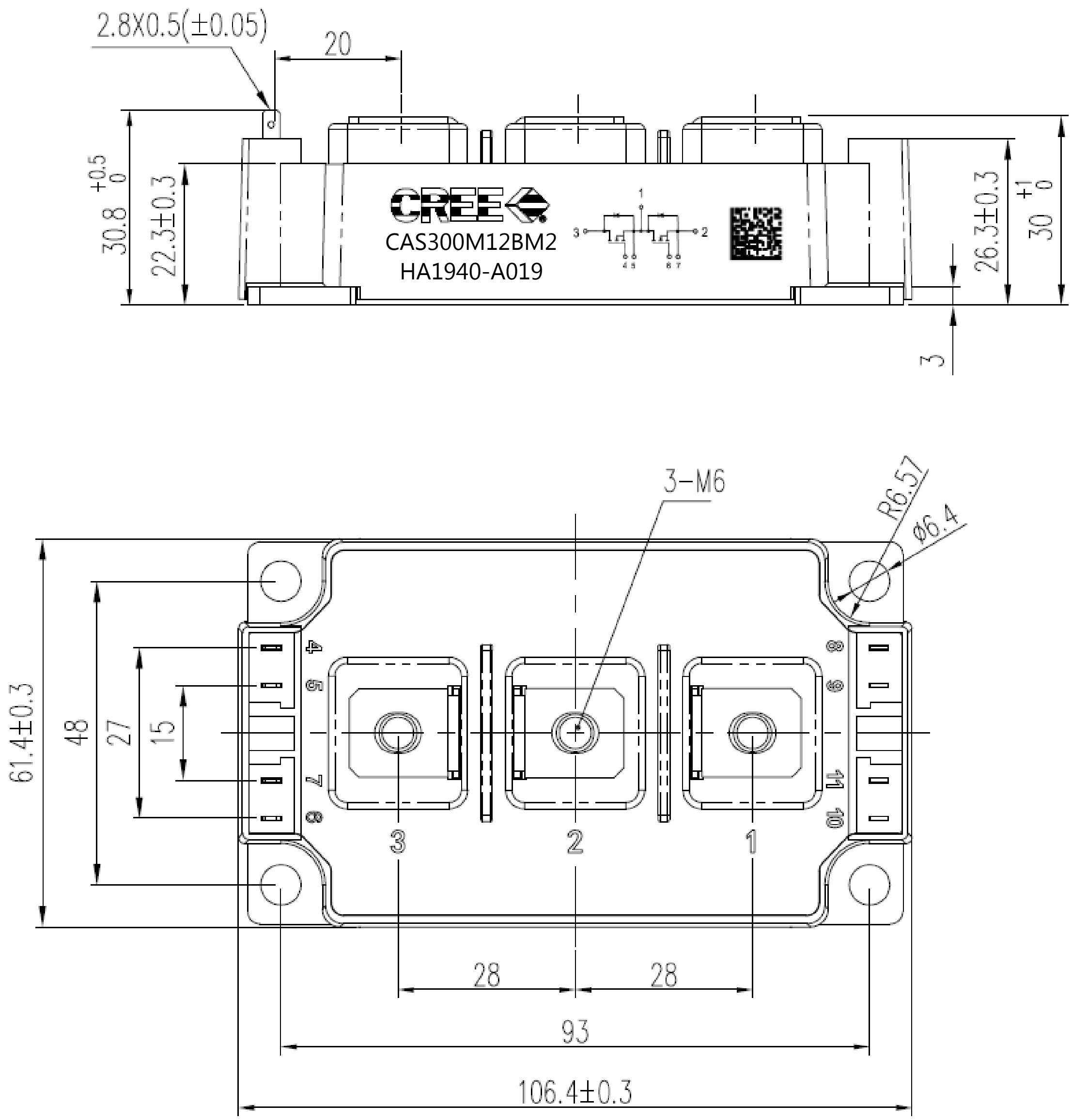


Figure 32. V_{GS} Transient Definitions

Schematic and Pin Out



Package Dimensions (mm)



Supporting Links & Tools

- CGD1200HB2P-BM2 Evaluation Gate Driver
- CGD12HB00D: Differential Transceiver Board
- CPWR-AN-35: Thermal Interface Material Application Note
- KIT-CRD-CIL12N-BM: Dynamic Performance Evaluation Board for the BM2 and BM3 Module

Notes

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