CAS300M12BM2

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

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

Applications

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

Package 61.4 mm X 106.4 mm X 30 mm

System Benefits

- 62mm Form Factor Enables System Retrofit
- Increased System Efficiency, due to Low Switching & Conduction Losses of SiC
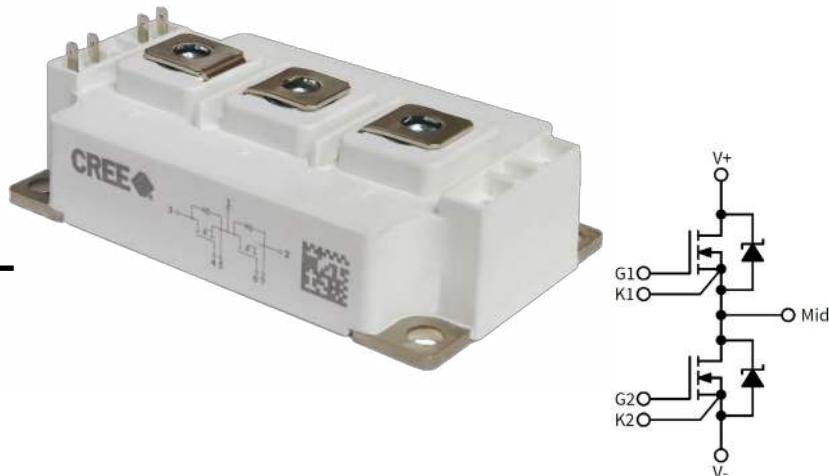
Maximum Parameters (Verified By Design)

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		Transient, <100 ns		Fig. 32
$V_{GS\,op}$	Gate-Source Voltage, Recommended Op. Value	-5		+20		Static		
I_{DS}	DC Continuous Drain Current		498		A	V_{GS} = 20 V, T_C = 25 ˚C, T_{VJ} ≤ 150 ˚C		Fig. 20
			345			V_{GS} = 20 V, T_C = 90 ˚C, T_{VJ} ≤ 150 ˚C		
I_{SD}	DC Source-Drain Current		876			V_{GS} = 20 V, T_C = 25 ˚C, T_{VJ} ≤ 150 ˚C		
I_F	Schottky Diode DC Forward Current		547			V_{GS} = - 5 V, T_C = 25 ˚C, T_{VJ} ≤ 150 ˚C		
$I_{DS\,(pulsed)}$	Maximum Pulsed Drain-Source Current			1500		V_{GS} = 20 V	T_C = 25 ˚C; t_{Pmax} limited by T_{VJmax}	
$I_{F\,(pulsed)}$	Maximum Pulsed Diode Current			1500		V_{GS} = -5 V		
$T_{VJ\,op}$	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		$V_{DS} = V_{GS}$, $I_D = 90$ mA	
			2.4			$V_{DS} = V_{GS}$, $I_D = 90$ 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		$V_{GS} = 20$ 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			$V_{GS} = 20$ 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			$V_{DS} = 20$ 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, $R_{G(ext)} = 0.0\ \Omega$, 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				
$R_{G(int)}$	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				
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				
Q_G	Total Gate Charge		1025				
$R_{th\ JC}$	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_{1-3}	Package Resistance, M1		0.60		mΩ	T_C = 125 °C, Note 2
R_{1-2}	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
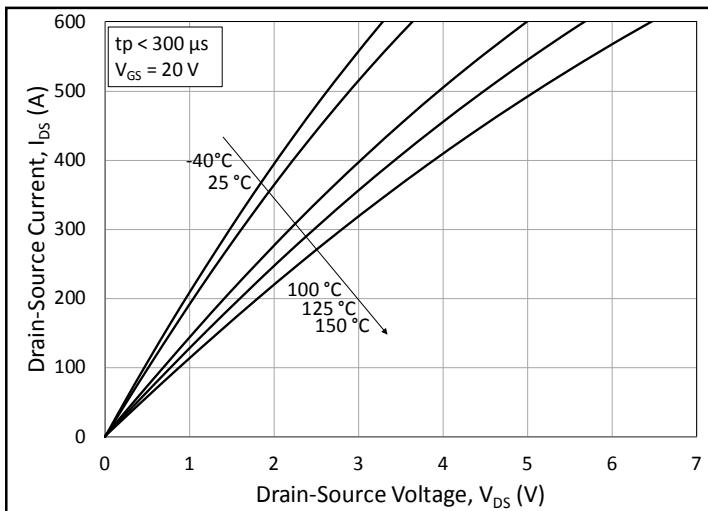
Figure 1. Output Characteristics for Various Junction Temperatures
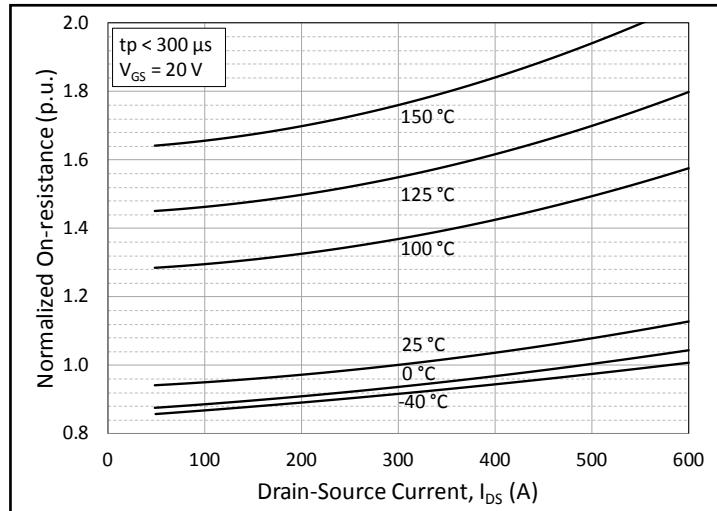
Figure 2. Normalized On-State Resistance vs. Drain Current for Various Junction Temperatures
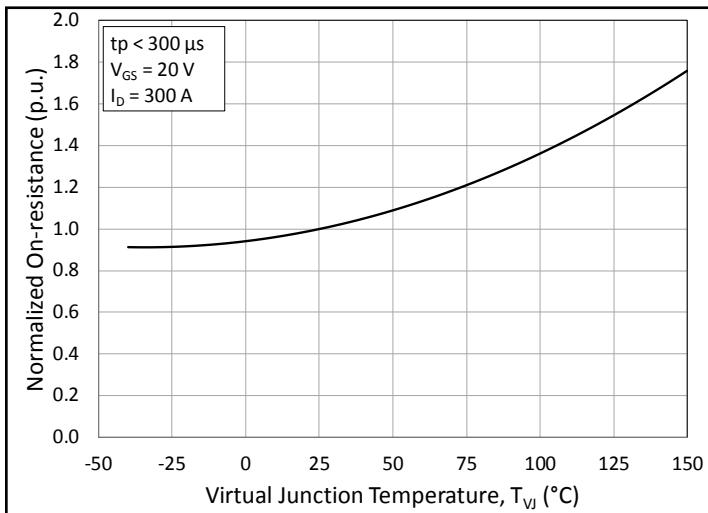
Figure 3. Normalized On-State Resistance vs. Junction Temperature
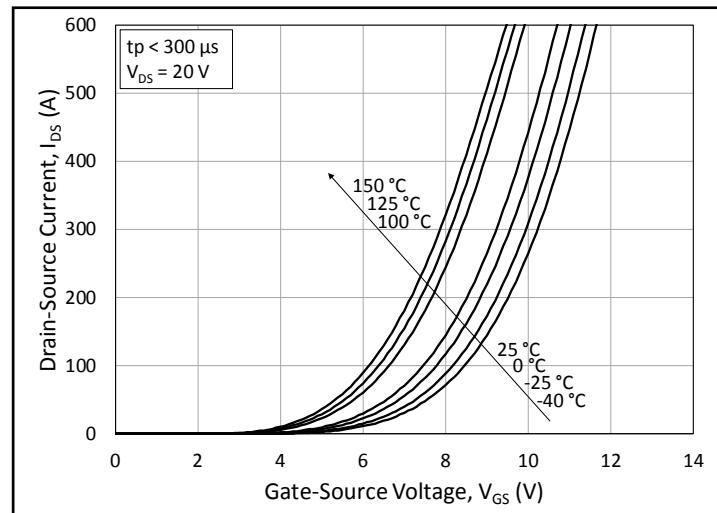
Figure 4. Transfer Characteristic for Various Junction Temperatures
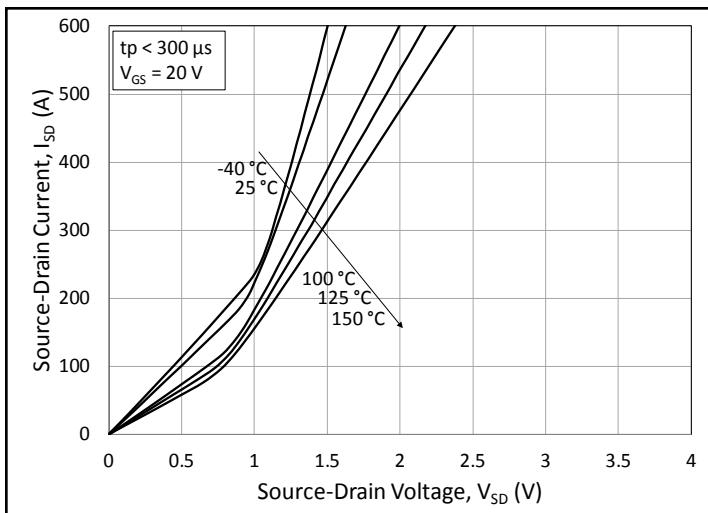
Figure 5. 3rd Quadrant Characteristic vs. Junction Temperatures at V_{GS} = 20 V
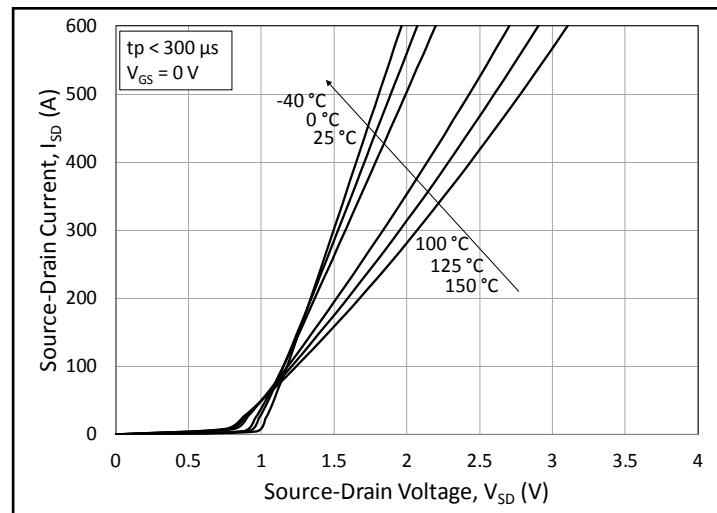
Figure 6. 3rd Quadrant Characteristic vs. Junction Temperatures at V_{GS} = 0V (Diode)

Typical Performance
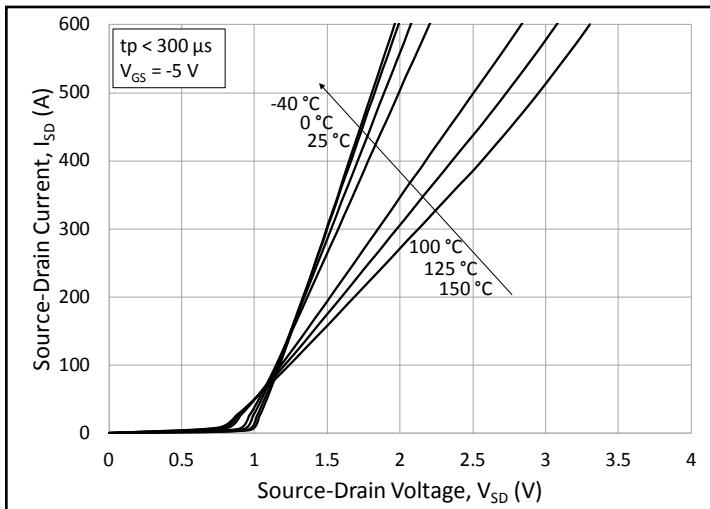
Figure 7. 3rd Quadrant Characteristic vs. Junction Temperatures at V$_{GS}$ = - 5 V (Diode)
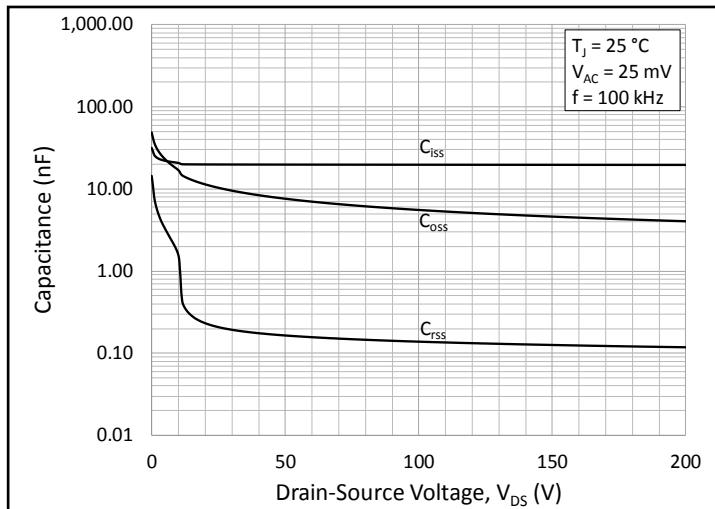
Figure 8. Typical Capacitances vs. Drain to Source Voltage (0 - 200V)
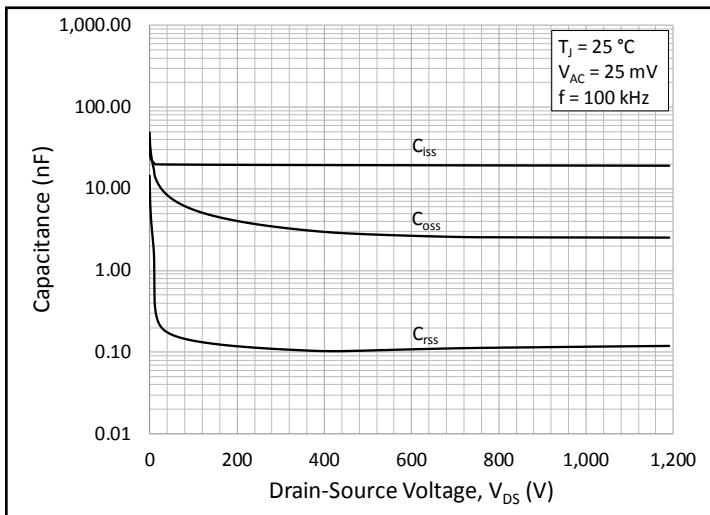
Figure 9. Typical Capacitances vs. Drain to Source Voltage (0 - 1200V)
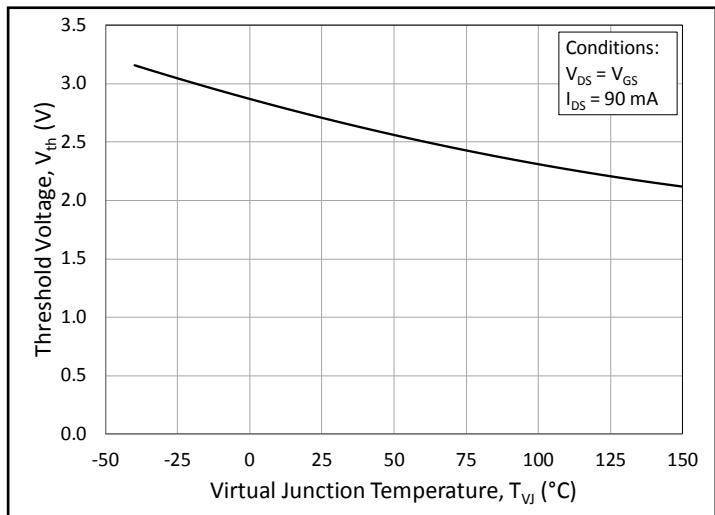
Figure 10. Threshold Voltage vs. Junction Temperature
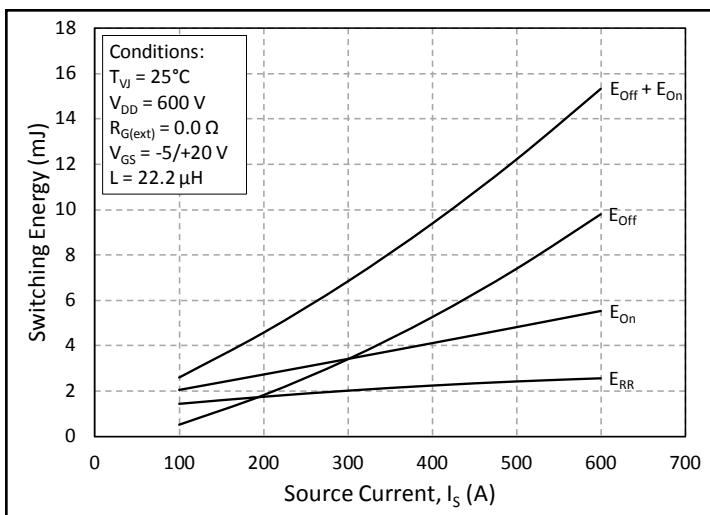
Figure 11. Switching Energy vs. Drain Current (V$_{DS}$ = 600 V)
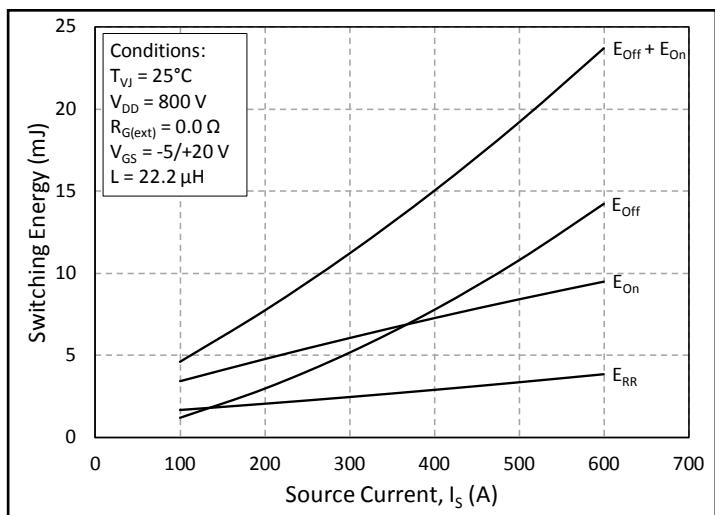
Figure 12. Switching Energy vs. Drain Current (V$_{DS}$ = 800 V)

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Typical Performance
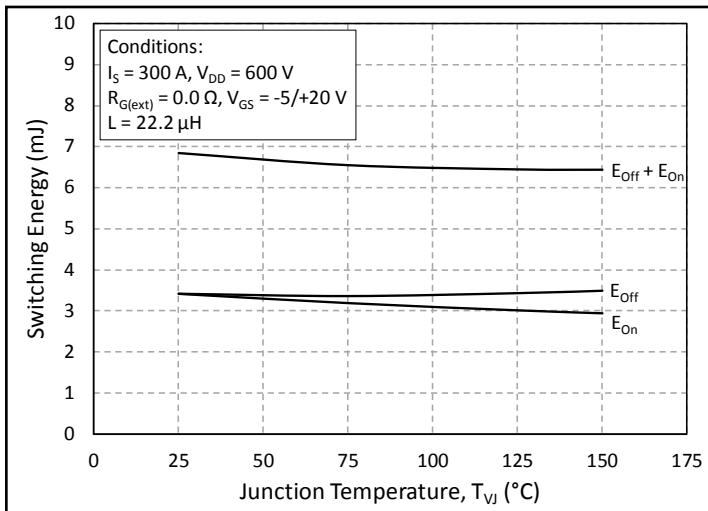
Figure 13. MOSFET Switching Energy vs. Junction Temperature
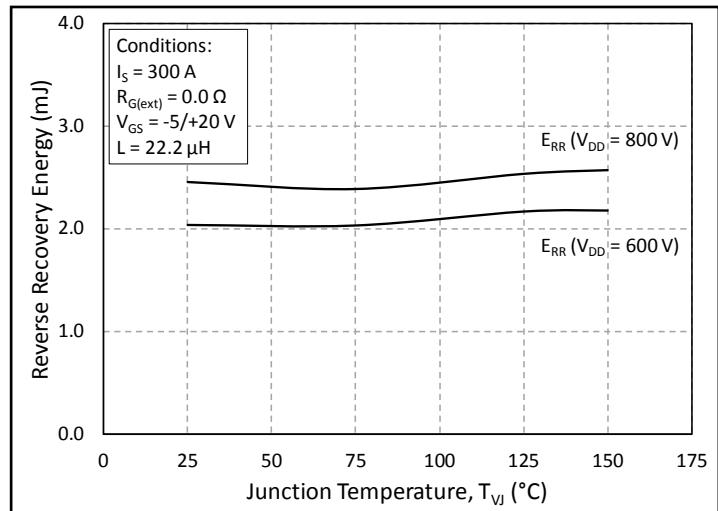
Figure 14. Reverse Recovery Energy vs. Junction Temperature
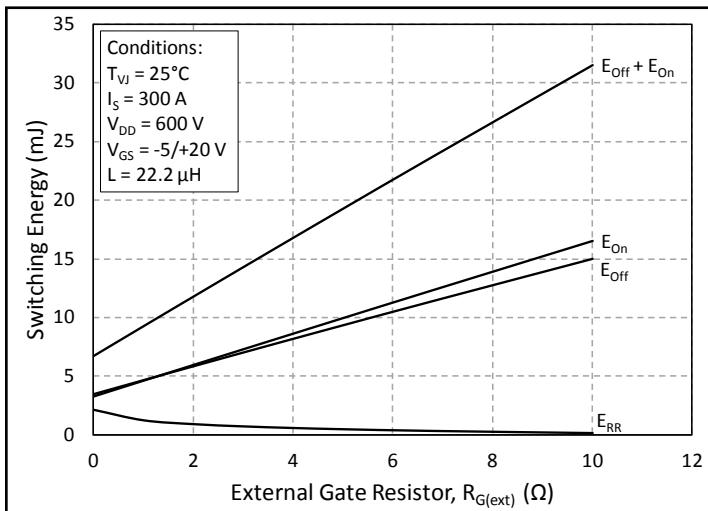
Figure 15. MOSFET Switching Energy vs. External Gate Resistance
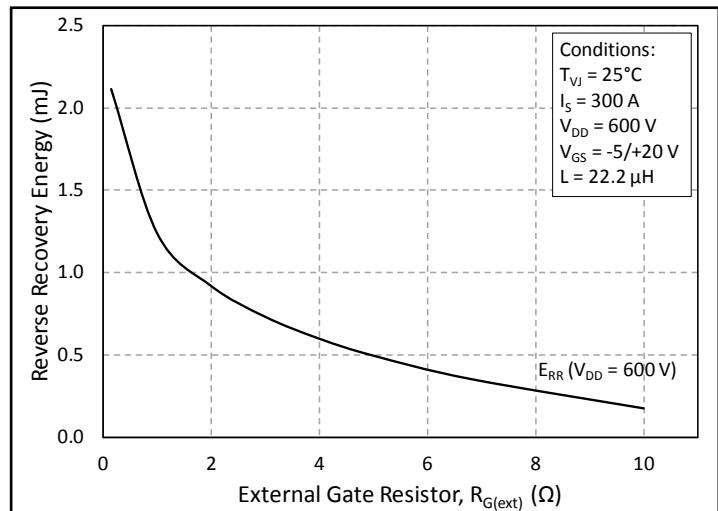
Figure 16. Reverse Recovery Energy vs. External Gate Resistance
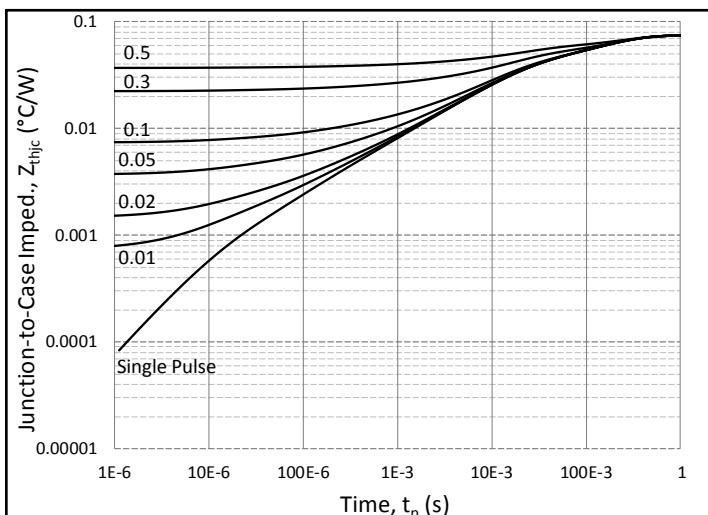
Figure 17. MOSFET Junction to Case Transient Thermal Impedance, $Z_{th\ JC}$ (°C/W)
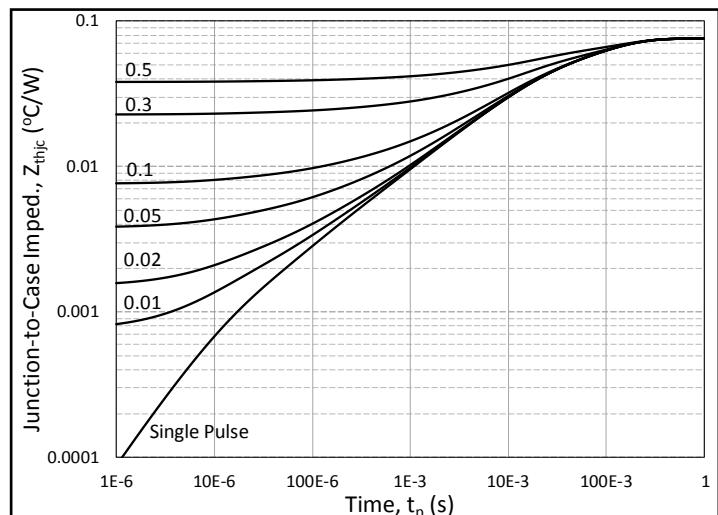
Figure 18. Diode Junction to Case Transient Thermal Impedance, $Z_{th\ JC}$ (°C/W)

Typical Performance
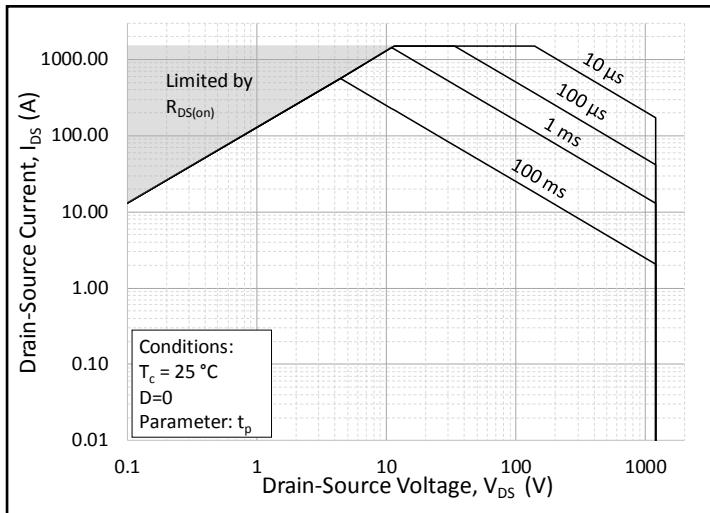

Figure 19. Forward Bias Safe Operating Area (FBSOA)

Conditions:
T_C = 25 °C
D=0
Parameter: t_p

Limited by $R_{DS(on)}$

10 µs
100 µs
1 ms
100 ms
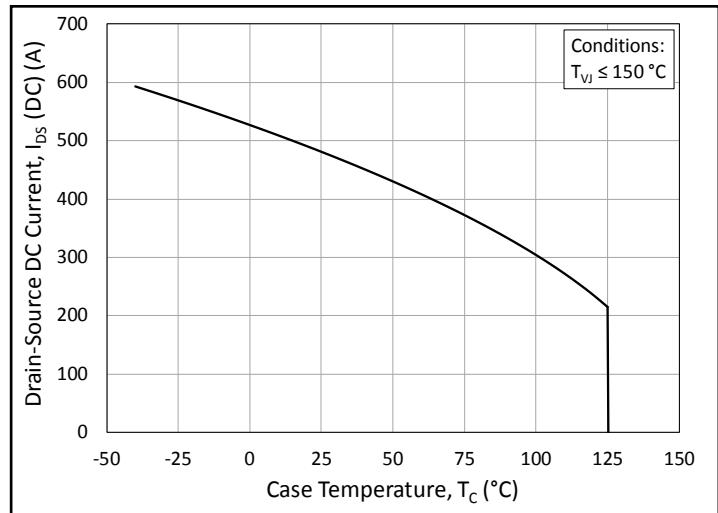
Figure 20. Continuous Drain Current Derating vs.
Case Temperature

Conditions:
T_{VJ} ≤ 150 °C
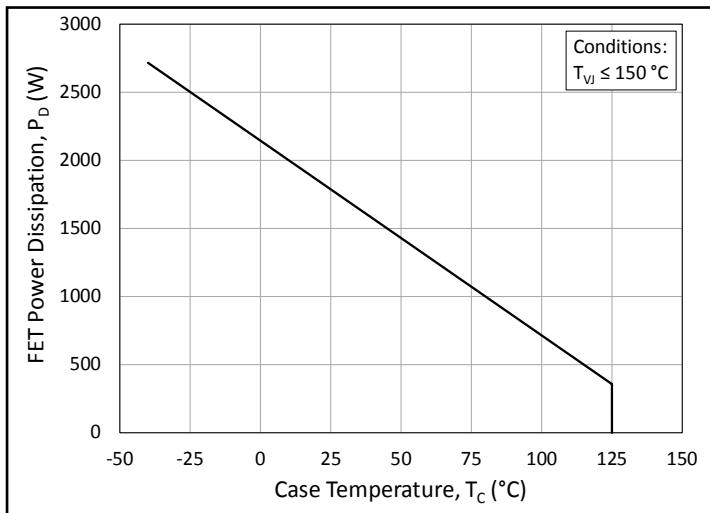
Figure 21. Maximum Power Dissipation Derating vs.
Case Temperature

Conditions:
T_{VJ} ≤ 150 °C
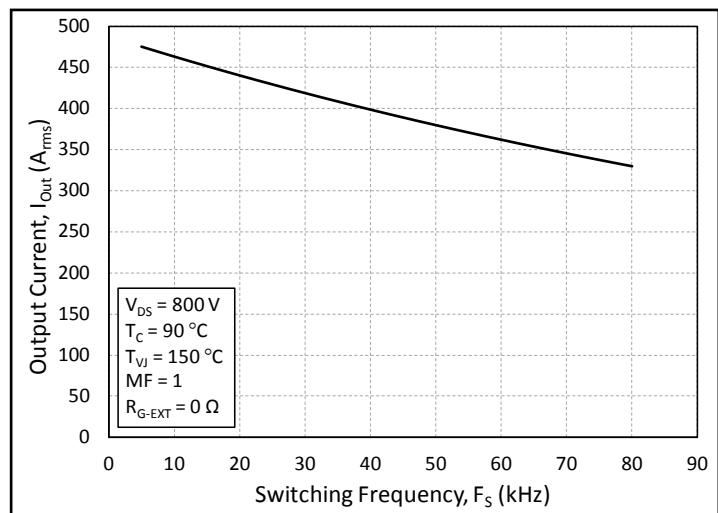
Figure 22. Typical Output Current Capability vs. Switching Frequency
(Inverter Application)

V_{DS} = 800 V
T_C = 90 °C
T_{VJ} = 150 °C
MF = 1
R_{G-EXT} = 0 Ω

Timing Characteristics
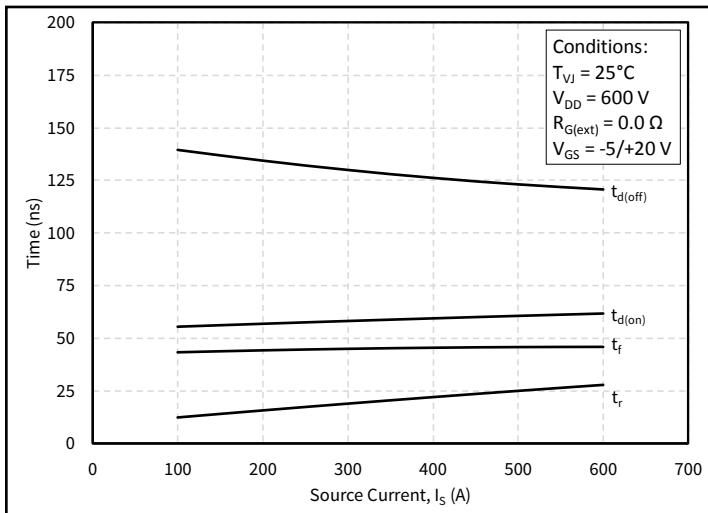
Figure 23. Timing vs. Source Current

Conditions:
T_{VJ} = 25°C
V_{DD} = 600 V
$R_{G(ext)}$ = 0.0 Ω
V_{GS} = -5/+20 V
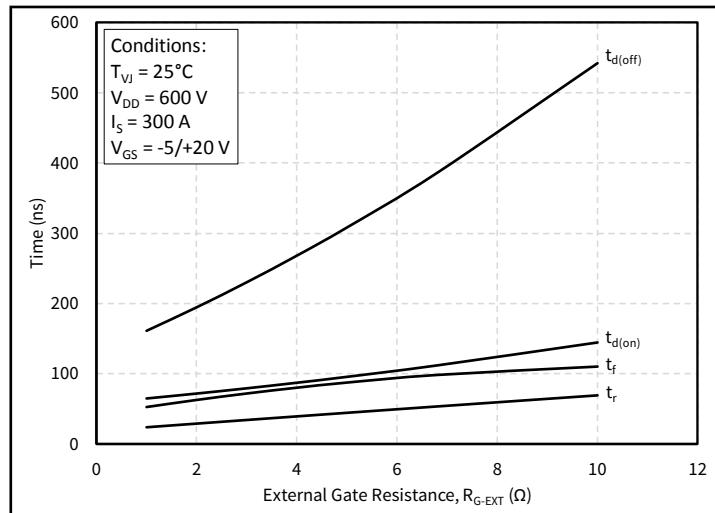
Figure 24. Timing vs. External Gate Resistance

Conditions:
T_{VJ} = 25°C
V_{DD} = 600 V
I_S = 300 A
V_{GS} = -5/+20 V
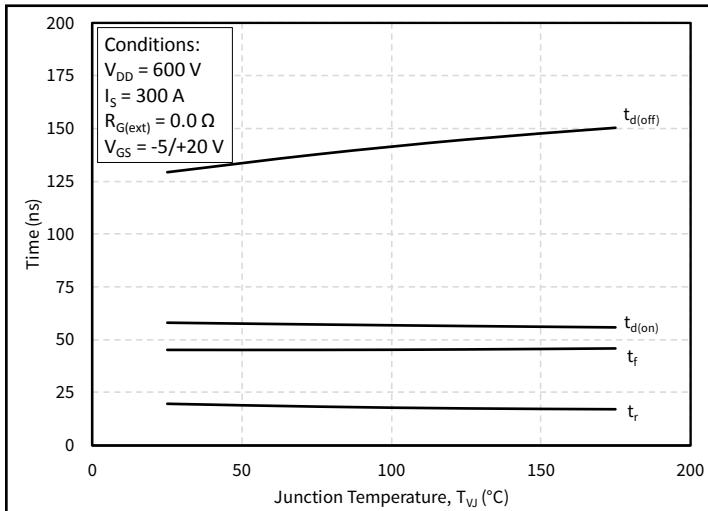
Figure 25. Timing vs. Junction Temperature

Conditions:
V_{DD} = 600 V
I_S = 300 A
$R_{G(ext)}$ = 0.0 Ω
V_{GS} = -5/+20 V
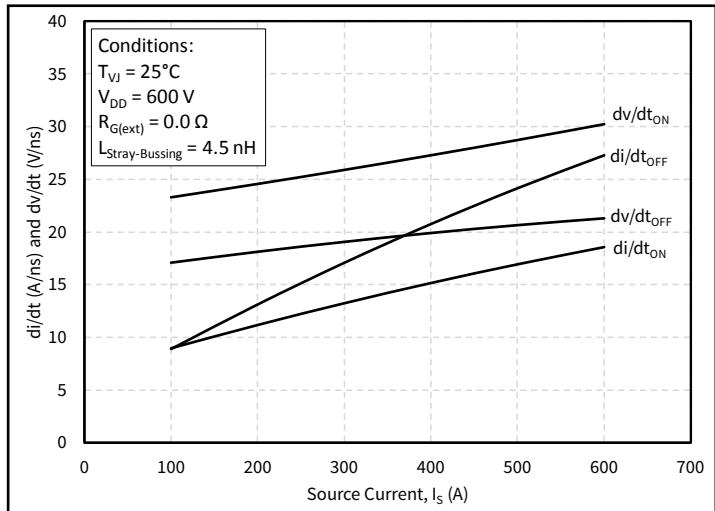
Figure 26. dv/dt and di/dt vs. Source Current

Conditions:
T_{VJ} = 25°C
V_{DD} = 600 V
$R_{G(ext)}$ = 0.0 Ω
$L_{Stray-Bussing}$ = 4.5 nH
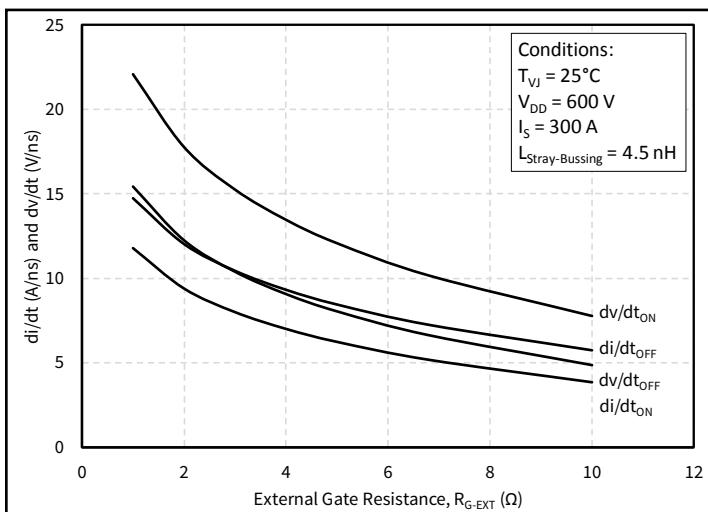
Figure 27. dv/dt and di/dt vs. External Gate Resistance

Conditions:
T_{VJ} = 25°C
V_{DD} = 600 V
I_S = 300 A
$L_{Stray-Bussing}$ = 4.5 nH
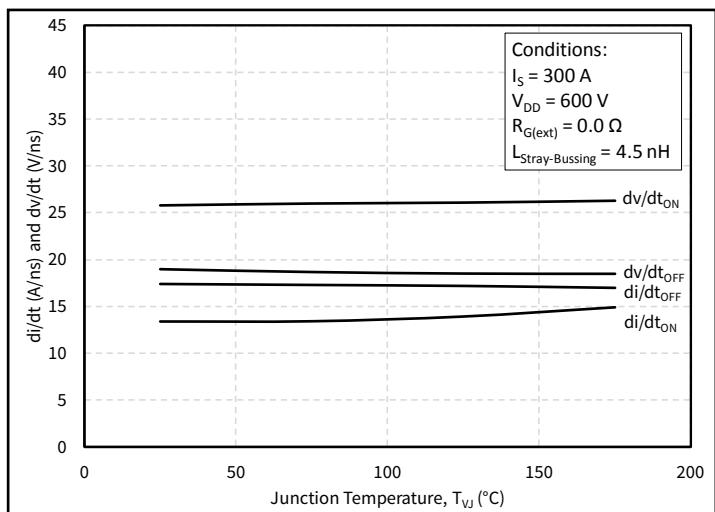
Figure 28. dv/dt and di/dt vs. Junction Temperature

Conditions:
I_S = 300 A
V_{DD} = 600 V
$R_{G(ext)}$ = 0.0 Ω
$L_{Stray-Bussing}$ = 4.5 nH
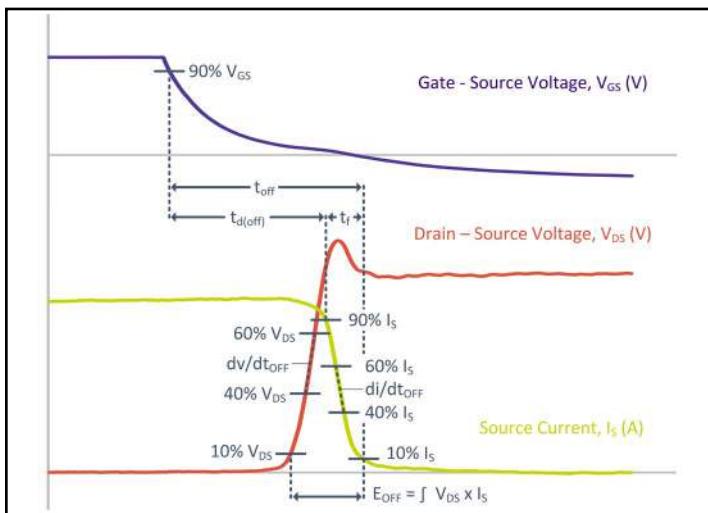
Definitions

Figure 29. Turn-off Transient Definitions
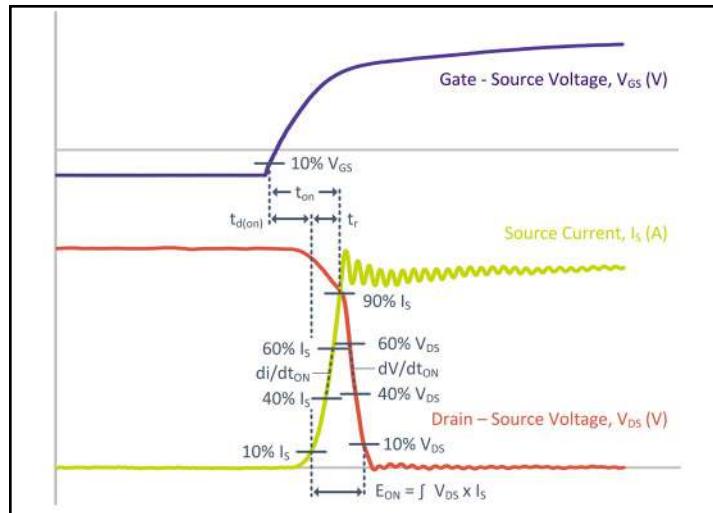

Figure 30. Turn-on Transient Definitions
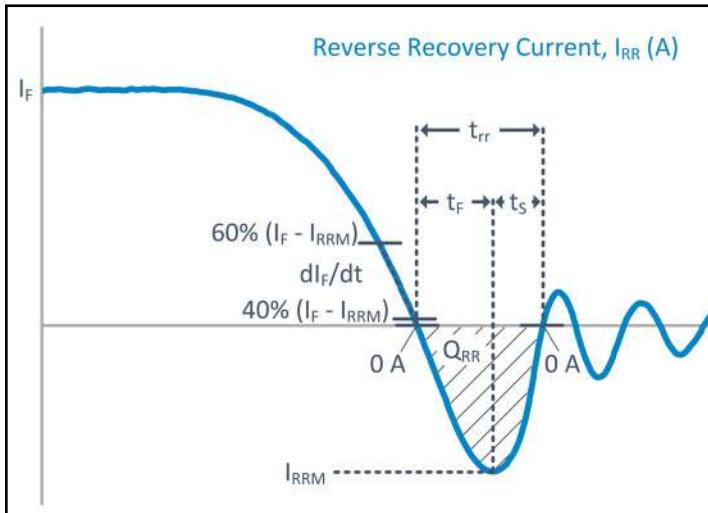
Figure 31. Reverse Recovery Definitions
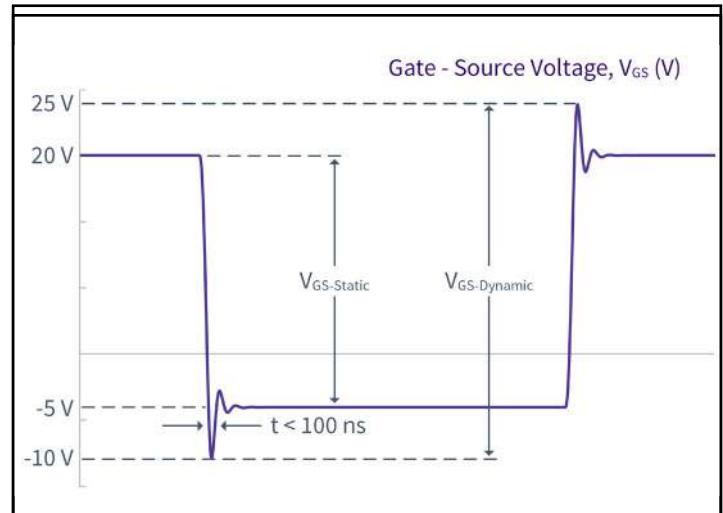
Figure 32. V_{GS} Transient Definitions

Schematic and Pin Out
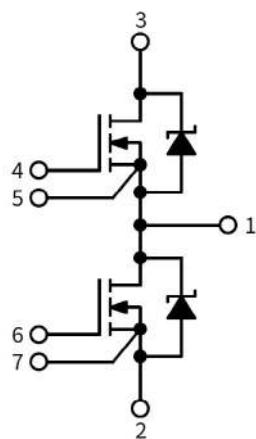
Package Dimensions (mm)
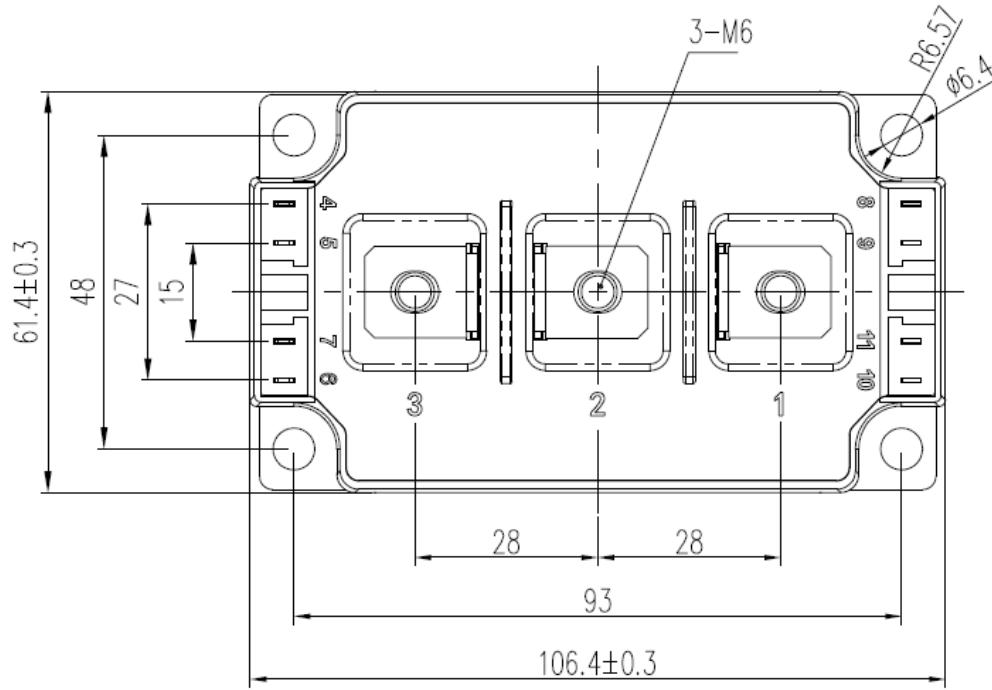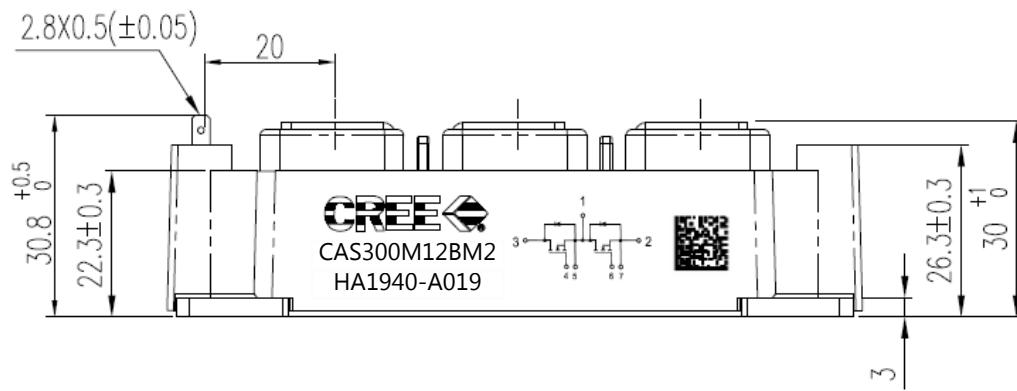
Supporting Links & Tools

- [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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