

$V_{DS}$	<b>1200 V</b>
$I_{DS}$	<b>300 A</b>

# CAS300M12BM2

## 1200 V, 300 A All-Silicon Carbide

### High Performance, Switching Optimized, Half-Bridge Module

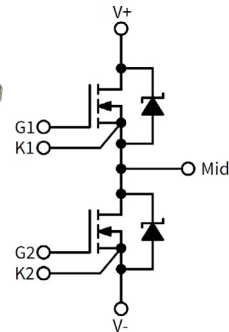
#### Technical Features

- 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

#### 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		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	$V_{GS} = 20\ V, T_c = 25\ ^\circ C, T_{VJ} \leq 150\ ^\circ C$	Fig. 20
			345			$V_{GS} = 20\ V, T_c = 90\ ^\circ C, T_{VJ} \leq 150\ ^\circ C$	
$I_{SD}$	DC Source-Drain Current		876			$V_{GS} = 20\ V, T_c = 25\ ^\circ C, T_{VJ} \leq 150\ ^\circ C$	
$I_F$	Schottky Diode DC Forward Current		547			$V_{GS} = -5\ V, T_c = 25\ ^\circ C, T_{VJ} \leq 150\ ^\circ C$	
$I_{DS\ (pulsed)}$	Maximum Pulsed Drain-Source Current			1500		$T_c = 25\ ^\circ C;$ $t_{Pmax}$ limited by $T_{VJmax}$	
$I_F\ (pulsed)$	Maximum Pulsed Diode Current			1500			
$T_{VJ\ op}$	Maximum Virtual Junction Temperature under Switching Conditions	-40		150	$^\circ C$		

**MOSFET Characteristics (Per Position)** ( $T_{VJ} = 25^\circ\text{C}$  unless otherwise specified)

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



### Diode Characteristics (Per Position) ( $T_{VJ} = 25^\circ\text{C}$ unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions	Note
$V_F$	Diode Forward Voltage		1.6		V	$V_{GS} = -5\text{ V}, I_F = 300\text{ A}$	Fig. 7
			2.1			$V_{GS} = -5\text{ V}, I_F = 300\text{ A}, T_{VJ} = 150^\circ\text{C}$	
$t_{rr}$	Reverse Recovery Time		27		ns	$V_{GS} = -5\text{ V}, I_{SD} = 300\text{ A}, V_R = 600\text{ V}$ $di_F/dt = 22\text{ A/ns}, T_{VJ} = 150^\circ\text{C}$	Fig. 31
$Q_{RR}$	Reverse Recovery Charge		4.9		$\mu\text{C}$		
$I_{RRM}$	Peak Reverse Recovery Current		-310		A		
$E_{rr}$	Diode Energy $T_{VJ} = 25^\circ\text{C}$ $T_{VJ} = 125^\circ\text{C}$ $T_{VJ} = 150^\circ\text{C}$		2.04		mJ	$V_{DS} = 600\text{ V}, I_D = 300\text{ A},$ $V_{GS} = -5\text{ V}/20\text{ V}, R_{G(\text{ext})} = 0.0\ \Omega,$ $L = 22.2\ \mu\text{H}$	Fig. 14 Note 1
			2.17				
			2.18				
$R_{th\text{ JC}}$	Diode Thermal Resistance, Junction to Case		0.073	0.076	$^\circ\text{C/W}$		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		m $\Omega$	$T_c = 125^\circ\text{C}$ , Note 2
$R_{1-2}$	Package Resistance, M2		0.51			$T_c = 125^\circ\text{C}$ , Note 2
$L_{\text{Stray}}$	Stray Inductance		11.1		nH	Between Terminals 3 and 2
$T_c$	Case Temperature	-40		125	$^\circ\text{C}$	
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
$V_{\text{isol}}$	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  $R_{DS(\text{on})}$  + Switch Position Package Resistance.



## Typical Performance

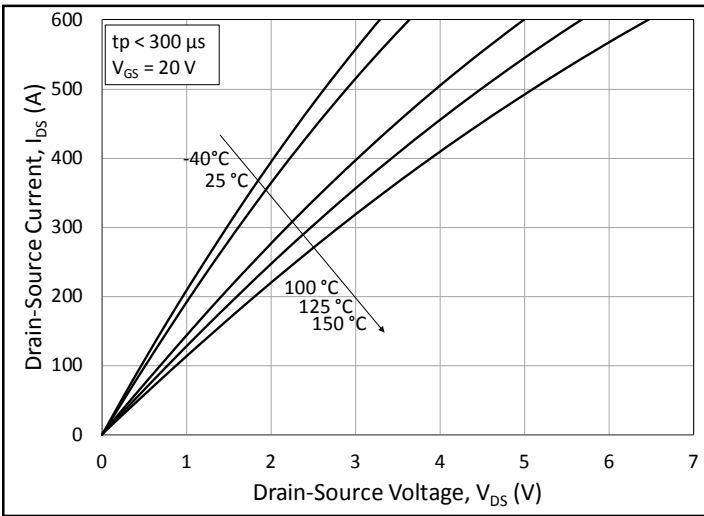


Figure 1. Output Characteristics for Various Junction Temperatures

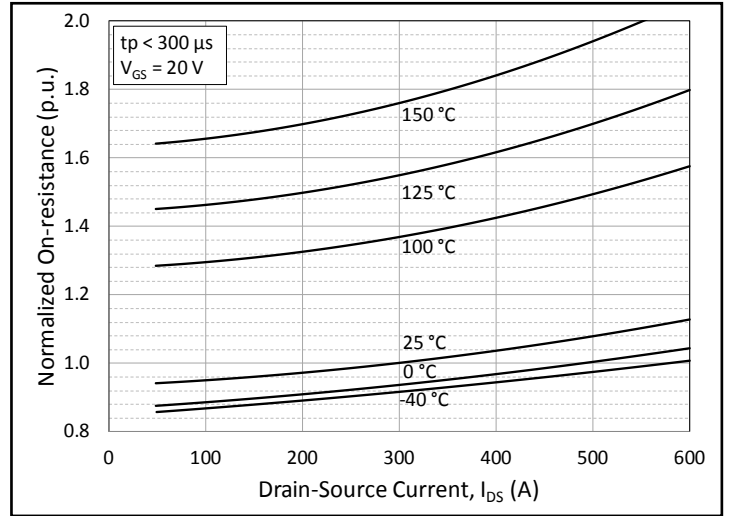


Figure 2. Normalized On-State Resistance vs. Drain Current for Various Junction Temperatures

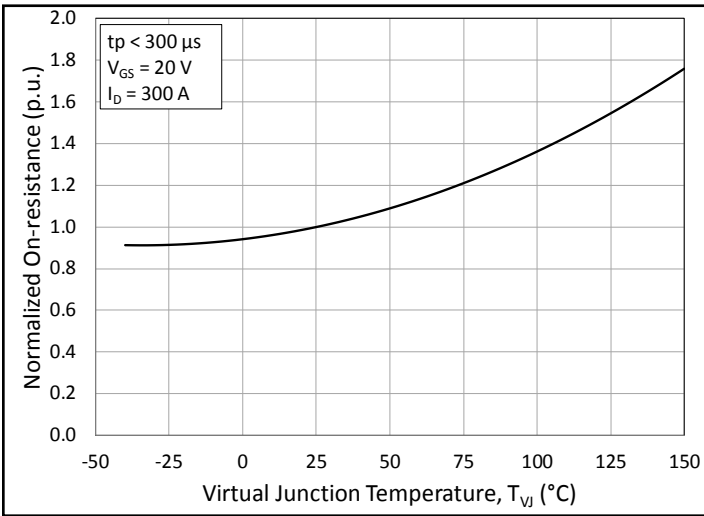


Figure 3. Normalized On-State Resistance vs. Junction Temperature

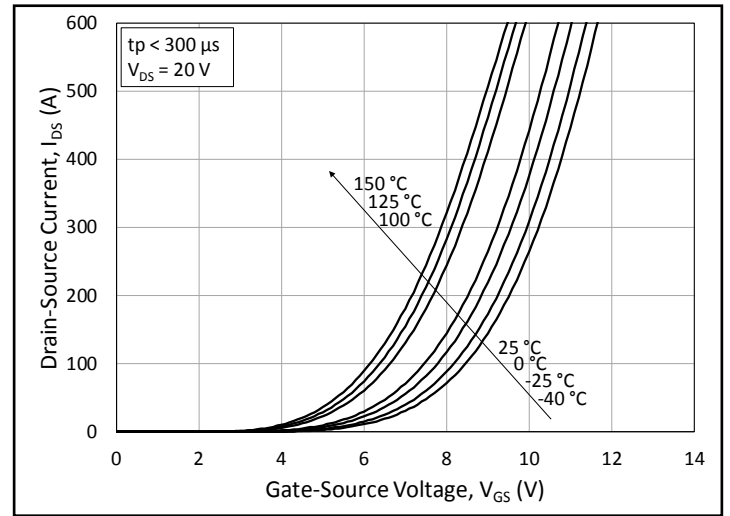


Figure 4. Transfer Characteristic for Various Junction Temperatures

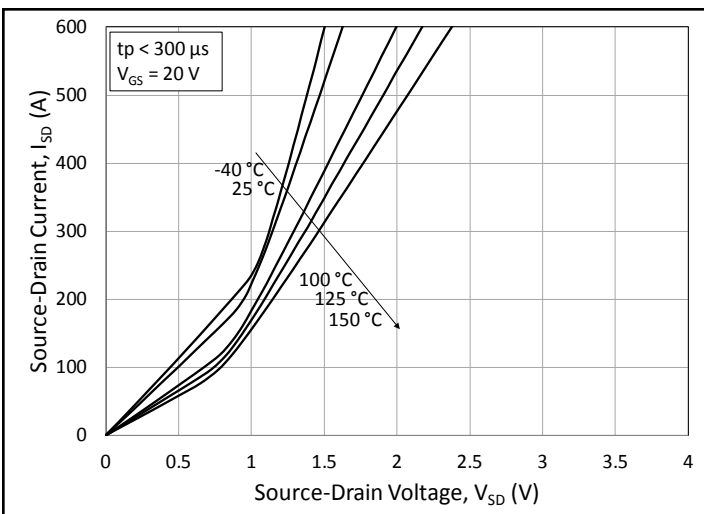


Figure 5. 3<sup>rd</sup> Quadrant Characteristic vs. Junction Temperatures at  $V_{GS} = 20\text{ V}$

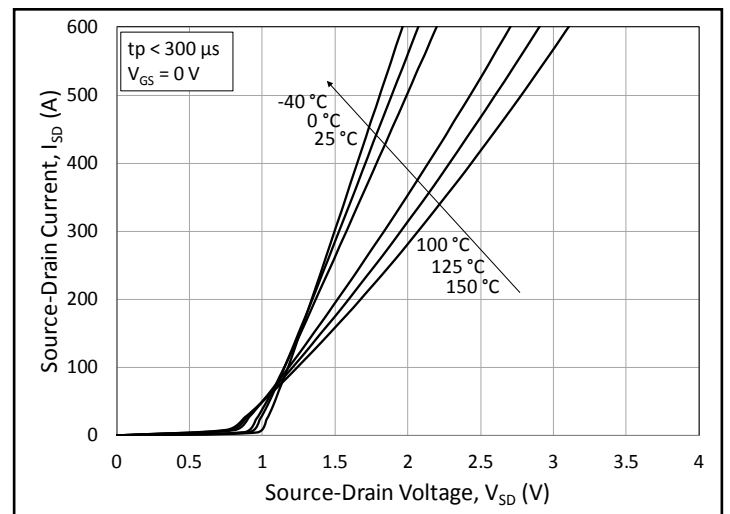


Figure 6. 3<sup>rd</sup> Quadrant Characteristic vs. Junction Temperatures at  $V_{GS} = 0\text{ V}$  (Diode)

**Typical Performance**

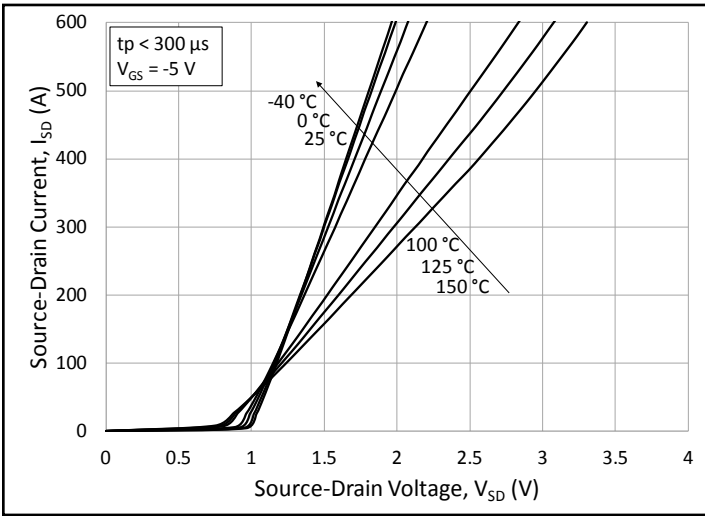


Figure 7. 3<sup>rd</sup> Quadrant Characteristic vs. Junction Temperatures at  $V_{GS} = -5\text{ V}$  (Diode)

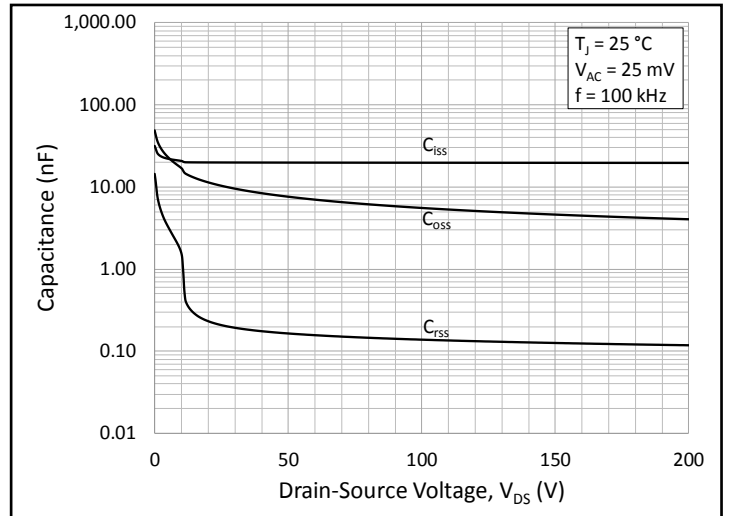


Figure 8. Typical Capacitances vs. Drain to Source Voltage (0 - 200V)

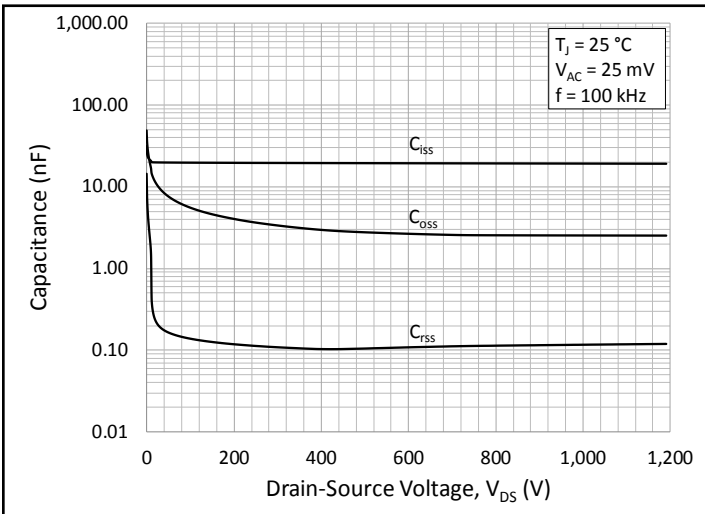


Figure 9. Typical Capacitances vs. Drain to Source Voltage (0 - 1200V)

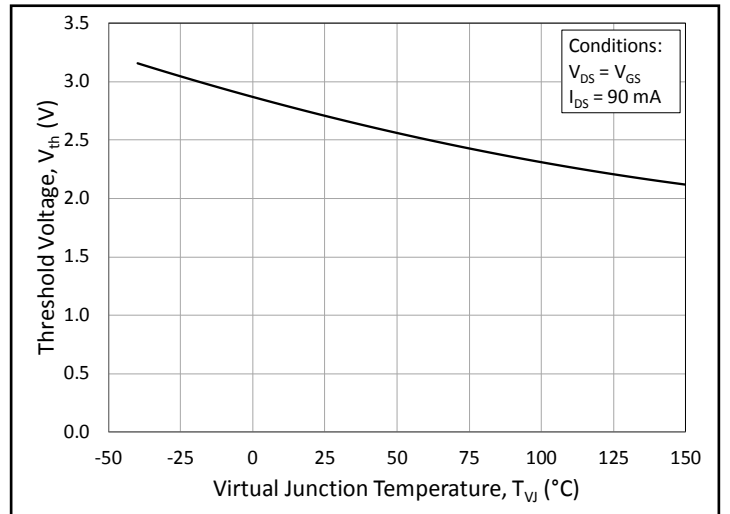


Figure 10. Threshold Voltage vs. Junction Temperature

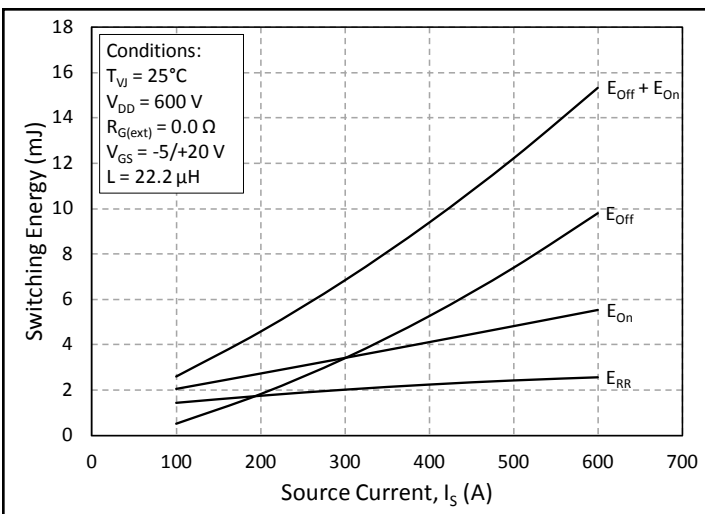


Figure 11. Switching Energy vs. Drain Current ( $V_{DS} = 600\text{ V}$ )

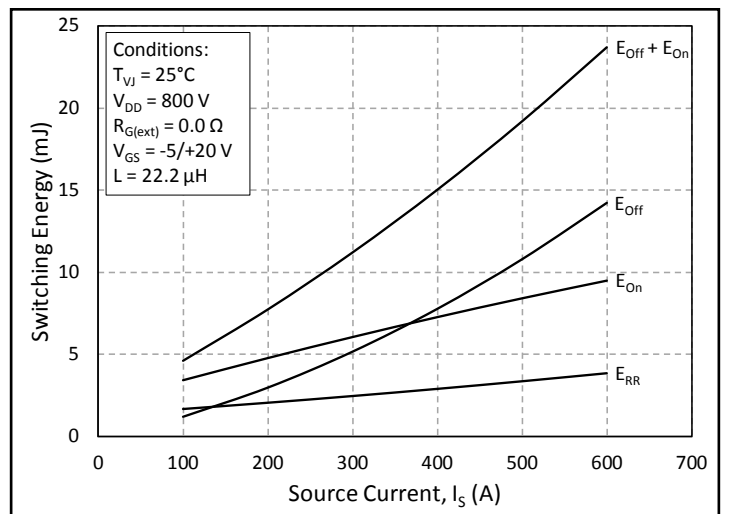


Figure 12. Switching Energy vs. Drain Current ( $V_{DS} = 800\text{ V}$ )



**Typical Performance**

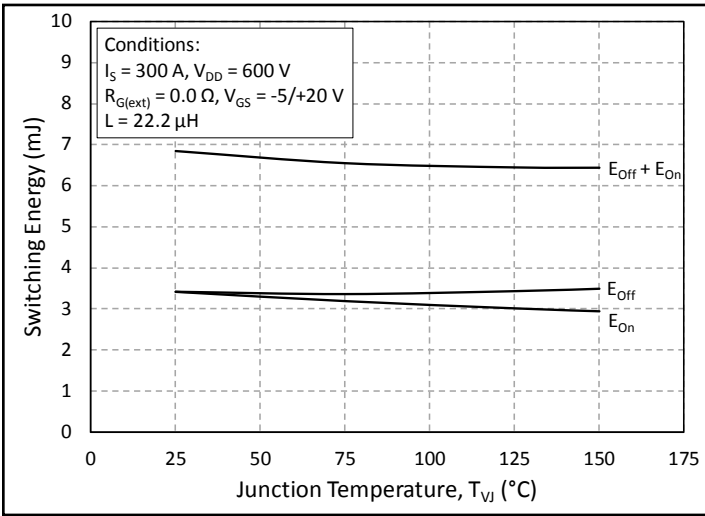


Figure 13. MOSFET Switching Energy vs. Junction Temperature

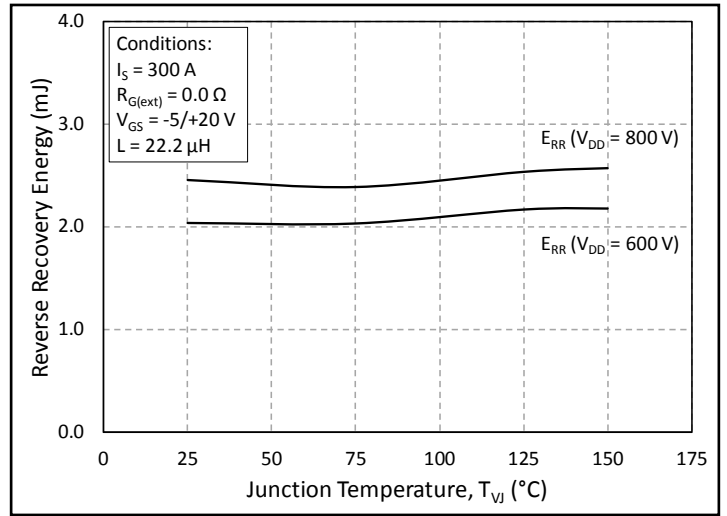


Figure 14. Reverse Recovery Energy vs. Junction Temperature

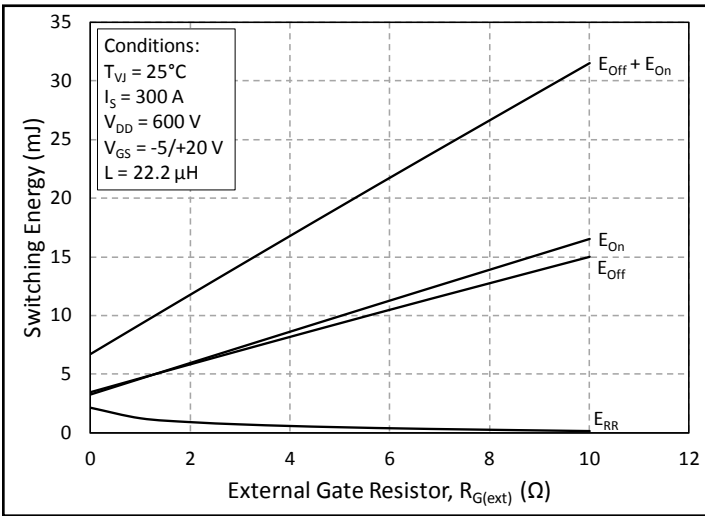


Figure 15. MOSFET Switching Energy vs. External Gate Resistance

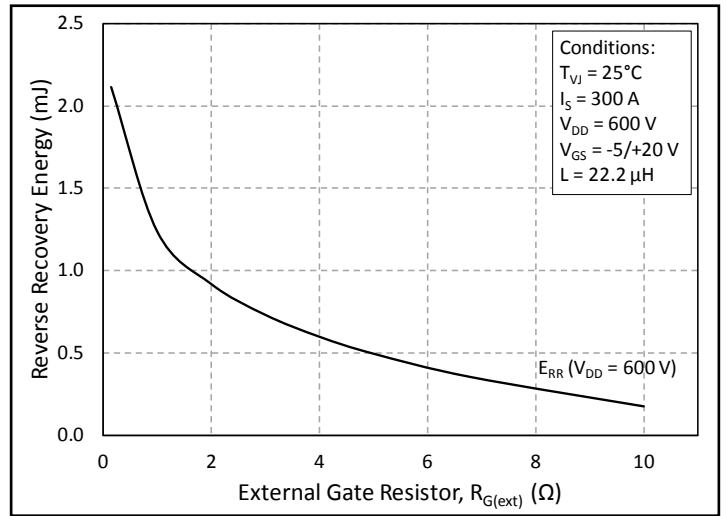


Figure 16. Reverse Recovery Energy vs. External Gate Resistance

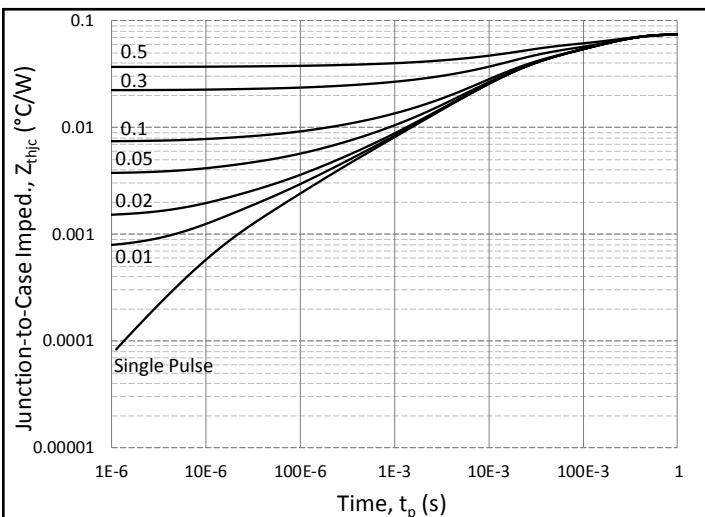


Figure 17. MOSFET Junction to Case Transient Thermal Impedance,  $Z_{thJC}$  (°C/W)

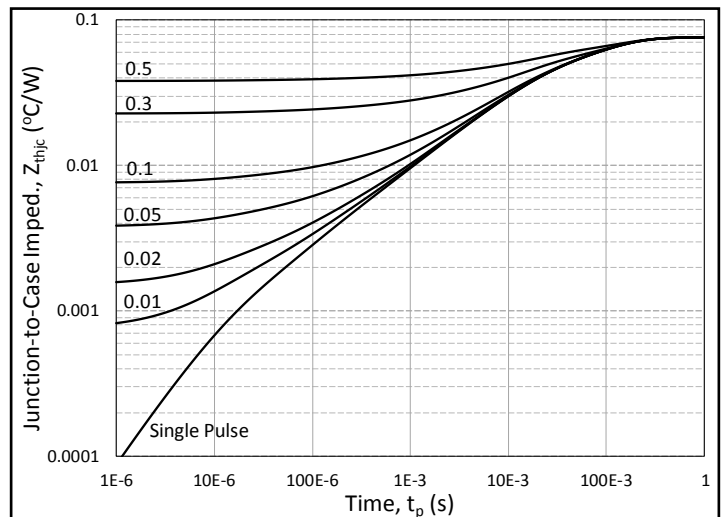


Figure 18. Diode Junction to Case Transient Thermal Impedance,  $Z_{thJC}$  (°C/W)

**Typical Performance**

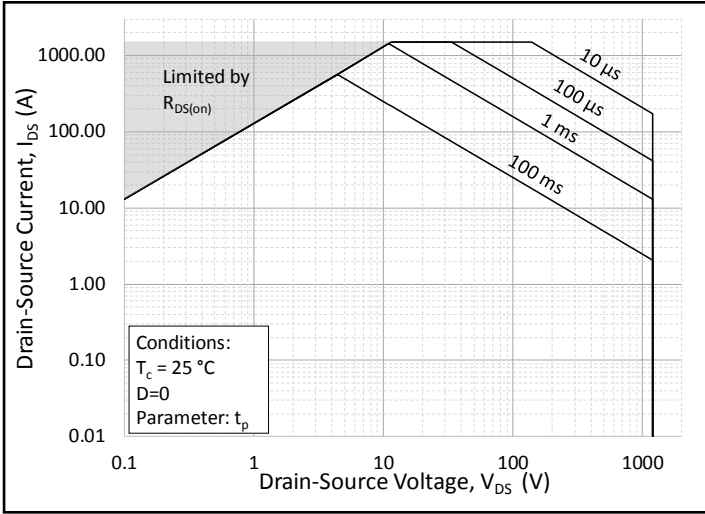


Figure 19. Forward Bias Safe Operating Area (FBSOA)

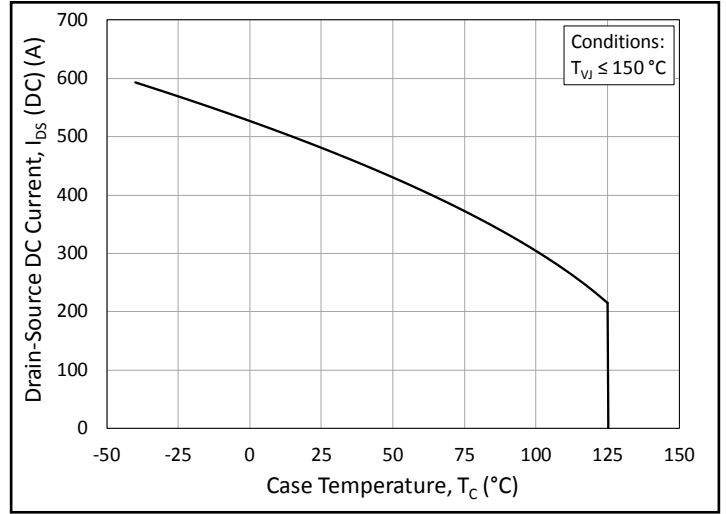


Figure 20. Continuous Drain Current Derating vs. Case Temperature

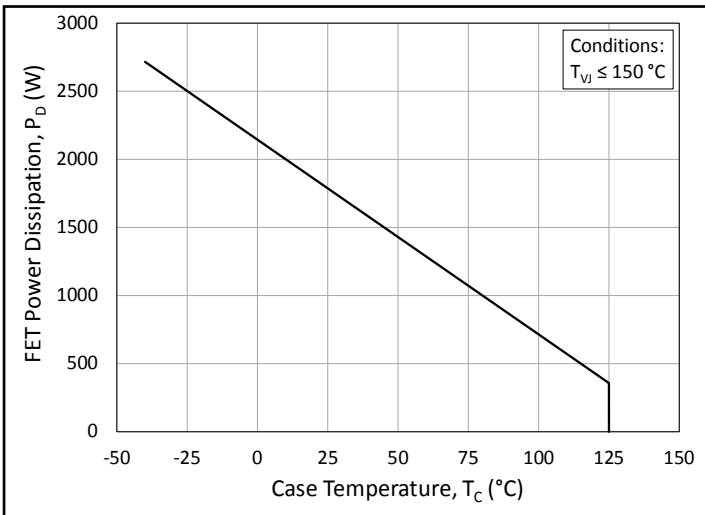


Figure 21. Maximum Power Dissipation Derating vs. Case Temperature

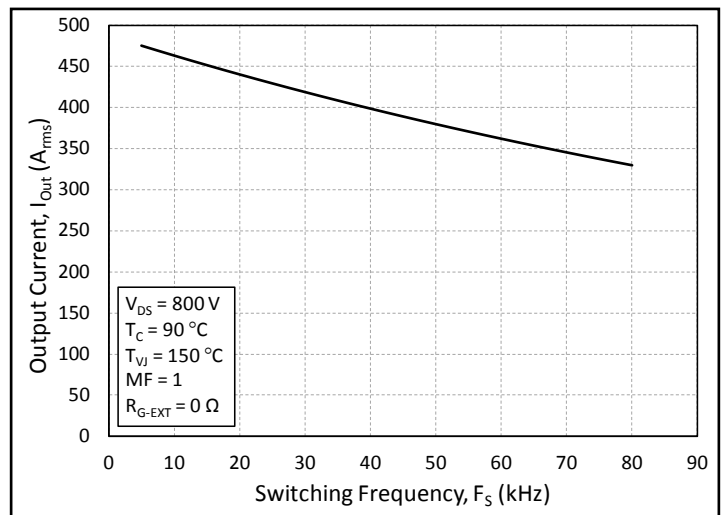


Figure 22. Typical Output Current Capability vs. Switching Frequency (Inverter Application)



**Timing Characteristics**

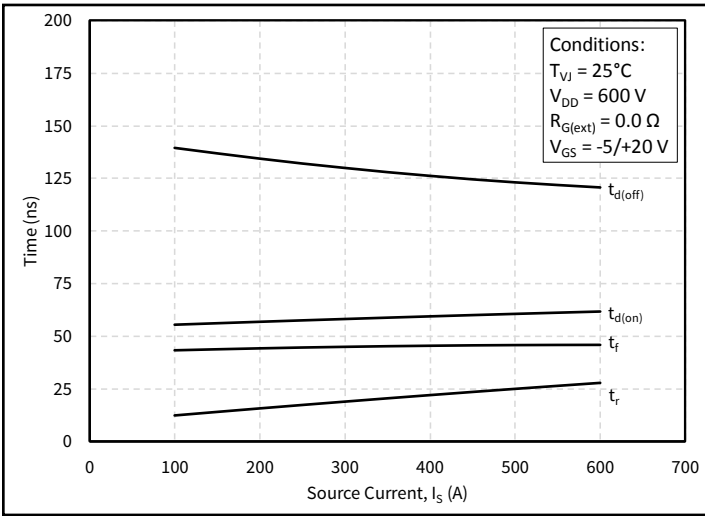


Figure 23. Timing vs. Source Current

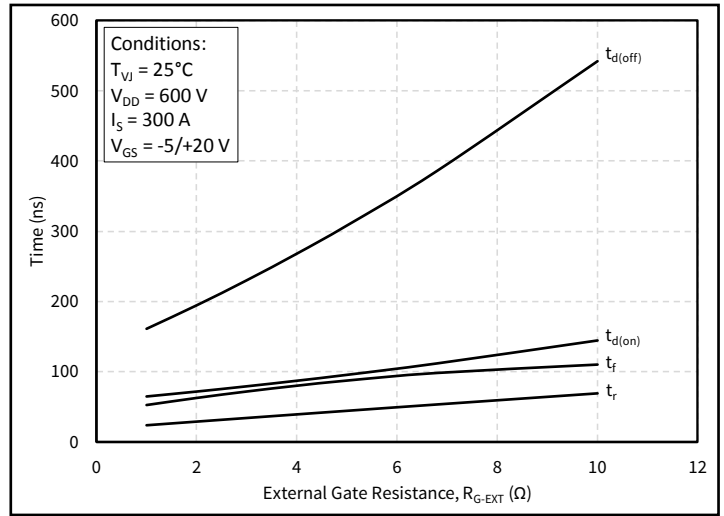


Figure 24. Timing vs. External Gate Resistance

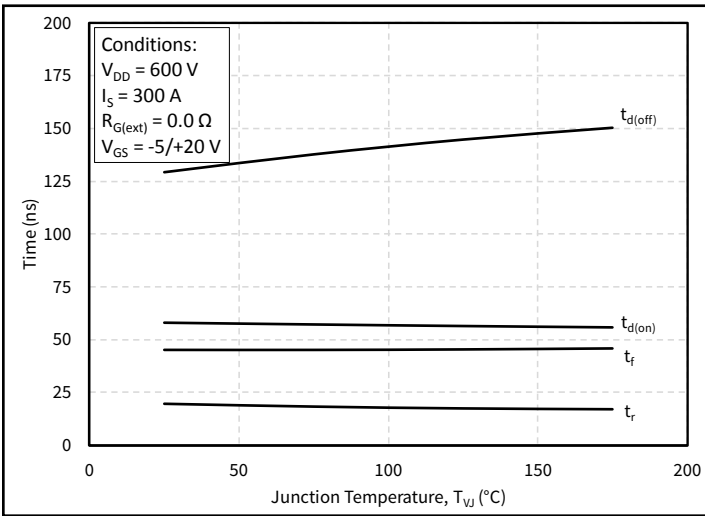


Figure 25. Timing vs. Junction Temperature

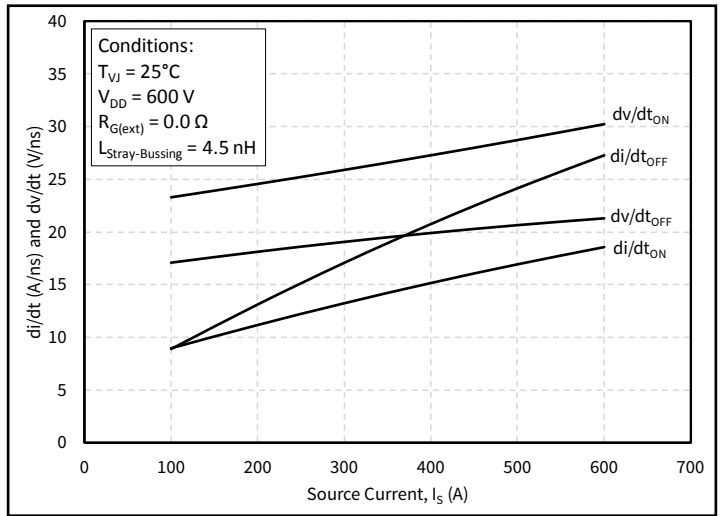


Figure 26. dv/dt and di/dt vs. Source Current

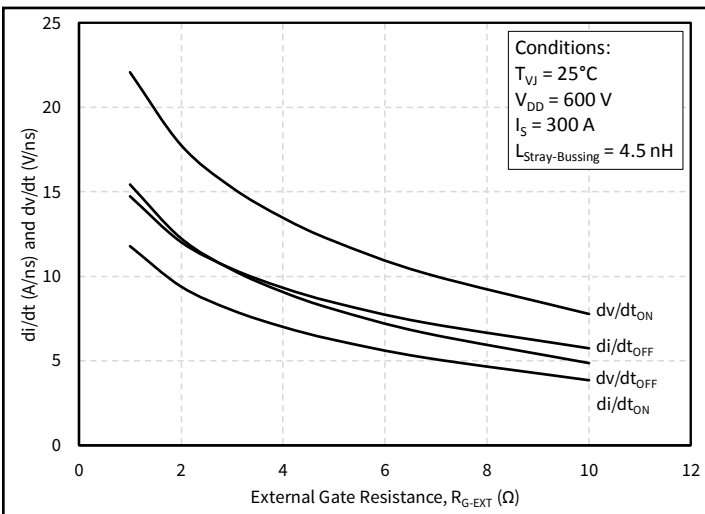


Figure 27. dv/dt and di/dt vs. External Gate Resistance

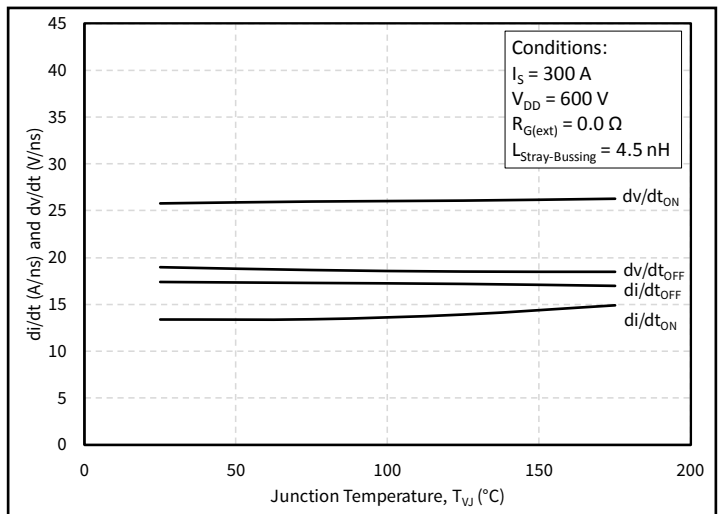


Figure 28. dv/dt and di/dt vs. Junction Temperature





**Definitions**

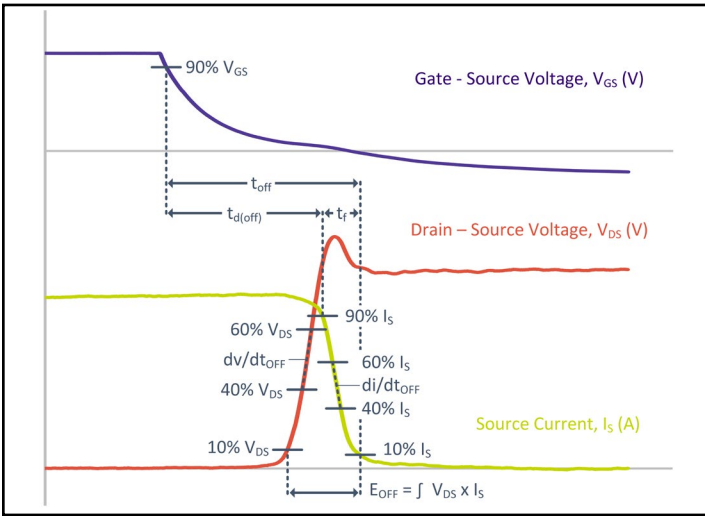


Figure 29. Turn-off Transient Definitions

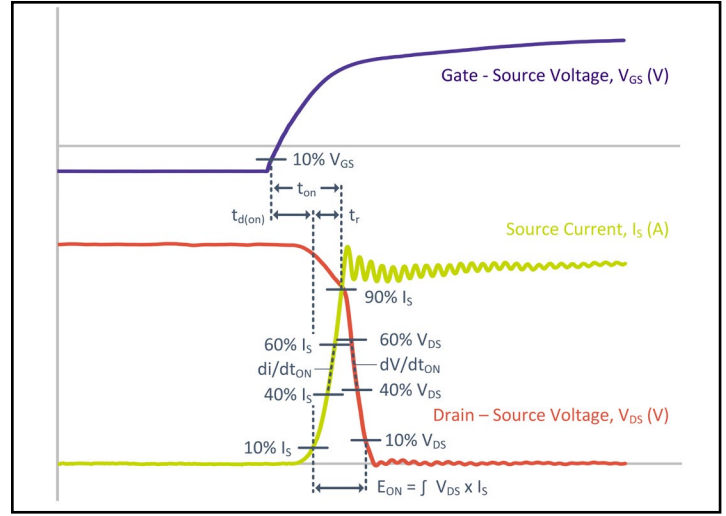


Figure 30. Turn-on Transient Definitions

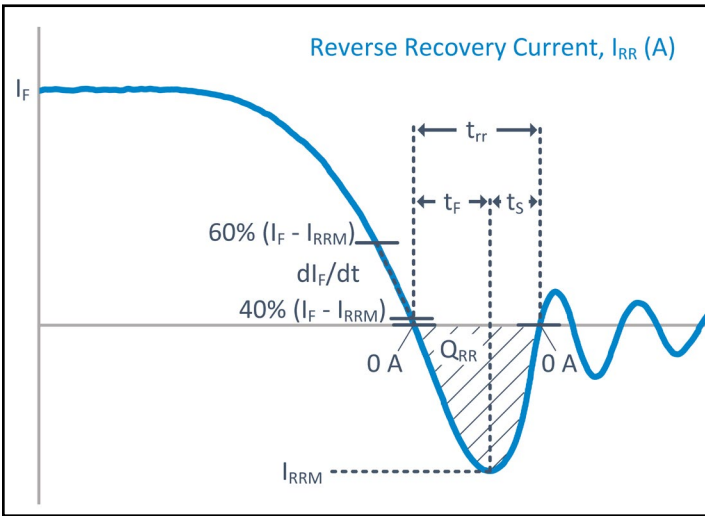


Figure 31. Reverse Recovery Definitions

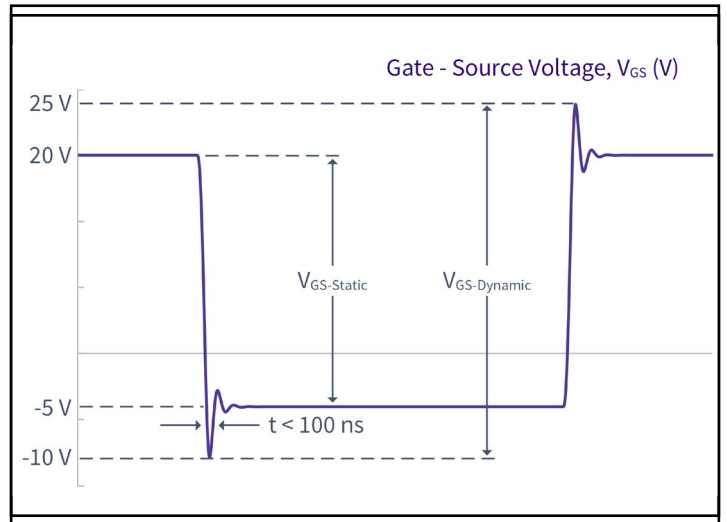
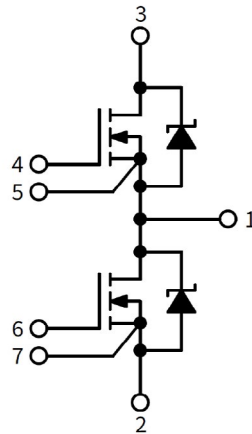


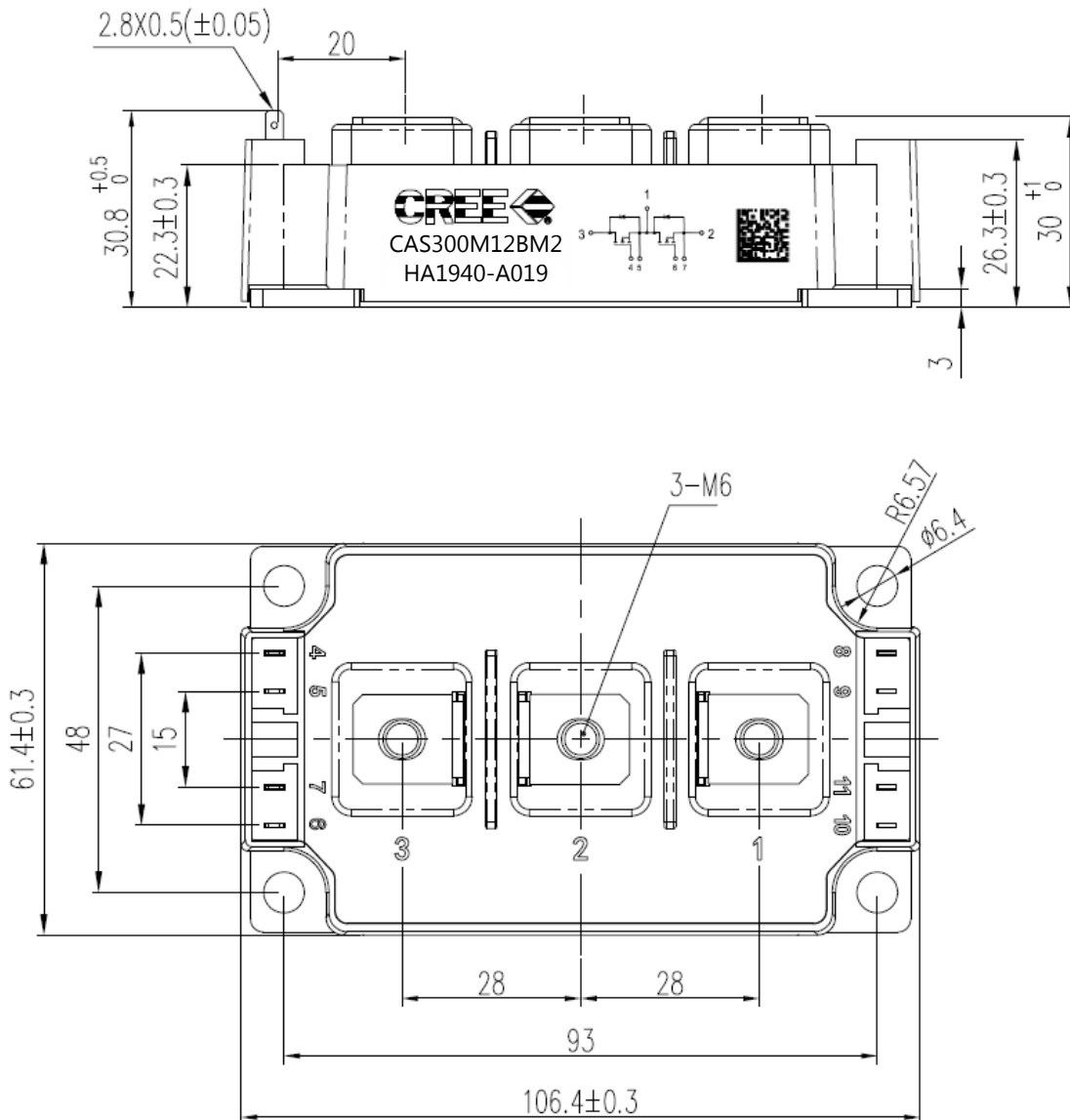
Figure 32.  $V_{GS}$  Transient Definitions



**Schematic and Pin Out**



**Package Dimensions (mm)**



## Supporting Links & Tools

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- [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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