

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

# WAB300M12BM3

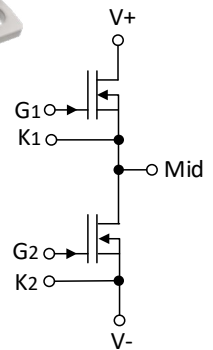
## 1200 V, 300 A All-Silicon Carbide

### THB-80 Qualified, Switching Optimized, Half-Bridge Module

#### Technical Features

- Industry Standard 62 mm Footprint
- High Humidity Operation THB-80 (HV-H3TRB)
- High Junction Temperature (175 °C) Operation
- Implements Switching Optimized Third Generation SiC MOSFET Technology
- Low Inductance (10.2 nH) Design
- Silicon Nitride Insulator and Copper Baseplate

#### Package 105mm x 61.5 mm x 31.4 mm



#### Applications

- Railway & Traction
- Solar
- EV Chargers
- Industrial Automation & Testing

#### System Benefits

- Fast Time-to-Market with Minimal Development Required for Transition from 62mm Si IGBT Packages
- Increased System Efficiency, due to Low Switching & Conduction Losses of SiC
- High Reliability Material Selection

#### Key Parameters ( $T_c = 25^\circ\text{C}$ unless otherwise specified)

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	-8		+19		Transient, <100 ns	Fig. 32
$V_{GS\text{op}}$	Gate-Source Voltage, Recommended Op. Value	-4		+15		Static	
$I_{DS}$	DC Continuous Drain Current		382		A	$V_{GS} = 15\text{ V}, T_c = 25^\circ\text{C}, T_{vj} \leq 175^\circ\text{C}$	Fig. 20
			270			$V_{GS} = 15\text{ V}, T_c = 90^\circ\text{C}, T_{vj} \leq 175^\circ\text{C}$	Note 1
$I_{SD}$	DC Source-Drain Current		382			$V_{GS} = 15\text{ V}, T_c = 25^\circ\text{C}, T_{vj} \leq 175^\circ\text{C}$	
$I_{SD\text{BD}}$	DC Source-Drain Current (Body Diode)		190			$V_{GS} = -4\text{ V}, T_c = 25^\circ\text{C}, T_{vj} \leq 175^\circ\text{C}$	
$I_{DS(\text{pulsed})}$	Maximum Pulsed Drain-Source Current			600		$t_{p\text{max}}$ limited by $T_{j\text{max}}$ $V_{GS} = 15\text{ V}, T_c = 25^\circ\text{C}$	
$I_{SD(\text{pulsed})}$	Maximum Pulsed Source-Drain Current			600			
$T_{vj\text{op}}$	Maximum Virtual Junction Temperature under Switching Conditions	-40		175	$^\circ\text{C}$		

Note 1 Assumes  $R_{\text{THJC}} = 0.16^\circ\text{W}$  and  $R_{\text{DS(on)}} = 6.4\text{ m}\Omega$ . Calculate  $P_D = (T_{vj} - T_c) / R_{\text{THJC}}$ . Calculate  $I_{D,\text{MAX}} = \sqrt{(P_D / R_{\text{DS(on)}})}$

**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	1.8	2.5	3.6		$V_{DS} = V_{GS}, I_D = 92\text{ mA}$	
			2.0			$V_{DS} = V_{GS}, I_D = 92\text{ mA}, T_{VJ} = 175^\circ\text{C}$	
$I_{DSS}$	Zero Gate Voltage Drain Current		10	150	$\mu\text{A}$	$V_{GS} = 0\text{ V}, V_{DS} = 1200\text{ V}$	
$I_{GSS}$	Gate-Source Leakage Current		0.05	1		$V_{GS} = 15\text{ V}, V_{DS} = 0\text{ V}$	
$R_{DS(on)}$	Drain-Source On-State Resistance (Devices Only)		4.0	5.2	m $\Omega$	$V_{GS} = 15\text{ V}, I_D = 300\text{ A}$	Fig. 2
			6.4			$V_{GS} = 15\text{ V}, I_D = 300\text{ A}, T_{VJ} = 175^\circ\text{C}$	Fig. 3
$g_{fs}$	Transconductance		212		S	$V_{DS} = 20\text{ V}, I_{DS} = 300\text{ A}$	Fig. 4
			200			$V_{DS} = 20\text{ V}, I_{DS} = 300\text{ A}, T_{VJ} = 175^\circ\text{C}$	
$E_{On}$	Turn-On Switching Energy, $T_J = 25^\circ\text{C}$ $T_J = 125^\circ\text{C}$ $T_J = 175^\circ\text{C}$		4.75		mJ	$V_{DS} = 600\text{ V},$ $I_D = 300\text{ A},$ $V_{GS} = -4\text{ V}/15\text{ V},$ $R_{G(ext)} = 2.0\ \Omega,$ $L = 20.7\ \mu\text{H}$	Fig. 11 Fig. 13
			5.33				
			5.88				
$E_{Off}$	Turn-Off Switching Energy, $T_J = 25^\circ\text{C}$ $T_J = 125^\circ\text{C}$ $T_J = 175^\circ\text{C}$		4.99		mJ	$V_{DS} = 600\text{ V},$ $I_D = 300\text{ A},$ $V_{GS} = -4\text{ V}/15\text{ V},$ $R_{G(ext)} = 2.0\ \Omega,$ $L = 20.7\ \mu\text{H}$	Fig. 11 Fig. 13
			5.23				
			5.30				
$R_{G(int)}$	Internal Gate Resistance		1.4		$\Omega$	$T_{VJ} = 25^\circ\text{C}$	
$C_{iss}$	Input Capacitance		24.5		nF	$V_{GS} = 0\text{ V}, V_{DS} = 1000\text{ V},$ $V_{AC} = 25\text{ mV}, f = 100\text{ kHz}$	Fig. 9
$C_{oss}$	Output Capacitance		0.97				
$C_{rss}$	Reverse Transfer Capacitance		50				
$Q_{GS}$	Gate to Source Charge		256		nC	$V_{DS} = 800\text{ V}, V_{GS} = -4\text{ V}/15\text{ V}$ $I_D = 400\text{ A}$ Per IEC60747-8-4 pg 21	
$Q_{GD}$	Gate to Drain Charge		308				
$Q_G$	Total Gate Charge		908				
$R_{thJC}$	FET Thermal Resistance, Junction to Case		0.16	0.18	$^\circ\text{C}/\text{W}$		Fig. 17

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

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions	Note
$V_{SD}$	Body Diode Forward Voltage		6.0		V	$V_{GS} = -4\text{ V}, I_{SD} = 300\text{ A}$	Fig. 7
			5.5			$V_{GS} = -4\text{ V}, I_{SD} = 300\text{ A}, T_J = 175^\circ\text{C}$	
$t_{RR}$	Reverse Recovery Time		36.5		ns	$V_{GS} = -4\text{ V}, I_{SD} = 300\text{ A}, V_R = 600\text{ V}$ $di_F/dt = 14.5\text{ A/ns}, T_J = 175^\circ\text{C}$	
$Q_{RR}$	Reverse Recovery Charge		7.3		$\mu\text{C}$		
$I_{RRM}$	Peak Reverse Recovery Current		323		A		
$E_{RR}$	Reverse Recovery Energy $T_J = 25^\circ\text{C}$ $T_J = 125^\circ\text{C}$ $T_J = 175^\circ\text{C}$		0.65		mJ	$V_{DS} = 600\text{ V}, I_D = 300\text{ A},$ $V_{GS} = -4\text{ V}/15\text{ V}, R_{G(ext)} = 2.0\ \Omega,$ $L = 20.7\ \mu\text{H}$	Fig. 14
			1.98				
			3.01				



## Module Physical Characteristics

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions
R <sub>3-1</sub>	Package Resistance, M1		0.60		mΩ	T <sub>c</sub> = 125 °C, Note 2
R <sub>1-2</sub>	Package Resistance, M2		0.51			T <sub>c</sub> = 125 °C, Note 2
L <sub>Stray</sub>	Stray Inductance		10.2		nH	Between Terminals 2 and 3
T <sub>c</sub>	Case Temperature	-40		125	°C	
W	Weight		300		g	
M <sub>s</sub>	Mounting Torque	4.5	5	5.5	N-m	Baseplate, M6 bolts
		4.5	5	5.5		Power Terminals, M6 bolts
V <sub>isol</sub>	Case Isolation Voltage			5.5	kV	AC, 50 Hz, 1 min
CTI	Comparative Tracking Index		600			

Note 2 Total Effective Resistance (Per Switch Position) = MOSFET R<sub>DS(on)</sub> + Switch Position Package Resistance.

## Typical Performance

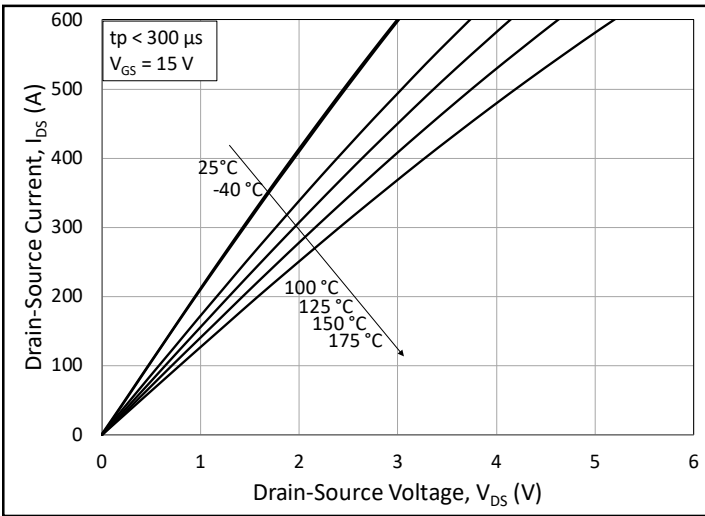


Figure 1. Output Characteristics for Various Junction Temperatures

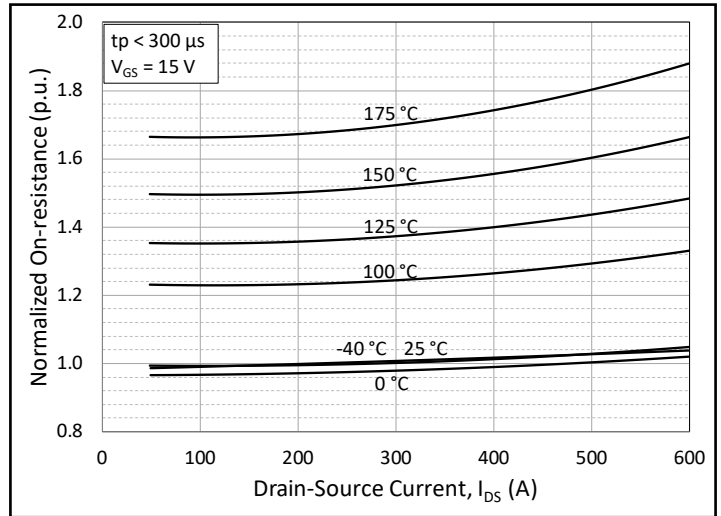


Figure 2. Normalized On-State Resistance vs. Drain Current for Various Junction Temperatures

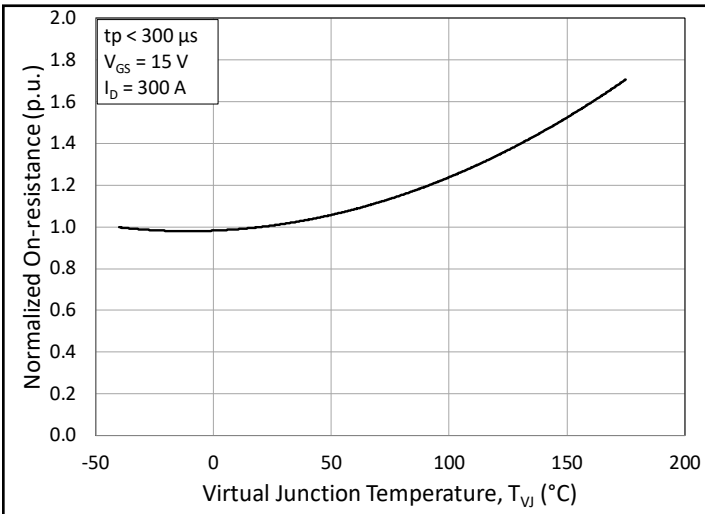


Figure 3. Normalized On-State Resistance vs. Junction Temperature

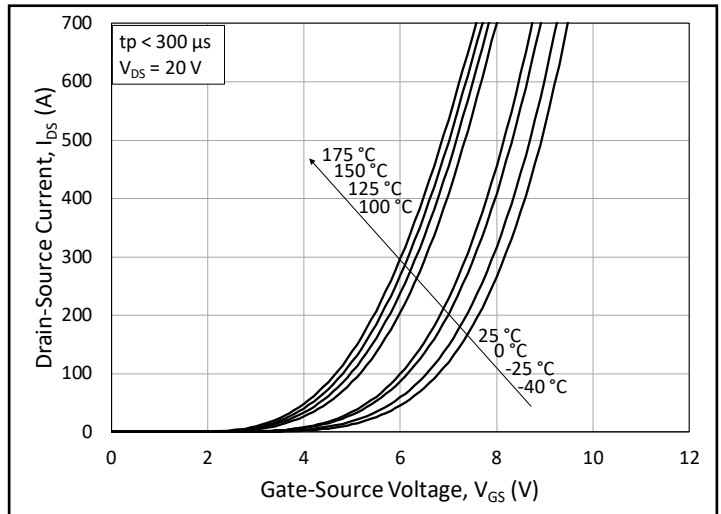


Figure 4. Transfer Characteristic for Various Junction Temperatures

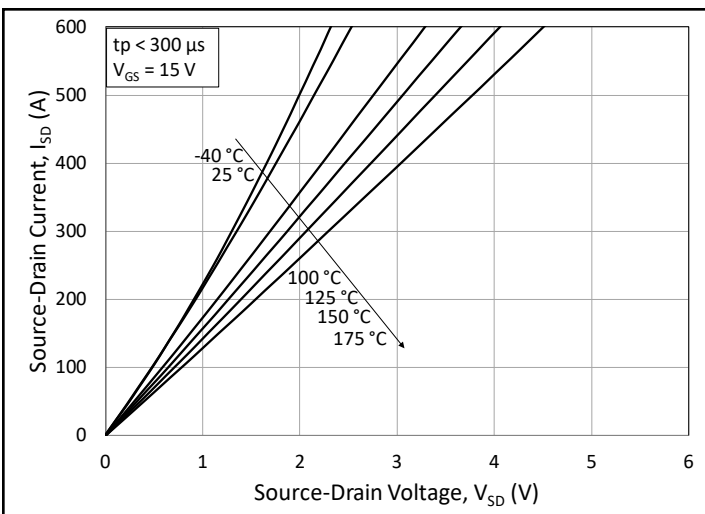


Figure 5. 3<sup>rd</sup> Quadrant Characteristic vs. Junction Temperatures at  $V_{GS} = 15\text{ V}$

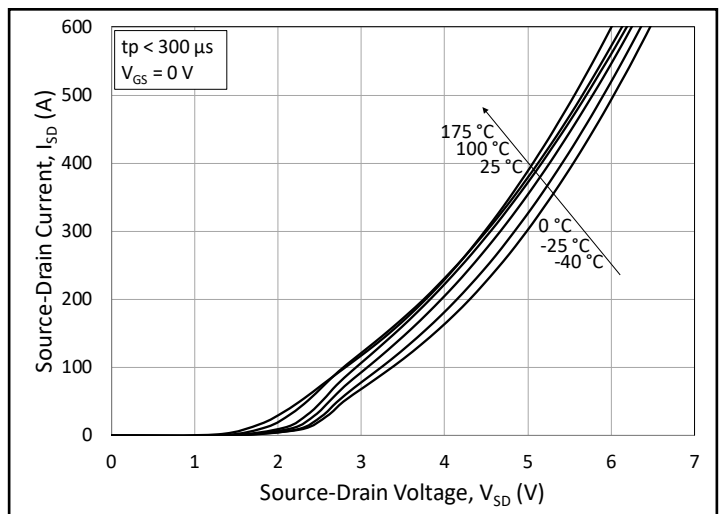


Figure 6. 3<sup>rd</sup> Quadrant Characteristic vs. Junction Temperatures at  $V_{GS} = 0\text{ V}$  (Body Diode)

**Typical Performance**

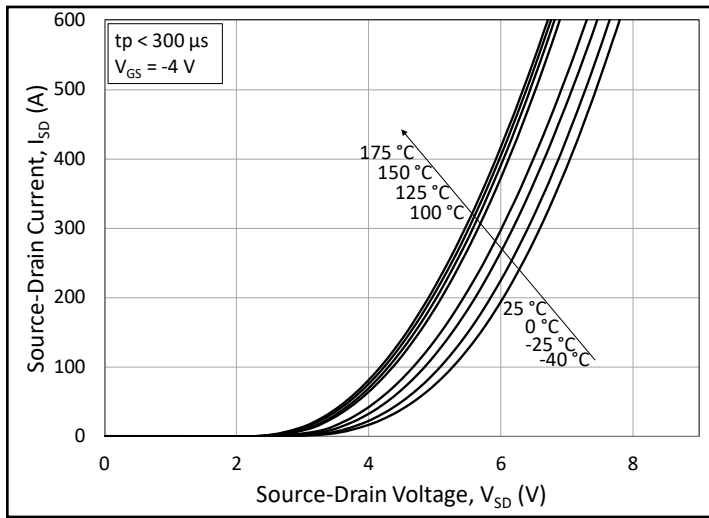


Figure 7. 3<sup>rd</sup> Quadrant Characteristic vs. Junction Temperatures at  $V_{GS} = -4\text{ V}$  (Body Diode)

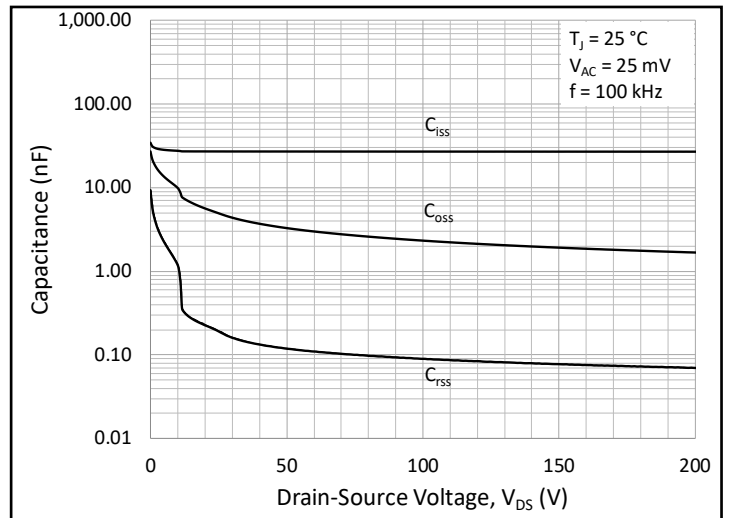


Figure 8. Typical Capacitances vs. Drain to Source Voltage (0 - 200V)

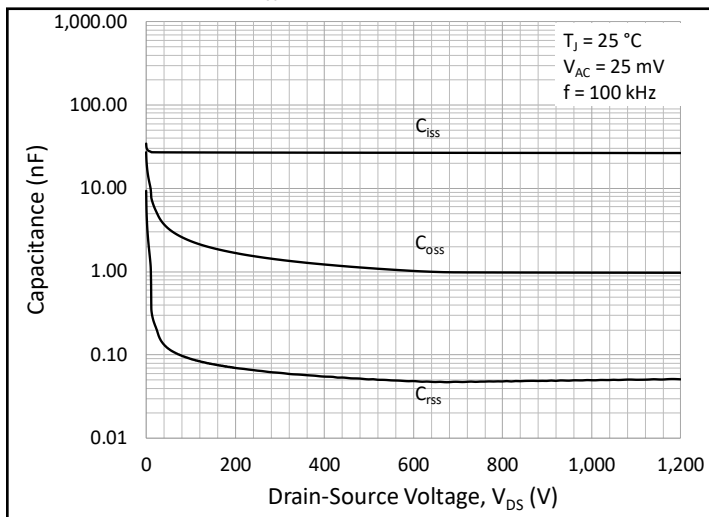


Figure 9. Typical Capacitances vs. Drain to Source Voltage (0 - 1200V)

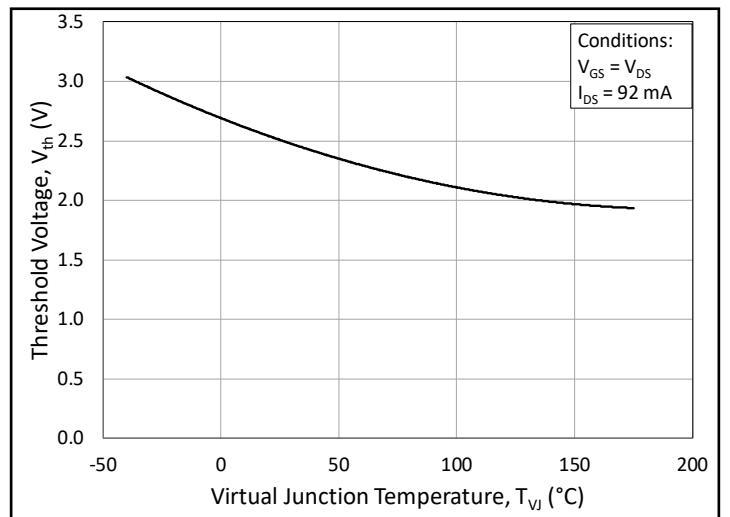


Figure 10. Threshold Voltage vs. Junction Temperature

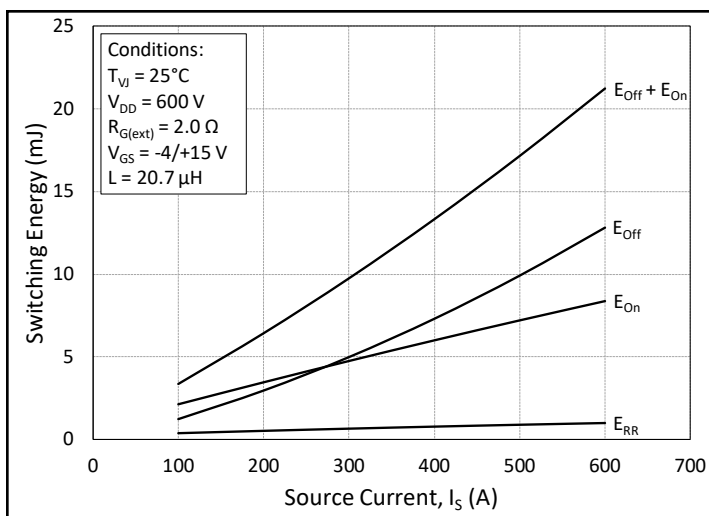


Figure 11. Switching Energy vs. Drain Current ( $V_{DS} = 600\text{ V}$ )

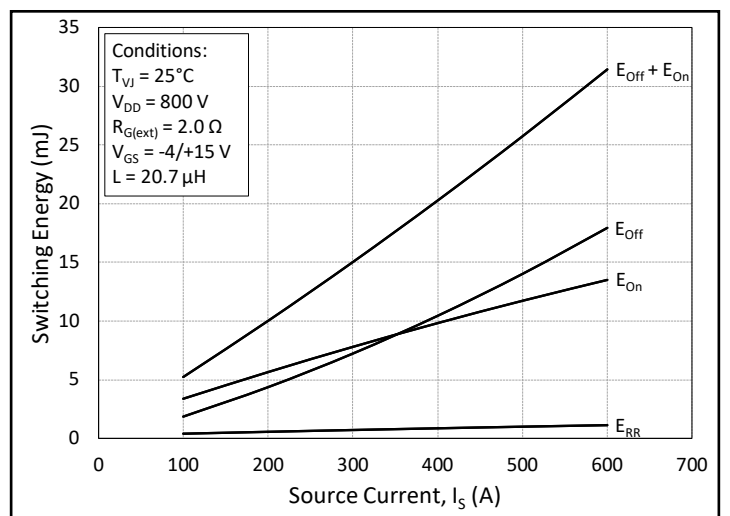


Figure 12. Switching Energy vs. Drain Current ( $V_{DS} = 800\text{ V}$ )



Typical Performance

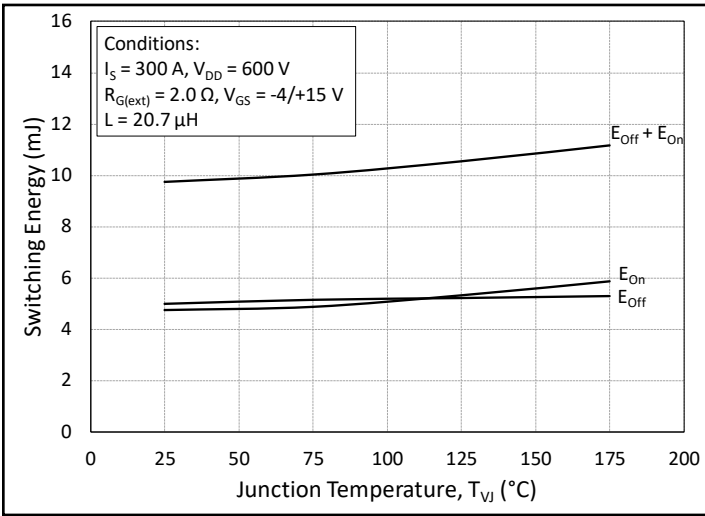


Figure 13. MOSFET Switching Energy vs. Junction Temperature

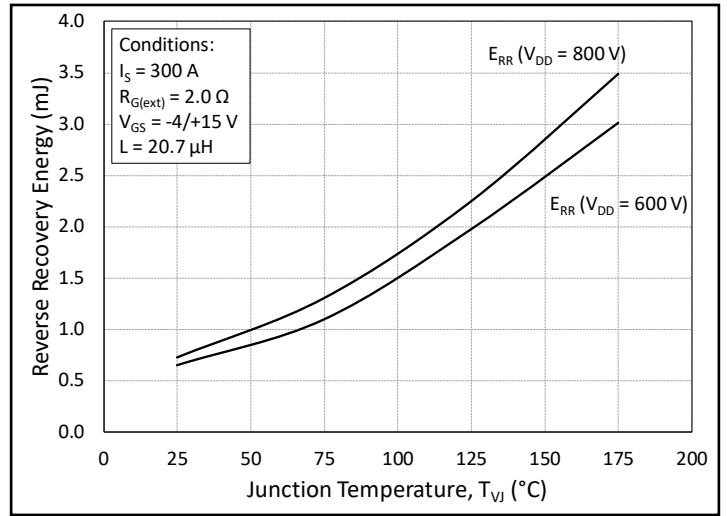


Figure 14. Reverse Recovery Energy vs. Junction Temperature

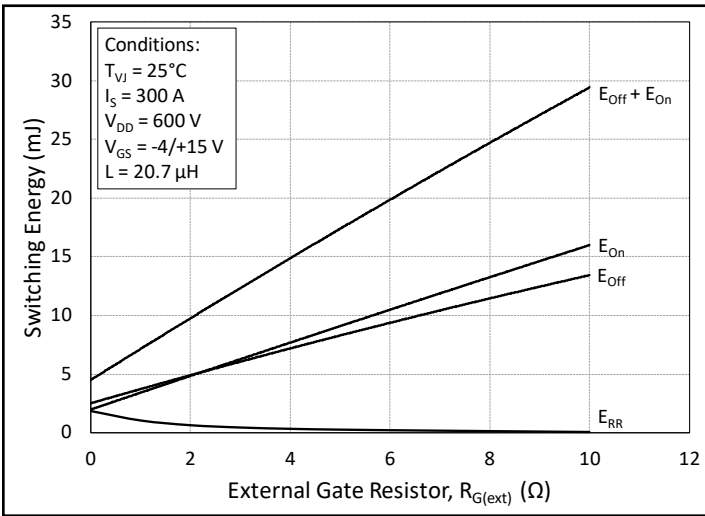


Figure 15. MOSFET Switching Energy vs. External Gate Resistance

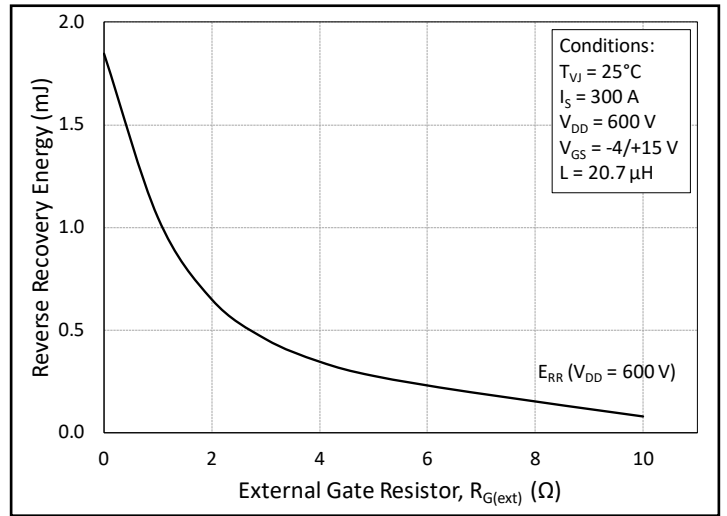


Figure 16. Reverse Recovery Energy vs. External Gate Resistance

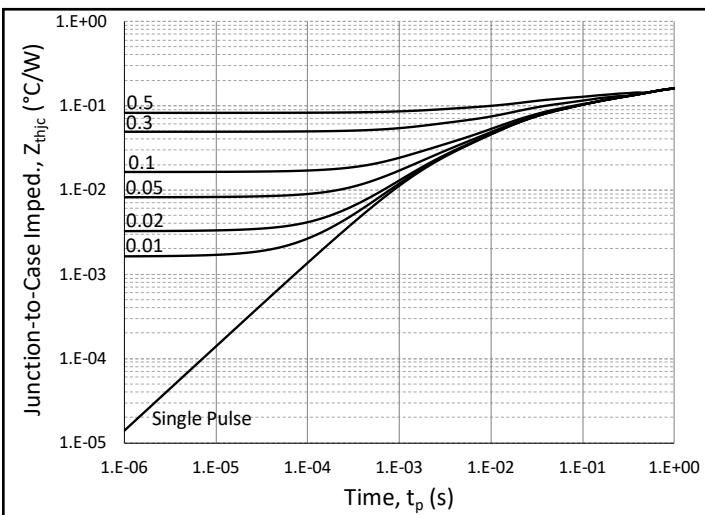


Figure 17. MOSFET Junction to Case Transient Thermal Impedance,  $Z_{th(jc)}$  (°C/W)

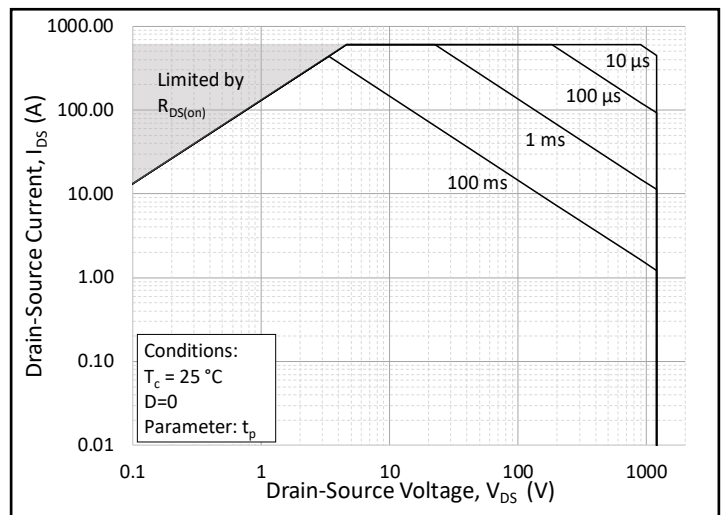


Figure 18. Forward Bias Safe Operating Area (FBSOA)

**Typical Performance**

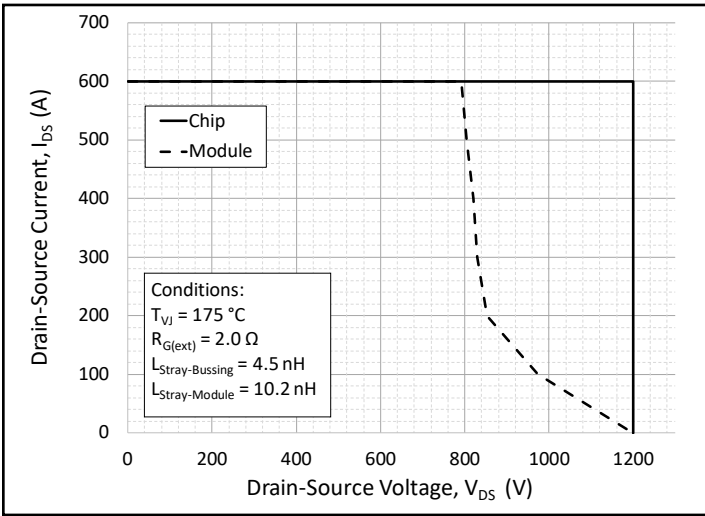


Figure 19. Reverse Bias Safe Operating Area (RBSOA)

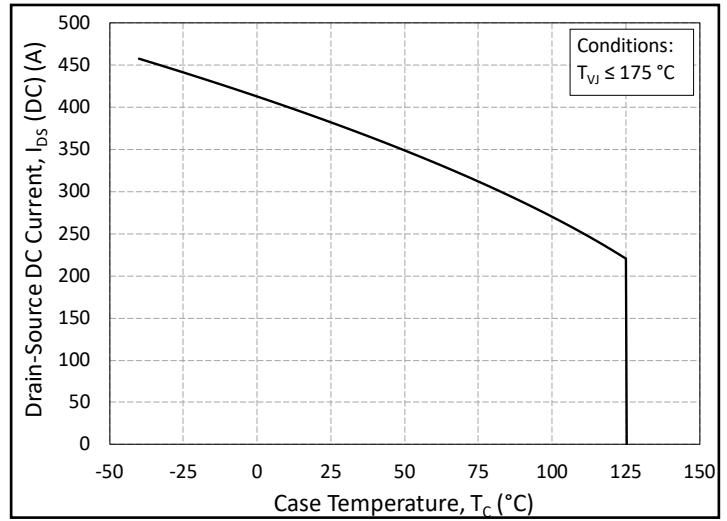


Figure 20. Continuous Drain Current Derating vs. Case Temperature

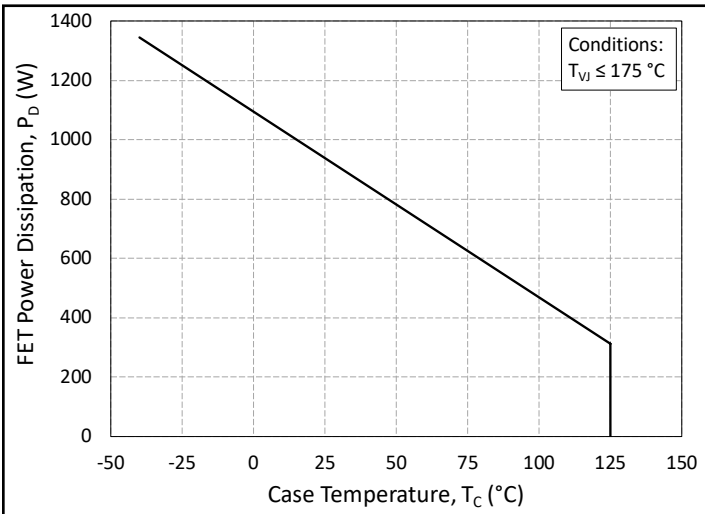


Figure 21. Maximum Power Dissipation Derating vs. Case Temperature

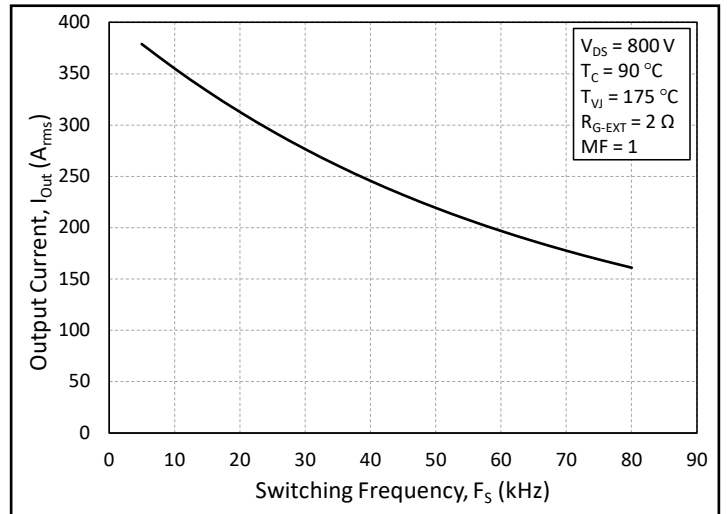


Figure 22. Typical Output Current Capability vs. Switching Frequency (Inverter Application)



### Timing Characteristics

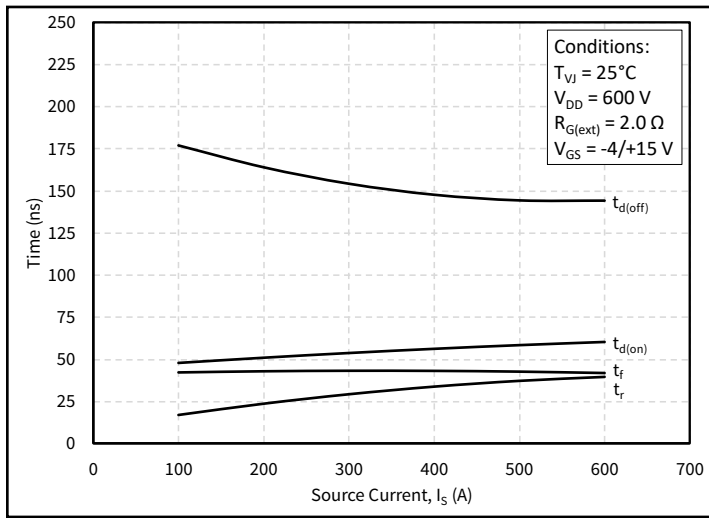


Figure 23. Timing vs. Source Current

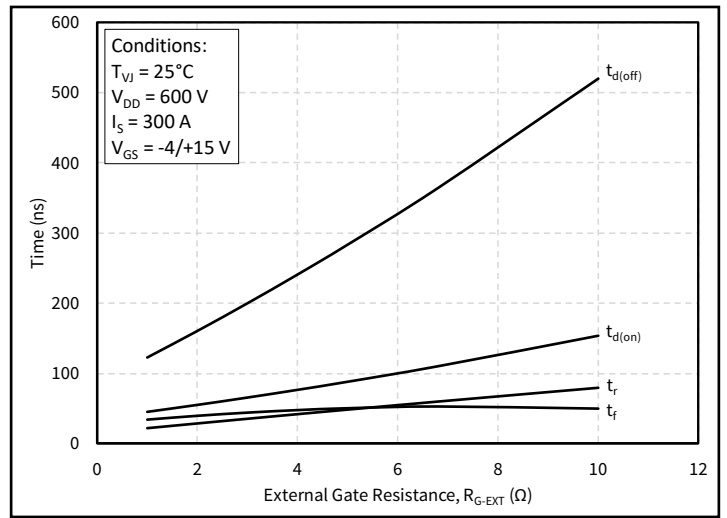


Figure 24. Timing vs. External Gate Resistance

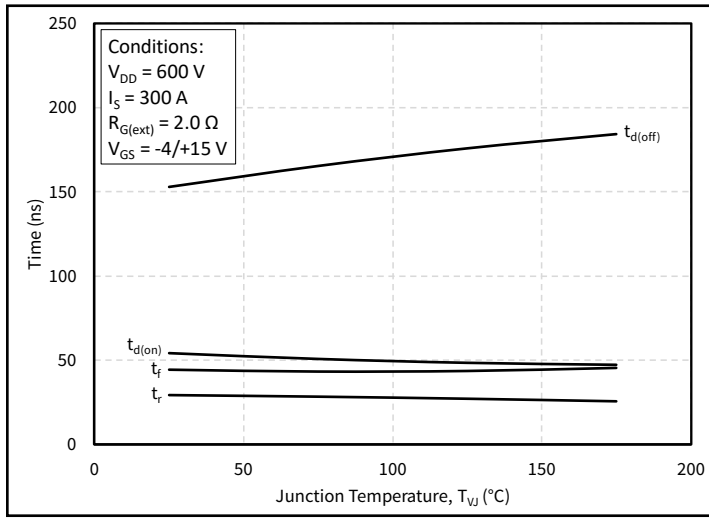


Figure 25. Timing vs. Junction Temperature

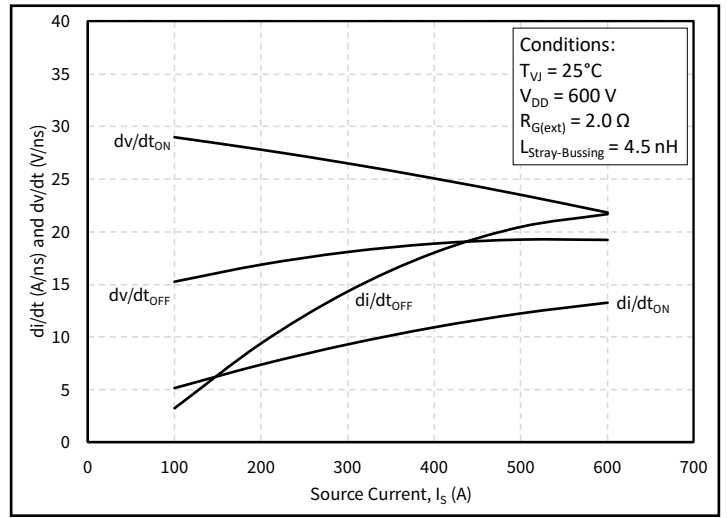


Figure 26.  $dv/dt$  and  $di/dt$  vs. Source Current

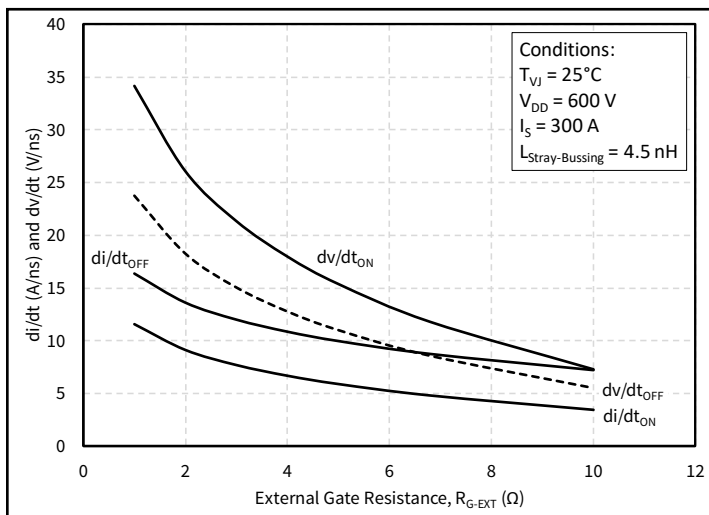


Figure 27.  $dv/dt$  and  $di/dt$  vs. External Gate Resistance

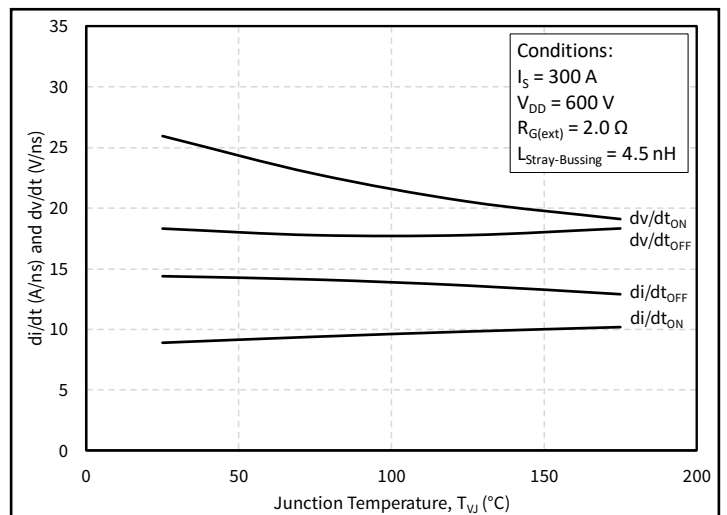


Figure 28.  $dv/dt$  and  $di/dt$  vs. Junction Temperature





**Definitions**

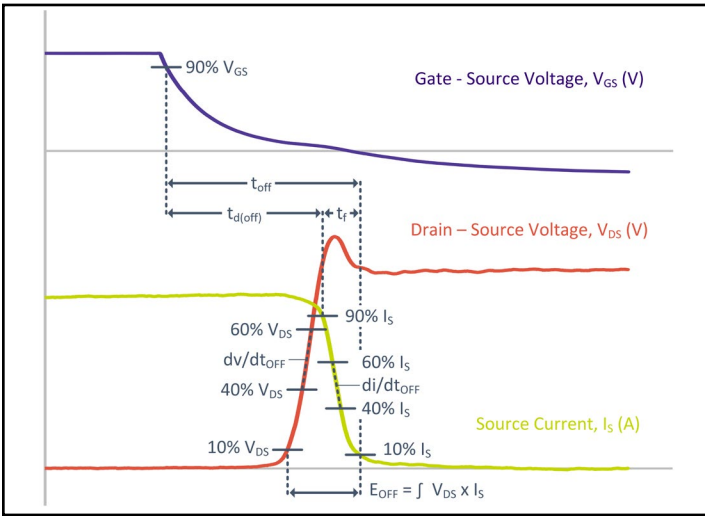


Figure 29. Turn-off Transient Definitions

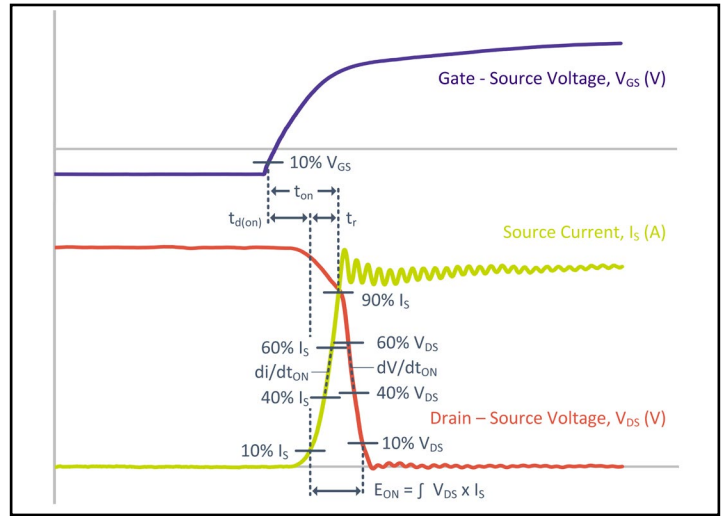


Figure 30. Turn-on Transient Definitions

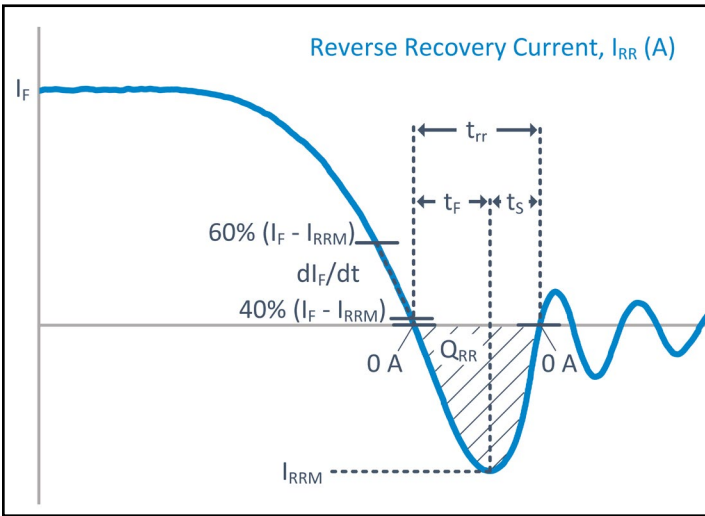


Figure 31. Reverse Recovery Definitions

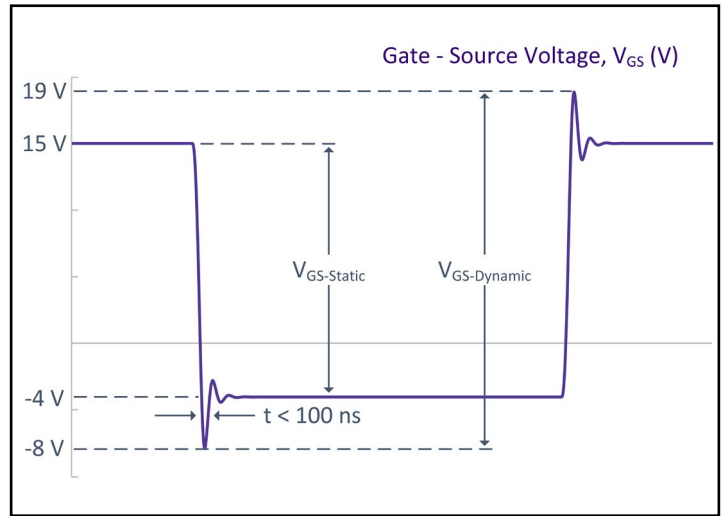
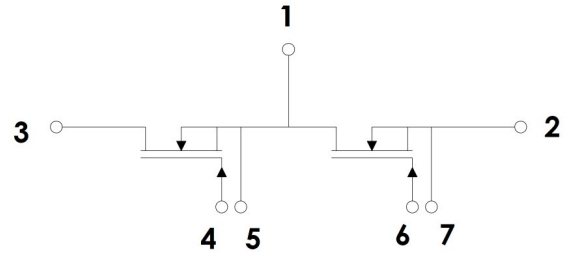
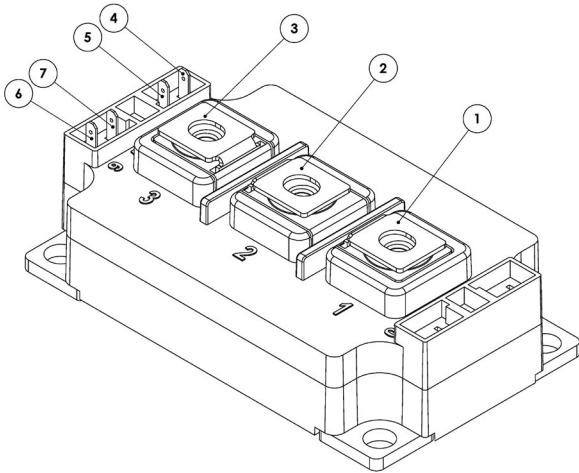


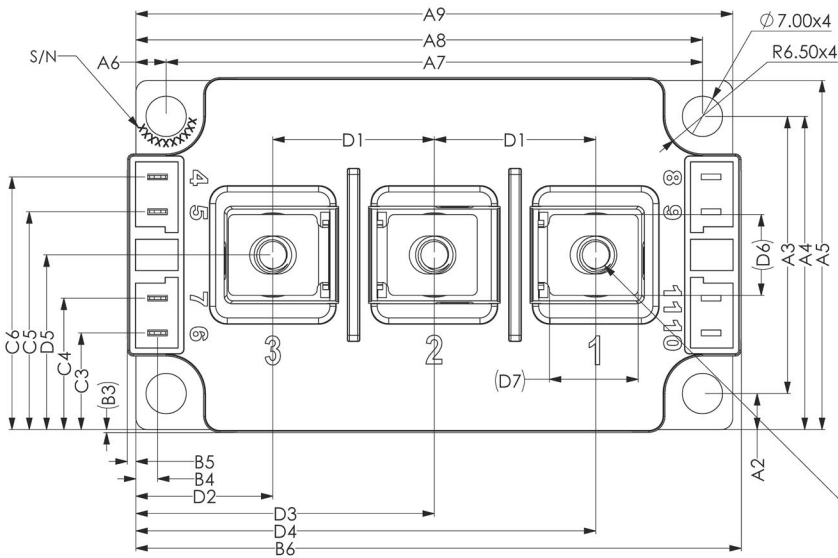
Figure 32.  $V_{GS}$  Transient Definitions



## Schematic and Pin Out

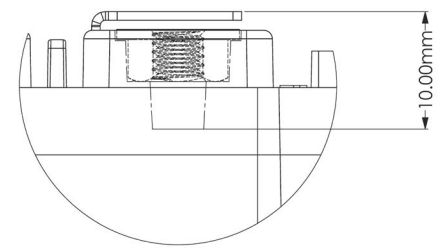


## Package Dimensions (mm)

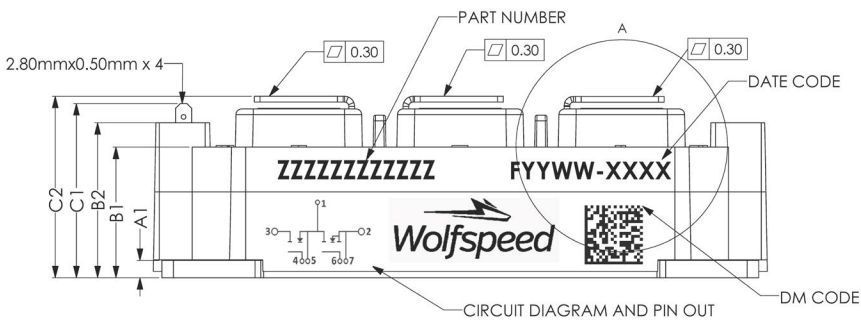


DIMENSION TABLE		
SYMBOL	DIMENSION (mm)	TOLERANCE (mm)
A1	3.00	+0.30
A2	6.22	+0.30
A3	48.00	+0.30
A4	54.22	+0.30
A5	60.44	+0.30
A6	5.25	+0.30
A7	93	+0.30
A8	98.25	+0.30
A9	103.50	+0.30
B1	22.75	+0.30
B2	27.30	+0.30
B3	0.51 x 2	REF
B4	3.76	+0.40
B5	1.25	+0.40
B6	105.00	+0.30
C1	30.60	+0.50
C2	31.40	+0.40
C3	16.72	+0.40
C4	22.75	+0.40
C5	37.7	+0.40
C6	43.73	+0.40
D1	28.00	+0.50
D2	24.20	+0.40
D3	52.00	+0.40
D4	79.80	+0.40
D5	30.22	+0.40
D6	14.00 x 3	REF
D7	15.40 x 3	REF

M6x6mm HEX NUT x 3  
MAXIMUM BOLT PENETRATION DEPTH: 10mm



DETAIL A  
SCALE 3:1



**3D Model (Requires Adobe Acrobat or Compatible Viewer With 3D Capability)**

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## Supporting Links & Tools

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- [CGD1200HB2P-BM3 Evaluation Gate Driver](#)
- [CGD12HB00D: Differential Transceiver Board](#)
- [KIT-CRD-CIL12N-BM: Dynamic Performance Evaluation Board for the BM2 & BM3 Module \(CPWR-AN-36\)](#)
- [CPWR-AN-34: Module Mounting Application Note](#)
- [CPWR-AN-35: Thermal Interface Material Application Note](#)

## Notes

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- This product has not been designed or tested for use in, and is not intended for use in, applications implanted into the human body nor in applications in which failure of the product could lead to death, personal injury or property damage, including but not limited to equipment used in the operation of nuclear facilities, life-support machines, cardiac defibrillators or similar emergency medical equipment, aircraft navigation or communication or control systems, or air traffic control systems.
- The SiC MOSFET module switches at speeds beyond what is customarily associated with IGBT-based modules. Therefore, special precautions are required to realize optimal performance. The interconnection between the gate driver and module housing needs to be as short as possible. This will afford optimal switching time and avoid the potential for device oscillation. Also, great care is required to insure minimum inductance between the module and DC link capacitors to avoid excessive VDS overshoot.

