

CAB760M12HM3

1200 V, 760 A All-Silicon Carbide

High Performance, Switching Optimized, Half-Bridge Module

V_{DS}	1200 V
I_{DS}	760 A

Technical Features

- Low Inductance, Low Profile 62mm Footprint
- High Junction Temperature (175 °C) Operation
- Implements Switching Optimized Third Generation SiC MOSFET Technology
- Light Weight AlSiC Baseplate
- High Reliability Silicon Nitride Insulator

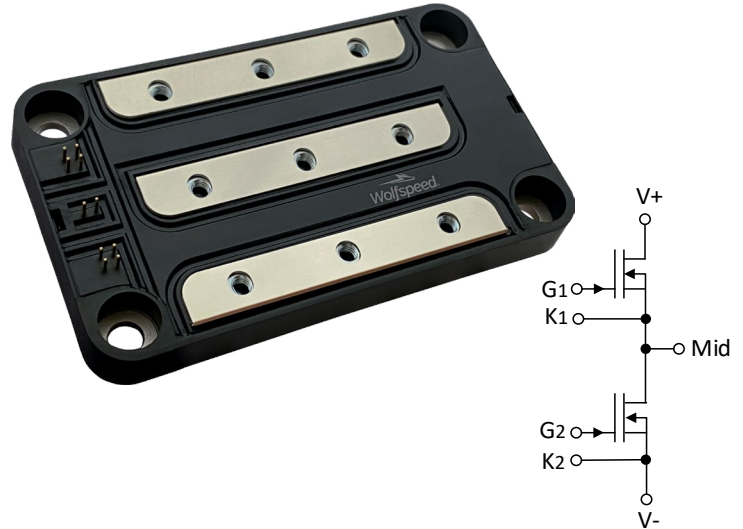
Applications

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

System Benefits

- Lightweight, Compact Form Factor with 62mm Compatible Baseplate Enables System Retrofit
- Increased System Efficiency, due to Low Switching & Conduction Losses of SiC
- High Reliability Material Selection

Package 110mm x 65 mm x 12.2 mm



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		1015		A	$V_{GS} = 15\text{ V}, T_c = 25^\circ\text{C}, T_{vj} \leq 175^\circ\text{C}$	Fig. 20
			765			$V_{GS} = 15\text{ V}, T_c = 90^\circ\text{C}, T_{vj} \leq 175^\circ\text{C}$	Note 1
I_{SD}	DC Source-Drain Current		1015			$V_{GS} = 15\text{ V}, T_c = 25^\circ\text{C}, T_{vj} \leq 175^\circ\text{C}$	
$I_{SD\text{BD}}$	DC Source-Drain Current (Body Diode)		515			$V_{GS} = -4\text{ V}, T_c = 25^\circ\text{C}, T_{vj} \leq 175^\circ\text{C}$	
$I_{DS(\text{pulsed})}$	Maximum Pulsed Drain-Source Current			1530		$t_{p\text{max}}$ 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			1530			
$T_{vj\text{op}}$	Maximum Virtual Junction Temperature under Switching Conditions	-40		175	$^\circ\text{C}$		

Note 1 Assumes $R_{thJC} = 0.068^\circ\text{C/W}$ and $R_{DS(on)} = 2.13\text{ m}\Omega$. Calculate $P_D = (T_{vj} - T_c) / R_{thJC}$. Calculate $I_{D\text{MAX}} = \sqrt{(P_D / R_{DS(on)})}$

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		$V_{DS} = V_{GS}, I_D = 280\text{ mA}$	
			2.0			$V_{DS} = V_{GS}, I_D = 280\text{ mA}, T_{vj} = 175^\circ\text{C}$	
I_{DSS}	Zero Gate Voltage Drain Current		15	400	μA	$V_{GS} = 0\text{ V}, V_{DS} = 1200\text{ V}$	
I_{GSS}	Gate-Source Leakage Current		0.12	3		$V_{GS} = 15\text{ V}, V_{DS} = 0\text{ V}$	
$R_{DS(on)}$	Drain-Source On-State Resistance (Devices Only)		1.33	1.73	$\text{m}\Omega$	$V_{GS} = 15\text{ V}, I_D = 760\text{ A}$	Fig. 2
			2.13			$V_{GS} = 15\text{ V}, I_D = 760\text{ A}, T_{vj} = 175^\circ\text{C}$	Fig. 3
g_{fs}	Transconductance		548		S	$V_{DS} = 20\text{ V}, I_{DS} = 760\text{ A}$	Fig. 4
			585			$V_{DS} = 20\text{ V}, I_{DS} = 760\text{ A}, T_{vj} = 175^\circ\text{C}$	
E_{On}	Turn-On Switching Energy, $T_J = 25^\circ\text{C}$ $T_J = 125^\circ\text{C}$ $T_J = 175^\circ\text{C}$		20.3 20.7 23.7		mJ	$V_{DS} = 600\text{ V},$ $I_D = 760\text{ A},$ $V_{GS} = -4\text{ V}/15\text{ V},$ $R_{G(ext)} = 1.0\ \Omega,$ $L = 13.6\ \mu\text{H}$	Fig. 11 Fig. 13
E_{Off}	Turn-Off Switching Energy, $T_J = 25^\circ\text{C}$ $T_J = 125^\circ\text{C}$ $T_J = 175^\circ\text{C}$		17.9 17.5 17.8				
$R_{G(int)}$	Internal Gate Resistance		0.47		Ω	$T_{vj} = 25^\circ\text{C}$	
C_{iss}	Input Capacitance		79.4		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		2.9				
C_{rss}	Reverse Transfer Capacitance		90		pF		
Q_{GS}	Gate to Source Charge		768		nC	$V_{DS} = 800\text{ V}, V_{GS} = -4\text{ V}/15\text{ V}$ $I_D = 760\text{ A}$ Per IEC60747-8-4 pg 21	
Q_{GD}	Gate to Drain Charge		924				
Q_G	Total Gate Charge		2724				
R_{thJC}	FET Thermal Resistance, Junction to Case		0.068	0.073	$^\circ\text{C}/\text{W}$		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_{SD}	Body Diode Forward Voltage		5.4		V	$V_{GS} = -4\text{ V}, I_{SD} = 760\text{ A}$	Fig. 7
			4.7			$V_{GS} = -4\text{ V}, I_{SD} = 760\text{ A}, T_{vj} = 175^\circ\text{C}$	
t_{rr}	Reverse Recovery Time		49		ns	$V_{GS} = -4\text{ V}, I_{SD} = 760\text{ A}, V_R = 600\text{ V}$ $di/dt = 20\text{ A/ns}, T_j = 175^\circ\text{C}$	Fig. 31
Q_{RR}	Reverse Recovery Charge		17.0		μC		
I_{RRM}	Peak Reverse Recovery Current		540		A		

Module Physical Characteristics

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions
R_{1-2}	Package Resistance, M1		106.5		$\mu\Omega$	$T_c = 125^\circ\text{C}$, Note 2
R_{2-3}	Package Resistance, M2		126.3			$T_c = 125^\circ\text{C}$, Note 2
L_{Stray}	Stray Inductance		4.9		nH	Between Terminals 1 and 3
T_c	Case Temperature			125	$^\circ\text{C}$	
W	Weight		179		g	
M_s	Mounting Torque	3	4.5	5	N-m	Baseplate, M6 bolts
		0.9	1.1	1.3		Power Terminals, M4 bolts
V_{isol}	Case Isolation Voltage	4			kV	AC, 50 Hz, 1 min
CTI	Comparative Tracking Index	600				
	Clearance Distance	13.07			mm	Terminal to Terminal
		6.00				Terminal to Baseplate
	Creepage Distance	14.27				Terminal to Terminal
		12.34				Terminal to Baseplate

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



Typical Performance

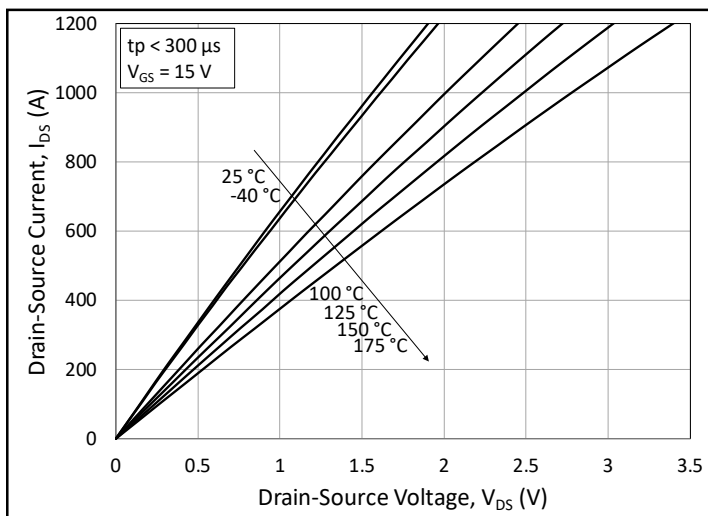


Figure 1. Output Characteristics for Various Junction Temperatures

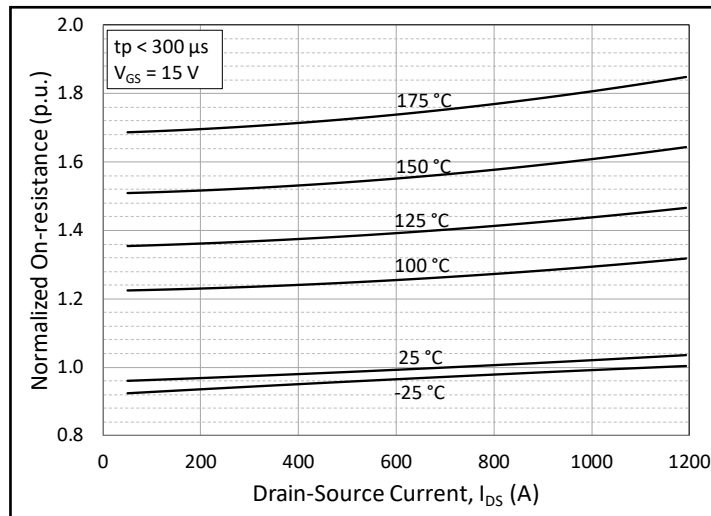


Figure 2. Normalized On-State Resistance vs. Drain Current for Various Junction Temperatures

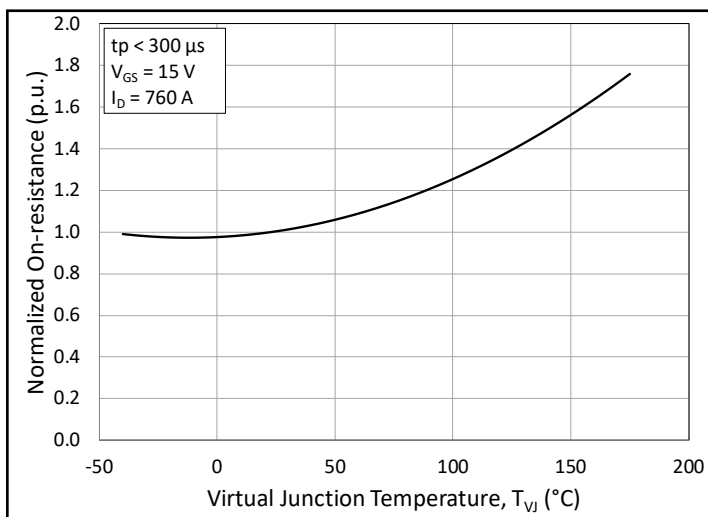


Figure 3. Normalized On-State Resistance vs. Junction Temperature

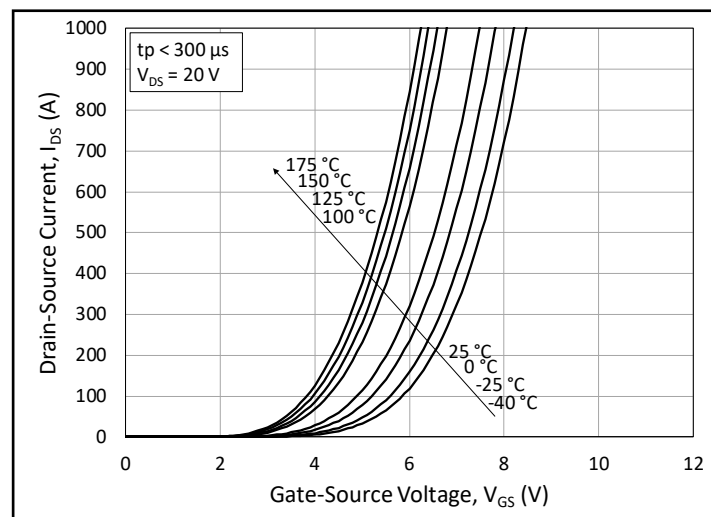


Figure 4. Transfer Characteristic for Various Junction Temperatures

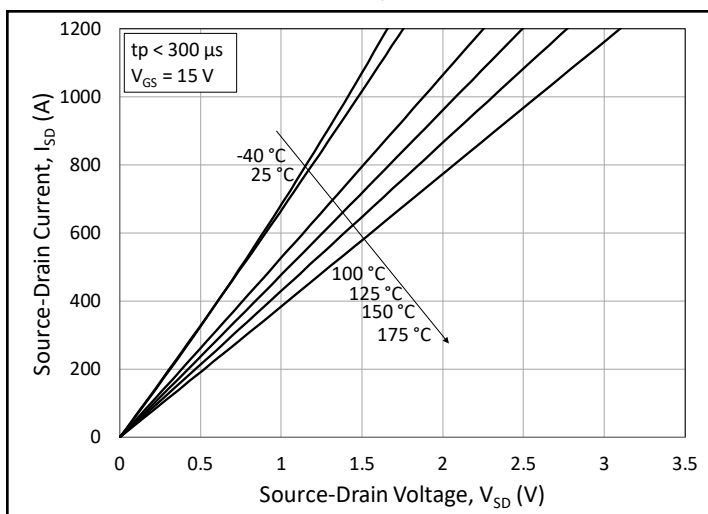


Figure 5. 3rd Quadrant Characteristic vs. Junction Temperatures at $V_{GS} = 15\text{ V}$

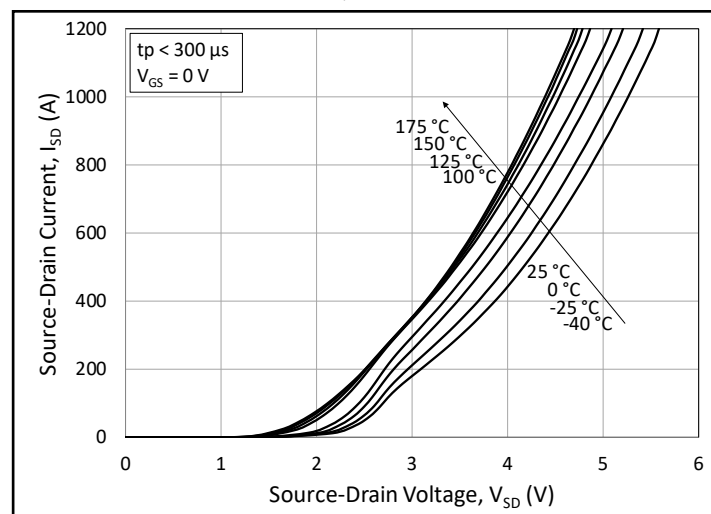


Figure 6. 3rd Quadrant Characteristic vs. Junction Temperatures at $V_{GS} = 0\text{ V}$ (Body Diode)

Typical Performance

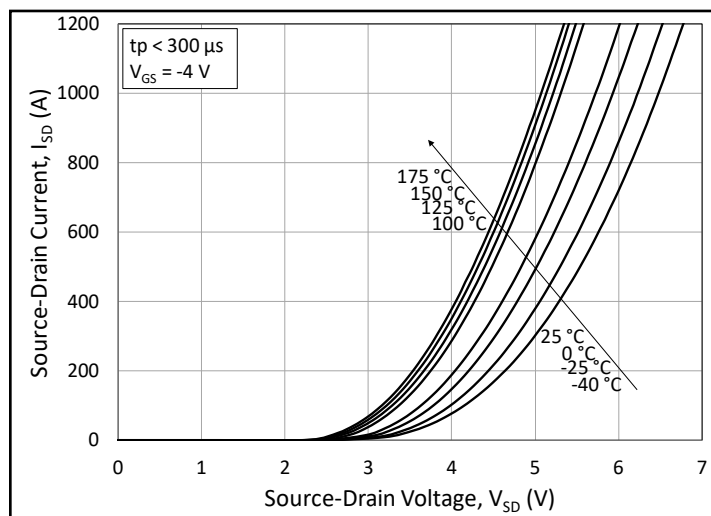


Figure 7. 3rd Quadrant Characteristic vs. Junction Temperatures at $V_{GS} = -4$ V (Body Diode)

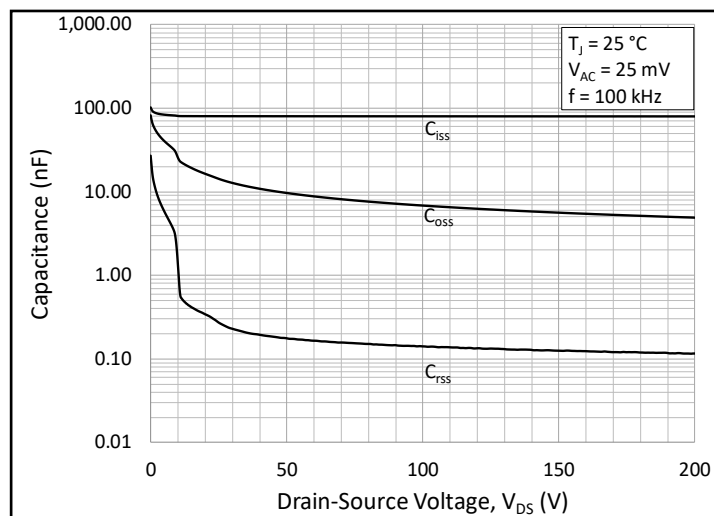


Figure 8. Typical Capacitances vs. Drain to Source Voltage (0 - 200V)

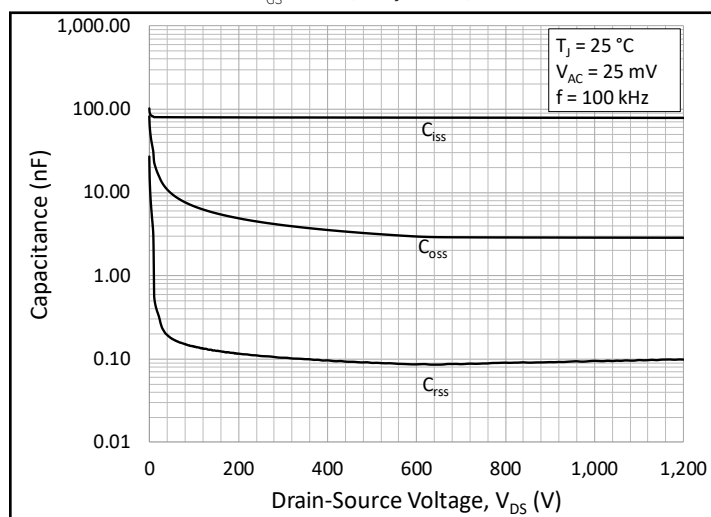


Figure 9. Typical Capacitances vs. Drain to Source Voltage (0 - 1200V)

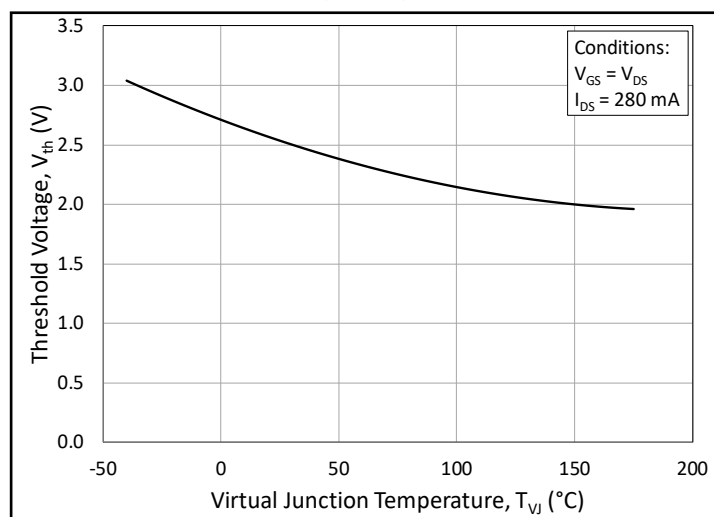


Figure 10. Threshold Voltage vs. Junction Temperature

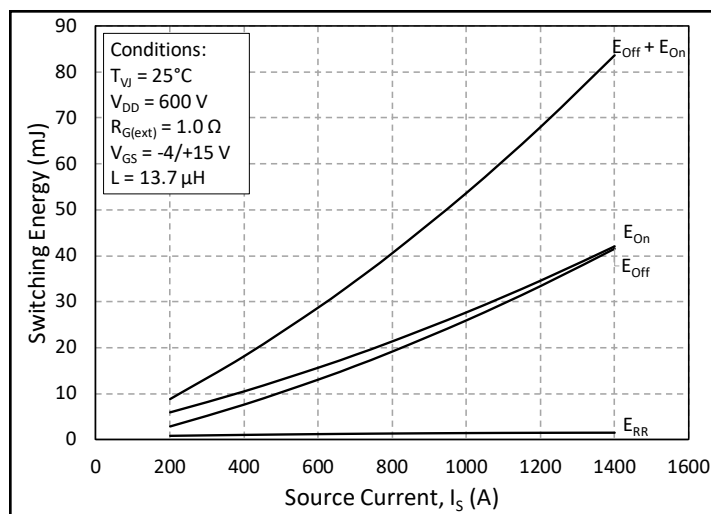


Figure 11. Switching Energy vs. Drain Current ($V_{DS} = 600$ V)

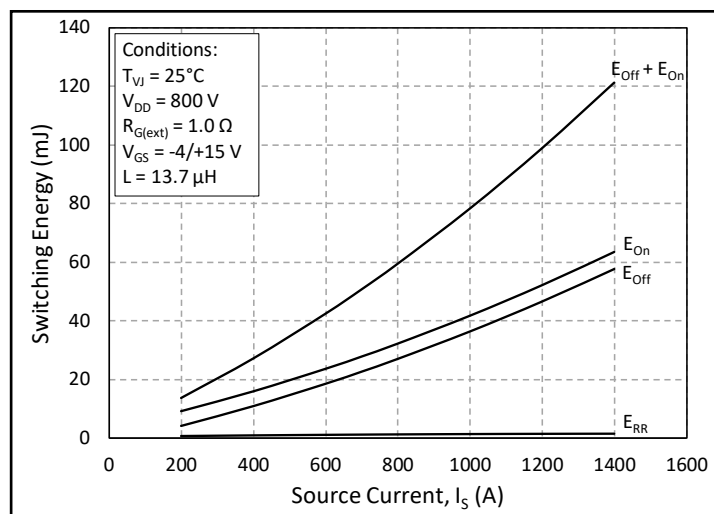


Figure 12. Switching Energy vs. Drain Current ($V_{DS} = 800$ V)

Typical Performance

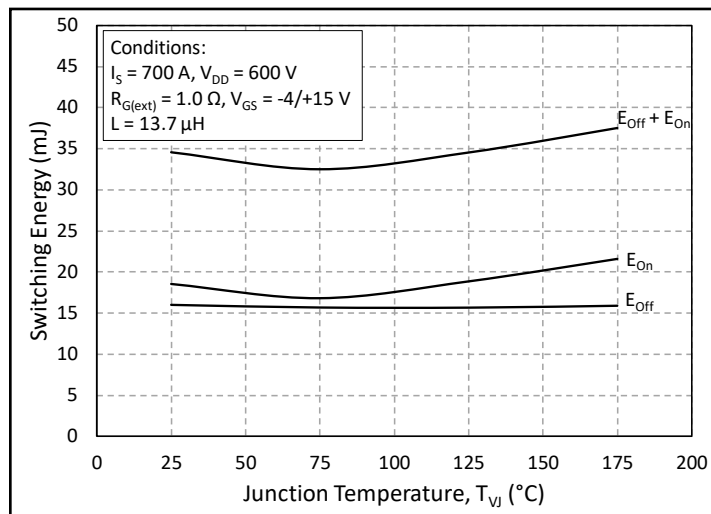


Figure 13. MOSFET Switching Energy vs. Junction Temperature

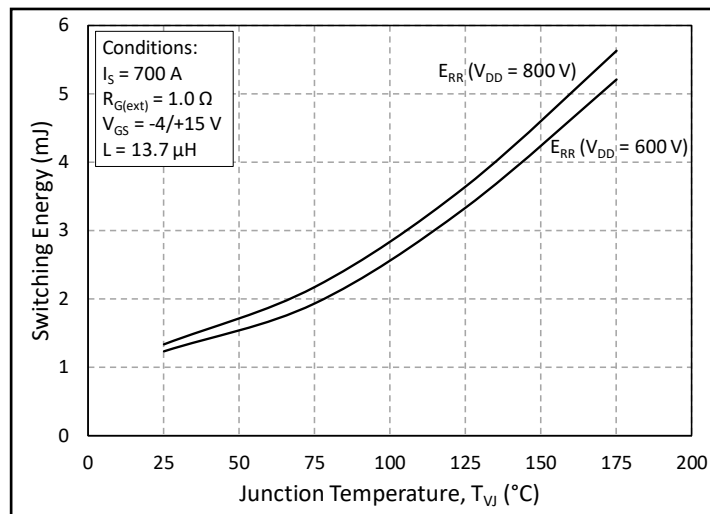


Figure 14. Reverse Recovery Energy vs. Junction Temperature

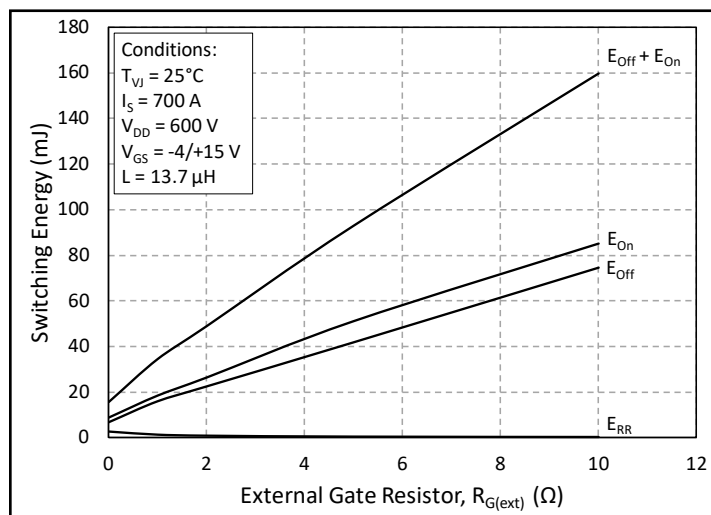


Figure 15. MOSFET Switching Energy vs. External Gate Resistance

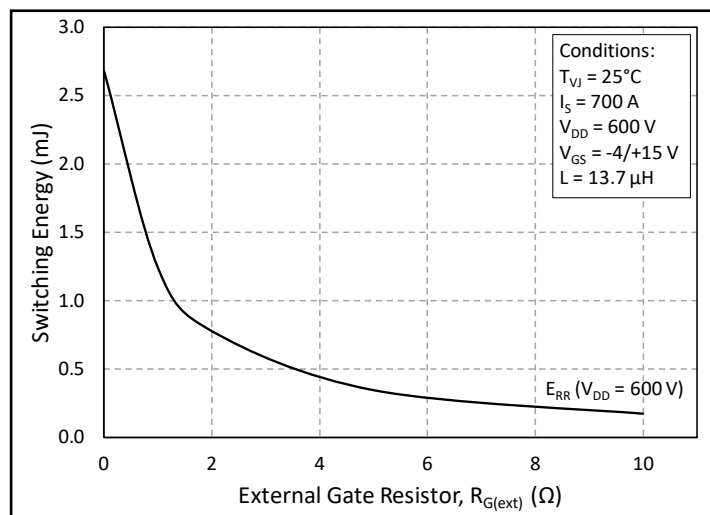


Figure 16. Reverse Recovery Energy vs. External Gate Resistance

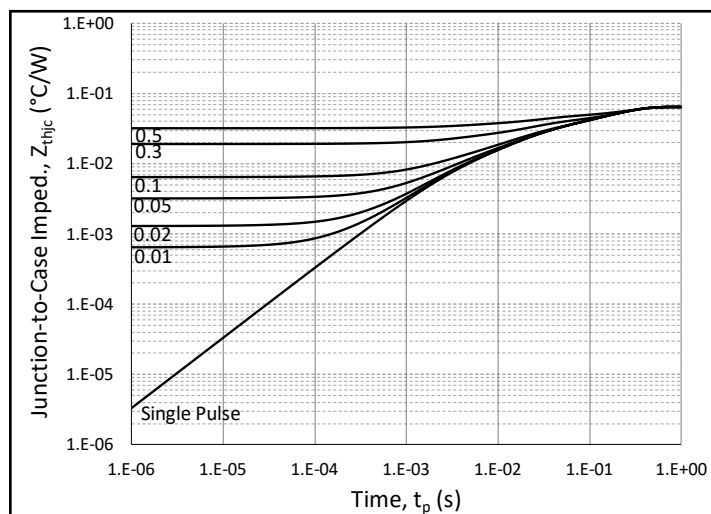


Figure 17. MOSFET Junction to Case Transient Thermal Impedance, Z_{thJC} (°C/W)

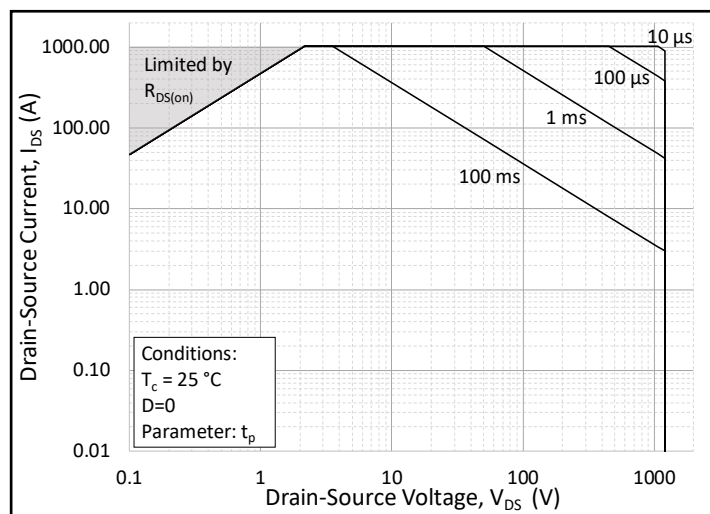


Figure 18. Forward Bias Safe Operating Area (FBSOA)

Typical Performance

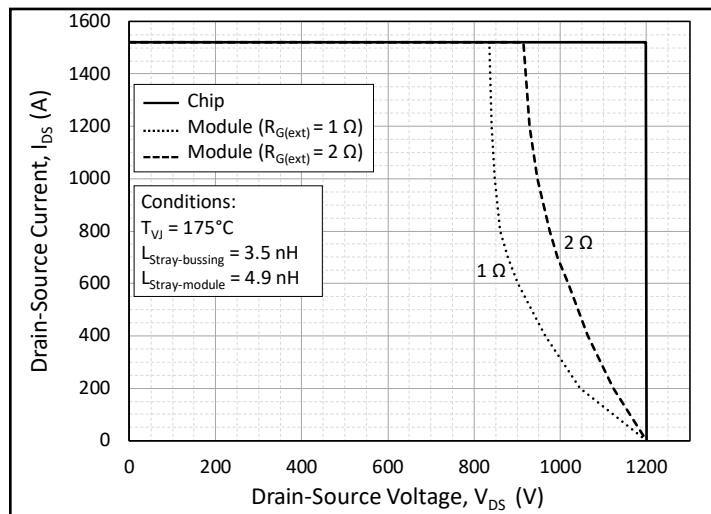


Figure 19. Reverse Bias Safe Operating Area (RBSOA)

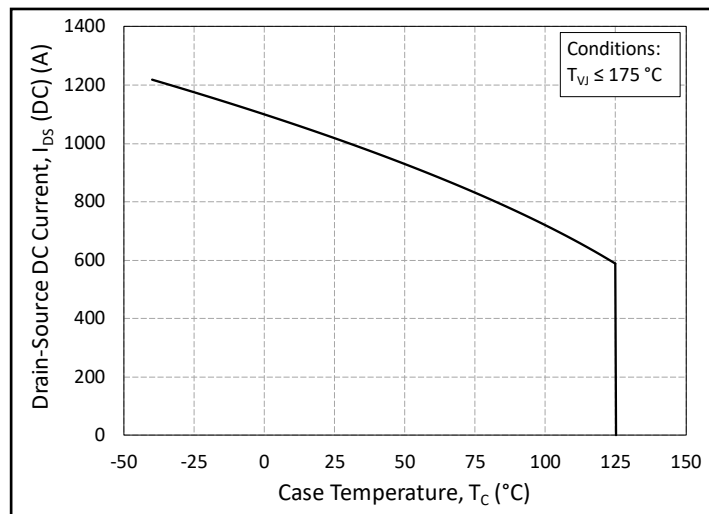


Figure 20. Continuous Drain Current Derating vs. Case Temperature

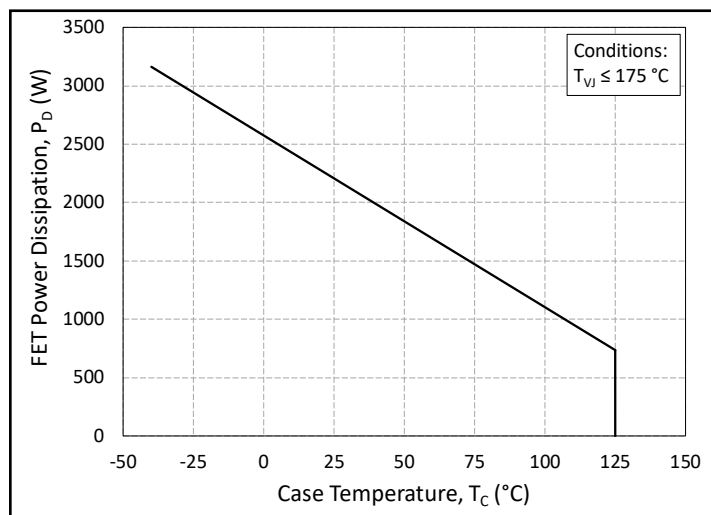


Figure 21. Maximum Power Dissipation Derating vs. Case Temperature

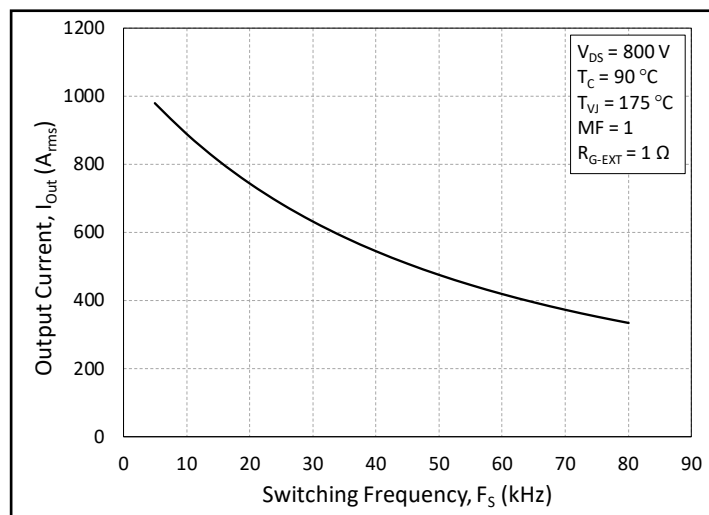


Figure 22. Typical Output Current Capability vs. Switching Frequency (Inverter Application)

Timing Characteristics

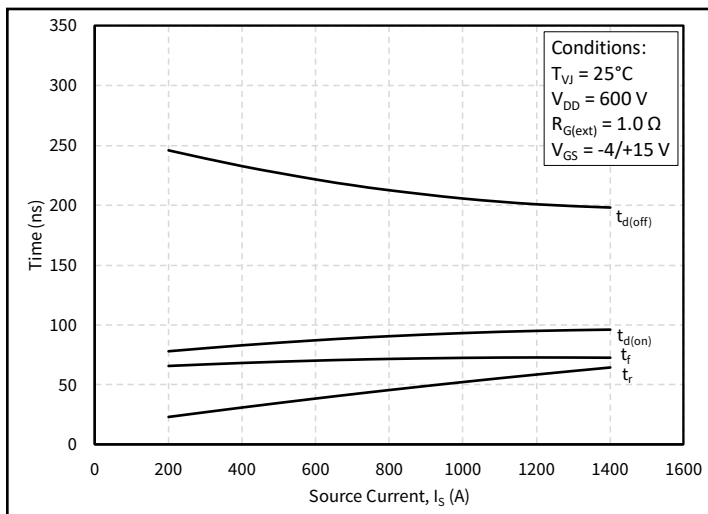


Figure 23. Timing vs. Source Current

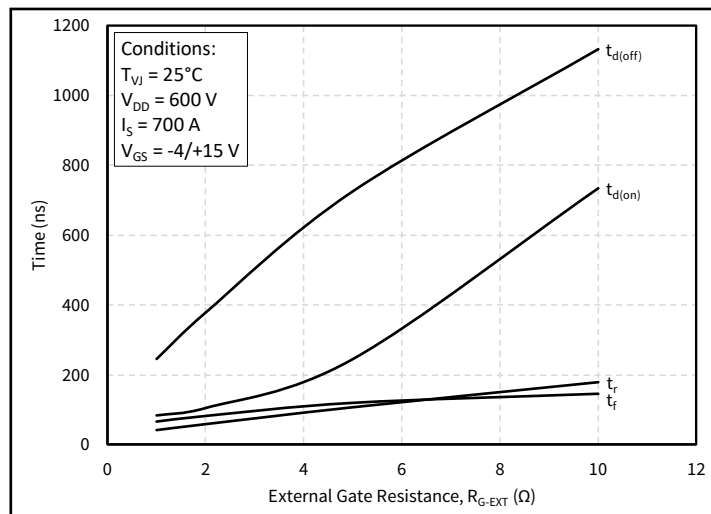


Figure 24. Timing vs. External Gate Resistance

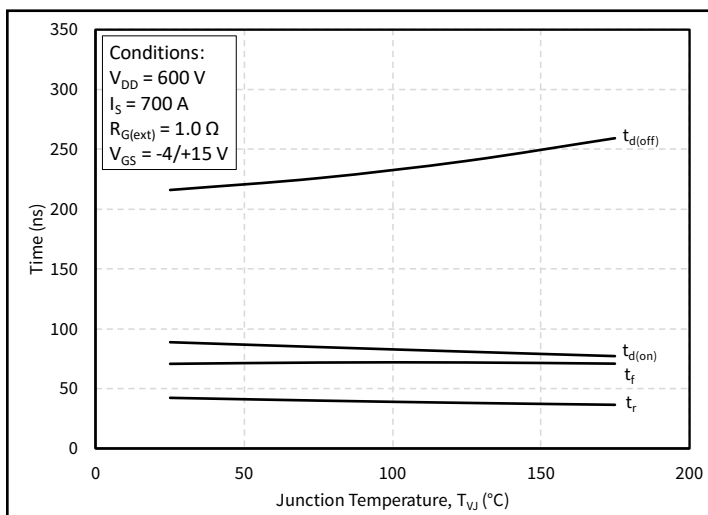


Figure 25. Timing vs. Junction Temperature

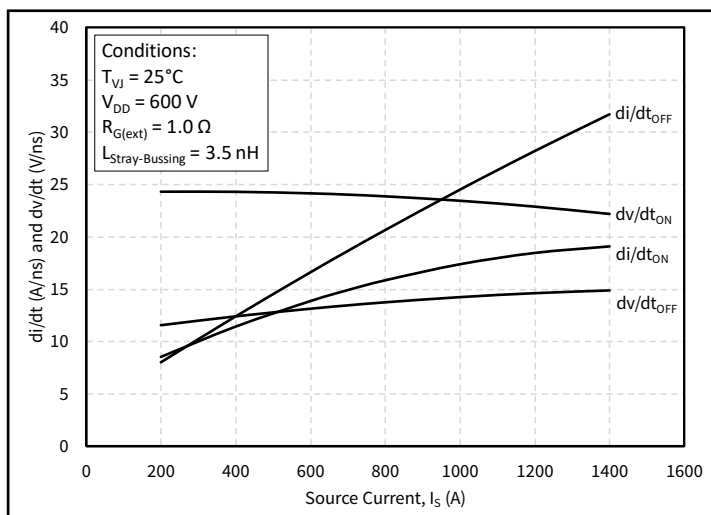


Figure 26. dv/dt and di/dt vs. Source Current

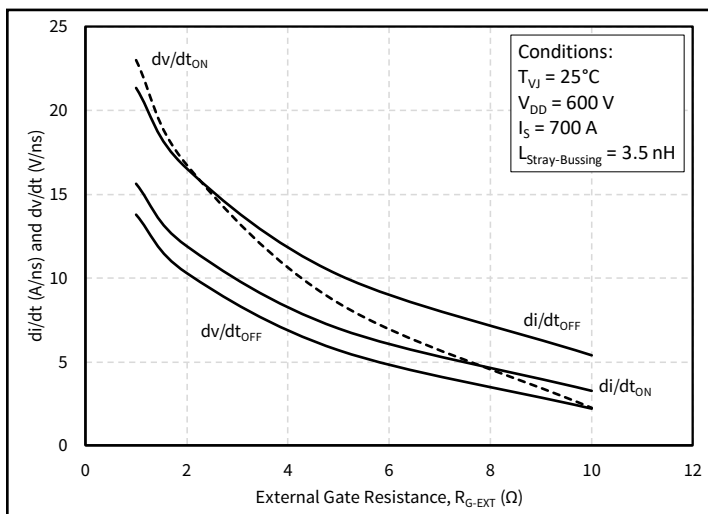


Figure 27. dv/dt and di/dt vs. External Gate Resistance

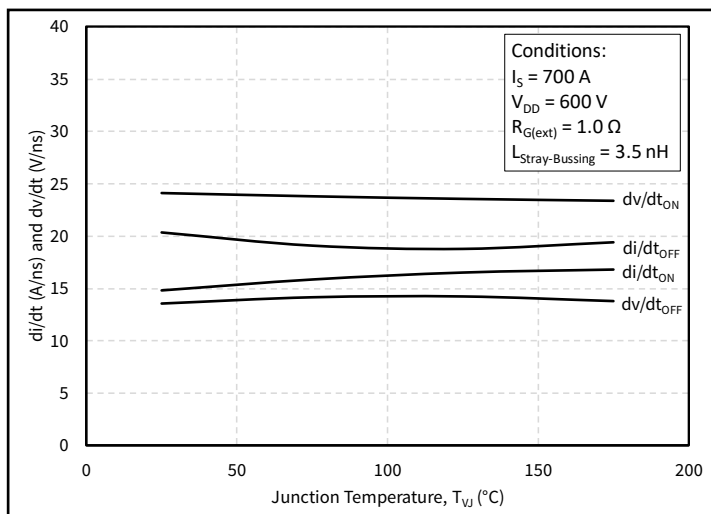


Figure 28. dv/dt and di/dt vs. Junction Temperature

Definitions

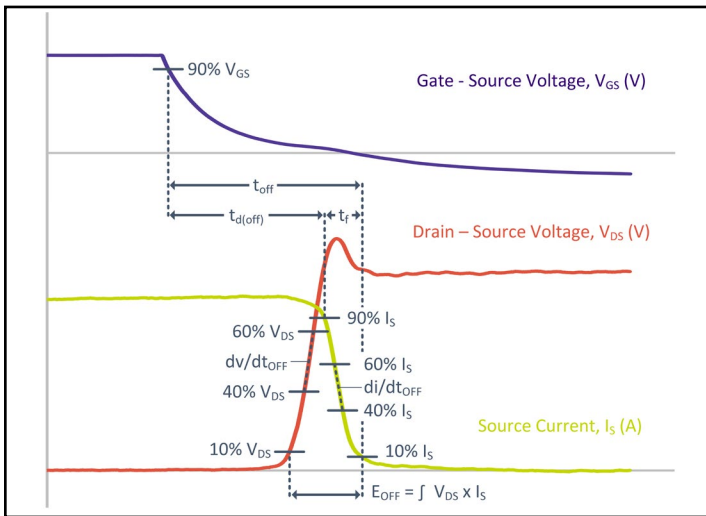


Figure 29. Turn-off Transient Definitions

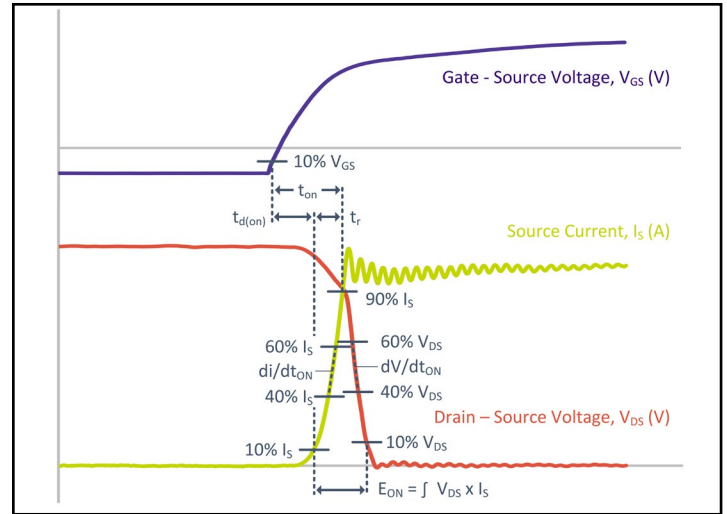


Figure 30. Turn-on Transient Definitions

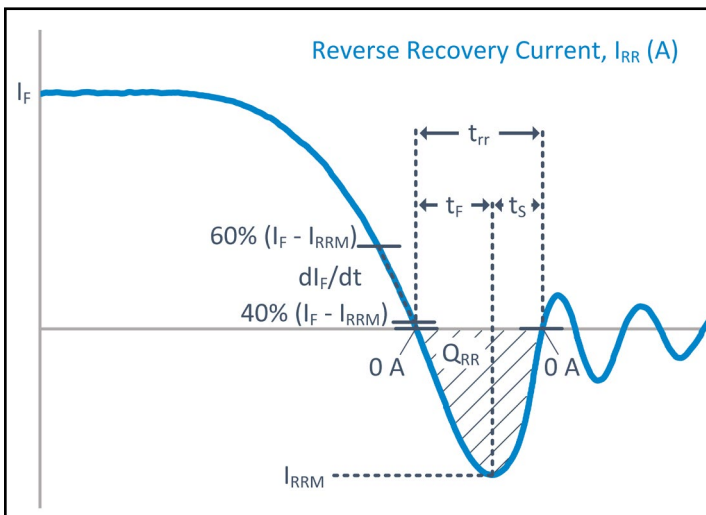


Figure 31. Reverse Recovery Definitions

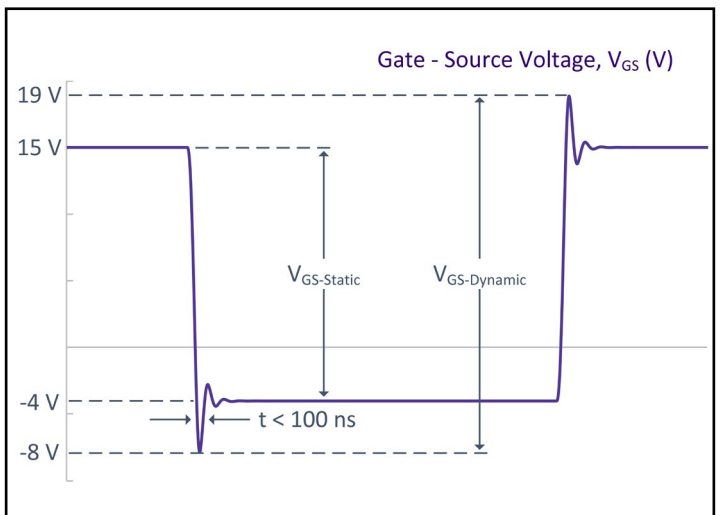
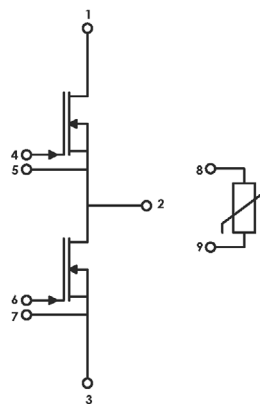
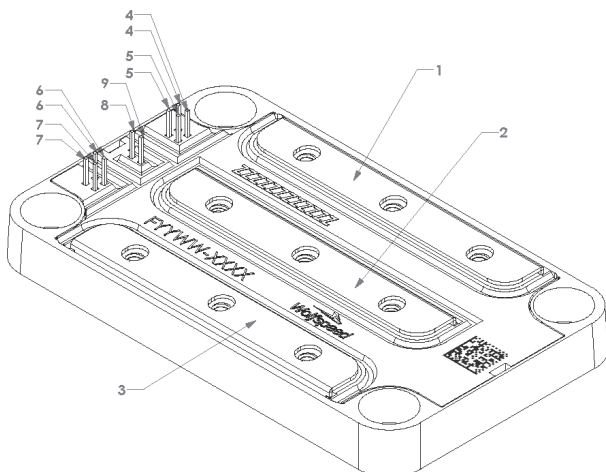


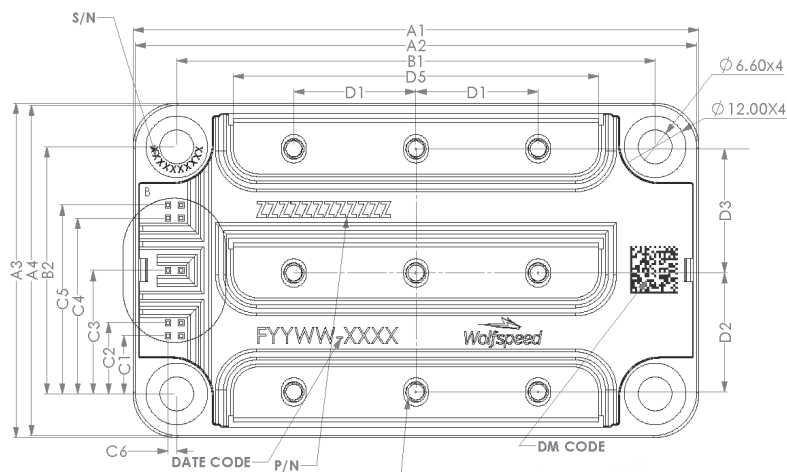
Figure 32. V_{GS} Transient Definitions

Schematic and Pin Out

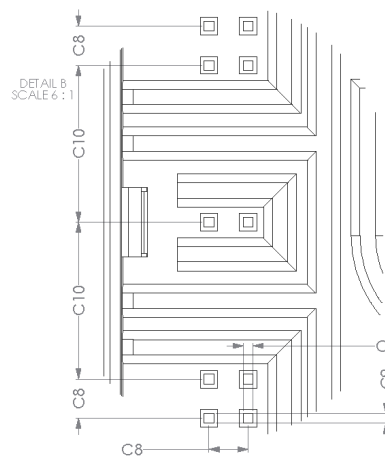
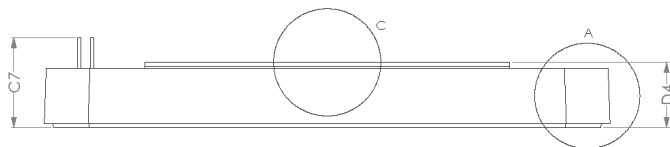
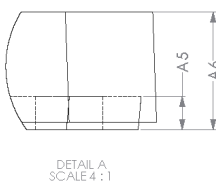
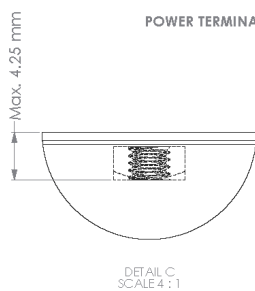


PIN	LABEL
1	V+
2	Mid
3	V-
4	G1, Top row pins (2)
5	K1, Bottom row pins (2)
6	G2, Top row pins (2)
7	K2, Bottom row pins (2)
8	NTC1
9	NTC2

Package Dimension (mm)



DIMENSION TABLE		
SYMBOL	DIMENSION (mm)	TOLERANCE (mm)
A1	110.00	±0.60
A2	109.25	±0.60
A3	65.00	±0.60
A4	64.25	±0.60
A5	3.25	±0.30
A6	11.45	±0.60
B1	93.00	±0.30
B2	48.00	±0.30
C1	11.30	±0.40
C2	13.84	±0.40
C3	24.00	±0.40
C4	34.16	±0.40
C5	36.70	±0.40
C6	1.71	±0.40
C7	17.30	±0.50
C8	2.54	±0.30
C9	0.64	±0.30
C10	10.16	±0.40
D1	23.75	±0.50
D2	23.13	±0.50
D3	24.13	±0.50
D4	12.20	±0.50
D5	71.00	±0.30
D6	10.75	±0.30



Supporting Links & Tools

- [CGD1700HB3P-HM3 Evaluation Gate Driver](#)
- [CGD12HB00D: Differential Transceiver Board](#)
- [CPWR-AN-35: Thermal Interface Material Application Note](#)
- [KIT-CRD-CIL12N-HM: Dynamic Performance Evaluation Board for the HM2 and HM3 Module](#)

Notes

- 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.