

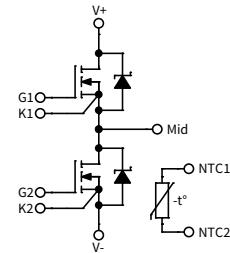
CAS480M12HM3

1200 V, 480 A, Silicon Carbide, Half-Bridge Module

V_{DS}	1200 V
I_{DS}	480 A

Technical Features

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



Typical Applications

- Railway, Traction, and Motor Drives
- EV Chargers
- High-Efficiency Converters/Inverters
- Renewable Energy
- Smart-Grid/Grid-Tied Distributed Generation

System Benefits

- Enables Compact, Lightweight Systems
- Increased System Efficiency, due to Low Switching & Conduction Losses of SiC
- Reduced Thermal Requirements and System Cost

Key Parameters

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Note
Drain-Source Voltage	V _{DS}			1200	V	T _C = 25 °C	
Gate-Source Voltage, Maximum Value	V _{GS(max)}	-8		+19		Transient	Note 1 Fig. 33
Gate-Source Voltage, Recommended	V _{GS(op)}		-4/+15			Static	
DC Continuous Drain Current	I _D		640		A	V _{GS} = 15 V, T _C = 25 °C, T _{VJ} ≤ 175 °C	Notes 2, 3 Fig. 20
			481			V _{GS} = 15 V, T _C = 90 °C, T _{VJ} ≤ 175 °C	
DC Source-Drain Current (Schottky Diode)	I _{SD(SD)}		464			V _{GS} = -4 V, T _C = 25 °C, T _{VJ} ≤ 175 °C	
Pulsed Drain-Source Current	I _{DM}		960			t _{pmax} limited by T _{VJmax} V _{GS} = 15 V, T _C = 25 °C	
Power Dissipation	P _D		1500		W	T _C = 25 °C, T _{VJ} ≤ 175 °C	Note 4 Fig. 20
Virtual Junction Temperature	T _{VJ(op)}	-40		175	°C		

Note (1): Recommended turn-on gate voltage is 15 V with ±5 % regulation tolerance

Note (2): Current limit calculated by $I_{D(max)} = \sqrt{(P_D/R_{DS(typ)})(T_{VJ(max)}, I_{D(max)})}$

Note (3): Verified by design

Note (4): $P_D = (T_{VJ} - T_C)/R_{TH(JC,typ)}$

MOSFET Characteristics (Per Position) ($T_{VJ} = 25^\circ\text{C}$ Unless Otherwise Specified)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Note
Drain-Source Breakdown Voltage	$V_{(BR)DSS}$	1200			V	$V_{GS} = 0\text{ V}, T_{VJ} = -40^\circ\text{C}$	
Gate Threshold Voltage	$V_{GS(\text{th})}$	1.8	2.5	3.6		$V_{DS} = V_{GS}, I_D = 160\text{ mA}$	
			2.0			$V_{DS} = V_{GS}, I_D = 160\text{ mA}, T_{VJ} = 175^\circ\text{C}$	
Zero Gate Voltage Drain Current	I_{DSS}		10	280	μA	$V_{GS} = 0\text{ V}, V_{DS} = 1200\text{ V}$	
Gate-Source Leakage Current	I_{GSS}		0.1	2	nA	$V_{GS} = 15\text{ V}, V_{DS} = 0\text{ V}$	
Drain-Source On-State Resistance (Devices Only)	$R_{DS(\text{on})}$		2.29	2.97	$\text{m}\Omega$	$V_{GS} = 15\text{ V}, I_D = 480\text{ A}$	Fig. 2 Fig. 3
			3.66			$V_{GS} = 15\text{ V}, I_D = 480\text{ A}, T_{VJ} = 175^\circ\text{C}$	
Transconductance	g_{fs}		356		S	$V_{DS} = 20\text{ V}, I_D = 480\text{ A}$	Fig. 4
			345			$V_{DS} = 20\text{ V}, I_D = 480\text{ A}, T_{VJ} = 175^\circ\text{C}$	
Turn-On Switching Energy, $T_{VJ} = 25^\circ\text{C}$ $T_{VJ} = 125^\circ\text{C}$ $T_{VJ} = 175^\circ\text{C}$	E_{ON}	11.3 9.6 9.9			mJ	$V_{DD} = 600\text{ V}$ $I_D = 480\text{ A}$, $V_{GS} = -4\text{ V}/15\text{ V}$, $R_{G(\text{OFF})} = 1.0\ \Omega$, $R_{G(\text{ON})} = 1.0\ \Omega$, $L = 13.7\ \mu\text{H}$	Fig. 11 Fig. 13
Turn-Off Switching Energy, $T_{VJ} = 25^\circ\text{C}$ $T_{VJ} = 125^\circ\text{C}$ $T_{VJ} = 175^\circ\text{C}$	E_{OFF}	7.2 7.3 7.4					
Internal Gate Resistance	$R_{G(\text{int})}$		0.8		Ω	$f = 100\text{ kHz}$	
Input Capacitance	C_{iss}		43.1		nF	$V_{GS} = 0\text{ V}, V_{DS} = 800\text{ V}$ $V_{AC} = 25\text{ mV}, f = 100\text{ kHz}$	Fig. 9
Output Capacitance	C_{oss}		2.76				
Reverse Transfer Capacitance	C_{rss}		70.7		pF		
Gate to Source Charge	Q_{GS}		448		nC	$V_{DS} = 800\text{ V}, V_{GS} = -4\text{ V}/15\text{ V}$ $I_D = 480\text{ A}$ Per IEC60747-8-4 pg 21	
Gate to Drain Charge	Q_{GD}		539				
Total Gate Charge	Q_G		1590				
FET Thermal Resistance, Junction to Case	R_{thJC}		0.1	0.115	$^\circ\text{C}/\text{W}$		Fig. 17

Diode Characteristics (Per Position) ($T_{VJ} = 25^\circ\text{C}$ Unless Otherwise Specified)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Note
Diode Forward Voltage	V_{SD}		1.95		V	$V_{GS} = -4\text{ V}, I_{SD} = 480\text{ A}$	Fig. 7
			3.10			$V_{GS} = -4\text{ V}, I_{SD} = 480\text{ A}, T_{VJ} = 175^\circ\text{C}$	
Reverse Recovery Time	t_{RR}		28		ns	$V_{GS} = -4\text{ V}, I_{SD} = 500\text{ A}, V_R = 600\text{ V}$ $di/dt = 17\text{ A}/\text{ns}, T_{VJ} = 175^\circ\text{C}$	Fig. 32
Reverse Recovery Charge	Q_{RR}		4.5		μC		
Peak Reverse Recovery Current	I_{RRM}		270		A		
Reverse Recovery Energy, $T_{VJ} = 25^\circ\text{C}$ $T_{VJ} = 125^\circ\text{C}$ $T_{VJ} = 175^\circ\text{C}$	E_{RR}	1.1 1.3 1.5			mJ	$V_{DD} = 600\text{ V}, I_D = 500\text{ A}$, $V_{GS} = -4\text{ V}/15\text{ V}, R_{G(\text{ext})} = 1.0\ \Omega$, $L = 13.7\ \mu\text{H}$	Fig. 14 Note 5
Diode Thermal Resistance, Junction to Case	R_{thJC}		0.11	0.13	$^\circ\text{C}/\text{W}$		

Note (5): SiC Schottky diodes do not have reverse recovery energy but still contribute capacitive energy

Module Physical Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Package Resistance, M1 (High-Side)	R ₁₋₂		106.5		μΩ	T _C = 125 °C, Note 6
Package Resistance, M2 (Low-Side)	R ₂₋₃		126.3			T _C = 125 °C, Note 6
Stray Inductance	L _{Stray}		4.8		nH	Between DC- and DC+, f = 10 MHz
Case Temperature	T _C	-40		125	°C	
Mounting Torque	M _S	3	4.5	5	N·m	Baseplate, M6 Bolts
		0.9	1.1	1.3		Power Terminals, M4 Bolts
Weight	W		180		g	
Case Isolation Voltage	V _{isol}	4			kV	AC, 50 Hz, 1 minute
Comparative Tracking Index	CTI	600				
Clearance Distance		13.07			mm	Terminal to Terminal
		6.00				Terminal to Heatsink
Creepage Distance		14.27				Terminal to Terminal
		12.34				Terminal to Heatsink

Note (6): Total Effective Resistance (Per Switch Position) = MOSFET R_{DS(on)} + Switch Position Package Resistance

NTC Characteristics (T_{NTC} = 25 °C Unless Otherwise Specified)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
Resistance at 25 °C	R ₂₅		4700		Ω	
Tolerance of R ₂₅			±1		%	
Beta Value for 25 °C to 85 °C	B _{25/85}		3435		K	
Beta Value for 0 °C to 100 °C	B _{0/100}		3399		K	
Tolerance of B _{25/85}			±1		%	
Maximum Power Dissipation	P _{Max}		50		mW	

Steinhart & Hart Coefficients for NTC Resistance & NTC Temperature Computation (T in K)

$$\ln\left(\frac{R}{R_{25}}\right) = A + \frac{B}{T} + \frac{C}{T^2} + \frac{D}{T^3}$$

$$\frac{1}{T} = A_1 + B_1 \ln\left(\frac{R}{R_{25}}\right) + C_1 \ln^2\left(\frac{R}{R_{25}}\right) + D_1 \ln^3\left(\frac{R}{R_{25}}\right)$$

A	B	C	D
-1.289E+01	4.245E+03	-8.749E+04	-9.588E+06

A ₁	B ₁	C ₁	D ₁
3.354E-03	3.001E-04	5.085E-06	2.188E-07

Typical Performance

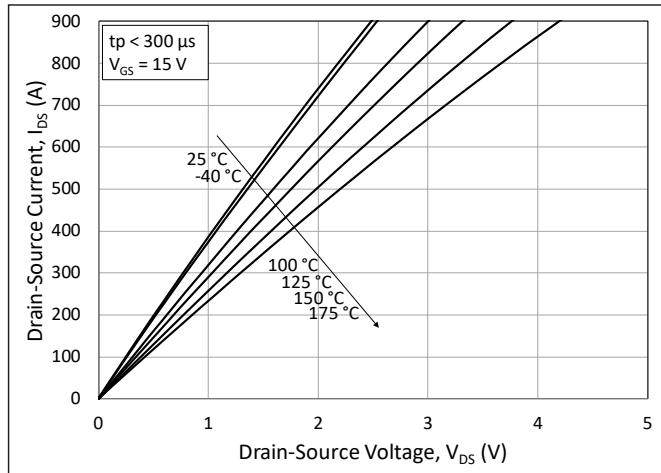


Figure 1. Output Characteristics for Various Junction Temperatures

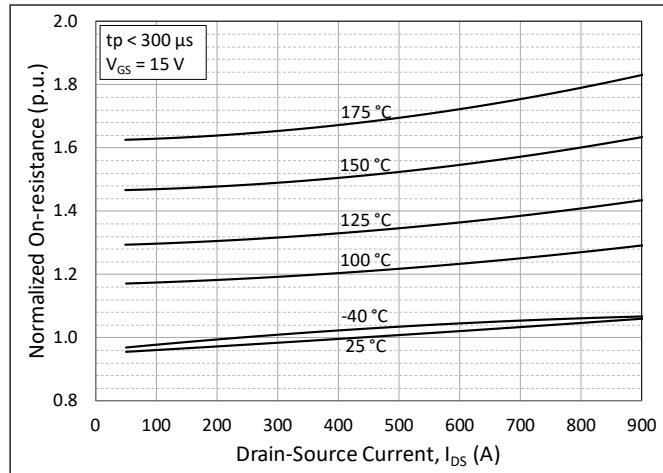


Figure 2. Normalized On-State Resistance vs. Drain Current for Various Junction Temperatures

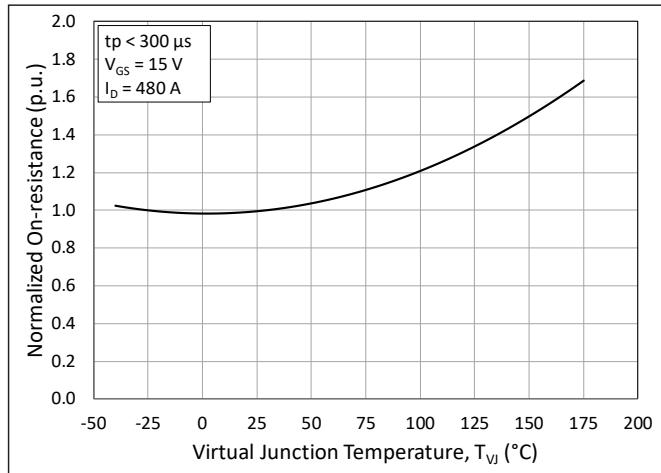


Figure 3. Normalized On-State Resistance vs. Junction Temperature

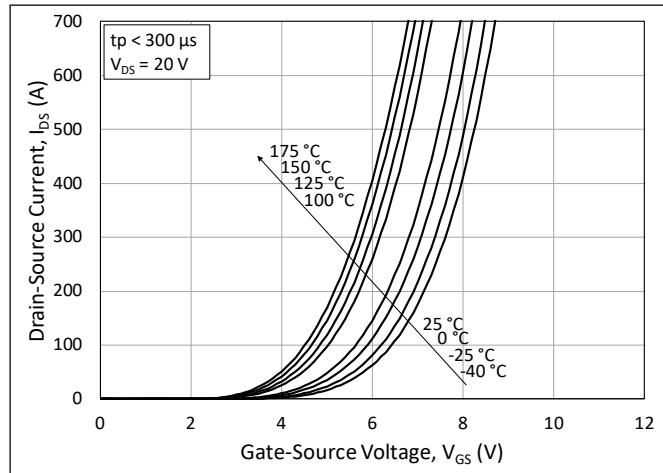


Figure 4. Transfer Characteristic for Various Junction Temperatures

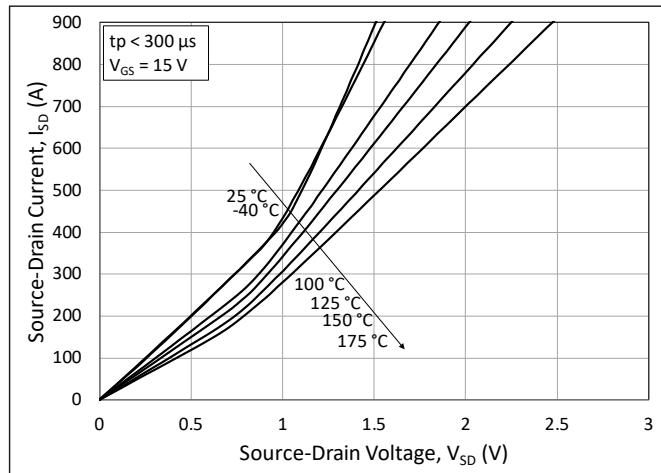


Figure 5. 3rd Quadrant Characteristic vs. Junction Temperatures at $V_{GS} = 15$ V

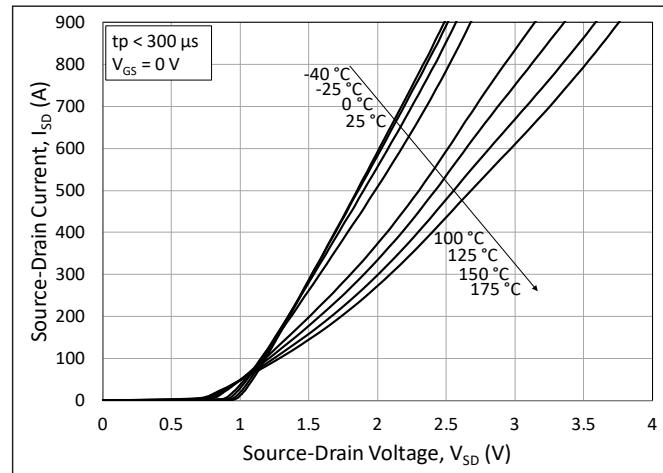


Figure 6. 3rd Quadrant Characteristic vs. Junction Temperatures at $V_{GS} = 0$ V

Typical Performance

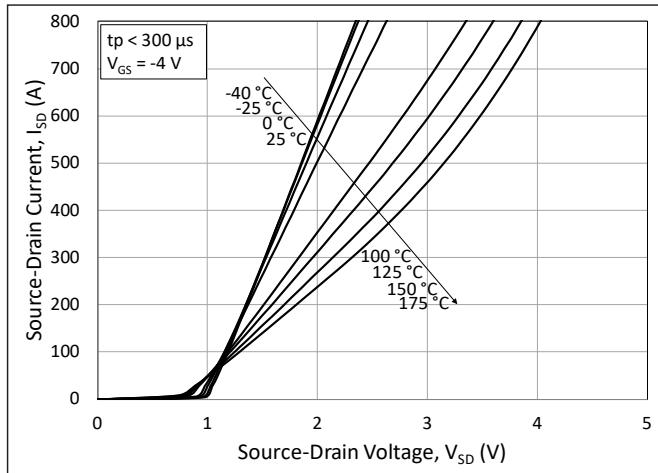


Figure 7. 3rd Quadrant Characteristic vs. Junction Temperatures at $V_{GS} = -4$ V

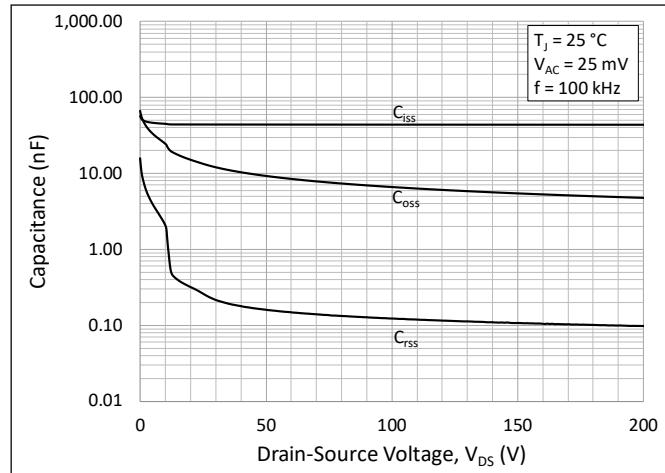


Figure 8. Typical Capacitances vs. Drain to Source Voltage (0 - 200 V)

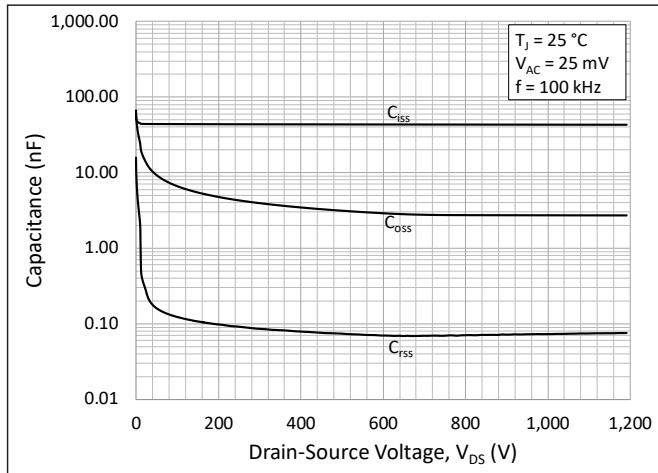


Figure 9. Typical Capacitances vs. Drain to Source Voltage (0 - 1200 V)

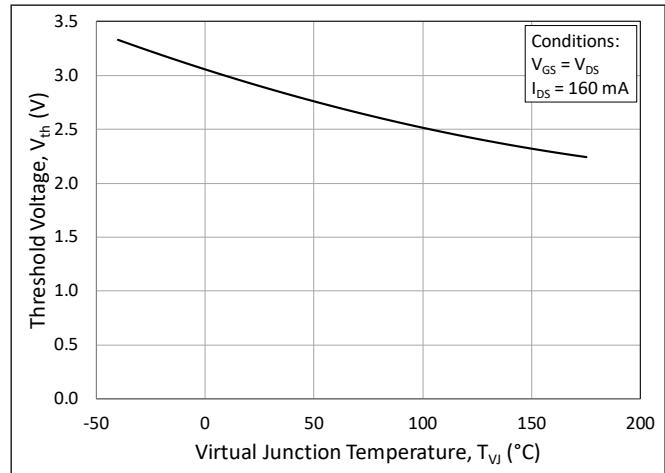


Figure 10. Threshold Voltage vs. Junction Temperature

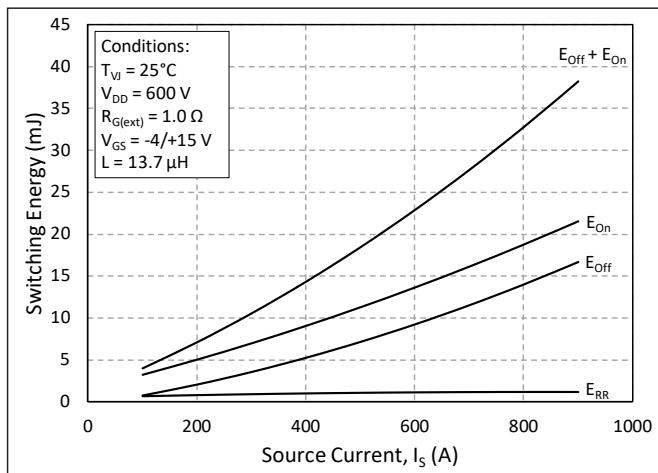


Figure 11. Switching Energy vs. Drain Current ($V_{DD} = 900$ V)

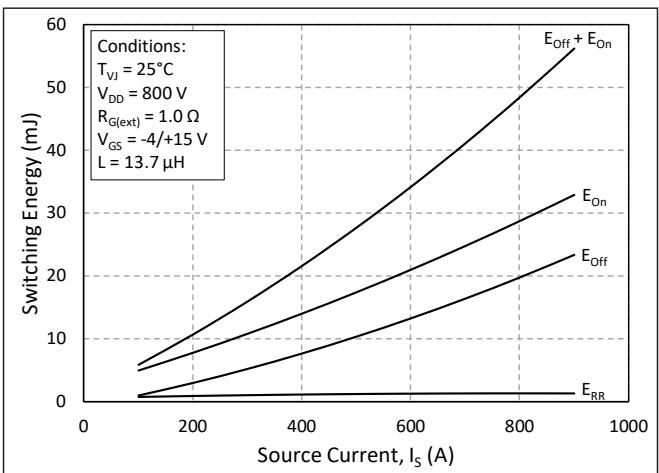


Figure 12. Switching Energy vs. Drain Current ($V_{DD} = 1200$ V)

Typical Performance

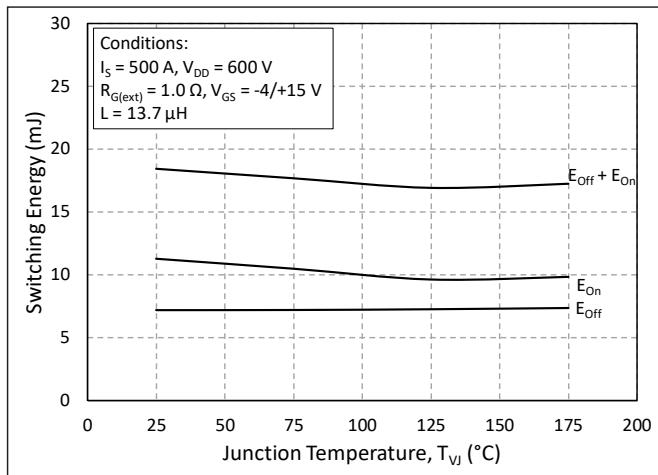


Figure 13. MOSFET Switching Energy vs. Junction Temperature

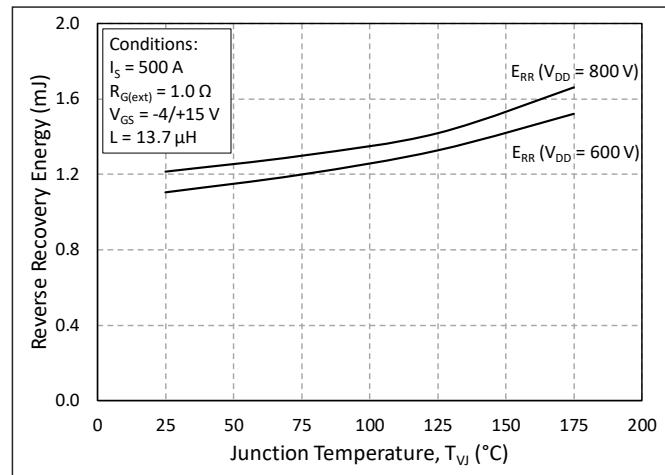


Figure 14. Reverse Recovery Energy vs. Junction Temperature

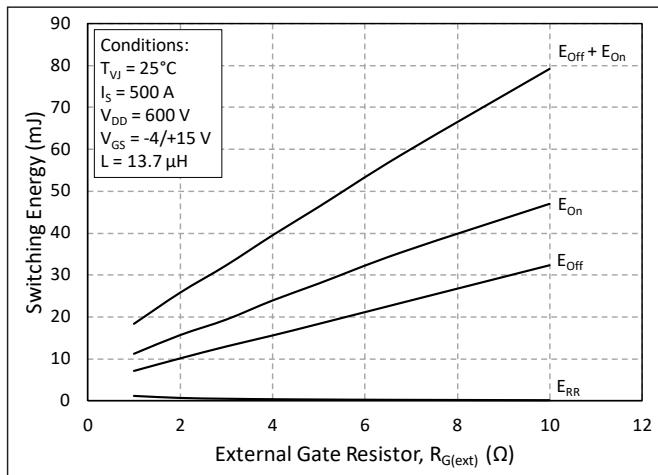


Figure 15. MOSFET Switching Energy vs. External Gate Resistance

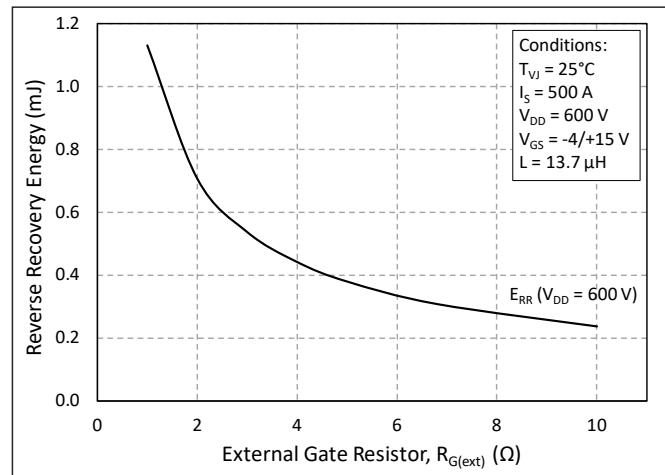


Figure 16. Reverse Recovery Energy vs. External Gate Resistance

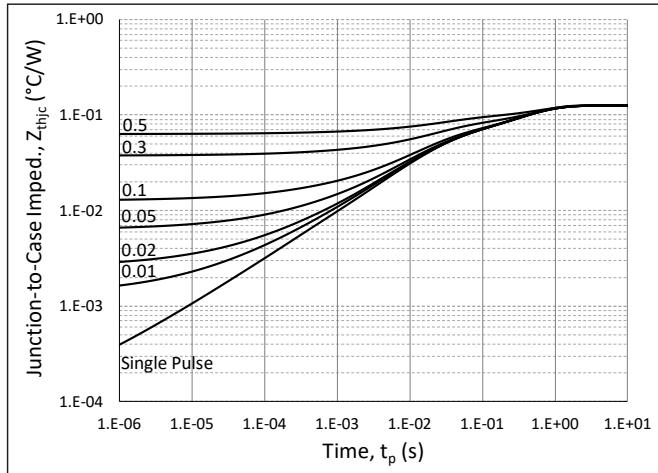


Figure 17. MOSFET Junction to Case Transient Thermal Impedance, Z_{thJC} (°C/W)

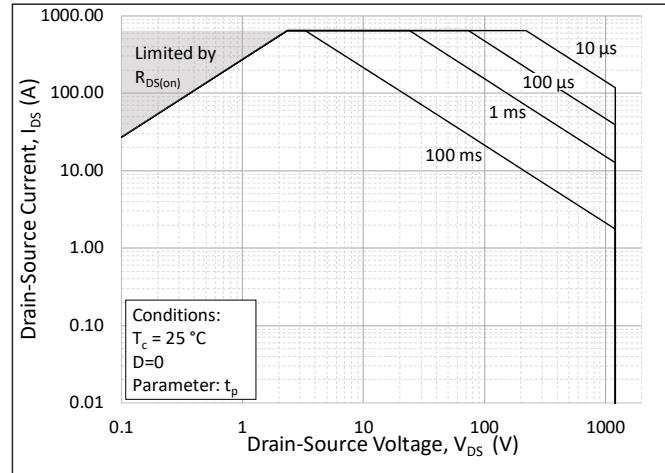


Figure 18. Forward Bias Safe Operating Area (FBSOA)

Typical Performance

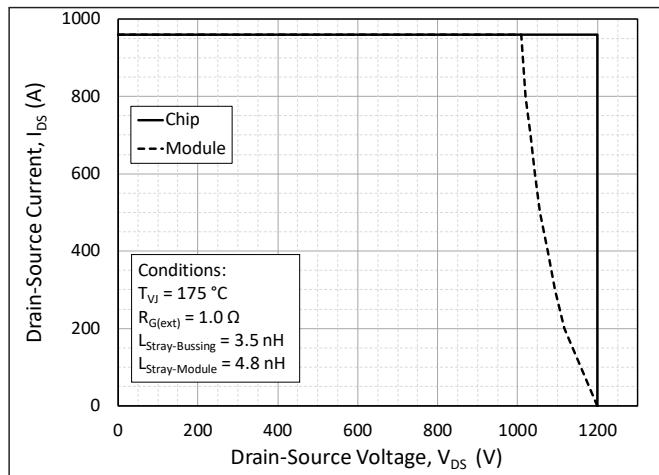


Figure 19. Reverse Bias Safe Operating Area (RBSOA)

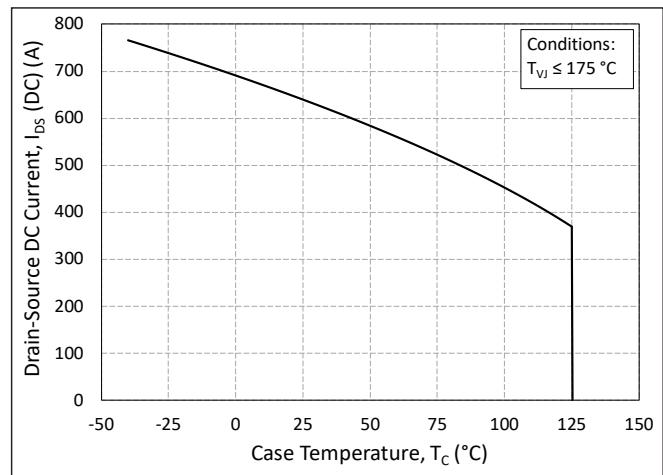


Figure 20. Continuous Drain Current Derating vs. Case Temperature

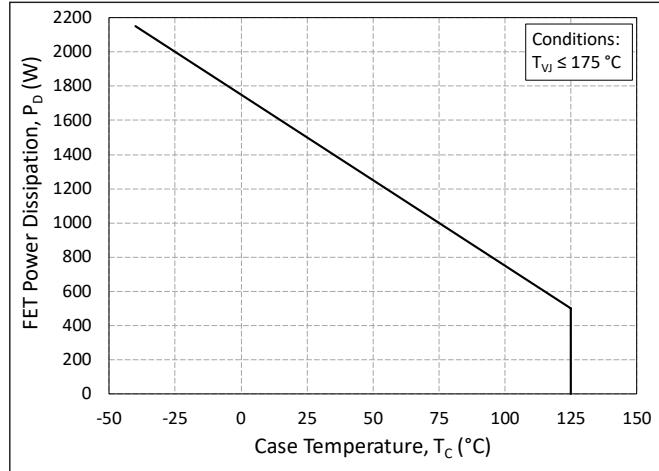


Figure 21. Maximum Power Dissipation Derating vs. Case Temperature

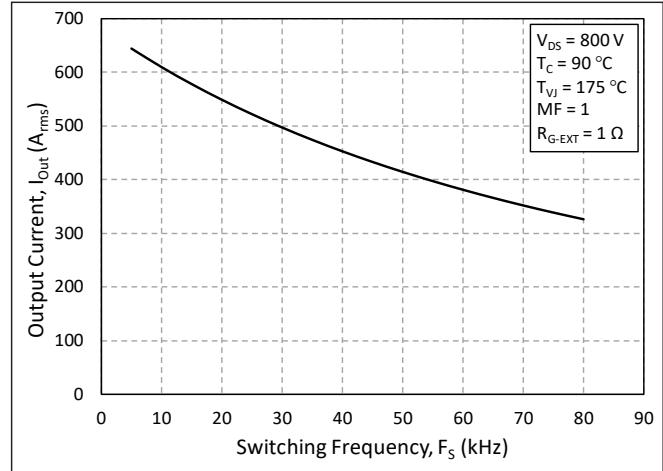


Figure 22. Typical Output Current Capability vs. Switching Frequency (Inverter Application)

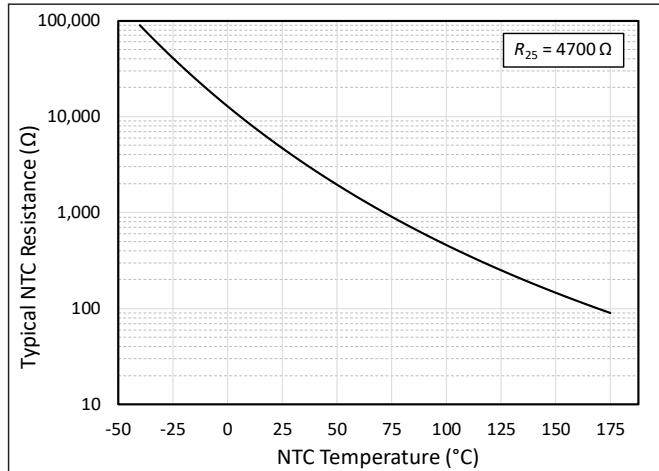
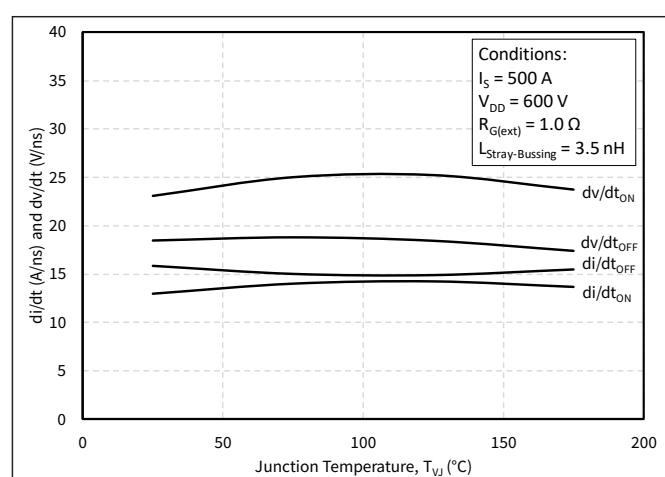
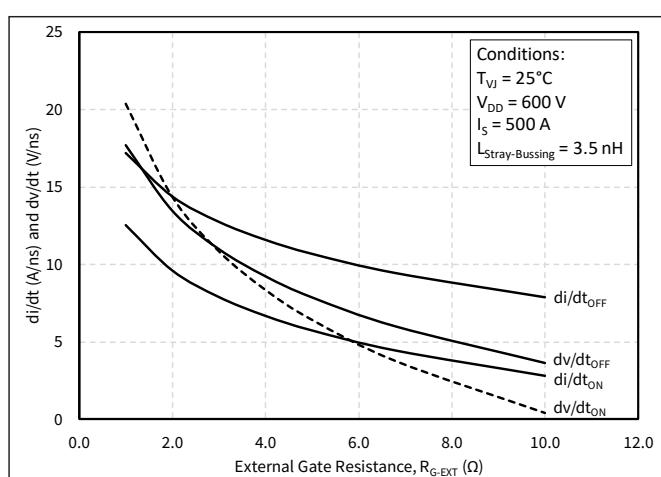
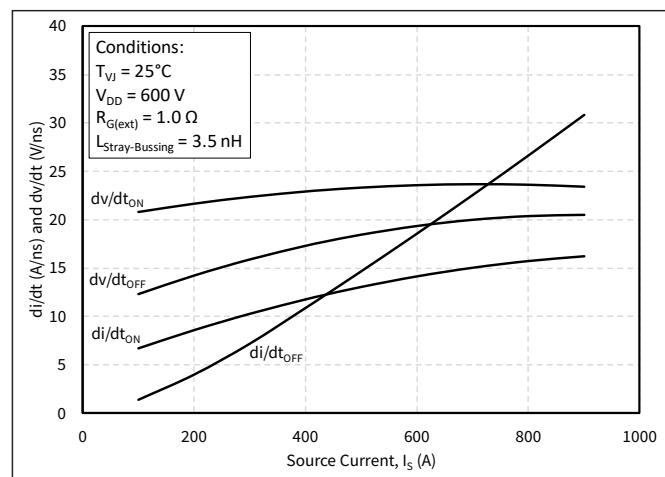
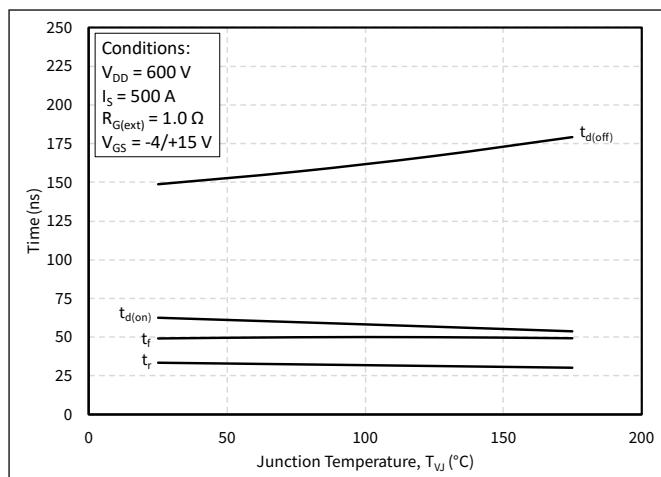
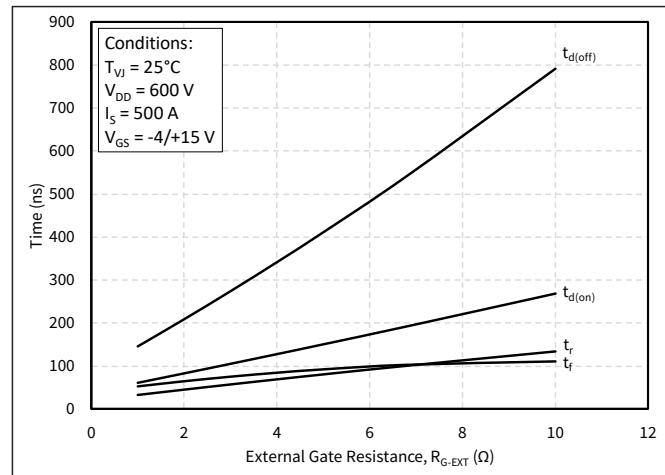
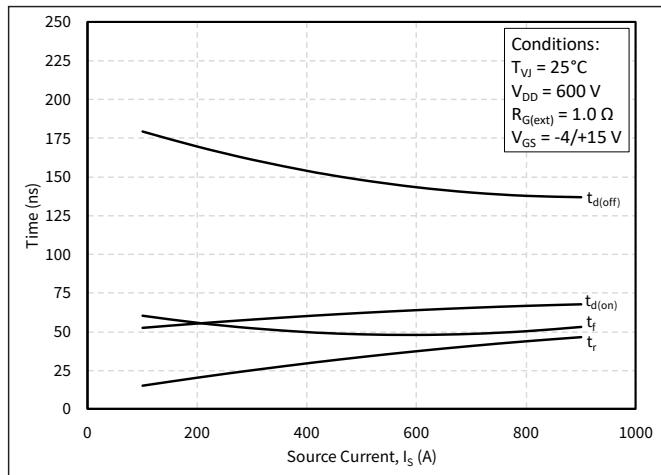


Figure 23. NTC Resistance vs. NTC Temperature

Timing Characteristics



Definitions

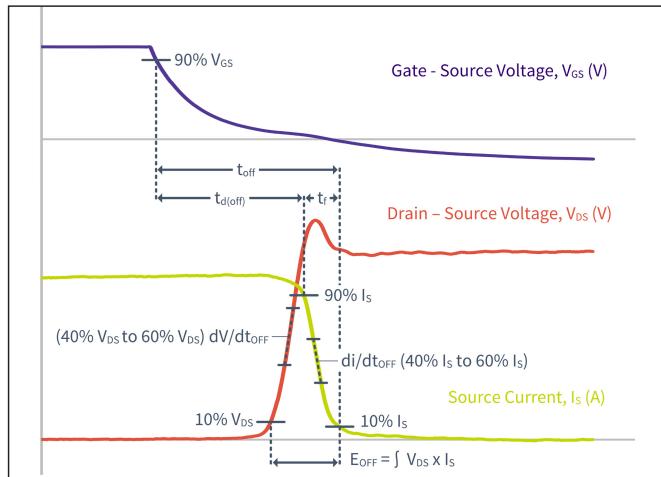


Figure 30. Turn-Off Transient Definitions

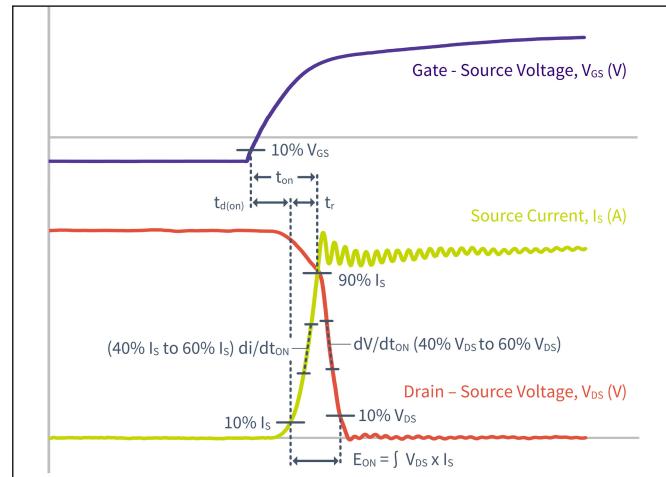


Figure 31. Turn-On Transient Definitions

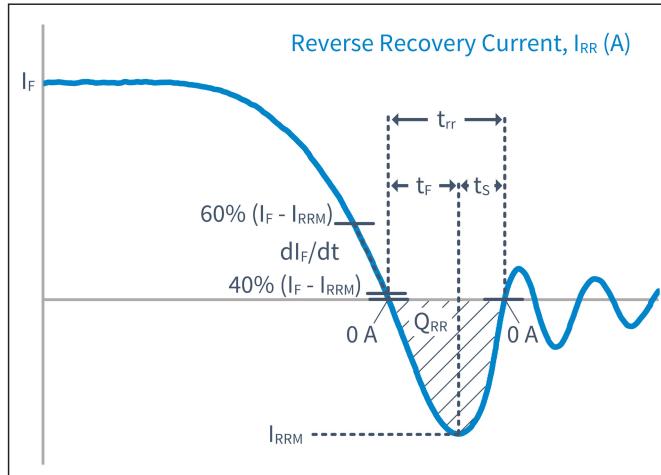


Figure 32. Reverse Recovery Definitions

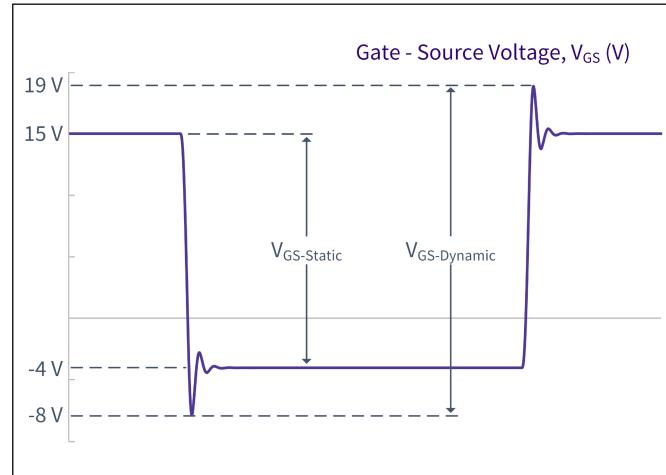
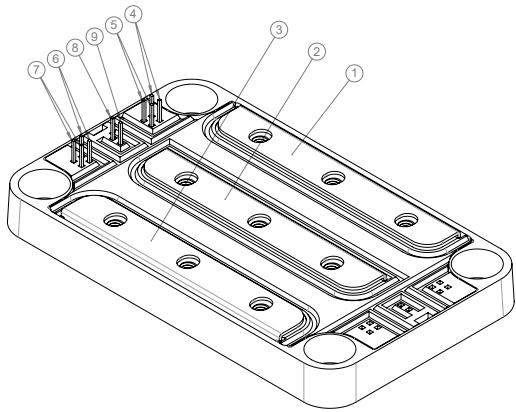
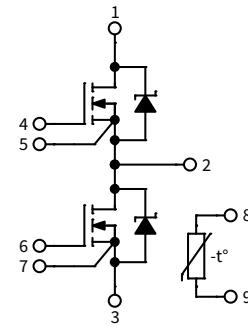


Figure 33. V_{GS} Transient Definitions

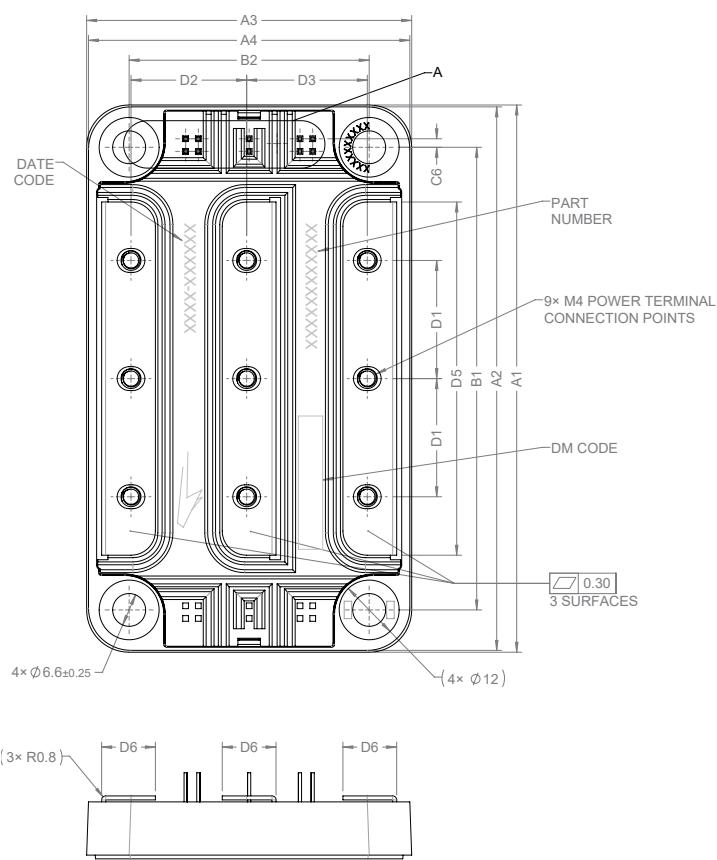
Schematic and Pin Out



PIN OUT SCHEME	
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

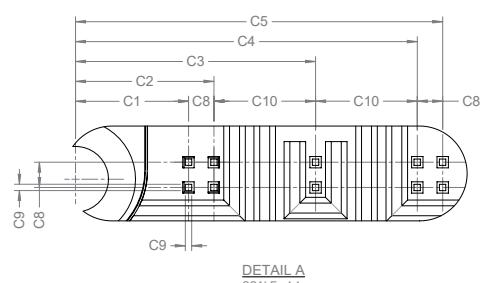


Package Dimension (mm)



NOTE:
ALL MARKINGS SHALL
CONFORM TO PRC-00786.

DIMENSION TABLE		
SYMBOL	DIMENSION	TOLERANCE
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



DETAIL A
SCALE: 4:1



Supporting Links & Tools

Evaluation Tools & Support

- [SpeedFit 2.0 Design Simulator™](#)
- [Technical Support Forum](#)
- [Dynamic Characterization Evaluation Tool for the High Performance 62mm \(HM\) Module Platform](#)

Dual-Channel Gate Driver Board

- [CGD1700HB3P-HM3: Wolfspeed Gate Driver Board](#)
- [CGD12HB00D: Differential Transceiver Daughter Board Companion Tool for Differential Gate Drivers](#)

Application Notes

- [CPWR-AN35: 62mm Thermal Interface Material Application Note](#)
- [CPWR-AN39: KIT-CRD-CIL12N-HM User Guide](#)
- [PRD-04814: Design Options for Wolfspeed® Silicon Carbide MOSFET Gate Bias Power Supplies](#)



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