

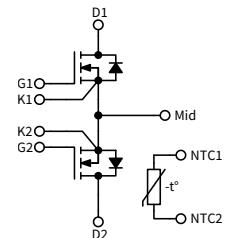
# CLB800M12HM3P, CLB800M12HM3PT

1200 V, 800 A, Silicon Carbide, Common-Source Module

<b>V<sub>DS</sub></b>	<b>1200 V</b>
<b>I<sub>DS</sub></b>	<b>800 A</b>

## Technical Features

- Low Inductance, Low Profile 62 mm Footprint
- High Junction Temperature (175 °C) Operation
- Implements Gen 3+ SiC MOSFET Technology with Improved Conduction Loss
- Light Weight AlSiC Baseplate
- High Reliability Silicon Nitride Insulator



## Typical Applications

- Solid State Circuit Breakers
- EV Battery Disconnect
- T-type Inverters
- Four-Quadrant Power Converters
- UPS and SMPS

## System Benefits

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

## Maximum Parameters (Verified by Design)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Note
Drain-Source Voltage	V <sub>DS</sub>			1200	V		
Gate-Source Voltage, Maximum Value	V <sub>GS(max)</sub>	-8		+19		Transient	Note 1 Fig. 19
Gate-Source Voltage, Recommended	V <sub>GS(op)</sub>		-4/+15			Static	
DC Continuous Drain Current	I <sub>D</sub>		1051		A	V <sub>GS</sub> = 15 V, T <sub>C</sub> = 25 °C, T <sub>VJ</sub> ≤ 175 °C	Notes 2, 3 Fig. 13
			791			V <sub>GS</sub> = 15 V, T <sub>C</sub> = 90 °C, T <sub>VJ</sub> ≤ 175 °C	
DC Source-Drain Current (Body Diode)	I <sub>SD(BD)</sub>		512			V <sub>GS</sub> = -4 V, T <sub>C</sub> = 25 °C, T <sub>VJ</sub> ≤ 175 °C	
Pulsed Drain-Source Current	I <sub>DM</sub>		3164			t <sub>pmax</sub> limited by T <sub>VJmax</sub> V <sub>GS</sub> = 15 V, T <sub>C</sub> = 25 °C	
Power Dissipation	P <sub>D</sub>		2540		W	T <sub>C</sub> = 25 °C, T <sub>VJ</sub> ≤ 175 °C	Note 4 Fig. 14
Virtual Junction Temperature	T <sub>VJ(op)</sub>	-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	$V_{(\text{BR})\text{DSS}}$	1200			V	$V_{GS} = 0 \text{ V}, T_{VJ} = -40^\circ\text{C}$	
Gate Threshold Voltage	$V_{GS(\text{th})}$	1.3	2.5	3.9		$V_{DS} = V_{GS}, I_D = 255 \text{ mA}$	
			2.0			$V_{DS} = V_{GS}, I_D = 255 \text{ mA}, T_{VJ} = 175^\circ\text{C}$	
Zero Gate Voltage Drain Current	$I_{DSS}$		12	384	$\mu\text{A}$	$V_{GS} = 0 \text{ V}, V_{DS} = 1200 \text{ V}$	
Gate-Source Leakage Current	$I_{GSS}$		0.12	1.2		$V_{GS} = 15 \text{ V}, V_{DS} = 0 \text{ V}$	
Drain-Source On-State Resistance (Devices Only)	$R_{DS(\text{on})}$		1.3	1.7	$\text{m}\Omega$	$V_{GS} = 15 \text{ V}, I_D = 800 \text{ A}$	Fig. 2 Fig. 3
			2.35			$V_{GS} = 15 \text{ V}, I_D = 800 \text{ A}, T_{VJ} = 175^\circ\text{C}$	
Transconductance	$g_{fs}$		619		S	$V_{DS} = 20 \text{ V}, I_{DS} = 800 \text{ A}$	Fig. 4
			573			$V_{DS} = 20 \text{ V}, I_{DS} = 800 \text{ A}, T_{VJ} = 175^\circ\text{C}$	
Internal Gate Resistance	$R_{G(\text{int})}$		0.48		$\Omega$	$f = 100 \text{ kHz}$	
Input Capacitance	$C_{iss}$		94.9		nF	$V_{GS} = 0 \text{ V}, V_{DS} = 800 \text{ V},$ $V_{AC} = 25 \text{ mV}, f = 100 \text{ kHz}$	Fig. 9
Output Capacitance	$C_{oss}$		3.1				
Reverse Transfer Capacitance	$C_{rss}$		180		pF		
Gate to Source Charge	$Q_{GS}$		888		nC	$V_{DS} = 800 \text{ V}, V_{GS} = -4 \text{ V}/15 \text{ V}$ $I_D = 800 \text{ A}$ Per IEC60747-8-4 pg 21	
Gate to Drain Charge	$Q_{GD}$		804				
Total Gate Charge	$Q_G$		2784				
Short Circuit Energy	$E_{sc}$		11.7		J	$V_{BUS} = 800 \text{ V}, V_{GS} = -4/15 \text{ V},$ $R_{G(\text{EXT})} = 5 \Omega, T_{VJ} = 175^\circ\text{C},$ $t_{sc} < 1.54 \mu\text{s}, L_{\text{stray,SC}} = 8.4 \text{ nH}$	Note 5,6
FET Thermal Resistance, Junction to Case	$R_{th\text{JC}}$		0.059		$^\circ\text{C/W}$		Fig. 11

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

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Note
Body Diode Forward Voltage	$V_{SD}$		5.7		V	$V_{GS} = -4 \text{ V}, I_{SD} = 800 \text{ A}$	Fig. 7
			5.2			$V_{GS} = -4 \text{ V}, I_{SD} = 800 \text{ A}, T_{VJ} = 175^\circ\text{C}$	

Note (5): Refer to PRD-08296

Note (6):  $V_{DS\text{max}}$  depends on effective short circuit stray inductance ( $L_{\text{stray,SC}}$ ),  $V_{DS\text{max}} = V_{BUS} + L_{\text{stray,SC}} \cdot di/dt$



## Module Physical Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Package Resistance, M1	R <sub>1-2</sub>		106.5		$\mu\Omega$	T <sub>C</sub> = 125 °C, Note 7
Package Resistance, M2	R <sub>2-3</sub>		126.3			T <sub>C</sub> = 125 °C, Note 7
Stray Inductance	L <sub>Stray</sub>		4.9		nH	Between Terminals 1 and 3
Case Temperature	T <sub>C</sub>	-40		125	°C	
Weight	W		179		g	
Mounting Torque	M <sub>S</sub>	3.0	4.5	5.0	N·m	CLB800M12HM3P, Baseplate, M6 Bolts
		4.5		6.0		CLB800M12HM3PT, Baseplate, M6 Bolts
		0.9	1.1	1.3		Power Terminals, M4 × 0.7 mm Bolts
Case Isolation Voltage	V <sub>isol</sub>	4			kV	AC, 50 Hz, 1 min
Comparative Tracking Index	CTI	600				
Clearance Distance		9.43			mm	Terminal to Terminal
		12.70				Terminal to Baseplate
Creepage Distance		13.05				Terminal to Terminal
		15.30				Terminal to Baseplate

Note (7): Total Effective Resistance (Per Switch Position) = MOSFET R<sub>DS(on)</sub> + Switch Position Package Resistance

## Temperature Sensor (NTC) Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Resistance at 25 °C	R <sub>25</sub>		4700		Ω	T <sub>NTC</sub> = 25 °C
Tolerance of R <sub>25</sub>			±1		%	
Beta Value for 25 °C to 85 °C	B <sub>25/85</sub>		3435		K	
Beta Value for 0 °C to 100 °C	B <sub>0/100</sub>		3399		K	
Tolerance of B <sub>25/85</sub>			±1		%	
Maximum Power Dissipation	P <sub>25</sub>		50		mW	

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

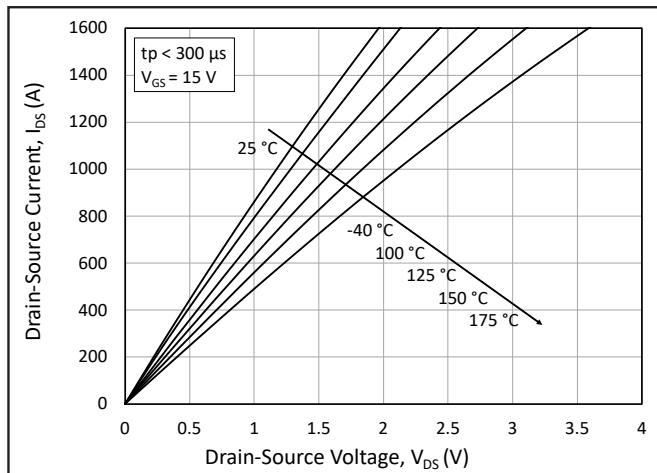
$$\ln\left(\frac{R}{R_{25}}\right) = A + \frac{B}{T} + \frac{C}{T^2} + \frac{D}{T^3}$$

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

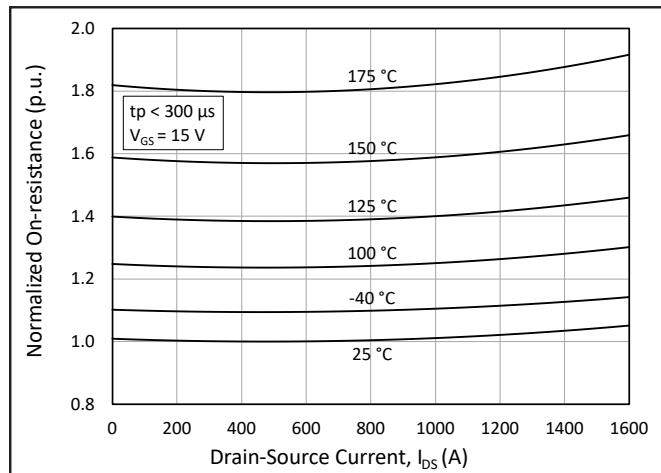
A	B	C	D
-1.289E+01	4.245E+03	-8.749E+04	-9.588E+06

A <sub>1</sub>	B <sub>1</sub>	C <sub>1</sub>	D <sub>1</sub>
3.354E-03	3.001E-04	5.085E-06	2.188E-07

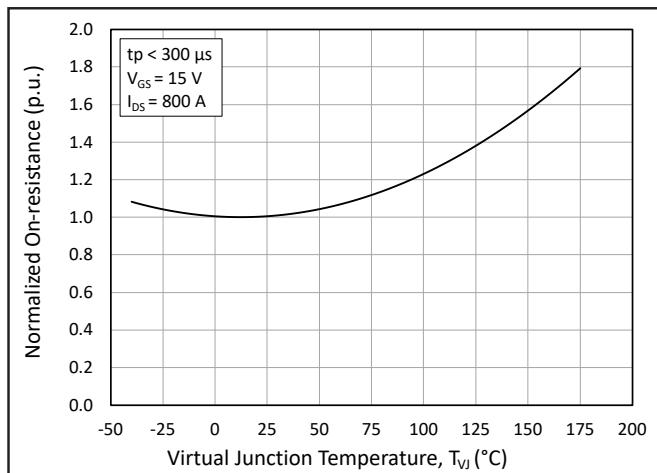
## Typical Performance



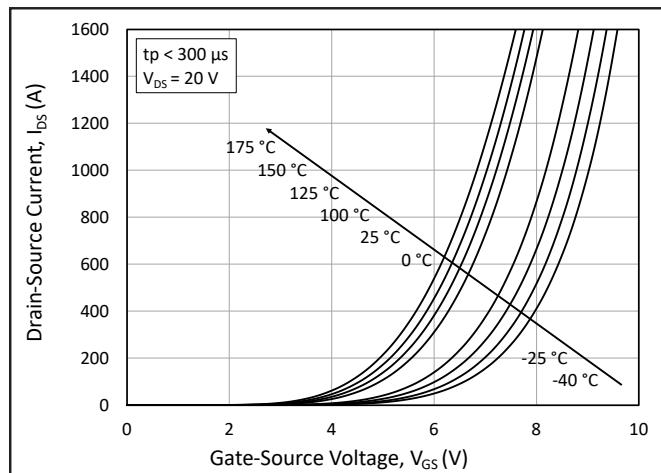
**Figure 1.** Output Characteristics for Various Junction Temperatures



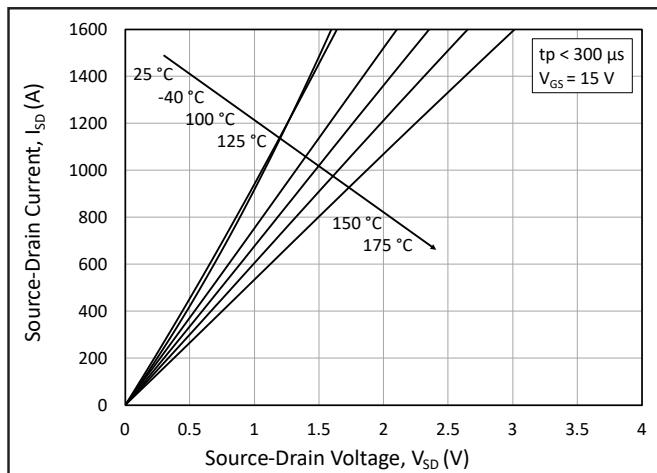
**Figure 2.** Normalized On-State Resistance vs. Drain Current for Various Junction Temperatures



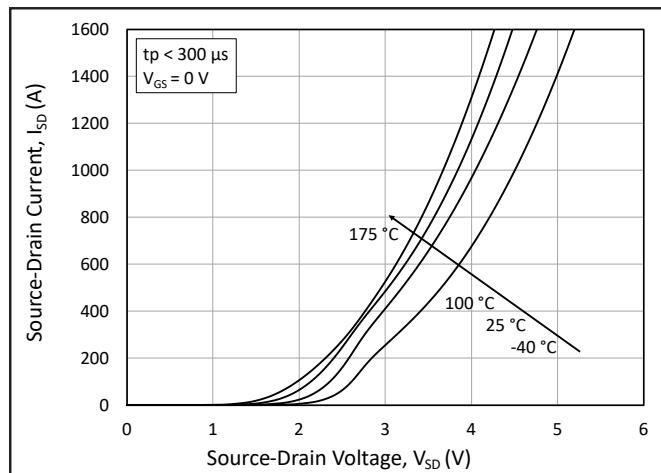
**Figure 3.** Normalized On-State Resistance vs. Junction Temperature



**Figure 4.** Transfer Characteristic for Various Junction Temperatures

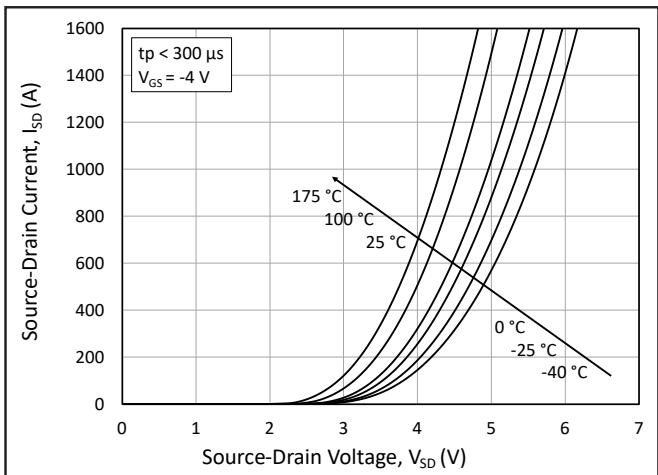


**Figure 5.** 3<sup>rd</sup> Quadrant Characteristic vs. Junction Temperatures at  $V_{GS} = 15 V$

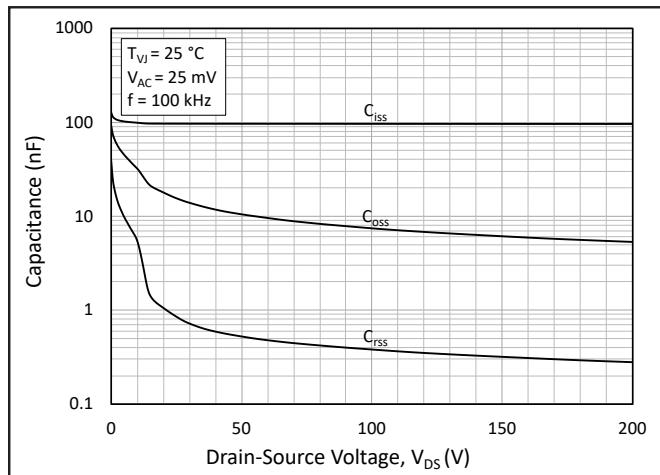


**Figure 6.** 3<sup>rd</sup> Quadrant Characteristic vs. Junction Temperatures at  $V_{GS} = 0 V$  (Body Diode)

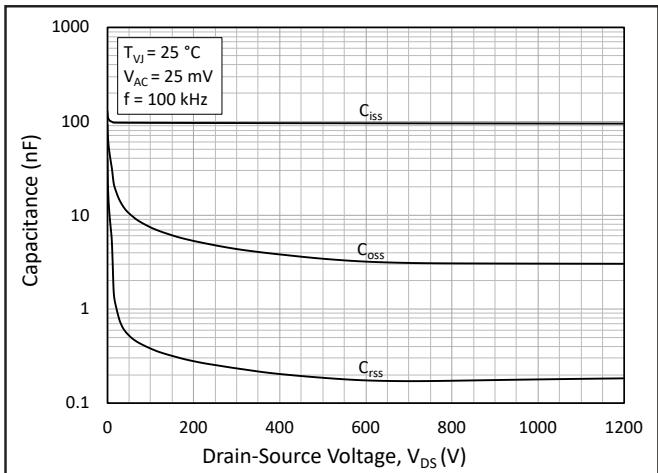
## Typical Performance



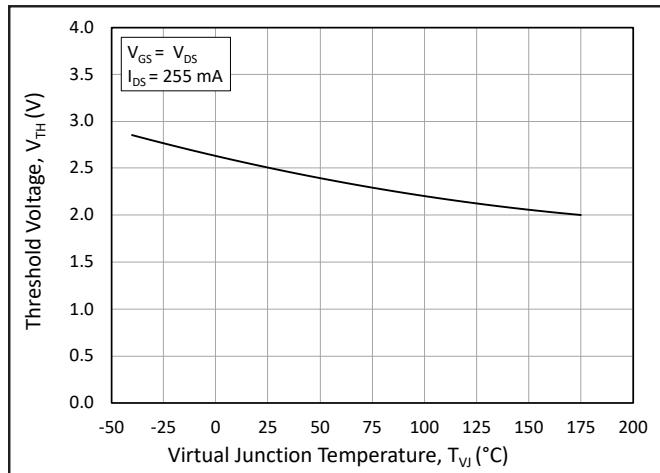
**Figure 7.** 3<sup>rd</sup> Quadrant Characteristic vs. Junction Temperature at  $V_{GS} = -4 \text{ V}$  (Body Diode)



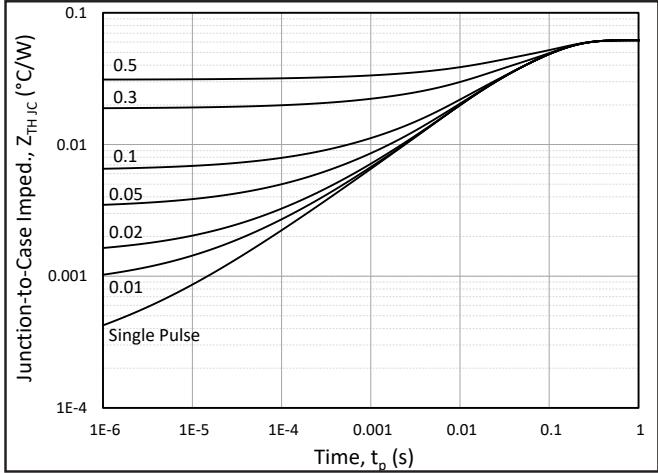
**Figure 8.** Typical Capacitances vs. Drain to Source Voltage (0 - 200 V)



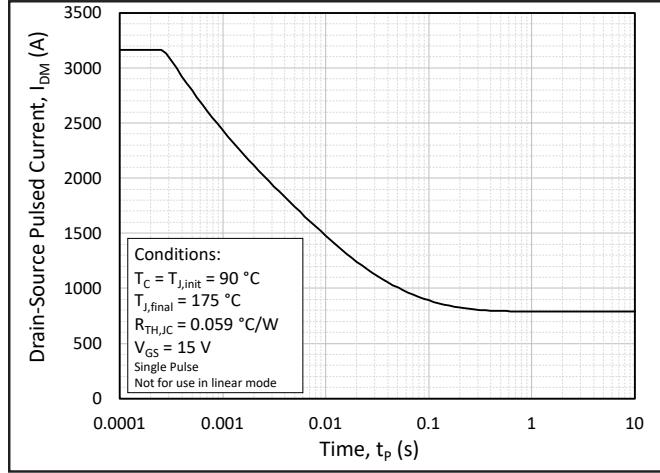
**Figure 9.** Typical Capacitances vs. Drain to Source Voltage (0 - 1200V)



**Figure 10.** Threshold Voltage vs. Junction Temperature



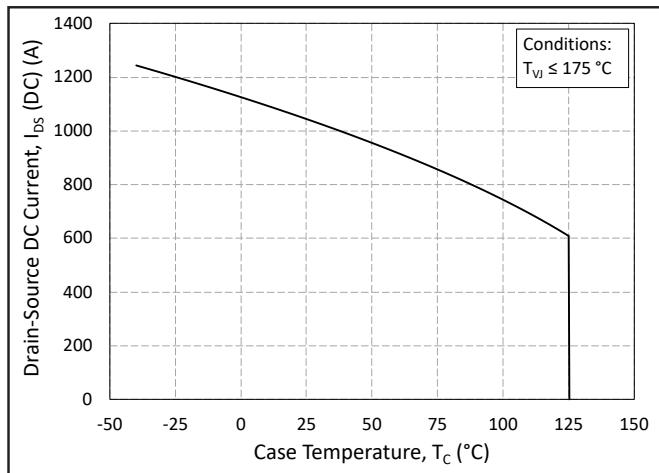
**Figure 11.** MOSFET Junction to Case Transient Thermal Impedance,  $Z_{th,JC}$  (°C/W)



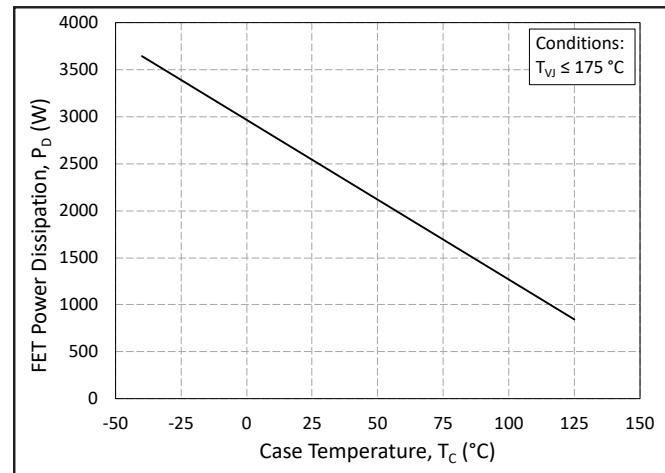
**Figure 12.** Pulsed Current SOA



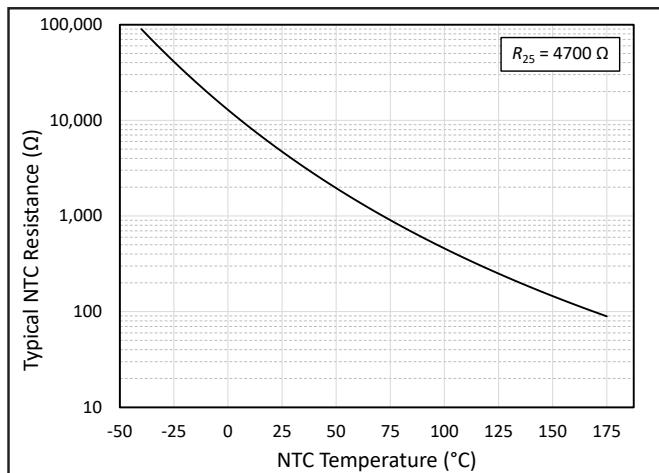
## Typical Performance



**Figure 13.** Continuous Drain Current Derating vs. Case Temperature

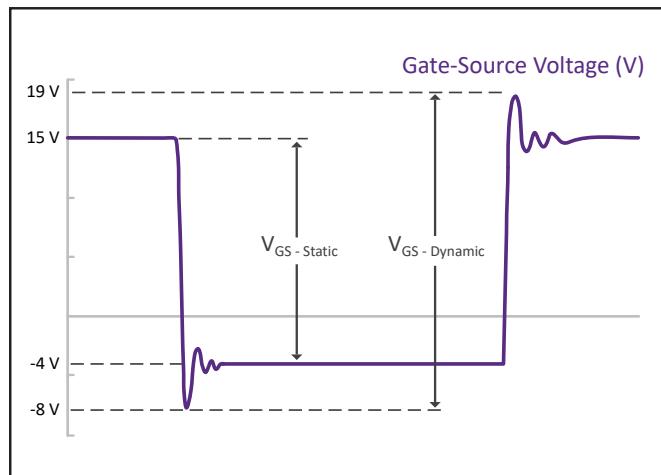
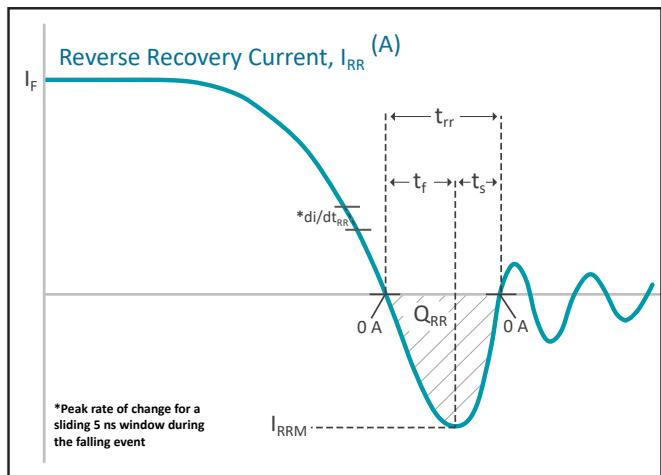
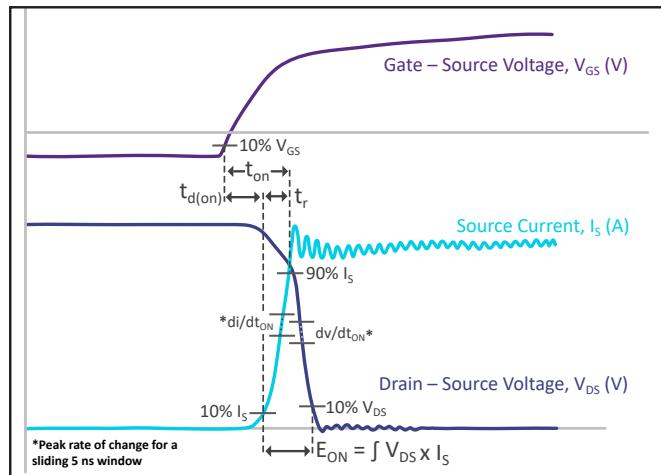
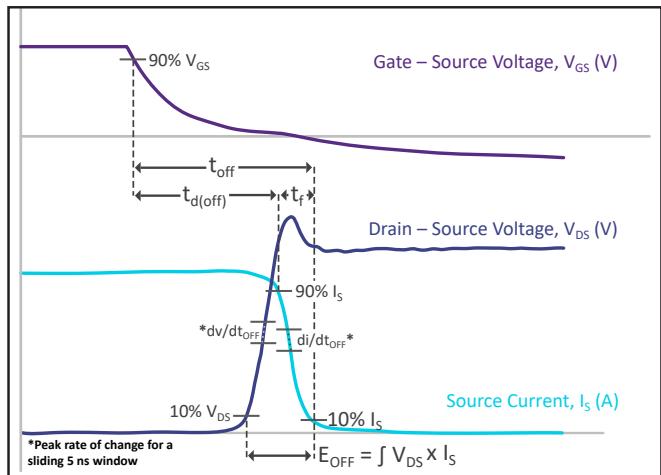


**Figure 14.** Maximum Power Dissipation Derating vs. Case Temperature



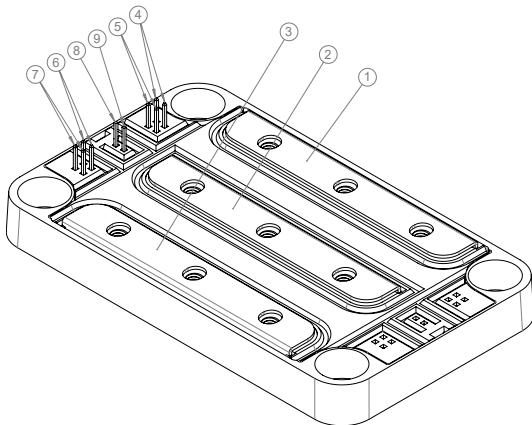
**Figure 15.** Typical NTC Resistance vs. Temperature

## Definitions

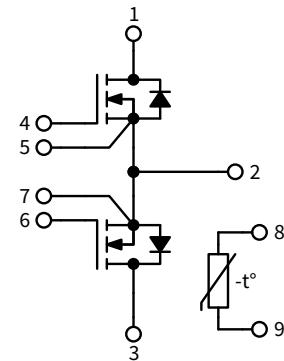




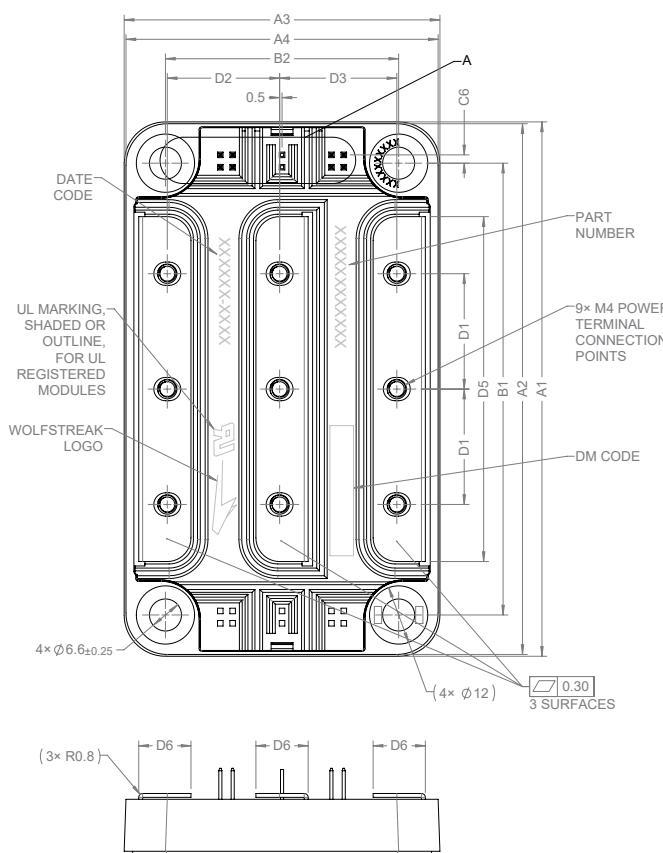
## Schematic and Pin Out



PIN OUT SCHEME	
PIN	LABEL
①	D1
②	Mid
③	D2
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

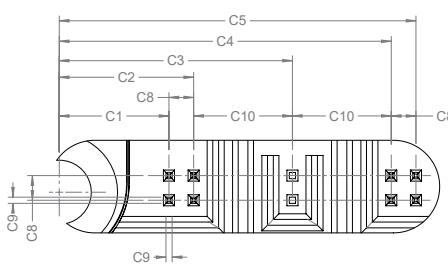


## Package Dimensions (mm)



NOTE:  
ALL MARKINGS SHALL  
CONFORM TO PRC-00786

DIMENSION TABLE		
SYMBOL	DIMENSION	TOLERANCE
A1	110	±0.60
A2	109.25	±0.60
A3	65	±0.60
A4	64.25	±0.60
A5	3.25	±0.40
A6	11.45	±0.60
B1	93	±0.30
B2	48	±0.30
C1	11.29	±0.40
C2	13.83	±0.40
C3	24	±0.40
C4	34.17	±0.40
C5	36.71	±0.40
C6	1.71	±0.40
C7	17.84	±0.75
C8	2.54	±0.30
C9	0.64	±0.30
C10	10.17	±0.40
D1	23.75	±0.50
D2	23.13	±0.50
D3	24.13	±0.50
D4	12.65	±0.50
D5	71	±0.30
D6	10.75	±0.50



Note (8): To improve product traceability, Wolfspeed products include Data Matrix Content barcodes in the form of ZZZZZZZZZZ-DDDDDD-XXXX-NNNNNNNNNN, where -Z, -D, -X/-N represent product number, date code, and module serial number, respectively. For instance, CLB800M12HM3P-FA2036-0042-6706546042 is a CLB800M12HM3P produced in 2020 week 36 with a unique serial number.

Note (9): CLB800M12HM3P has been certified by UL as an “Electrically Isolated Semiconductor Devices – Component” in accordance with UL 1557. Only power modules that bear the UL marking shown in the Package Dimension figure above should be considered as being covered under the UL Component Recognition Program.



## Product Ordering Code

Part Number	Description
CLB800M12HM3P	Without Pre-Applied Phase Change Thermal Interface Material
CLB800M12HM3PT	With Pre-Applied Phase Change Thermal Interface Material

## Supporting Links & Tools

### Evaluation Tools & Support

- [SpeedFit 2.0 Design Simulator™](#)
- [Technical Support Forum](#)
- [LTspice and PLECS Models](#)

### Dual-Channel Gate Driver Board

- [CGD12HB00D: Differential Transceiver Daughter Board Companion Tool for Differential Gate Drivers](#)
- [CGD1700HB3P-HM3 Wolfspeed H Module Gate Driver Board](#)
- [EVAL-ADUM4146WHB1Z: Analog Devices® Gate Driver Board](#)
- [UCC21710QDWEVM-054: Texas Instruments® Gate Driver Board](#)

### Application Notes

- [PRD-04814: Design Options for Wolfspeed® Silicon Carbide MOSFET Gate Bias Power Supplies](#)
- [PRD-06379: Environmental Considerations for Power Electronics Systems](#)
- [PRD-08333: Wolfspeed Module CIL Evaluation Kits User Guide](#)
- [PRD-07933: Wolfspeed Power Module Thermal Interface Material Application User Guide](#)
- [PRD-08376: Thermal Characterization Methods and Applications](#)
- [PRD-07845: Power Module Baseplate Capacitance and Electromagnetic Compatibility](#)
- [PRD-08710: Measuring Stray Inductance in Power Electronics Systems](#)
- [PRD-08911: Considerations for Current Balancing in Paralleled SiC Power Modules](#)
- [PRD-09035: Power Module RC Thermal Models User Guide](#)
- [PRD-08296: SiC MOSFET Short Circuit Application Note](#)
- [PRD-07913: Wolfspeed Power Module SPICE Models User Guide](#)
- [PRD-09002: Wolfspeed H Module Mounting Guide](#)



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### REACH Compliance

REACH substances of high concern (SVHCs) information is available for this product. Since the European Chemical Agency (ECHA) has published notice of their intent to frequently revise the SVHC listing for the foreseeable future, please contact your Wolfspeed representative to ensure you get the most up-to-date REACH SVHC Declaration. REACH banned substance information (REACH Article 67) is also available upon request.

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