

$V_{DS}$	1200 V
$R_{DS,on}$	4.4 m $\Omega$
$I_D (T_C=25^\circ C)$	383 A
$T_{J,max}$	175 $^\circ C$

## 1200V SiC Half-Bridge Module

### Features

- High speed switching SiC MOSFETs
- Reliable body diode
- All parts tested to above 1350V
- Kelvin reference for stable operation
- Press fit terminal connections

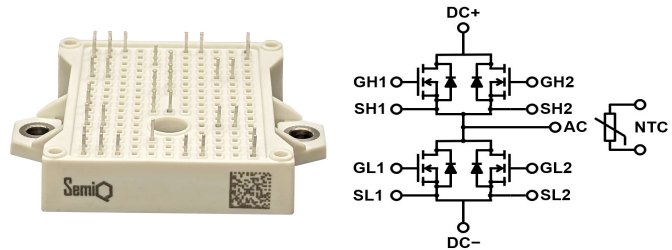
### Benefits

- Low switching losses
- Low junction to case thermal resistance
- Very rugged and easy mounting
- Direct mounting to heatsink (isolated package)

### Applications

- Photovoltaic Inverter
- Battery charger
- Energy storage system
- High voltage DC to DC converter

### Package



Part #	Package	Marking
GCMX005A120B3B1P	B3	GCMX005A120B3B1P



### Absolute Maximum Ratings, at $T_J=25^\circ C$ , unless otherwise specified

Characteristics	Symbol	Conditions	Values	Unit
Drain-Source Voltage	$V_{rated}$	$V_{GS}=0V, I_D=1\mu A$	1200	V
Continuous Drain Current	$I_{DS}$	$T_C=25^\circ C, V_{GS}=20V, T_J=175^\circ C$	383	A
		$T_C=65^\circ C, V_{GS}=20V, T_J=175^\circ C$	331	
Body Diode Drain Current	$I_{SD}$	$T_C=25^\circ C, V_{GS}=-5V, T_J=175^\circ C$	300	
Pulsed Drain Current	$I_{DS,pulse}$	$T_C=25^\circ C, V_{GS}=20V$	700	
Gate Source Voltage	$V_{GSmax}$		-10/25	V
	$V_{GSop}$	Recommended operational	-5/20	
Power Dissipation	$P_{tot}$	$T_C=25^\circ C, T_J=175^\circ C$	1154	W
Junction Temperature	$T_J$	Continuous	-40...175	$^\circ C$
Case & Storage Temperature	$T_C, T_{storage}$	Continuous	-40...150	$^\circ C$

# 1200V SiC Half-Bridge Module

# GCMX005A120B3B1P

Static Electrical Characteristics, at  $T_J=25^\circ\text{C}$ , unless otherwise specified

Characteristics	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Drain-Source Breakdown Voltage	$BV_{DSS}$	$V_{GS}=0V, I_D=1mA$	1200	-	-	V
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS}=1200V, V_{GS}=0V$	-	0.4	4	$\mu\text{A}$
		$V_{DS}=1200V, V_{GS}=0V, T_J=150^\circ\text{C}$	-	7	400	
Gate-Source Leakage Current	$I_{GSS+}$	$V_{GS}=20V, V_{DS}=0V$	-	40	1000	nA
	$I_{GSS-}$	$V_{GS}=-5V, V_{DS}=0V$	-	-40	-1000	
Gate Threshold Voltage	$V_{GS(th)}$	$V_{GS}=V_{DS}, I_D=80mA$	1.8	2.7	4	V
		$V_{GS}=V_{DS}, I_D=80mA, T_J=150^\circ\text{C}$	-	1.8	-	
Drain-Source On-Resistance	$R_{DS(on)}^*$	$V_{GS}=20V, I_D=200A$	-	4.4	7	m $\Omega$
		$V_{GS}=20V, I_D=100A$	-	4.3	-	
		$V_{GS}=20V, I_D=200A, T_J=150^\circ\text{C}$	-	7.0	-	
Transconductance	$g_{fs}$	$V_{DS}=20V, I_D=200A$	-	101.3	-	S
		$V_{DS}=20V, I_D=200A, T_J=150^\circ\text{C}$	-	106.6	-	
Internal Gate Resistance	$R_{G(int)}$	f=1MHz, $V_{AC}=25mV$ , D-S Short, including internal 0.5 ohm series gate resistor**	-	0.8	-	$\Omega$

\* $R_{DS(on)}$  including package resistance

\*\*Internal series gate resistor limits maximum switching frequency defined by Figure 31

AC Electrical Characteristics, at  $T_J=25^\circ\text{C}$ , unless otherwise specified

Characteristics	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Input Capacitance	$C_{ISS}$	$V_{GS}=0V$	-	23.5	-	nF
Output Capacitance	$C_{OSS}$	$V_{DS}=800V$	-	1.14	-	
Reverse Transfer Capacitance	$C_{RSS}$	f=200kHz	-	0.06	-	
Coss Stored Energy	$E_{OSS}^{***}$	Vac=25mV	-	446	-	
Turn-On Switching Energy	$E_{ON}$	$T_J=25^\circ\text{C}$	-	2.92	-	mJ
		$T_J=125^\circ\text{C}$	-	3.64	-	
		$T_J=150^\circ\text{C}$	-	3.92	-	
Turn-Off Switching Energy	$E_{OFF}$	$T_J=25^\circ\text{C}$	-	1.67	-	
		$T_J=125^\circ\text{C}$	-	1.90	-	
		$T_J=150^\circ\text{C}$	-	1.94	-	
Turn-On Delay Time	$t_{D(on)}$	$V_{DD}=600V, I_{DS}=200A,$ $R_{G(ext)}=2.5\Omega, V_{GS}=-5V/20V,$ $L=90\mu\text{H}$	-	51	-	ns
Rise Time	$t_R$		-	22	-	
Turn-Off Delay Time	$t_{D(off)}$		-	114	-	
Fall Time	$t_F$		-	29	-	
Total Gate Charge	$Q_G$		$V_{DD}=800V, I_{DS}=200A$	-	927	
Gate to Source Charge	$Q_{GS}$	$V_{GS}=-5/20V$	-	278	-	
Gate to Drain Charge	$Q_{GD}$		-	142	-	

\*\*\* $E_{OSS}$  is calculated from  $C_{OSS}$  curve

# 1200V SiC Half-Bridge Module

# GCMX005A120B3B1P

**Freewheeling Diode Characteristics**, at  $T_J=25^\circ\text{C}$ , unless otherwise specified

Characteristics	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Diode Forward Voltage	$V_{SD}$	$V_{GS}=-5\text{V}, I_S=200\text{A}$	-	4.1	-	V
		$V_{GS}=-5\text{V}, I_S=200\text{A}, T_J=150^\circ\text{C}$	-	3.6	-	
Reverse Recovery Time	$t_{RR}$	$T_J=25^\circ\text{C}$ $I_S=200\text{A},$ $V_R=600\text{V},$ $V_{GS}=-5\text{V},$ $di/dt=10.3\text{A/ns}$	-	44	-	ns
Reverse Recovery Charge	$Q_{RR}$		-	1483	-	nC
Peak Reverse Recovery Current	$I_{RRM}$		-	110	-	A
Reverse Recovery Energy	$E_{RR}$	$T_J=25^\circ\text{C}$	-	0.41	-	mJ
		$T_J=125^\circ\text{C}$	-	1.01	-	
		$T_J=150^\circ\text{C}$ $R_{G(\text{ext})} = 2.5\Omega$	-	1.26	-	

**Thermal and Package Characteristics**, at  $T_J=25^\circ\text{C}$ , unless otherwise specified

Characteristics	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Thermal resistance, junction-case	$R_{thJC}$		-	0.12	0.13	$^\circ\text{C/W}$
Mounting torque	$M_d$	M4-0.7 screws	-	2.00	2.3	N-m
Press fit pin PCB end hole diameter			0.99	-	1.09	mm
Press fit pin PCB hole drill diameter			1.12	1.15	-	mm
Press fit pin PCB hole copper thickness			25	-	50	$\mu\text{m}$
Package weight	$W_t$		-	40	-	g
Isolation voltage	$V_{ISOL}$	$I_{ISOL} < 1\text{mA}, 50/60\text{ Hz}, 1\text{ min}$	2500	-	-	V

**NTC Characteristics**, at  $T_J=25^\circ\text{C}$ , unless otherwise specified

Characteristics	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Rated resistance	$R_{NTC}$	$T_{NTC} = 25^\circ\text{C}$	-	5.0	-	k $\Omega$
Resistance tolerance	$\Delta R/R$		-5	-	5	%
Beta Value ( $T_2 = 50^\circ\text{C}$ )	$\beta_{25/50}$		-	3380	-	k
Beta Value ( $T_2 = 80^\circ\text{C}$ )	$\beta_{25/80}$		-	3440	-	k
Power dissipation	$P_{MAX}$	$T_{NTC} = 25^\circ\text{C}$	-	-	50	mW

## Typical Performance

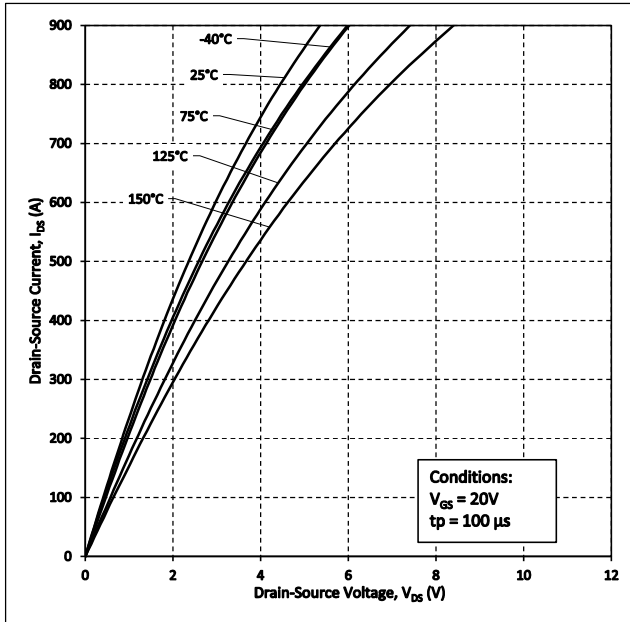


Figure 1. Output Characteristics for Various Temperatures

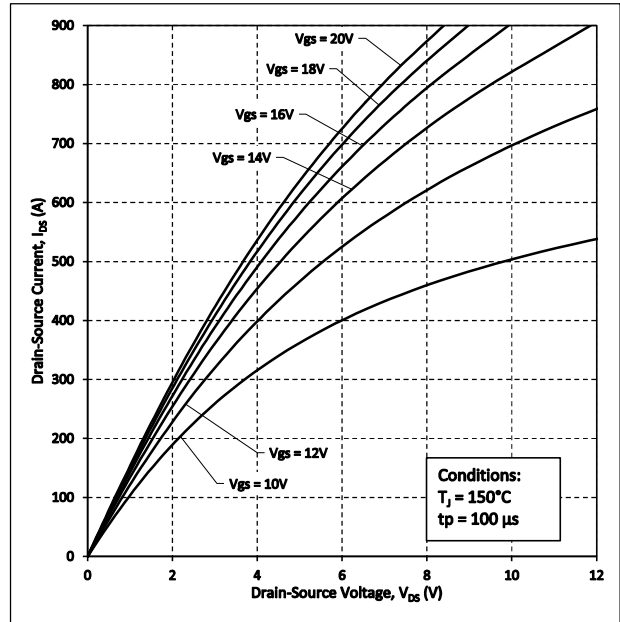


Figure 2. Output Characteristics  $T_J = 150^\circ C$

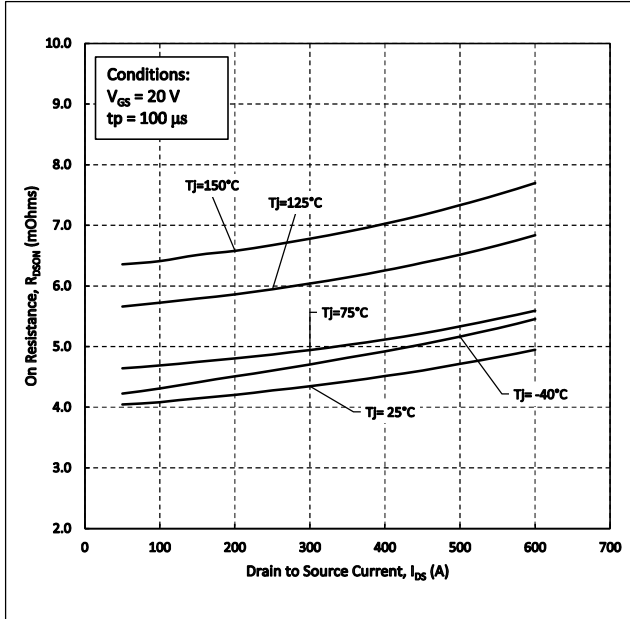


Figure 3. On-Resistance vs. Drain Current For Various Temperatures

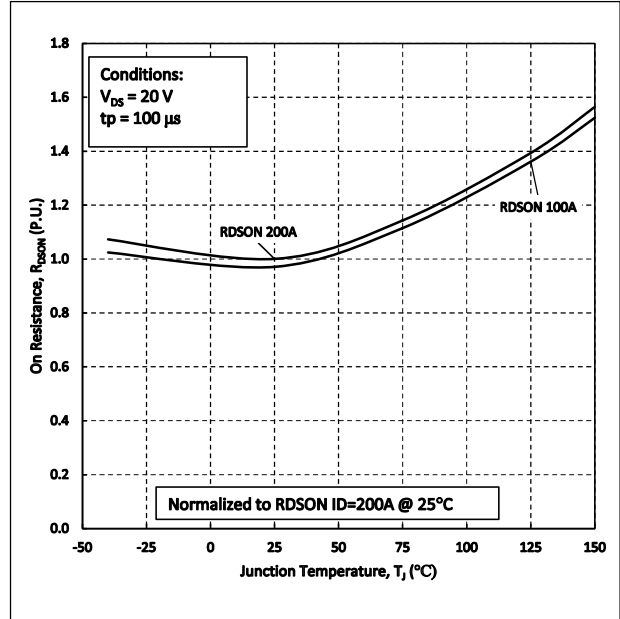


Figure 4. Normalized On-Resistance vs. Temperature

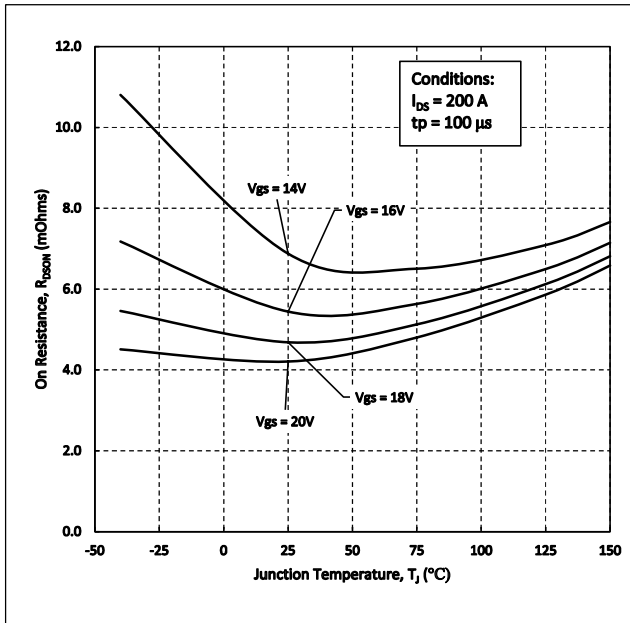


Figure 5. On-Resistance vs. Temperature For Various Gate Voltages

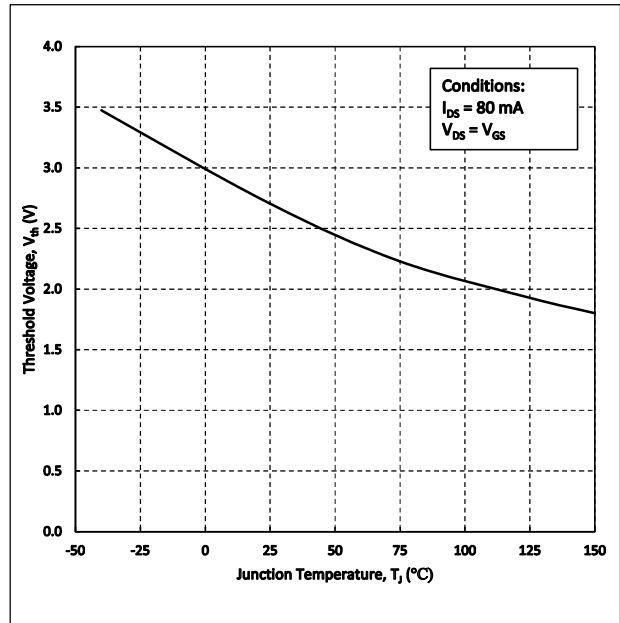


Figure 6. Threshold Voltage vs. Temperature

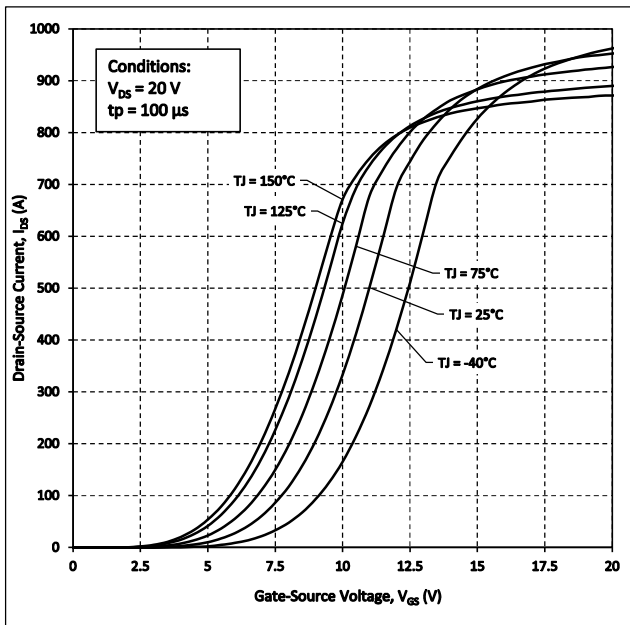


Figure 7. Transfer Characteristic for Various Junction Temperatures

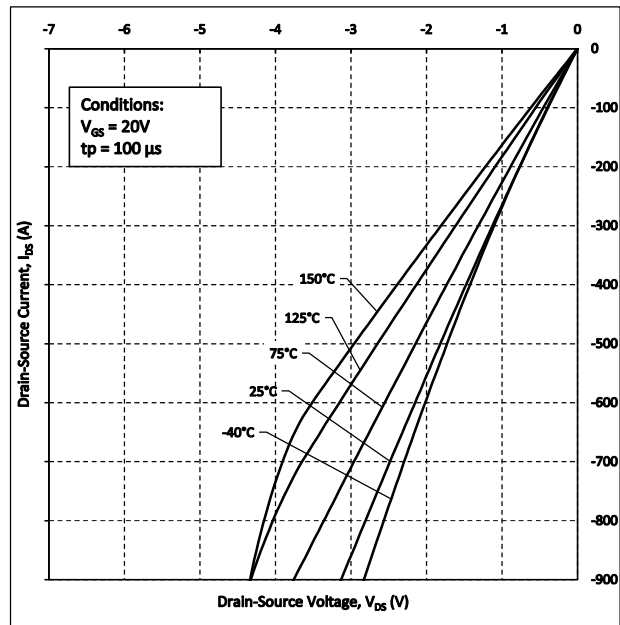


Figure 8. 3<sup>rd</sup> Quadrant Characteristics at  $V_{GS} = 20V$

# 1200V SiC Half-Bridge Module

# GCMX005A120B3B1P

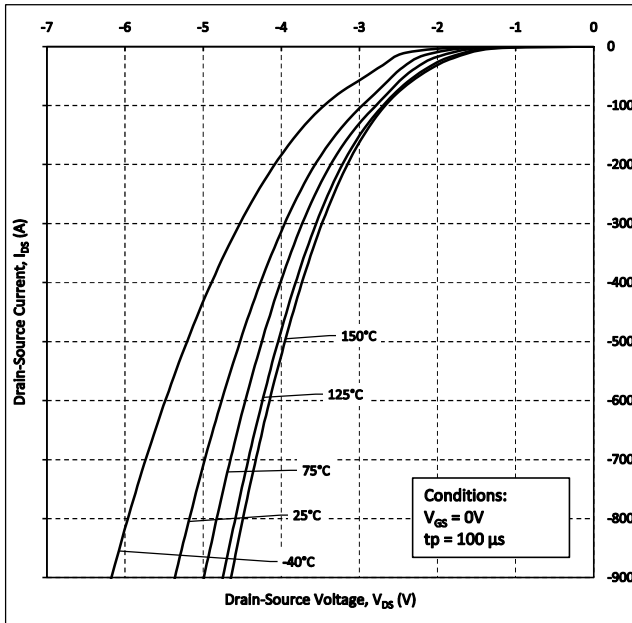


Figure 9. Body Diode Characteristics at  $V_{GS} = 0V$

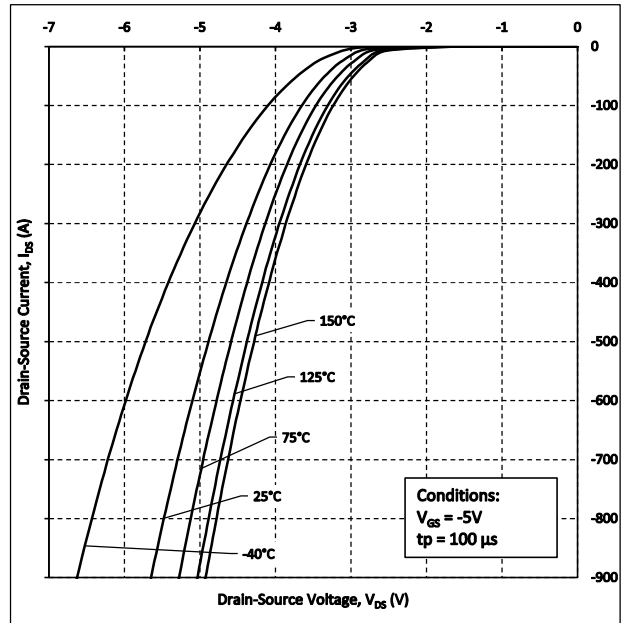


Figure 10. Body Diode Characteristics at  $V_{GS} = -5V$

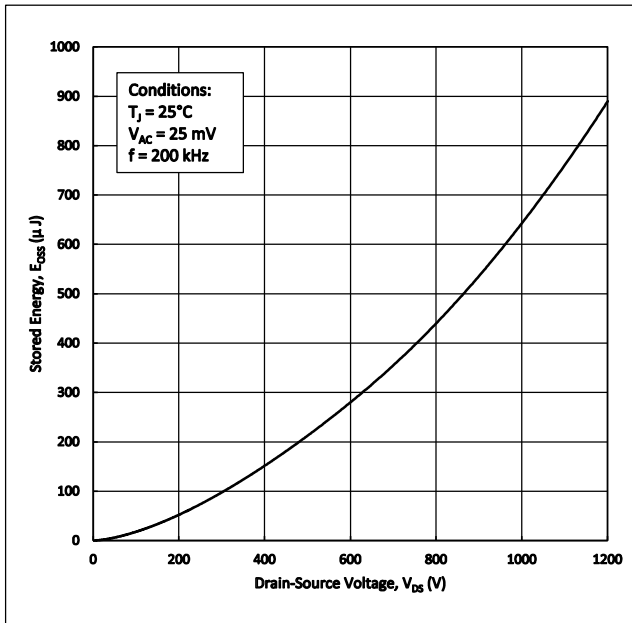


Figure 11. Output Capacitor Stored Energy

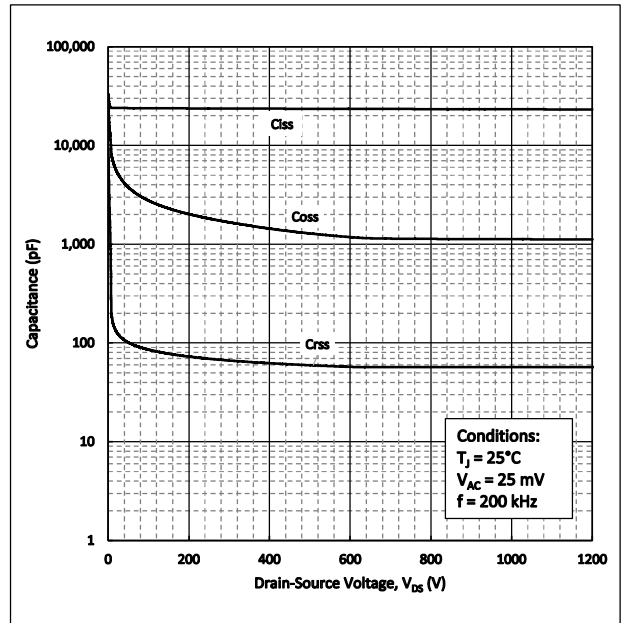


Figure 12. Capacitance vs. Drain-Source Voltage

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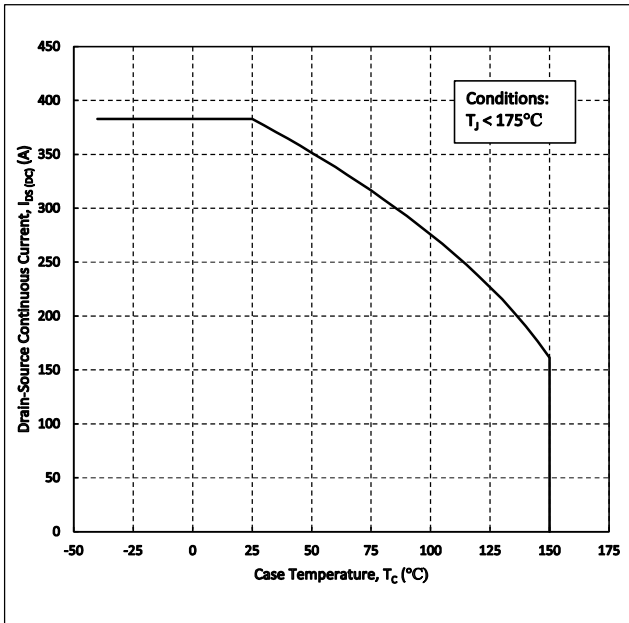


Figure 13. Continuous Drain Current Derating vs. Case Temperature

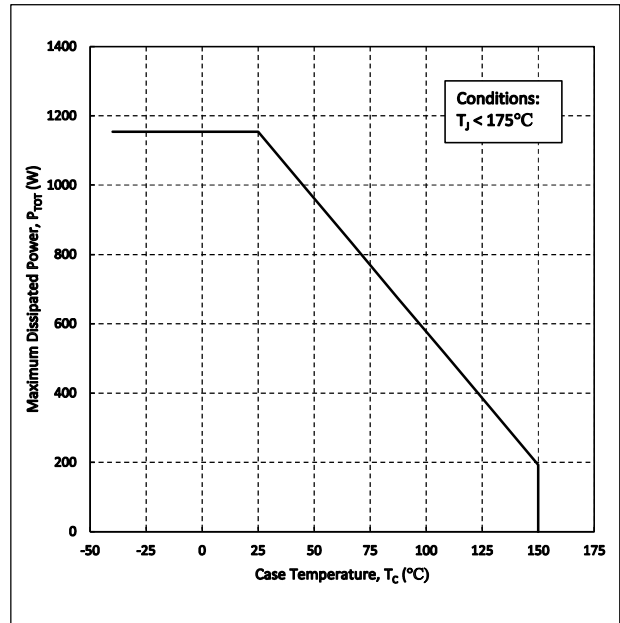


Figure 14. Maximum Power Dissipation Derating vs. Case Temperature

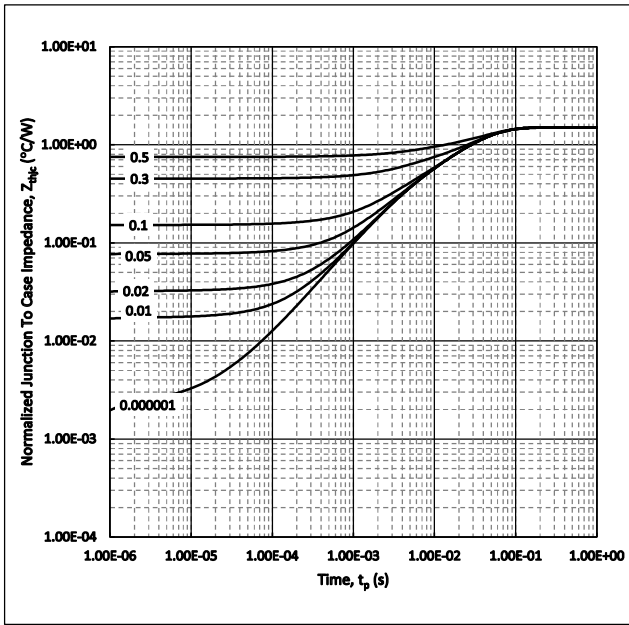


Figure 15. Transient Thermal impedance (Junction to Case)

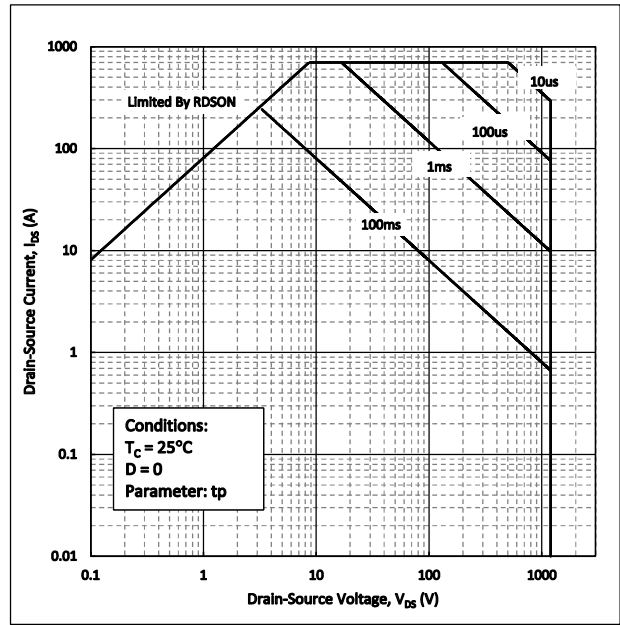


Figure 16. Safe Operating Area

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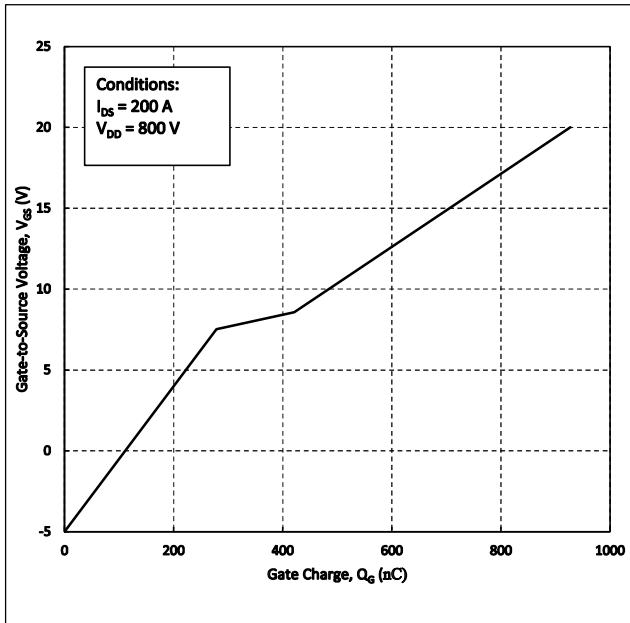


Figure 17. Gate Charge Characteristics

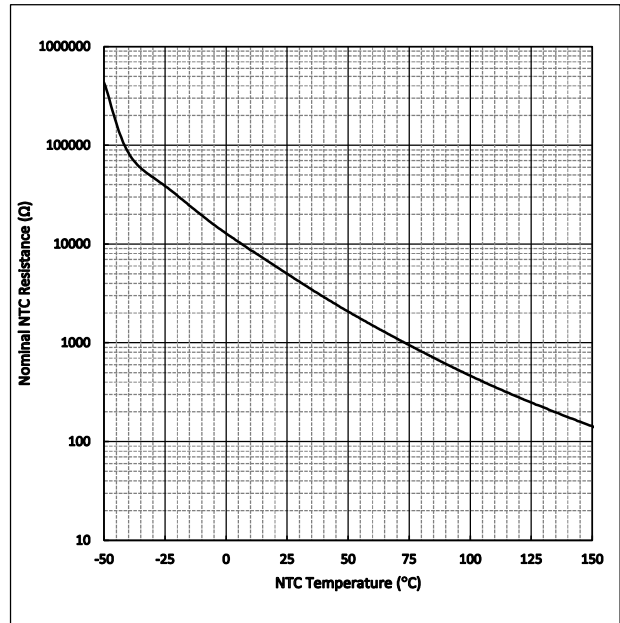


Figure 18. Nominal NTC Resistance vs. Temperature

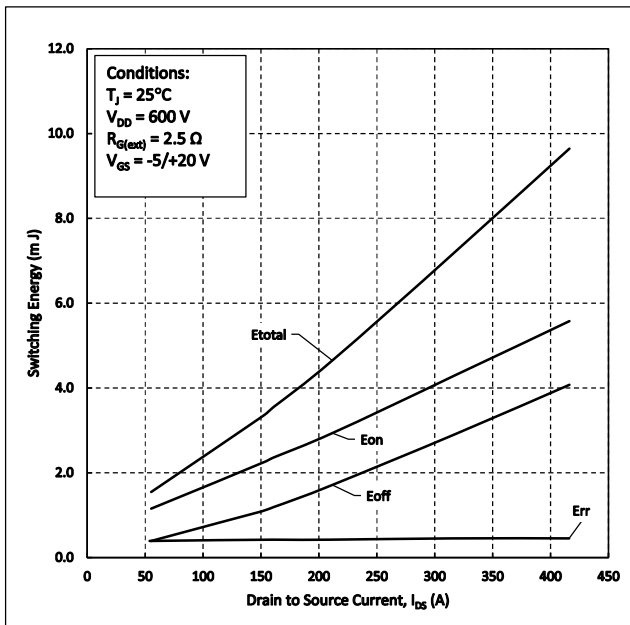


Figure 19. Clamped Inductive Switching Energy vs. Drain Current (600V)

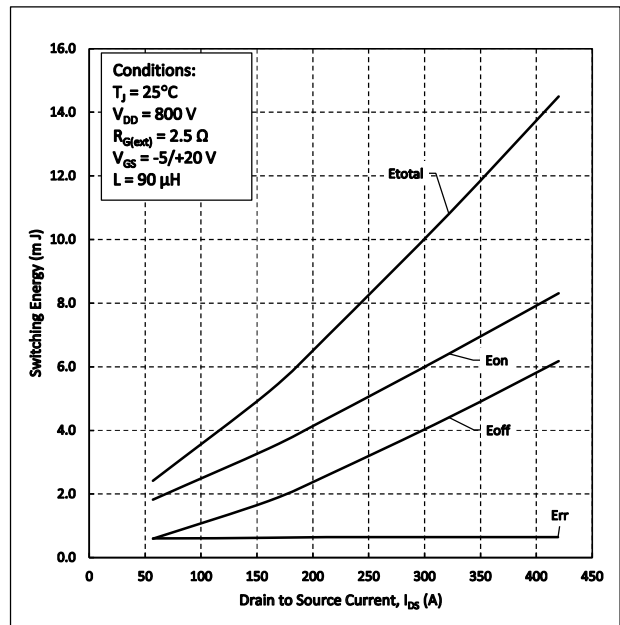


Figure 20. Clamped Inductive Switching Energy vs. Drain Current (800V)



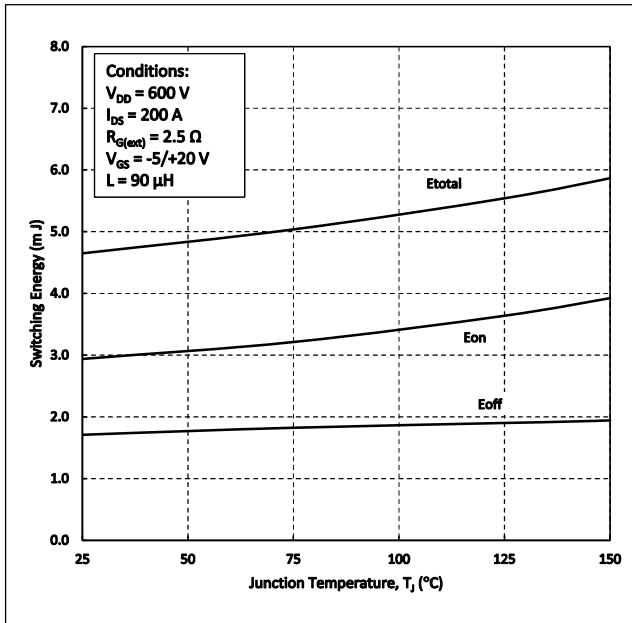


Figure 21. Clamped Inductive Switching Energy vs. Temperature

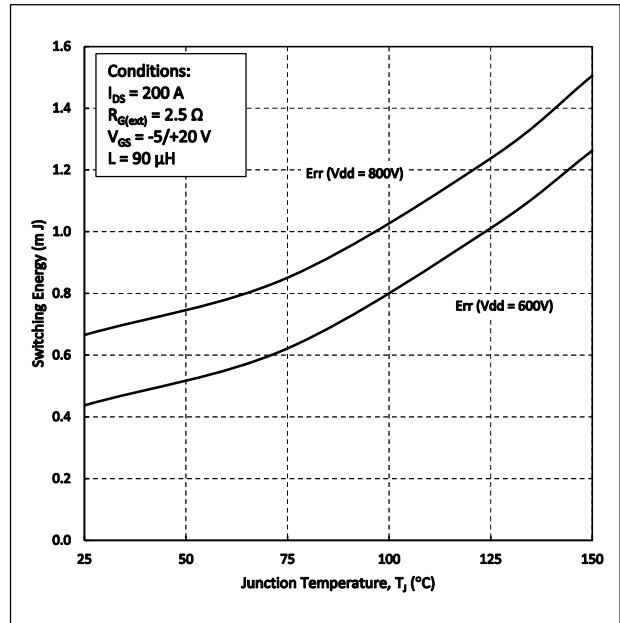


Figure 22. Reverse Recovery Energy vs. Temperature

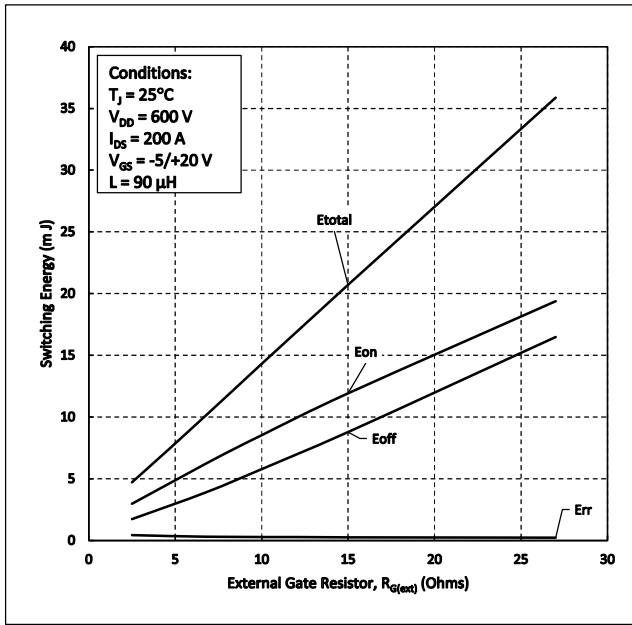


Figure 23. Clamped Inductive Switching Energy vs.  $R_{G(ext)}$

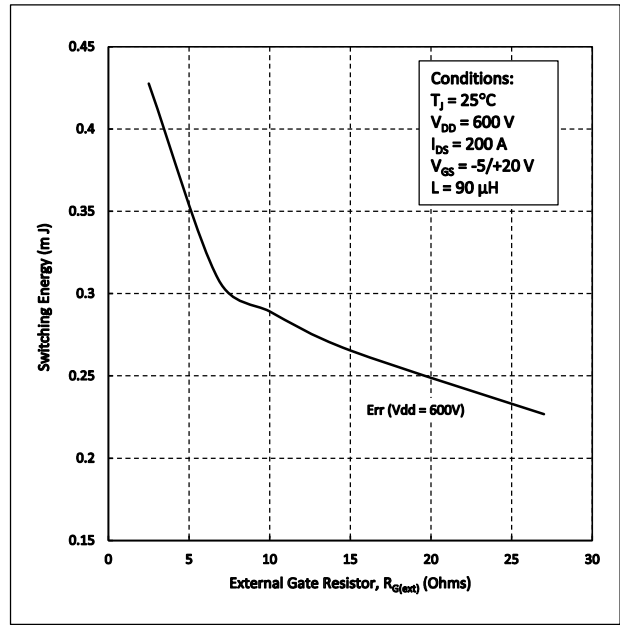


Figure 24. Reverse Recovery Energy vs.  $R_{G(ext)}$

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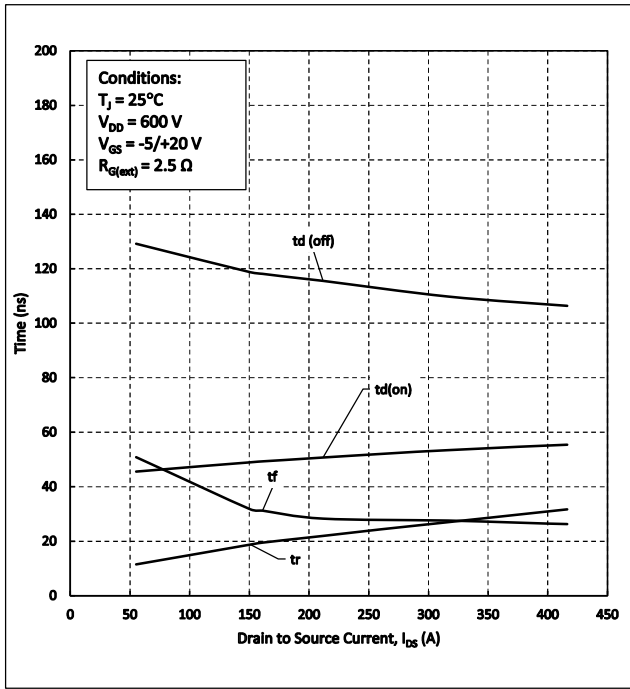


Figure 25. Switching Times vs. Drain Current

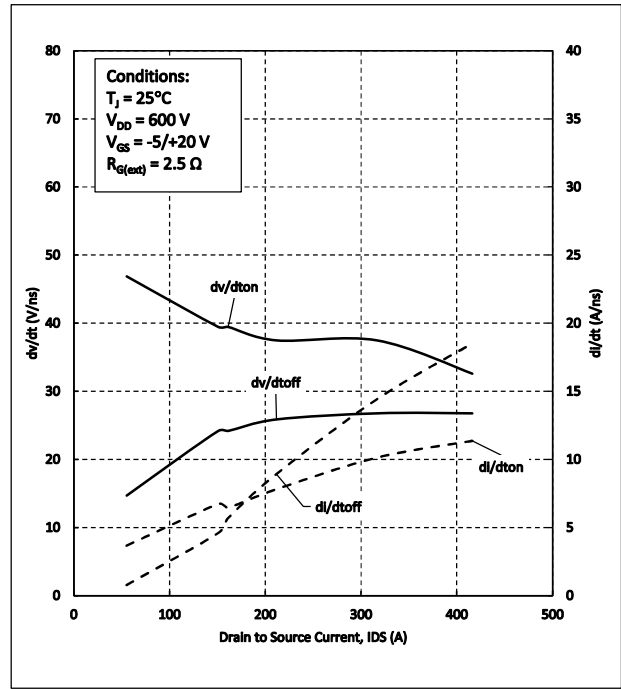


Figure 26.  $dv/dt$  and  $di/dt$  vs. Source Current

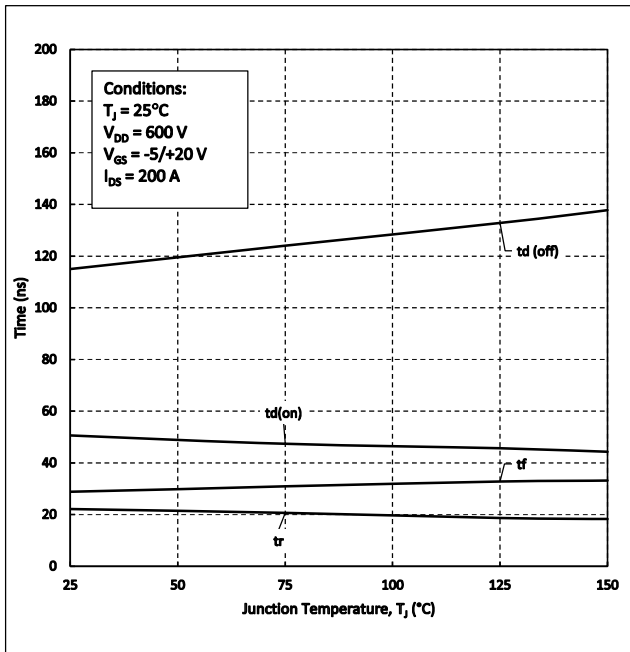


Figure 27. Switching Times vs. Temperature

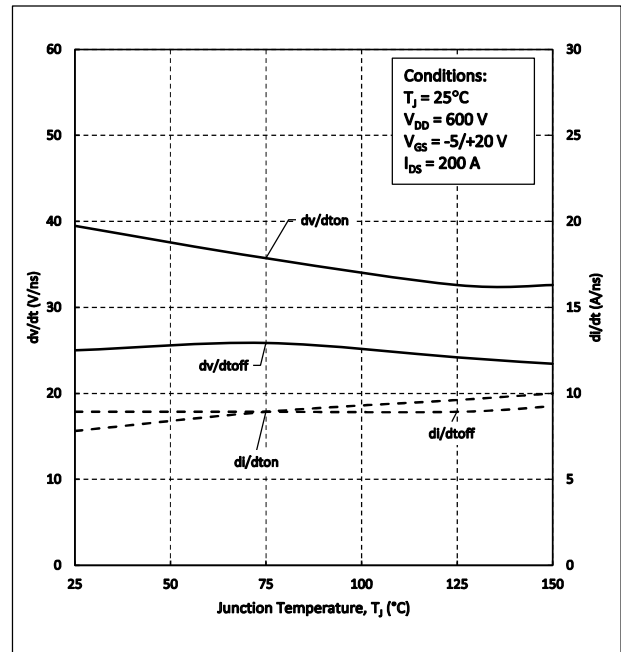


Figure 28.  $dv/dt$  and  $di/dt$  vs. Temperature

# 1200V SiC Half-Bridge Module

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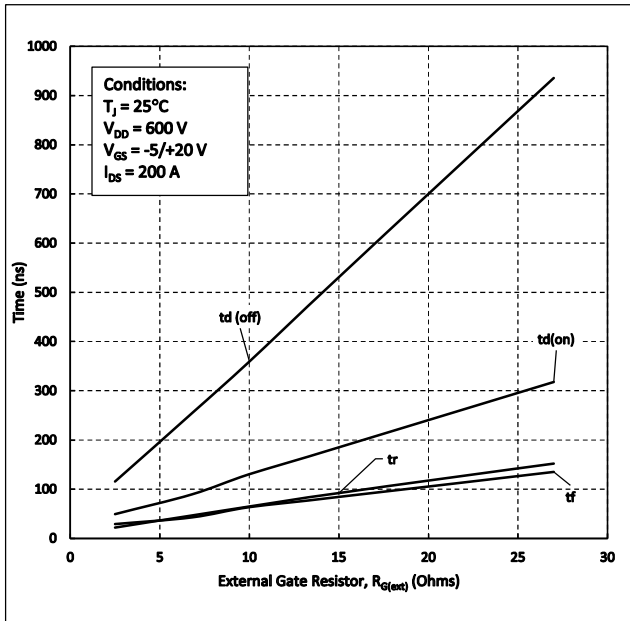


Figure 29. Switching Times vs.  $R_{G(ext)}$

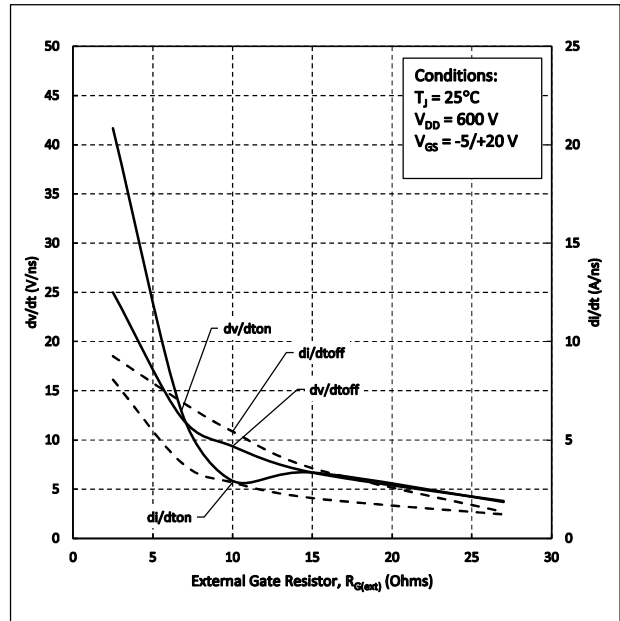


Figure 30.  $dv/dt$  and  $di/dt$  vs.  $R_{G(ext)}$

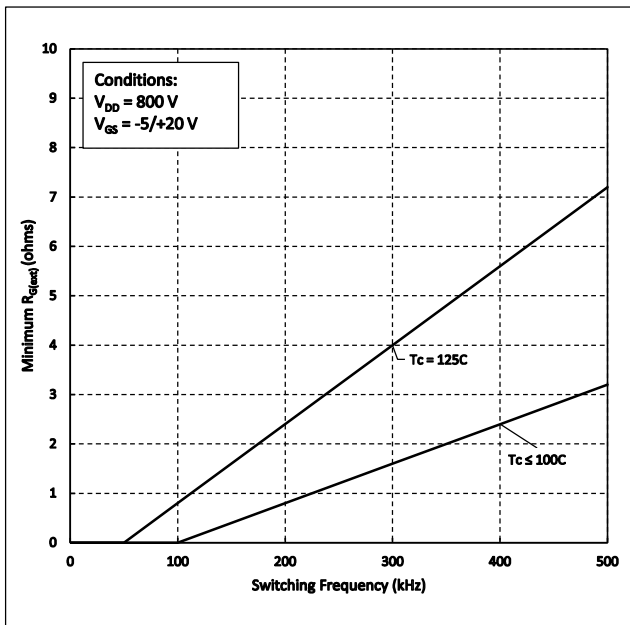


Figure 31. Frequency vs. Minimum  $R_{G(ext)}$

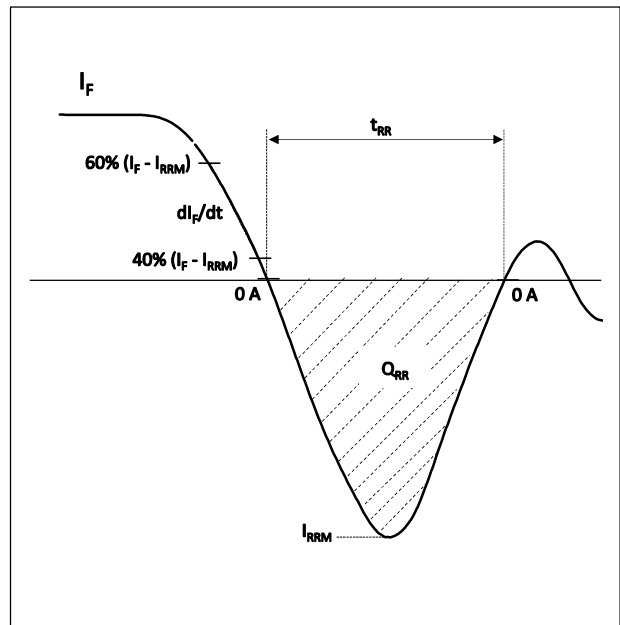


Figure 32. Reverse Recovery Definitions

# 1200V SiC Half-Bridge Module

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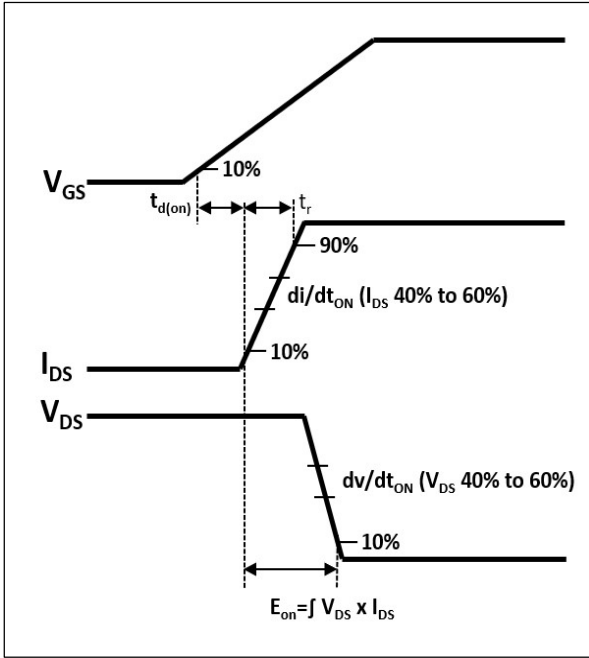


Figure 33. Turn-on Transient Definitions

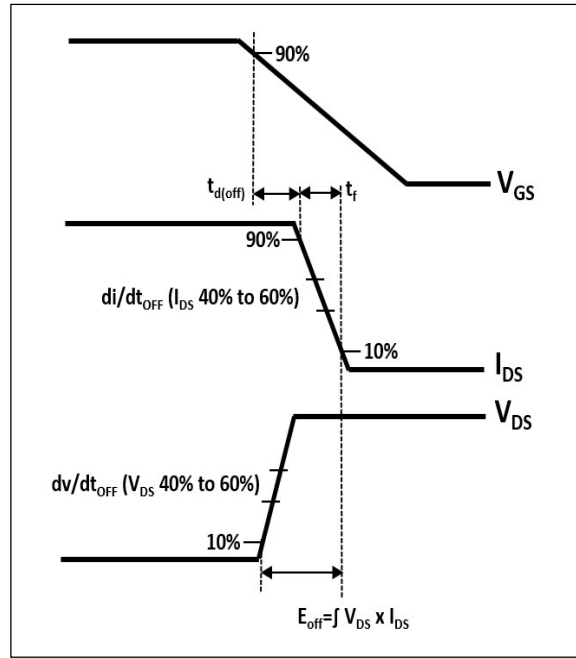
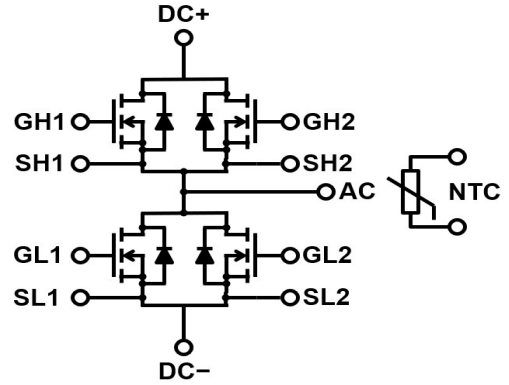
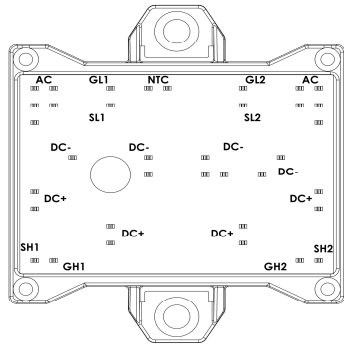


Figure 34. Turn-off Transient Definitions

# 1200V SiC Half-Bridge Module

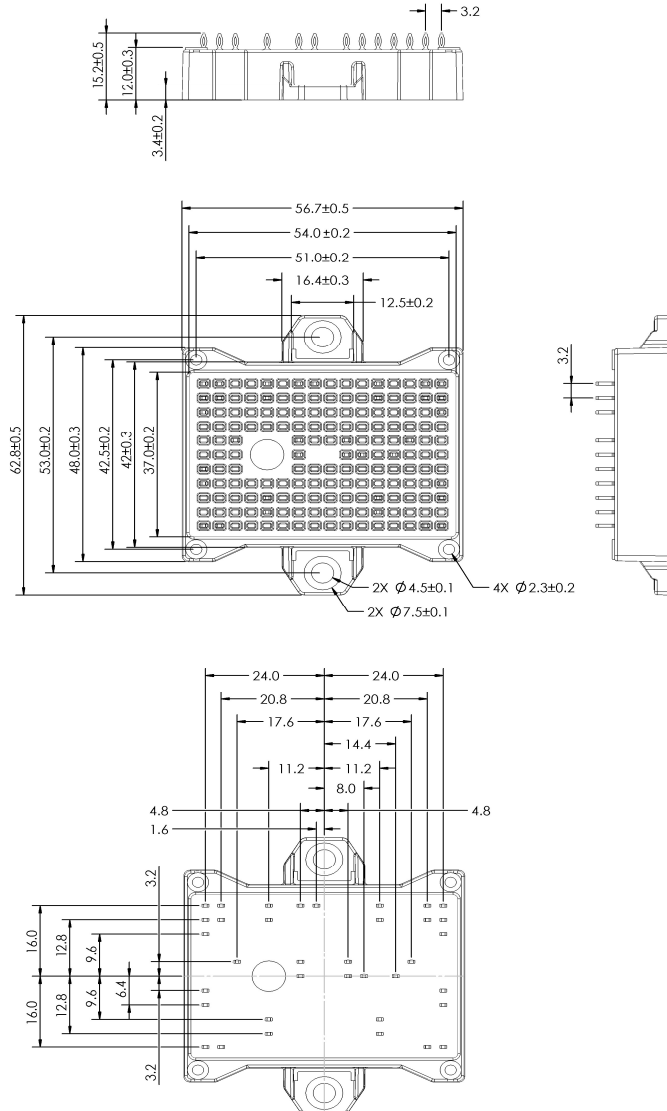
**GCMX005A120B3B1P**

## Pinout and Circuit Diagram



**Notes:** Gate pin pairs for high side and low side (GL1-GL2, GH1-GH2) are not internally connected.  
 Source sense pin pairs for high side and low side (SL1-SL2, SH1-SH2) are not internally connected.  
 Recommended to use separate  $R_{Gext}$  for each gate pin.

## Package Dimensions (mm)



# 1200V SiC Half-Bridge Module

**GCMX005A120B3B1P**

Revision History		
Date	Revision	Notes
7/24/2023	1.0	Initial release

## Notes

### RoHS Compliance

The levels of RoHS restricted materials in this product are below the maximum concentration values (also referred to as the threshold limits) permitted for such substances, or are used in an exempted application, in accordance with EU Directive 2011/65/EC (RoHS2), as implemented March, 2013. RoHS Declarations for this product can be obtained from the Product Documentation sections of [www.SemiQ.com](http://www.SemiQ.com).

### REACH Compliance

REACH substances of high concern (SVHC) information is available for this product. Since the European Chemicals Agency (ECHA) has published notice of their intent to frequently revise the SVHC listing for the foreseeable future, please contact our office at SemiQ Headquarters in Lake Forest, California to insure 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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