

# GCMX005A170S3B1-N

## QSiC™ 1700V SiC Half-Bridge Module

$V_{DS}$	1700 V
$R_{DS,on}$	5.3 mΩ
$I_D (T_C=25^\circ C)$	397 A
$T_{J,max}$	175°C

### Features

- 62mm standard footprint
- High speed switching SiC MOSFETs
- Reliable body diode
- All parts tested to above 1900V
- Kelvin reference for stable operation
- AlN Isolated baseplate

### Benefits

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

### Applications

- Photovoltaic and Wind Inverter
- EV/Battery charger
- Energy storage system
- High voltage DC to DC converter
- Induction Heating
- SMPS and UPS

### Package



Part #	Package	Marking
GCMX005A170S3B1-N	S3	GCMX005A170S3B1-N



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

Characteristics	Symbol	Conditions	Values	Unit
Drain-Source Voltage	$V_{rated}$	$V_{GS}=0V, I_D=1\mu A$	1700	V
Continuous Drain Current	$I_{DS}$	$T_C=25^\circ C, V_{GS}=20V, T_J=175^\circ C$	397	A
		$T_C=65^\circ C, V_{GS}=20V, T_J=175^\circ C$	344	
Body Diode Drain Current	$I_{SD}$	$T_C=25^\circ C, V_{GS}=-5V, T_J=175^\circ C$	486	
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	$P_{tot}$	$T_C=25^\circ C, T_J=175^\circ C$	2113	W
Junction Temperature	$T_J$	Continuous	-40...175	°C
Case & Storage Temperature	$T_C, T_{storage}$	Continuous	-40...150	°C

Static Electrical Characteristics, at T<sub>J</sub>=25°C, unless otherwise specified

Characteristics	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Drain-Source Breakdown Voltage	BV <sub>DSS</sub>	V <sub>GS</sub> =0V, I <sub>D</sub> =1mA	1700	-	-	V
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>DS</sub> =1700V, V <sub>GS</sub> =0V	-	0.6	6	μA
		V <sub>DS</sub> =1700V, V <sub>GS</sub> =0V, T <sub>J</sub> =150°C	-	6	600	
Gate-Source Leakage Current	I <sub>GSS+</sub>	V <sub>GS</sub> =20V, V <sub>DS</sub> =0V	-	60	1000	nA
	I <sub>GSS-</sub>	V <sub>GS</sub> =-5V, V <sub>DS</sub> =0V	-	-60	-1000	
Gate Threshold Voltage	V <sub>GS(th)</sub>	V <sub>GS</sub> =V <sub>DS</sub> , I <sub>D</sub> =120mA	1.8	2.7	4	V
		V <sub>GS</sub> =V <sub>DS</sub> , I <sub>D</sub> =120mA, T <sub>J</sub> =150°C	-	1.9	-	
Drain-Source On-Resistance	R <sub>DSon</sub> *	V <sub>GS</sub> =20V, I <sub>D</sub> =200A	-	5.3	7	mΩ
		V <sub>GS</sub> =20V, I <sub>D</sub> =100A	-	5.1	-	
		V <sub>GS</sub> =20V, I <sub>D</sub> =200A, T <sub>J</sub> =150°C	-	10.6	-	
Transconductance	g <sub>fs</sub>	V <sub>DS</sub> =20V, I <sub>D</sub> =200A	-	84.7	-	S
		V <sub>DS</sub> =20V, I <sub>D</sub> =200A, T <sub>J</sub> =150°C	-	94.8	-	
Internal Gate Resistance	R <sub>G(int)</sub>	f=1MHz, V <sub>AC</sub> =25mV, D-S Short, including internal 0.9 ohm series gate resistor**	-	1.3	-	Ω

\*R<sub>DSon</sub> including package resistance

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

AC Electrical Characteristics, at T<sub>J</sub>=25°C, unless otherwise specified

Characteristics	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Input Capacitance	C <sub>ISS</sub>	V <sub>GS</sub> =0V	-	43.6	-	nF
Output Capacitance	C <sub>OSS</sub>	V <sub>DS</sub> =1200V	-	1.17	-	
Reverse Transfer Capacitance	C <sub>RSS</sub>	f=200kHz	-	0.05	-	
Coss Stored Energy	E <sub>OSS</sub> ***	Vac=25mV	-	948	-	
Turn-On Switching Energy	E <sub>ON</sub>	T <sub>J</sub> =25°C	-	5.32	-	mJ
		T <sub>J</sub> =125°C	-	7.51	-	
		T <sub>J</sub> =150°C	-	7.97	-	
Turn-Off Switching Energy	E <sub>OFF</sub>	T <sub>J</sub> =25°C	-	2.39	-	
		T <sub>J</sub> =125°C	-	2.18	-	
		T <sub>J</sub> =150°C	-	2.16	-	
Turn-On Delay Time	t <sub>D(on)</sub>	V <sub>DD</sub> =900V, I <sub>DS</sub> =200A, R <sub>G(ext)</sub> =1Ω, V <sub>GS</sub> =-5/+20V, L=90μH	-	86	-	ns
Rise Time	t <sub>R</sub>		-	21	-	
Turn-Off Delay Time	t <sub>D(off)</sub>		-	143	-	
Fall Time	t <sub>F</sub>		-	32	-	
Total Gate Charge	Q <sub>G</sub>		V <sub>DD</sub> =1200V, I <sub>DS</sub> =200A	-	1415	
Gate to Source Charge	Q <sub>GS</sub>	V <sub>GS</sub> =-5/20V	-	491	-	
Gate to Drain Charge	Q <sub>GD</sub>		-	222	-	

\*\*\*E<sub>OSS</sub> is calculated from C<sub>OSS</sub> curve

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

Characteristics	Symbol	Conditions	Values			Unit	
			min.	typ.	max.		
Diode Forward Voltage	$V_{SD}$	$V_{GS}=-5V, I_S=200A$	-	4.0	-	V	
		$V_{GS}=-5V, I_S=200A, T_J=150^\circ\text{C}$	-	3.5	-		
Reverse Recovery Time	$t_{RR}$	$T_J=25^\circ\text{C}$	$I_S=200A,$ $V_R=900V,$ $V_{GS}=-5V,$ $di/dt=15.2A/ns$	-	24	-	ns
Reverse Recovery Charge	$Q_{RR}$			-	3052	-	nC
Peak Reverse Recovery Current	$I_{RRM}$			-	222	-	A
Reverse Recovery Energy	$E_{RR}$	$T_J=25^\circ\text{C}$	$I_S=200A,$ $V_R=900V,$ $V_{GS}=-5V/20V,$ $R_{G(ext)} = 1\Omega$	-	1.41	-	mJ
		$T_J=125^\circ\text{C}$		-	3.72	-	
		$T_J=150^\circ\text{C}$		-	4.52	-	

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	$R_{thJC}$		-	0.060	0.071	$^\circ\text{C/W}$
Mounting torque	$M_d$	M6-1.0 screws	-	-	5.0	N-m
Terminal connection torque	$M_{dt}$		-	-	5.0	N-m
Package weight	$W_t$		-	310	-	g
Isolation voltage	$V_{ISOL}$	$I_{ISOL} < 1mA, 50/60\text{ Hz}, 1\text{ min}$	4000	-	-	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

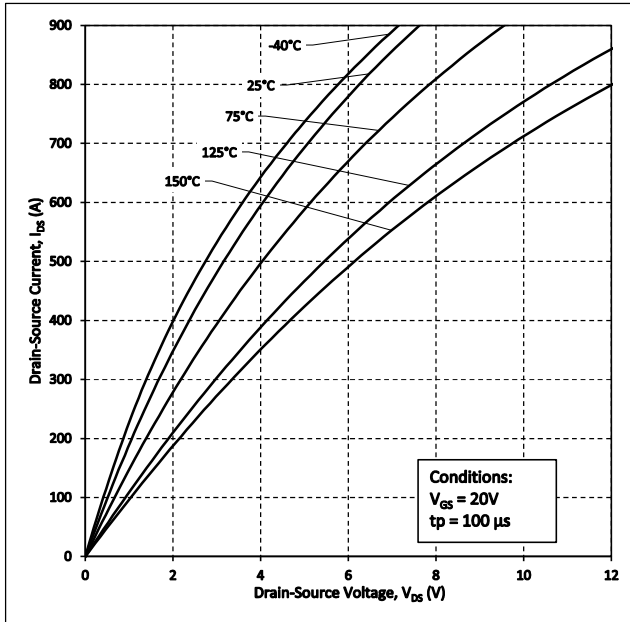


Figure 1. Output Characteristics for Various Temperatures

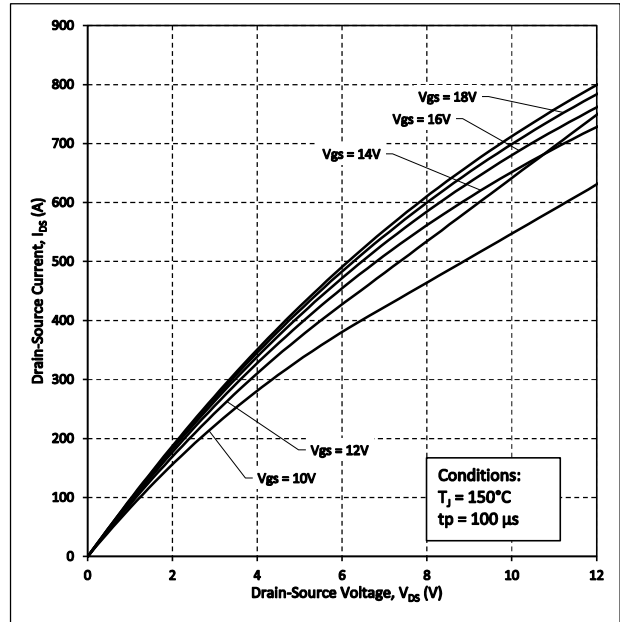


Figure 2. Output Characteristics  $T_J = 150^\circ C$

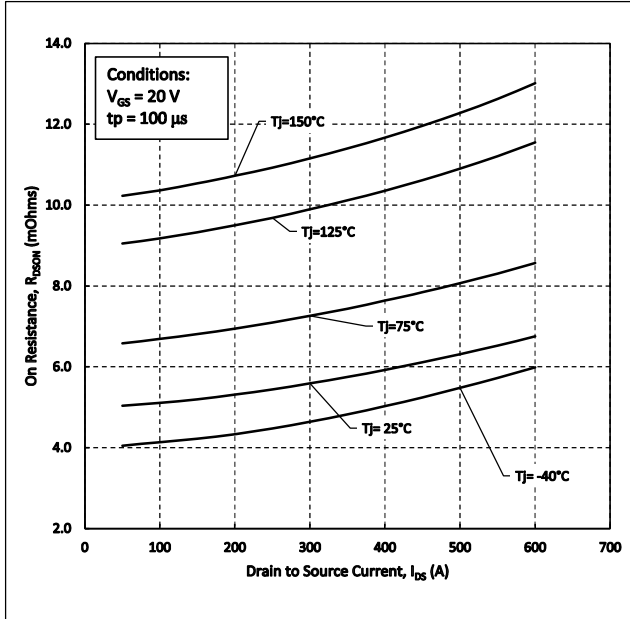


Figure 3. On-Resistance vs. Drain Current For Various Temperatures

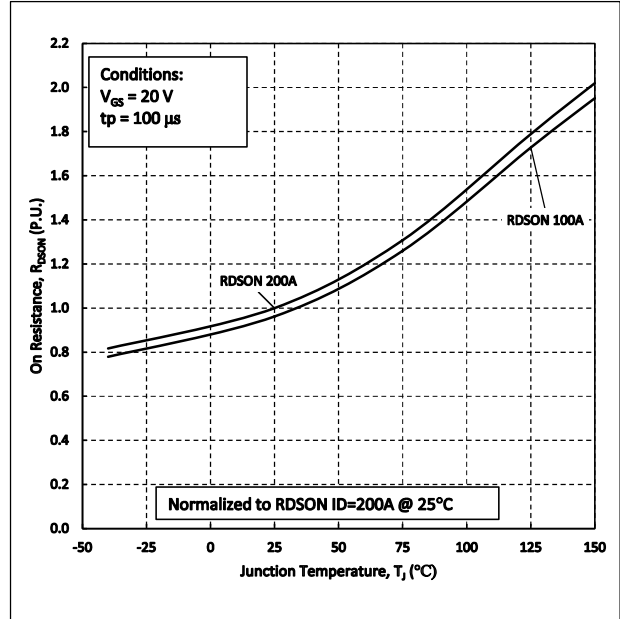


Figure 4. Normalized On-Resistance vs. Temperature

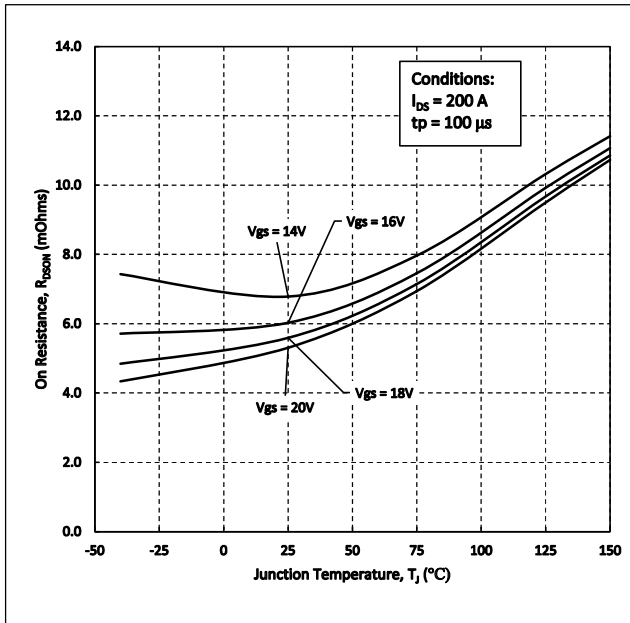


Figure 5. On-Resistance vs. Temperature For Various Gate Voltages

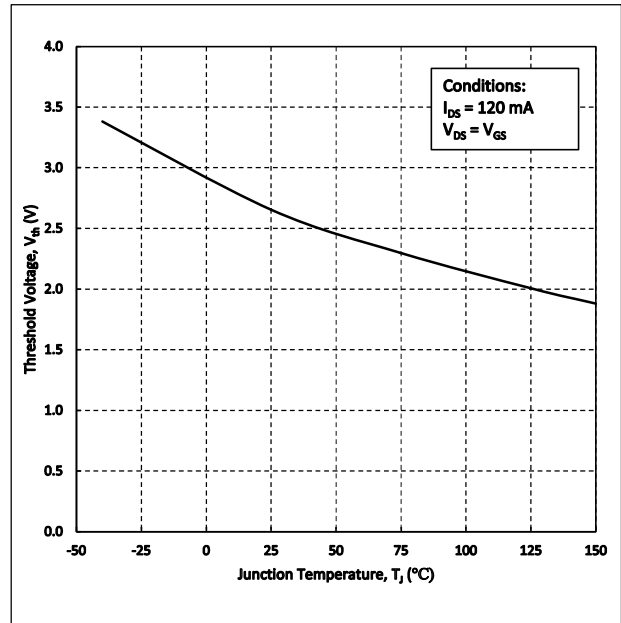


Figure 6. Threshold Voltage vs. Temperature

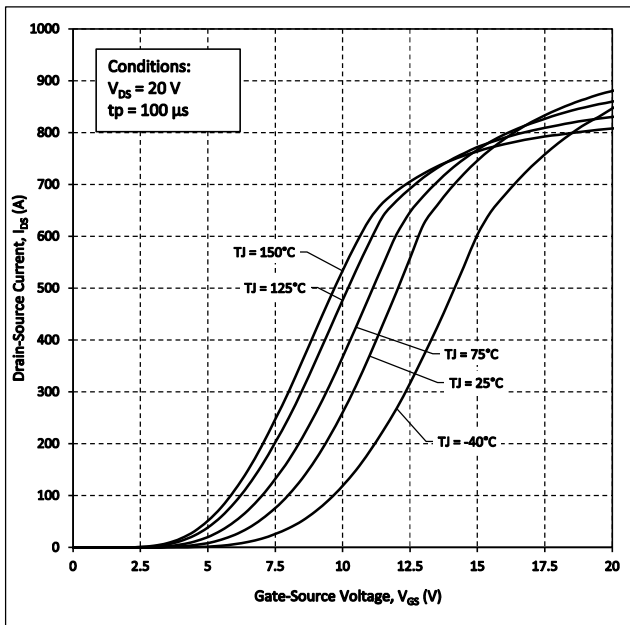


Figure 7. Transfer Characteristic for Various Junction Temperatures

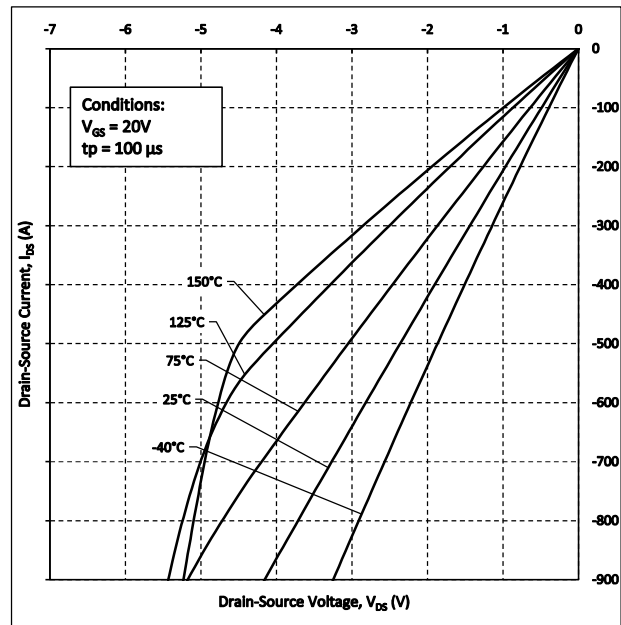


Figure 8. 3<sup>rd</sup> Quadrant Characteristics at V<sub>GS</sub> = 20V

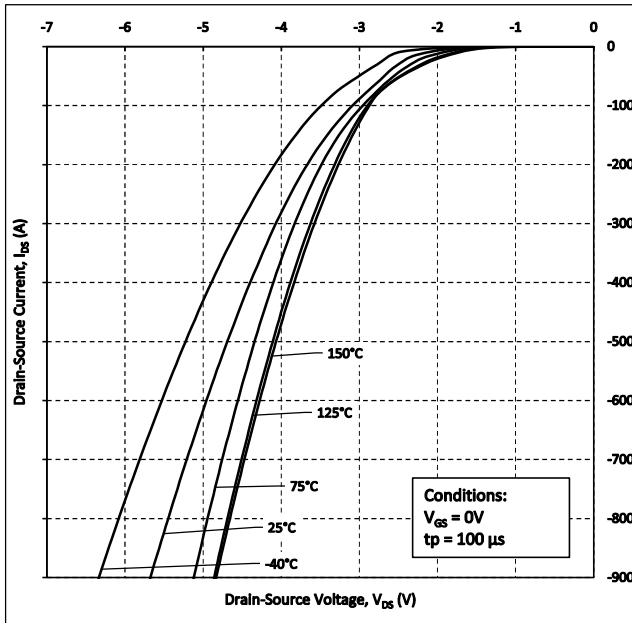


Figure 9. Body Diode Characteristics at  $V_{GS} = 0V$

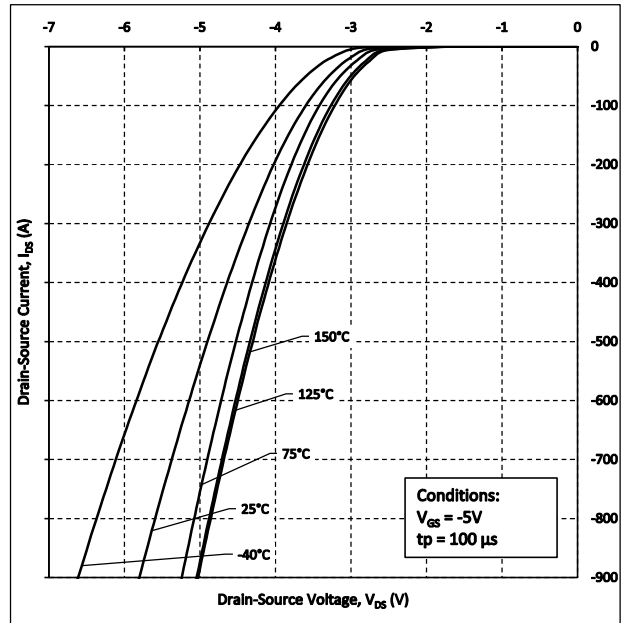


Figure 10. Body Diode Characteristics at  $V_{GS} = -5V$

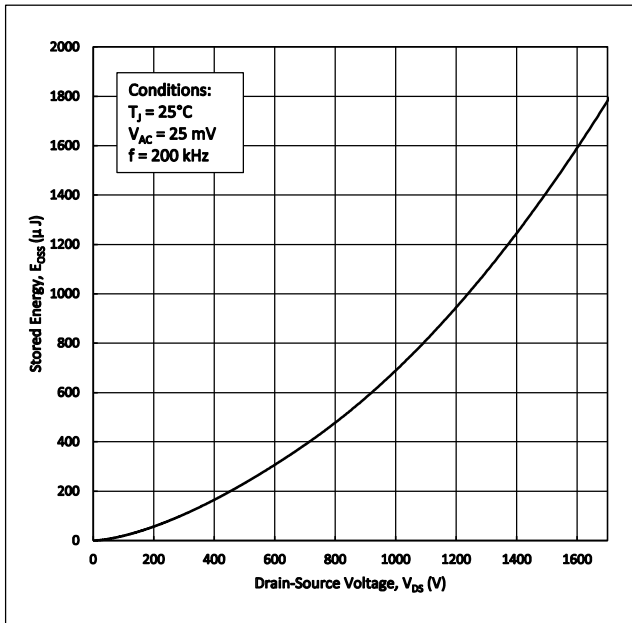


Figure 11. Output Capacitor Stored Energy

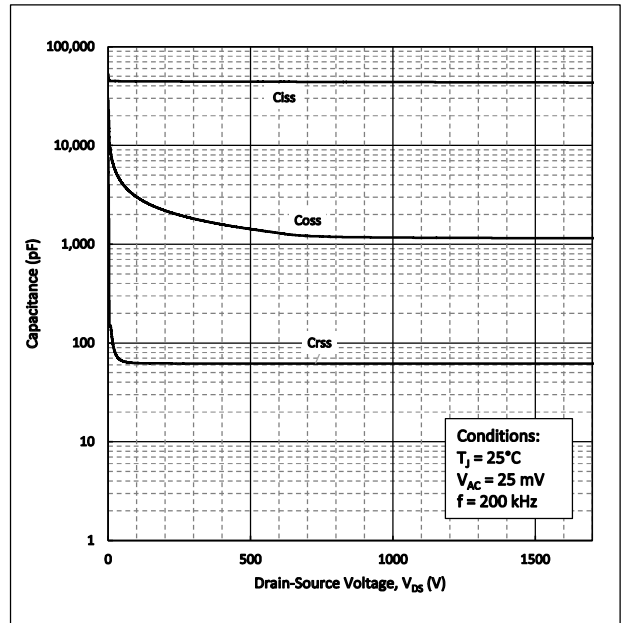


Figure 12. Capacitance vs. Drain-Source Voltage

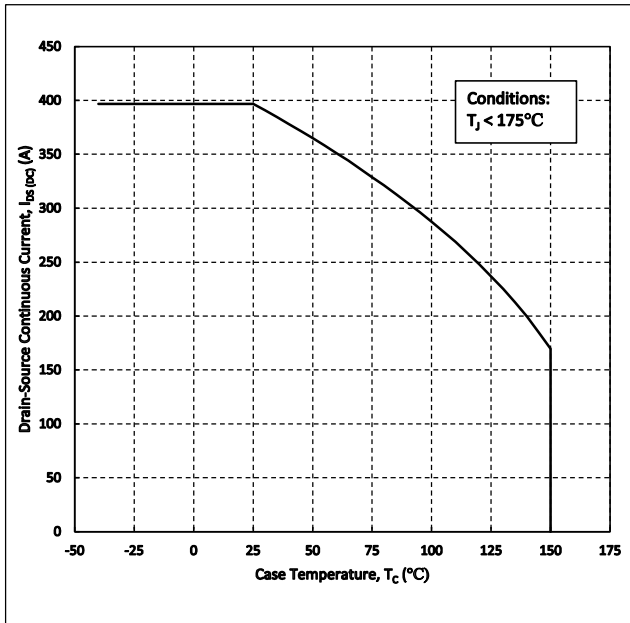


Figure 13. Continuous Drain Current Derating vs. Case Temperature

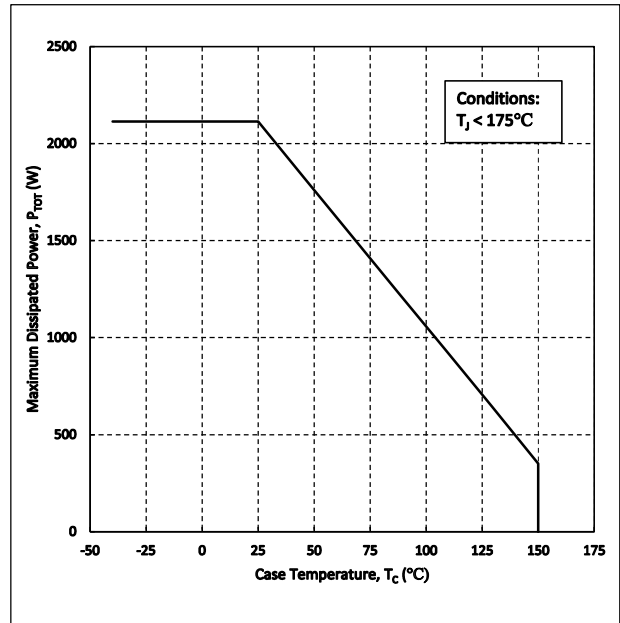


Figure 14. Maximum Power Dissipation Derating vs. Case Temperature

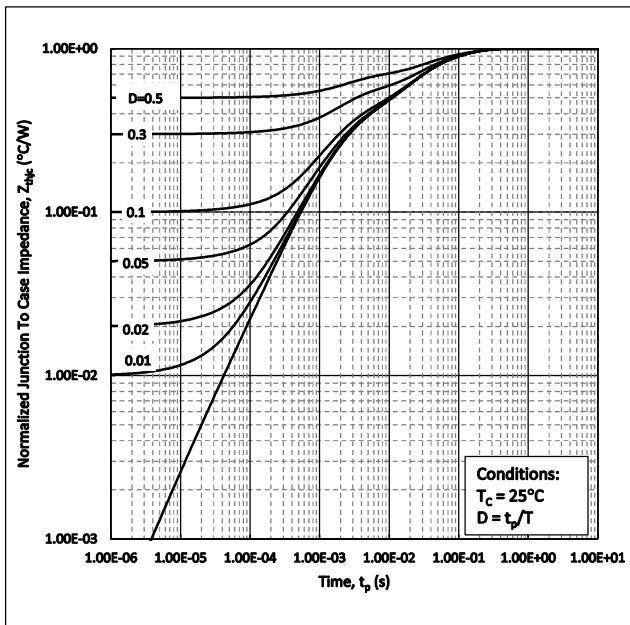


Figure 15. Transient Thermal impedance (Junction to Case)

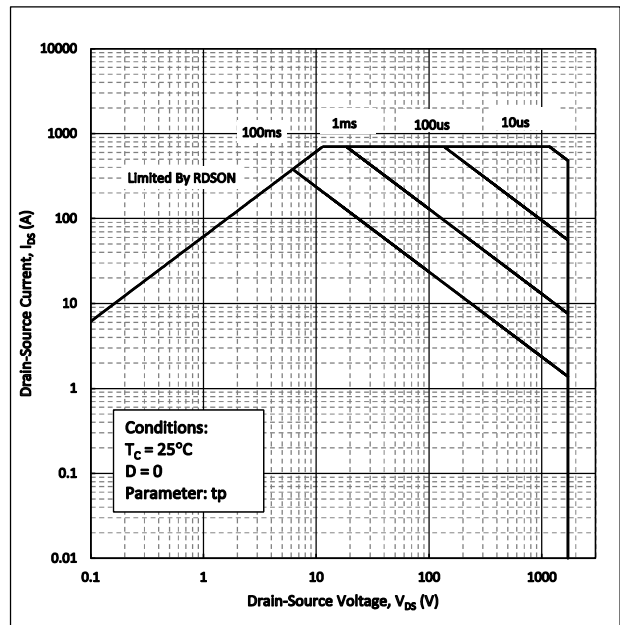


Figure 16. Safe Operating Area

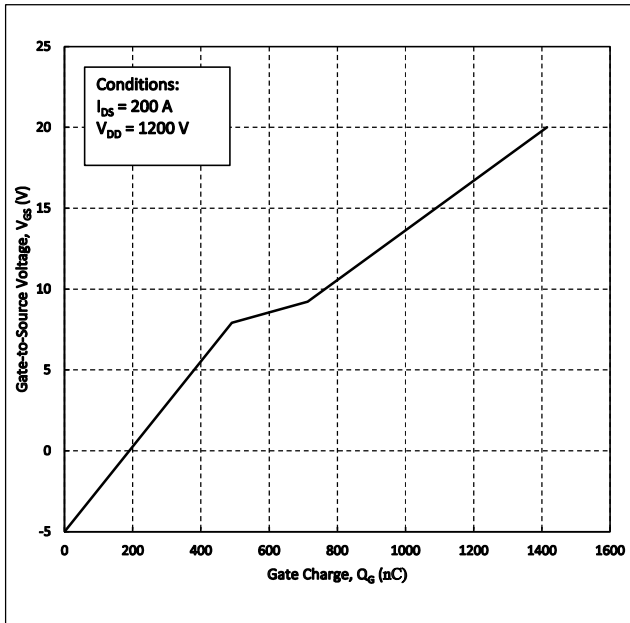


Figure 17. Gate Charge Characteristics

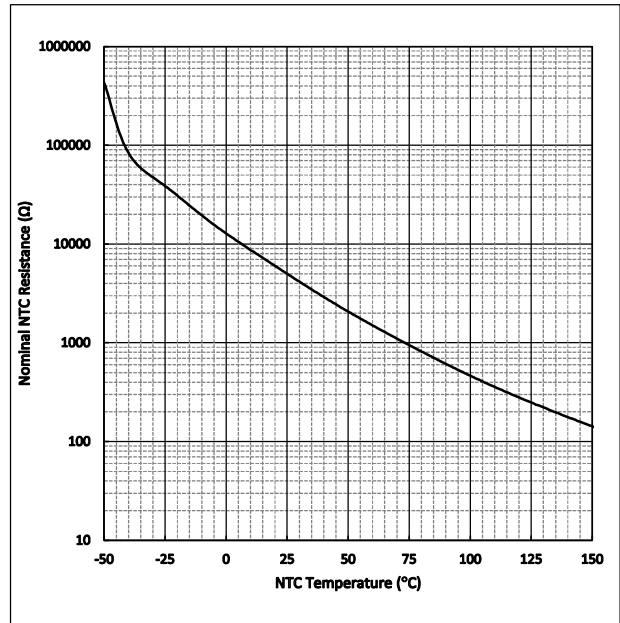


Figure 18. Nominal NTC Resistance vs. Temperature

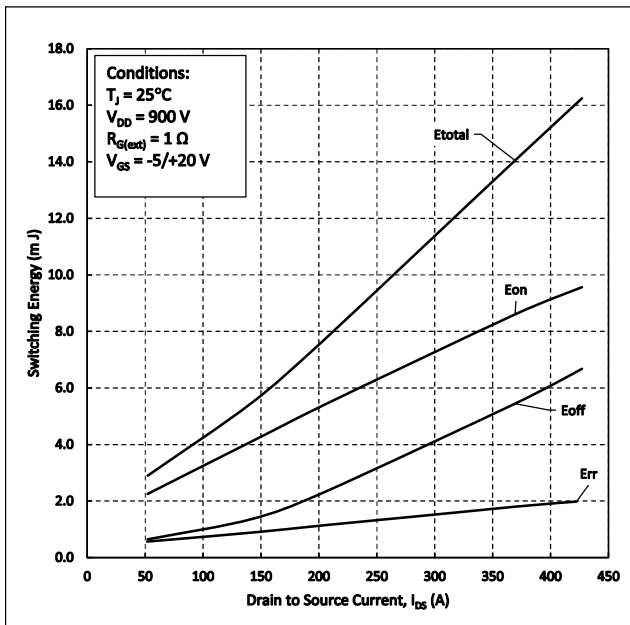


Figure 19. Clamped Inductive Switching Energy vs. Drain Current (900V)

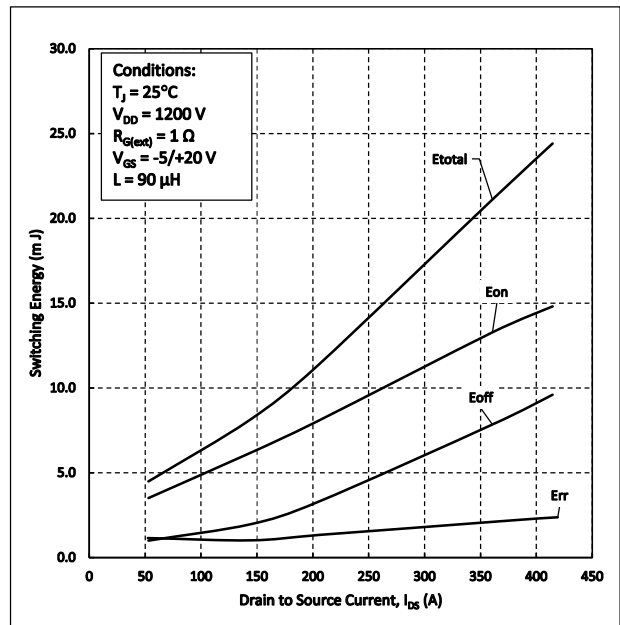


Figure 20. Clamped Inductive Switching Energy vs. Drain Current (1200V)

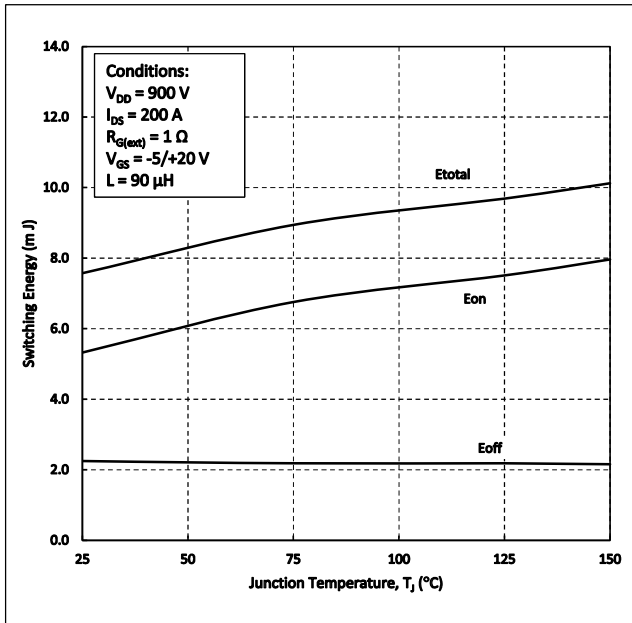


Figure 21. Clamped Inductive Switching Energy vs. Temperature

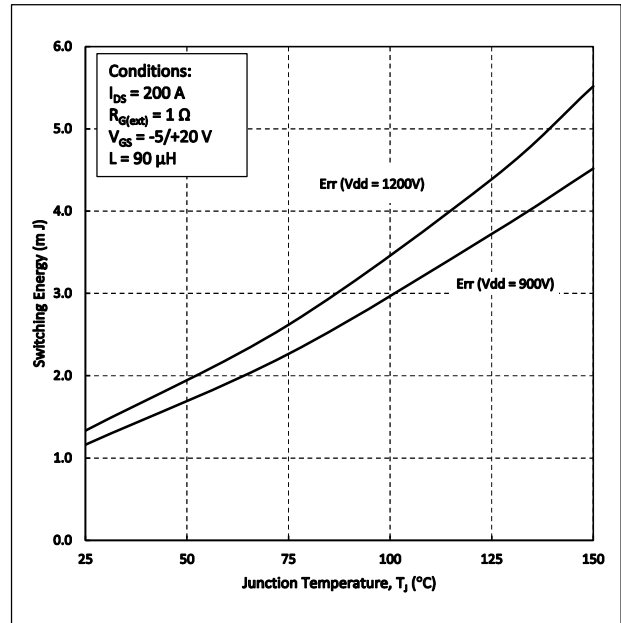


Figure 22. Reverse Recovery Energy vs. Temperature

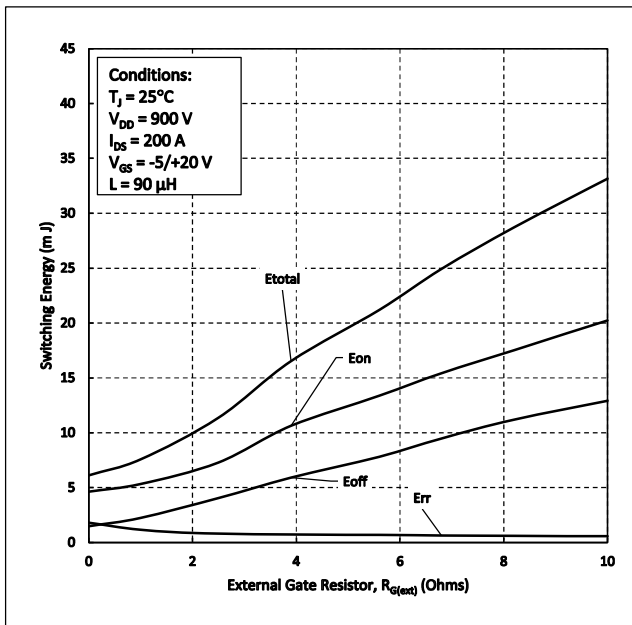


Figure 23. Clamped Inductive Switching Energy vs.  $R_{G(ext)}$

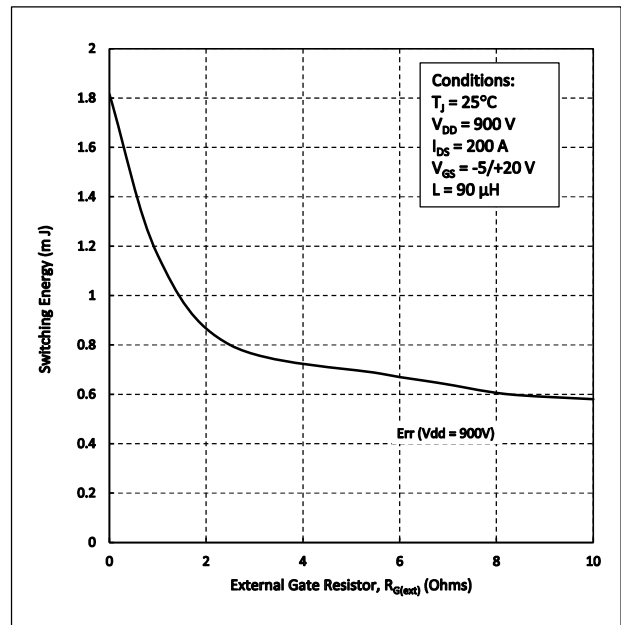


Figure 24. Reverse Recovery Energy vs.  $R_{G(ext)}$

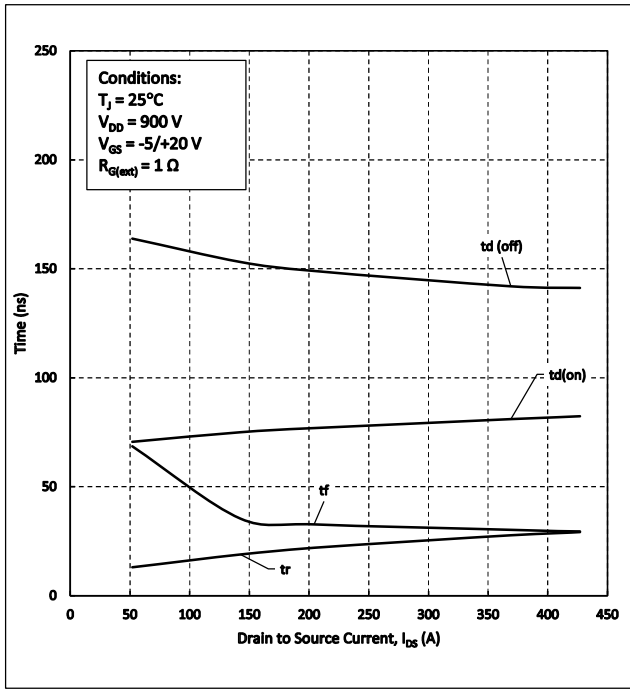


Figure 25. Switching Times vs. Drain Current

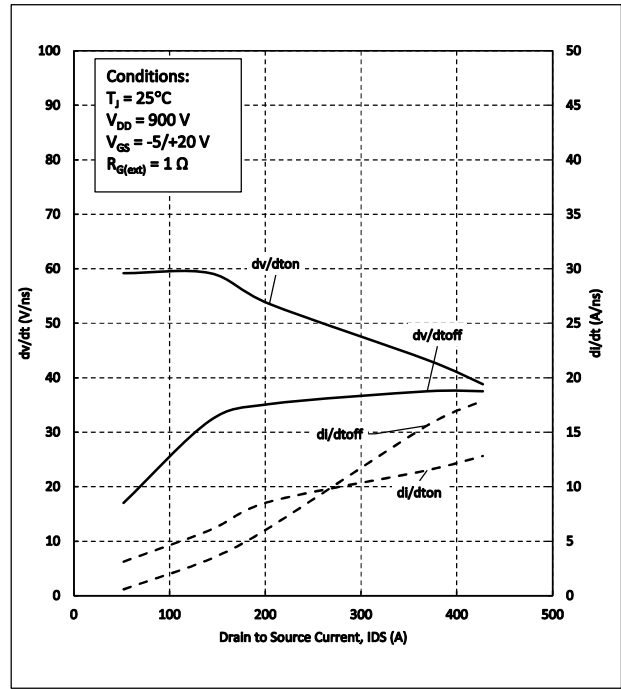


Figure 26.  $dv/dt$  and  $di/dt$  vs. Source Current

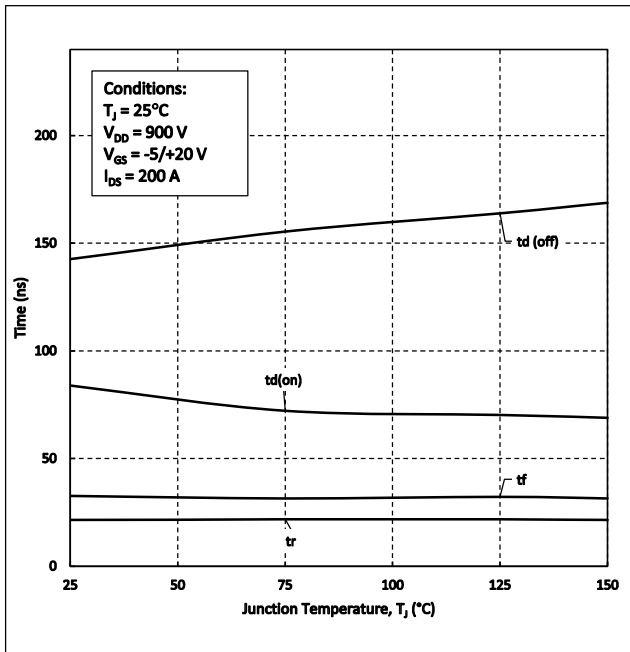


Figure 27. Switching Times vs. Temperature

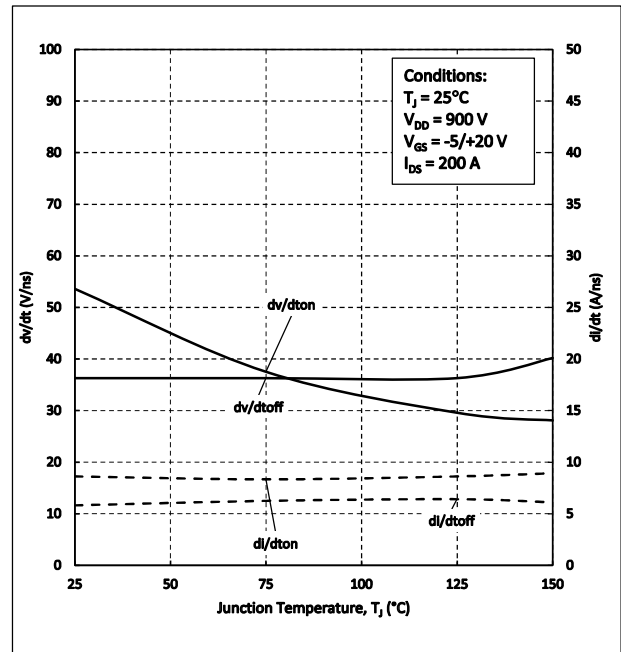


Figure 28.  $dv/dt$  and  $di/dt$  vs. Temperature

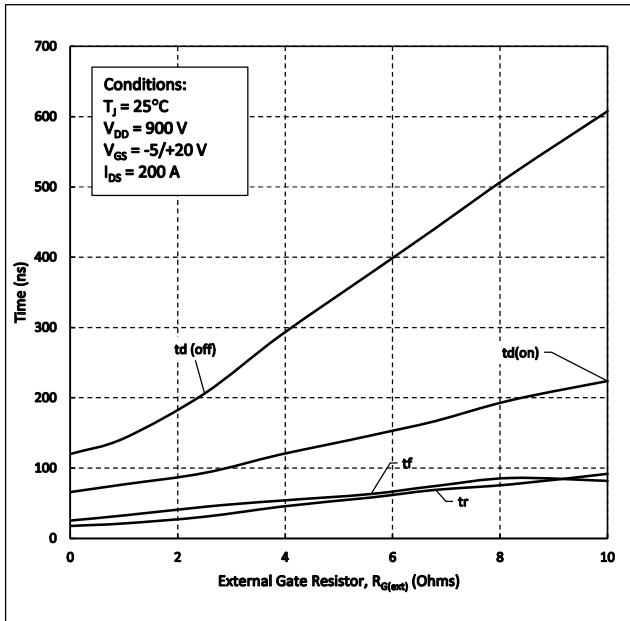


Figure 29. Switching Times vs.  $R_{G(ext)}$

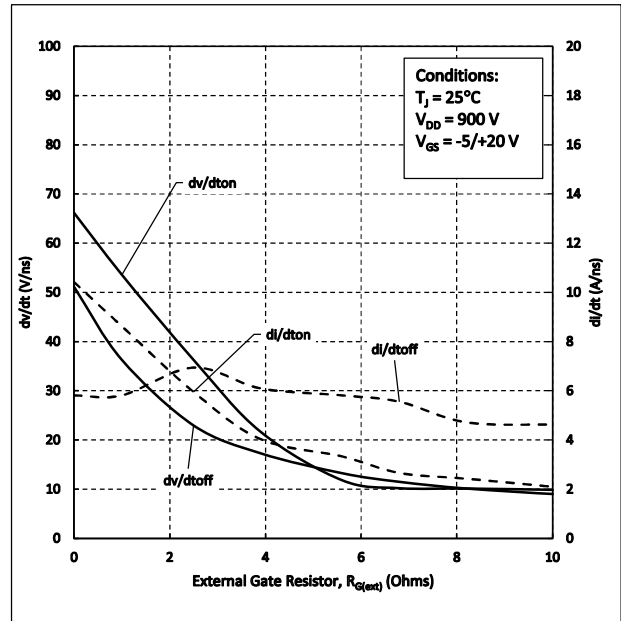


Figure 30.  $dv/dt$  and  $di/dt$  vs.  $R_{G(ext)}$

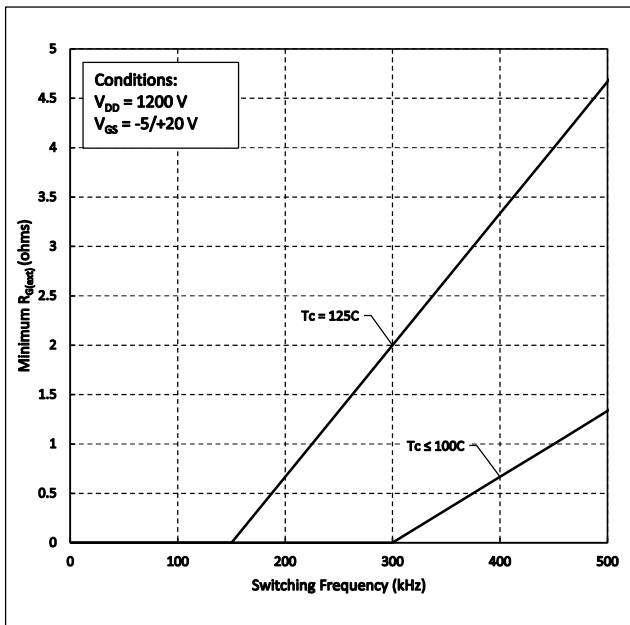


Figure 31. Frequency vs Minimum  $R_{G(ext)}$

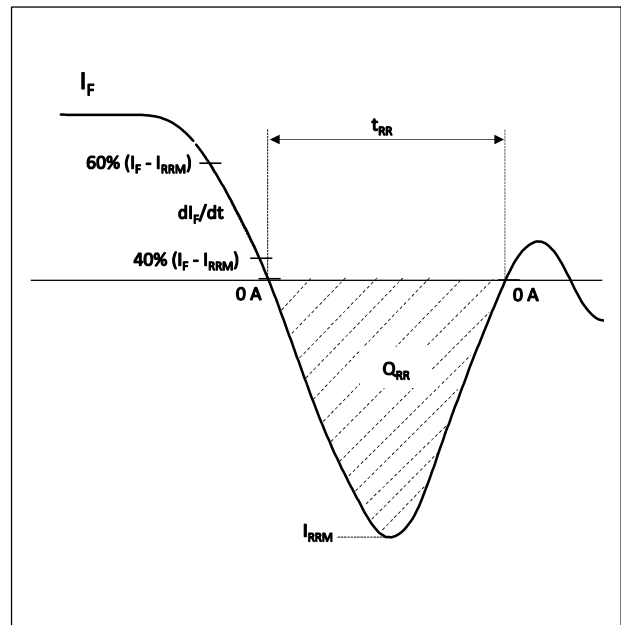


Figure 32. Reverse Recovery Definitions

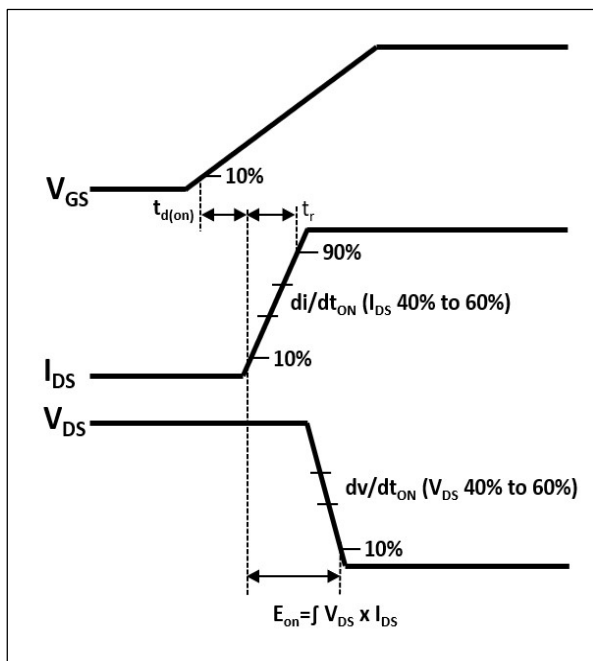


Figure 33. Turn-on Transient Definitions

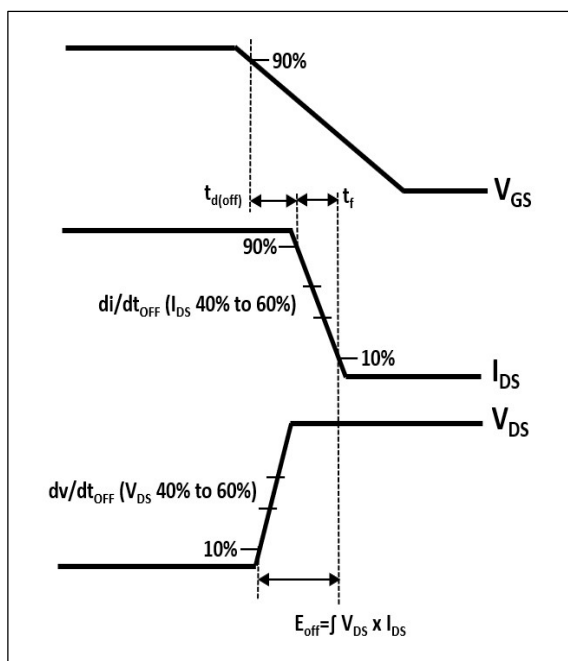
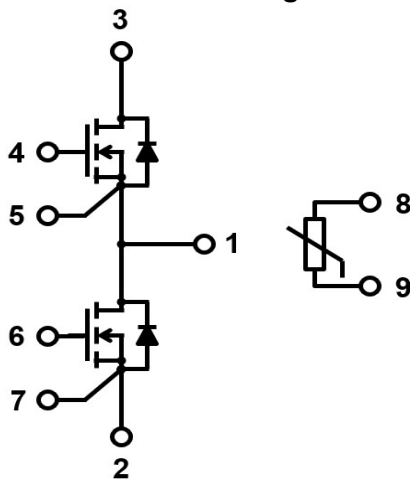


Figure 34. Turn-off Transient Definitions

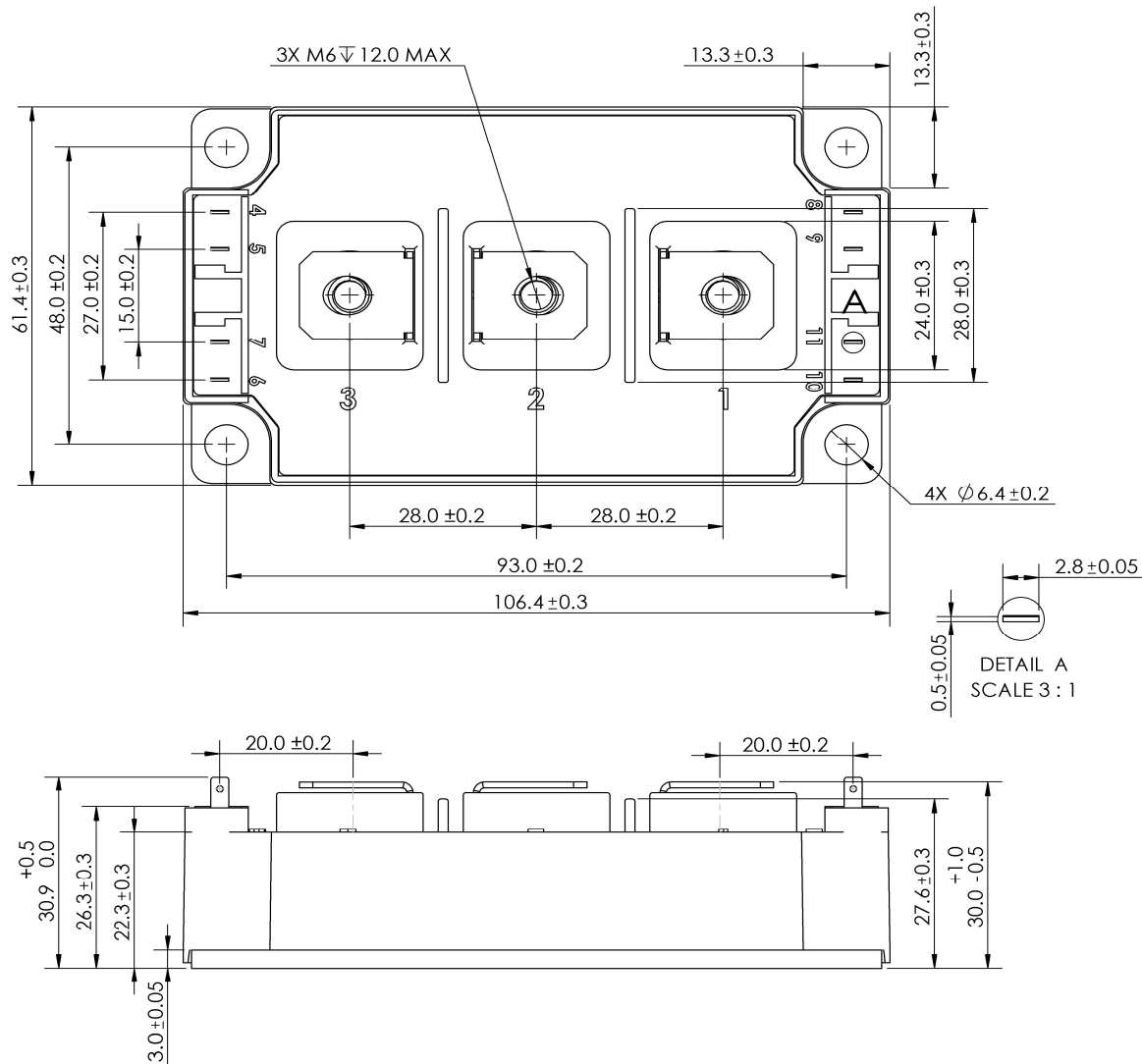
# QSiC™ 1700V SiC Half-Bridge Module

GCMX005A170S3B1-N

## Pinout and Circuit Diagram



## Package Dimensions (mm)



Revision History		
Date	Revision	Notes
12/13/2024	0.1	Preliminary release
12/20/2024	0.2	Fixed typo in tested voltage
4/4/2025	1	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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