



## Features

- High blocking voltage with low on-resistance
- High-speed switching with low capacitances
- Fast intrinsic diode with low reverse recovery ( $Q_{rr}$ )
- Halogen free, RoHS compliant

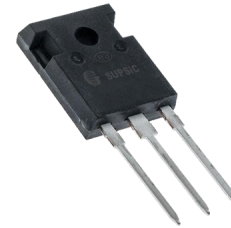
## Benefits

- Reduce switching losses and minimize gate ringing
- Higher system efficiency
- Reduce cooling requirements
- Increase power density
- Increase system switching frequency

## Applications

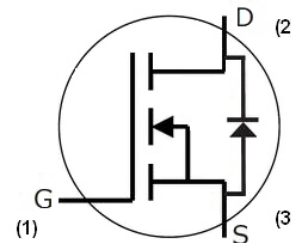
- Solar inverters
- EV motor drive
- High voltage DC/DC converters
- Switched mode power supplies
- Load switch

$V_{DS}$	1200 V
$I_D @ 25^\circ\text{C}$	81 A
$R_{DS(on)}$	21 m $\Omega$



TO-247-3

### Package



Part Number	Package	Marking
GC3M0021120D	TO-247-3	GC3M0021120

## Maximum Ratings ( $T_C = 25^\circ\text{C}$ unless otherwise specified)

Symbol	Parameter	Value	Unit	Test Conditions	Note
$V_{DSmax}$	Drain - Source Voltage	1200	V	$V_{GS} = 0\text{ V}, I_b = 100\ \mu\text{A}$	
$V_{GSmax}$	Gate - Source Voltage (dynamic)	-8/+19	V	AC ( $f > 1\text{ Hz}$ )	Note 1
$V_{GSop}$	Gate - Source Voltage (static)	-4/+15	V	Static	Note 2
$I_D$	Continuous Drain Current	81	A	$V_{GS} = 15\text{ V}, T_C = 25^\circ\text{C}$	Fig. 19 Note 3
		56		$V_{GS} = 15\text{ V}, T_C = 100^\circ\text{C}$	
$I_{D(pulse)}$	Pulsed Drain Current	200	A	Pulse width $t_p$ limited by $T_{jmax}$	
$P_D$	Power Dissipation	469	W	$T_C = 25^\circ\text{C}, T_J = 175^\circ\text{C}$	Fig. 20
$T_J, T_{stg}$	Operating Junction and Storage Temperature	-40 to +175	$^\circ\text{C}$		
$T_L$	Solder Temperature	260	$^\circ\text{C}$	1.6mm (0.063") from case for 10s	
$M_d$	Mounting Torque	1	Nm lbf-in	M3 or 6-32 screw	
		8.8			

Note (1): When using MOSFET Body Diode  $V_{GSmax} = -4\text{V}/+19\text{V}$

Note (2): MOSFET can also safely operate at 0/+15 V

Note (3): Die limits are 100A (25°C) and 74A (100°C)

**Electrical Characteristics** (T<sub>c</sub> = 25°C unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions	Note
V <sub>(BR)DSS</sub>	Drain-Source Breakdown Voltage	1200			V	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 100 μA	
V <sub>GS(th)</sub>	Gate Threshold Voltage	1.8	2.5	3.6	V	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 17.7 mA	Fig. 11
			2.0		V	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 17.7 mA, T <sub>J</sub> = 175°C	
I <sub>DSS</sub>	Zero Gate Voltage Drain Current		1	50	μA	V <sub>DS</sub> = 1200 V, V <sub>GS</sub> = 0 V	
I <sub>GSS</sub>	Gate-Source Leakage Current		10	250	nA	V <sub>GS</sub> = 15 V, V <sub>DS</sub> = 0 V	
R <sub>DS(on)</sub>	Drain-Source On-State Resistance	14.7	21	28.8	mΩ	V <sub>GS</sub> = 15 V, I <sub>D</sub> = 50 A	Fig. 4, 5, 6
			38			V <sub>GS</sub> = 15 V, I <sub>D</sub> = 50 A, T <sub>J</sub> = 175°C	
g <sub>fs</sub>	Transconductance		35		S	V <sub>DS</sub> = 20 V, I <sub>DS</sub> = 50 A	Fig. 7
			33			V <sub>DS</sub> = 20 V, I <sub>DS</sub> = 50 A, T <sub>J</sub> = 175°C	
C <sub>iss</sub>	Input Capacitance		4818		pF	V <sub>GS</sub> = 0 V, V <sub>DS</sub> = 1000 V f = 100 KHz V <sub>AC</sub> = 25 mV	Fig. 17, 18
C <sub>oss</sub>	Output Capacitance		180				
C <sub>rss</sub>	Reverse Transfer Capacitance		12				
E <sub>oss</sub>	C <sub>oss</sub> Stored Energy		99		μJ		Fig. 16
E <sub>ON</sub>	Turn-On Switching Energy (SiC Diode FWD)		3.05		mJ	V <sub>DS</sub> = 800 V, V <sub>GS</sub> = -4 V/+15 V, I <sub>D</sub> = 50 A, R <sub>G(ext)</sub> = 5Ω, L = 65.7 μH, T <sub>J</sub> = 175°C	Fig. 26, 29
E <sub>OFF</sub>	Turn Off Switching Energy (SiC Diode FWD)		1.67				
E <sub>ON</sub>	Turn-On Switching Energy (Body Diode FWD)		4.65		mJ	V <sub>DS</sub> = 800 V, V <sub>GS</sub> = -4 V/+15 V, I <sub>D</sub> = 50 A, R <sub>G(ext)</sub> = 5Ω, L = 65.7 μH, T <sub>J</sub> = 175°C	Fig. 26, 29
E <sub>OFF</sub>	Turn Off Switching Energy (Body Diode FWD)		1.58				
t <sub>d(on)</sub>	Turn-On Delay Time		142		ns	V <sub>DD</sub> = 800 V, V <sub>GS</sub> = -4 V/15 V R <sub>G(ext)</sub> = 2.5 Ω, L = 65.7 μH Timing relative to V <sub>DS</sub> , Inductive load	Fig. 27
t <sub>r</sub>	Rise Time		27				
t <sub>d(off)</sub>	Turn-Off Delay Time		72				
t <sub>f</sub>	Fall Time		25				
R <sub>G(int)</sub>	Internal Gate Resistance		3.3		Ω	f = 1 MHz, V <sub>AC</sub> = 25 mV	
Q <sub>gs</sub>	Gate to Source Charge		51		nC	V <sub>DS</sub> = 800 V, V <sub>GS</sub> = -4 V/15 V I <sub>D</sub> = 50 A Per IEC60747-8-4 pg 21	Fig. 12
Q <sub>gd</sub>	Gate to Drain Charge		54				
Q <sub>g</sub>	Total Gate Charge		160				

**Reverse Diode Characteristics** (T<sub>c</sub> = 25°C unless otherwise specified)

Symbol	Parameter	Typ.	Max.	Unit	Test Conditions	Note
V <sub>SD</sub>	Diode Forward Voltage	4.6		V	V <sub>GS</sub> = -4 V, I <sub>SD</sub> = 25 A, T <sub>J</sub> = 25 °C	Fig. 8, 9, 10
		4.2		V	V <sub>GS</sub> = -4 V, I <sub>SD</sub> = 25 A, T <sub>J</sub> = 175 °C	
I <sub>S</sub>	Continuous Diode Forward Current		90	A	V <sub>GS</sub> = -4 V, T <sub>C</sub> = 25°C	Note 1
I <sub>S, pulse</sub>	Diode pulse Current		200	A	V <sub>GS</sub> = -4 V, pulse width t <sub>p</sub> limited by T <sub>Jmax</sub>	Note 1
t <sub>rr</sub>	Reverse Recover time	81		ns	V <sub>GS</sub> = -4 V, I <sub>SD</sub> = 50 A, V <sub>R</sub> = 800 V dif/dt = 1000 A/μs, T <sub>J</sub> = 175 °C	Note 1
Q <sub>rr</sub>	Reverse Recovery Charge	879		nC		
I <sub>rrm</sub>	Peak Reverse Recovery Current	19		A		

**Thermal Characteristics**

Symbol	Parameter	Typ.	Unit	Test Conditions	Note
R <sub>θJC</sub>	Thermal Resistance from Junction to Case	0.32	°C/W		Fig. 21
R <sub>θJA</sub>	Thermal Resistance From Junction to Ambient	40			

Typical Performance

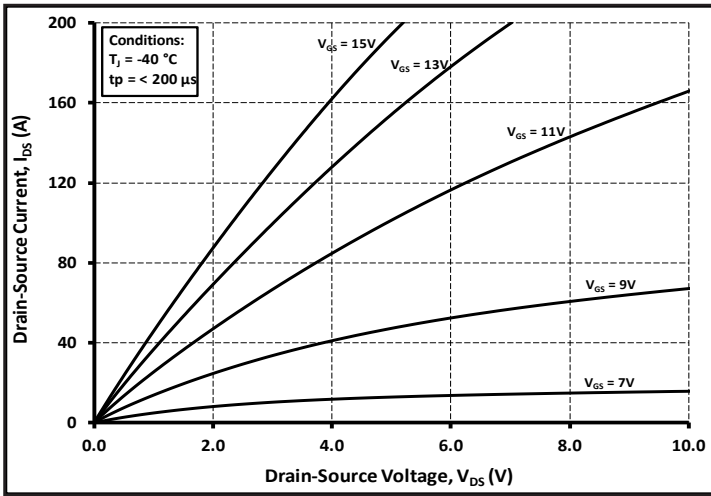


Figure 1. Output Characteristics  $T_J = -40\text{ }^\circ\text{C}$

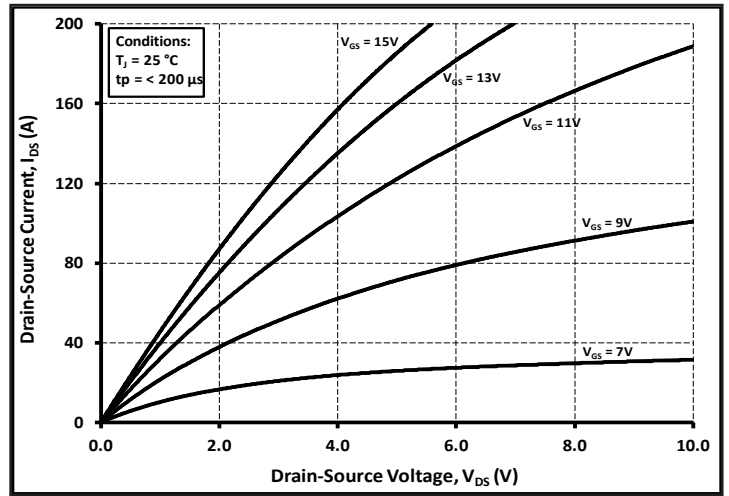


Figure 2. Output Characteristics  $T_J = 25\text{ }^\circ\text{C}$

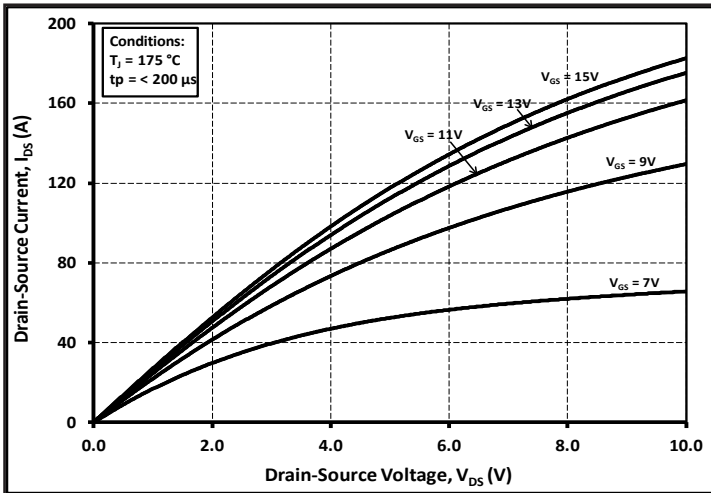


Figure 3. Output Characteristics  $T_J = 175\text{ }^\circ\text{C}$

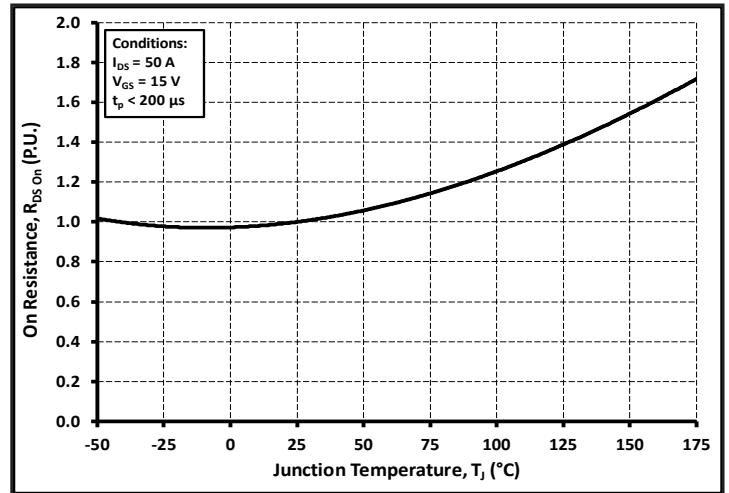


Figure 4. Normalized On-Resistance vs. Temperature

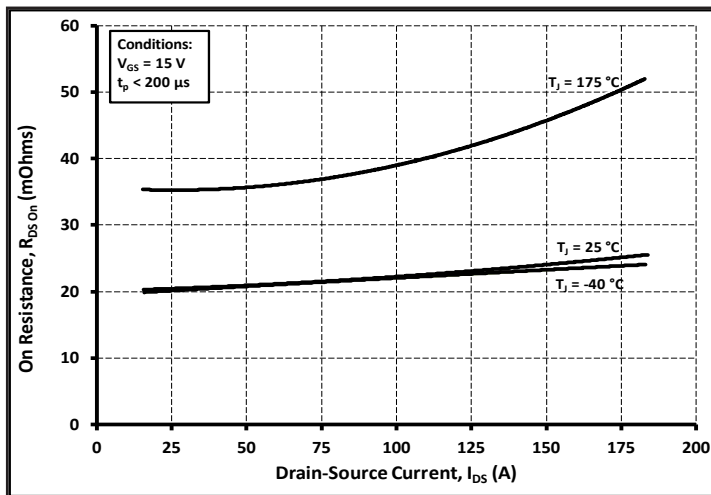


Figure 5. On-Resistance vs. Drain Current For Various Temperatures

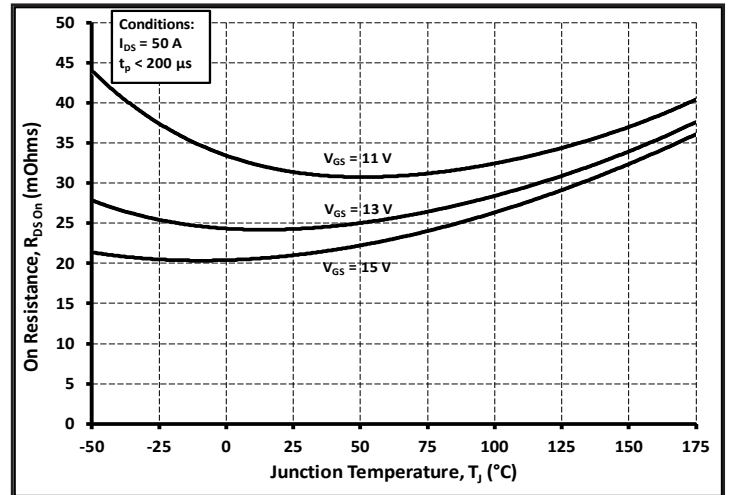


Figure 6. On-Resistance vs. Temperature For Various Gate Voltage

Typical Performance

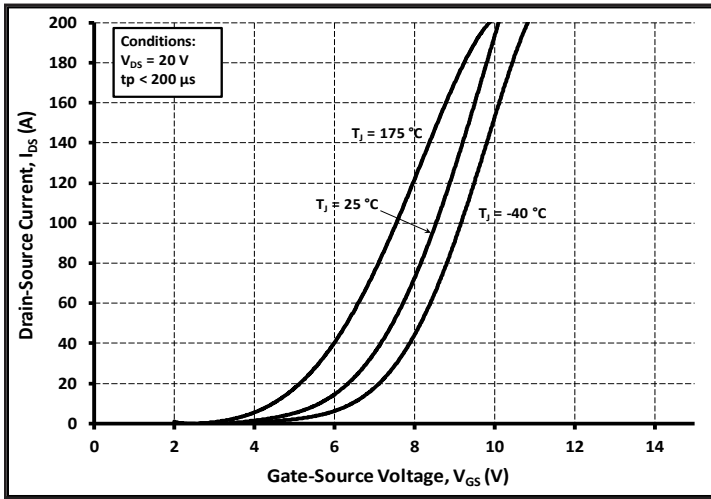


Figure 7. Transfer Characteristic for Various Junction Temperatures

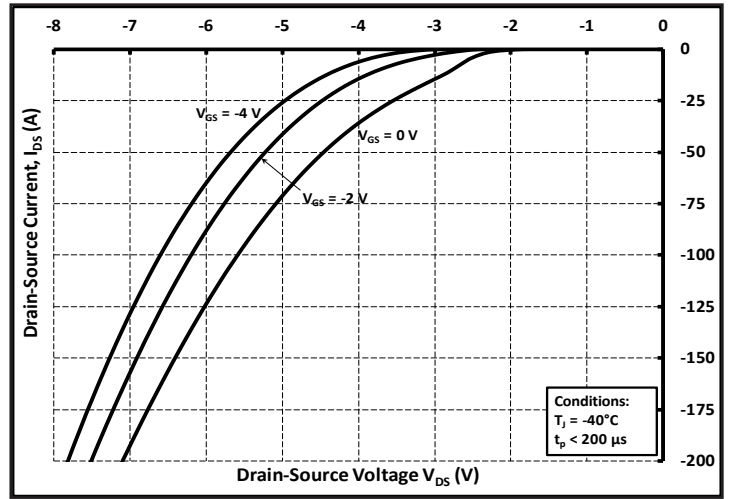


Figure 8. Body Diode Characteristic at -40 °C

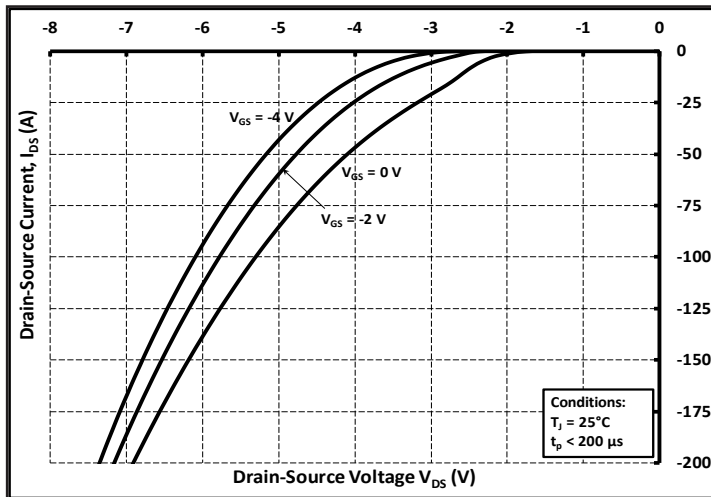


Figure 9. Body Diode Characteristic at 25 °C

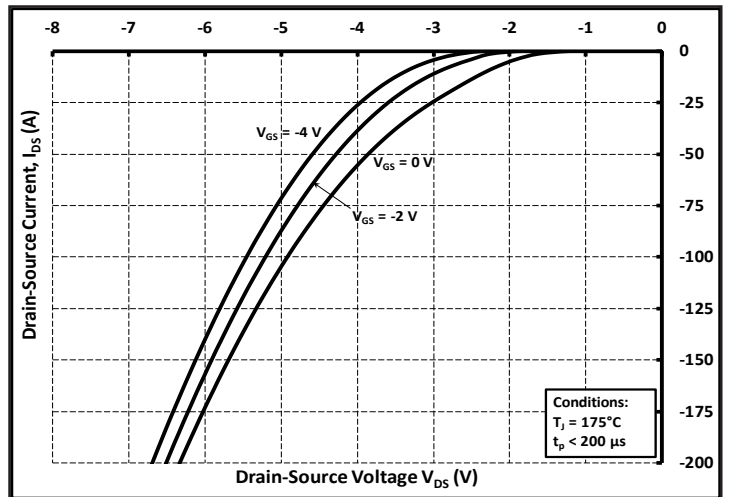


Figure 10. Body Diode Characteristic at 175 °C

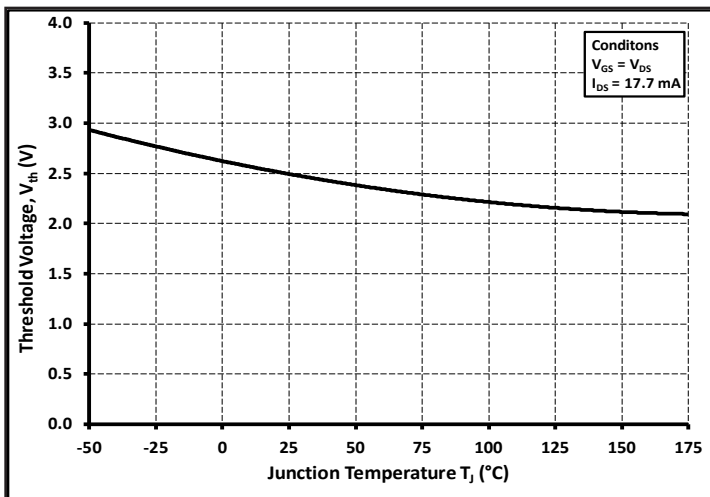


Figure 11. Threshold Voltage vs. Temperature

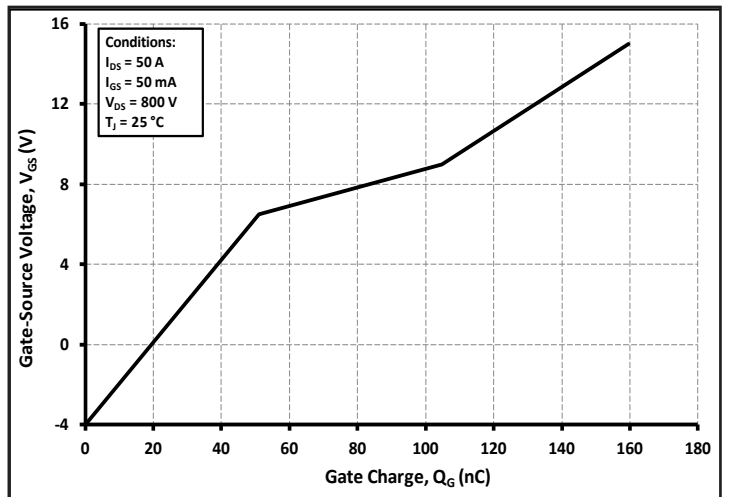


Figure 12. Gate Charge Characteristics

Typical Performance

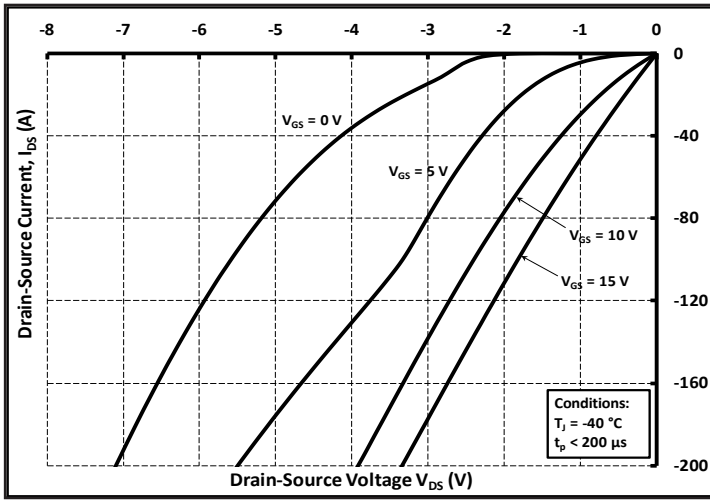


Figure 13. 3rd Quadrant Characteristic at -40 °C

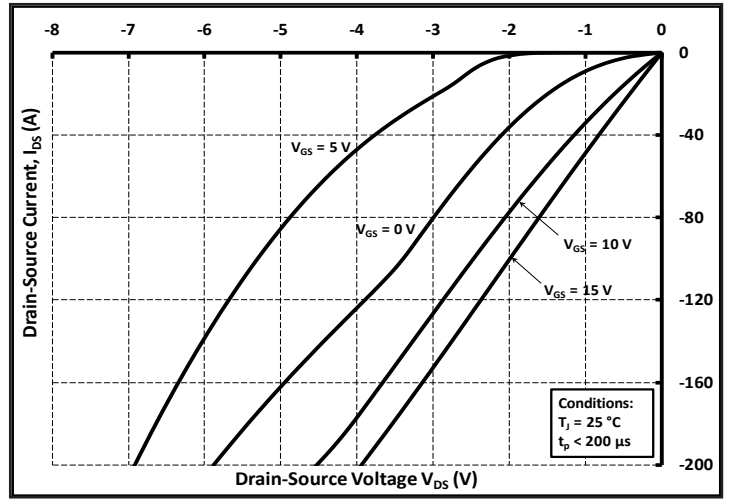


Figure 14. 3rd Quadrant Characteristic at 25 °C

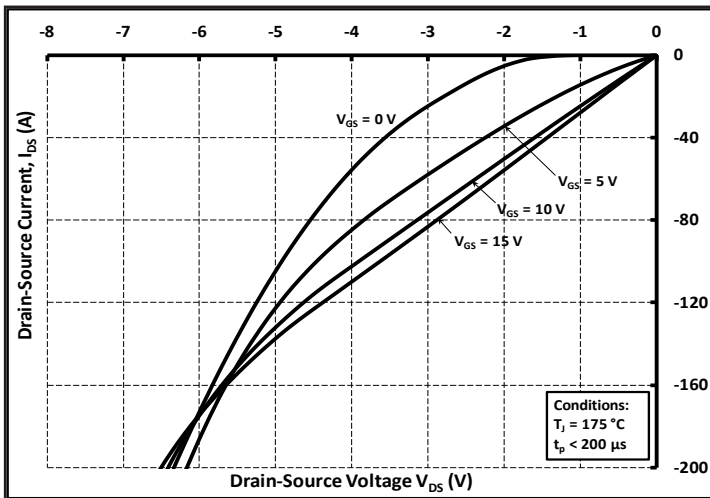


Figure 15. 3rd Quadrant Characteristic at 175 °C

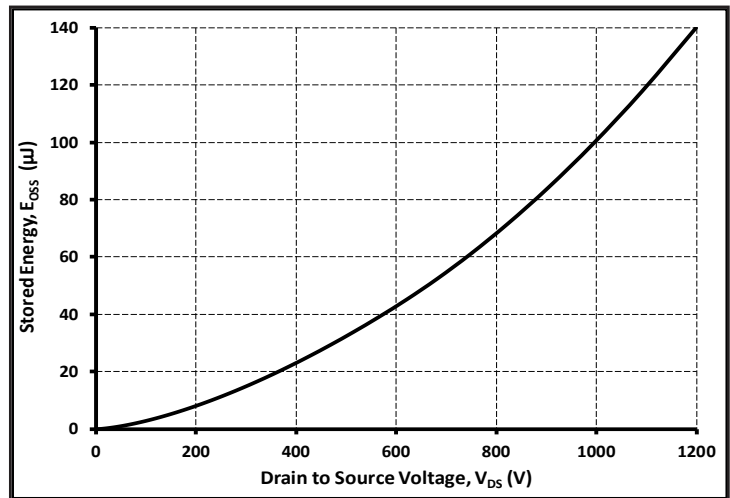


Figure 16. Output Capacitor Stored Energy

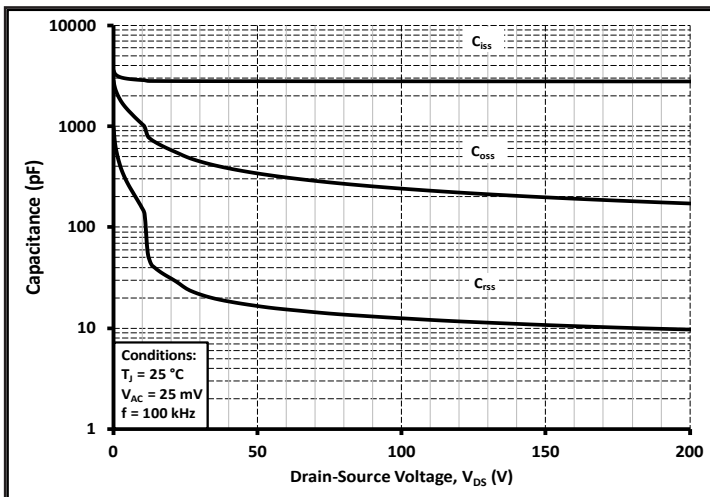


Figure 17. Capacitances vs. Drain-Source Voltage (0 - 200V)

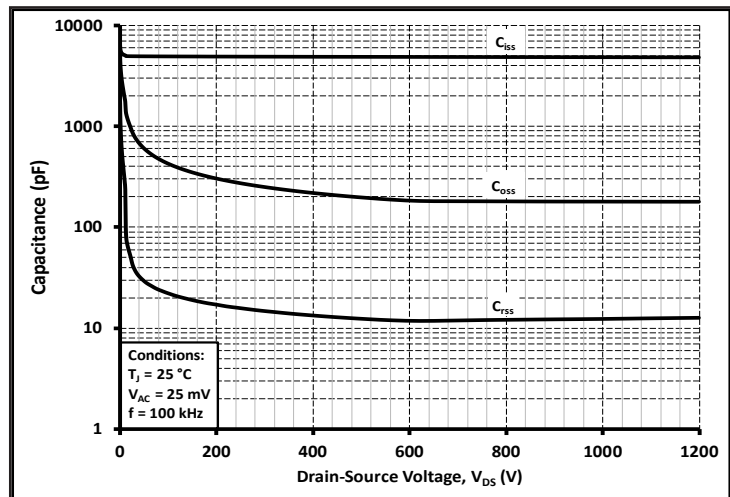


Figure 18. Capacitances vs. Drain-Source Voltage (0 - 1000V)

Typical Performance

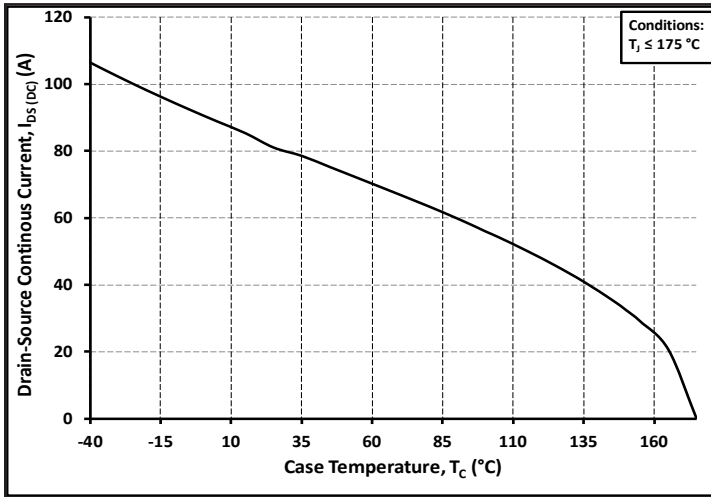


Figure 19. Continuous Drain Current Derating vs. Case Temperature

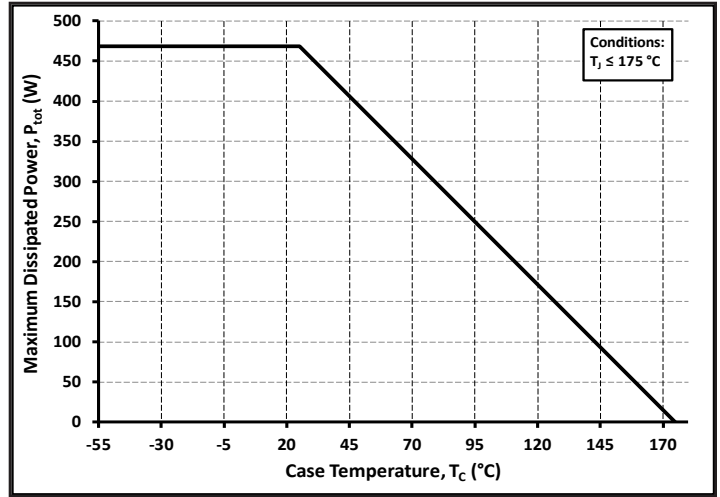


Figure 20. Maximum Power Dissipation Derating vs. Case Temperature

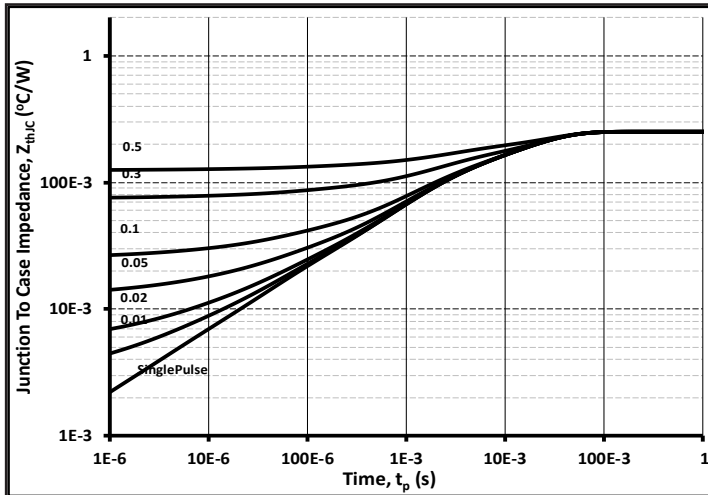


Figure 21. Transient Thermal Impedance (Junction - Case)

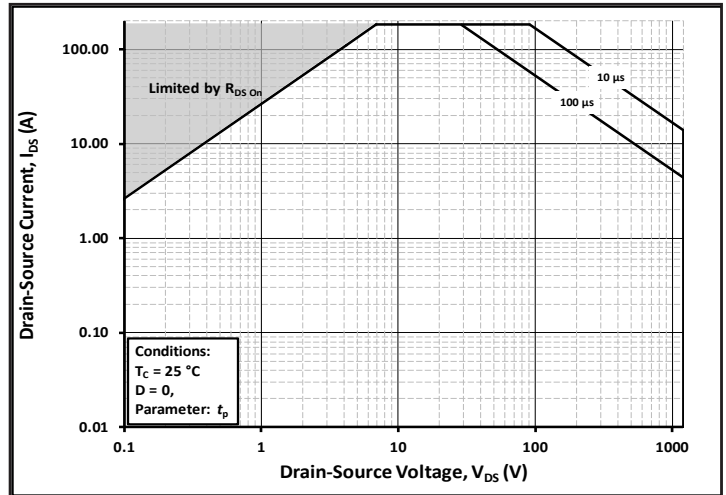


Figure 22. Safe Operating Area

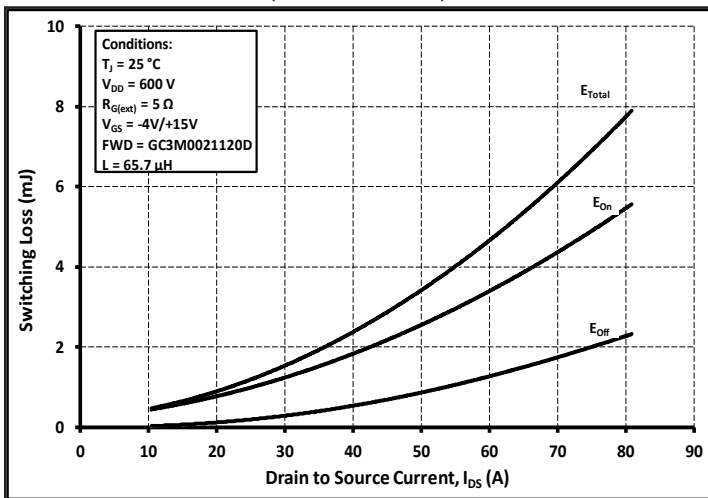


Figure 23. Clamped Inductive Switching Energy vs. Drain Current ( $V_{DD} = 600V$ )

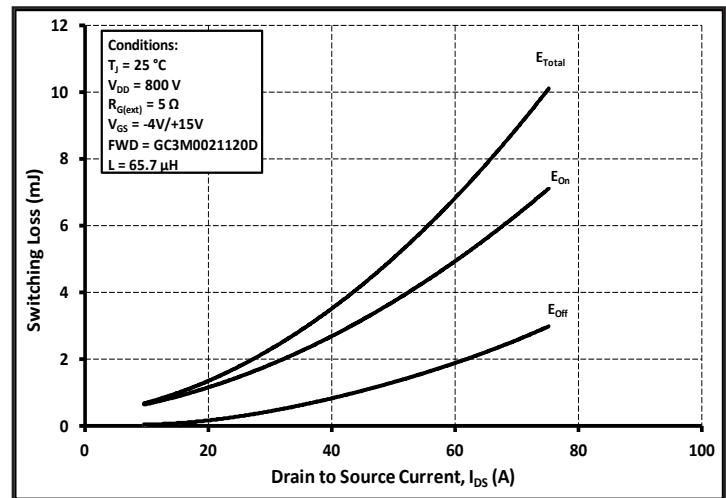


Figure 24. Clamped Inductive Switching Energy vs. Drain Current ( $V_{DD} = 800V$ )

Typical Performance

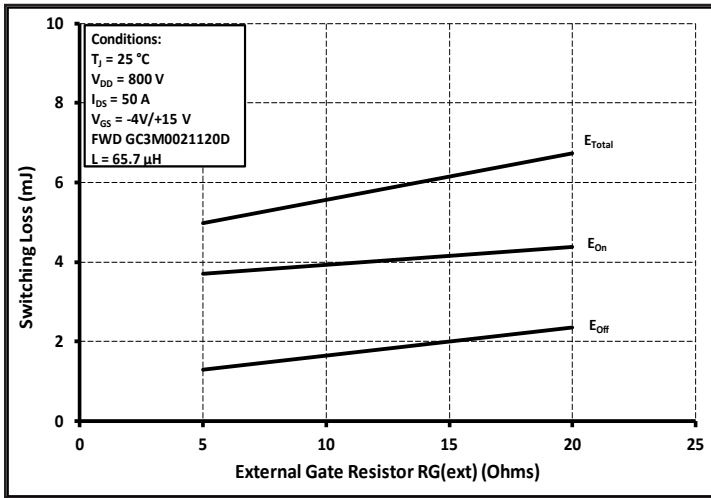


Figure 25. Clamped Inductive Switching Energy vs.  $R_{G(ext)}$

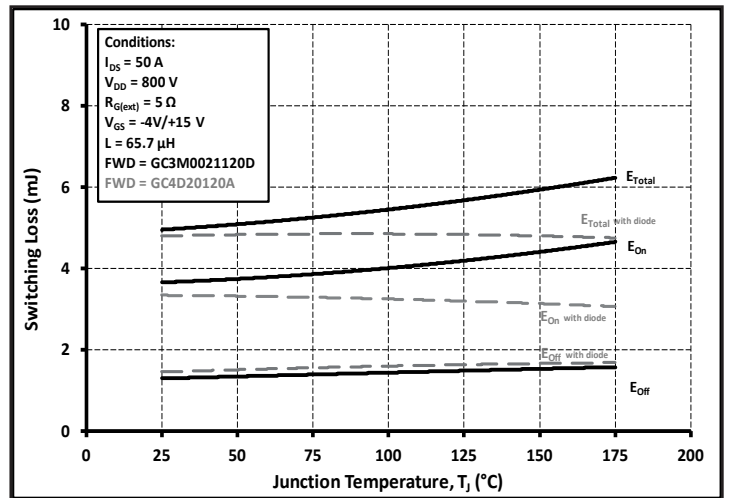


Figure 26. Clamped Inductive Switching Energy vs. Temperature

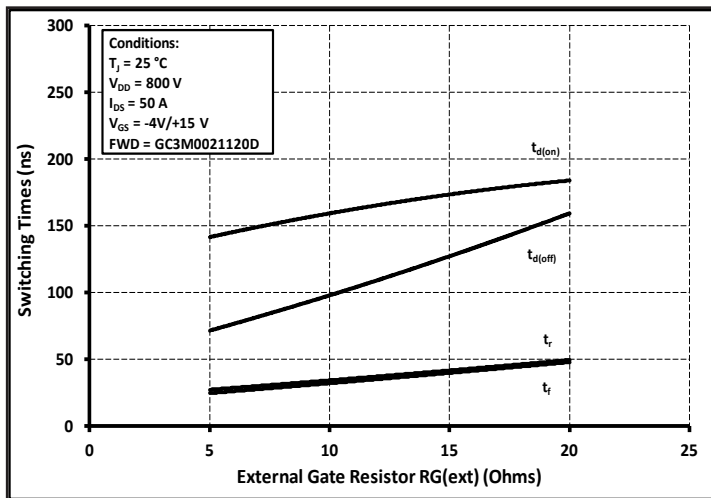


Figure 27. Switching Times vs.  $R_{G(ext)}$

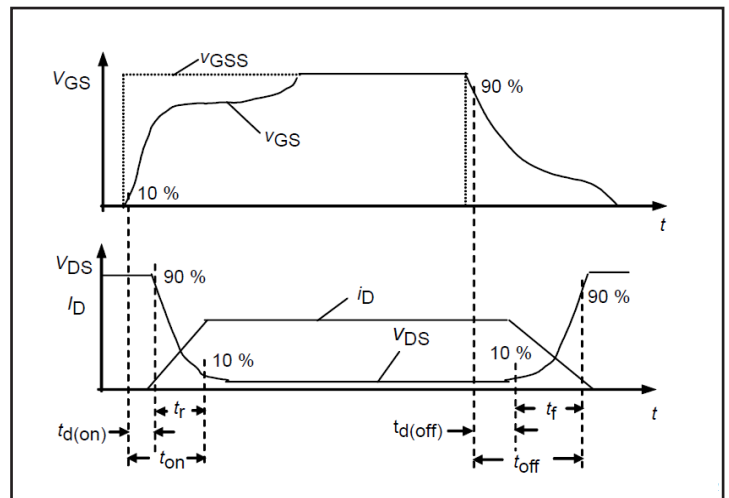


Figure 28. Switching Times Definition

**Test Circuit Schematic**

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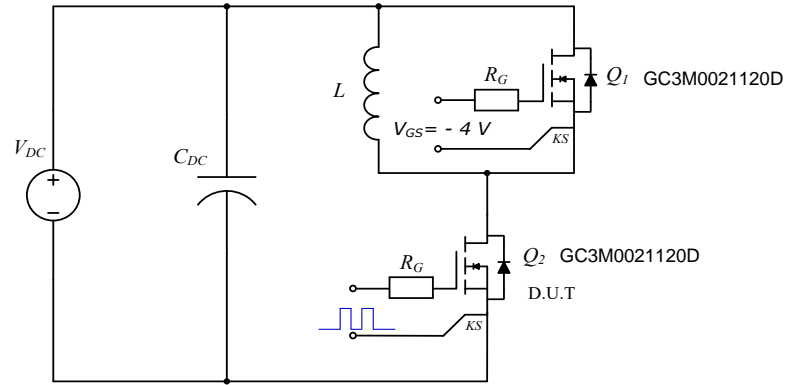


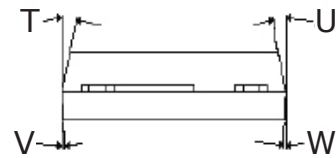
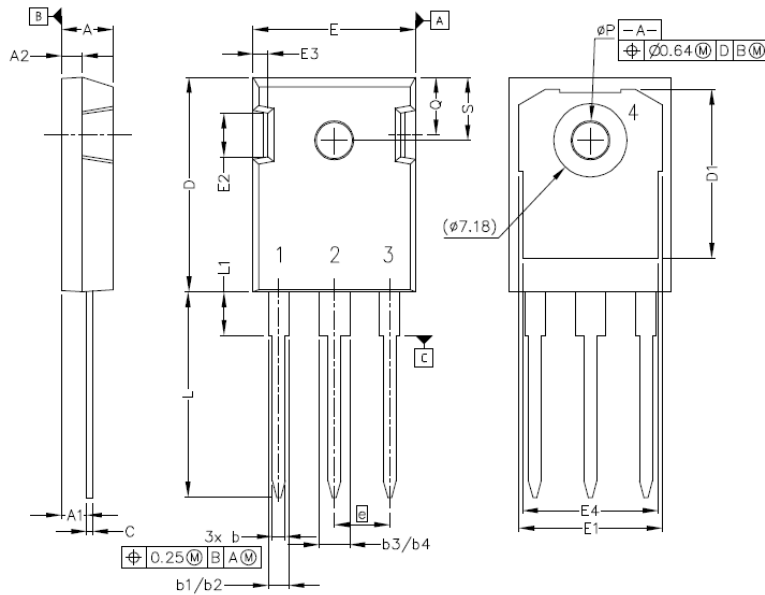
Figure 29. Clamped Inductive Switching  
Waveform Test Circuit

Note (4): Turn-off and Turn-on switching energy and timing values measured using SiC MOSFET Body Diode as shown above.



## Package Dimensions

Package TO-247-3

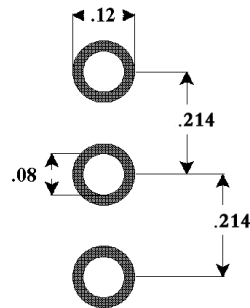


Pinout Information:

- Pin 1 = Gate
- Pin 2, 4 = Drain
- Pin 3 = Source

POS	Inches		Millimeters	
	Min	Max	Min	Max
A	.190	.205	4.83	5.21
A1	.090	.100	2.29	2.54
A2	.075	.085	1.91	2.16
b	.042	.052	1.07	1.33
b1	.075	.095	1.91	2.41
b2	.075	.085	1.91	2.16
b3	.113	.133	2.87	3.38
b4	.113	.123	2.87	3.13
c	.022	.027	0.55	0.68
D	.819	.831	20.80	21.10
D1	.640	.695	16.25	17.65
D2	.037	.049	0.95	1.25
E	.620	.635	15.75	16.13
E1	.516	.557	13.10	14.15
E2	.145	.201	3.68	5.10
E3	.039	.075	1.00	1.90
E4	.487	.529	12.38	13.43
e	.214 BSC		5.44 BSC	
N	3		3	
L	.780	.800	19.81	20.32
L1	.161	.173	4.10	4.40
ØP	.138	.144	3.51	3.65
Q	.216	.236	5.49	6.00
S	.238	.248	6.04	6.30
T	9°	11°	9°	11°
U	9°	11°	9°	11°
V	2°	8°	2°	8°
W	2°	8°	2°	8°

## Recommended Solder Pad Layout



TO-247-3