

### Features

- High Blocking Voltage with Low On-Resistance
- High Speed Switching with Low Capacitances
- Easy to Parallel and Simple to Drive
- Resistant to Latch-Up
- Halogen Free, RoHS Compliant

### Benefits

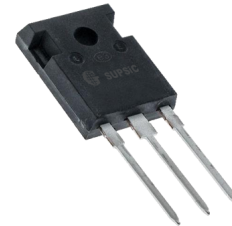
- Higher System Efficiency
- Reduced Cooling Requirements
- Increased Power Density
- Increased System Switching Frequency

### Applications

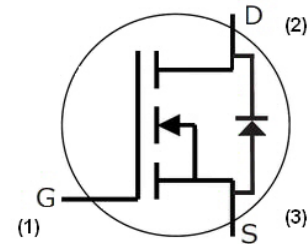
- Solar Inverters
- Switch Mode Power Supplies
- High Voltage DC/DC converters
- Battery Chargers
- Motor Drives
- Pulsed Power Applications

Part Number	Package	Marking
GC2M0040120D	TO-247-3	GC2M0040120

$V_{DS}$	1200 V
$I_D @ 25^\circ\text{C}$	55 A
$R_{DS(on)}$	40 m $\Omega$



TO-247-3  
Package



### 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	-10/+25	V	Absolute maximum values	
$V_{GSop}$	Gate - Source Voltage	-5/+20	V	Recommended operational values	
$I_D$	Continuous Drain Current	55	A	$V_{GS} = 20\text{ V}, T_c = 25^\circ\text{C}$	Fig. 19
		36		$V_{GS} = 20\text{ V}, T_c = 100^\circ\text{C}$	
$I_{D(pulse)}$	Pulsed Drain Current	160	A	Pulse width $t_p$ limited by $T_{jmax}$	Fig. 22
$P_D$	Power Dissipation	278	W	$T_c = 25^\circ\text{C}, T_j = 150^\circ\text{C}$	Fig. 20
$T_J, T_{stg}$	Operating Junction and Storage Temperature	-55 to +150	$^\circ\text{C}$		
$T_L$	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			

**Electrical Characteristics** ( $T_c = 25^\circ\text{C}$  unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions	Note
$V_{(BR)DSS}$	Drain-Source Breakdown Voltage	1200			V	$V_{GS} = 0\text{ V}, I_D = 100\ \mu\text{A}$	
$V_{GS(th)}$	Gate Threshold Voltage	2.0	3.2	4	V	$V_{DS} = V_{GS}, I_D = 10\text{mA}$	Fig. 11
			2.4		V	$V_{DS} = V_{GS}, I_D = 10\text{mA}, T_J = 150^\circ\text{C}$	
$I_{DSS}$	Zero Gate Voltage Drain Current		1	100	$\mu\text{A}$	$V_{DS} = 1200\text{ V}, V_{GS} = 0\text{ V}$	
$I_{GSS}$	Gate-Source Leakage Current			250	nA	$V_{GS} = 20\text{ V}, V_{DS} = 0\text{ V}$	
$R_{DS(on)}$	Drain-Source On-State Resistance		44	52	m $\Omega$	$V_{GS} = 20\text{ V}, I_D = 40\text{ A}$	Fig. 4,5,6
			82			$V_{GS} = 20\text{ V}, I_D = 40\text{ A}, T_J = 150^\circ\text{C}$	
$g_{fs}$	Transconductance		18.2		S	$V_{DS} = 20\text{ V}, I_{DS} = 40\text{ A}$	Fig. 7
			17.2			$V_{DS} = 20\text{ V}, I_{DS} = 40\text{ A}, T_J = 150^\circ\text{C}$	
$C_{iss}$	Input Capacitance		2440		pF	$V_{GS} = 0\text{ V}$ $V_{DS} = 1000\text{ V}$ $f = 1\text{ MHz}$	Fig. 17,18
$C_{oss}$	Output Capacitance		171				
$C_{rss}$	Reverse Transfer Capacitance		11				
$E_{oss}$	$C_{oss}$ Stored Energy		89		$\mu\text{J}$	$V_{AC} = 25\text{ mV}$	Fig 16
$E_{ON}$	Turn-On Switching Energy (Body Diode)		1.7		mJ	$V_{DS} = 800\text{ V}, V_{GS} = -5/20\text{ V}$ $I_D = 40\text{ A}, R_{G(ext)} = 2.5\ \Omega, L = 99\ \mu\text{H}$	Fig. 25
$E_{OFF}$	Turn Off Switching Energy (Body Diode)		0.4				
$E_{ON}$	Turn-On Switching Energy (External SiC Diode)		1.3			$V_{DS} = 800\text{ V}, V_{GS} = -5/20\text{ V}$ $I_D = 40\text{ A}, R_{G(ext)} = 2.5\ \Omega, L = 99\ \mu\text{H}$	
$E_{OFF}$	Turn Off Switching Energy (External SiC Diode)		0.4				
$t_{d(on)}$	Turn-On Delay Time		13		ns	$V_{DD} = 800\text{ V}, V_{GS} = -5/20\text{ V}$ $I_D = 40\text{ A}$ $R_{G(ext)} = 2.5\ \Omega, R_L = 20\ \Omega$ Timing relative to $V_{DS}$ Per IEC60747-8-4 pg 83	Fig. 27
$t_r$	Rise Time		61				
$t_{d(off)}$	Turn-Off Delay Time		25				
$t_f$	Fall Time		13				
$R_{G(int)}$	Internal Gate Resistance		1.8		$\Omega$	$f = 1\text{ MHz}, V_{AC} = 25\text{ mV}$	
$Q_{gs}$	Gate to Source Charge		34		nC	$V_{DS} = 800\text{ V}, V_{GS} = -5/20\text{ V}$ $I_D = 40\text{ A}$ Per IEC60747-8-4 pg 21	Fig. 12
$Q_{gd}$	Gate to Drain Charge		42				
$Q_g$	Total Gate Charge		120				

### Reverse Diode Characteristics

Symbol	Parameter	Typ.	Max.	Unit	Test Conditions	Note
$V_{SD}$	Diode Forward Voltage	4.0		V	$V_{GS} = -5\text{ V}, I_{SD} = 20\text{ A}, T_J = 25\text{ }^\circ\text{C}$	Fig. 8, 9, 10
		3.6		V	$V_{GS} = -5\text{ V}, I_{SD} = 20\text{ A}, T_J = 150\text{ }^\circ\text{C}$	
$I_S$	Continuous Diode Forward Current		60	A	$T_C = 25\text{ }^\circ\text{C}$	Note 1
$I_{S,pulse}$	Diode Pulse Current		160	A	$V_{GS} = -5\text{ V}$ , Pulse width $t_p$ limited by $T_{jmax}$	
$t_{rr}$	Reverse Recovery Time	54		ns	$V_{GS} = -5\text{ V}, I_{SD} = 40\text{ A}, T_J = 25\text{ }^\circ\text{C}$ $VR = 800\text{ V}$ $dif/dt = 1000\text{ A}/\mu\text{s}$	Note 1
$Q_{rr}$	Reverse Recovery Charge	283		nC		
$I_{rrm}$	Peak Reverse Recovery Current	15		A		

Note (1): When using SiC Body Diode the maximum recommended  $V_{GS} = -5\text{V}$

### Thermal Characteristics

Symbol	Parameter	Typ.	Max.	Unit	Test Conditions	Note
$R_{\theta JC}$	Thermal Resistance from Junction to Case	0.33	0.45	$^\circ\text{C}/\text{W}$		Fig. 21
$R_{\theta JA}$	Thermal Resistance from Junction to Ambient		40			

Typical Performance

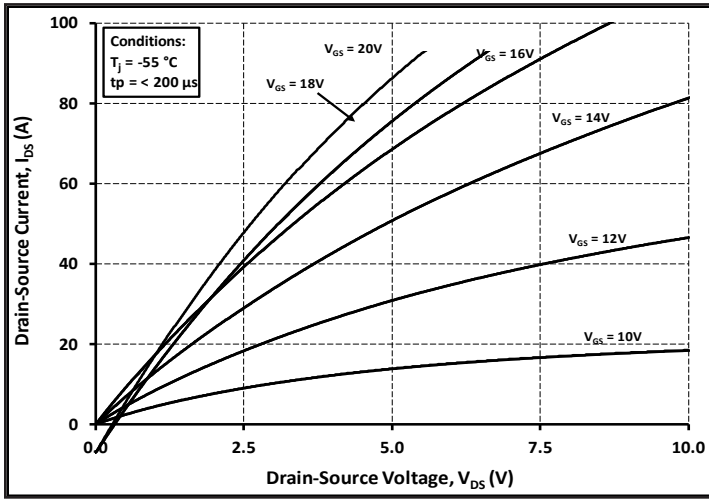


Figure 1. Output Characteristics  $T_J = -55\text{ }^\circ\text{C}$

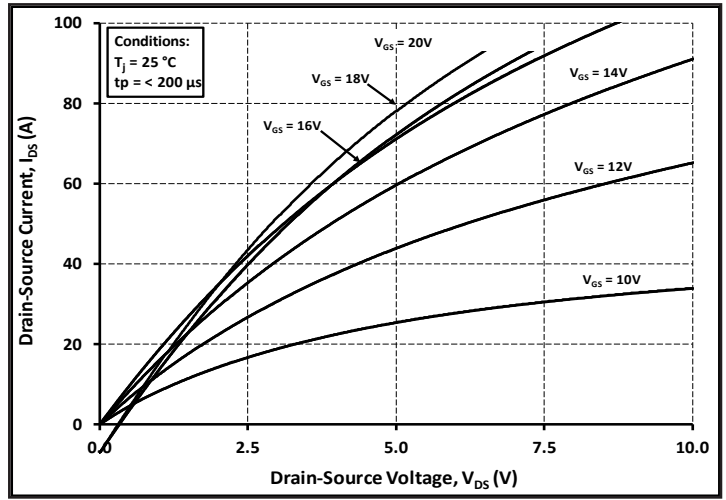


Figure 2. Output Characteristics  $T_J = 25\text{ }^\circ\text{C}$

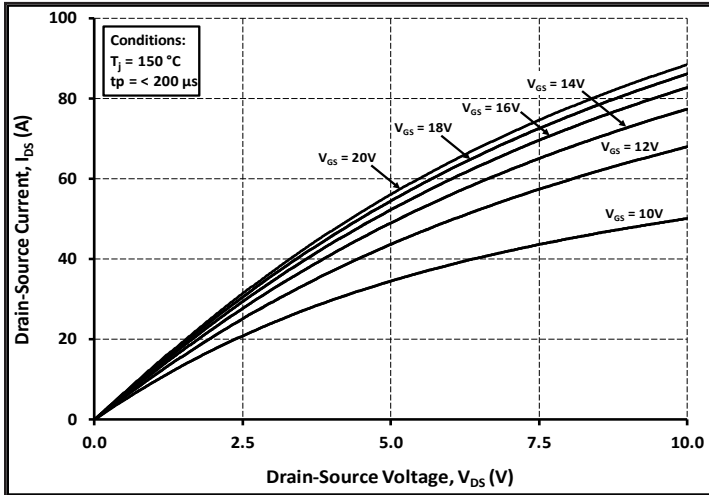


Figure 3. Output Characteristics  $T_J = 150\text{ }^\circ\text{C}$

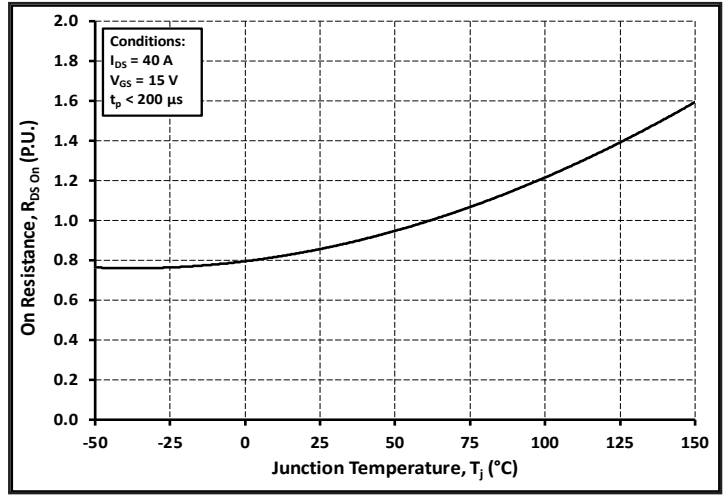


Figure 4. Normalized On-Resistance vs. Temperature

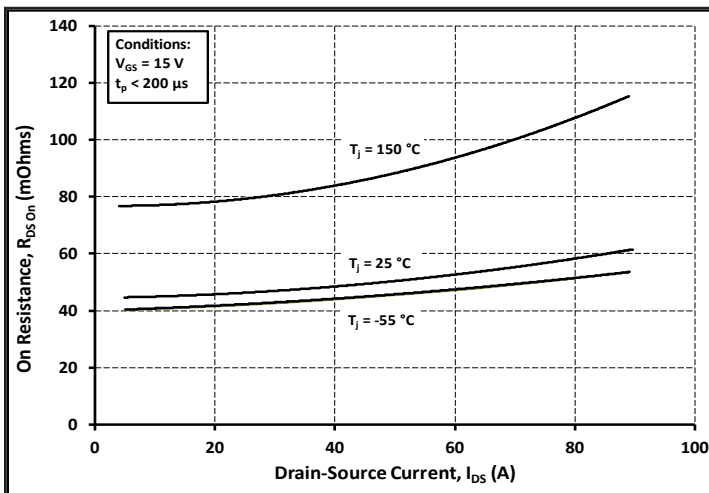


Figure 5. On-Resistance vs. Drain Current For Various Temperatures

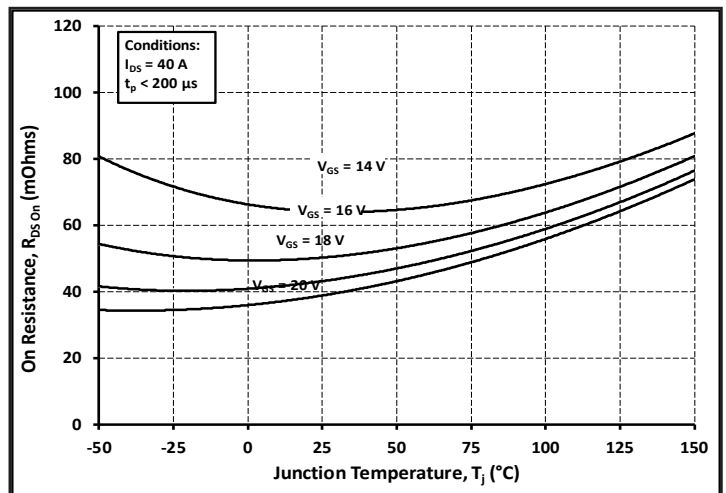


Figure 6. On-Resistance vs. Temperature For Various Gate Voltage

Typical Performance

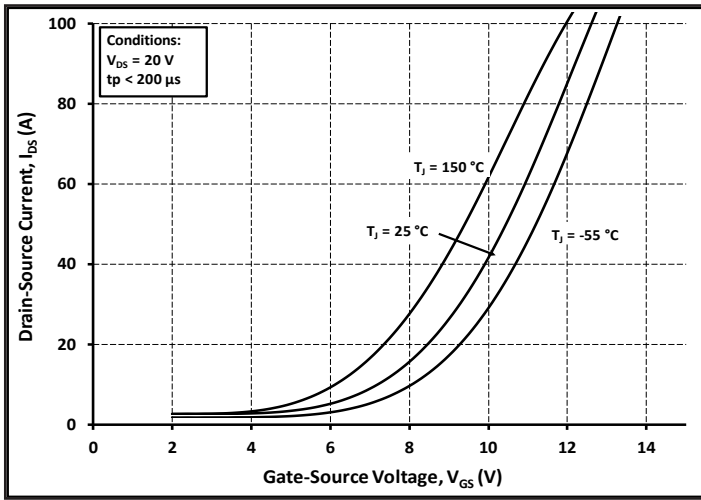


Figure 7. Transfer Characteristic for Various Junction Temperatures

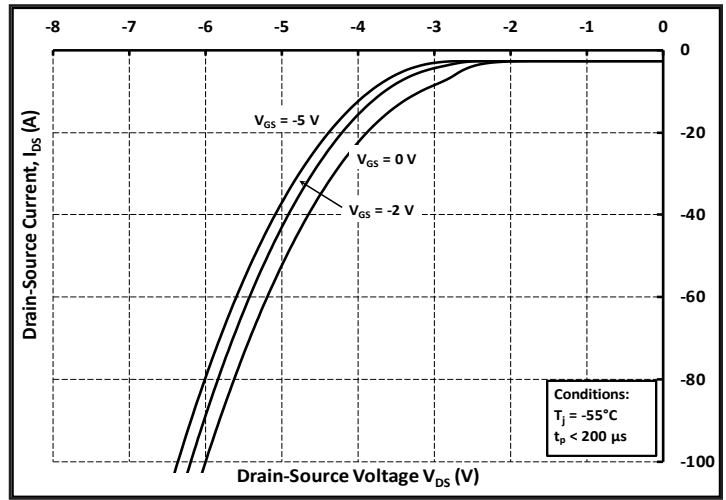


Figure 8. Body Diode Characteristic at -55 °C

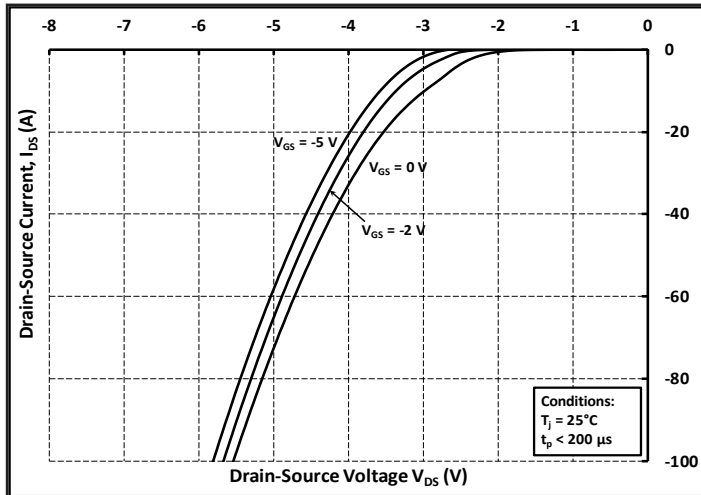


Figure 9. Body Diode Characteristic at 25 °C

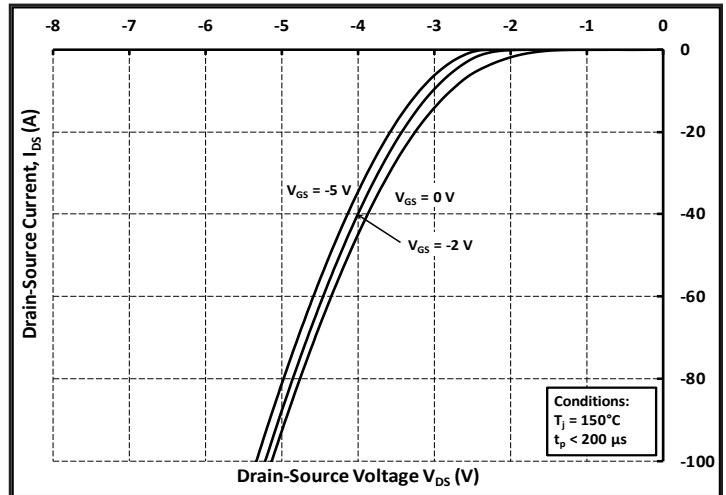


Figure 10. Body Diode Characteristic at 150 °C

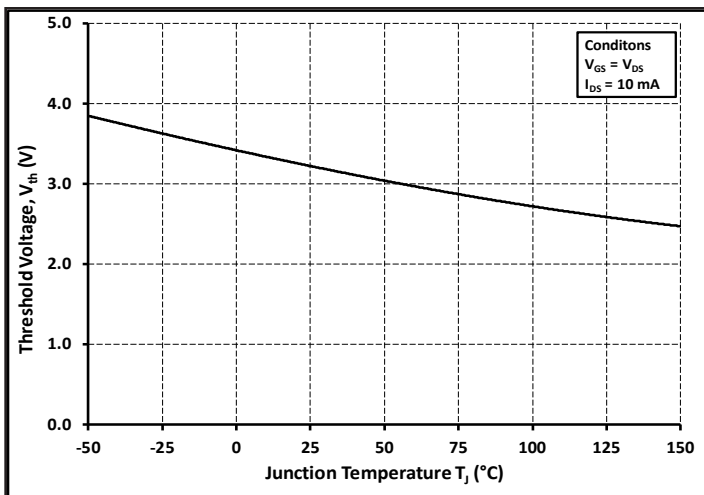


Figure 11. Threshold Voltage vs. Temperature

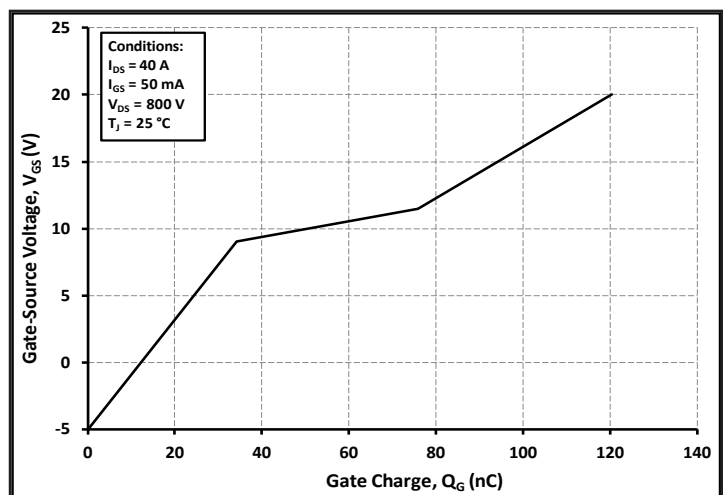


Figure 12. Gate Charge Characteristics

Typical Performance

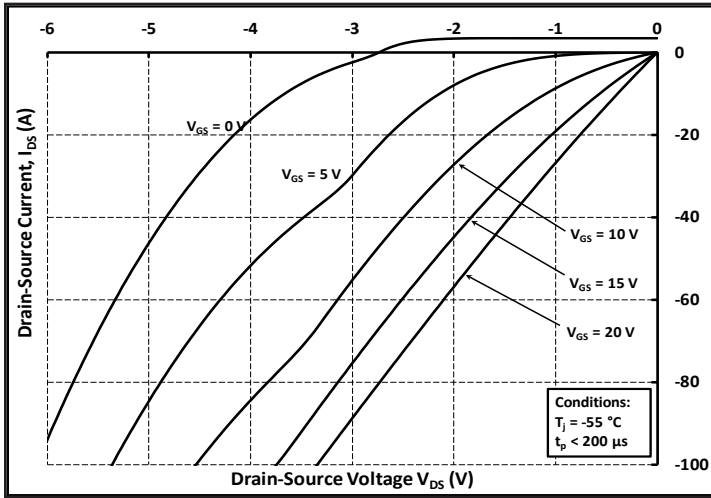


Figure 13. 3rd Quadrant Characteristic at -55 °C

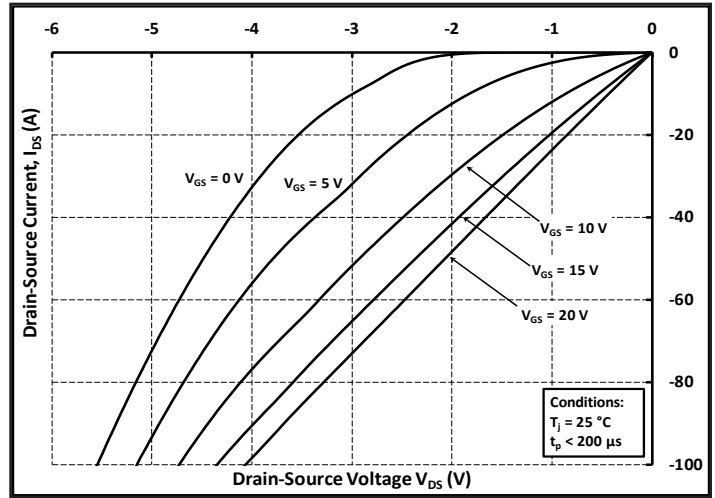


Figure 14. 3rd Quadrant Characteristic at 25 °C

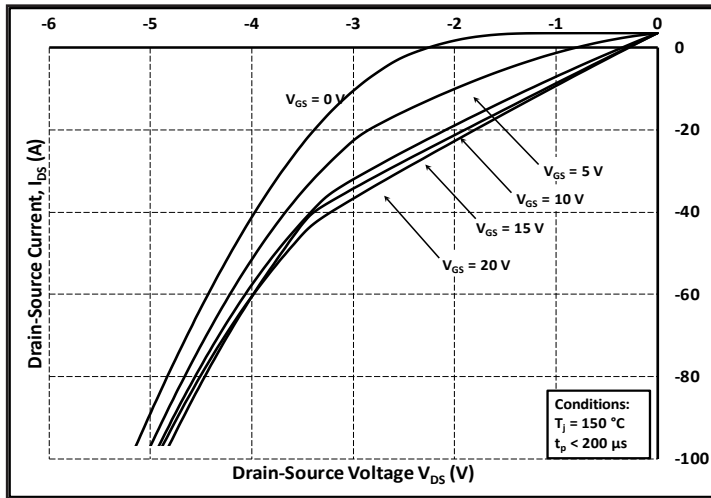


Figure 15. 3rd Quadrant Characteristic at 150 °C

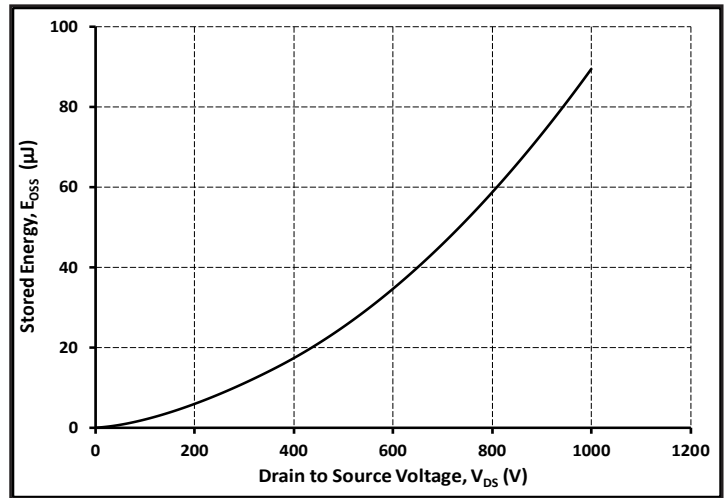


Figure 16. Output Capacitor Stored Energy

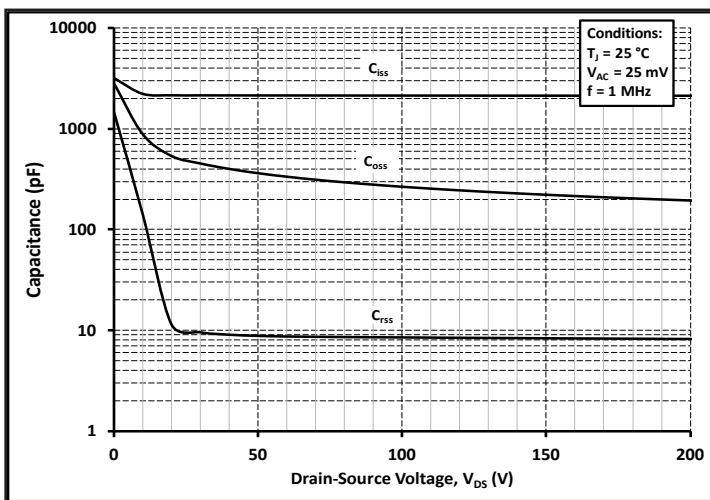


Figure 17. Capacitances vs. Drain-Source Voltage (0-200 V)

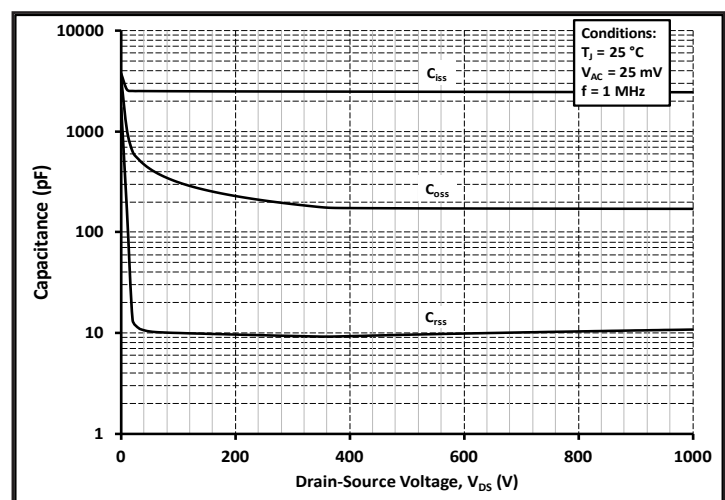


Figure 18. Capacitances vs. Drain-Source Voltage (0-1000 V)

Typical Performance

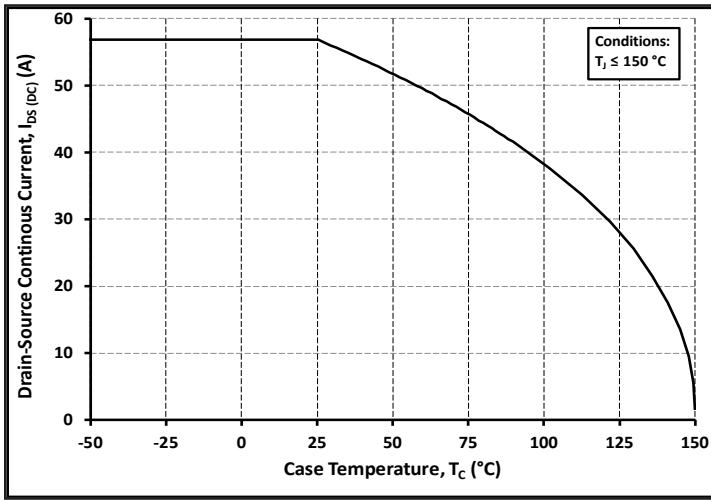


Figure 19. Continuous Drain Current Derating vs. Case Temperature

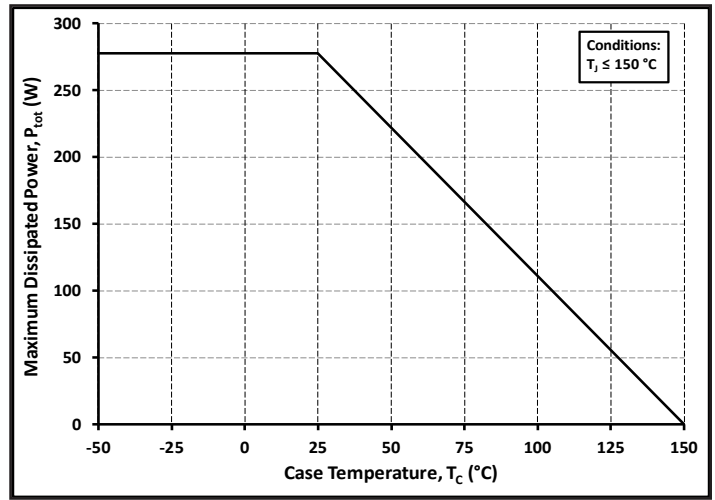


Figure 20. Maximum Power Dissipation Derating vs. Case Temperature

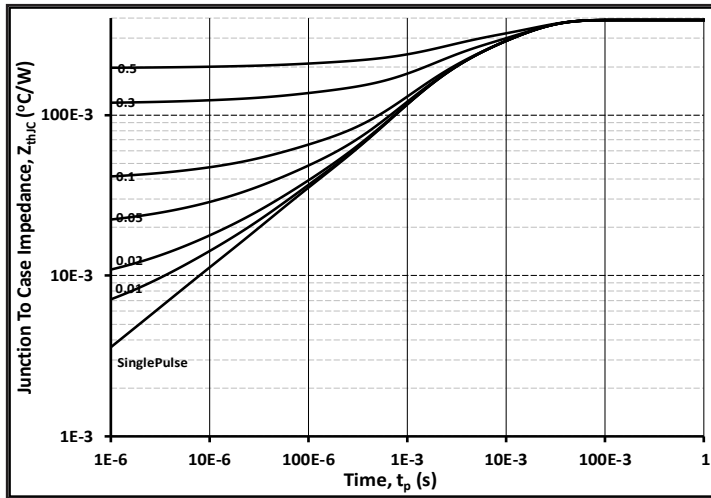


Figure 21. Transient Thermal Impedance (Junction - Case)

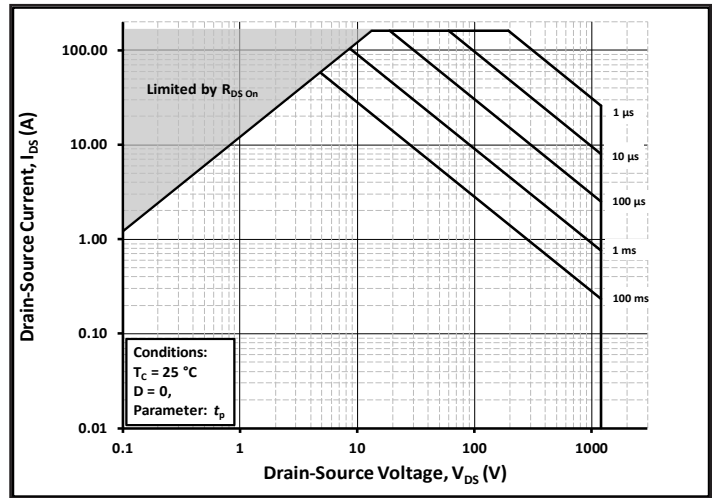


Figure 22. Safe Operating Area

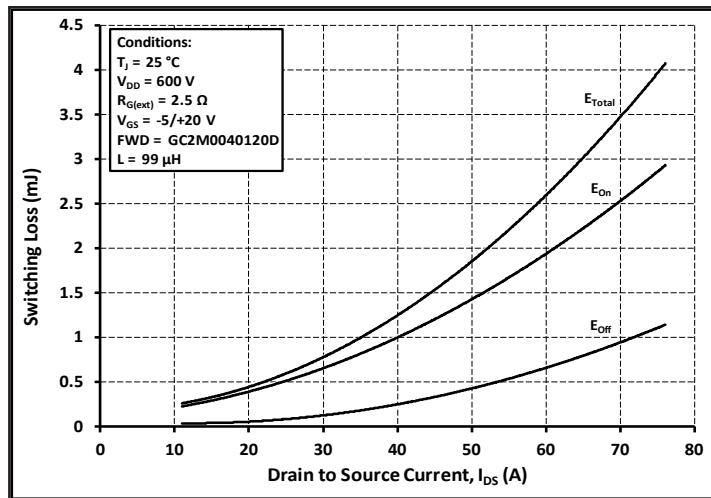


Figure 23. Clamped Inductive Switching Energy vs. Drain Current ( $V_{DD} = 600V$ )

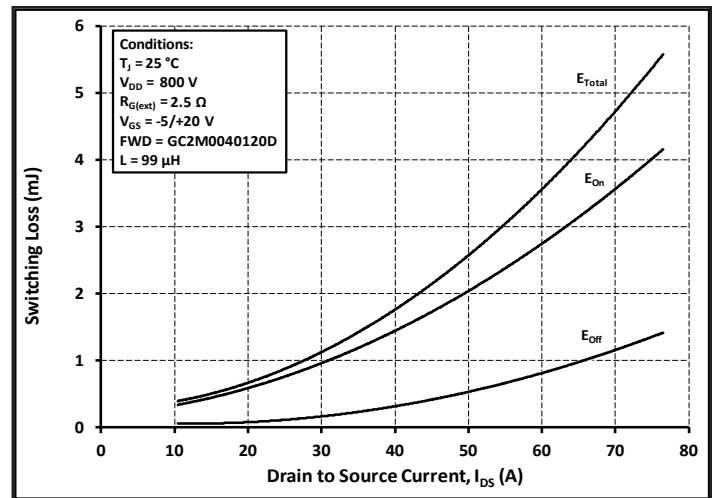


Figure 24. Clamped Inductive Switching Energy vs. Drain Current ( $V_{DD} = 800V$ )

Typical Performance

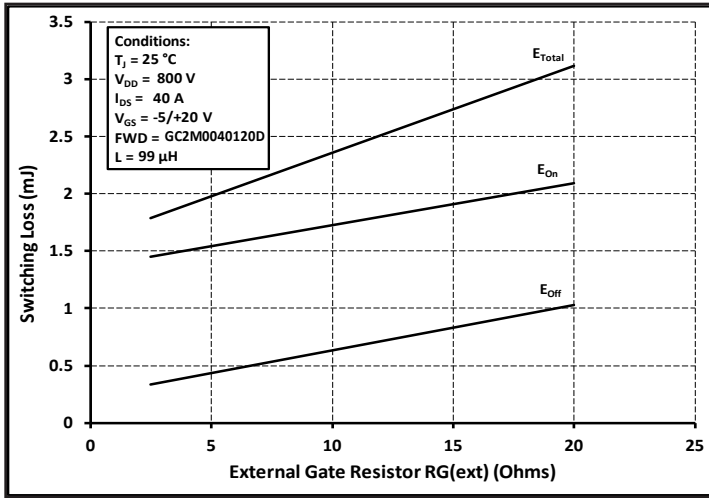


Figure 25. Clamped Inductive Switching Energy vs.  $R_{G(ext)}$

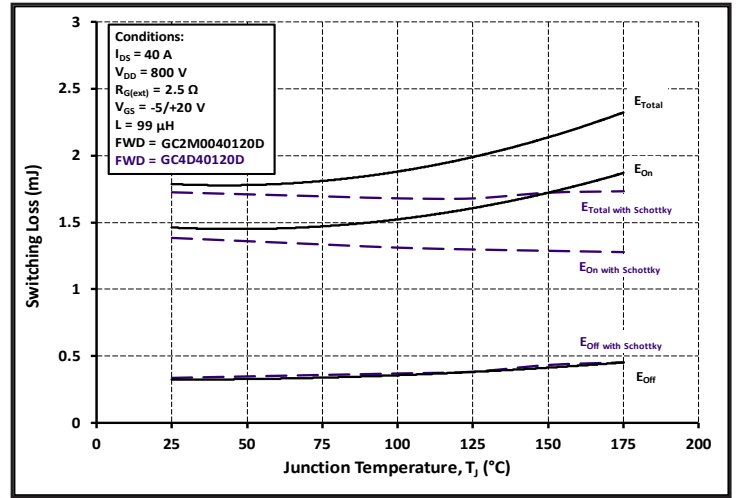


Figure 26. Clamped Inductive Switching Energy vs. Temperature

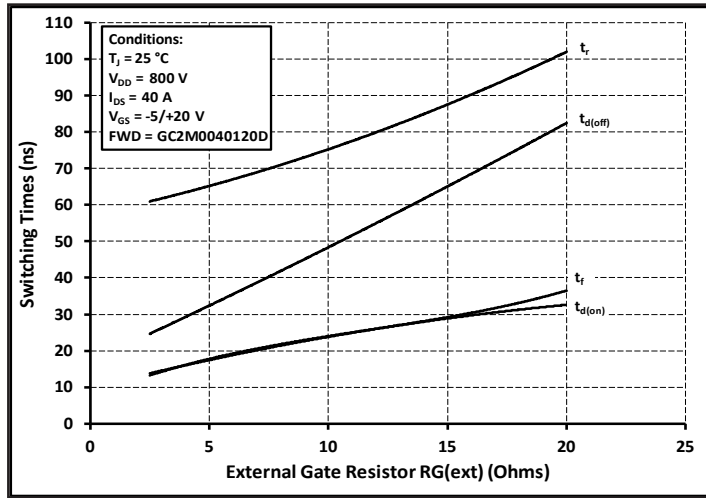


Figure 27. Switching Times vs.  $R_{G(ext)}$

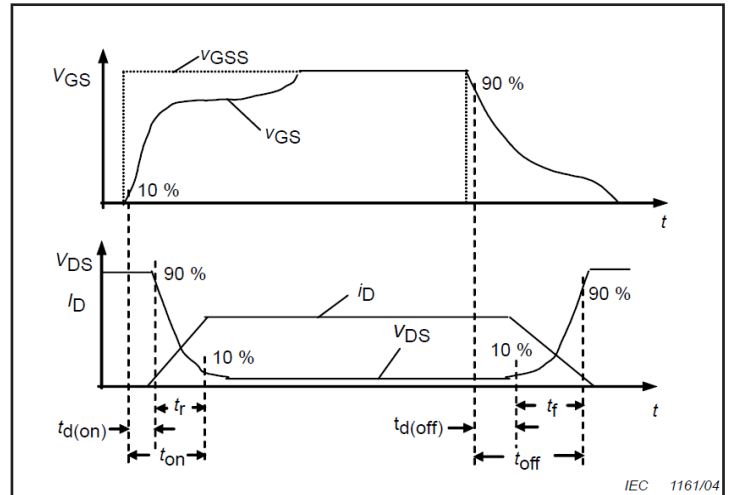


Figure 28. Switching Times Definition



**Test Circuit Schematic**

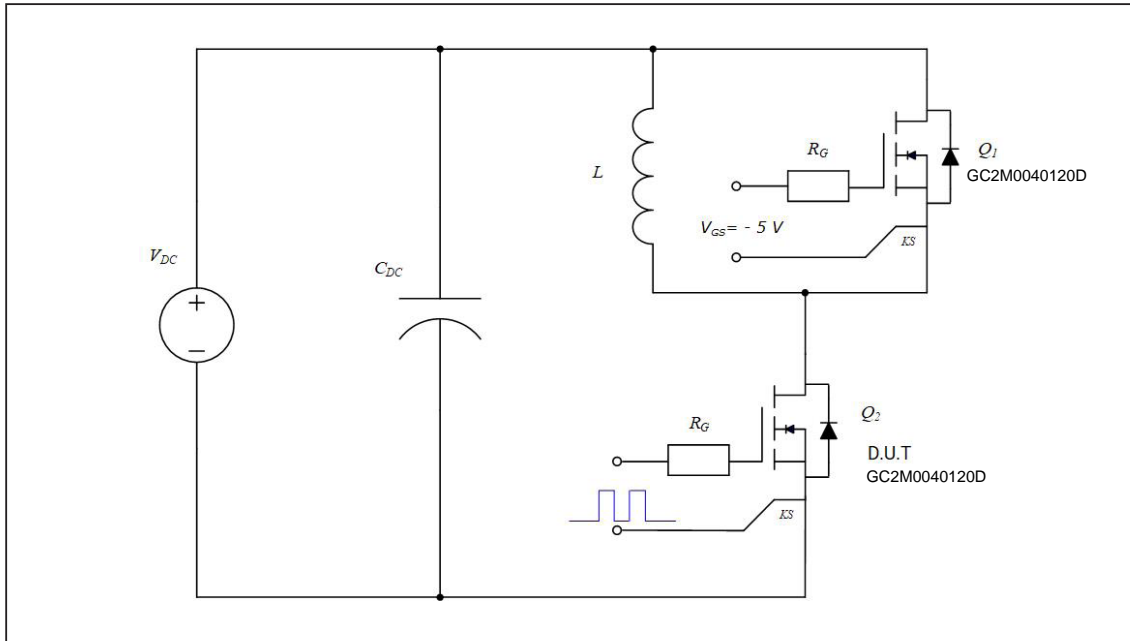


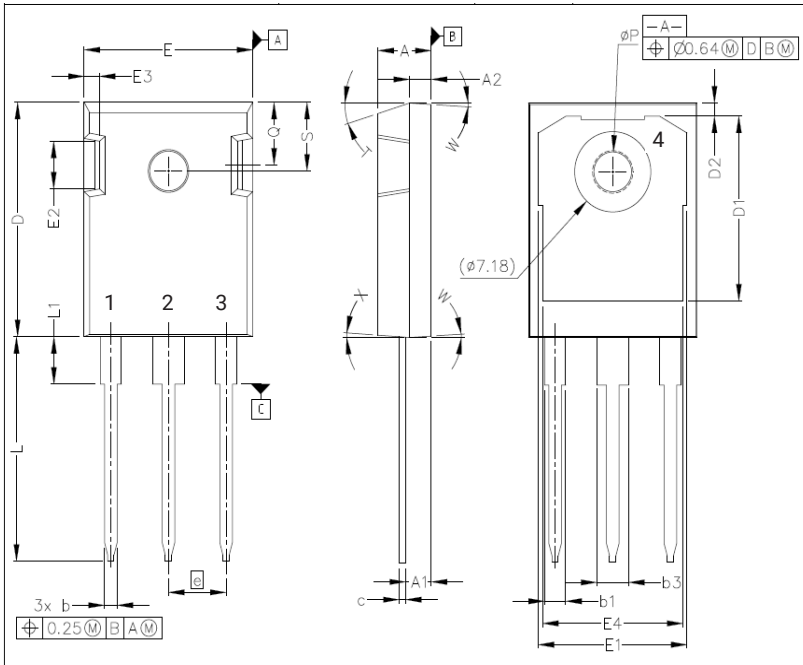
Figure 29. Clamped Inductive Switching  
Waveform Test Circuit

**ESD Ratings**

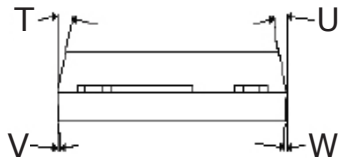
ESD Test	Resulting Classification
ESD-HBM	3A (4000V - 8000V)
ESD-CDM	C3 (>=1000V)

## Package Dimensions

Package TO-247-3



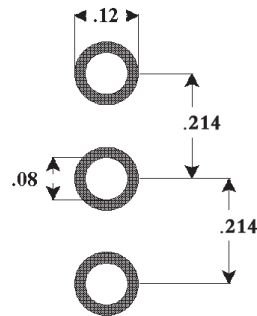
SYM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.83	5.21	.190	.205
A1	2.29	2.54	.090	.100
A2	1.91	2.16	.075	.085
b	1.07	1.33	.042	.052
b1	1.91	2.41	.075	.095
b3	2.87	3.38	.113	.133
c	0.55	0.68	.022	.027
D	20.80	21.10	.819	.831
D1	16.25	17.65	.640	.695
D2	0.95	1.25	.037	.049
E	15.75	16.13	.620	.635
E1	13.10	14.15	.516	.557
E2	3.68	5.10	.145	.201
E3	1.00	1.90	.039	.075
E4	12.38	13.43	.487	.529
e	5.44 BSC		.214 BSC	
N	3		3	
L	19.81	20.32	.780	.800
L1	4.10	4.40	.161	.173
φP	3.51	3.65	.138	.144
Q	5.49	6.00	.216	.236
S	6.04	6.30	.238	.248
T	17.5° REF.			
W	3.5° REF.			
X	4° REF.			



Pinout Information:

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

## Recommended Solder Pad Layout



TO-247-3