

## Features

- Optimized package with separate driver source pin
- 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

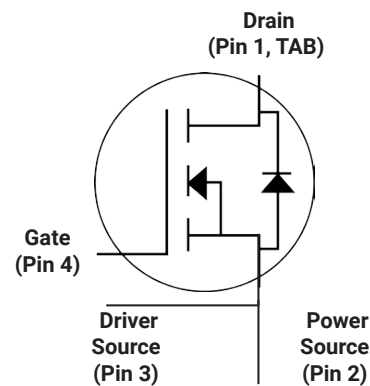
Part Number	Package	Marking
GC3M0040120K	TO-247-4	GC3M0040120

$V_{DS}$	1200 V
$I_D @ 25^\circ\text{C}$	66 A
$R_{DS(on)}$	40 m $\Omega$



TO-247-4

### 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	$V_{GS} = 0\text{ V}, I_D = 100\ \mu\text{A}$	
$V_{GSmax}$	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	66	A	$V_{GS} = 15\text{ V}, T_c = 25^\circ\text{C}$	Fig. 19
		48		$V_{GS} = 15\text{ V}, T_c = 100^\circ\text{C}$	
$I_{D(pulse)}$	Pulsed Drain Current	100	A	Pulse width $t_p$ limited by $T_{jmax}$	
$P_D$	Power Dissipation	326	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	

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

**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	1.8	2.7	3.6	V	$V_{DS} = V_{GS}, I_D = 9.2\ \text{mA}$	Fig. 11
			2.2		V	$V_{DS} = V_{GS}, I_D = 9.2\ \text{mA}, T_J = 175^\circ\text{C}$	
$I_{DSS}$	Zero Gate Voltage Drain Current		1	50	$\mu\text{A}$	$V_{DS} = 1200\ \text{V}, V_{GS} = 0\ \text{V}$	
$I_{GSS}$	Gate-Source Leakage Current		10	250	nA	$V_{GS} = 15\ \text{V}, V_{DS} = 0\ \text{V}$	
$R_{DS(on)}$	Drain-Source On-State Resistance		40	53.5	m $\Omega$	$V_{GS} = 15\ \text{V}, I_D = 33.3\ \text{A}$	Fig. 4, 5, 6
			68			$V_{GS} = 15\ \text{V}, I_D = 33.3\ \text{A}, T_J = 175^\circ\text{C}$	
$g_{fs}$	Transconductance		21		S	$V_{DS} = 20\ \text{V}, I_{DS} = 33.3\ \text{A}$	Fig. 7
			20			$V_{DS} = 20\ \text{V}, I_{DS} = 33.3\ \text{A}, T_J = 175^\circ\text{C}$	
$C_{iss}$	Input Capacitance		2900		pF	$V_{GS} = 0\ \text{V}, V_{DS} = 1000\ \text{V}$ $f = 100\ \text{kHz}$ $V_{AC} = 25\ \text{mV}$	Fig. 17, 18
$C_{oss}$	Output Capacitance		103				
$C_{rss}$	Reverse Transfer Capacitance		5				
$E_{oss}$	$C_{oss}$ Stored Energy		60				$\mu\text{J}$
$E_{ON}$	Turn-On Switching Energy (SiC Diode FWD)		243		$\mu\text{J}$	$V_{DS} = 800\ \text{V}, V_{GS} = -4\ \text{V}/+15\ \text{V},$ $I_D = 33.3\ \text{A},$ $R_{G(ext)} = 2.5\ \Omega, L = 99\ \mu\text{H}, T_J = 175^\circ\text{C}$	Fig. 26
$E_{OFF}$	Turn Off Switching Energy (SiC Diode FWD)		104				
$E_{ON}$	Turn-On Switching Energy (Body Diode FWD)		611		$\mu\text{J}$	$V_{DS} = 800\ \text{V}, V_{GS} = -4\ \text{V}/+15\ \text{V},$ $I_D = 33.3\ \text{A},$ $R_{G(ext)} = 2.5\ \Omega, L = 99\ \mu\text{H}, T_J = 175^\circ\text{C}$	Fig. 26
$E_{OFF}$	Turn Off Switching Energy (Body Diode FWD)		99				
$t_{d(on)}$	Turn-On Delay Time		13		ns	$V_{DD} = 800\ \text{V}, V_{GS} = -4\ \text{V}/15\ \text{V}$ $R_{G(ext)} = 2.5\ \Omega, I_D = 33.3\ \text{A}, L = 99$ Timing relative to $V_{DS}$ , Inductive load	Fig. 27
$t_r$	Rise Time		17				
$t_{d(off)}$	Turn-Off Delay Time		23				
$t_f$	Fall Time		9				
$R_{G(int)}$	Internal Gate Resistance		3.5		$\Omega$	$f = 1\ \text{MHz}, V_{AC} = 25\ \text{mV}$	
$Q_{gs}$	Gate to Source Charge		34		nC	$V_{DS} = 800\ \text{V}, V_{GS} = -4\ \text{V}/15\ \text{V}$ $I_D = 33.3\ \text{A}$ Per IEC60747-8-4 pg 21	Fig. 12
$Q_{gd}$	Gate to Drain Charge		28				
$Q_g$	Total Gate Charge		99				

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

Symbol	Parameter	Typ.	Max.	Unit	Test Conditions	Note
$V_{SD}$	Diode Forward Voltage	5.5		V	$V_{GS} = -4\text{ V}, I_{SD} = 20\text{ A}, T_J = 25^\circ\text{C}$	Fig. 8, 9, 10
		4.9		V	$V_{GS} = -4\text{ V}, I_{SD} = 20\text{ A}, T_J = 175^\circ\text{C}$	
$I_S$	Continuous Diode Forward Current		51	A	$V_{GS} = -4\text{ V}, T_c = 25^\circ\text{C}$	Note 1
$I_{S, pulse}$	Diode pulse Current		100	A	$V_{GS} = -4\text{ V}$ , pulse width $t_p$ limited by $T_{jmax}$	Note 1
$t_{rr}$	Reverse Recover time	17		ns	$V_{GS} = -4\text{ V}, I_{SD} = 33.3\text{ A}, V_R = 800\text{ V}$ $dif/dt = 7725\text{ A}/\mu\text{s}, T_J = 175^\circ\text{C}$	Note 1
$Q_{rr}$	Reverse Recovery Charge	850		nC		
$I_{rrm}$	Peak Reverse Recovery Current	79		A		
$t_{rr}$	Reverse Recover time	33		ns	$V_{GS} = -4\text{ V}, I_{SD} = 33.3\text{ A}, V_R = 800\text{ V}$ $dif/dt = 2325\text{ A}/\mu\text{s}, T_J = 175^\circ\text{C}$	Note 1
$Q_{rr}$	Reverse Recovery Charge	691		nC		
$I_{rrm}$	Peak Reverse Recovery Current	30		A		

**Thermal Characteristics**

Symbol	Parameter	Typ.	Unit	Test Conditions	Note
$R_{\theta JC}$	Thermal Resistance from Junction to Case	0.46	°C/W		Fig. 21
$R_{\theta JA}$	Thermal Resistance From Junction to Ambient	40			

Typical Performance

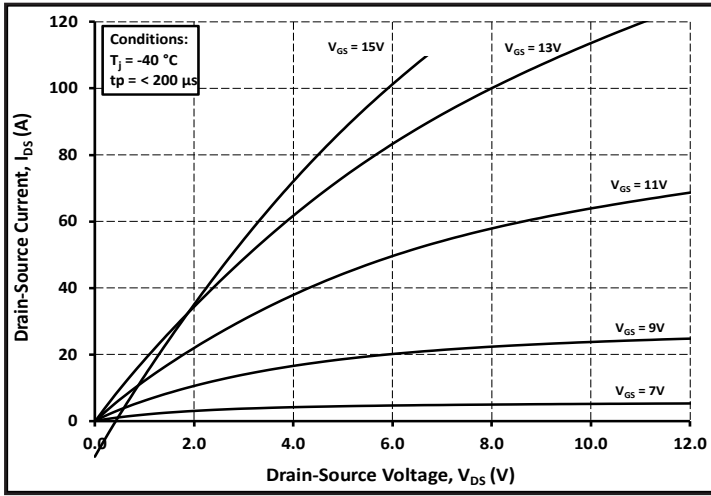


Figure 1. Output Characteristics  $T_J = -40\text{ }^\circ\text{C}$

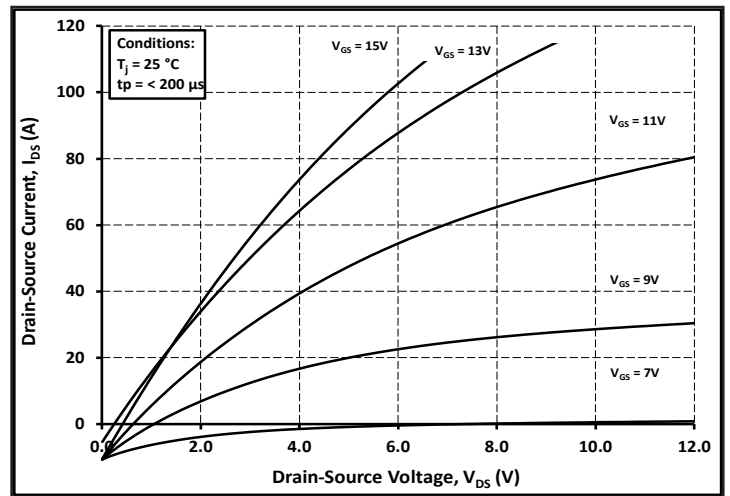


Figure 2. Output Characteristics  $T_J = 25\text{ }^\circ\text{C}$

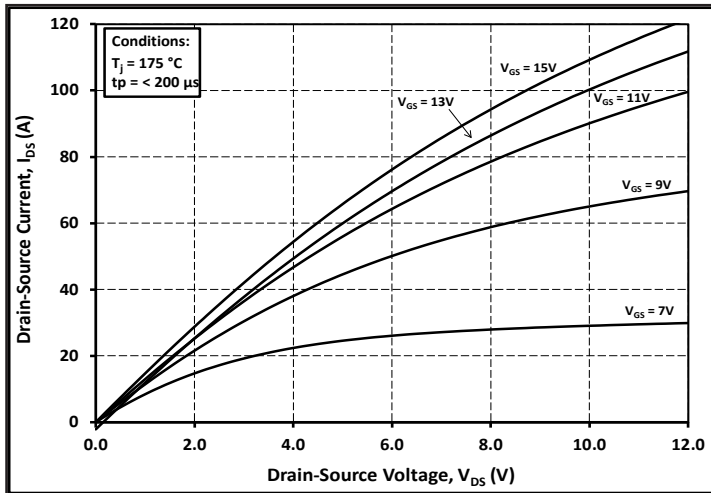


Figure 3. Output Characteristics  $T_J = 175\text{ }^\circ\text{C}$

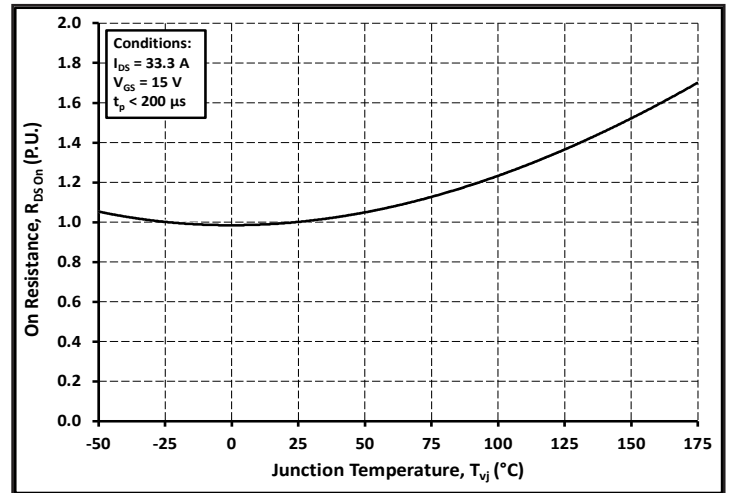


Figure 4. Normalized On-Resistance vs. Temperature

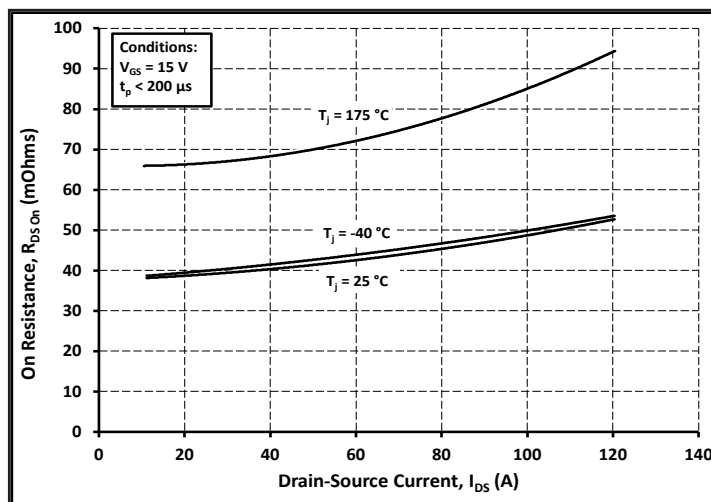


Figure 5. On-Resistance vs. Drain Current For Various Temperatures

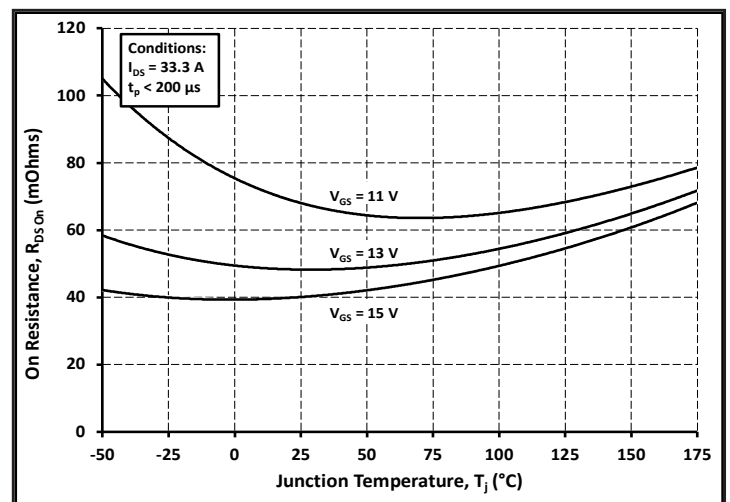


Figure 6. On-Resistance vs. Temperature For Various Gate Voltage

Typical Performance

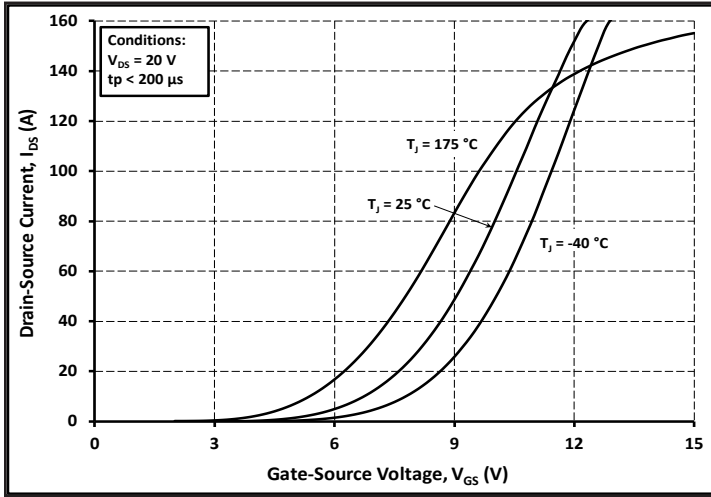


Figure 7. Transfer Characteristic for Various Junction Temperatures

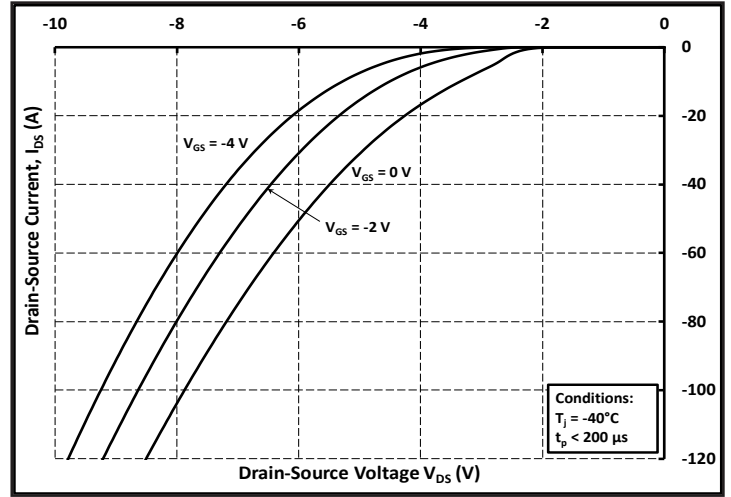


Figure 8. Body Diode Characteristic at -40 °C

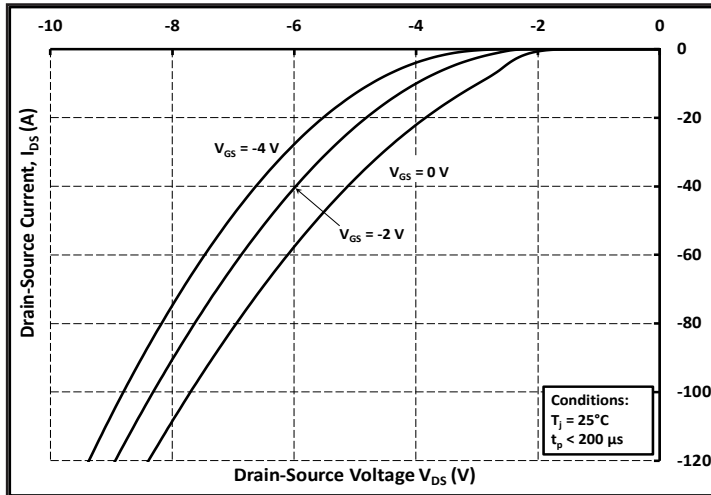


Figure 9. Body Diode Characteristic at 25 °C

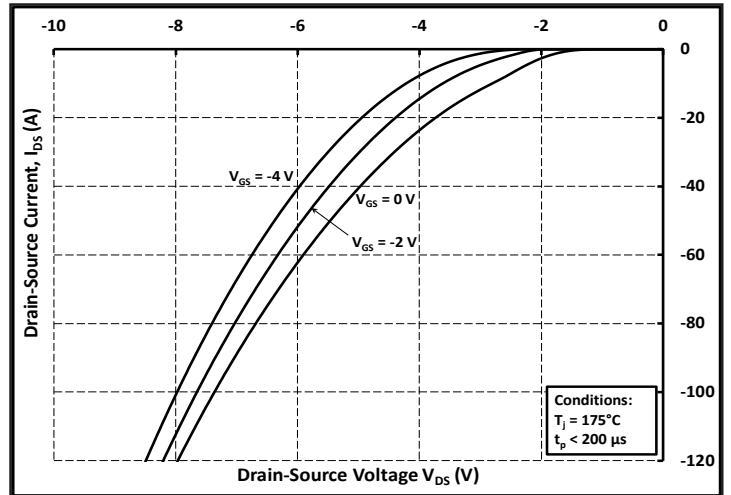


Figure 10. Body Diode Characteristic at 175 °C

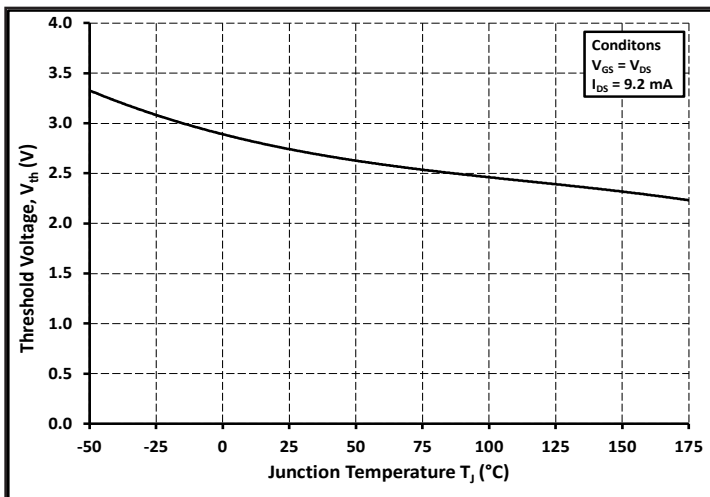


Figure 11. Threshold Voltage vs. Temperature

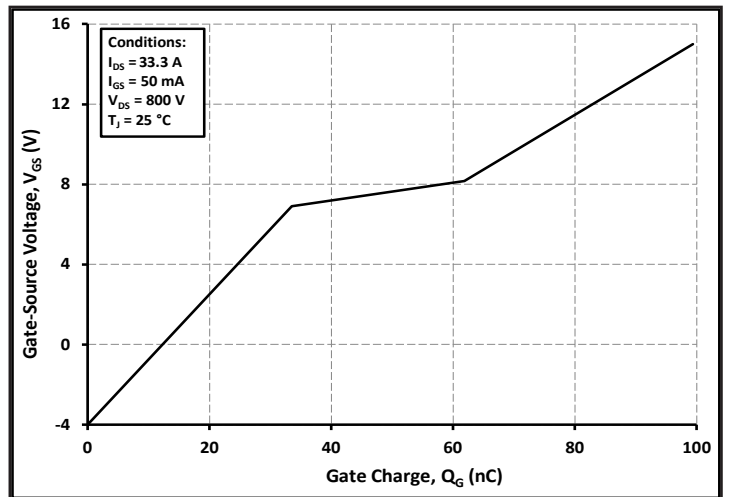


Figure 12. Gate Charge Characteristics

Typical Performance

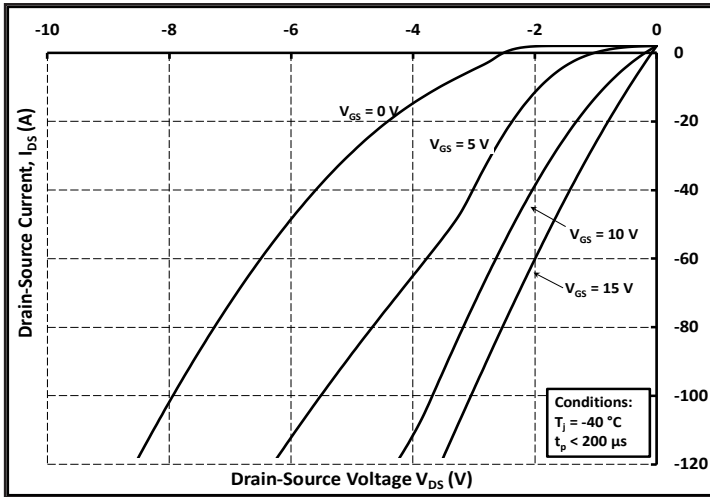


Figure 13. 3rd Quadrant Characteristic at  $-40\text{ }^\circ\text{C}$

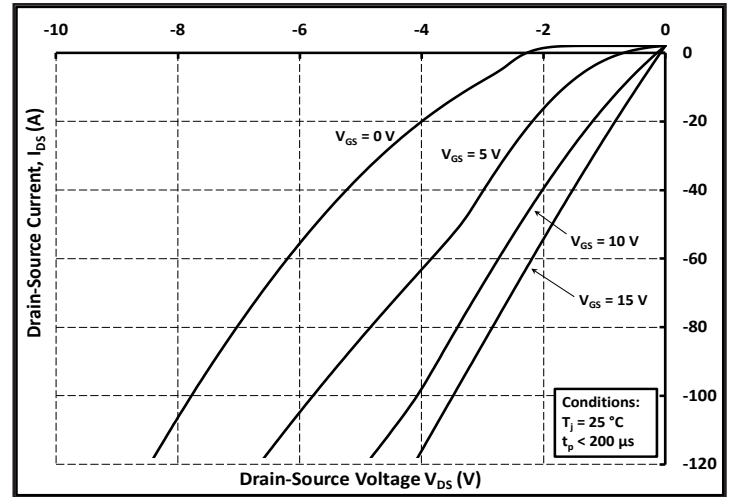


Figure 14. 3rd Quadrant Characteristic at  $25\text{ }^\circ\text{C}$

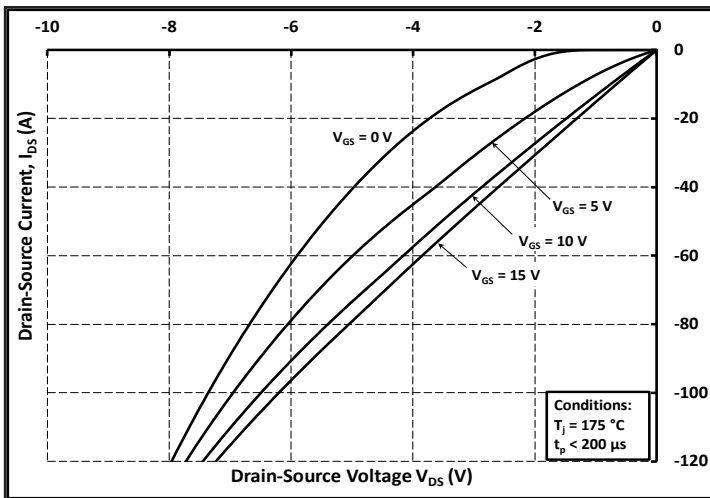


Figure 15. 3rd Quadrant Characteristic at  $175\text{ }^\circ\text{C}$

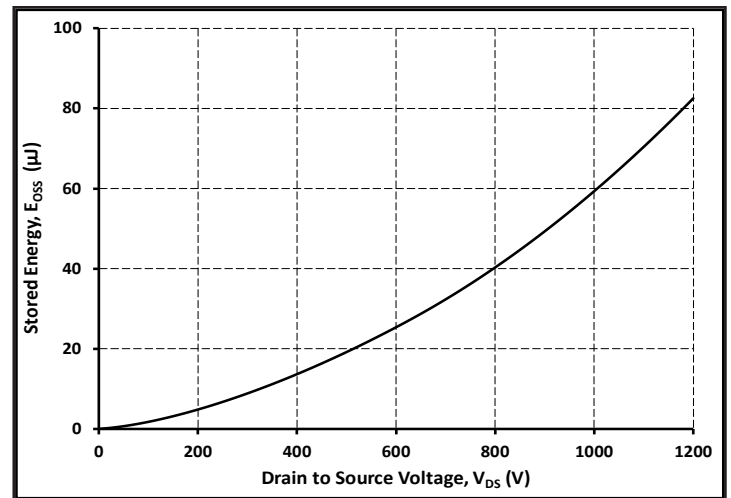


Figure 16. Output Capacitor Stored Energy

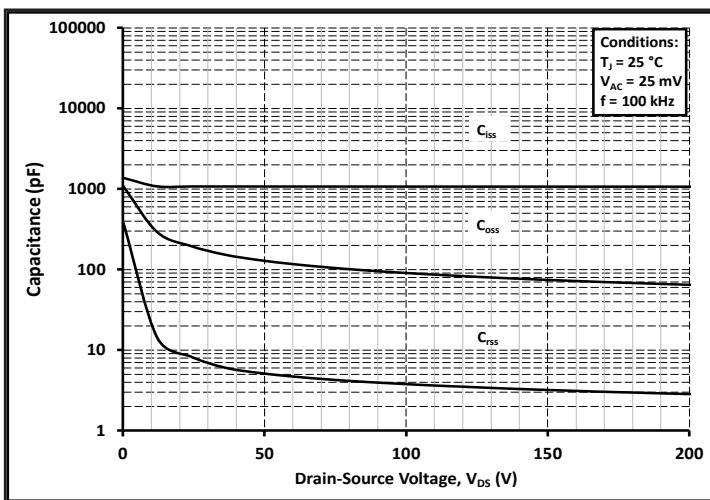


Figure 17. Capacitances vs. Drain-Source Voltage (0 - 200V)

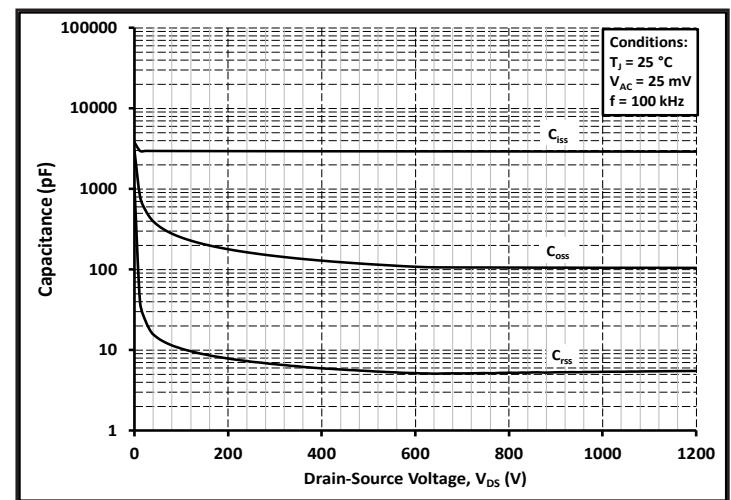


Figure 18. Capacitances vs. Drain-Source Voltage (0 - 1200V)

Typical Performance

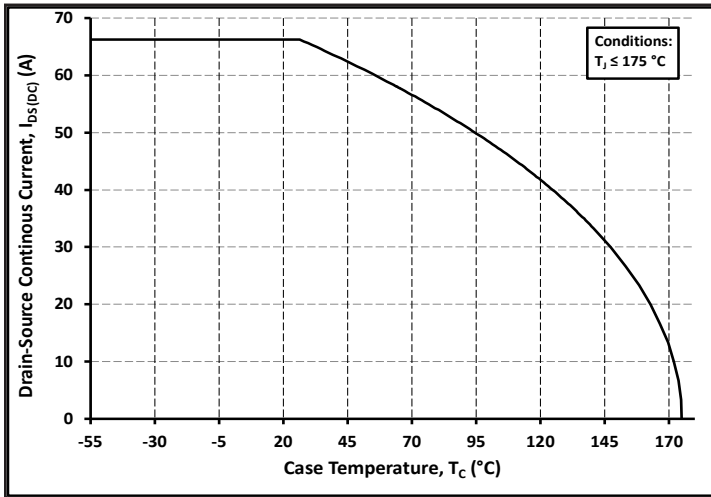


Figure 19. Continuous Drain Current Derating vs. Case Temperature

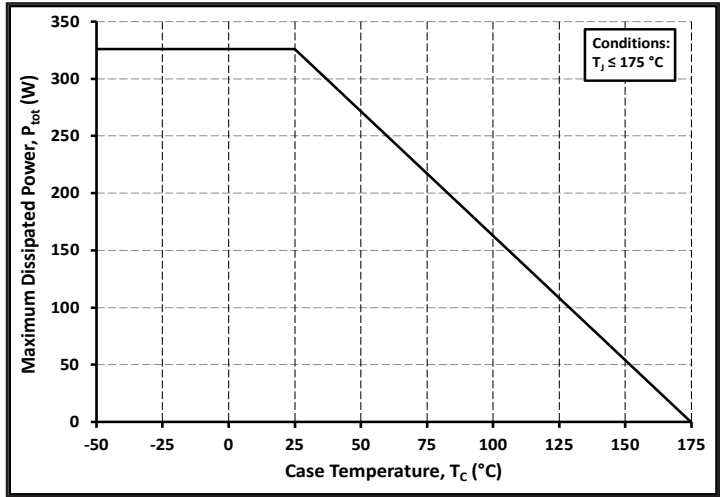


Figure 20. Maximum Power Dissipation Derating vs. Case Temperature

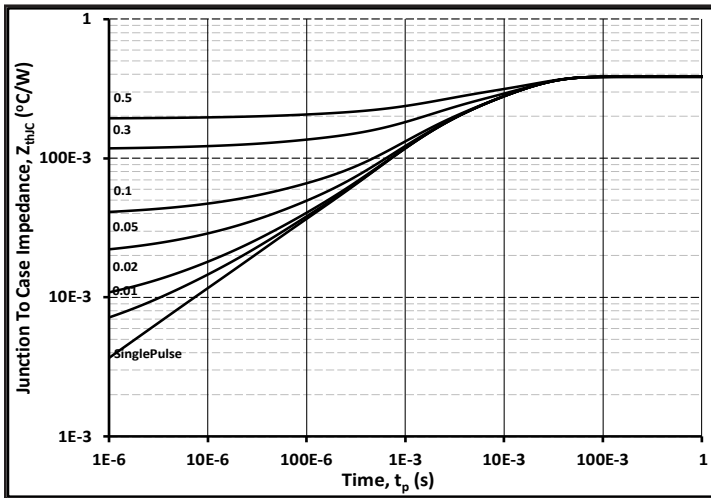


Figure 21. Transient Thermal Impedance (Junction - Case)

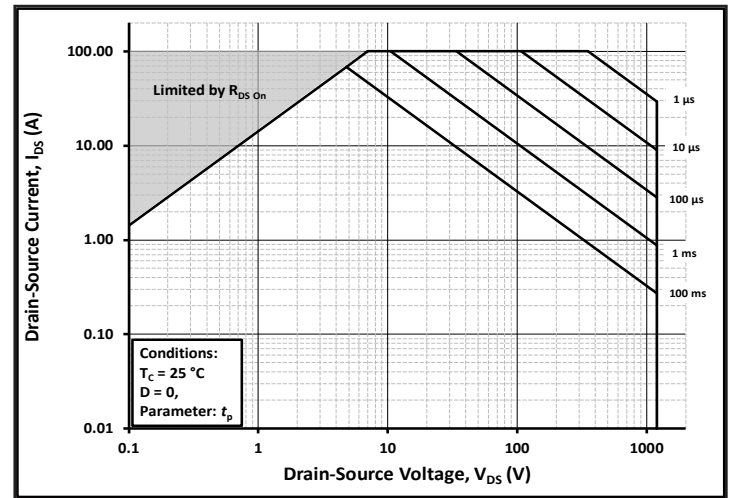


Figure 22. Safe Operating Area

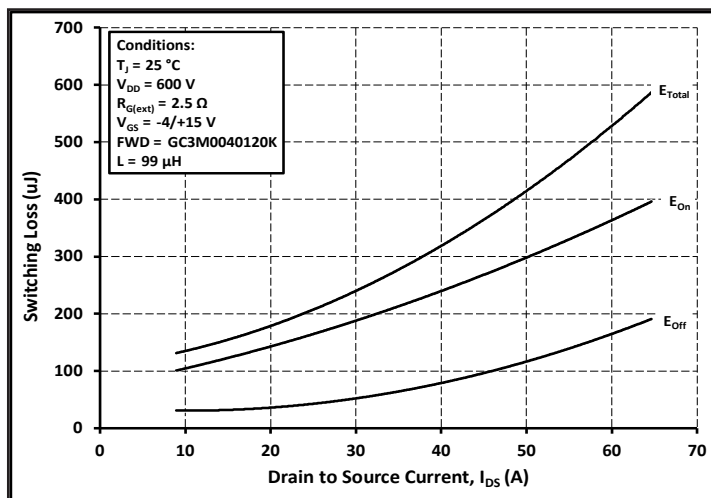


Figure 23. Clamped Inductive Switching Energy vs. Drain Current ( $V_{DD} = 600V$ )

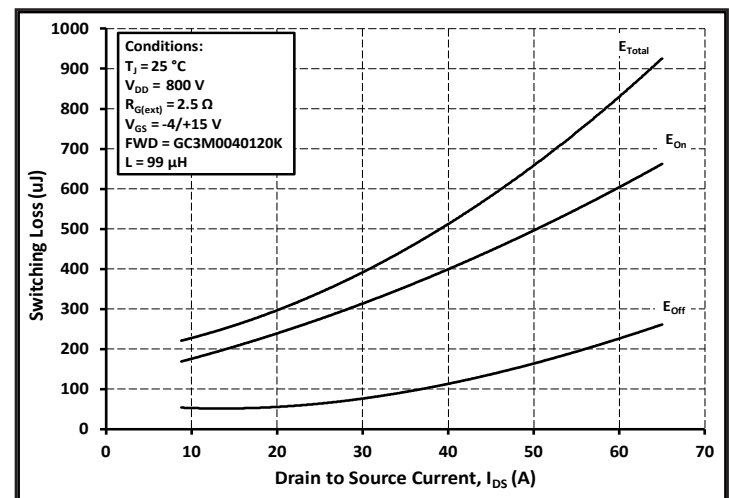


Figure 24. Clamped Inductive Switching Energy vs. Drain Current ( $V_{DD} = 800V$ )

Typical Performance

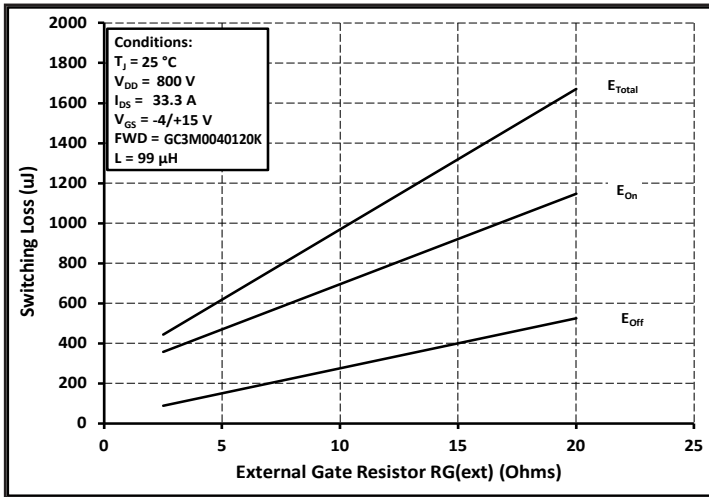


Figure 25. Clamped Inductive Switching Energy vs.  $R_{G(ext)}$

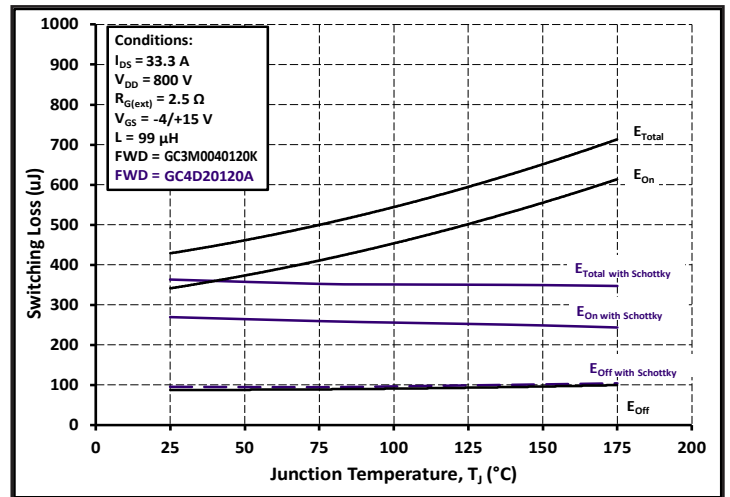


Figure 26. Clamped Inductive Switching Energy vs. Temperature

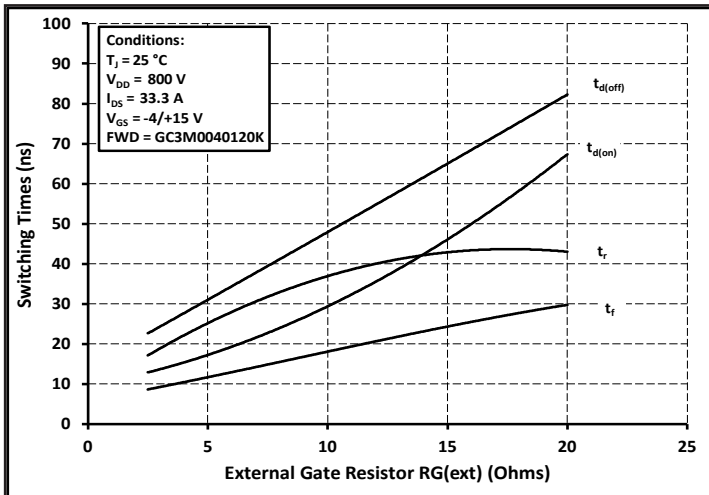


Figure 27. Switching Times vs.  $R_{G(ext)}$

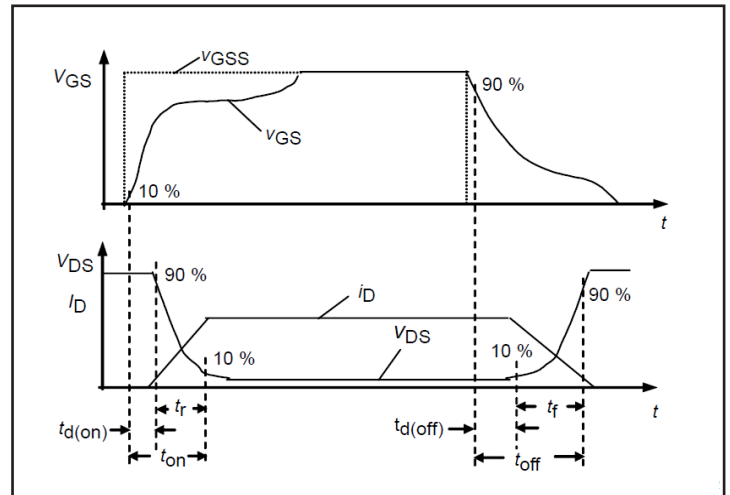


Figure 28. Switching Times Definition



**Test Circuit Schematic**

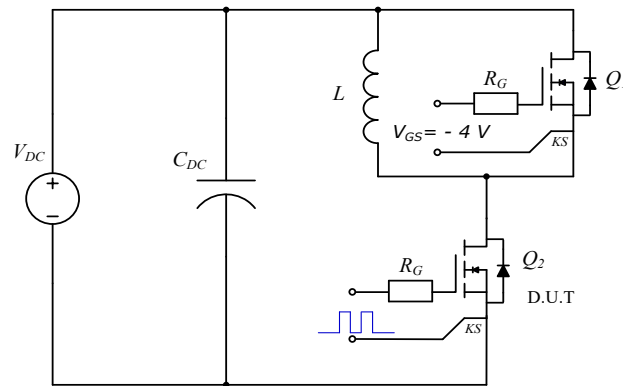
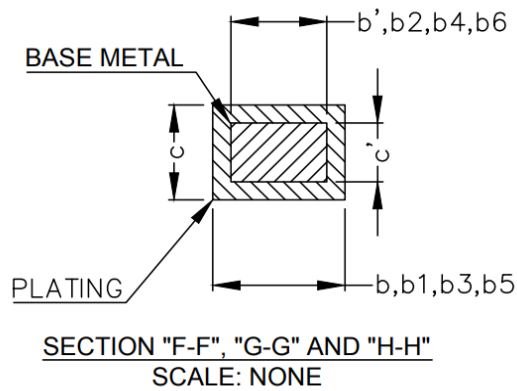
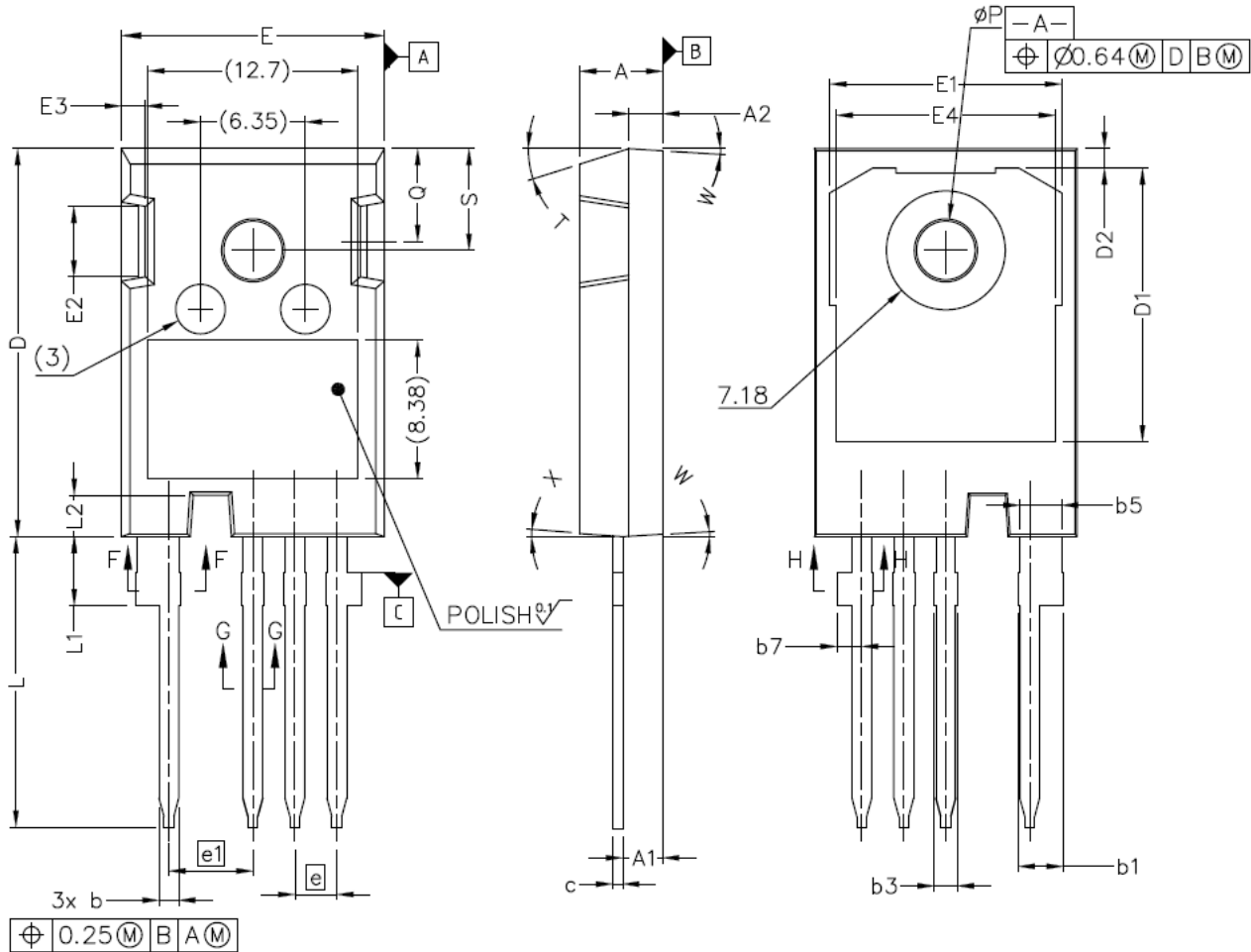


Figure 29. Clamped Inductive Switching Waveform Test Circuit

Note (3): Turn-off and Turn-on switching energy and timing values measured using SiC MOSFET Body Diode as shown above.

**Package Dimensions**

Package TO-247-4L

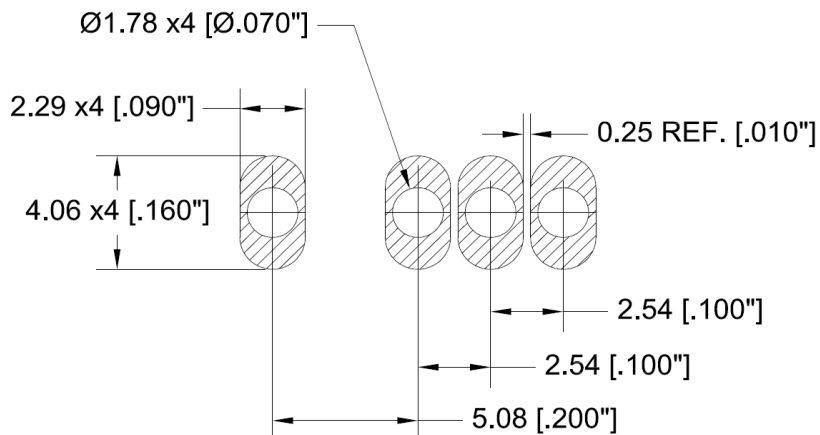


**Package Dimensions**

Package TO-247-4L

SYM	MILLIMETERS	
	MIN	MAX
A	4.83	5.21
A1	2.29	2.54
A2	1.91	2.16
b`	1.07	1.28
b	1.07	1.33
b1	2.39	2.94
b2	2.39	2.84
b3	1.07	1.60
b4	1.07	1.50
b5	2.39	2.69
b6	2.39	2.64
b7	1.30	1.70
c`	0.55	0.65
c	0.55	0.68
D	23.30	23.60
D1	16.25	17.65
D2	0.95	1.25
E	15.75	16.13

SYM	MILLIMETERS	
	MIN	MAX
E1	13.10	14.15
E2	3.68	5.10
E3	1.00	1.90
E4	12.38	13.43
e	2.54 BSC	
e1	5.08 BSC	
N*	4	
L	17.31	17.82
L1	3.97	4.37
L2	2.35	2.65
Ø P	3.51	3.65
Q	5.49	6.00
S	6.04	6.30
T	17.5° REF.	
W	3.5° REF.	
X	4° REF.	



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