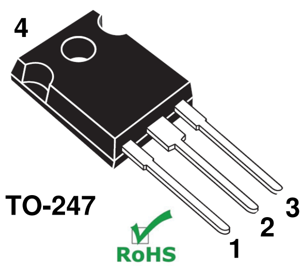
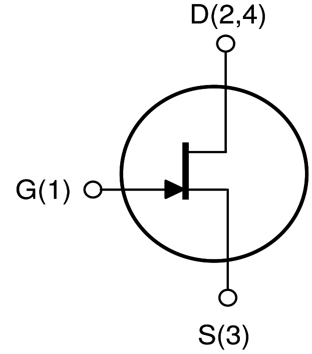
Normally-OFF Trench Silicon Carbide Power JFET

Product Summary		
BV_{DS}	1200	V
$R_{DS(ON)max}$	0.100	Ω
$E_{TS,typ}$	170	µJ

Features:
- Compatible with Standard Gate Driver ICs
- Positive Temperature Coefficient for Ease of Paralleling
- Extremely Fast Switching with No "Tail" Current at 150 ℃
- 150 ℃ Maximum Operating Temperature
- $R_{DS(on)max}$ of 0.100 Ω
- Voltage Controlled
- Low Gate Charge
- Low Intrinsic Capacitance





Internal Schematic

Applications:
- Solar Inverter
- SMPS
- Power Factor Correction
- Induction Heating
- UPS
- Motor Drive

MAXIMUM RATINGS

Parameter	Symbol	Conditions	Value	Unit
Continuous Drain Current	$I_{D,\ Tj=100}$	T_j = 100 ℃	17	A
	$I_{D,\ Tj=150}$	T_j = 150 ℃	10	
Pulsed Drain Current (1)	I_{DM}	T_j = 25 ℃	30	A
Short Circuit Withstand Time	t_{SC}	V_{DD} < 800 V, T_C < 125 ℃	50	µs
Power Dissipation	P_D	T_C = 25 ℃	114	W
Gate-Source Voltage	V_{GS}	AC(2)	-15 to +15	V
Operating and Storage Temperature	T_j, T_{stg}		-55 to +150	℃
Lead Temperature for Soldering	T_{sold}	1/8" from case < 10 s	260	℃

(1) Limited by pulse width

(2) Rg_{EXT} = 1 Ω, $t_p \leq$ 200 ns, see Figure 6 for static conditions

THERMAL CHARACTERISTICS

Parameter	Symbol	Value		Unit
		Typ	Max	
Thermal Resistance, junction-to-case	$R_{th\ JC}$	-	1.1	℃ / W
Thermal Resistance, junction-to-ambient	$R_{th\ JA}$	-	50	

ELECTRICAL CHARACTERISTICS

Parameter	Symbol	Conditions	Value			Unit
			Min	Typ	Max	
Off Characteristics						
Drain-Source Blocking Voltage	BV_{DS}	V_{GS} = 0 V, I_D = 600 µA	1200	-	-	V
Total Drain Leakage Current	I_{DSS}	V_{DS} = 1200 V, V_{GS} = 0 V, Tj = 25°C	-	100	600	µA
		V_{DS} = 1200 V, V_{GS} = 0 V, Tj = 150°C	-	300	-	
		V_{DS} = 1200 V, $V_{GS} \leq$ -15 V, Tj = 25°C	-	1	-	
		V_{DS} = 1200 V, $V_{GS} \leq$ -15 V, Tj = 150°C	-	10	-	
Total Gate Reverse Leakage	I_{GSS}	V_{GS} = -15 V, VDS = 0 V	-	-0.1	-0.3	mA
		V_{GS} = -15 V, VDS = 1200 V	-	-0.1	-	
On Characteristics						
Drain-Source On-resistance	$R_{DS(on)}$	I_D = 10 A, V_{GS} = 3 V, T_j = 25 °C	-	0.08	0.1	Ω
		I_D = 10 A, V_{GS} = 3 V, T_j = 100 °C	-	0.2	-	
Gate Threshold Voltage	$V_{GS(th)}$	V_{DS} = 1 V, I_D = 34 mA	0.75	1.00	1.25	V
Gate Forward Current	I_{GFWD}	V_{GS} = 3 V	-	220	-	mA
Gate Resistance	R_G	f = 1 MHz, drain-source shorted	-	6	-	Ω
	$R_{G(ON)}$	V_{GS} >2.7 V; See Figure 6	-	0.5	-	Ω
Dynamic Characteristics						
Input Capacitance	C_{iss}	V_{DD} = 100 V	-	670	-	pF
Output Capacitance	C_{oss}		-	103	-	
Reverse Transfer Capacitance	C_{rss}		-	97	-	
Effective Output Capacitance, energy related	$C_{o(er)}$	V_{DS} = 0 V to 600 V, V_{GS} = 0 V	-	60	-	
Switching Characteristics						
Turn-on Delay	t_{on}	V_{DS} = 600 V, I_D = 12 A, Inductive Load, T_J = 25°C Gate Driver = +15 V, -15 V, See Figure 17 and application note for gate drive recommendations	-	10	-	ns
Rise Time	t_r		-	12	-	
Turn-off Delay	t_{off}		-	30	-	
Fall Time	t_f		-	25	-	
Turn-on Energy	E_{on}		-	68	-	µJ
Turn-off Energy	E_{off}		-	87	-	
Total Switching Energy	E_{ts}		-	155	-	
Turn-on Delay	t_{on}	V_{DS} = 600 V, I_D = 12 A, Inductive Load, T_J = 150°C Gate Driver = +15 V, -15 V, See Figure 17 and application note for gate drive recommendations	-	10	-	ns
Rise Time	t_r		-	15	-	
Turn-off Delay	t_{off}		-	30	-	
Fall Time	t_f		-	25	-	
Turn-on Energy	E_{on}		-	82	-	µJ
Turn-off Energy	E_{off}		-	94	-	
Total Switching Energy	E_{ts}		-	176	-	
Total Gate Charge	Q_g	V_{DS} = 600 V, I_D = 5 A, V_{GS} = + 2.5 V	-	30	-	nC
Gate-Source Charge	Q_{gs}		-	1	-	
Gate-Drain Charge	Q_{gd}		-	24	-	

Figure 1. Typical Output Characteristics
$I_D = f(V_{DS})$; $T_j = 25$ °C; parameter: V_{GS}

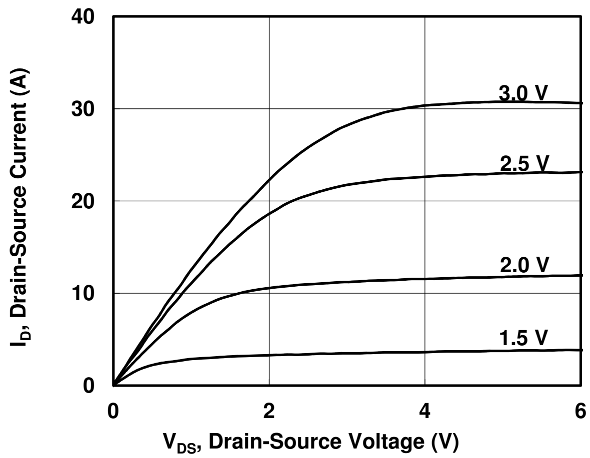


Figure 2. Typical Output Characteristics
$I_D = f(V_{DS})$; $T_j = 100$ °C; parameter: V_{GS}

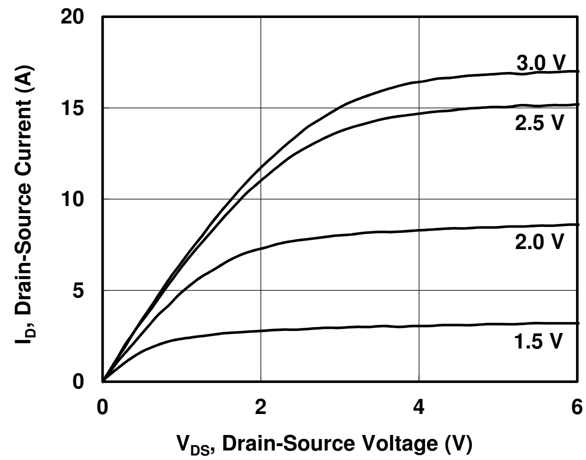


Figure 3. Typical Output Characteristics
$I_D = f(V_{DS})$; $T_j = 150$ °C; parameter: V_{GS}

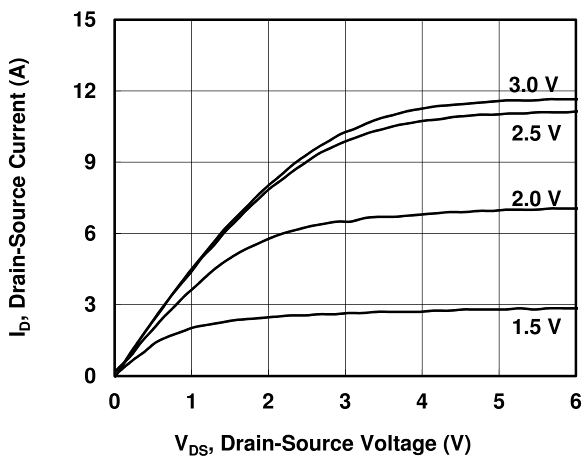


Figure 4. Safe Operating Area
$I_D = f(V_{DS})$; $T_C = 25$ °C, D = 0, parameter: t_P

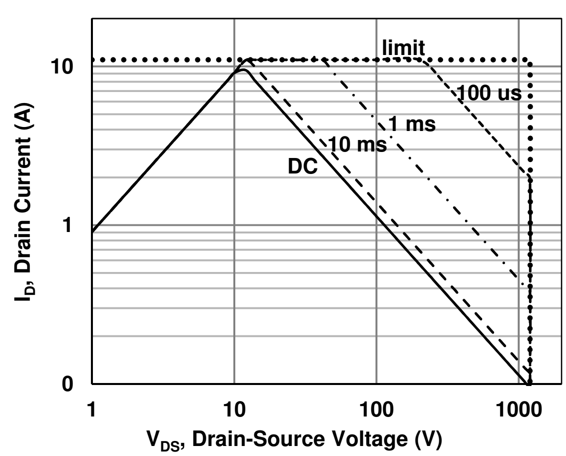


Figure 5. Typical Transfer Characteristics
$I_D = f(V_{GS})$; $V_{DS} = 5$ V

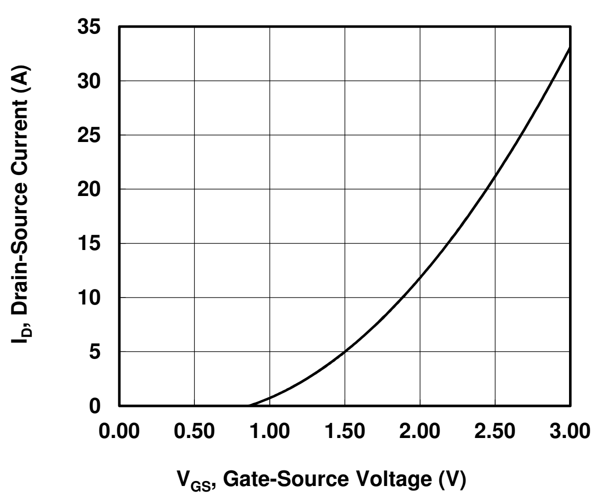


Figure 6. Gate-Source Current
$I_{GS} = f(V_{GS})$; parameter: T_j

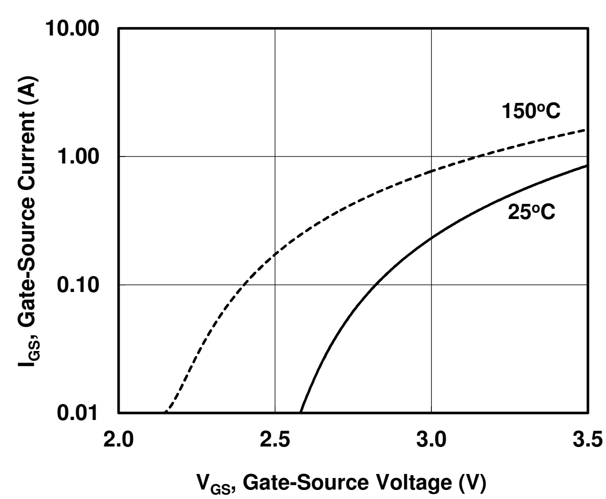


Figure 7. Drain-Source On-resistance

$R_{DS(on)} = f(I_D)$; V_{GS} = 3.0 V; parameter: T_j

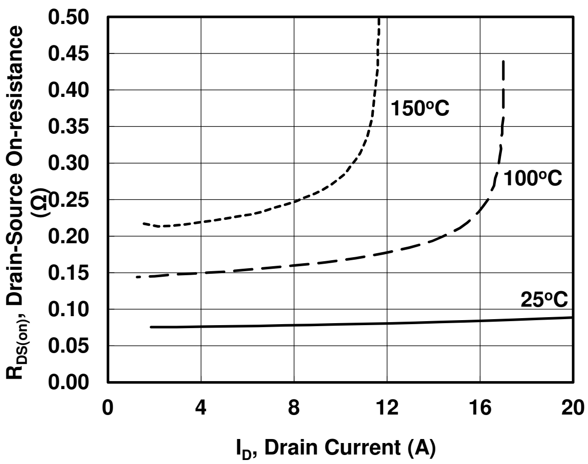


Figure 8. Drain-Source On-resistance

$R_{DS(ON)} = f(T_j)$; I_D = 10 A; parameter: I_{GS}

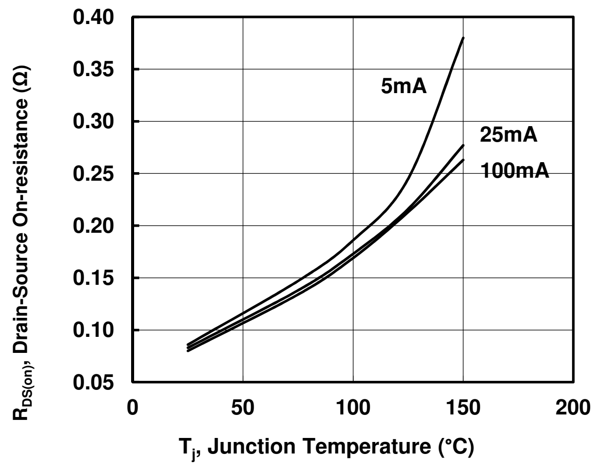


Figure 9. Drain-Source On-resistance

$R_{DS(ON)} = f(I_{GS})$; I_D = 10 A; T_j = 25°C

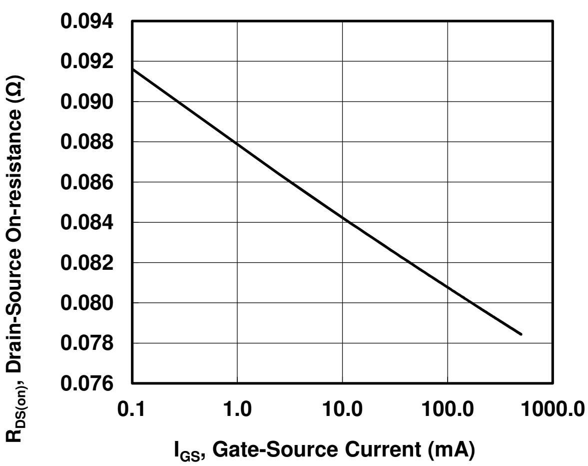


Figure 10. Typical Capacitance

$C = f(V_{DS})$; V_{GS} = 0 V; f = 1 MHz

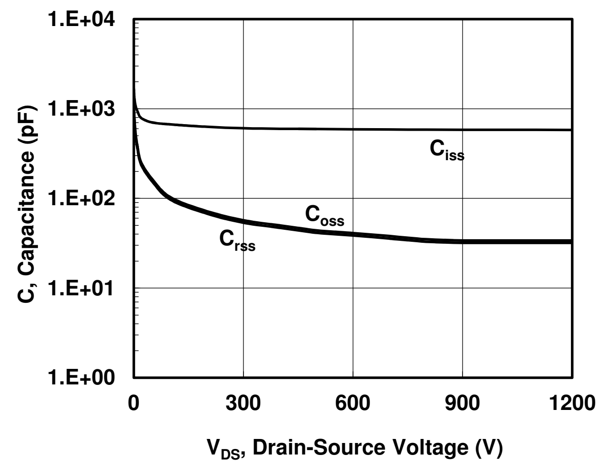


Figure 11. Gate Charge

$Q_g = f(V_{GS})$; V_{DS} = 600 V; I_D = 5 A, T_j = 25°C

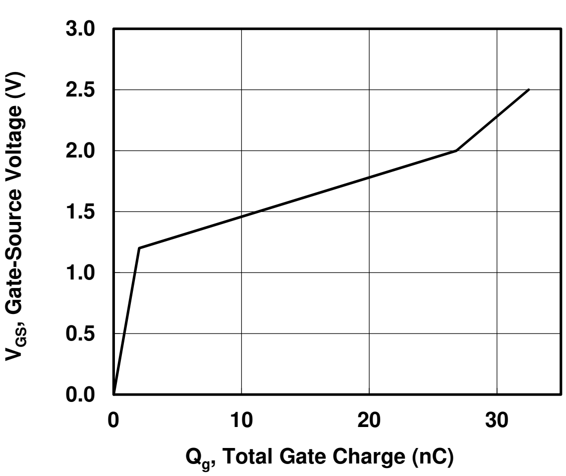


Figure 12. Gate Threshold Voltage

$V_{th} = f(T_j)$

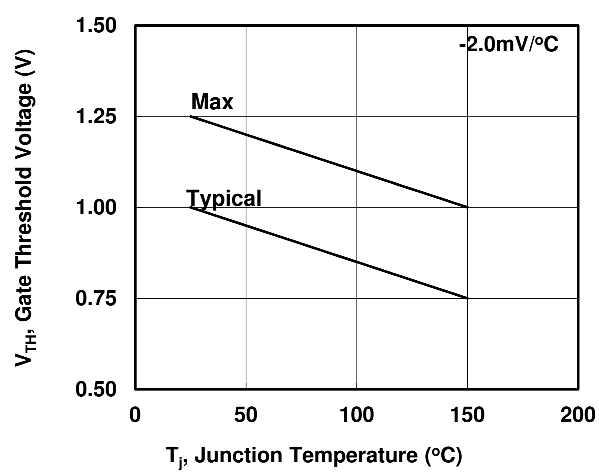


Figure 13. Drain-Source Leakage

$I_D = f(V_{DS})$; $V_{GS} = 0$ V; parameter: T_j

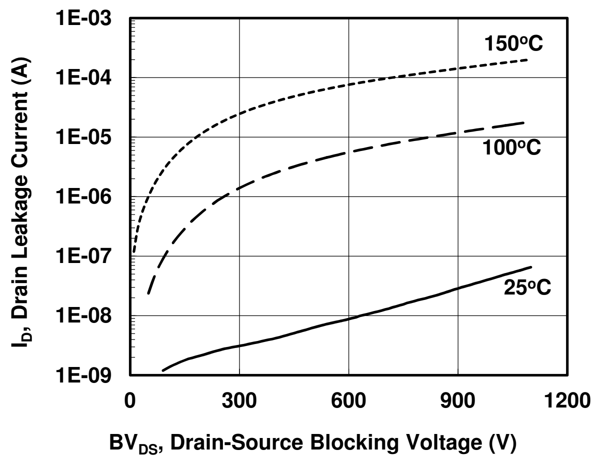


Figure 14. Transient Thermal Impedance

$Z_{th(jc)} = f(t_P)$; parameter: Duty Ratio

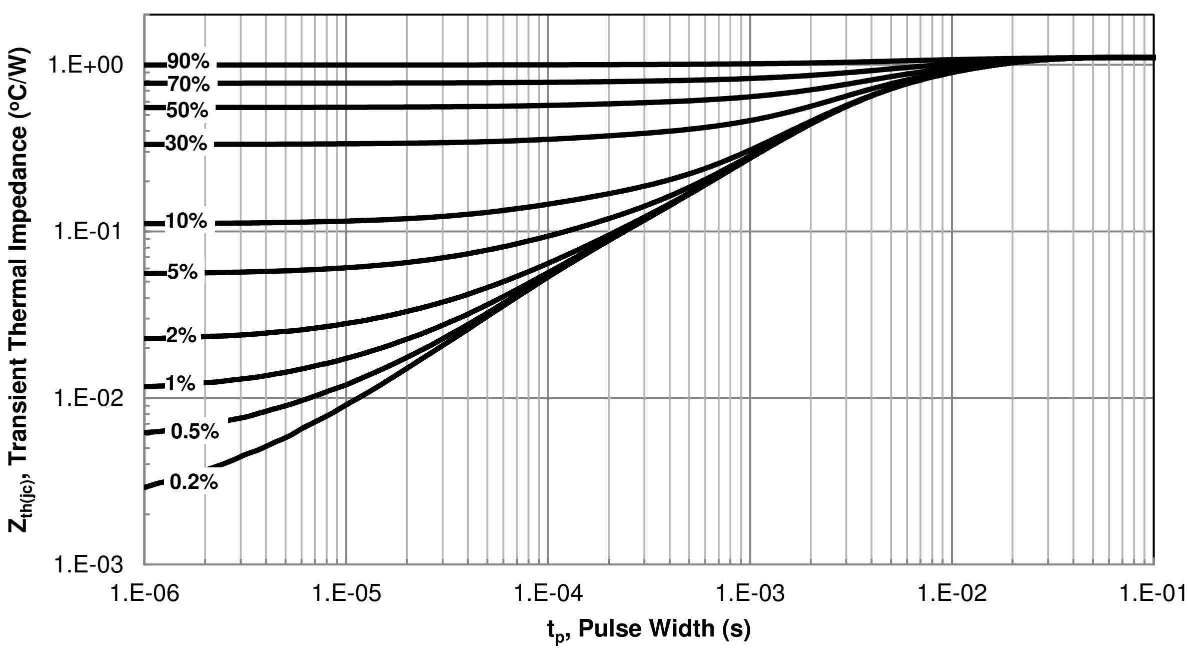


Figure 15. Switching Energy Losses

$E_s = f(I_D)$; V_{DS} = 600 V; GD = +15 V/-15 V, R_{GEXT} = 5 Ω

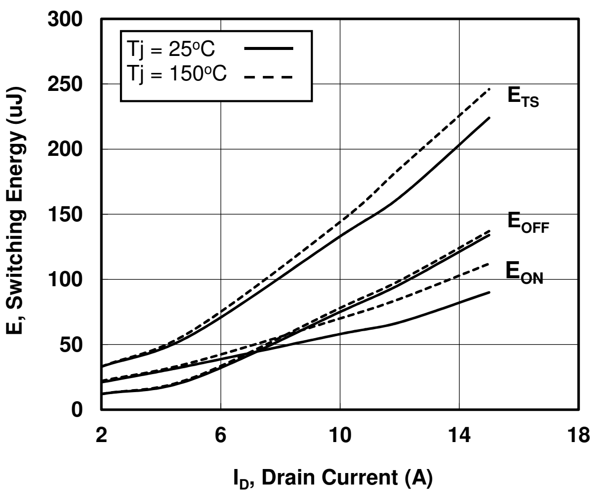


Figure 16. Switching Energy Losses

$E_s = f(R_{GEXT})$; V_{DS} = 600 V; I_D = 12 A, GD = +15 V/-15 V

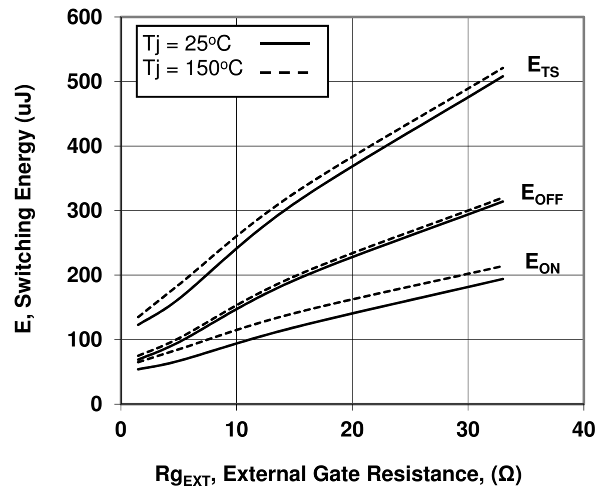
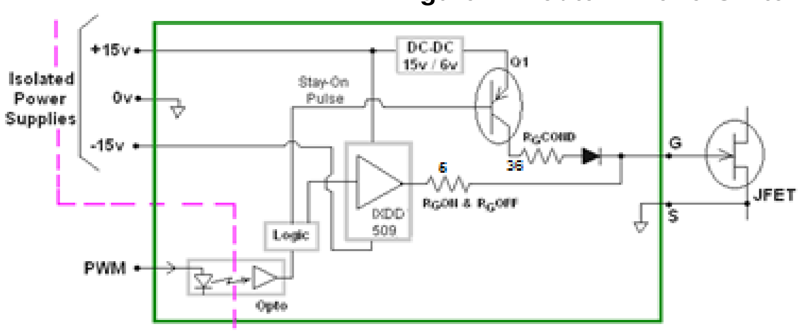


Figure 17. Gate Driver & Switching Test Circuit



Modified SGDR600P1

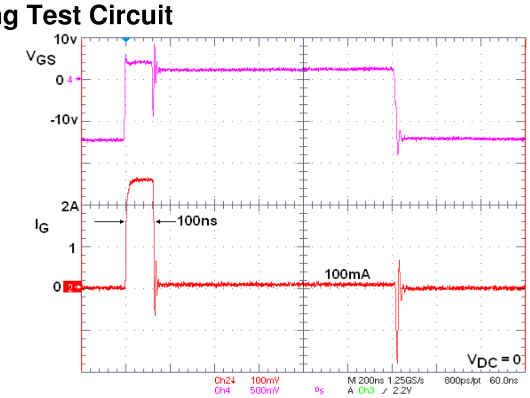
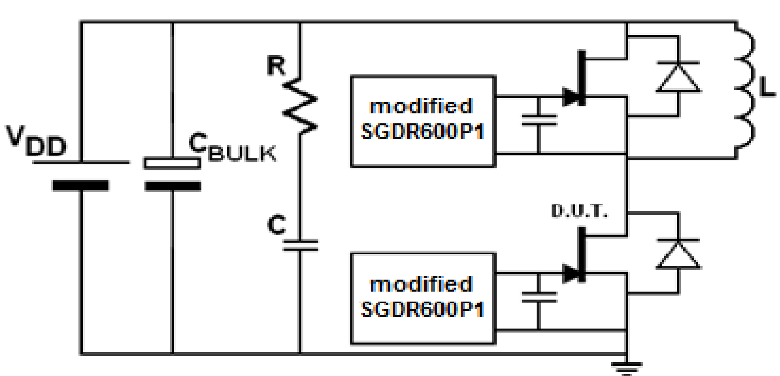


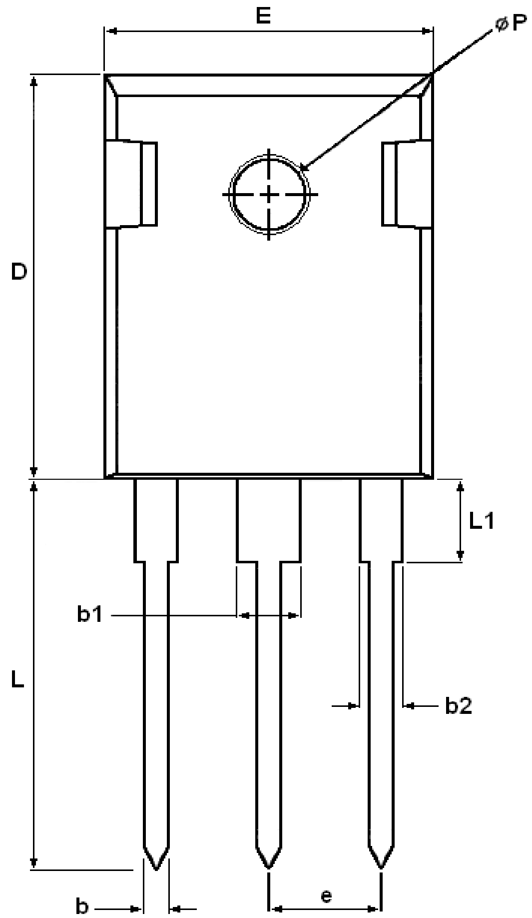
Figure 18. Test Circuit & Test Conditions

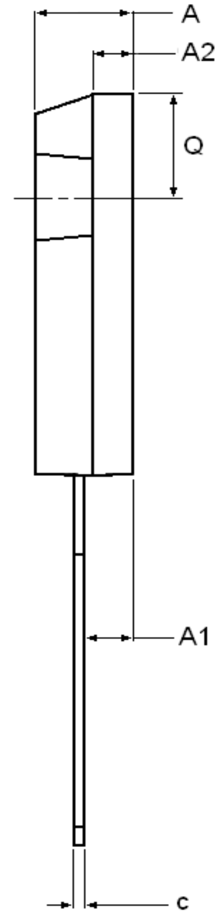


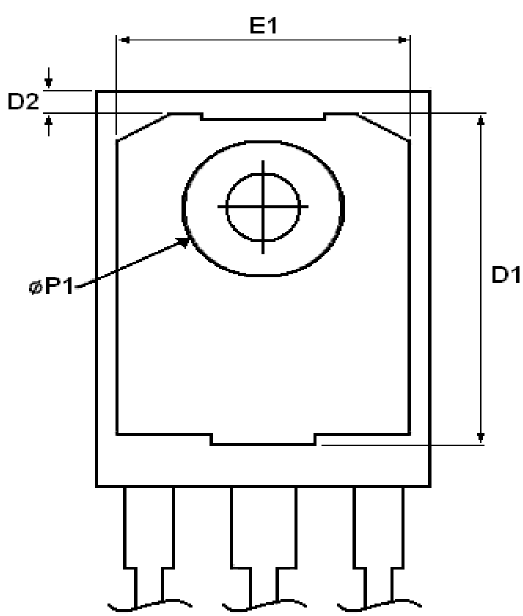
Test Conditions

- Single Device configuration
- V_{DD} = 600 V, I_{LPK} = 12 A, T_A = 25°C
- RC snubber: R= 22 Ω and C = 4.7 nF
- 400 uH load inductance
- Each device driven by separate modified SGD600P1
- Gate driver approx. 5mm from gate terminal
- 3.3 nF gate-source capacitive clamp

The SGDR600P1 is a gate driver reference design available for purchase from SemiSouth. See applications note AN-SS3 for full circuit description, test results, schematics, and bill of materials. Gerber files also available upon request.







DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.903	5.157	0.193	0.203
A1	2.273	2.527	0.090	0.100
A2	1.853	2.108	0.073	0.083
b	1.073	1.327	0.042	0.052
b1	2.873	3.381	0.113	0.133
b2	1.903	2.386	0.042	0.052
c	0.600	0.752	0.024	0.029
D	20.823	21.077	0.820	0.830
D1	17.393	17.647	0.685	0.695
D2	1.063	1.317	0.042	0.052
e	5.450		0.215	
E	15.773	16.027	0.621	0.631
E1	13.893	14.147	0.547	0.557
L	20.053	20.307	0.789	0.799
L1	4.168	4.472	0.165	0.175
Q	6.043	6.297	0.238	0.248
ØP	3.560	3.660	0.140	0.144
ØP1	7.063	7.317	0.278	0.288

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