

Normally-OFF Trench Silicon Carbide Power JFET

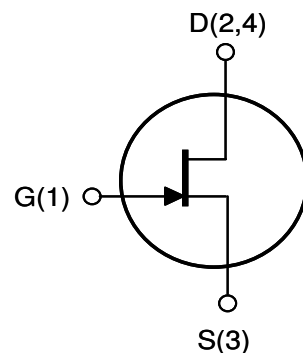
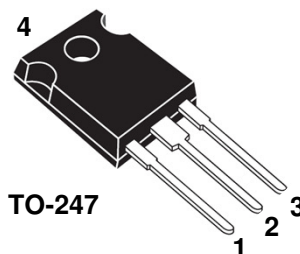
Features:

- Compatible with Standard Gate Driver ICs
- Positive Temperature Coefficient for Ease of Paralleling
- Temperature Independent Switching Behavior
- 150 °C Maximum Operating Temperature
- $R_{DS(on)max}$ of 0.063 Ω
- Voltage Controlled
- Low Gate Charge
- Low Intrinsic Capacitance

Applications:

High Performance Audio

Product Summary		
BV_{DS}	1200	V
$R_{DS(ON)max}$	0.063	Ω
$E_{TS,typ}$	440	μJ



Internal Schematic

MAXIMUM RATINGS

Parameter	Symbol	Conditions	Value	Unit
Continuous Drain Current	$I_D, T_j=125$	$T_j = 125\text{ }^{\circ}\text{C}$	30	A
	$I_D, T_j=150$	$T_j = 150\text{ }^{\circ}\text{C}$	20	
Pulsed Drain Current ⁽¹⁾	I_{DM}	$T_C = 25\text{ }^{\circ}\text{C}$	60	A
Short Circuit Withstand Time	t_{SC}	$V_{DD} < 800\text{ V}, T_C < 125\text{ }^{\circ}\text{C}$	50	μs
Power Dissipation	P_D	$T_C = 25\text{ }^{\circ}\text{C}$	250	W
Gate-Source Voltage	V_{GS}	static	-10 to +3	V
		AC ⁽²⁾	-10 to +15	V
Operating and Storage Temperature	$T_j, T_{j,stg}$		-55 to +150	$^{\circ}\text{C}$
Lead Temperature for Soldering	T_{sold}	1/8" from case < 10 s	260	$^{\circ}\text{C}$

⁽¹⁾ Limited by pulse width

⁽²⁾ $R_{gEXT} = 1\text{ ohm}, t_p \leq 200ns$, see Figure 5 for static conditions

THERMAL CHARACTERISTICS

Parameter	Symbol	Value		Unit
		Typ	Max	
Thermal Resistance, junction-to-case	$R_{th,JC}$	-	0.6	$^{\circ}\text{C} / \text{W}$
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}	$V_{GS} = 0 \text{ V}, I_D = 1200 \mu\text{A}$	1200	-	-	V
Total Drain Leakage Current	I_{DSS}	$V_{DS} = 1200 \text{ V}, V_{GS} = 0 \text{ V}, T_J = 25^\circ\text{C}$	-	200	1200	μA
		$V_{DS} = 1200 \text{ V}, V_{GS} = 0 \text{ V}, T_J = 150^\circ\text{C}$	-	600	-	
		$V_{DS} = 1200 \text{ V}, V_{GS} \leq -10 \text{ V}, T_J = 25^\circ\text{C}$	-	2	-	
		$V_{DS} = 1200 \text{ V}, V_{GS} \leq -10 \text{ V}, T_J = 150^\circ\text{C}$	-	20	-	
Total Gate Reverse Leakage	I_{GSS}	$V_{GS} = -10 \text{ V}, V_{DS} = 0 \text{ V}$	-	-0.2	-0.6	mA
		$V_{GS} = -10 \text{ V}, V_{DS} = 1200 \text{ V}$	-	-0.2	-	

On Characteristics

Drain-Source On-resistance	$R_{DS(on)}$	$I_D = 20 \text{ A}, V_{GS} = 3 \text{ V}, T_J = 25^\circ\text{C}$	-	0.05	0.063	Ω
		$I_D = 20 \text{ A}, V_{GS} = 3 \text{ V}, T_J = 125^\circ\text{C}$	-	0.13	-	
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS} = 1 \text{ V}, I_D = 70 \text{ mA}$	0.75	1.00	1.25	V
Gate Forward Current	I_{GFWD}	$V_{GS} = 3 \text{ V}$	-	440	-	mA
Gate Resistance	R_G	$f = 1 \text{ MHz}, \text{ drain-source shorted}$	-	4	-	Ω
	$R_{G(ON)}$	$V_{GS} > 2.7 \text{ V}; \text{ See Figure 5}$	-	0.25	-	Ω

Dynamic Characteristics

Input Capacitance	C_{iss}	$V_{DD} = 100 \text{ V}$	-	1220	-	pF
Output Capacitance	C_{oss}		-	180	-	
Reverse Transfer Capacitance	C_{rss}		-	169	-	
Effective Output Capacitance, energy related	$C_{o(er)}$	$V_{DS} = 0 \text{ V to } 600 \text{ V}, V_{GS} = 0 \text{ V}$	-	100	-	

Switching Characteristics

Turn-on Delay	t_{on}	$V_{DS} = 600 \text{ V}, I_D = 24 \text{ A},$ Inductive Load, $T_J = 25^\circ\text{C}$ Gate Driver = SGDR600P1, GD Voltages: +15V, -10V	-	15	-	ns
Rise Time	t_r		-	12	-	
Turn-off Delay	t_{off}		-	35	-	
Fall Time	t_f		-	30	-	
Turn-on Energy	E_{on}	See Figure 15 and application note for gate drive recommendations	-	131	-	μJ
Turn-off Energy	E_{off}		-	222	-	
Total Switching Energy	E_{ts}		-	353	-	
Turn-on Delay	t_{on}	$V_{DS} = 600 \text{ V}, I_D = 24 \text{ A},$ Inductive Load, $T_J = 150^\circ\text{C}$ Gate Driver = SGDR600P1, GD Voltages: +15V, -10V	-	15	-	ns
Rise Time	t_r		-	15	-	
Turn-off Delay	t_{off}		-	35	-	
Fall Time	t_f		-	30	-	
Turn-on Energy	E_{on}	See Figure 15 and application note for gate drive recommendations	-	145	-	μJ
Turn-off Energy	E_{off}		-	229	-	
Total Switching Energy	E_{ts}		-	374	-	
Total Gate Charge	Q_g	$V_{DS} = 600 \text{ V}, I_D = 10 \text{ A},$ $V_{GS} = +2.5 \text{ V}$	-	60	-	nC
Gate-Source Charge	Q_{gs}		-	2	-	
Gate-Drain Charge	Q_{gd}		-	49	-	

Figure 1. Typical Output Characteristics

$I_D = f(V_{DS}); T_J = 25^\circ\text{C}; \text{parameter: } V_{GS}$

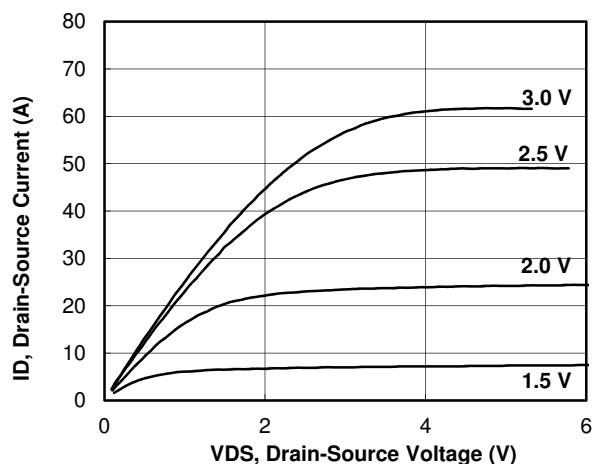


Figure 2. Typical Output Characteristics

$I_D = f(V_{DS}); T_J = 125^\circ\text{C}; \text{parameter: } V_{GS}$

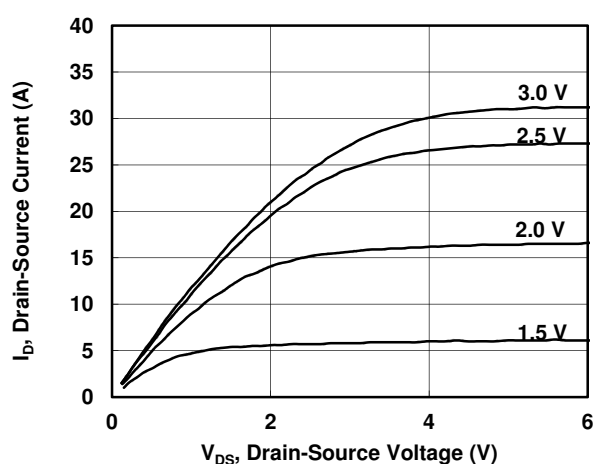


Figure 3. Typical Output Characteristics

$I_D = f(V_{DS}); T_J = 150^\circ\text{C}; \text{parameter: } V_{GS}$

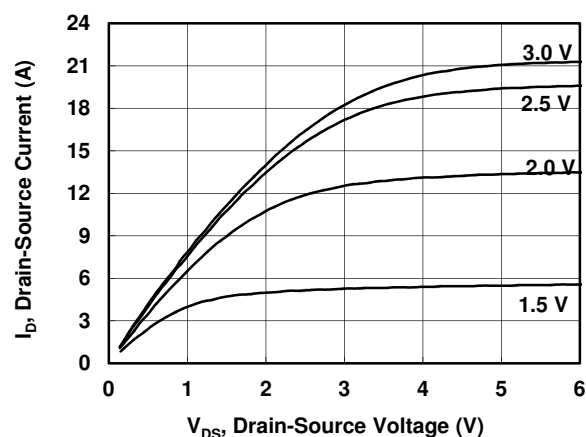


Figure 4. Typical Transfer Characteristics

$I_D = f(V_{GS}); V_{DS} = 5\text{ V}$

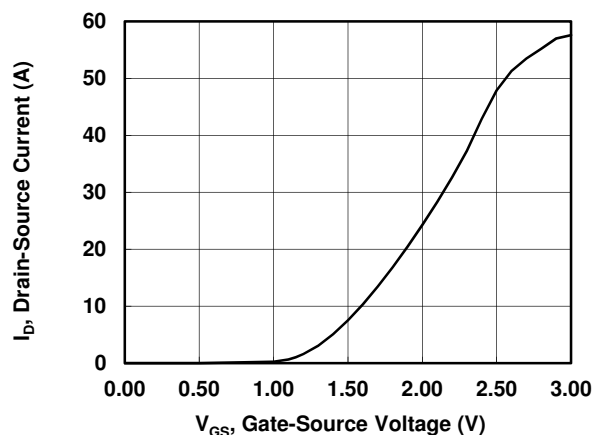


Figure 5. Typical Gate-Source Current

$I_{GS} = f(V_{GS}); \text{parameter: } T_J$

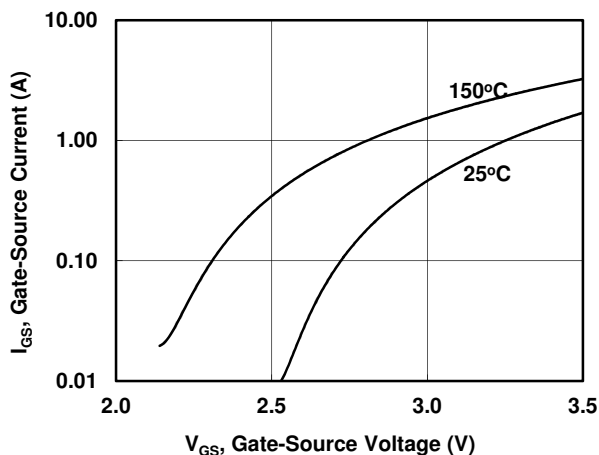


Figure 6. Typical Drain-Source On-resistance

$R_{DS(on)} = f(I_D); V_{GS} = 3.0; \text{parameter: } T_J$

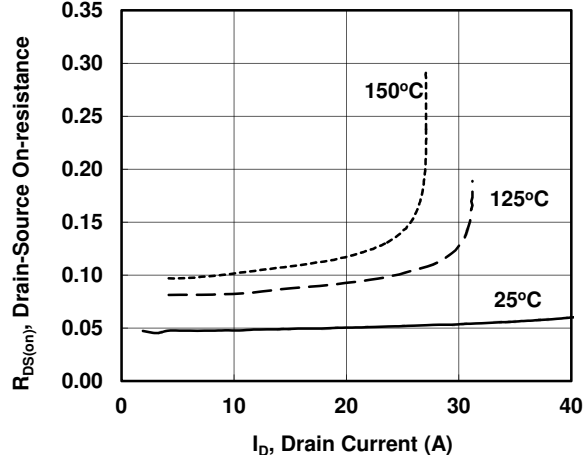


Figure 7. Typical Drain-Source On-resistance

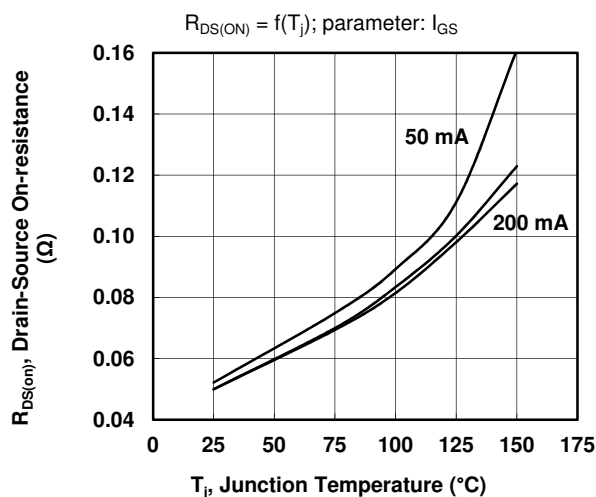


Figure 8. Typical Drain-Source On-resistance

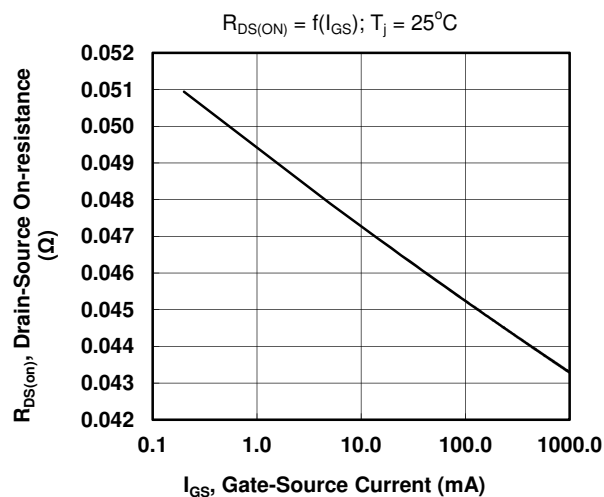


Figure 9. Typical Capacitance

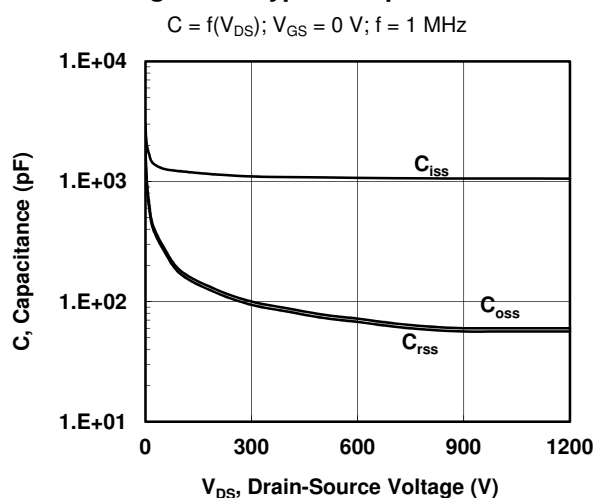


Figure 10. Typical Gate Charge

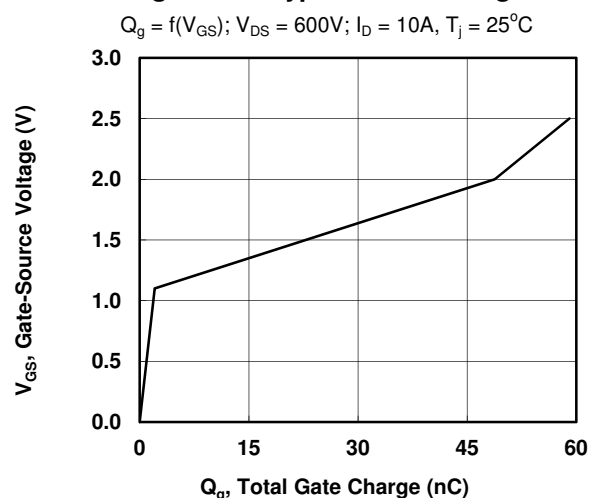


Figure 11. Gate Threshold Voltage

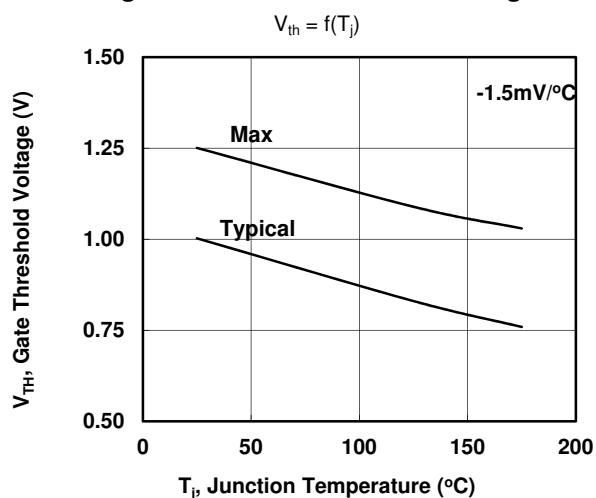


Figure 12. Typical Drain-Source Leakage

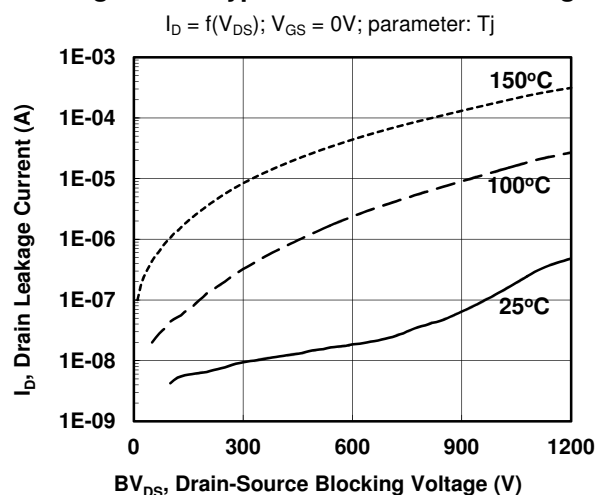


Figure 13. Switching Energy Losses

$E_s = f(I_D)$; $V_{DS} = 600V$; $GD = +15V/-10V$, $R_{GEXT} = 2.5\Omega$

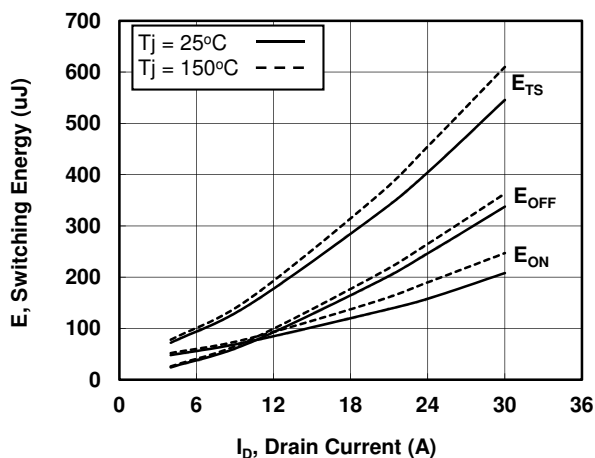


Figure 14. Switching Energy Losses

$E_s = f(R_{GEXT})$; $V_{DS} = 600V$; $I_D = 24A$, $GD = +15V/-10V$

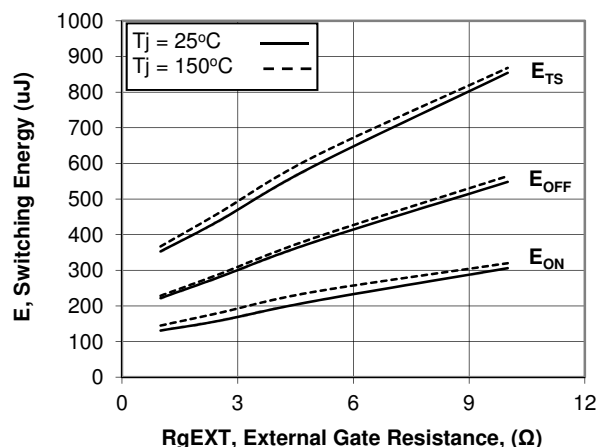


Figure 15. Gate Driver & Gate Waveforms

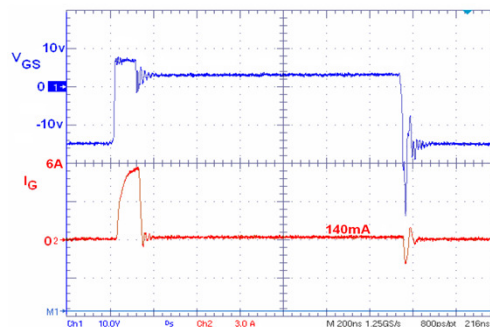
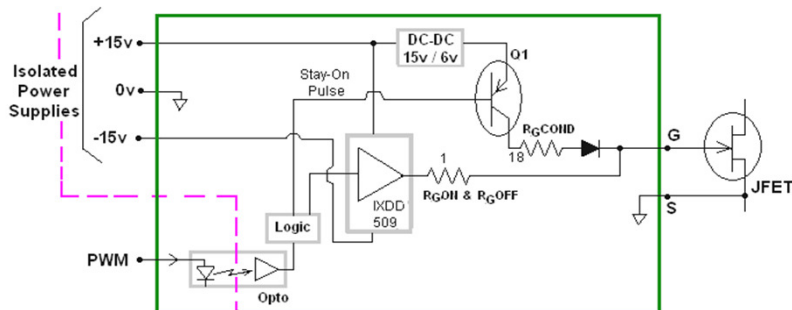
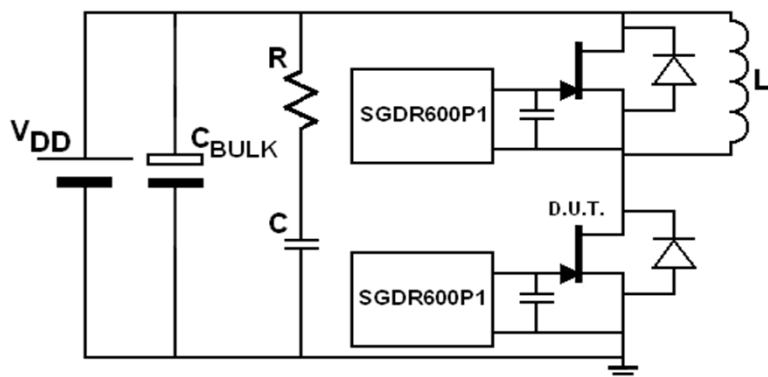


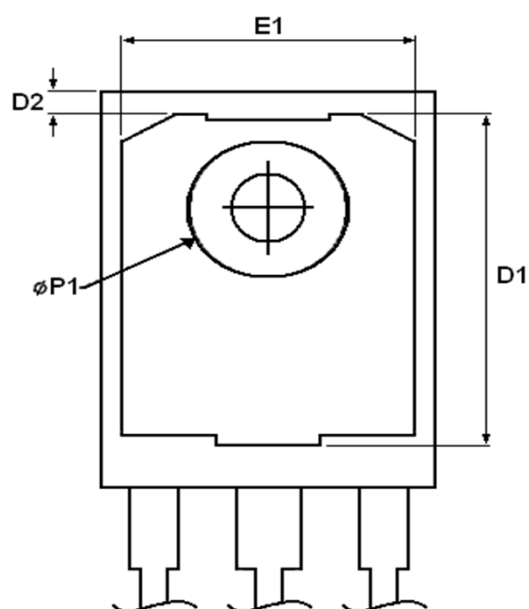
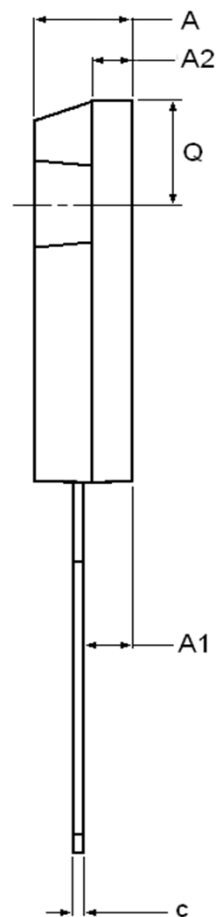
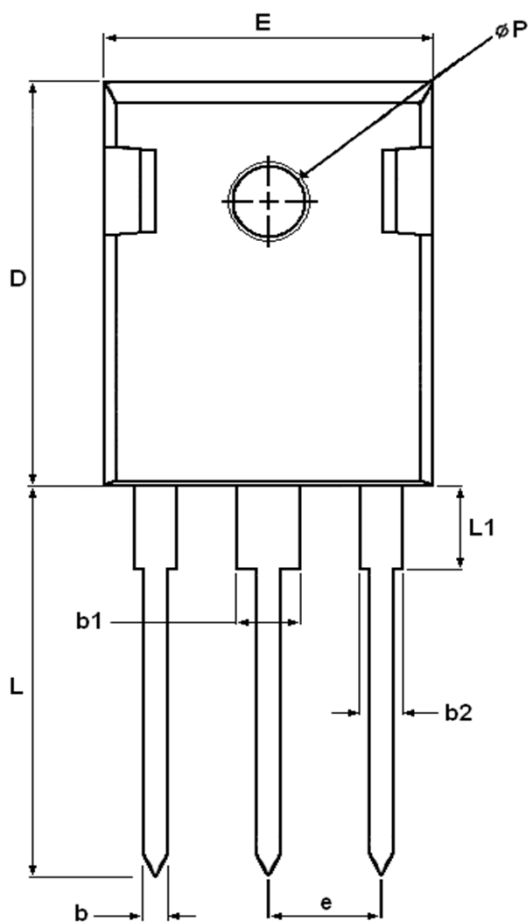
Figure 16. Test Circuit & Test Conditions



Test Conditions

- Phase-leg configuration
- $V_{DD} = 600V$, $I_{LPK} = 25A$, $T_A = 25^\circ C$
- RC snubber: $R = 22$ and $C = 4.7nF$
- 400uH load inductance
- Each device driven by separate SGDR600P1
- Gate driver approx. 5mm from gate terminal
- 3.3nF 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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