

**Normally-OFF Trench Silicon Carbide Power JFET**

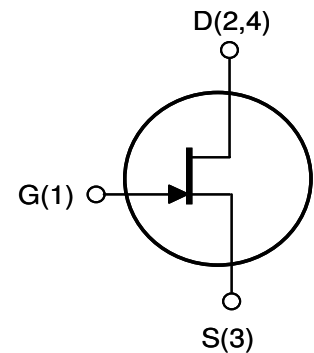
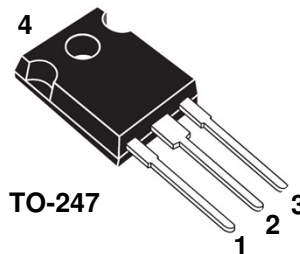
Product Summary		
$BV_{DS}$	1200	V
$R_{DS(ON)max}$	0.063	$\Omega$
$E_{TS,typ}$	440	$\mu J$

**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  $\Omega$
- Voltage Controlled
- Low Gate Charge
- Low Intrinsic Capacitance

**Applications:**

High Performance Audio



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 <sup>(1)</sup>	$I_{DM}$	$T_C = 25\text{ }^\circ\text{C}$	60	A
Short Circuit Withstand Time	$t_{SC}$	$V_{DD} < 800\text{ V}, T_C < 125\text{ }^\circ\text{C}$	50	$\mu\text{s}$
Power Dissipation	$P_D$	$T_C = 25\text{ }^\circ\text{C}$	250	W
Gate-Source Voltage	$V_{GS}$	static	-10 to +3	V
		AC <sup>(2)</sup>	-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	$^\circ\text{C}$

<sup>(1)</sup> Limited by pulse width

<sup>(2)</sup>  $R_{gEXT} = 1\text{ ohm}, t_p \leq 200\text{ns}$ , 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	$\mu\text{A}$
		$V_{DS} = 1200\text{ V}, V_{GS} = 0\text{ V}, T_j = 150^\circ\text{C}$	-	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	$\Omega$
		$I_D = 20\text{ A}, V_{GS} = 3\text{ V}, T_j = 125^\circ\text{C}$	-	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	-	$\Omega$
	$R_{G(ON)}$	$V_{GS} > 2.7\text{ V}; \text{ See Figure 5}$	-	0.25	-	$\Omega$

**Dynamic Characteristics**

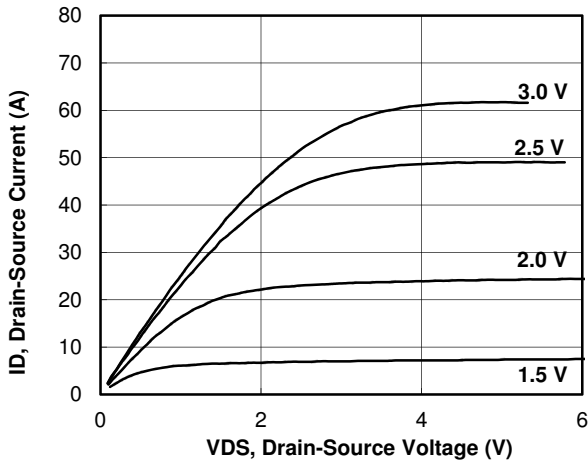
Input Capacitance	$C_{iss}$	$V_{DD} = 100\text{ V}$	-	1220	-	pF
Output Capacitance	$C_{oss}$		-	180	-	
Reverse Transfer Capacitance	$C_{rss}$		-	169	-	
Effective Output Capacitance, energy related	$C_{o(er)}$	$V_{DS} = 0\text{ V to } 600\text{ V}, V_{GS} = 0\text{ V}$	-	100	-	

**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	-	$\mu\text{J}$
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	-	$\mu\text{J}$
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	-	

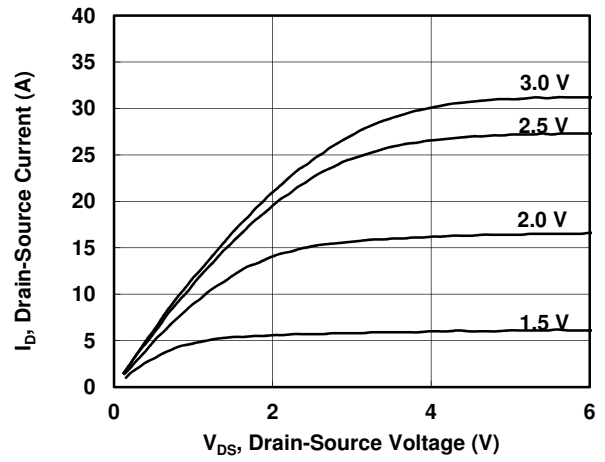
**Figure 1. Typical Output Characteristics**

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



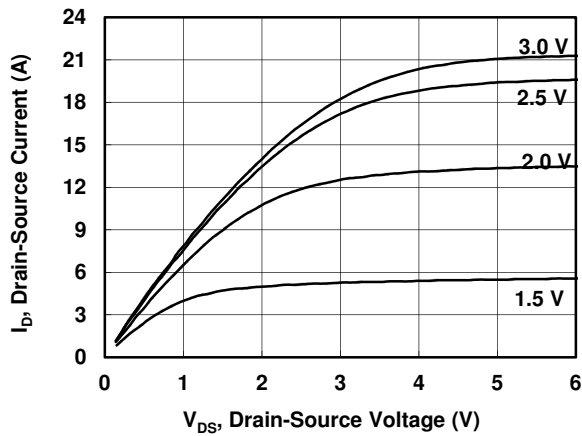
**Figure 2. Typical Output Characteristics**

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



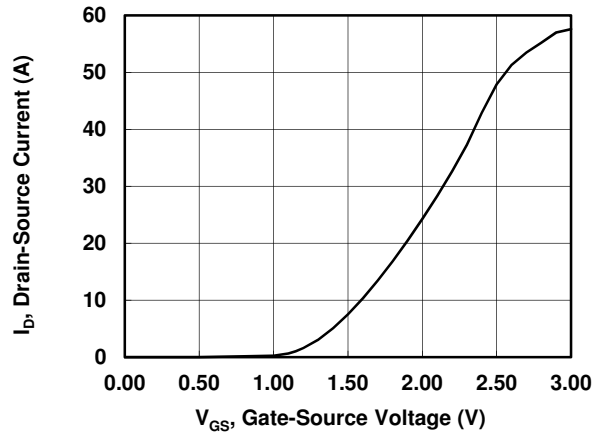
**Figure 3. Typical Output Characteristics**

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



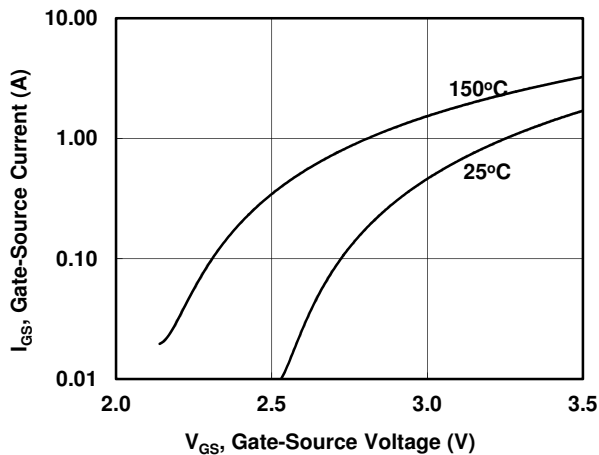
**Figure 4. Typical Transfer Characteristics**

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



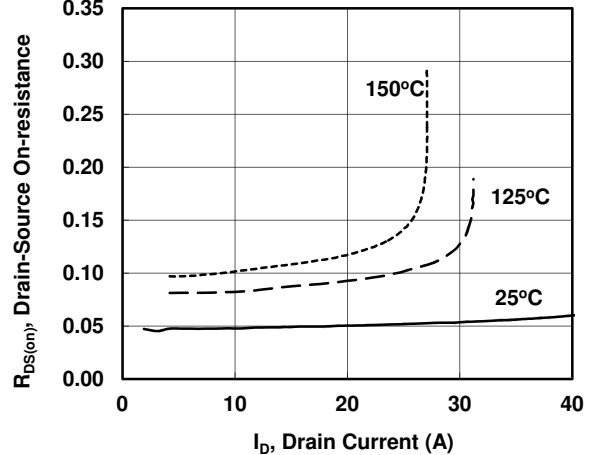
**Figure 5. Typical Gate-Source Current**

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

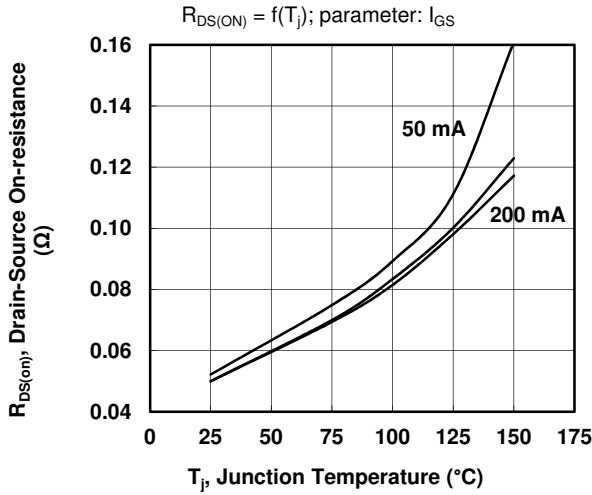


**Figure 6. Typical Drain-Source On-resistance**

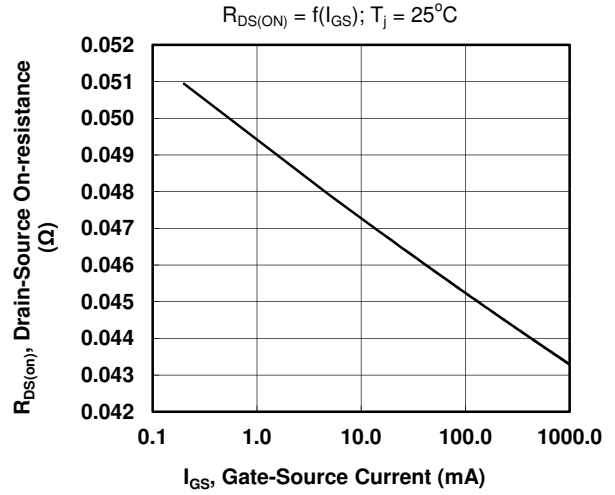
$R_{DS(on)} = f(I_D); V_{GS} = 3.0; \text{parameter: } T_j$



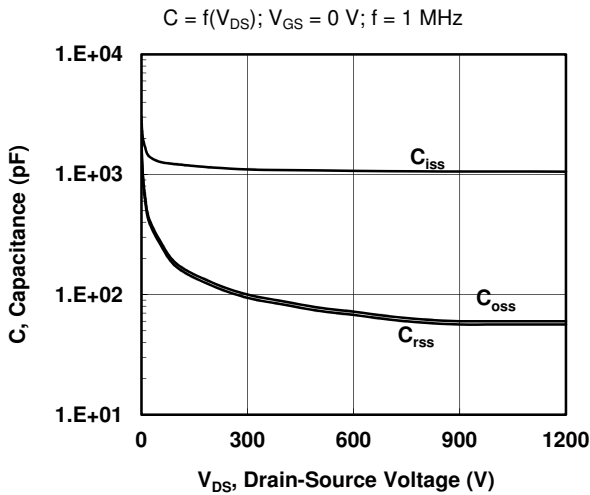
**Figure 7. Typical Drain-Source On-resistance**



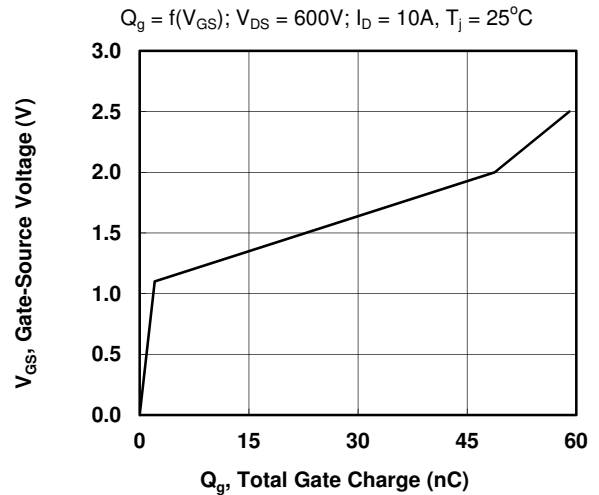
**Figure 8. Typical Drain-Source On-resistance**



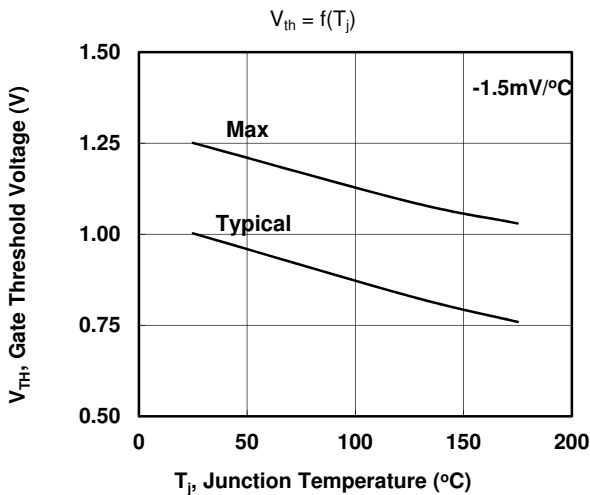
**Figure 9. Typical Capacitance**



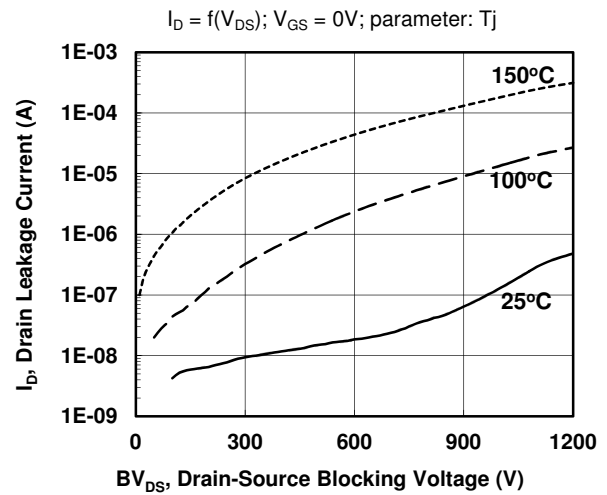
**Figure 10. Typical Gate Charge**



**Figure 11. Gate Threshold Voltage**

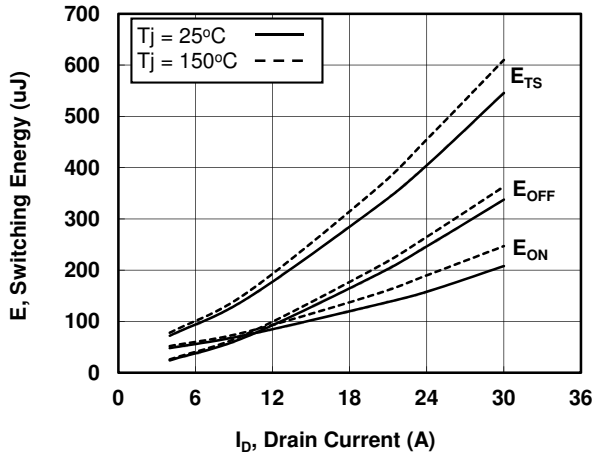


**Figure 12. Typical Drain-Source Leakage**



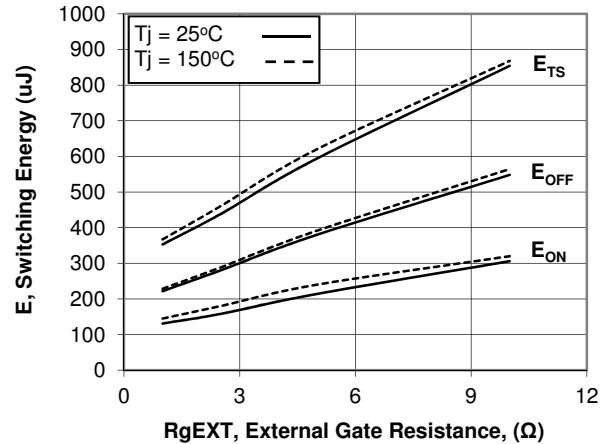
**Figure 13. Switching Energy Losses**

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

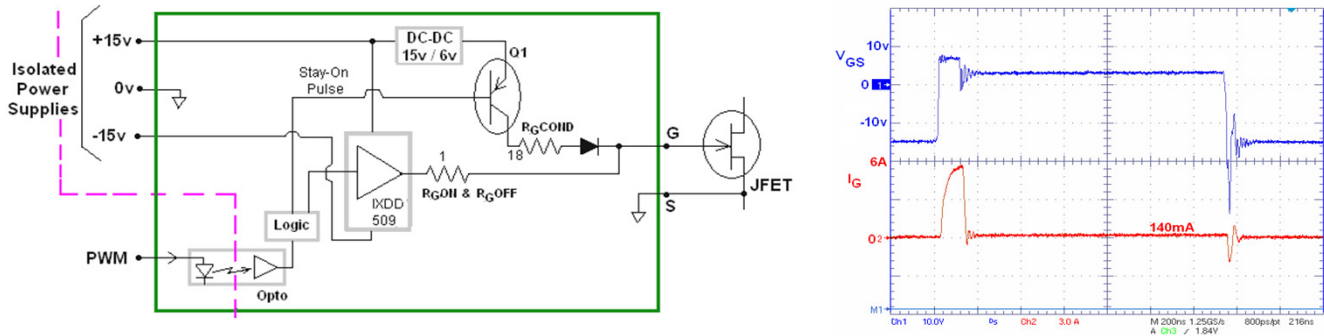


**Figure 14. Switching Energy Losses**

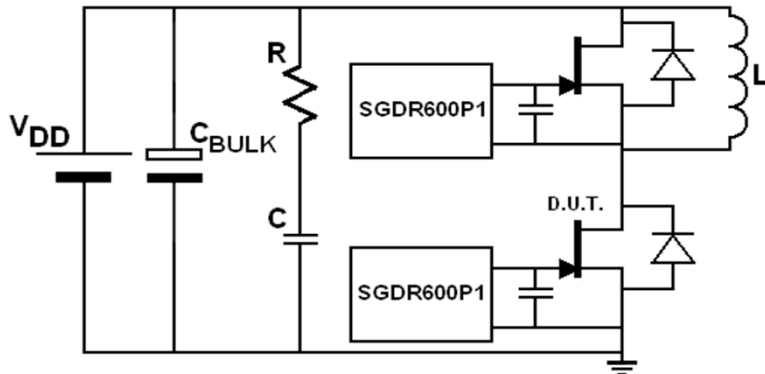
$E_s = f(R_{GEXT})$ ;  $V_{DS} = 600V$ ;  $I_D = 24A$ ,  $GD = +15V/-10V$



**Figure 15. Gate Driver & Gate Waveforms**



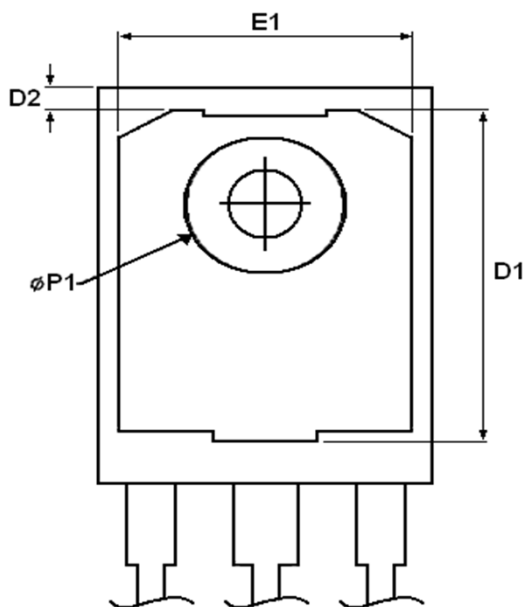
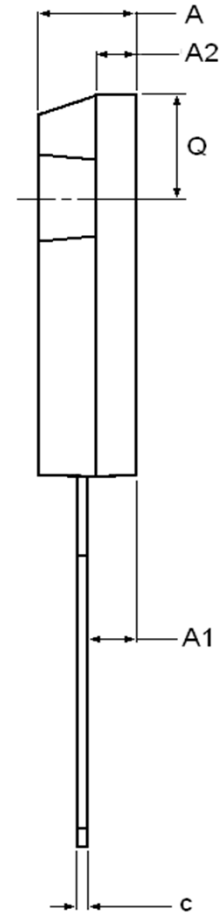
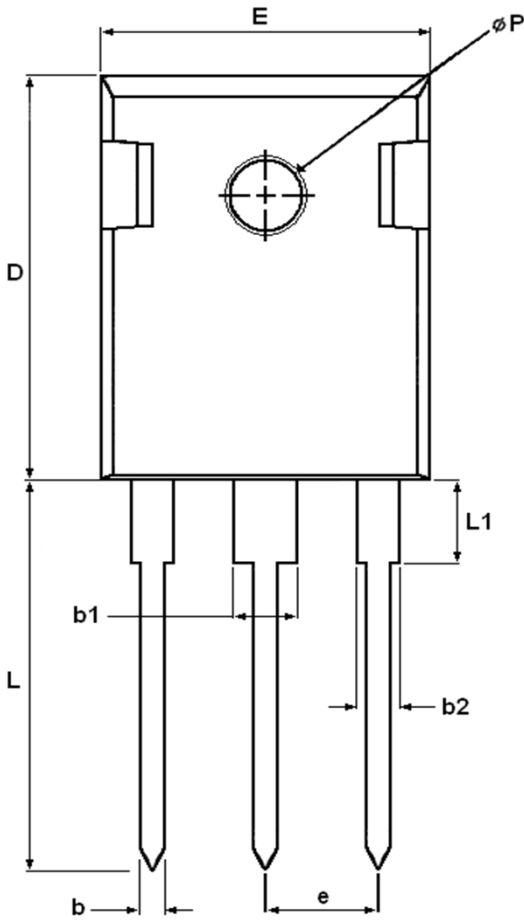
**Figure 16. Test Circuit & Test Conditions**



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 SG600P1
- 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
$\phi P$	3.560	3.660	0.140	0.144
$\phi P1$	7.063	7.317	0.278	0.288

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