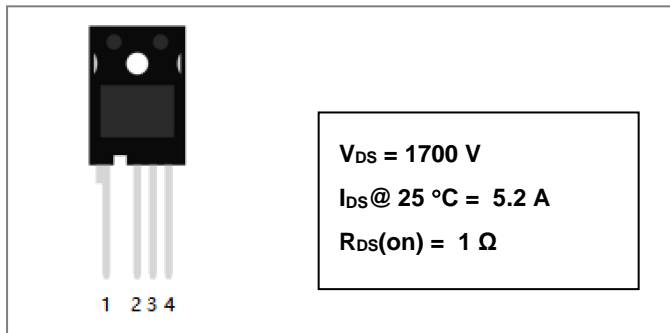


S1M1000170K

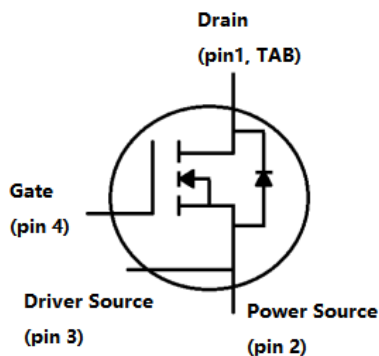
1700V Silicon Carbide Power MOSFET



Description

S1M1000170K is a single SiC Power MOSFET packaged in a TO-247-4 case. The device is a high voltage n-channel enhancement mode MOSFET which has very low total conduction losses and very stable switching characteristics over temperature extremes. The S1M1000170K is ideal for energy sensitive, high frequency applications in challenging environments.

Circuit Diagram



Features

- Positive temperature characteristics, easy to parallel.
- Low on-resistance typ. $R_{DS(on)} = 1\ \Omega$.
- Fast switching speed and low switching losses.
- Very fast and robust intrinsic body diode.
- Process of non-bright tin electroplating.
- “-A” is an AEC-Q101 qualified device.

Applications

- EV Fast Charging Modules
- EV On-Board Chargers
- Solar Inverters
- Online UPS/Industrial UPS
- SMPS (Switch Mode Power Supplies)
- DC-DC Converters
- ESS (Energy Storage Systems)

Maximum Ratings ($T_A = 25\text{ }^\circ\text{C}$, unless otherwise specified)

| Characteristics | Symbol | Conditions | Min. | Typ. | Max. | Units | Note |
|---------------------------------|----------------|--|------|-------------|------|-------|------|
| Drain - Source Voltage | V_{DSmax} | $V_{GS} = 0\text{ V}$, $I_D = 100\text{ }\mu\text{A}$ | | | 1700 | V | |
| Gate - Source Voltage (dynamic) | V_{GSmax} | AC ($f > 1\text{ Hz}$) | -10 | | +25 | V | |
| Gate - Source Voltage (static) | V_{GSop} | Static | | -5 / +20 | | V | [1] |
| Continuous Drain Current | I_D | $V_{GS} = 20\text{ V}$, $T_C = 25\text{ }^\circ\text{C}$ | | 5.2 | | A | |
| | | $V_{GS} = 20\text{ V}$, $T_C = 100\text{ }^\circ\text{C}$ | | 3.7 | | | |
| Pulsed Drain Current | $I_{D(pulse)}$ | Pulse width t_P limited by T_{jmax} | | | 15 | A | |
| Power Dissipation | P_D | $T_C = 25\text{ }^\circ\text{C}$ | | | 81 | W | |

[1] Recommended turn off gate voltage is -5 V. Recommended turn on gate voltage is 20 V. Do not use with $V_{GSON} < 15\text{ V}$.

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

| Characteristics | Symbol | Conditions | Min. | Typ. | Max. | Units |
|----------------------------------|---------------|---|------|------|------|---------------|
| Drain Source Breakdown Voltage | $V_{(BR)DSS}$ | $V_{GS} = 0\text{ V}$, $I_D = 100\text{ }\mu\text{A}$ | 1700 | | | V |
| Gate Threshold Voltage | $V_{GS(th)}$ | $V_{DS} = V_{GS}$, $I_D = 0.5\text{ mA}$ | 2 | 3.2 | 4 | V |
| | | $V_{DS} = V_{GS}$, $I_D = 0.5\text{ mA}$, $T_J = 175\text{ }^\circ\text{C}$ | | 2.4 | | V |
| Zero Gate Voltage Drain Current | I_{DSS} | $V_{DS} = 1700\text{ V}$, $V_{GS} = 0\text{ V}$ | | 1 | 100 | μA |
| Gate Source Leakage Current | I_{GSS} | $V_{GS} = 20\text{ V}$, $V_{DS} = 0\text{ V}$ | | 10 | 250 | nA |
| Drain Source On-State Resistance | $R_{DS(on)}$ | $V_{GS} = 20\text{ V}$, $I_D = 2\text{ A}$ | | 1 | 1.3 | Ω |
| | | $V_{GS} = 20\text{ V}$, $I_D = 2\text{ A}$, $T_J = 175\text{ }^\circ\text{C}$ | | 1.9 | | Ω |
| Transconductance | gfs | $V_{DS} = 20\text{ V}$, $I_{DS} = 2\text{ A}$ | | 1 | | S |
| | | $V_{DS} = 20\text{ V}$, $I_{DS} = 2\text{ A}$, $T_J = 175\text{ }^\circ\text{C}$ | | 1.05 | | S |
| Input Capacitance | C_{ISS} | $V_{GS} = 0\text{ V}$ | | 160 | | pF |
| Output Capacitance | C_{OSS} | $V_{DS} = 1000\text{ V}$ | | 10 | | |
| Reverse Transfer Capacitance | C_{RSS} | $V_{AC} = 25\text{ mV}$ | | 2 | | |
| C_{OSS} Stored Energy | E_{OSS} | $f = 1\text{ MHz}$ | | 4 | | |
| Turn-On Switching Energy | E_{ON} | $V_{DS} = 1000\text{ V}$, $V_{GS} = -5 / 20\text{ V}$ | | 55 | | μJ |
| Turn-Off Switching Energy | E_{OFF} | $I_D = 2\text{ A}$, $R_{G(ext)} = 2.5\text{ }\Omega$, $L = 99\text{ }\mu\text{H}$ | | 24 | | |
| Turn-On Delay Time | $t_{d(on)}$ | $V_{DS} = 1000\text{ V}$, $V_{GS} = -5 / 20\text{ V}$ | | 4 | | ns |
| Rise Time | t_r | $I_D = 2\text{ A}$, $R_{G(ext)} = 2.5\text{ }\Omega$ | | 6 | | |

Technical Data
Data Sheet N2807, REV.-

RoHS

| | | | | | |
|--------------------------|--------------|--|-----|--|----------|
| Turn-Off Delay Time | $t_{d(off)}$ | Inductive Load Timing relative to VDS Per IEC60747-8-4 pg 83 | 8 | | |
| Fall Time | t_f | | 77 | | |
| Internal Gate Resistance | $R_{G(int)}$ | $f = 1 \text{ MHz}, AC = 25 \text{ mV}$ | 20 | | Ω |
| Gate to Source Charge | Q_{gs} | $V_{DS} = 1700 \text{ V}, V_{GS} = -5 / 20 \text{ V}$ $I_D = 2 \text{ A}$ Per IEC60747-8-4 pg 21 | 2.5 | | nC |
| Gate to Drain Charge | Q_{gd} | | 5.2 | | |
| Total Gate Charge | Q_g | | 10 | | |

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

| Characteristics | Symbol | Conditions | Typ. | Max. | Units |
|----------------------------------|----------|--|------|------|-------|
| Diode Forward Voltage | V_{SD} | $V_{GS} = -5 \text{ V}, I_{SD} = 1 \text{ A}$ | 4.6 | | V |
| | V_{SD} | $V_{GS} = -5 \text{ V}, I_{SD} = 1 \text{ A}, T_J = 175 \text{ }^\circ\text{C}$ | 4.3 | | V |
| Continuous Diode Forward Current | I_S | $V_{GS} = -5 \text{ V}, T_C = 25 \text{ }^\circ\text{C}$ | 9 | | A |
| Reverse Recovery Time | t_{rr} | $V_{GS} = -5 \text{ V}, I_{SD} = 2 \text{ A}, T_J = 25 \text{ }^\circ\text{C}$ $V_R = 1200 \text{ V}$ $di/dt = 2500 \text{ A} / \mu\text{s}$ | 6 | | ns |
| Reverse Recovery Charge | Q_{rr} | | 25 | | nC |
| Peak Reverse Recovery Current | I_{mm} | | 7 | | A |

Thermal-Mechanical Specifications

| Characteristics | Symbol | Condition | Specification | Units |
|---|-----------------|--------------|---------------|--------|
| Junction Temperature | T_J | - | -55 to +175 | °C |
| Storage Temperature | T_{stg} | - | -55 to +175 | °C |
| Typical Thermal Resistance Junction to Case | $R_{\theta JC}$ | DC operation | 1.85 | °C / W |

Ordering Information

| Device | Package | Shipping |
|-------------|----------|--------------|
| S1M1000170K | TO-247-4 | 30pcs / tube |

Marking Diagram



Where XXXXX is YYWWL

S1M = Device Type
 1000 = $R_{DS(on)}$
 170 = Reverse Voltage (1700V)
 K = Package
 SSG = SSG
 YY = Year
 WW = Week
 L = Lot Number

Cautions: Molding resin
 Epoxy resin UL:94V-0

Ratings and Characteristics Curves

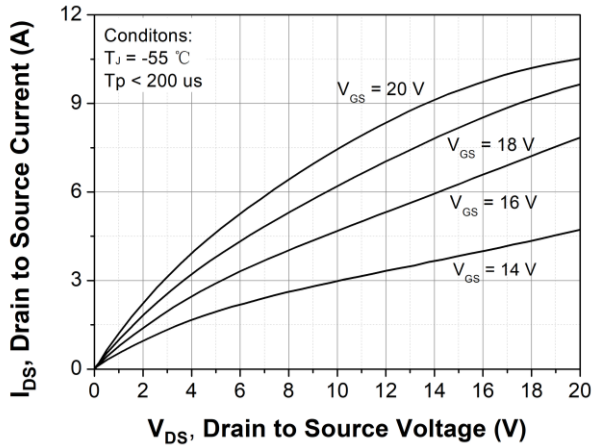


Figure 1. Output Characteristics $T_J = -55\text{ }^\circ\text{C}$

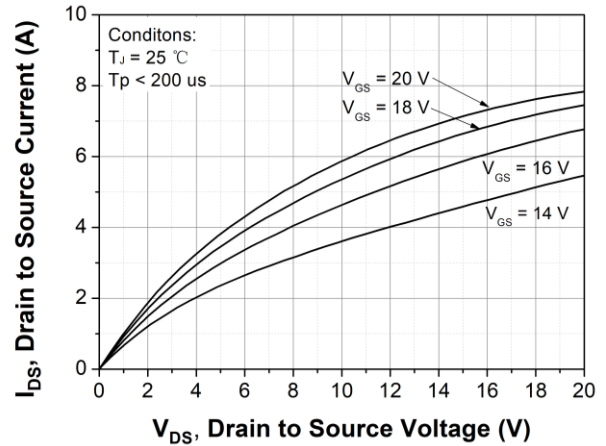


Figure 2. Output Characteristics $T_J = 25\text{ }^\circ\text{C}$

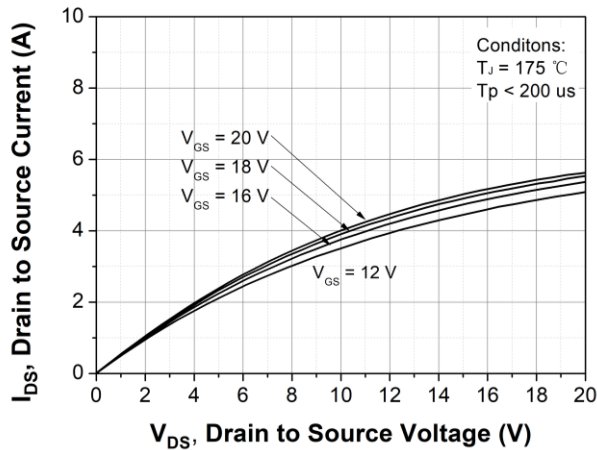


Figure 3. Output Characteristics $T_J = 175\text{ }^\circ\text{C}$

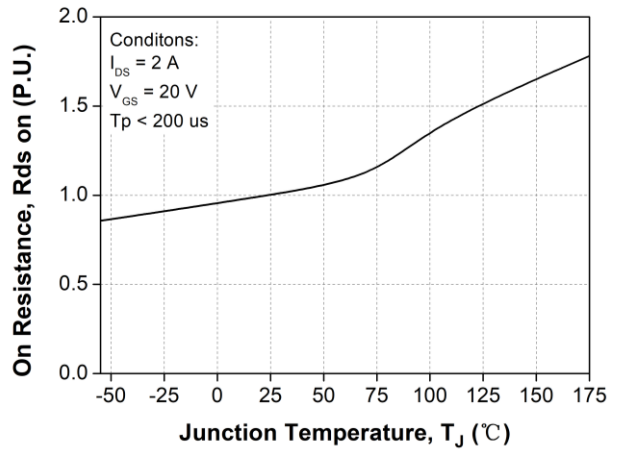


Figure 4. Normalized On-Resistance vs. Temperature

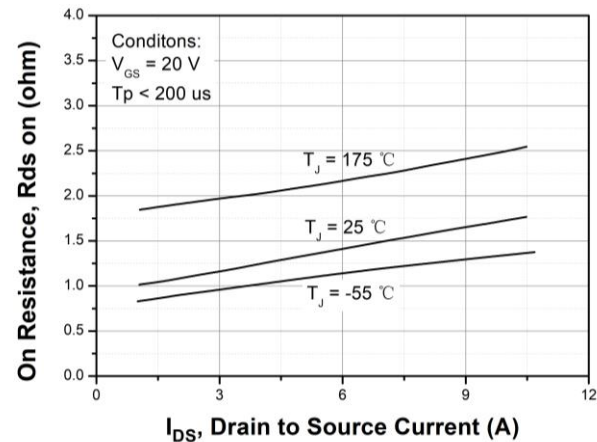


Figure 5. On-Resistance vs. Drain Current For Various Temperatures

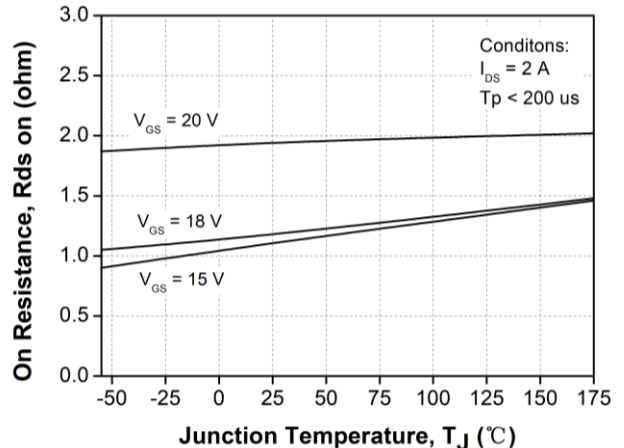


Figure 6. On-Resistance vs. Temperature For Various Gate Voltage

Technical Data
Data Sheet N2807, REV.-

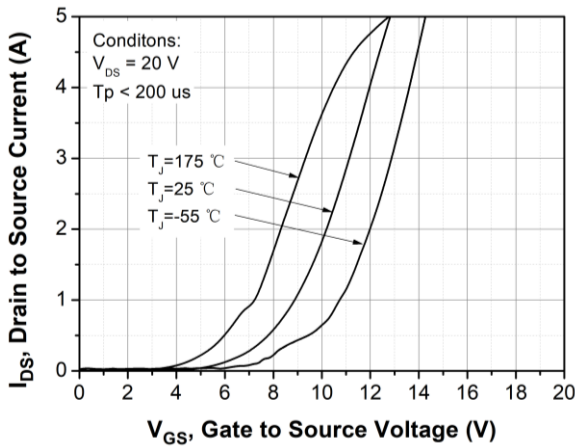


Figure 7. Transfer Characteristic for Various Junction Temperatures

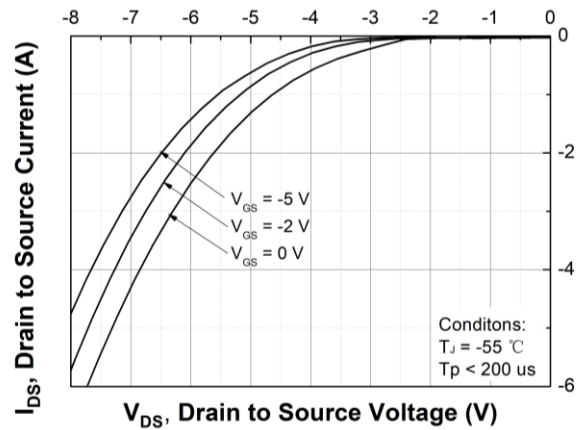


Figure 8. Body Diode Characteristic at $T_J = -55\text{ }^\circ\text{C}$

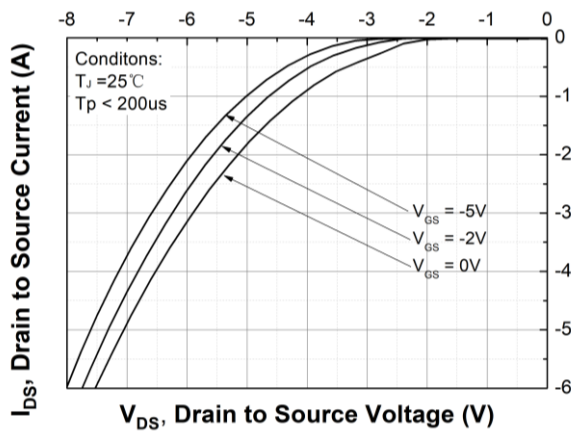


Figure 9. Body Diode Characteristic at $T_J = 25\text{ }^\circ\text{C}$

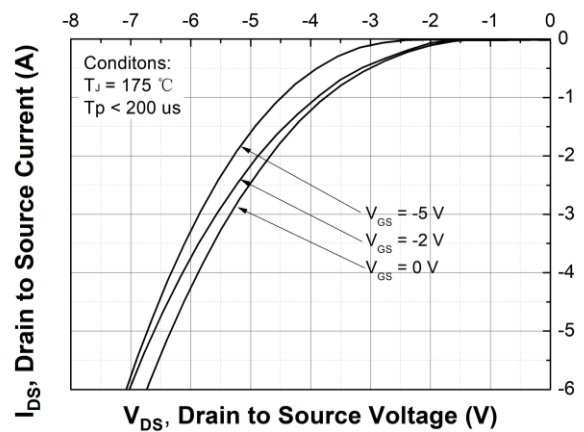


Figure 10. Body Diode Characteristic at $T_J = 175\text{ }^\circ\text{C}$

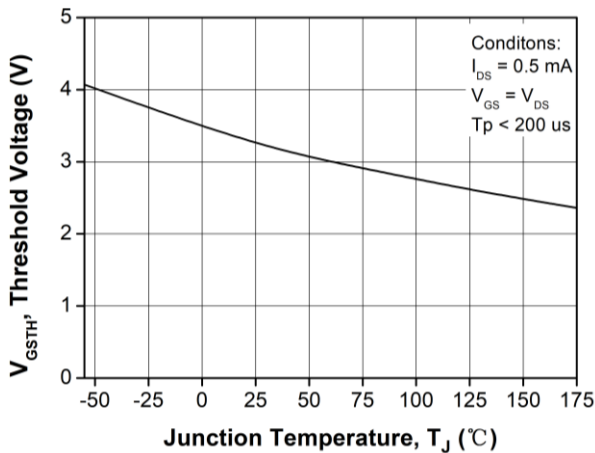


Figure 11. Threshold Voltage vs. Temperature

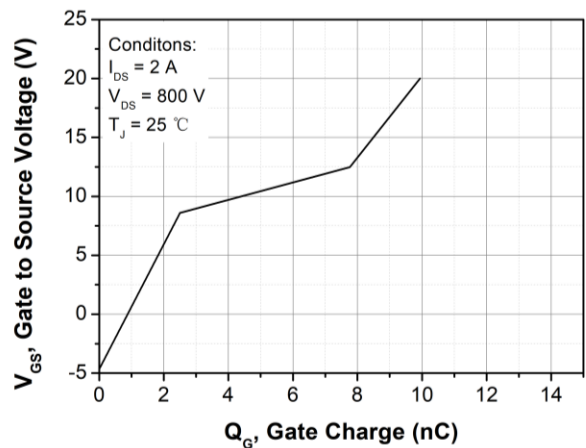


Figure 12. Gate Charge Characteristic

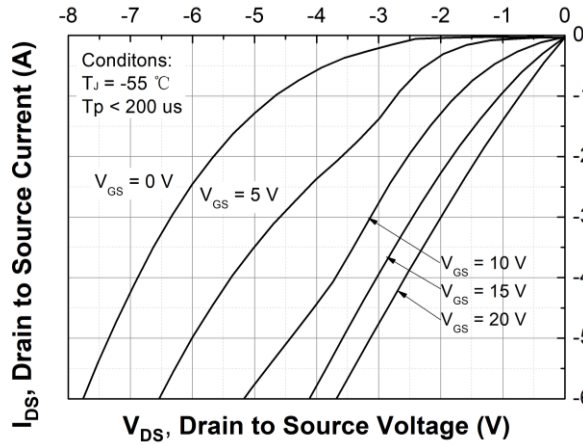


Figure 13. 3rd Quadrant Characteristic at $T_J = -55\text{ }^\circ\text{C}$

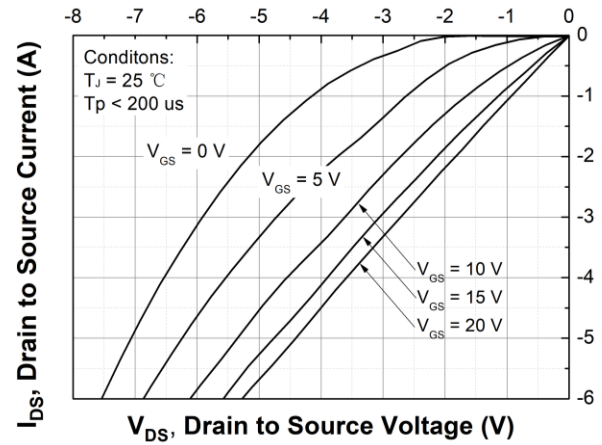


Figure 14. 3rd Quadrant Characteristic at $T_J = 25\text{ }^\circ\text{C}$

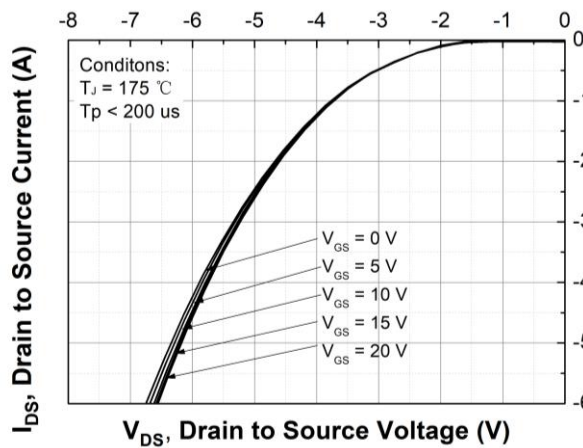


Figure 15. 3rd Quadrant Characteristic at $T_J = 175\text{ }^\circ\text{C}$

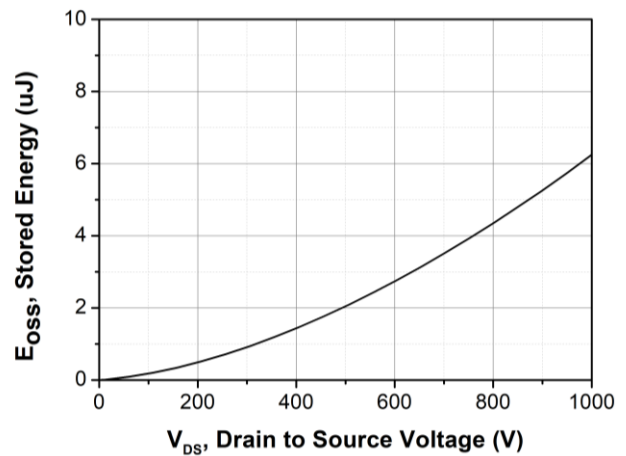


Figure 16. Output Capacitor Stored Energy

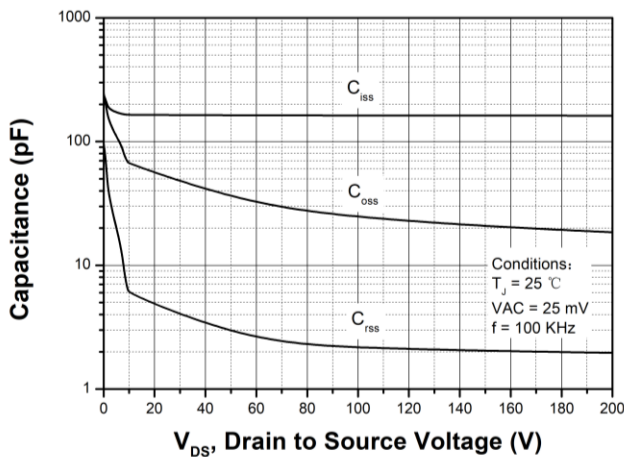


Figure 17. Capacitances vs. Drain-Source Voltage (0 - 200 V)

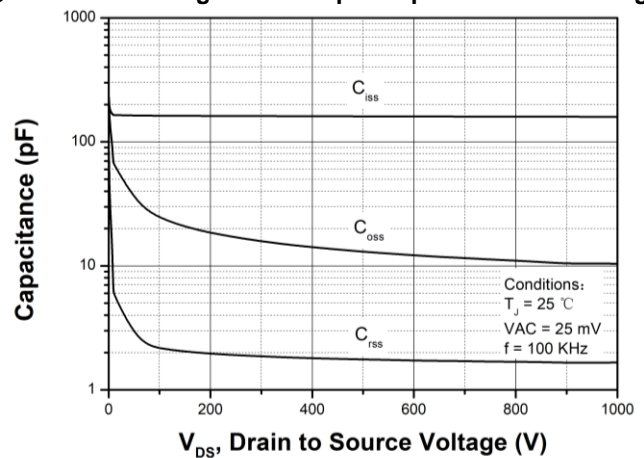


Figure 18. Capacitances vs. Drain-Source Voltage (0 - 1000 V)

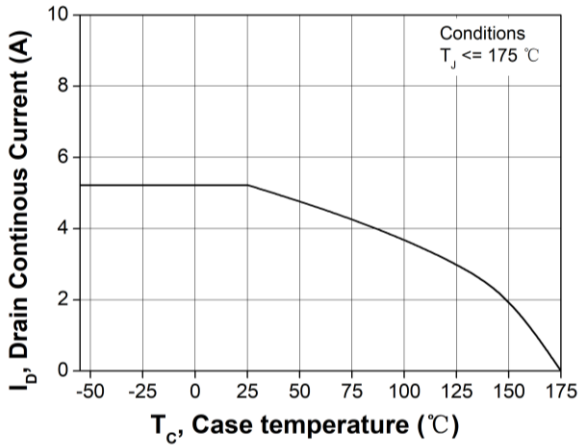


Figure 19. Continuous Drain Current Derating vs. Case Temperature

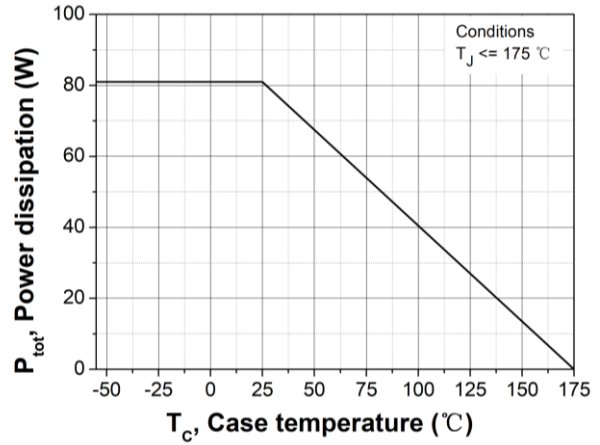


Figure 20. Maximum Power Dissipation Derating vs. Case Temperature

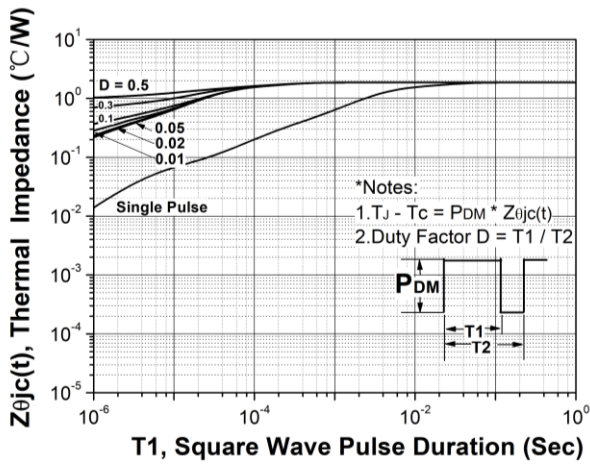


Figure 21. Transient Thermal Impedance (Junction - Case)

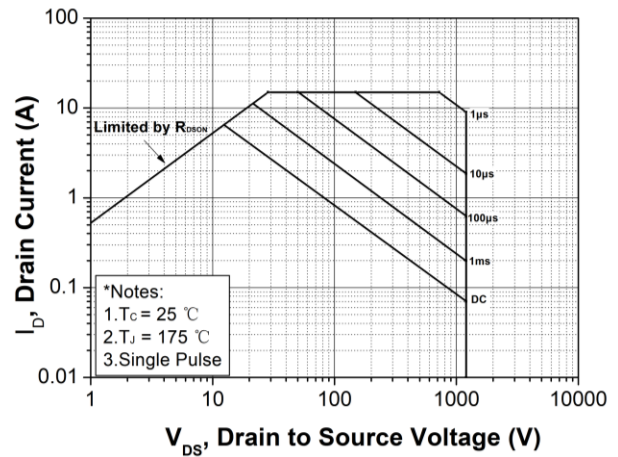


Figure 22. Safe Operating Area

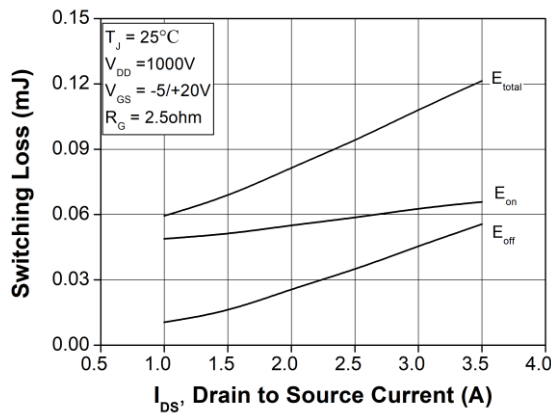


Figure 23. Clamped Inductive Switching Energy vs. Drain Current ($V_{DD} = 600V$)

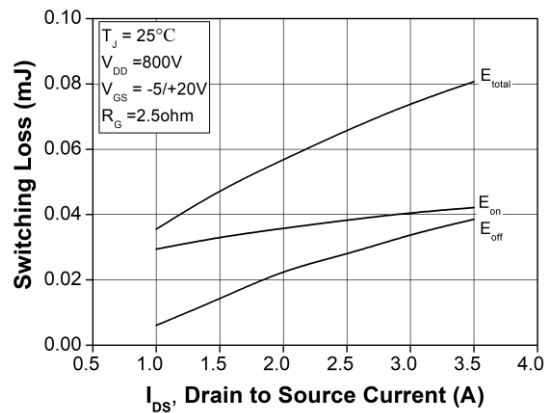


Figure 24. Clamped Inductive Switching Energy vs. Drain Current ($V_{DD} = 800V$)

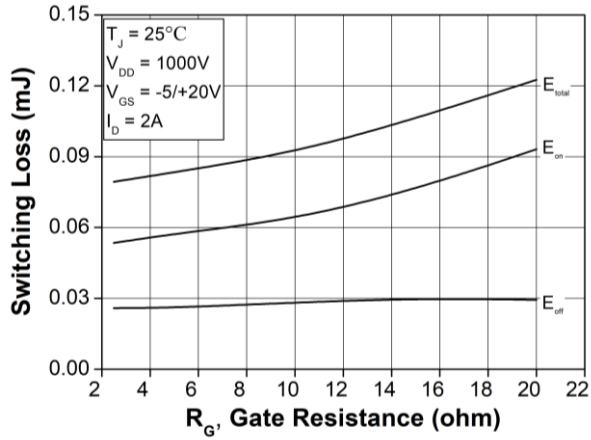


Figure 25. Clamped Inductive Switching Energy vs. $R_{G(ext)}$

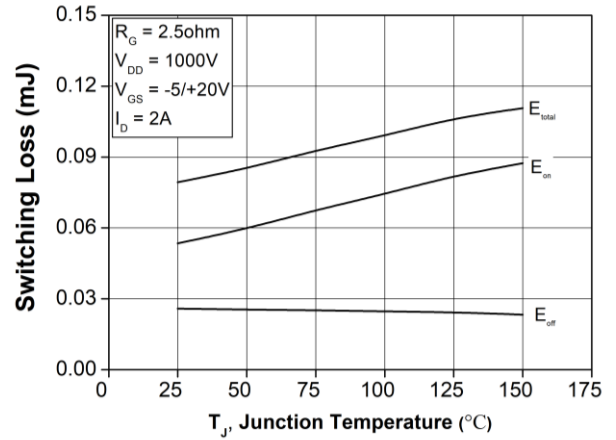


Figure 26. Clamped Inductive Switching Energy vs. Temperature

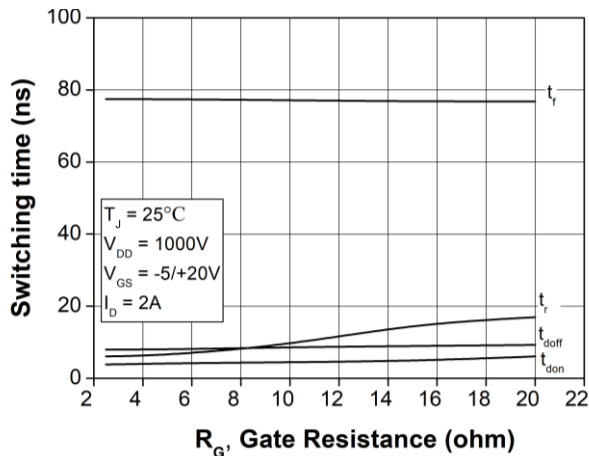


Figure 27. Switching Times vs. $R_{G(ext)}$

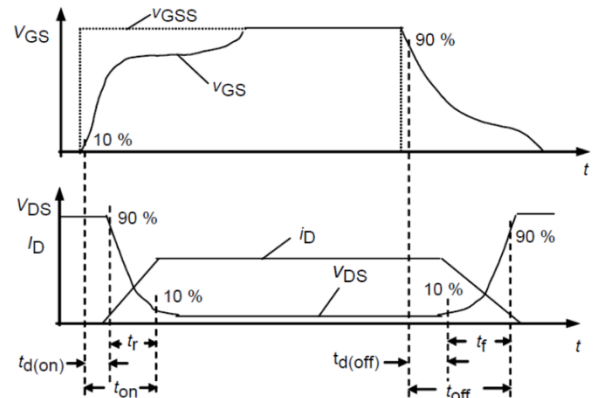
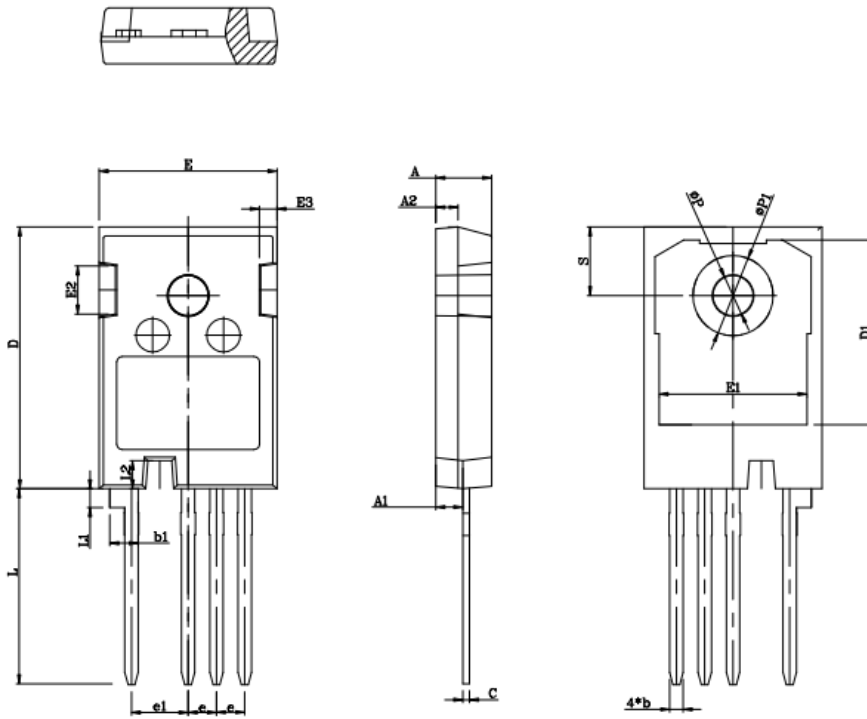


Figure 28. Switching Times Definition

Mechanical Dimensions TO-247-4



| SYMBOL | mm | | |
|--------|-------|---------|-------|
| | Min | Nom | Max |
| A | 4.80 | 5.00 | 5.20 |
| A1 | 2.23 | 2.41 | 2.59 |
| A2 | 1.85 | 2.00 | 2.15 |
| b | 1.11 | 1.21 | 1.36 |
| b1 | 2.35 | 2.55 | 2.75 |
| c | 0.51 | 0.61 | 0.75 |
| D | 23.30 | 23.45 | 23.60 |
| D1 | 16.25 | 16.55 | 16.85 |
| E | 15.75 | 15.94 | 16.10 |
| E1 | 13.00 | 13.26 | 13.43 |
| E2 | 4.00 | 4.30 | 4.60 |
| E3 | 1.15 | 1.45 | 1.75 |
| e | | 2.54BSC | |
| e1 | | 5.08BSC | |
| L | 17.31 | 17.47 | 17.82 |
| L1 | 1.50 | 1.70 | 1.90 |
| ØP | 3.51 | 3.60 | 3.65 |
| ØP1 | 7.08 | 7.19 | 7.30 |
| S | | 6.15BSC | |

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