# H1M045170P

1700V, 45mΩ, TO-247-3L SiC MOSFET

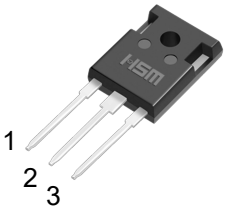
## Product Summary

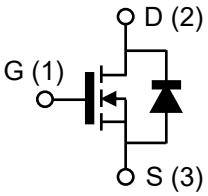
| | |
|---|---|
| $V_{DS}$ | 1700V |
| $I_{D(@25^{\circ}C)}$ | 55A |
| $R_{DS(on)}$ | 45mΩ |

## Features

- Low On-Resistance and High Current Density
- Low Capacitance for High Frequency Operation
- Ultra-high Avalanche Ruggedness
- Positive Temperature Coefficient Device
- AEC-Q101 Qualified
- RoHS Compliant and Halogen Free

## Circuit Diagram




## Benefits

- Higher System Efficiency
- Increase Parallel Device Convenience
- Capable of 175˚C High $T_j$ Application
- Allow High Frequency Operation
- Realize Compact and Lightweight Systems

| Part Number | Package | Marking |
|---|---|---|
| H1M045170P | TO-247-3L | H1M045170P |

## Applications

- Switching Mode Power Supply
- DC/DC Converters, UPS, and PFC
- Power Inverters
- Auxiliary Power Supplies
- Solar/Wind Renewable Energy

## Description

The H1M045170P 1700V, 45mΩ silicon carbide power MOSFET is an N-channel enhancement mode device. Exploiting the outstanding wide bandgap material properties, this device shows high current density and great switching behavior. Thanks for the excellent thermal conductivity and many advantages of SiC, this device significantly improved in thermal capability and temperature independent switching behavior. With the high stability and reliability, this device also passes the qualification criteria based on AEC-Q101.

## Absolute Maximum Ratings ($T_c$ = 25˚C unless otherwise specified)

| Parameter | Symbol | Test Conditions | Value | Unit |
|---|---|---|---|---|
| Drain – Source Voltage | $V_{DS, max}$ | $V_{GS}$=0V, $I_{DS}$=100μA | 1700 | V |
| Continuous Drain Current | $I_D$ | $V_{GS}$=20V, $T_C$=25°C | 55 | A |
| | | $V_{GS}$=20V, $T_C$=110°C | 38.5 | |
| Pulse Drain Current | $I_{D, pulse}$ | $t_{PW}$ limitation per Fig.15 | 280 | |
| Power Dissipation | $P_D$ | $T_C$=25°C | 375 | W |
| Recommend Gate Source Voltage | $V_{GS, op}$ | Static, recommended DC operating values | -5/+20 | V |
| Maximum Gate Source Voltage | $V_{GS, max}$ | Transient operating limit (AC f > 1Hz, duty cycle < 1%) | -10/+25 | |
| Junction & Storage Temperature | $T_j$ , $T_{stg}$ | | -55/+175 | °C |
| Soldering Temperature | $T_L$ | | 260 | |
| Mounting Torque | $M_D$ | M3 or 6-32 screw | 1.0 | Nm |

## Thermal Resistance

| Parameter | Symbol | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| Thermal Resistance, Junction to Case | $R_{\theta JC}$ | | 0.4 | | ˚C/W |

## Electrical Characteristics ($T_c$ = 25°C unless otherwise specified)

| Parameter | Symbol | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Drain-Source Breakdown Voltage | $V_{(BR)DSS}$ | $V_{GS}$=0V, $I_{DS}$=100μA | 1700 | | | V |
| Gate Threshold Voltage | $V_{GS(th)}$ | $V_{DS}$=10V, $I_{DS}$=50mA | | 2.6 | | V |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{DS}$=1700V, $V_{GS}$=0V | | <1 | 100 | μA |
| | | $V_{DS}$=1700V, $V_{GS}$=0V $T_j$=175°C | | 10 | 500 | |
| Gate-Source Leakage Current | $I_{GSS}$ | $V_{GS}$=20V, $V_{DS}$=0V | | | 250 | nA |
| Drain-Source On-State Resistance | $R_{DS(on)}$ | $V_{GS}$=20V, $I_{DS}$=30A | | 45 | 70 | mΩ |
| | | $V_{GS}$=20V, $I_{DS}$=30A, $T_j$=175°C | | 100 | | |
| Transconductance | $g_{fs}$ | $V_{DS}$=8.5V, $I_{DS}$=30A | | 16 | | S |
| Input Capacitance | $C_{iss}$ | $V_{GS}$=0V, $V_{DS}$=1000V f =1MHz, $V_{AC}$=25mV | | 4141 | | pF |
| Output Capacitance | $C_{oss}$ | | | 145 | | |
| Reverse Transfer Capacitance | $C_{rss}$ | | | 25 | | |
| Effective Output Capacitance, Energy Related | $C_{o(er)}$ | $V_{GS}$=0V, $V_{DS}$=0 to 1000V | | 187 | | |
| Effective Output Capacitance, Time Related | $C_{o(tr)}$ | $I_D$=const., $V_{GS}$=0V, $V_{DS}$=0 to 1000V | | 253 | | |
| Turn On Delay Time | $t_{d(on)}$ | $V_{DS}$=1200V, $V_{GS}$=-4/20V, $I_D$=30A, $R_L$=1200Ω, $R_{G(ext)}$= 2.7 Ω | | 51 | | ns |
| Rise Time | $t_r$ | | | 53 | | |
| Turn Off Delay Time | $t_{d(off)}$ | | | 59 | | |
| Fall Time | $t_f$ | | | 22 | | |
| $C_{oss}$ Stored Energy | $E_{oss}$ | $V_{GS}$=0V, $V_{DS}$=1200V f =1MHz, $V_{AC}$=25mV | | 119 | | μJ |
| Turn-on Switching Energy | $E_{on}$ | $V_{DS}$=1200V, $V_{GS}$=0/20V, $I_D$=30A, $R_{G(ext)}$= 2.7 Ω | | 194* | | |
| Turn-off Switching Energy | $E_{off}$ | | | 326* | | |
| Internal Gate Resistance | $R_{G(int.)}$ | f =1MHz, $V_{AC}$=25mV | | 0.7 | | Ω |

*Based on the results of calculation, note that the energy loss caused by the reverse recovery of free-wheeling diode is not included in $E_{on}$.

## Built-in SiC Diode Characteristics ($T_c$ = 25°C unless otherwise specified)

| Parameter | Symbol | Test Conditions | Typ. | Unit |
|---|---|---|---|---|
| Inverse Diode Forward Voltage | $V_{SD}$ | $V_{GS}$=0V, $I_{SD}$=7.5A | 2.7 | V |
| Continuous Diode Forward Current | $I_S$ | $V_{GS}$=0V, $T_C$=25°C | 53 | A |
| Reverse Recovery Time | $t_{rr}$ | $V_{GS}$=0V, $I_{SD}$=30A, $V_{DS}$=400V, di/dt=300A/μs | 81 | Ns |
| Reverse Recovery Charge | $Q_{rr}$ | | 274 | nC |
| Peak Reverse Recovery Current | $I_{rrm}$ | | 6.4 | A |

## Gate Charge Characteristics ($T_c$ = 25°C unless otherwise specified)

| Parameter | Symbol | Test Conditions | Value | Unit |
|---|---|---|---|---|
| Gate to Source Charge | $Q_{GS}$ | $V_{DS}$=1200V, $V_{GS}$=-5/+20V, $I_D$=30A | 79 | nC |
| Gate to Drain Charge | $Q_{GD}$ | | 99 | |
| Total Gate Charge | $Q_G$ | | 304 | |
| Gate plateau voltage | $V_{pl}$ | | 7.5 | V |

## Typical Device Performance

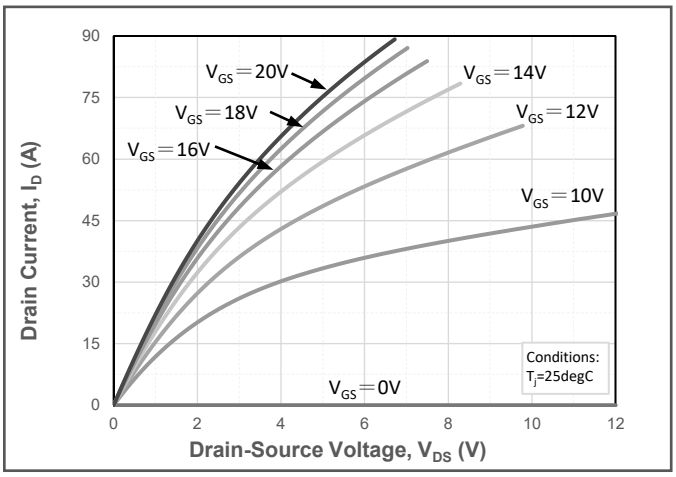



**Fig.1 Forward Output Characteristics at $T_j$=25˚C**

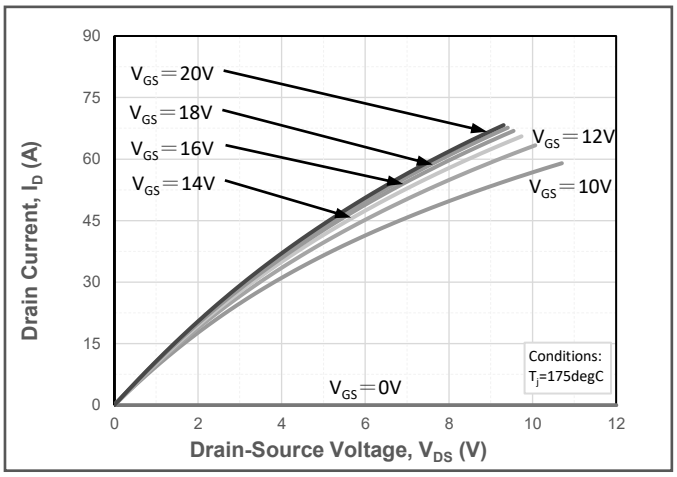



**Fig.2 Forward Output Characteristics at $T_j$=175˚C**

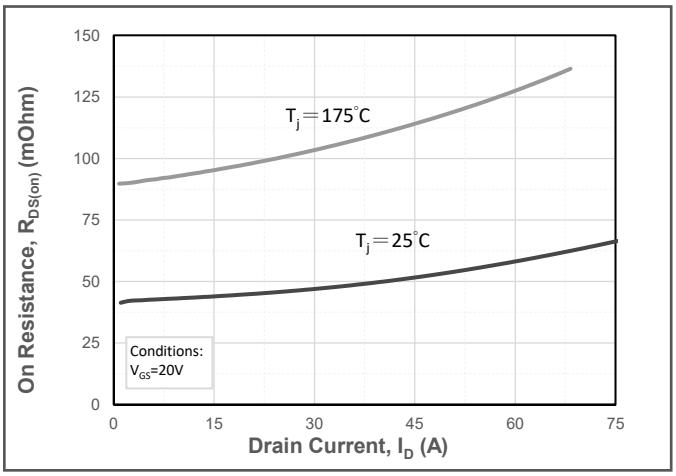



**Fig.3 On-Resistance vs. Drain Current for Various $T_j$**

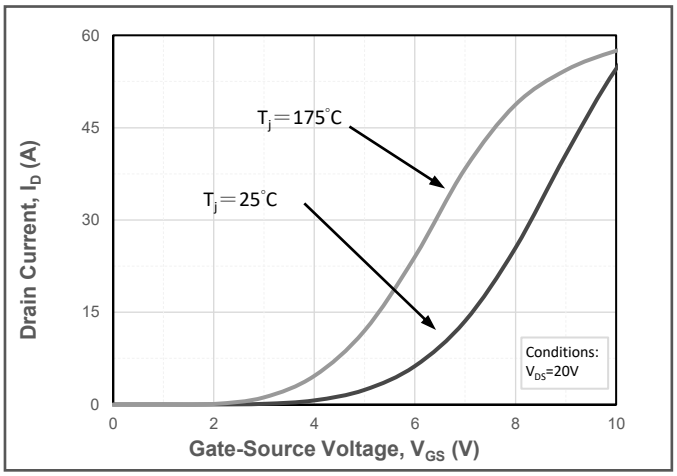



**Fig.4 Transfer Characteristics for Various $T_j$**

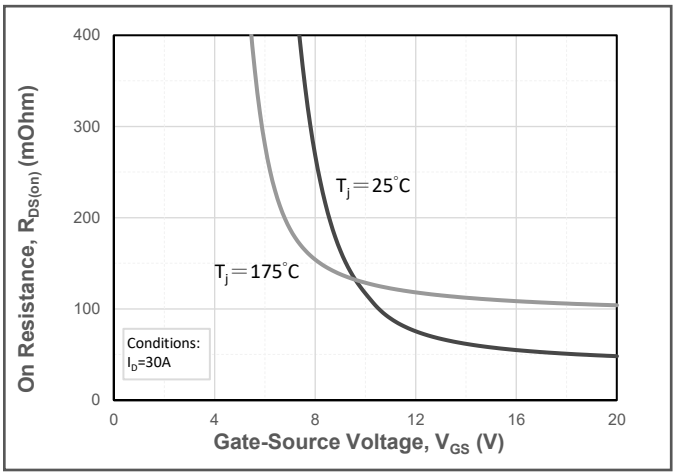



**Fig.5 On-Resistance vs. Gate Voltage for Various**

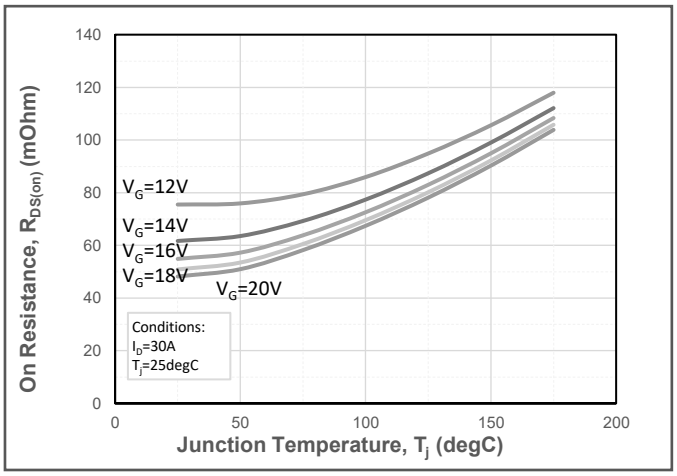



**Fig.6 On-Resistance vs. Temperature for Various Gate Voltage**

## Typical Device Performance

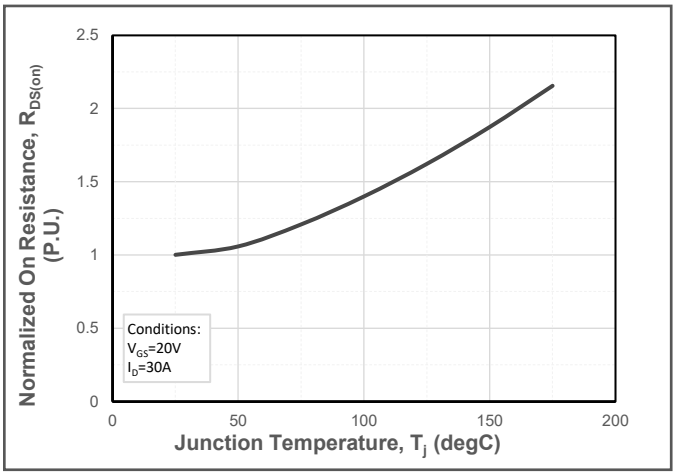



**Fig.7 Normalized On-Resistance vs. Temperature**

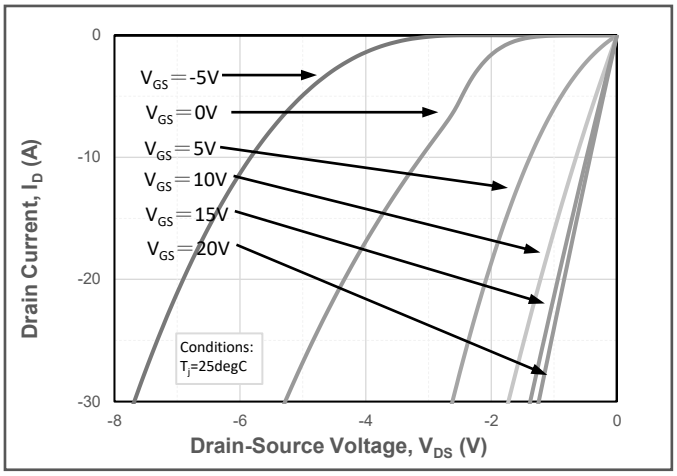



**Fig.8 Reverse Output Characteristics at $T_j$ = 25˚C**

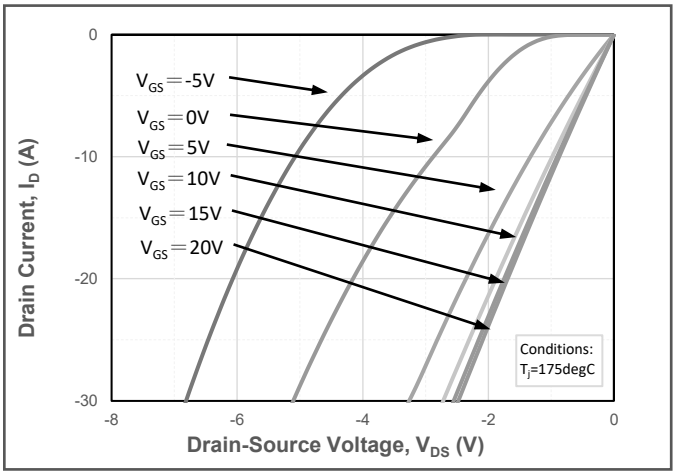



**Fig.9 Reverse Output Characteristics at $T_j$ = 175˚C**

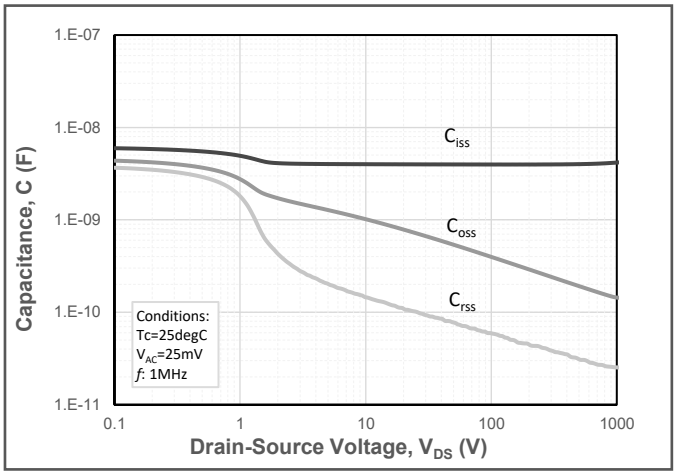



**Fig.10 Capacitances vs. Drain to Source Voltage**

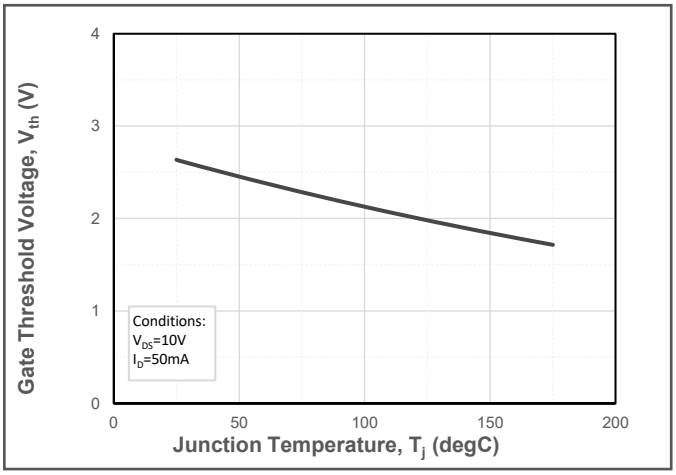



**Fig.11 Threshold Voltage vs. Temperature**

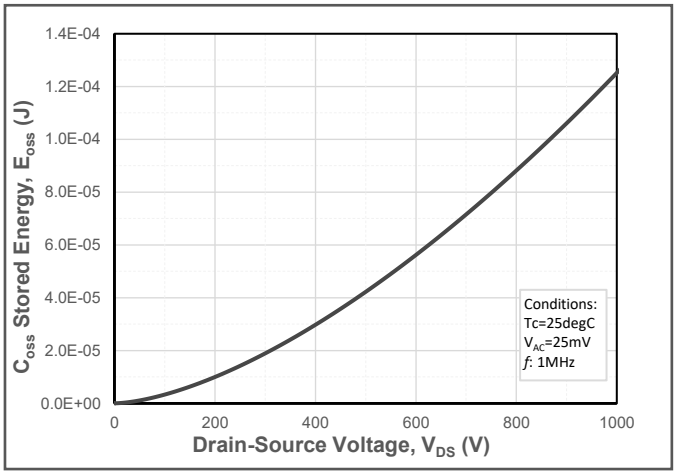



**Fig.12 Output Capacitor Stored Energy**

## Typical Device Performance

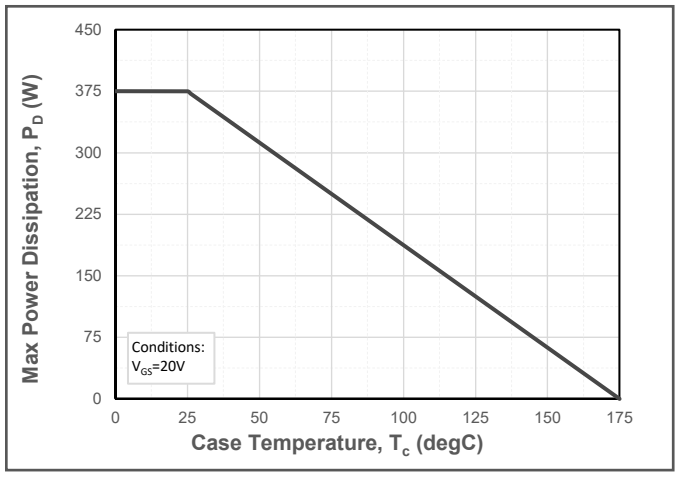



**Fig.13 Maximum Power Dissipation Derating vs. Case Temperature**

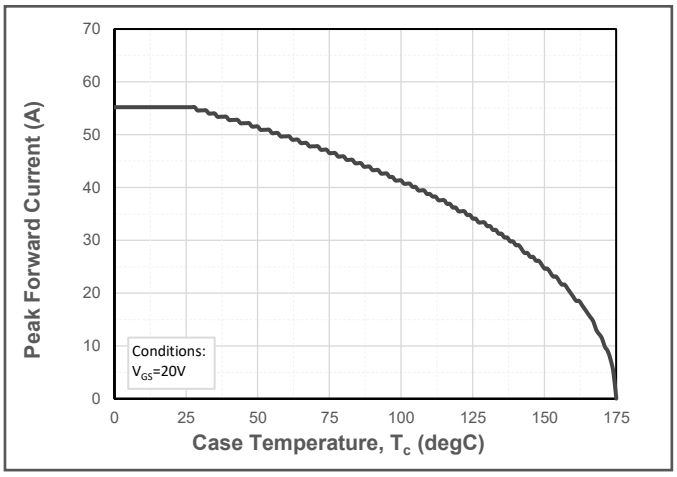



**Fig.14 Drain Current Derating vs. Case Temperature**

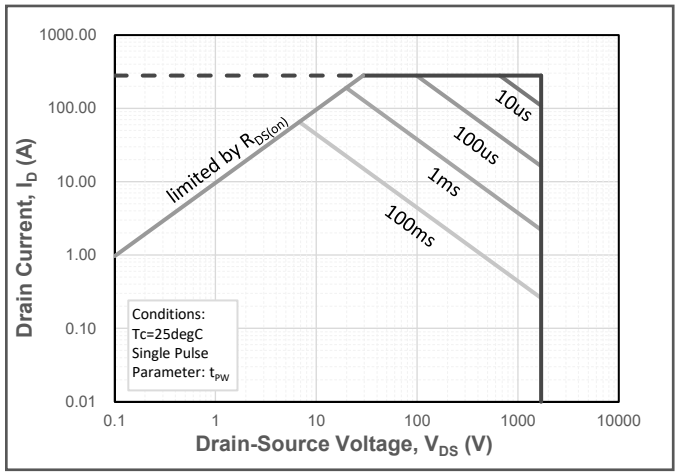



**Fig.15 Safe Operating Area**

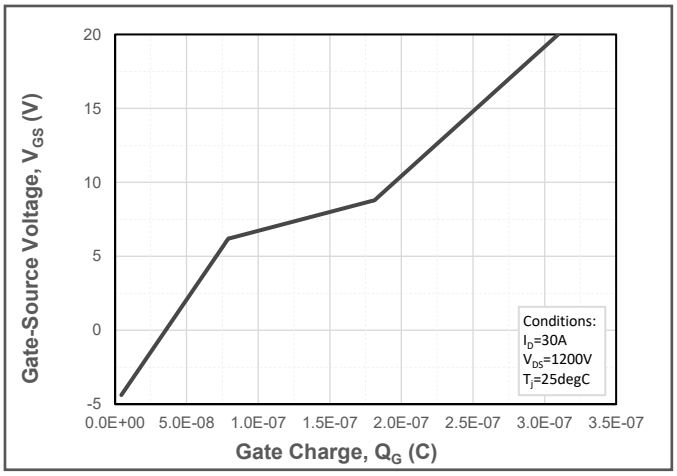



**Fig.16 Gate Charge Characteristics**

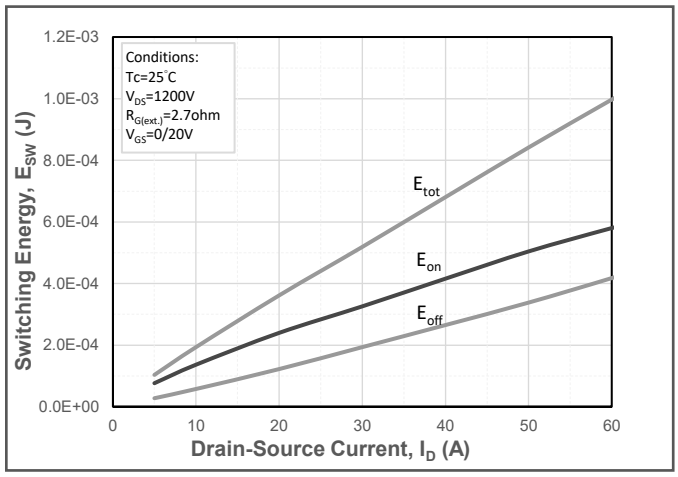



**Fig.17 Clamped Inductive Switching Energy vs. Drain Current**

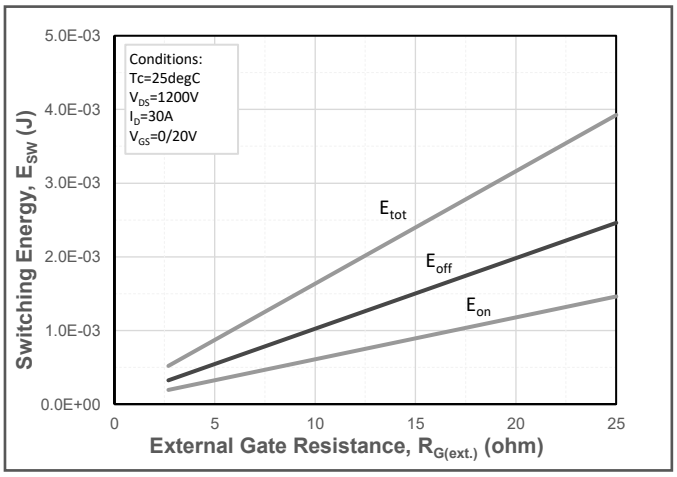
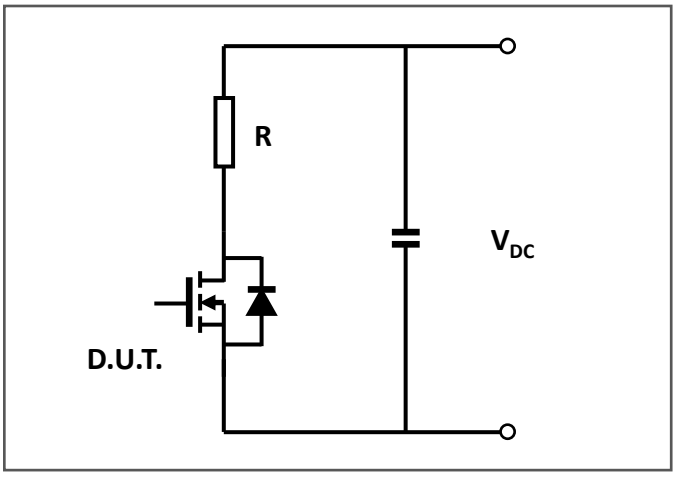



**Fig.18 Clamped Inductive Switching Energy vs. External Gate Resistor ($R_{G(ext.)}$)**

## Typical Device Performance



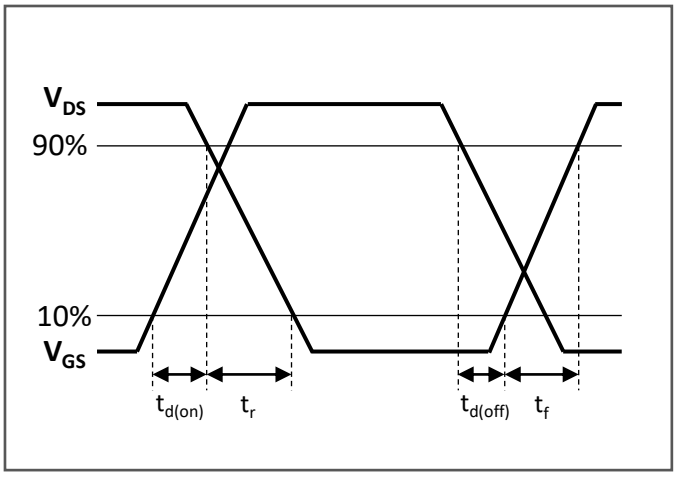




**Fig.19 Schematic of Resistive Switching** **Fig.20 Switching Times Definition**

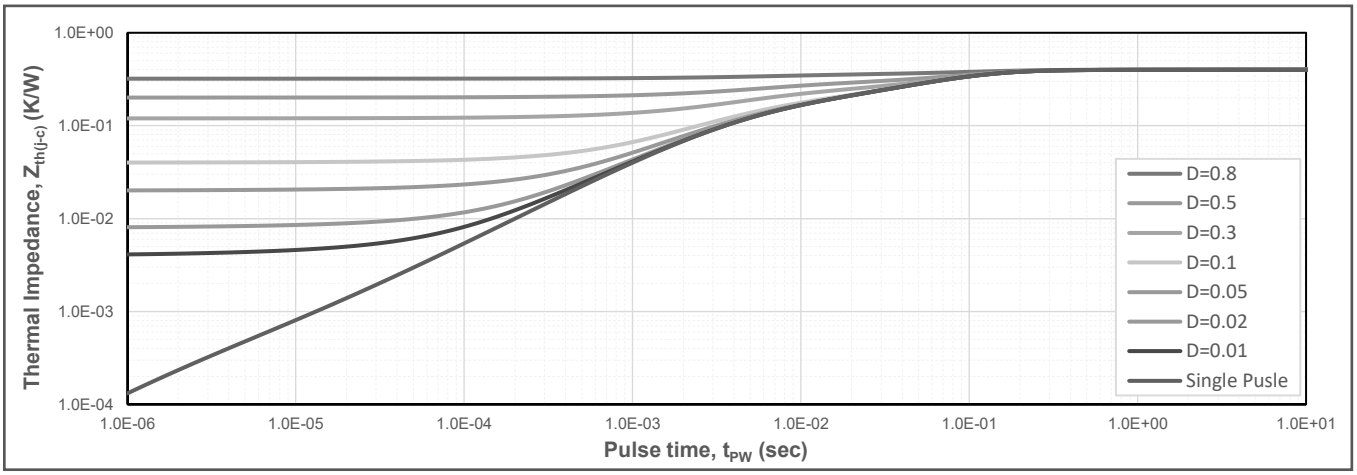
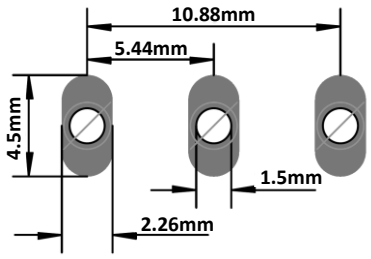


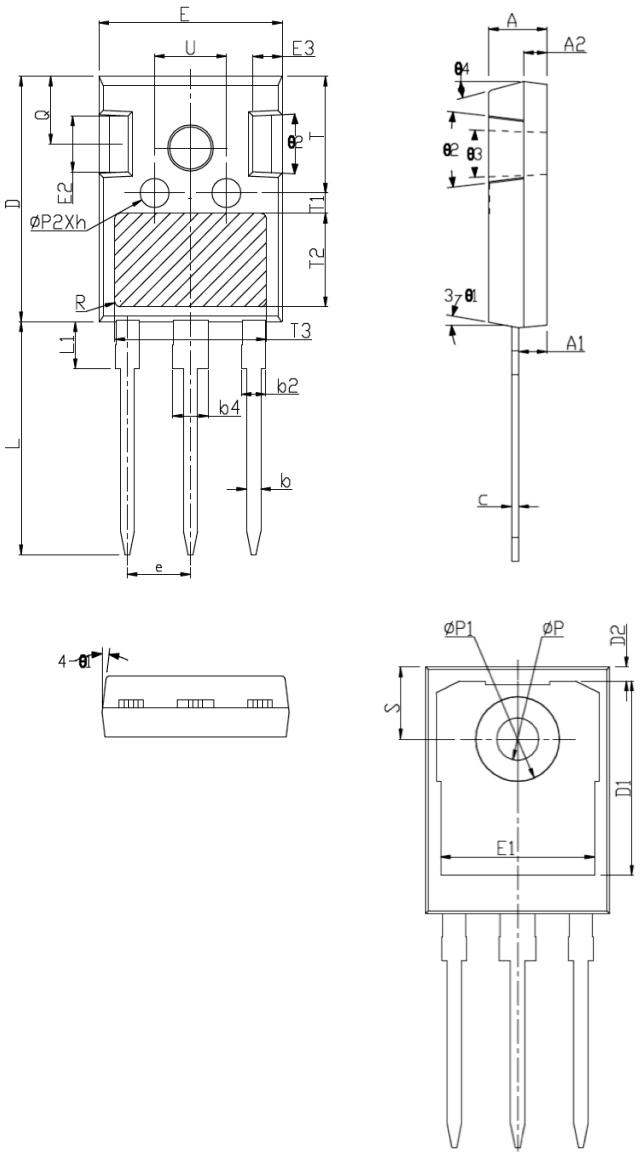

**Fig.21 Transient Junction to Case Thermal Impedance**

## Recommended Solder Pad Layout

**TO-247-3L**



## Package Dimensions




| Symbol | mm | | |
|---|---|---|---|
| | Min. | Typ. | Max. |
| A | 4.75 | 5.00 | 5.25 |
| A1 | 2.16 | 2.41 | 2.66 |
| A2 | 1.85 | 2.00 | 2.15 |
| b | 1.11 | 1.21 | 1.35 |
| b2 | 1.90 | 2.01 | 2.25 |
| b4 | 2.90 | 3.01 | 3.25 |
| c | 0.51 | 0.61 | 0.75 |
| D | 20.60 | 21.00 | 21.40 |
| D1 | 16.15 | 16.55 | 16.95 |
| D2 | 1.00 | 1.20 | 1.40 |
| E | 15.50 | 15.80 | 16.10 |
| E1 | 13.00 | 13.30 | 13.60 |
| E2 | 4.70 | 5.00 | 5.30 |
| E3 | 2.25 | 2.50 | 2.75 |
| e | | 5.44 BSC | |
| h | 0.00 | 0.10 | 0.25 |
| L | 19.52 | 19.92 | 20.32 |
| L1 | - | - | 4.30 |
| $\phi$P | 3.35 | 3.60 | 3.85 |
| $\phi$P1 | - | - | 7.30 |
| $\phi$P2 | 2.25 | 2.50 | 2.75 |
| Q | 5.50 | 5.80 | 6.10 |
| S | | 6.15 BSC | |
| R | | 0.50 REF | |
| T | 9.70 | - | 10.30 |
| T1 | | 1.65 REF | |
| T2 | | 8.00 REF | |
| T3 | | 12.80 REF | |
| U | 5.90 | - | 6.50 |
| $\Theta$1 | 4° | 7° | 10° |
| $\Theta$2 | 2° | 5° | 8° |
| $\Theta$3 | 1° | - | 2° |
| $\Theta$4 | 10° | 15° | 20° |

## Notes

- The information provided herein is subject to change without notice.