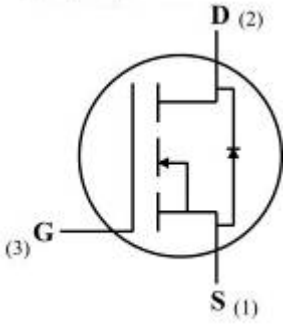
# Silicon Carbide Power MOSFET （N-Channel Enhancement）

| | |
|---|---|
| $V_{DS}$ | 1200V |
| $I_{D\ (25°C)}$ | 68A |
| $R_{DS(on)}$ | 30mΩ |


## Features

- High speed switching
- Essentially no switching losses
- Reduction of heat sink requirements
- Maximum working temperature at 175 °C
- High blocking voltage
- Fast Intrinsic diode with low recovery current
- High-frequency operation
- Halogen free, RoHS compliant

## Typical Applications

Typical applications are in power factor correction(PFC), solar inverter, uninterruptible power supply, motor drives, photovoltaic inverter, electric car and charger.

## Mechanical Data

- **Package**: TO-247AB
- **Terminals**: Tin plated leads
- **Polarity**: As marked
- AEC-Q101 qualified

## ■Maximum Ratings ($T_C$=25℃ Unless otherwise specified）

| PARAMTETER | SYMBOL | UNIT | VALUE | TEST CONDITIONS | NOTE |
|---|---|---|---|---|---|
| Device marking code | | | D212030NCTG2Q | | |
| Drain source voltage @ $T_j$=25°C | $V_{DS,max}$ | V | 1200 | $V_{GS}$=0 V, $I_D$=100uA | |
| Gate source voltage @ $T_j$=25°C | $V_{GS,max}$ | V | -8/+20 | Absolute maximum values | |
| Gate source voltage @ $T_j$=25°C | $V_{GS,op}$ | V | -5/+18 | Recommended operational values | |
| Continuous drain current @ $T_c$=25°C | $I_D$ | A | 68 | $V_{GS}$=18V, Tc=25℃ | Fig.17 |
| Continuous drain current @ $T_c$=100°C | | | 50 | $V_{GS}$=18V, Tc=100℃ | |
| Pulsed drain current | $I_{D(pulsed)}$ | A | 100 | Pulse width $t_p$ limited by $T_{j,max}$ | Fig.22 |
| Power Dissipation | $P_{TOT}$ | W | 333 | $T_c$=25°C , Tj = 175℃ | Fig.16 |
| Power Dissipation | | | 165 | $T_c$=100°C, Tj = 175℃ | |
| Operating junction and Storage temperature range | Tj ,Tstg | °C | -55 to +175 | | |
| Soldering temperature | $T_L$ | °C | 260 | 1.6mm (0.063") from case for 10s | |
| Mounting torque | $T_M$ | Nm | 0.6 | M3 screw Maximum of mounting process: 3 | |

## ■Static Electrical Characteristics（Tc=25℃ unless otherwise specified ）

| PARAMTETER | SYMBOL | UNIT | Min. | Typ. | Max. | Test Conditions | Note |
|---|---|---|---|---|---|---|---|
| Gate threshold voltage | $V_{GS(th)}$ | V | 2.0 | 3.7 | 4.2 | $V_{DS}$=$V_{GS}$, $I_D$= 10mA | Fig.4, 11 |
| | | | | 2.8 | | $V_{DS}$=$V_{GS}$, $I_D$= 10mA, Tj=175℃ | |
| Drain source breakdown voltage | $V_{(BR)DSS}$ | V | 1200 | | | $V_{GS}$=0V, $I_D$=100uA | |
| Gate source leakage current | $I_{GSS}$ | nA | | | 200 | $V_{GS}$= 18V, $V_{DS}$=0V | |
| Current drain source on-state resistance | $R_{DS\ ON}$ | mΩ | | 30 | 50 | $V_{GS}$=18V, $I_D$=30A,Tj=25℃ | Fig.5, 6, 7 |
| | | | | 50 | | $V_{GS}$=18V, $I_D$=30A,Tj=175℃ | |
| Internal gate resistance | Rg | Ω | | 2.1 | | f=1MHz,$V_{AC}$=25mV | |
| Transconductance | $g_{fs}$ | S | | 20 | | $V_{DS}$=20V,$I_D$=30A,Tj=25℃ | Fig.4 |
| | | | | 18.5 | | $V_{DS}$=20V,$I_D$=30A,Tj=175℃ | |

## ■Dynamic Electrical Characteristics（Tc=25℃ unless otherwise specified ）

| PARAMTETER | SYMBOL | UNIT | Min. | Typ. | Max. | Test Conditions | Note |
|---|---|---|---|---|---|---|---|
| Input capacitance | Ciss | pF | | 2995 | | $V_{DS}$=1000V, $V_{GS}$=0V, Tj=25℃, f=1MHz, $V_{AC}$= 25mV | Fig.13, 14 |
| Output capacitance | Coss | | | 119 | | | |
| Reverse capacitance | Crss | | | 11.4 | | | |
| Coss stored energy | Eoss | uJ | | 130 | | | Fig.15 |
| Gate source charge | Qgs | nC | | 24 | | $V_{DS}$=800V, $V_{GS}$=-5/18V, $I_D$=30A | Fig.12 |
| Gate drain charge | Qgd | | | 58 | | | |
| Gate charge | Qg | | | 127 | | | |

## ■Switching Characteristics（Tc=25℃ unless otherwise specified ）

| PARAMTETER | SYMBOL | UNIT | Min. | Typ. | Max. | Test Conditions | Note |
|---|---|---|---|---|---|---|---|
| Turn on switching energy | $E_{on}$ | uJ | | 685 | | $V_{DD}$=800V, $V_{GS}$=-5/+18V, $I_D$=30A, Rg=2.5Ω, L=200uH | Fig. 19, 20 |
| Turn off switching energy | $E_{off}$ | | | 78 | | | |
| Turn on delay time | $t_{d(on)}$ | ns | | 60 | | $V_{DD}$=800V, $V_{GS}$=-5/+18V, $I_D$=30A, Rg=2.5Ω, L=200uH | Fig.21 |
| Rise time | $t_r$ | | | 140 | | | |
| Turn off delay time | $t_{d(off)}$ | | | 50 | | | |
| Fall time | $t_f$ | | | 42 | | | |

## ■Body diode characteristics（Tc=25℃ unless otherwise specified ）

| PARAMTETER | SYMBOL | UNIT | Min. | Typ. | Max. | Test Conditions | Note |
|---|---|---|---|---|---|---|---|
| Diode forward voltage | $V_{SD}$ | V | | 3.5 | | $V_{GS}$=-5V,$I_{SD}$=15A, Tj=25℃ | Fig.8 |
| | | | | 3.0 | | $V_{GS}$=0V, $I_{SD}$=15A, Tj=175℃ | Fig.9 |
| Continuous diode forward current | $I_S$ | A | | 68 | | Tc=25℃ | |
| Reverse recovery time | trr | nS | | 34 | | $V_R$=800V, $V_{GS}$=-5V, $I_{SD}$=30A, di/dt=1428A/uS | |
| Reverse recovery charge | Qrr | nC | | 205 | | | |
| Peak reverse recovery current | Irrm | A | | 14 | | | |

## ■Thermal Characteristics （$T_a$=25℃ Unless otherwise specified）

| PARAMETER | SYMBOL | UNIT | Typ. |
|---|---|---|---|
| Thermal resistance | $R_{\theta J-C}$ | °C /W | 0.45 |

## ■Typical Characteristics

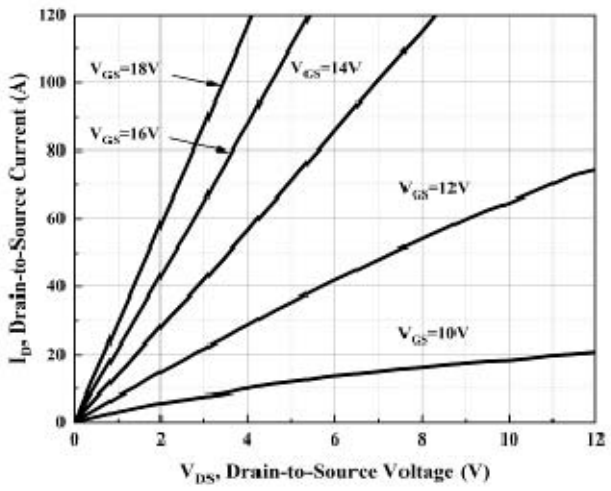



Figure 1. Output Characteristics Tj = -55℃

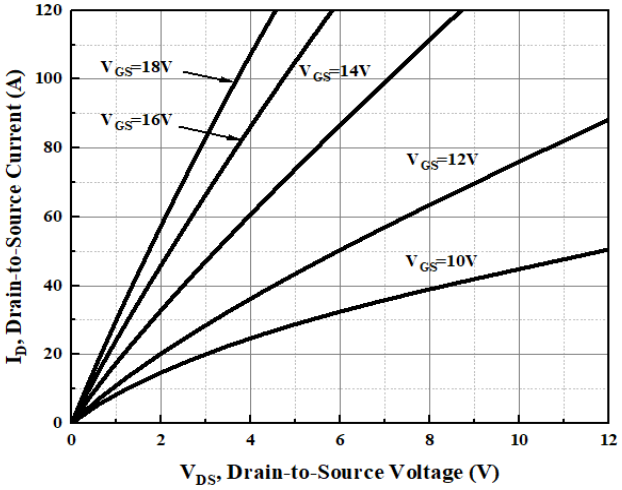



Figure2. Output Characteristics Tj = 25℃

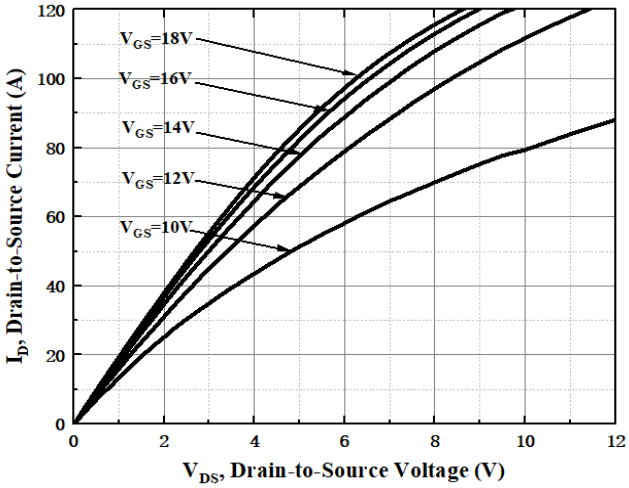



Figure 3. Output Characteristics Tj = 175℃

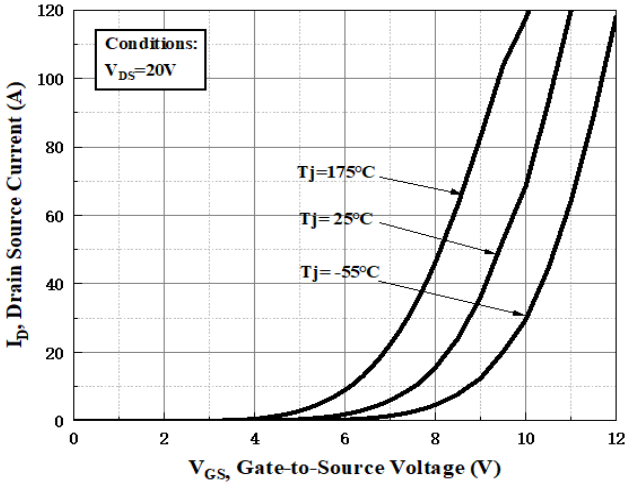



Figure 4. Transfer Characteristics for Various Junction Temperature

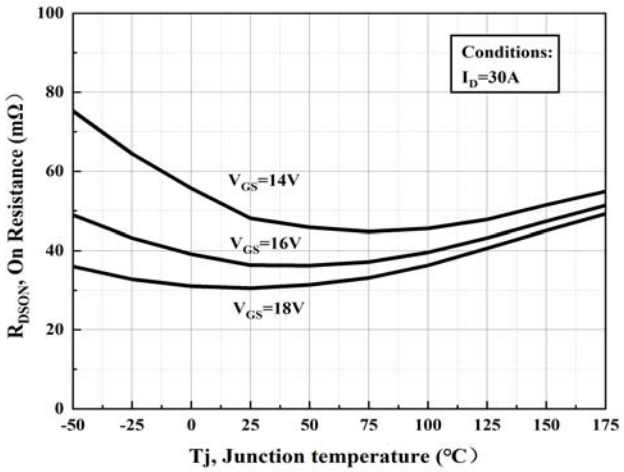



Figure 5. On-resistance vs. Temperature for Various Gate Voltage

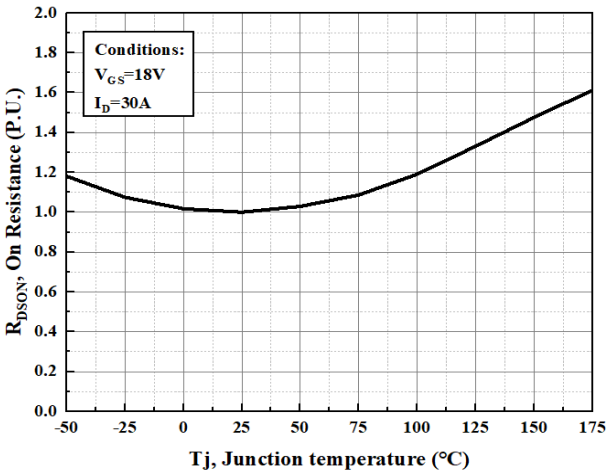



Figure 6. Normalized on-resistance vs. Temperature

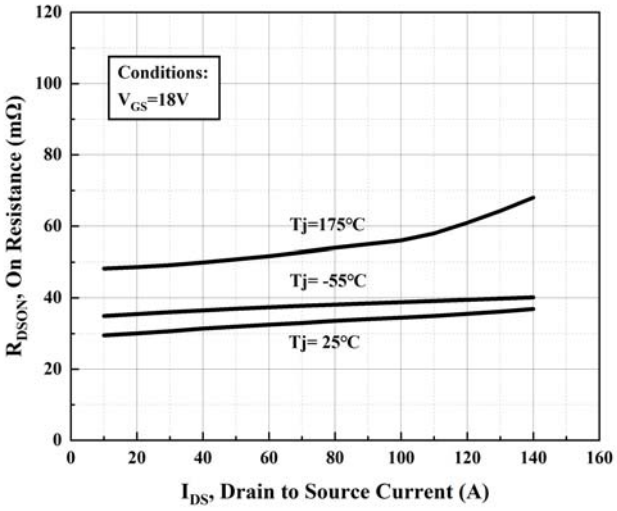



Figure 7. On-resistance vs. Drain Current

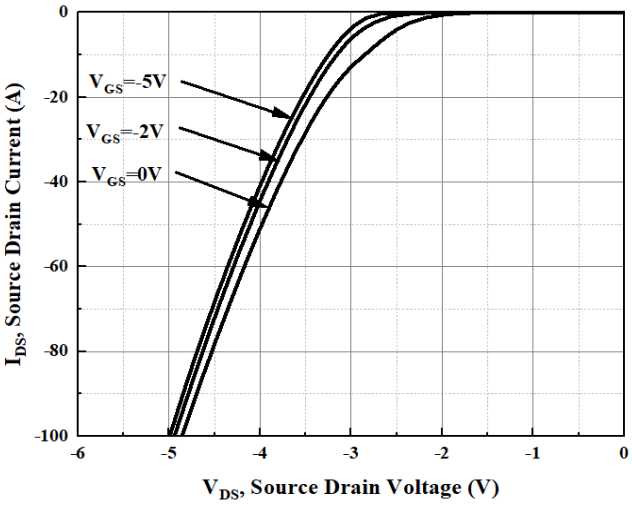



Figure 8. Body Diode Characteristic at Tj= 25 ℃

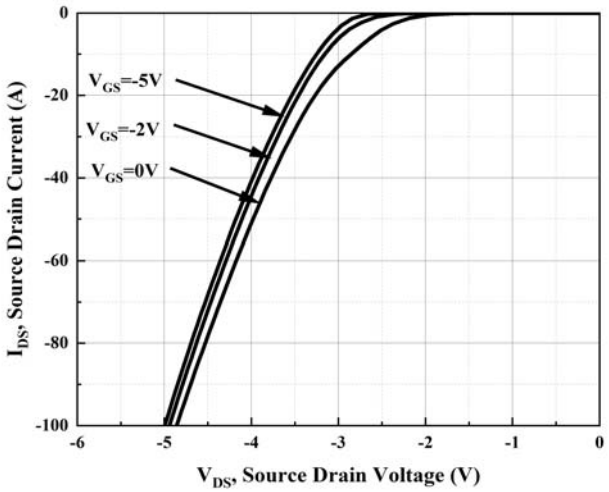



Figure 9. Body Diode Characteristic

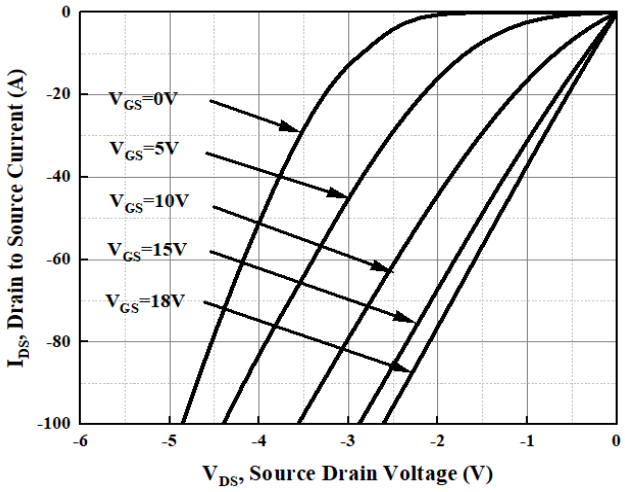



Figure 10. 3rd quadrant Characteristic at Tj= 25 ℃

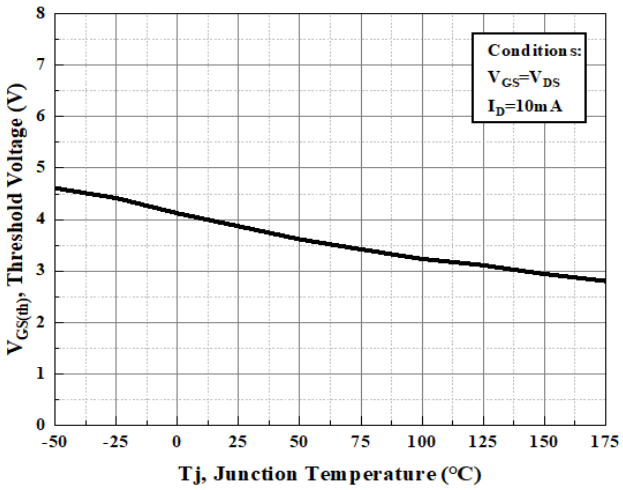



Figure 11. Threshold Voltage vs. Temperature

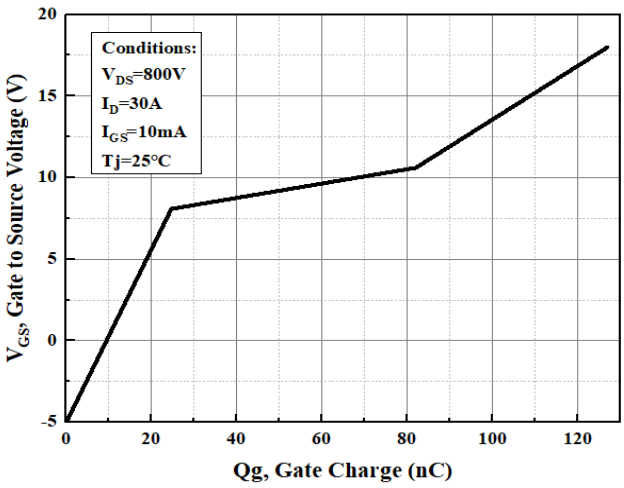



Figure 12. Gate Charge Characteristic

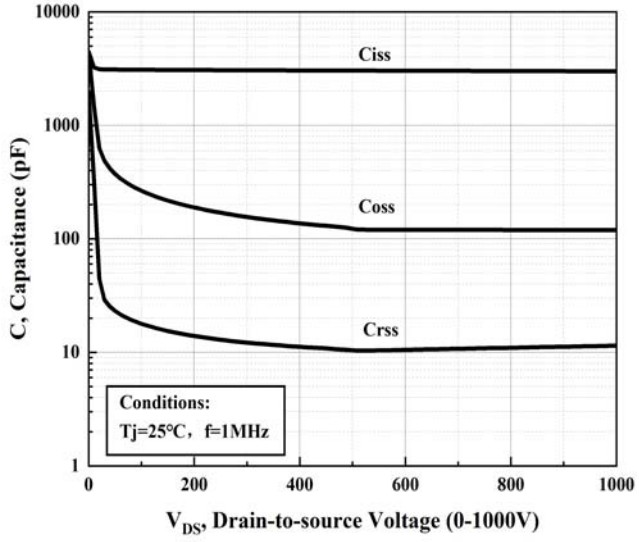



Figure 13. Capacitances vs. Drain Source Voltage (0-1000V)

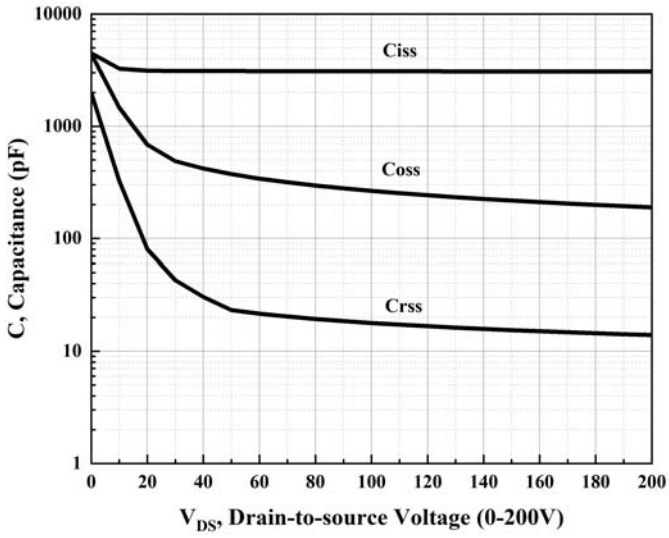



Figure 14. Capacitances vs. Drain Source Voltage (0-200V)

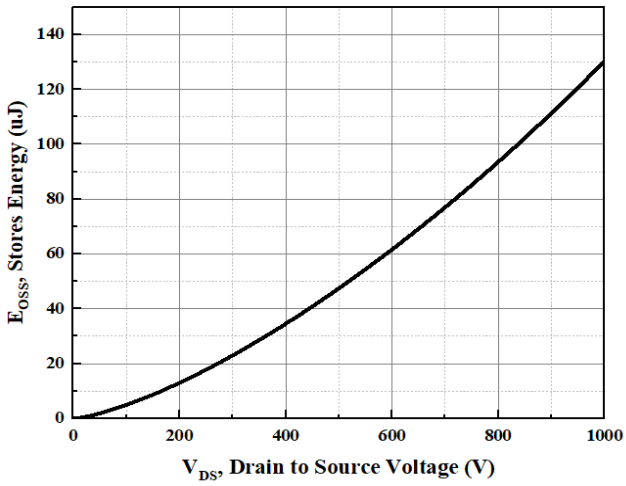



Figure 15. Output Capacitor Stored Energy

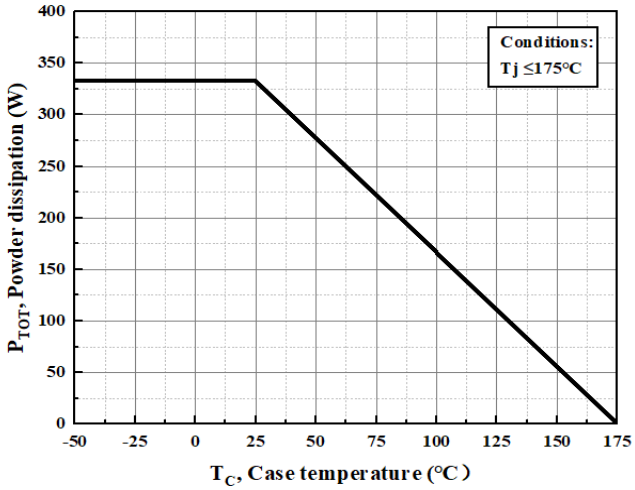



Figure 16. Maximun Power Dissipation Derating vs. Case Temperature

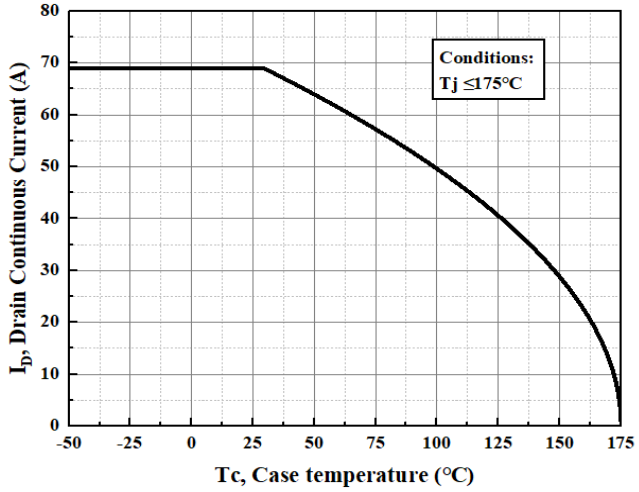



Figure 17. Coutinuous Drain Current Derating vs. Case Temperature

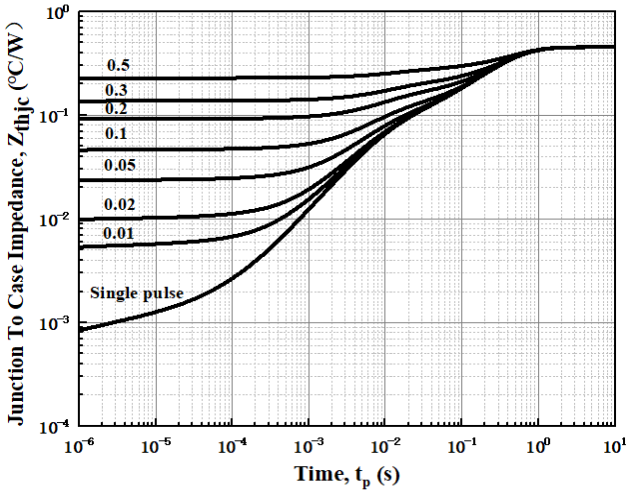



Figure18 Transient Thermal Impedance (Junction - Case)

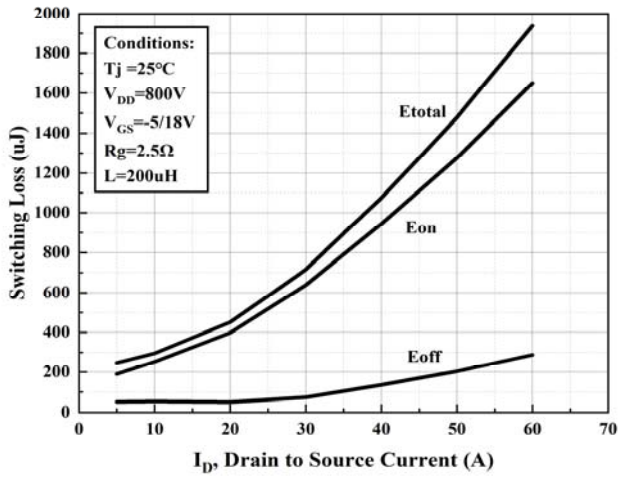



Figure 19. Clamped Inductive Switching Energy vs. Darin Current

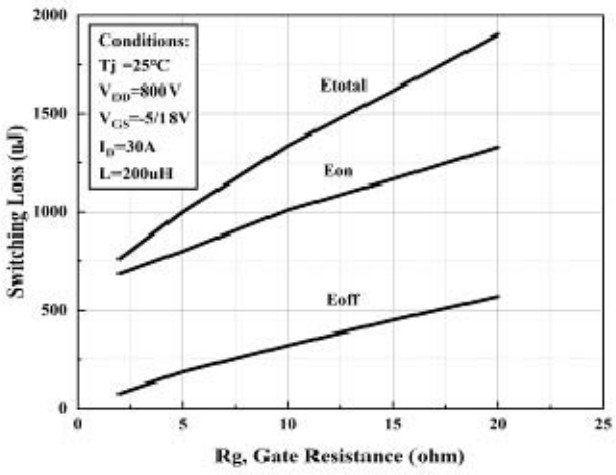



Figure 20. Clamped Inductive Switching Energy vs. Rg

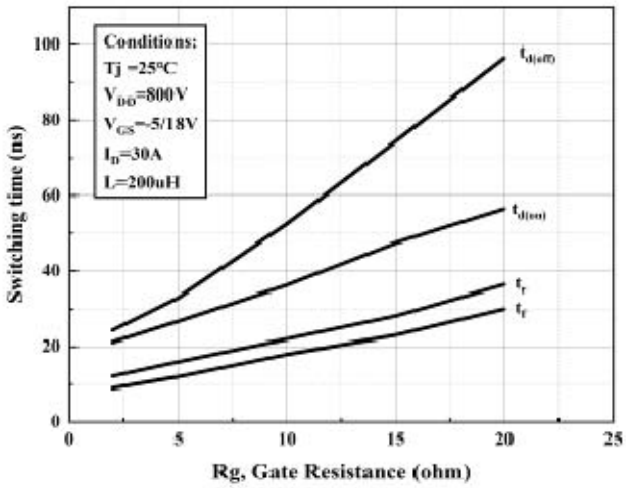



Figure 21. Switching Times vs. Rg

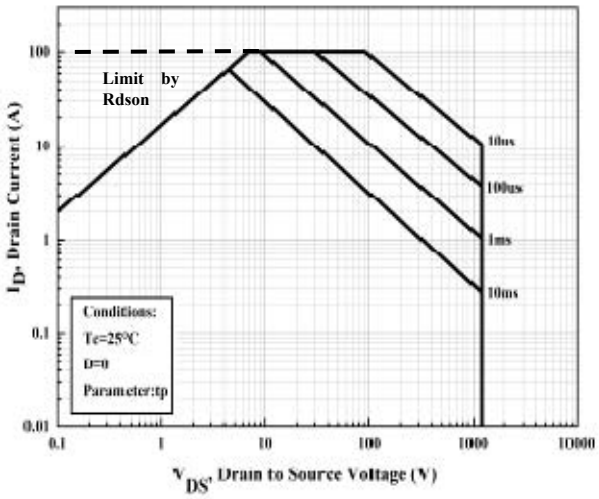



Figure 22. Safe Operating Area

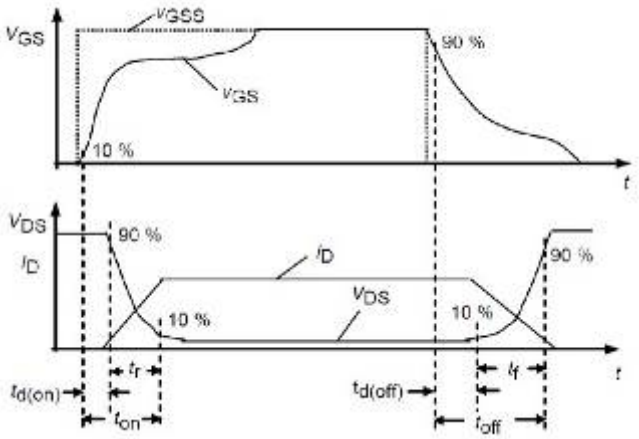



Figure 23. Switching Times Definition

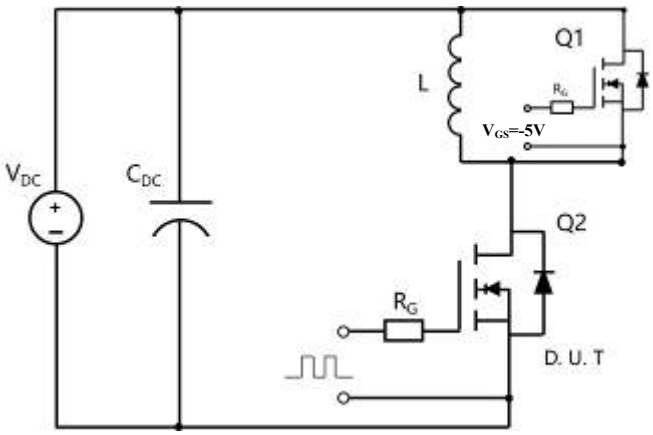
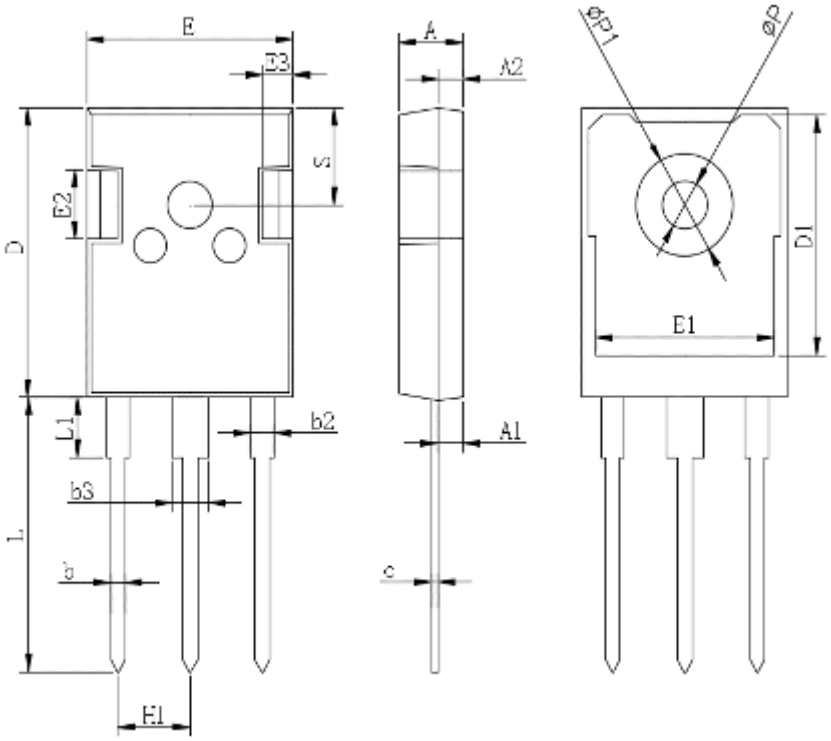



Figure 24. Clamped Inductive Switching Waveform Test Circuit

## ■Outline Dimensions

**TO-247AB**




| TO-247AB | | |
|---|---|---|
| Dim | Min | Max |
| A | 4.80 | 5.20 |
| A1 | 2.21 | 2.61 |
| A2 | 1.85 | 2.15 |
| b | 1.0 | 1.4 |
| b2 | 1.91 | 2.21 |
| C | 0.5 | 0.7 |
| D | 20.70 | 21.30 |
| D1 | 16.25 | 16.85 |
| E | 15.50 | 16.10 |
| E1 | 13.0 | 13.6 |
| E2 | 4.80 | 5.20 |
| E3 | 2.30 | 2.70 |
| L | 19.62 | 20.22 |
| L1 | - | 4.30 |
| ΦP | 3.40 | 3.80 |
| ΦP1 | - | 7.30 |
| S | 6.15TYP | |
| H1 | 5.44TYP | |
| b3 | 2.80 | 3.20 |

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