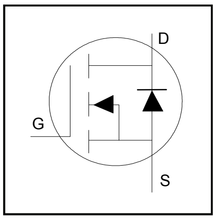
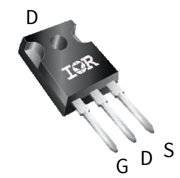
# IR MOSFET - StrongIRFET™




| $V_{DSS}$ | 200V |
|---|---|
| $R_{DS(on)}$ typ. | 5.3mΩ |
| max | 6.6mΩ |
| $I_D$ | 182A |

## Applications

- UPS and Inverter applications
- Half-bridge and full-bridge topologies
- Resonant mode power supplies
- DC/DC and AC/DC converters
- OR-ing and redundant power switches
- Brushed and BLDC Motor drive applications
- Battery powered circuits




TO-247AC
IRF200P222

## Benefits

- Improved Gate, Avalanche and Dynamic dv/dt Ruggedness
- Fully Characterized Capacitance and Avalanche SOA
- Enhanced body diode dv/dt and di/dt Capability
- Lead-Free; RoHS Compliant; Halogen-Free

| G | D | S |
|---|---|---|
| Gate | Drain | Source |

Halogen-Free RoHS

| Base part number | Package Type | Standard Pack | | Orderable Part Number |
|---|---|---|---|---|
| | | Form | Quantity | |
| IRF200P222 | TO-247AC | Tube | 25 | IRF200P222 |

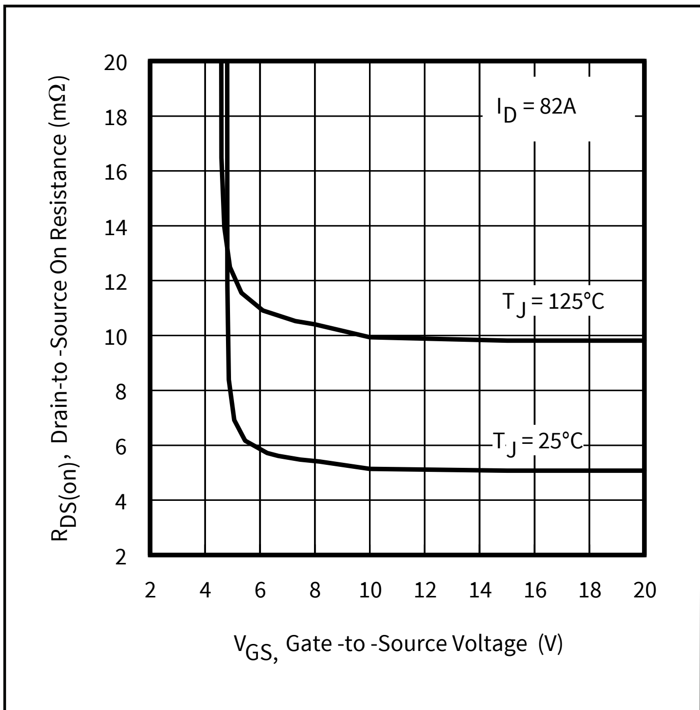



**Figure 1** Typical On-Resistance vs. Gate Voltage

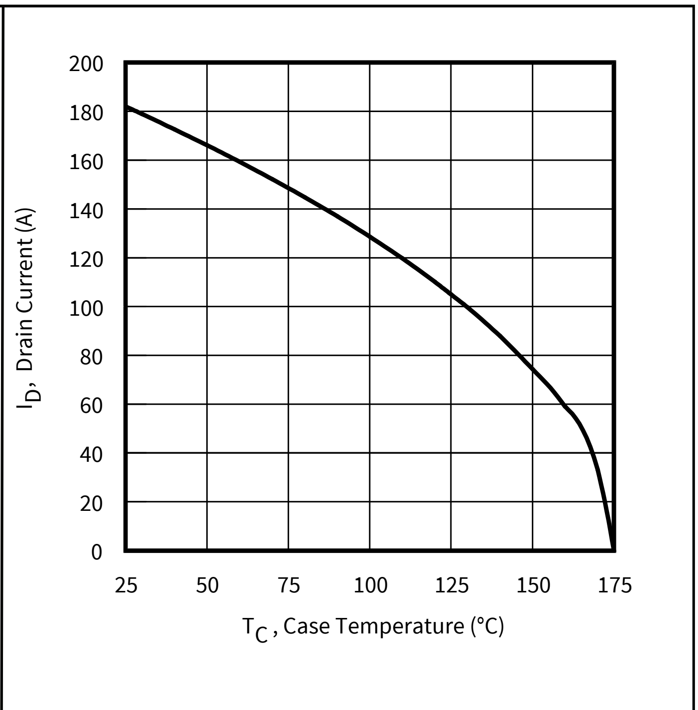



**Figure 2** Maximum Drain Current vs. Case Temperature

# Table of Contents

# 1 Parameters

**Table1 Key performance parameters**

| Parameter | Values | Units |
|---|---|---|
| $V_{DS}$ | 200 | V |
| $R_{DS(on)\ max}$ | 6.6 | mΩ |
| $I_D$ | 182 | A |

# 2 Maximum ratings and thermal characteristics

**Table 2 Maximum ratings (at $T_J$=25°C, unless otherwise specified)**

| Parameter | Symbol | Conditions | Values | Unit |
|---|---|---|---|---|
| Continuous Drain Current | $I_D$ | $T_C$ = 25°C, $V_{GS}$ @ 10V | 182 | A |
| Continuous Drain Current | $I_D$ | $T_C$ = 100°C, $V_{GS}$ @ 10V | 129 | |
| Pulsed Drain Current ① | $I_{DM}$ | $T_C$ = 25°C | 728 | |
| Maximum Power Dissipation | $P_D$ | $T_C$ = 25°C | 556 | W |
| Linear Derating Factor | | $T_C$ = 25°C | 3.7 | W/°C |
| Gate-to-Source Voltage | $V_{GS}$ | - | ± 20 | V |
| Operating Junction and Storage Temperature Range | $T_J$ $T_{STG}$ | - | -55 to + 175 | °C |
| Soldering Temperature, for 10 seconds (1.6mm from case) | - | - | 300 | |
| Mounting Torque, 6-32 or M3 Screw | - | - | 10 lbf·in (1.1 N·m) | - |

**Table 3 Thermal characteristics**

| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Junction-to-Case ⑦ | $R_{\theta JC}$ | $T_J$ approximately 90°C | - | - | 0.27 | °C/W |
| Case-to-Sink, Flat Greased Surface | $R_{\theta CS}$ | - | - | 0.24 | - | |
| Junction-to-Ambient | $R_{\theta JA}$ | - | - | - | 40 | |

**Table 4 Avalanche characteristics**

| Parameter | Symbol | Values | Unit |
|---|---|---|---|
| Single Pulse Avalanche Energy ② | $E_{AS\ (Thermally\ limited)}$ | 810 | mJ |
| Single Pulse Avalanche Energy ⑧ | $E_{AS\ (Thermally\ limited)}$ | 1070 | |
| Avalanche Current ① | $I_{AR}$ | See Fig 16, 17, 23a, 23b | A |
| Repetitive Avalanche Energy ① | $E_{AR}$ | | mJ |

***Notes:***

*① Repetitive rating; pulse width limited by max. junction temperature.*
*② Limited by $T_{Jmax}$, starting $T_J$ = 25°C, L = 0.24mH, $R_G$ = 50Ω, $I_{AS}$ = 82A, $V_{GS}$ =10V.*
*③ $I_{SD} \leq 82A$, di/dt ≤2290A/µs, $V_{DD} \leq V_{(BR)DSS}$, $T_J \leq 175°C$.*
*④ Pulse width ≤400µs; duty cycle ≤2%.*
*⑤ $C_{oss}$ eff. (TR) is a fixed capacitance that gives the same charging time as $C_{oss}$ while $V_{DS}$ is rising from 0 to 80% $V_{DSS}$.*
*⑥ $C_{oss}$ eff. (ER) is a fixed capacitance that gives the same energy as $C_{oss}$ while $V_{DS}$ is rising from 0 to 80% $V_{DSS}$.*
*⑦ $R_\theta$ is measured at $T_J$ approximately 90°C.*
*⑧ Limited by $T_{Jmax}$, starting $T_J$ = 25°C, L = 1mH, $R_G$ = 50Ω, $I_{AS}$ = 46A, $V_{GS}$ =10V.*

# 3 Electrical characteristics

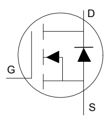
**Table 5 Static characteristics**

| Parameter | Symbol | Conditions | Values Min. | Values Typ. | Values Max. | Unit |
|---|---|---|---|---|---|---|
| Drain-to-Source Breakdown Voltage | $V_{(BR)DSS}$ | $V_{GS}$ = 0V, $I_D$ = 1mA | 200 | - | - | V |
| Breakdown Voltage Temp. Coefficient | $\Delta V_{(BR)DSS}/\Delta T_J$ | Reference to 25°C, $I_D$ = 2mA ① | - | 0.1 | - | V/°C |
| Static Drain-to-Source On-Resistance | $R_{DS(on)}$ | $V_{GS}$ = 10V, $I_D$ = 82A | - | 5.3 | 6.6 | mΩ |
| Gate Threshold Voltage | $V_{GS(th)}$ | $V_{DS}$ = $V_{GS}$, $I_D$ = 270μA | 2.0 | - | 4.0 | V |
| Drain-to-Source Leakage Current | $I_{DSS}$ | $V_{DS}$ = 160V, $V_{GS}$ = 0V | - | - | 1.0 | μA |
| | | $V_{DS}$ = 160V,$V_{GS}$ = 0V,$T_J$ =125°C | - | - | 100 | |
| Gate-to-Source Forward Leakage | $I_{GSS}$ | $V_{GS}$ = 20V | - | - | 100 | nA |
| Gate Resistance | $R_G$ | | - | 1.3 | - | Ω |

**Table 6 Dynamic characteristics**

| Parameter | Symbol | Conditions | Values Min. | Values Typ. | Values Max. | Unit |
|---|---|---|---|---|---|---|
| Forward Trans conductance | gfs | $V_{DS}$ = 50V, $I_D$ = 82A | 142 | - | - | S |
| Total Gate Charge | $Q_g$ | $I_D$ = 82A<br>$V_{DS}$ = 100V<br>$V_{GS}$ = 10V | - | 135 | 203 | nC |
| Gate-to-Source Charge | $Q_{gs}$ | | - | 49 | - | |
| Gate-to-Drain Charge | $Q_{gd}$ | | - | 26 | - | |
| Total Gate Charge Sync. (Qg– Qgd) | $Q_{sync}$ | | - | 109 | - | |
| Turn-On Delay Time | $t_{d(on)}$ | $V_{DD}$ = 130V<br>$I_D$ = 82A<br>$R_G$ = 2.7Ω<br>$V_{GS}$ = 10V | - | 25 | - | ns |
| Rise Time | $t_r$ | | - | 96 | - | |
| Turn-Off Delay Time | $t_{d(off)}$ | | - | 77 | - | |
| Fall Time | $t_f$ | | - | 97 | - | |
| Input Capacitance | $C_{iss}$ | $V_{GS}$ = 0V<br>$V_{DS}$ = 50V<br>$f$ = 1.0MHz, See Fig.7 | - | 9820 | - | pF |
| Output Capacitance | $C_{oss}$ | | - | 1240 | - | |
| Reverse Transfer Capacitance | $C_{rss}$ | | - | 6.5 | - | |
| Effective Output Capacitance (Energy Related) | $C_{oss\ eff.(ER)}$ | $V_{GS}$ = 0V, $V_{DS}$ = 0V to 160V ⑥ | - | 1025 | - | |
| Output Capacitance (Time Related) | $C_{oss\ eff.(TR)}$ | $V_{GS}$ = 0V, $V_{DS}$ = 0V to 160V ⑤ | - | 1540 | - | |

**Table 7 Reverse Diode**

| Parameter | Symbol | Conditions | Values Min. | Values Typ. | Values Max. | Unit |
|---|---|---|---|---|---|---|
| Continuous Source Current (Body Diode) | $I_S$ | MOSFET symbol showing the integral reverse p-n junction diode.  | - | - | 182 | A |
| Pulsed Source Current (Body Diode) ① | $I_{SM}$ | | - | - | 728 | |
| Diode Forward Voltage | $V_{SD}$ | $T_J$ = 25°C, $I_S$ = 82A,$V_{GS}$ = 0V ④ | - | - | 1.2 | V |
| Peak Diode Recovery dv/dt ③ | dv/dt | $T_J$ = 175°C, $I_S$ = 82A,$V_{DS}$ = 200V | - | 12.3 | - | V/ns |
| Reverse Recovery Time | $t_{rr}$ | $T_J$ = 25°C; $V_{DD}$ = 170V, $I_F$ = 82A, di/dt = 100A/μs ④ | - | 125 | - | ns |
| | | $T_J$ = 125°C | - | 180 | - | |
| Reverse Recovery Charge | $Q_{rr}$ | $T_J$ = 25°C | - | 390 | - | nC |
| | | $T_J$ = 125°C | - | 820 | - | |
| Reverse Recovery Current | $I_{RRM}$ | $T_J$ = 25°C | - | 4.8 | - | A |

# 4 Electrical characteristic diagrams

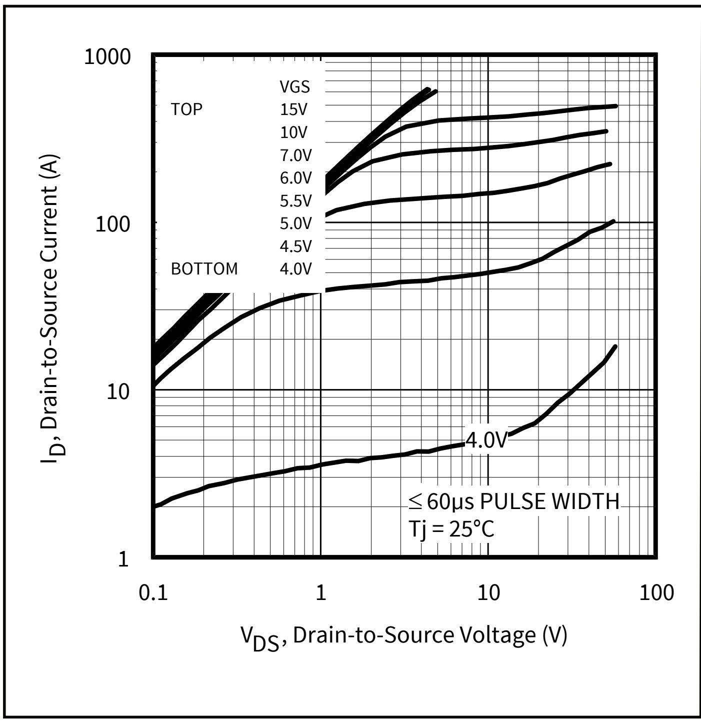



**Figure 3 Typical Output Characteristics**

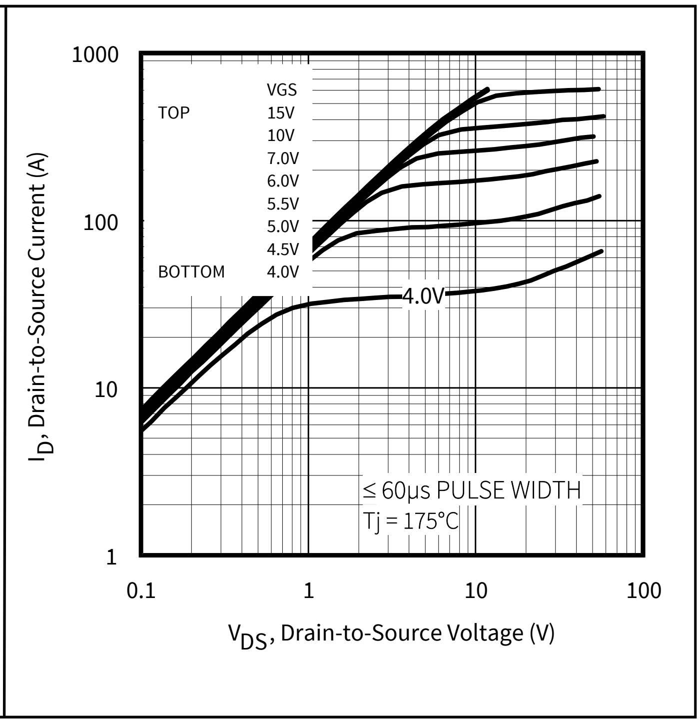



**Figure 4 Typical Output Characteristics**

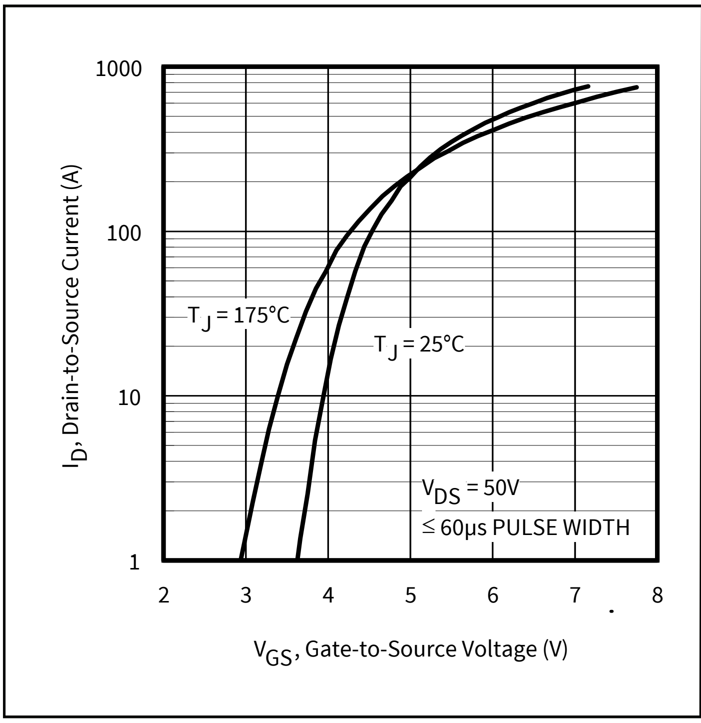



**Figure 5 Typical Transfer Characteristics**

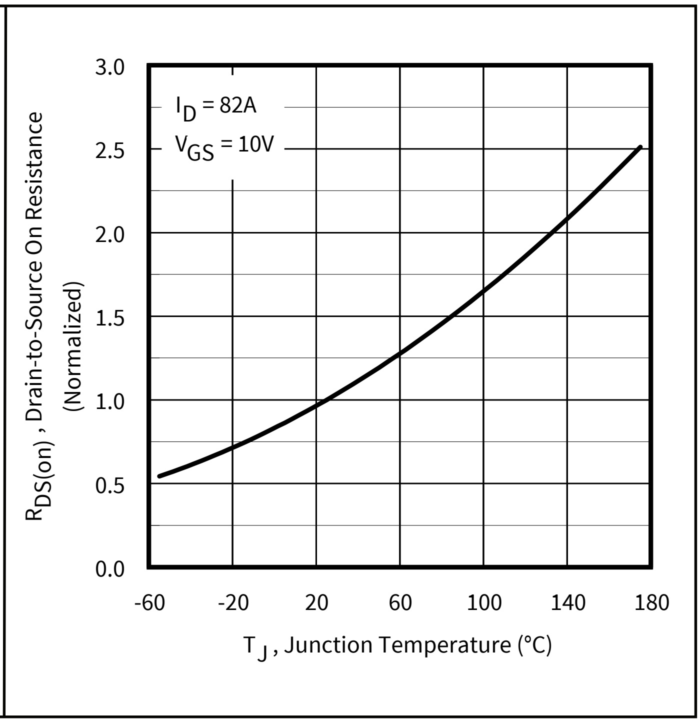



**Figure 6 Normalized On-Resistance vs. Temperature**

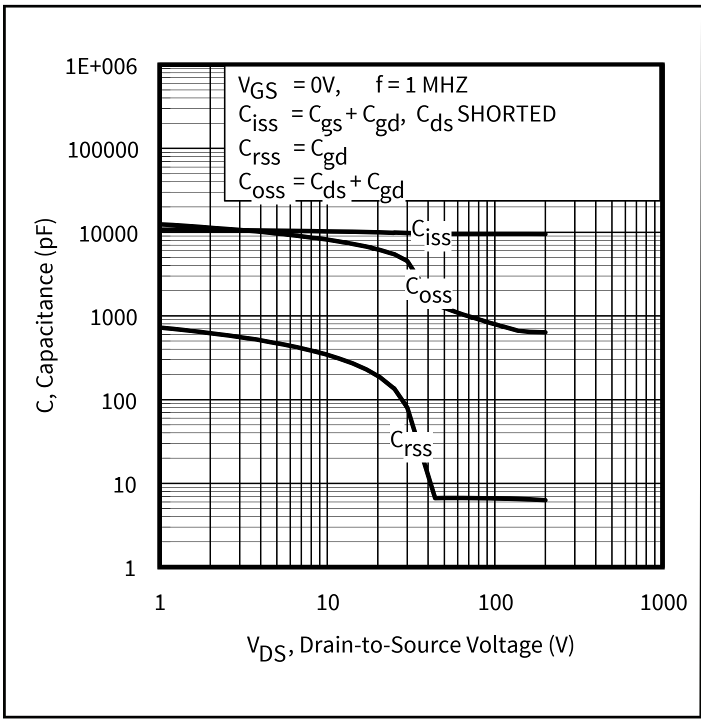



**Figure 7** **Typical Capacitance vs. Drain-to-Source Voltage**

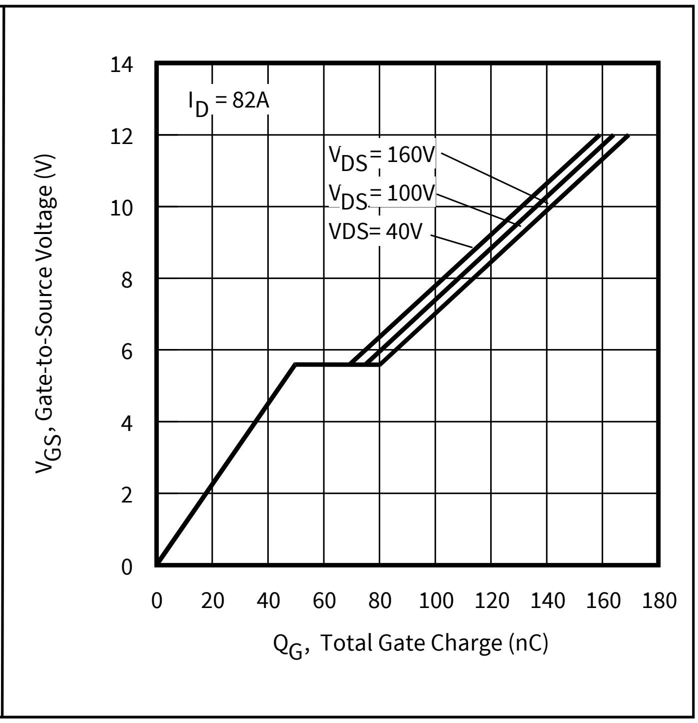



**Figure 8** **Typical Gate Charge vs. Gate-to-Source Voltage**

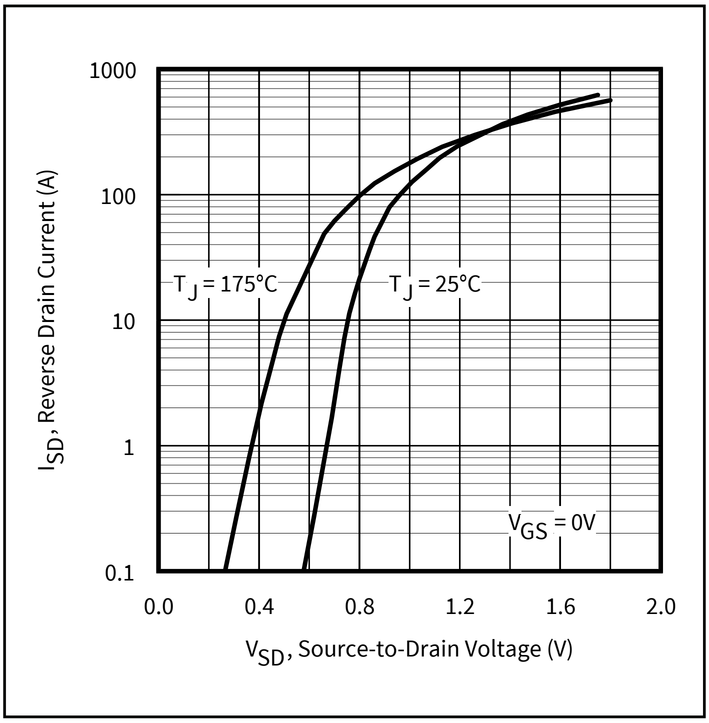



**Figure 9** **Typical Source-Drain Diode Forward**

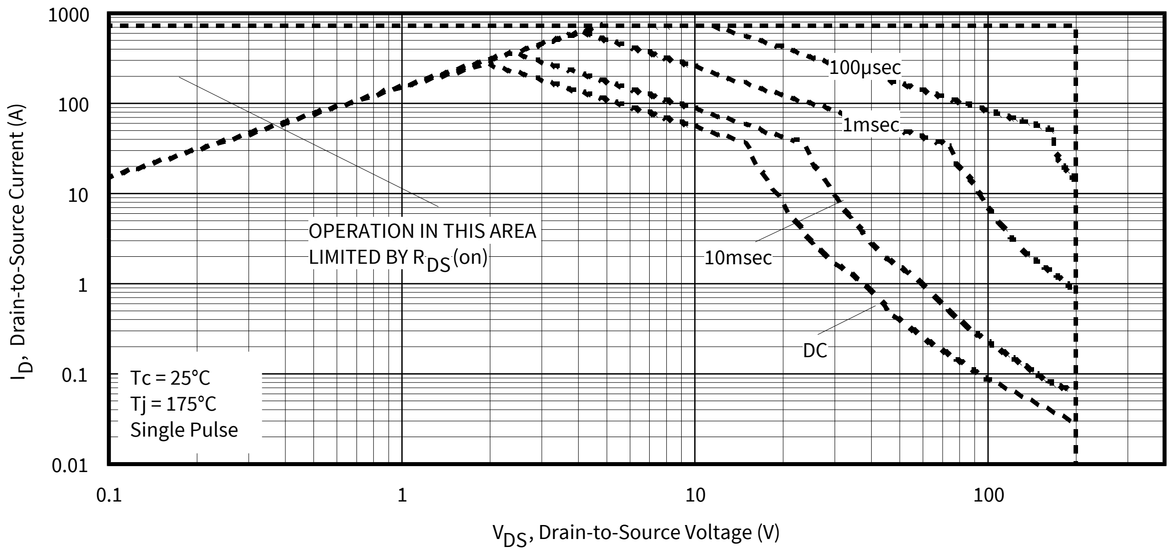



**Figure 10 Maximum Safe Operating Area**

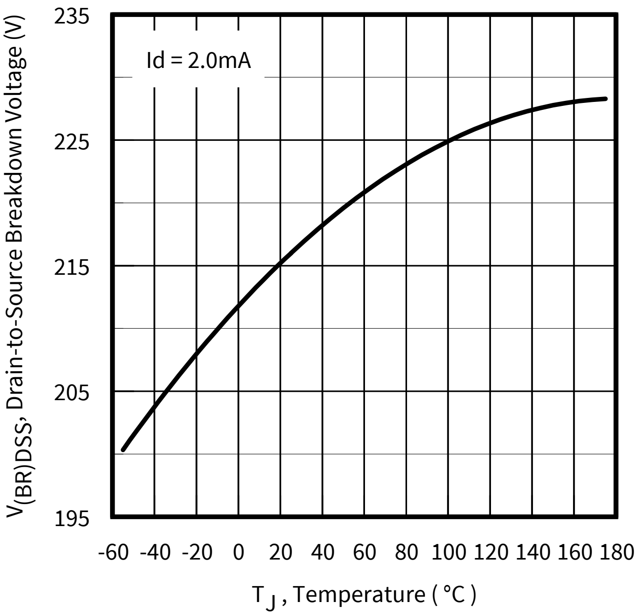



**Figure 11 Drain-to-Source Breakdown Voltage**

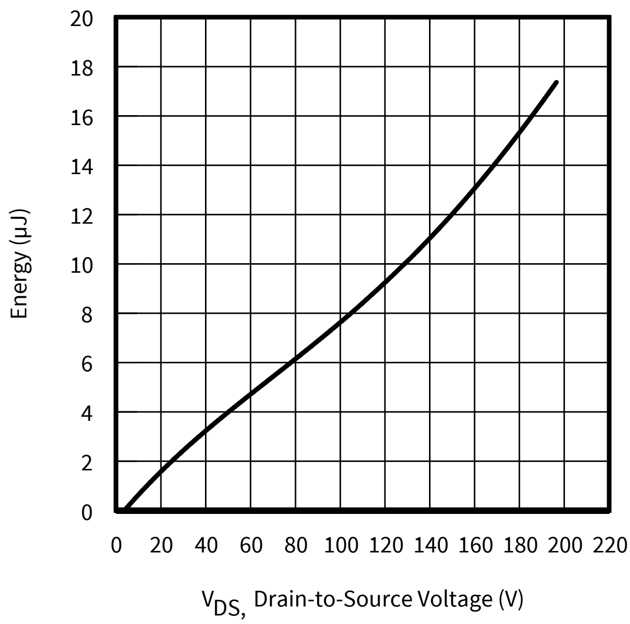



**Figure 12 Typical Coss Stored Energy**

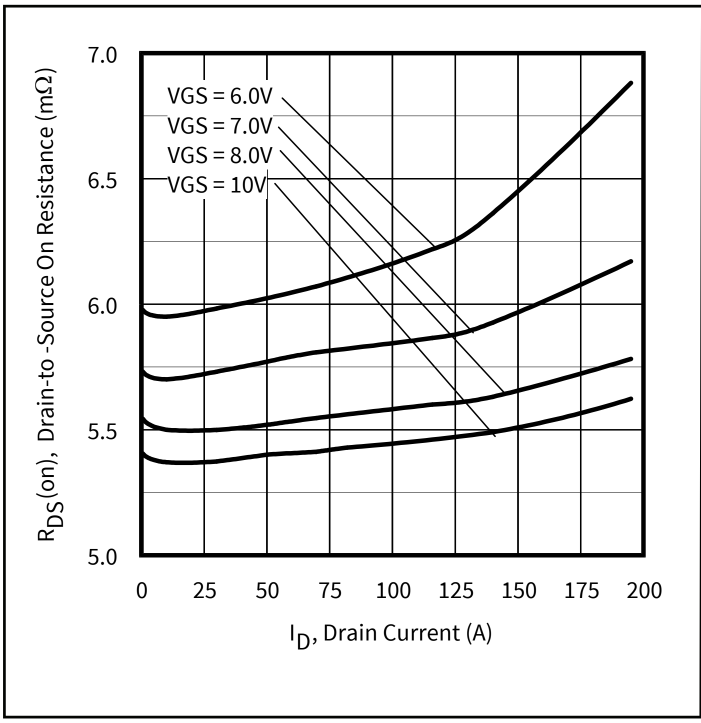



**Figure 13** Typical On-Resistance vs. Drain Current

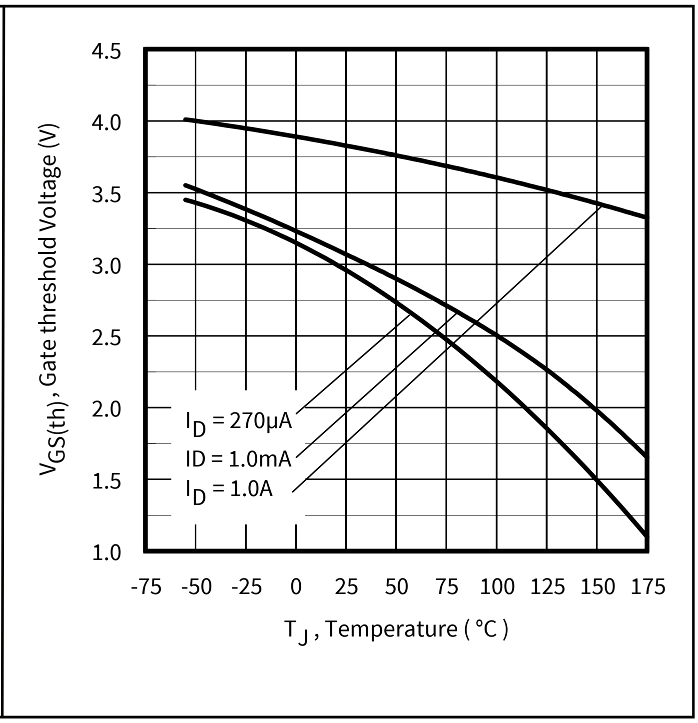



**Figure 14** Threshold Voltage vs. Temperature

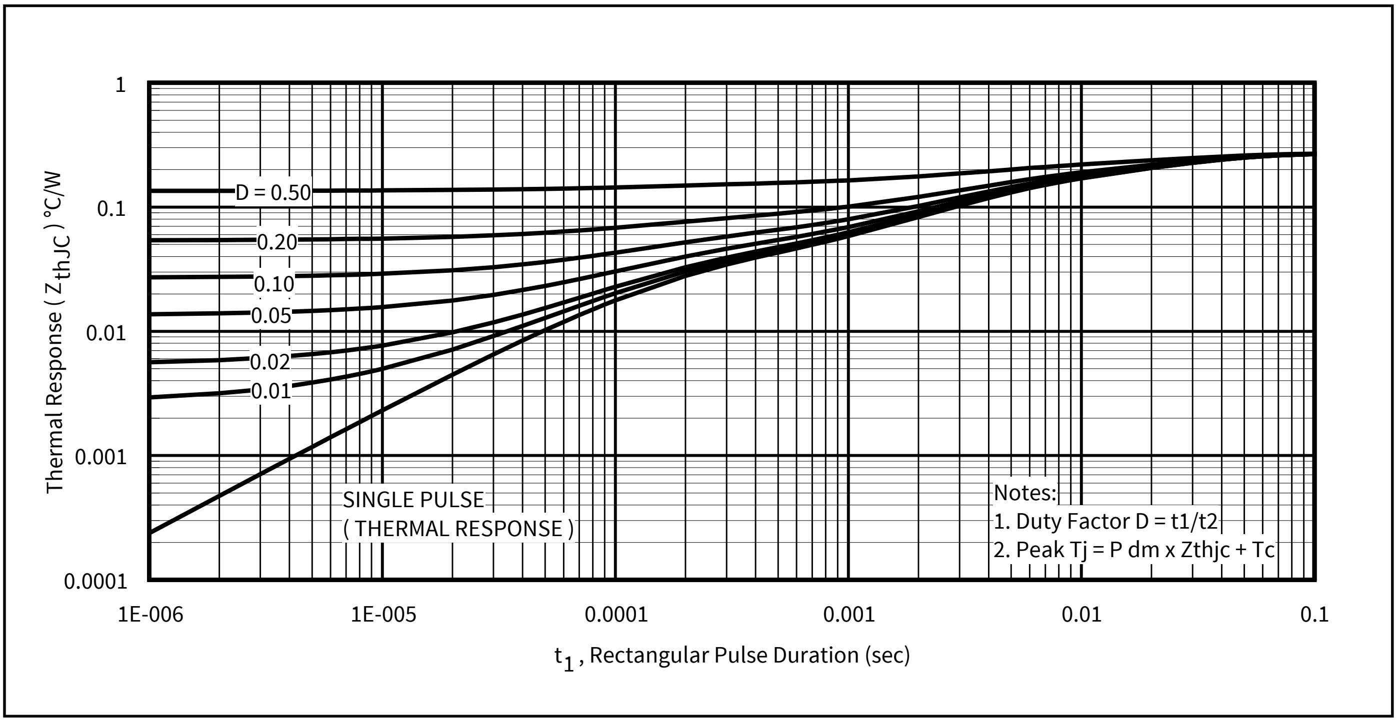



**Figure 15** Maximum Effective Transient Thermal Impedance, Junction-to-Case

**Electrical characteristic diagrams**

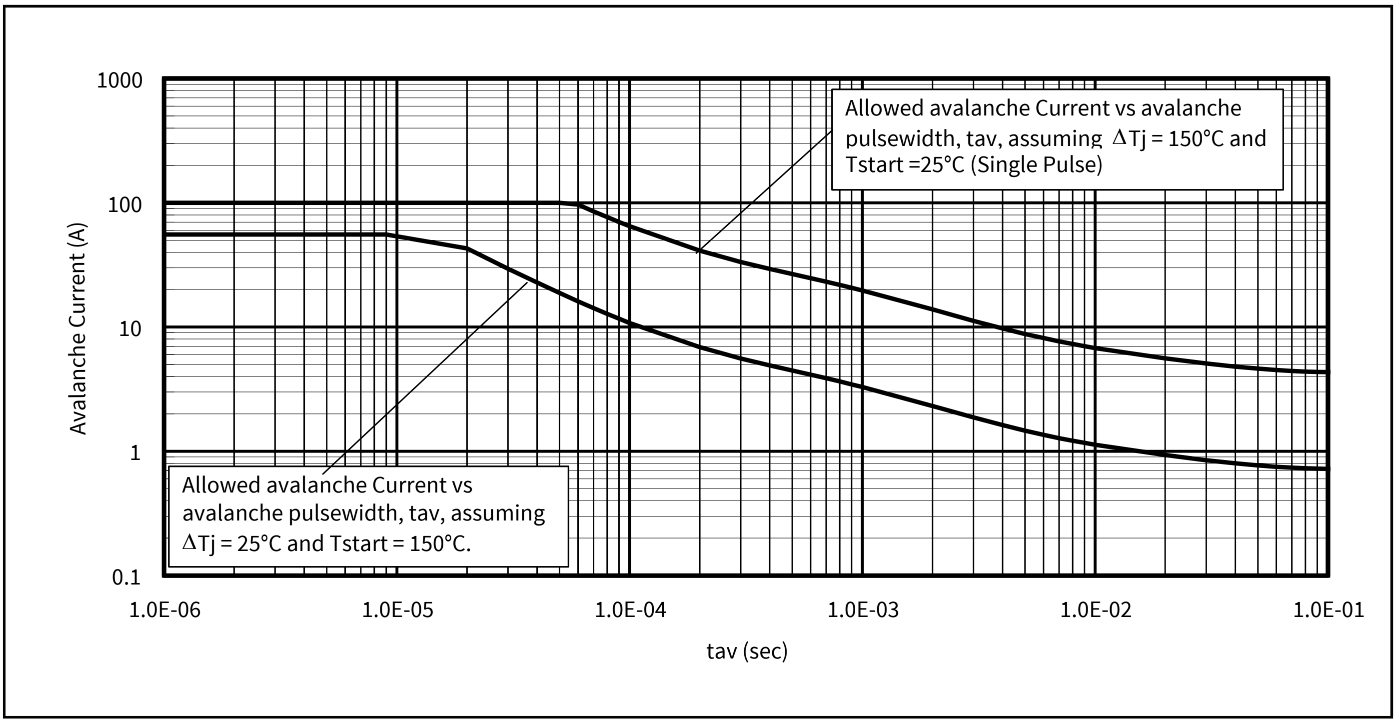



**Figure 16 Avalanche Current vs. Pulse Width**

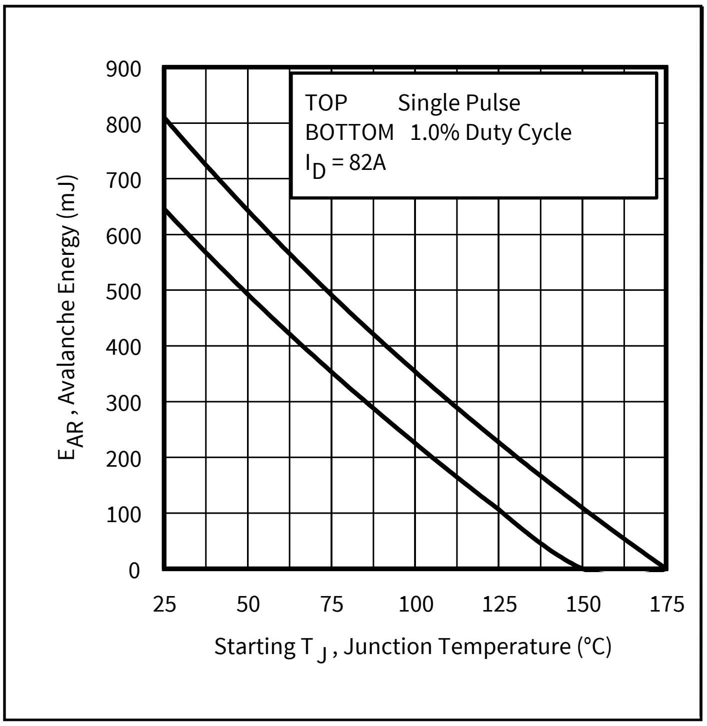



**Figure 17 Maximum Avalanche Energy vs. Temperature**

**Notes on Repetitive Avalanche Curves , Figures 16, 17:**
**(For further info, see AN-1005 at www.infineon.com)**

1. Avalanche failures assumption:
   Purely a thermal phenomenon and failure occurs at a temperature far in excess of $T_{jmax}$. This is validated for every part type.
2. Safe operation in Avalanche is allowed as long as $T_{jmax}$ is not exceeded.
3. Equation below based on circuit and waveforms shown in Figures 23a, 23b.
4. $P_{D\ (ave)}$ = Average power dissipation per single avalanche pulse.
5. BV = Rated breakdown voltage (1.3 factor accounts for voltage increase during avalanche).
6. $I_{av}$ = Allowable avalanche current.
7. DT = Allowable rise in junction temperature, not to exceed $T_{jmax}$ (assumed as 25°C in Figure 15, 16).
   $t_{av}$ = Average time in avalanche.
   D = Duty cycle in avalanche = tav ·f
   $Z_{thJC}(D, t_{av})$ = Transient thermal resistance, see Figures 14)

$$PD\ (ave) = 1/2\ (1.3 \cdot BV \cdot I_{av}) = \Delta T / Z_{thJC}$$

$$I_{av} = 2\Delta T / [1.3 \cdot BV \cdot Z_{th}]$$

$$E_{AS\ (AR)} = P_{D\ (ave)} \cdot t_{av}$$

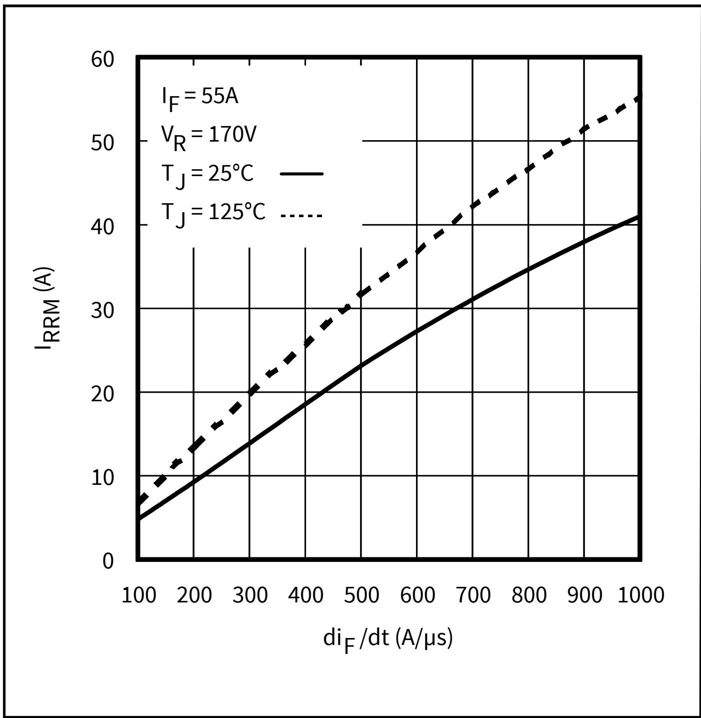



**Figure 18 Typical Recovery Current vs. dif/dt**

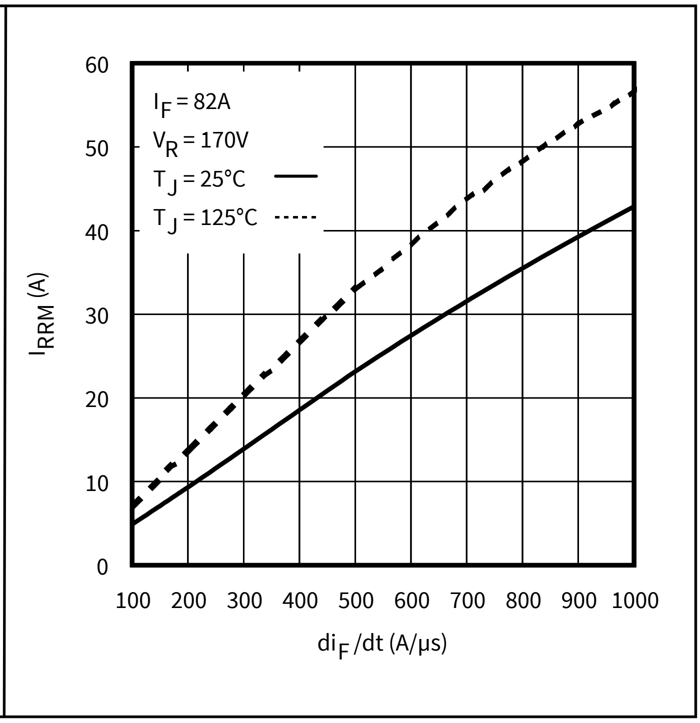



**Figure 19 Typical Recovery Current vs. dif/dt**

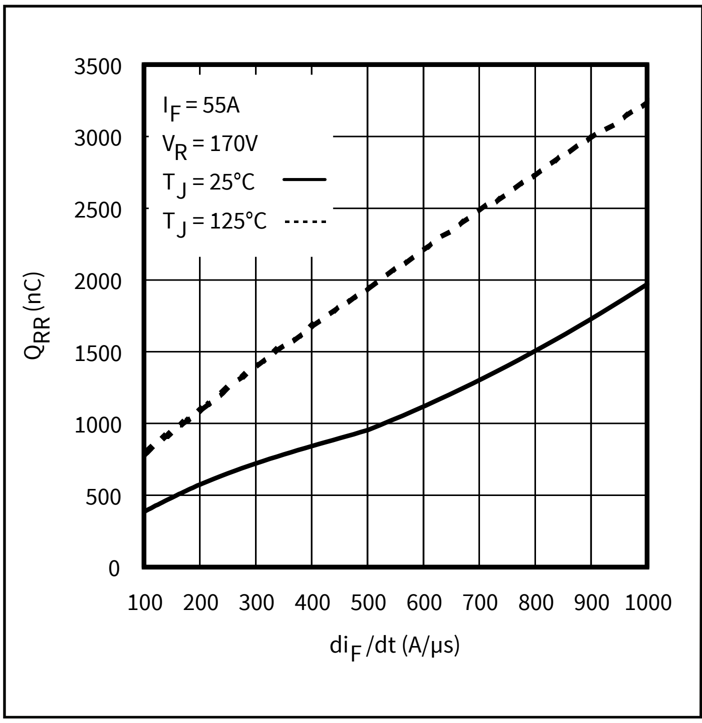



**Figure 20 Typical Stored Charge vs. dif/dt**

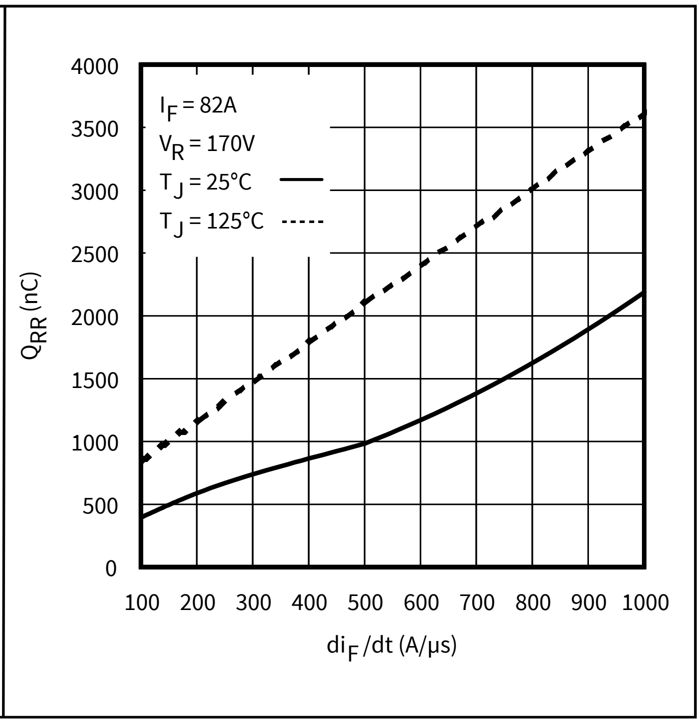



**Figure 21 Typical Stored Charge vs. dif/dt**

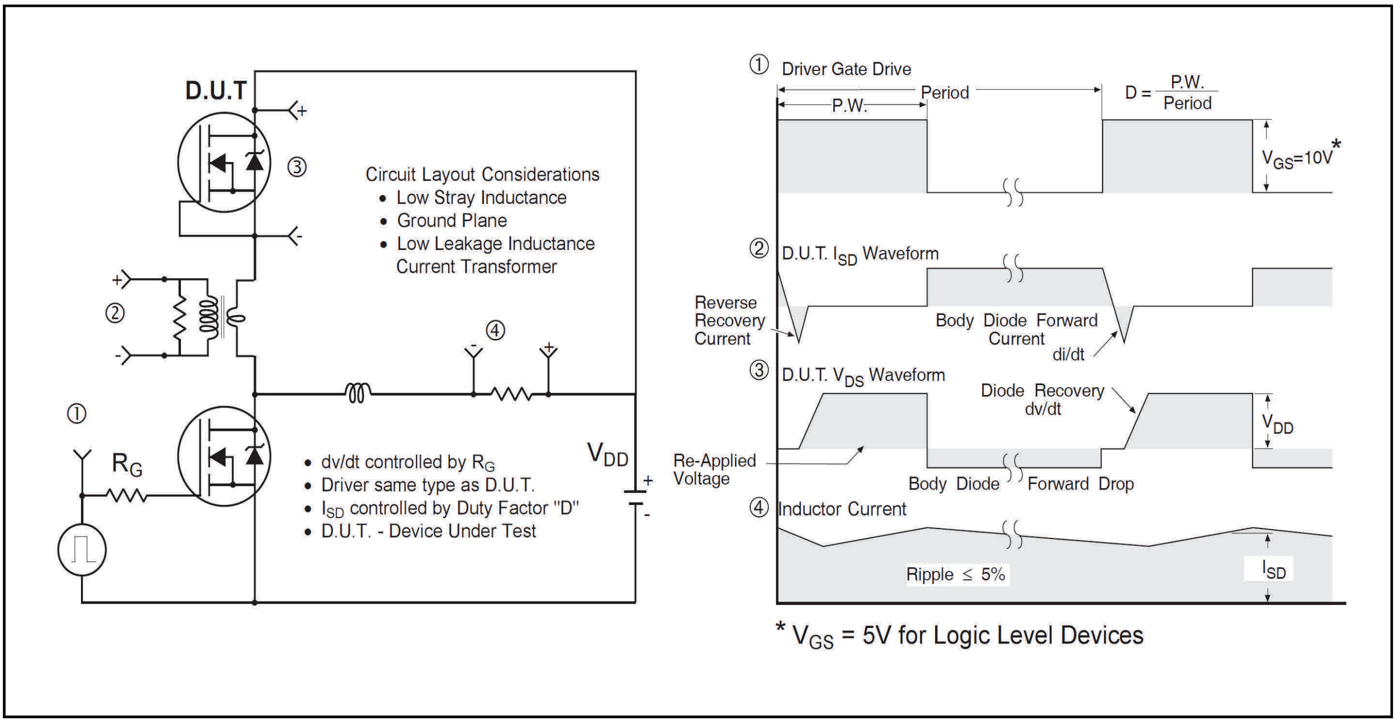
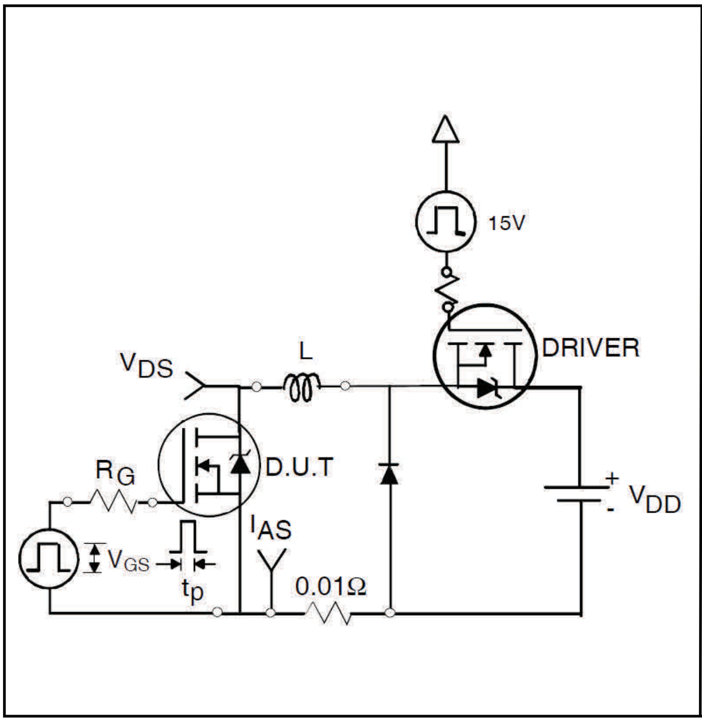



**Figure 22** Peak Diode Recovery dv/dt Test Circuit for N-Channel HEXFET™ Power MOSFETs



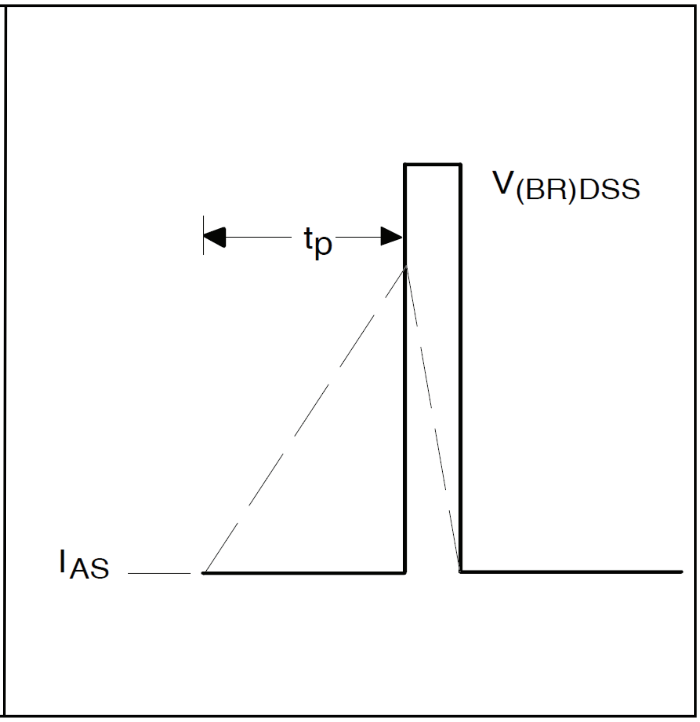




**Figure 23a** Unclamped Inductive Test Circuit

**Figure 23b** Unclamped Inductive Waveforms

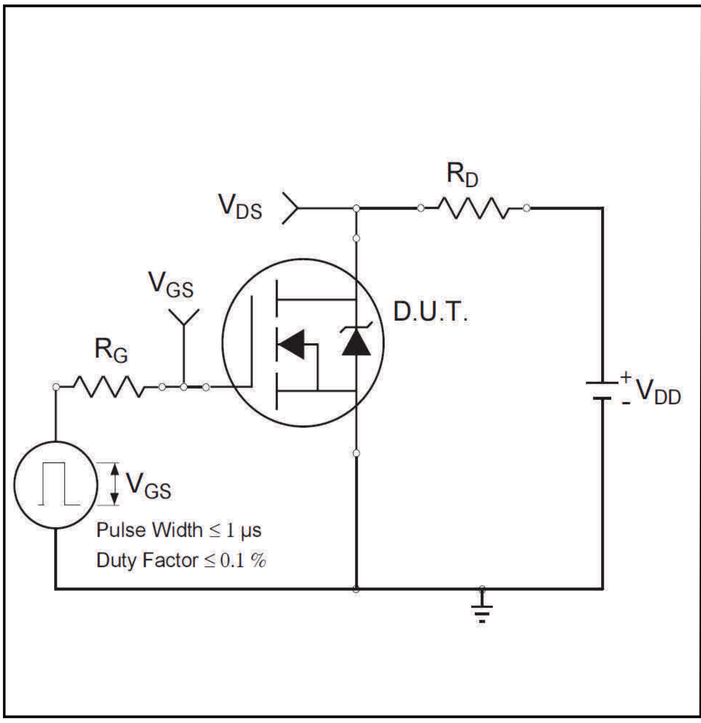



**Figure 24a** **Switching Time Test Circuit**

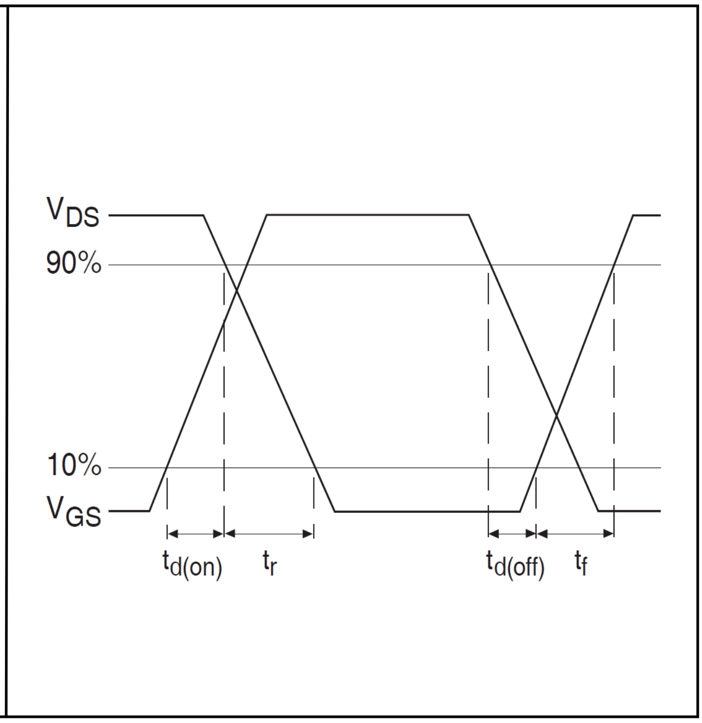



**Figure 24b** **Switching Time Waveforms**

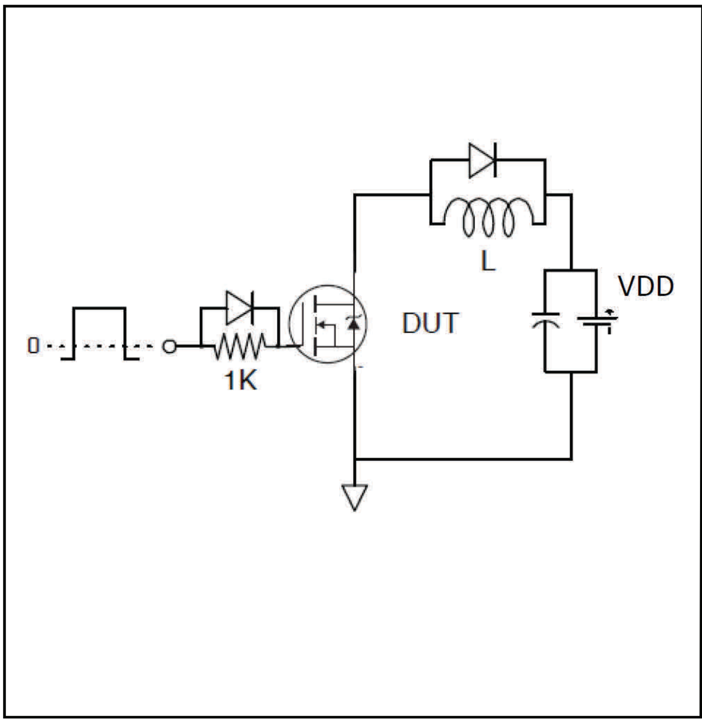



**Figure 25a** **Gate Charge Test Circuit**

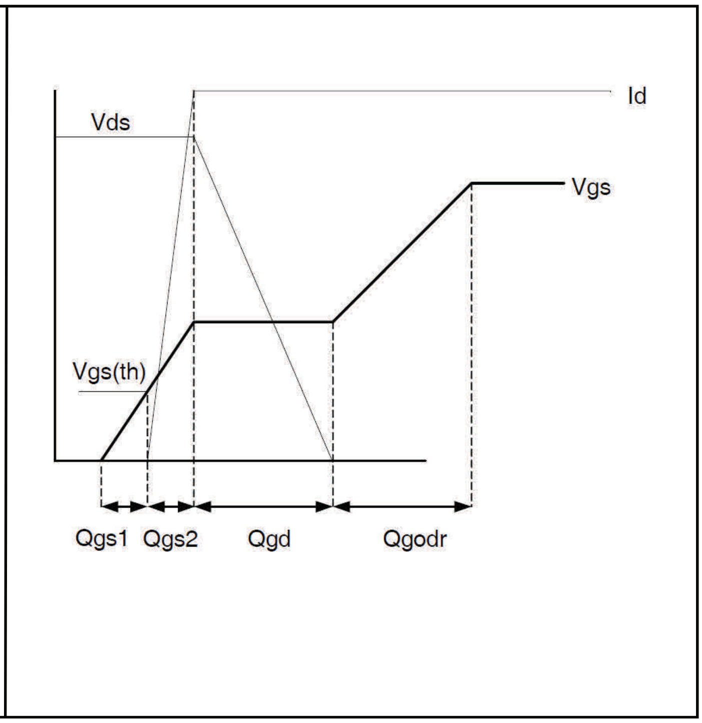
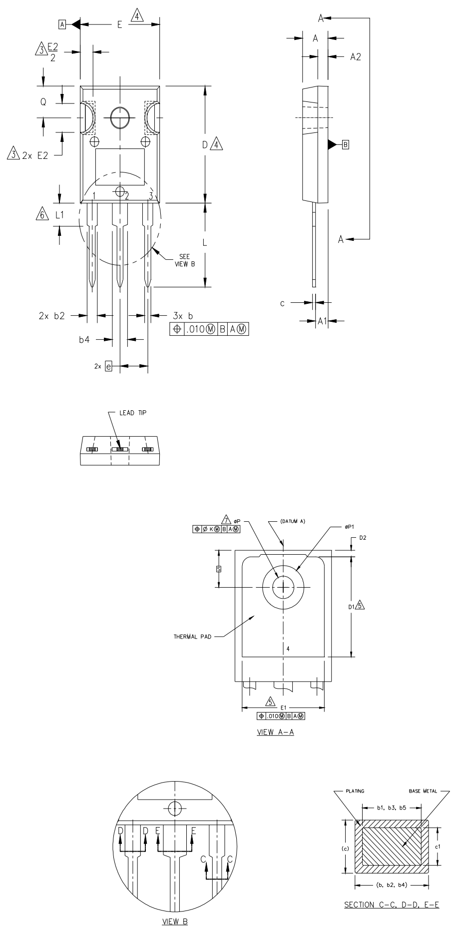



**Figure 25b** **Gate Charge Waveform**

# 5 Package Information

**TO-247AC Package Outline** (Dimensions are shown in millimeters (inches))




NOTES:

1. DIMENSIONING AND TOLERANCING AS PER ASME Y14.5M 1994.
2. DIMENSIONS ARE SHOWN IN INCHES.
3. CONTOUR OF SLOT OPTIONAL.
4. DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED .005" (0.127) PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY.
5. THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSIONS D1 & E1.
6. LEAD FINISH UNCONTROLLED IN L1.
7. ØP TO HAVE A MAXIMUM DRAFT ANGLE OF 1.5 ° TO THE TOP OF THE PART WITH A MAXIMUM HOLE DIAMETER OF .154 INCH.
8. OUTLINE CONFORMS TO JEDEC OUTLINE TO-247AC .

| SYMBOL | DIMENSIONS | | | | NOTES |
|---|---|---|---|---|---|
| | INCHES | | MILLIMETERS | | |
| | MIN. | MAX. | MIN. | MAX. | |
| A | .183 | .209 | 4.65 | 5.31 | |
| A1 | .087 | .102 | 2.21 | 2.59 | |
| A2 | .059 | .098 | 1.50 | 2.49 | |
| b | .039 | .055 | 0.99 | 1.40 | |
| b1 | .039 | .053 | 0.99 | 1.35 | |
| b2 | .065 | .094 | 1.65 | 2.39 | |
| b3 | .065 | .092 | 1.65 | 2.34 | |
| b4 | .102 | .135 | 2.59 | 3.43 | |
| b5 | .102 | .133 | 2.59 | 3.38 | |
| c | .015 | .035 | 0.38 | 0.89 | |
| c1 | .015 | .033 | 0.38 | 0.84 | |
| D | .776 | .815 | 19.71 | 20.70 | 4 |
| D1 | .515 | – | 13.08 | – | 5 |
| D2 | .020 | .053 | 0.51 | 1.35 | |
| E | .602 | .625 | 15.29 | 15.87 | 4 |
| E1 | .530 | – | 13.46 | – | |
| E2 | .178 | .216 | 4.52 | 5.49 | |
| e | .215 BSC | | 5.46 BSC | | |
| Øk | .010 | | 0.25 | | |
| L | .559 | .634 | 14.20 | 16.10 | |
| L1 | .146 | .169 | 3.71 | 4.29 | |
| ØP | .140 | .144 | 3.56 | 3.66 | |
| ØP1 | – | .291 | – | 7.39 | |
| Q | .209 | .224 | 5.31 | 5.69 | |
| S | .217 BSC | | 5.51 BSC | | |

LEAD ASSIGNMENTS

HEXFET

1.– GATE
2.– DRAIN
3.– SOURCE
4.– DRAIN

IGBTs, CoPACK

1.– GATE
2.– COLLECTOR
3.– EMITTER
4.– COLLECTOR

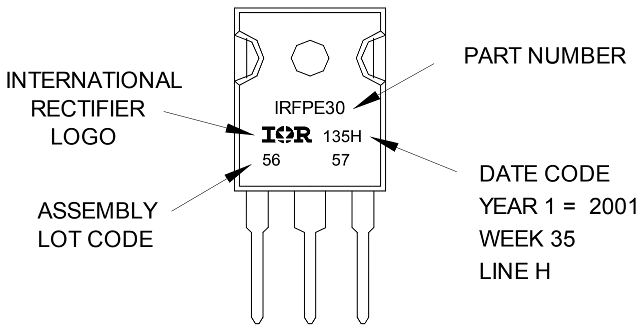
DIODES

1.– ANODE/OPEN
2.– CATHODE
3.– ANODE

## TO-247AC Part Marking Information

EXAMPLE: THIS IS AN IRFPE30
WITH ASSEMBLY
LOT CODE 5657
ASSEMBLED ON WW 35, 2001
IN THE ASSEMBLY LINE "H"

Note: "P" in assembly line position
indicates "Lead-Free"




TO-247AC package is not recommended for Surface Mount Application.

# 6 Qualification Information

| Qualification Information | | |
|---|---|---|
| **Qualification Level** | Industrial<br>(per JEDEC JESD47F) † | |
| **Moisture Sensitivity Level** | TO-247AC | N/A |
| **RoHS Compliant** | Yes | |

† Applicable version of JEDEC standard at the time of product release.

# Revision History

**Major changes since the last revision**

| Page or Reference | Revision | Date | Description of changes |
|---|---|---|---|
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