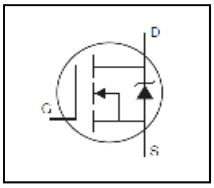
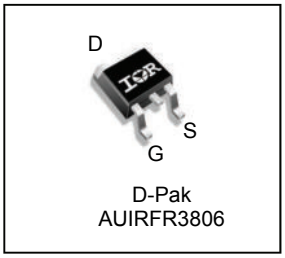
HEXFET® Power MOSFET

**Features**

- Advanced Process Technology
- Ultra Low On-Resistance
- Dynamic dV/dT Rating
- 175°C Operating Temperature
- Fast Switching
- Repetitive Avalanche Allowed up to Tjmax
- Lead-Free, RoHS Compliant
- Automotive Qualified *




| | | |
|---|---|---|
| $V_{DSS}$ | | 60V |
| $R_{DS(on)}$ | typ. | 12.6mΩ |
| | max. | 15.8mΩ |
| $I_D$ | | 43A |




D-Pak
AUIRFR3806

**Description**

Specifically designed for Automotive applications, this HEXFET® Power MOSFET utilizes the latest processing techniques to achieve extremely low on-resistance per silicon area. Additional features of this design are a 175°C junction operating temperature, fast switching speed and improved repetitive avalanche rating . These features combine to make this design an extremely efficient and reliable device for use in Automotive applications and a wide variety of other applications.

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

| Base part number | Package Type | Standard Pack | | Orderable Part Number |
|---|---|---|---|---|
| | | Form | Quantity | |
| AUIRFR3806 | D-Pak | Tube | 75 | AUIRFR3806 |
| | | Tape and Reel Left | 3000 | AUIRFR3806TRL |

**Absolute Maximum Ratings**

Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only; and functional operation of the device at these or any other condition beyond those indicated in the specifications is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability. The thermal resistance and power dissipation ratings are measured under board mounted and still air conditions. Ambient temperature (TA) is 25°C, unless otherwise specified.

| Symbol | Parameter | Max. | Units |
|---|---|---|---|
| $I_D$ @ $T_C$ = 25°C | Continuous Drain Current, $V_{GS}$ @ 10V | 43 | A |
| $I_D$ @ $T_C$ = 100°C | Continuous Drain Current, $V_{GS}$ @ 10V | 31 | |
| $I_{DM}$ | Pulsed Drain Current ① | 170 | |
| $P_D$ @$T_C$ = 25°C | Maximum Power Dissipation | 71 | W |
| | Linear Derating Factor | 0.47 | W/°C |
| $V_{GS}$ | Gate-to-Source Voltage | ± 20 | V |
| $E_{AS}$ | Single Pulse Avalanche Energy (Thermally Limited) ② | 73 | mJ |
| $I_{AR}$ | Avalanche Current ① | 25 | A |
| $E_{AR}$ | Repetitive Avalanche Energy ① | 7.1 | mJ |
| dv/dt | Pead Diode Recovery dv/dt③ | 24 | V/ns |
| $T_J$<br>$T_{STG}$ | Operating Junction and<br>Storage Temperature Range | -55 to + 175 | °C |
| | Soldering Temperature, for 10 seconds (1.6mm from case) | 300 | |

**Thermal Resistance**

| Symbol | Parameter | Typ. | Max. | Units |
|---|---|---|---|---|
| $R_{\theta JC}$ | Junction-to-Case ⑧ | —— | 2.12 | °C/W |
| $R_{\theta JA}$ | Junction-to-Ambient ( PCB Mount) ⑦ | —— | 50 | |
| $R_{\theta JA}$ | Junction-to-Ambient ⑦ | —— | 110 | |

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*Qualification standards can be found at www.infineon.com

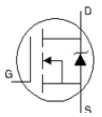
**Static @ $T_J$ = 25°C (unless otherwise specified)**

| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| $V_{(BR)DSS}$ | Drain-to-Source Breakdown Voltage | 60 | — | — | V | $V_{GS}$ = 0V, $I_D$ = 250µA |
| $\Delta V_{(BR)DSS}/\Delta T_J$ | Breakdown Voltage Temp. Coefficient | — | 0.075 | — | V/°C | Reference to 25°C, $I_D$ = 5mA ① |
| $R_{DS(on)}$ | Static Drain-to-Source On-Resistance | — | 12.6 | 15.8 | mΩ | $V_{GS}$ = 10V, $I_D$ = 25A ④ |
| $V_{GS(th)}$ | Gate Threshold Voltage | 2.0 | — | 4.0 | V | $V_{DS}$ = $V_{GS}$, $I_D$ = 50µA |
| gfs | Forward Trans conductance | 41 | — | — | S | $V_{DS}$ = 10V, $I_D$ = 25A |
| $R_{G(Int)}$ | Internal Gate Resistance | — | 0.79 | — | Ω | |
| $I_{DSS}$ | Drain-to-Source Leakage Current | — | — | 20 | µA | $V_{DS}$ = 60V, $V_{GS}$ = 0V |
| | | — | — | 250 | | $V_{DS}$ = 48V,$V_{GS}$ = 0V,$T_J$ =125°C |
| $I_{GSS}$ | Gate-to-Source Forward Leakage | — | — | 100 | nA | $V_{GS}$ = 20V |
| | Gate-to-Source Reverse Leakage | — | — | -100 | | $V_{GS}$ = -20V |

**Dynamic Electrical Characteristics @ $T_J$ = 25°C (unless otherwise specified)**

| | | | | | | |
|---|---|---|---|---|---|---|
| $Q_g$ | Total Gate Charge | — | 22 | 30 | nC | $I_D$ = 25A |
| $Q_{gs}$ | Gate-to-Source Charge | — | 5.0 | — | | $V_{DS}$ = 30V |
| $Q_{gd}$ | Gate-to-Drain Charge | — | 6.3 | — | | $V_{GS}$ = 10V④ |
| $Q_{sync}$ | Total Gate Charge Sync. ($Q_g$ - $Q_{gd}$) | — | 28.3 | — | | |
| $t_{d(on)}$ | Turn-On Delay Time | — | 6.3 | — | ns | $V_{DD}$ = 39V |
| $t_r$ | Rise Time | — | 40 | — | | $I_D$ = 25A |
| $t_{d(off)}$ | Turn-Off Delay Time | — | 49 | — | | $R_G$ = 20Ω |
| $t_f$ | Fall Time | — | 47 | — | | $V_{GS}$ = 10V④ |
| $C_{iss}$ | Input Capacitance | — | 1150 | — | pF | $V_{GS}$ = 0V |
| $C_{oss}$ | Output Capacitance | — | 130 | — | | $V_{DS}$ = 50V |
| $C_{rss}$ | Reverse Transfer Capacitance | — | 67 | — | | $f$ = 1.0MHz |
| $C_{oss\ eff.}$ (ER) | Effective Output Capacitance (Energy Related) | — | 190 | — | | $V_{GS}$ = 0V, $V_{DS}$ = 0V to 48V ⑥ |
| $C_{oss\ eff.}$ (TR) | Effective Output Capacitance (Time Related) | — | 230 | — | | $V_{GS}$ = 0V, $V_{DS}$ = 0V to 48V ⑤ |

**Diode Characteristics**

| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| $I_S$ | Continuous Source Current (Body Diode) | — | — | 43 | A | MOSFET symbol showing the integral reverse p-n junction diode.  |
| $I_{SM}$ | Pulsed Source Current (Body Diode) ① | — | — | 170 | | |
| $V_{SD}$ | Diode Forward Voltage | — | — | 1.3 | V | $T_J$ = 25°C,$I_S$ = 25A,$V_{GS}$ = 0V ④ |
| $t_{rr}$ | Reverse Recovery Time | — | 22 | 33 | ns | $T_J$ = 25°C |
| | | — | 26 | 39 | | $T_J$ = 125°C $V_R$ = 51V, |
| $Q_{rr}$ | Reverse Recovery Charge | — | 17 | 26 | nC | $T_J$ = 25°C $I_F$ = 25A |
| | | — | 24 | 36 | | $T_J$ = 125°C di/dt = 100A/µs ④ |
| | | — | 1.4 | — | A | $T_J$ = 25°C |
| $t_{on}$ | Forward Turn-On Time | Intrinsic turn-on time is negligible (turn-on is dominated by $L_S$+$L_D$) | | | | |

**Notes:**

① Repetitive rating; pulse width limited by max. junction temperature.

② Limited by $T_{Jmax}$, starting $T_J$ = 25°C, L = 0.23mH, $R_G$ = 25Ω, $I_{AS}$ = 25A, $V_{GS}$ =10V. Part not recommended for use above this value.

③ $I_{SD}$ ≤ 25A, di/dt ≤ 1580A/µs, $V_{DD}$ ≤ $V_{(BR)DSS}$, $T_J$ ≤ 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 When mounted on 1" square PCB (FR-4 or G-10 Material). For recommended footprint and soldering techniques refer to application note #AN-994

⑧ $R_\theta$ is measured at $T_J$ approximately 90°C.

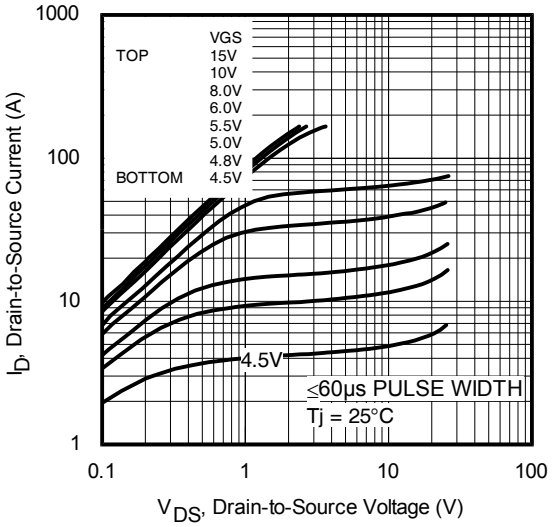



**Fig. 1** Typical Output Characteristics

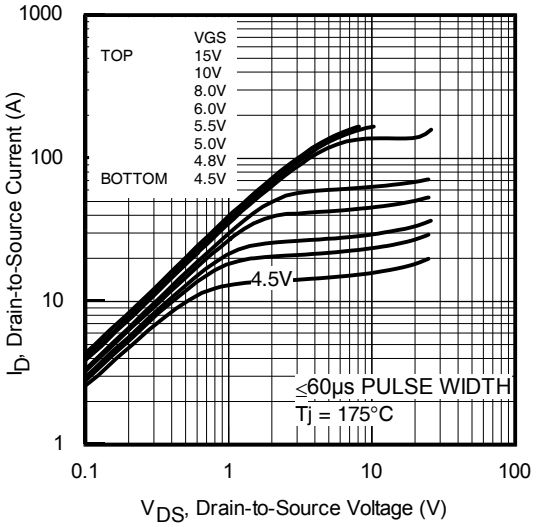



**Fig. 2** Typical Output Characteristics

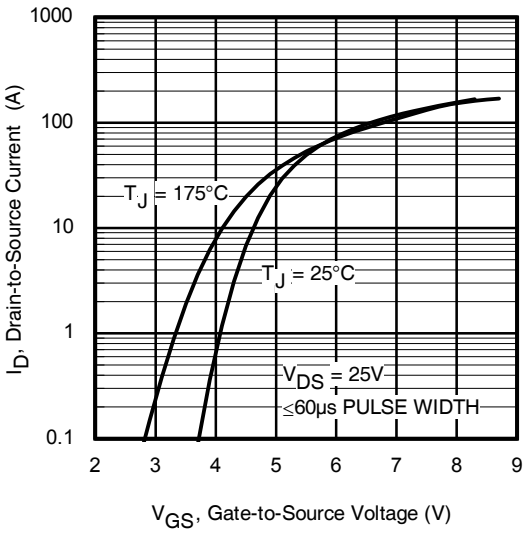



**Fig. 3** Typical Transfer Characteristics

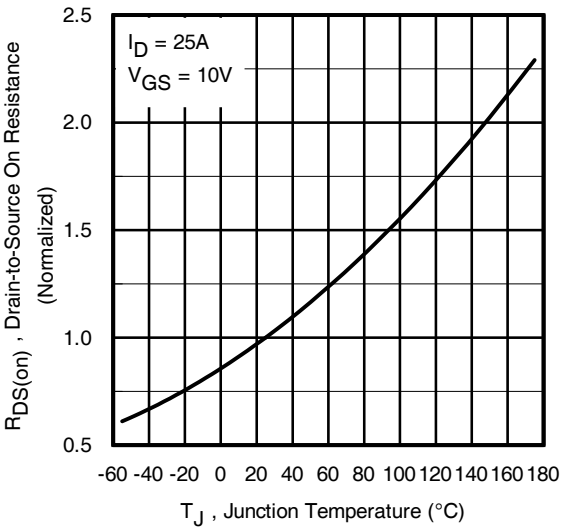



**Fig. 4** Normalized On-Resistance vs. Temperature

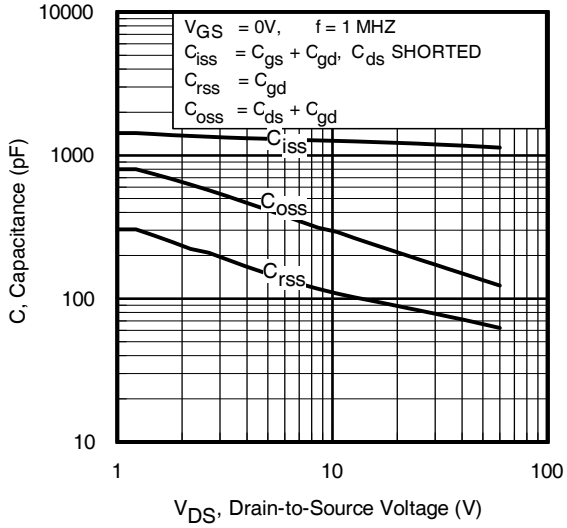



**Fig 5.** Typical Capacitance vs. Drain-to-Source Voltage

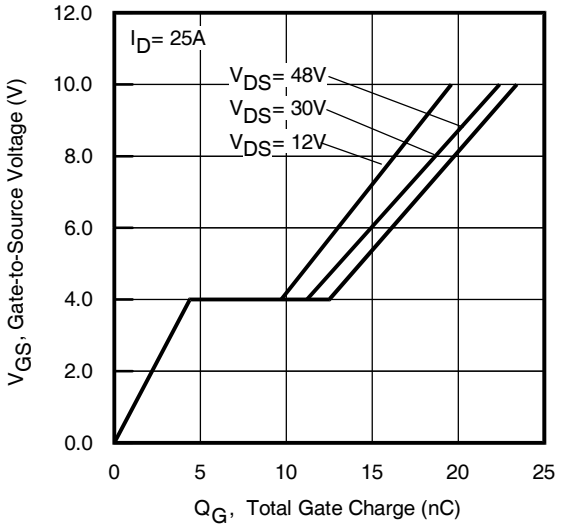



**Fig 6.** Typical Gate Charge vs. Gate-to-Source Voltage

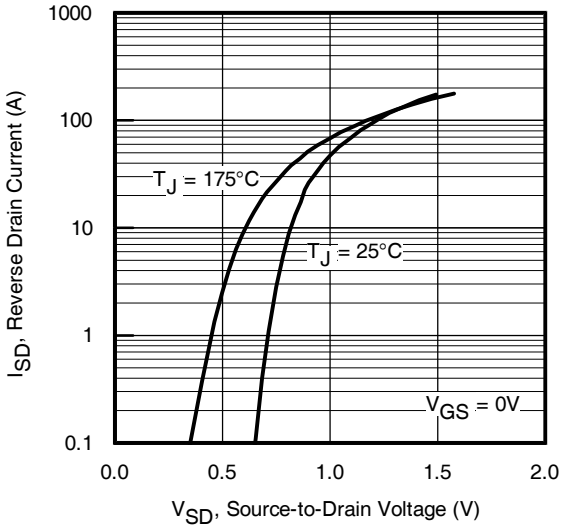



**Fig. 7** Typical Source-to-Drain Diode Forward Voltage

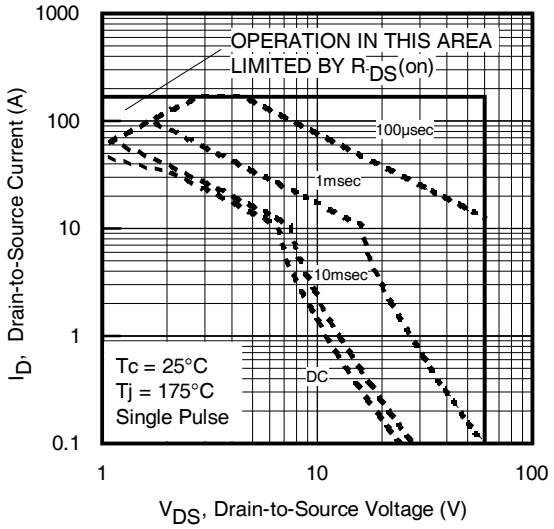



**Fig 8.** Maximum Safe Operating Area

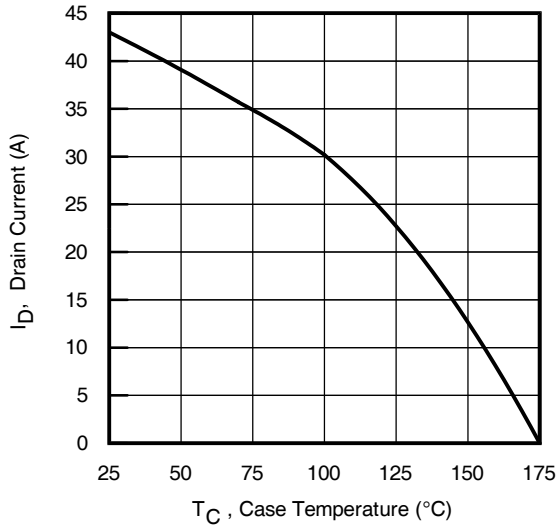



**Fig. 9** Maximum Drain Current vs. Case Temperature

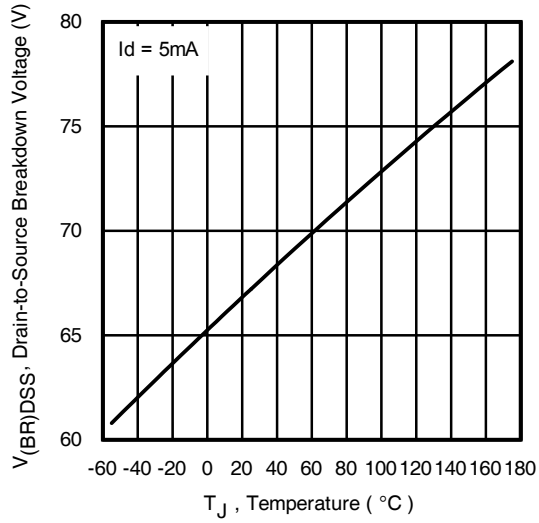



**Fig 10.** Drain-to-Source Breakdown Voltage

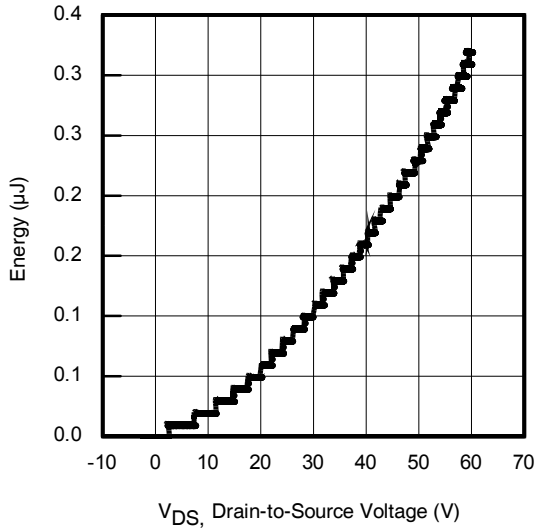



**Fig. 11** Typical Coss Stored Energy

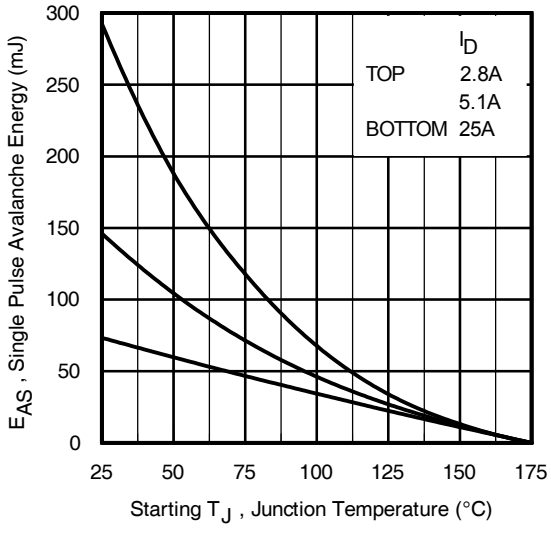



**Fig 12.** Maximum Avalanche Energy vs. Drain Current

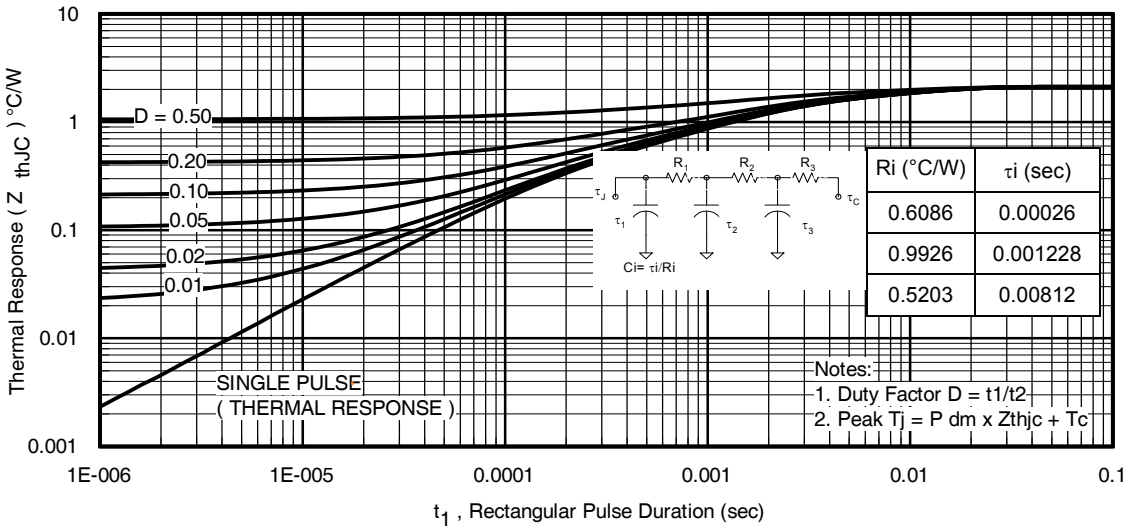



**Fig 13.** Maximum Effective Transient Thermal Impedance, Junction-to-Case

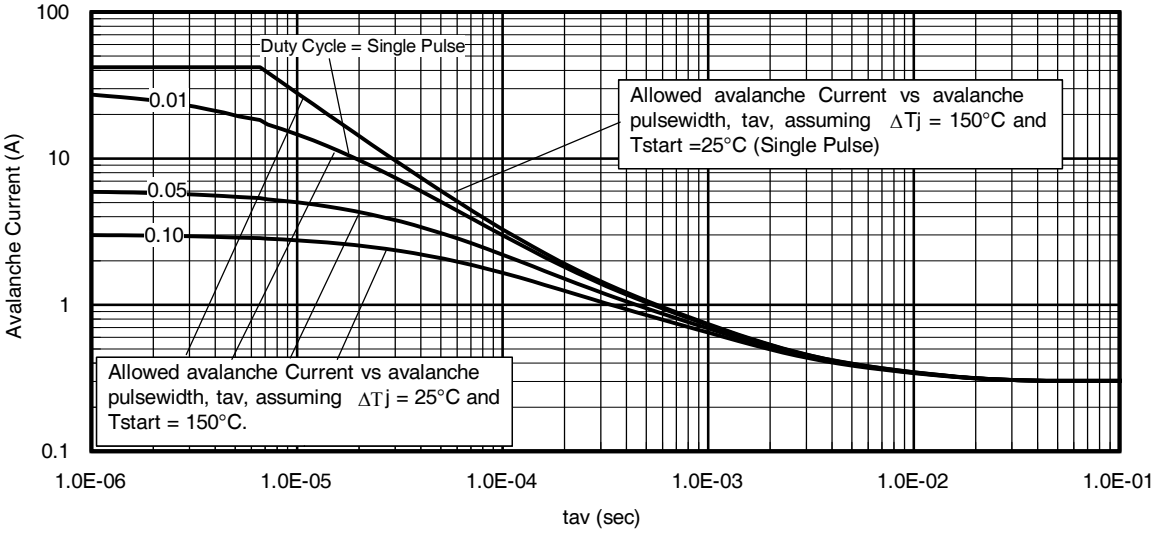



**Fig 14.** Typical Avalanche Current Vs. Pulse width

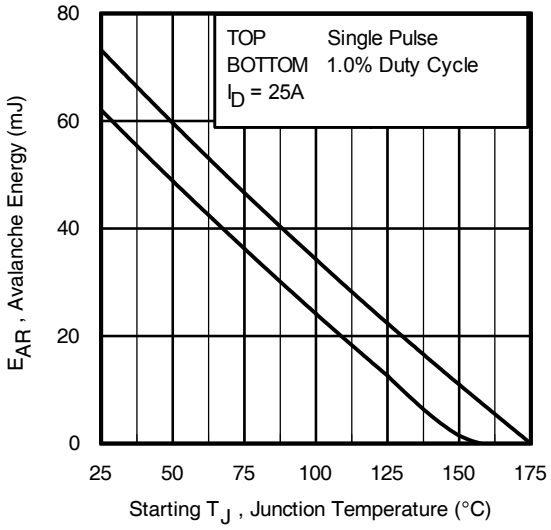



**Fig 15.** Maximum Avalanche Energy Vs. Temperature

**Notes on Repetitive Avalanche Curves , Figures 14, 15:**
**(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 22a, 22b.
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. $\Delta T$ = Allowable rise in junction temperature, not to exceed $T_{jmax}$ (assumed as 25°C in Figure 13, 14).
   $t_{av}$ = Average time in avalanche.
   D = Duty cycle in avalanche = $t_{av} \cdot f$
   $Z_{thJC}(D, t_{av})$ = Transient thermal resistance, see Figures 13)

$$P_{D\ (ave)} = 1/2\ (\ 1.3 \cdot BV \cdot I_{av}) = \Delta T / Z_{thJC}$$
$$I_{av} = 2\Delta T / [1.3 \cdot BV \cdot Z_{th}]$$
$$E_{AS\ (AR)} = P_{D\ (ave)} \cdot t_{av}$$

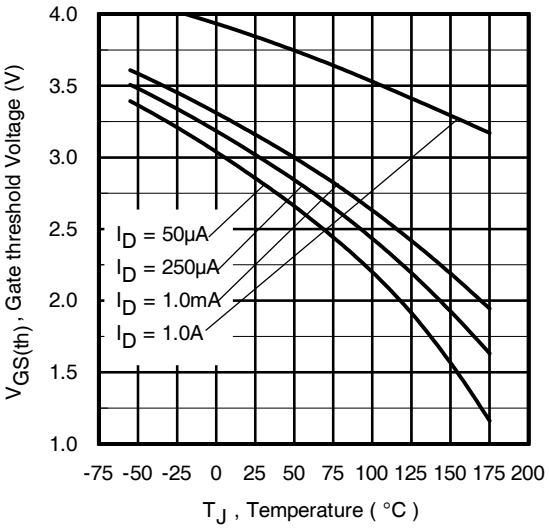



**Fig 16.** Threshold Voltage vs. Temperature

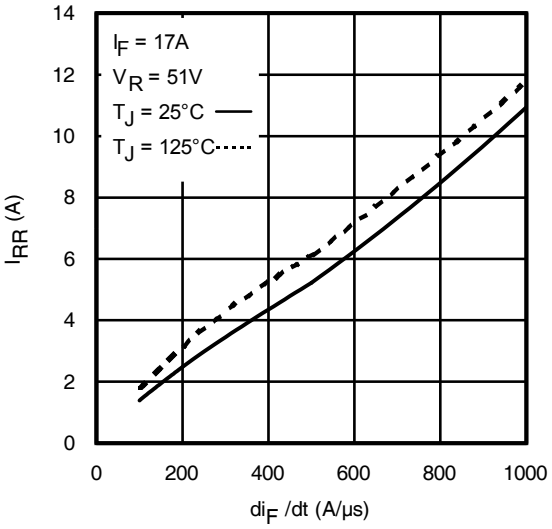



**Fig. 17** - Typical Recovery Current vs. dif/dt

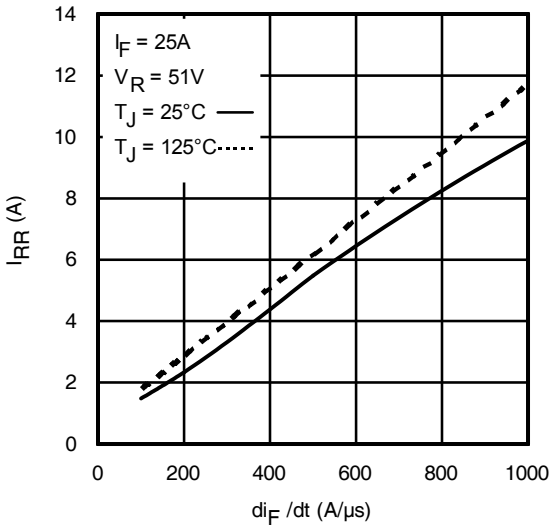



**Fig. 18** - Typical Recovery Current vs. dif/dt

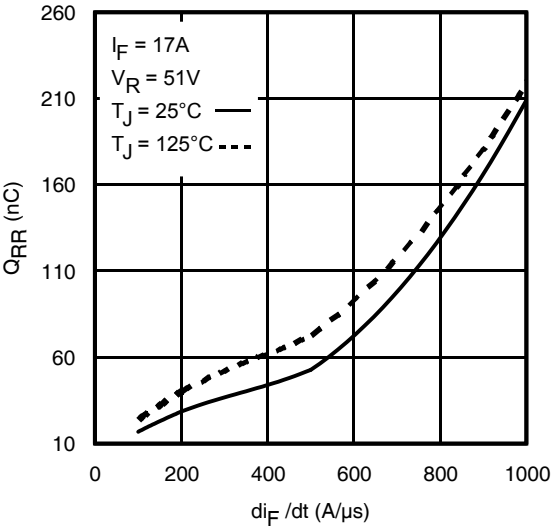



**Fig. 19** - Typical Stored Charge vs. dif/dt

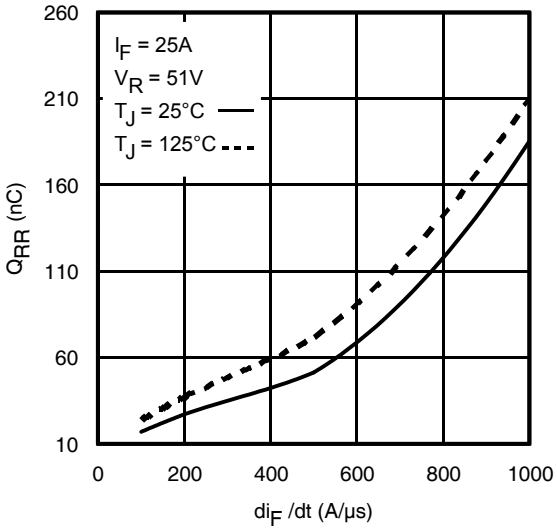



**Fig. 20** - Typical Stored Charge vs. dif/dt

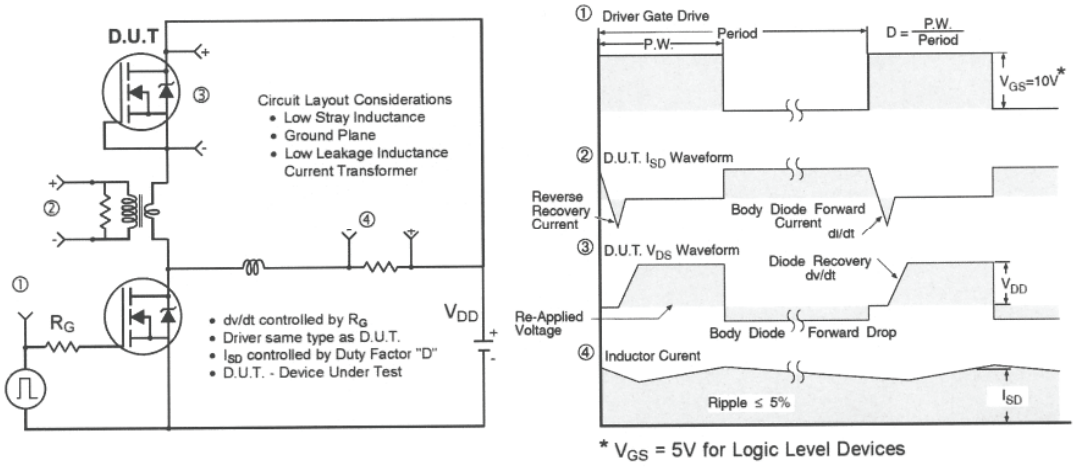



**Fig 20.** Peak Diode Recovery dv/dt Test Circuit for N-Channel HEXFET® Power MOSFETs

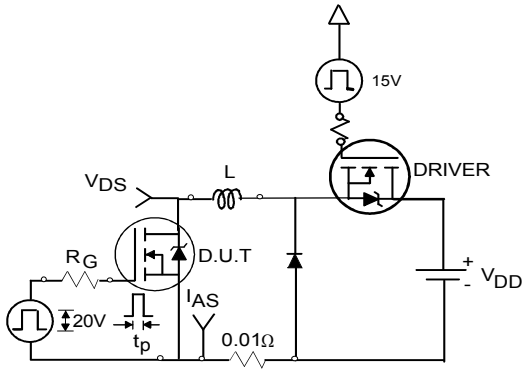



**Fig 21a.** Unclamped Inductive Test Circuit

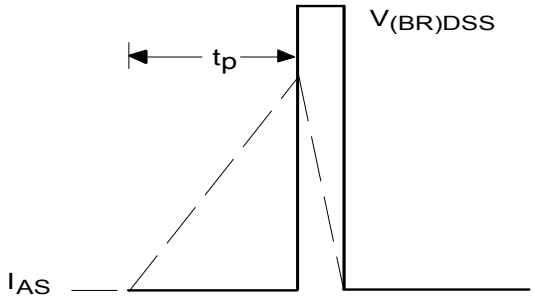



**Fig 21b.** Unclamped Inductive Waveforms

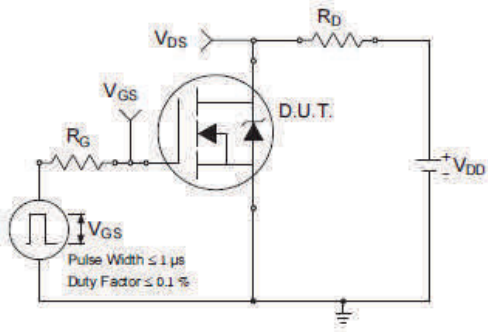



**Fig 22a.** Switching Time Test Circuit

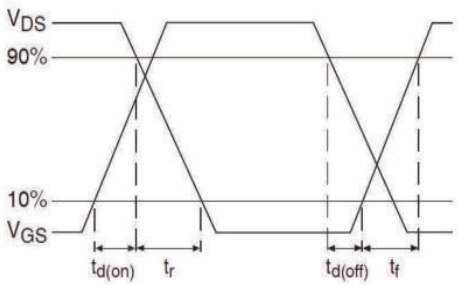



**Fig 22b.** Switching Time Waveforms

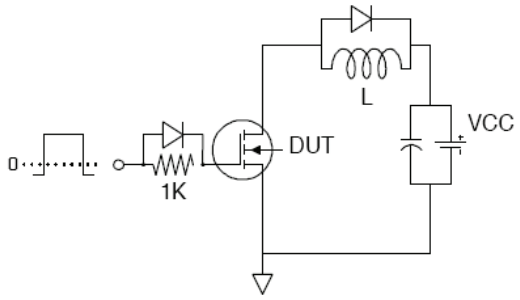



**Fig 23a.** Gate Charge Test Circuit

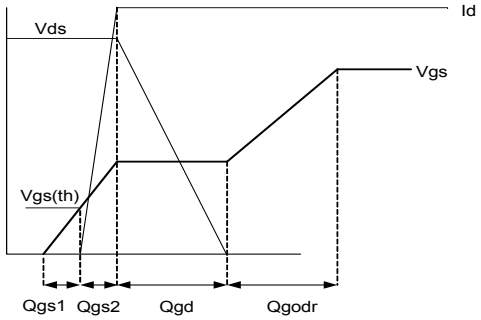
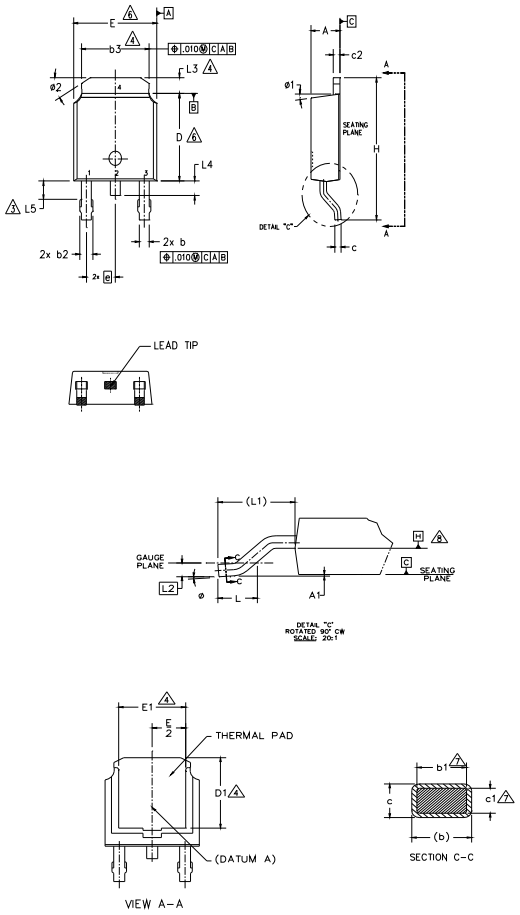



**Fig 23b.** Gate Charge Waveform

## D-Pak (TO-252AA) Package Outline (Dimensions are shown in millimeters (inches))




NOTES:

1.– DIMENSIONING AND TOLERANCING PER ASME Y14.5M–1994

2.– DIMENSION ARE SHOWN IN INCHES [MILLIMETERS].

3.– LEAD DIMENSION UNCONTROLLED IN L5.

4.– DIMENSION D1, E1, L3 & b3 ESTABLISH A MINIMUM MOUNTING SURFACE FOR THERMAL PAD.

5.– SECTION C–C DIMENSIONS APPLY TO THE FLAT SECTION OF THE LEAD BETWEEN .005 AND 0.10 [0.13 AND 0.25] FROM THE LEAD TIP.

6.– DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED .005 [0.13] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY.

7.– DIMENSION b1 & c1 APPLIED TO BASE METAL ONLY.

8.– DATUM A & B TO BE DETERMINED AT DATUM PLANE H.

9.– OUTLINE CONFORMS TO JEDEC OUTLINE TO–252AA.

| SYMBOL | DIMENSIONS | | | | NOTES |
|---|---|---|---|---|---|
| | MILLIMETERS | | INCHES | | |
| | MIN. | MAX. | MIN. | MAX. | |
| A | 2.18 | 2.39 | .086 | .094 | |
| A1 | – | 0.13 | – | .005 | |
| b | 0.64 | 0.89 | .025 | .035 | |
| b1 | 0.65 | 0.79 | .025 | .031 | 7 |
| b2 | 0.76 | 1.14 | .030 | .045 | |
| b3 | 4.95 | 5.46 | .195 | .215 | 4 |
| c | 0.46 | 0.61 | .018 | .024 | |
| c1 | 0.41 | 0.56 | .016 | .022 | 7 |
| c2 | 0.46 | 0.89 | .018 | .035 | |
| D | 5.97 | 6.22 | .235 | .245 | 6 |
| D1 | 5.21 | – | .205 | – | 4 |
| E | 6.35 | 6.73 | .250 | .265 | 6 |
| E1 | 4.32 | – | .170 | – | 4 |
| e | 2.29 BSC | | .090 BSC | | |
| H | 9.40 | 10.41 | .370 | .410 | |
| L | 1.40 | 1.78 | .055 | .070 | |
| L1 | 2.74 BSC | | .108 REF. | | |
| L2 | 0.51 BSC | | .020 BSC | | |
| L3 | 0.89 | 1.27 | .035 | .050 | 4 |
| L4 | – | 1.02 | – | .040 | |
| L5 | 1.14 | 1.52 | .045 | .060 | 3 |
| ø | 0° | 10° | 0° | 10° | |
| ø1 | 0° | 15° | 0° | 15° | |
| ø2 | 25° | 35° | 25° | 35° | |

LEAD ASSIGNMENTS

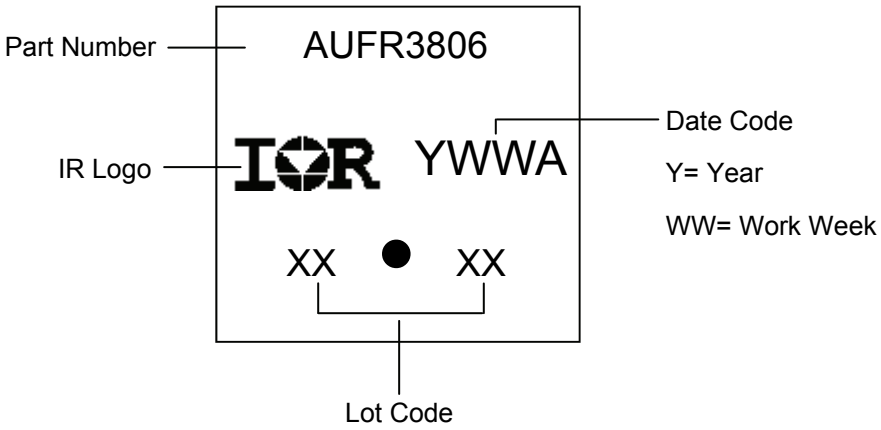
HEXFET

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

IGBT & CoPAK

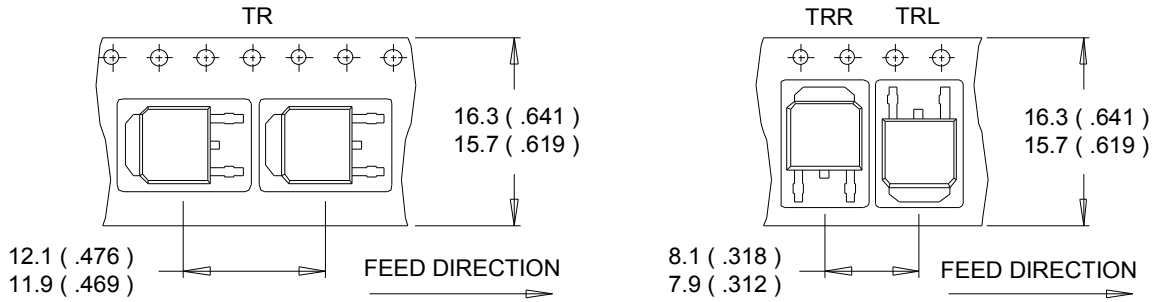
1.– GATE
2.– COLLECTOR
3.– EMITTER
4.– COLLECTOR

## D-Pak (TO-252AA) Part Marking Information

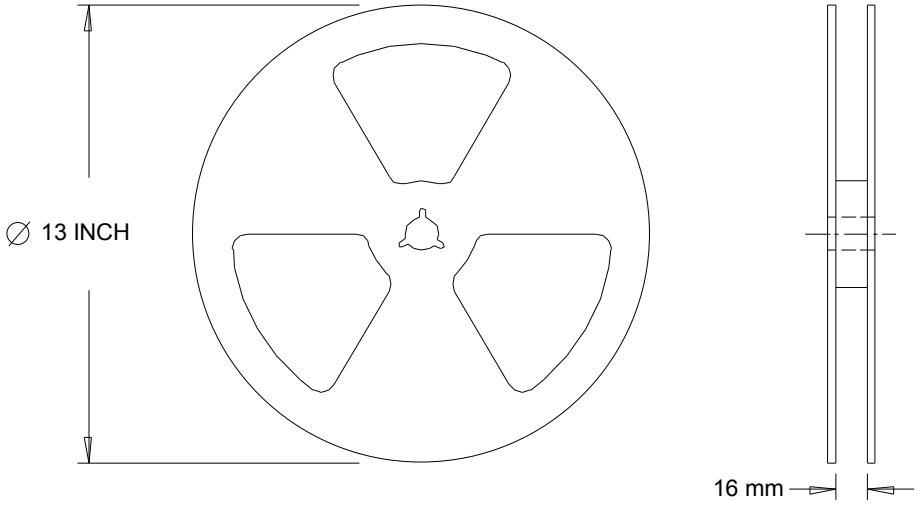



Note: For the most current drawing please refer to IR website at http://www.irf.com/package/

**D-Pak (TO-252AA) Tape & Reel Information** (Dimensions are shown in millimeters (inches))




NOTES :
1. CONTROLLING DIMENSION : MILLIMETER.
2. ALL DIMENSIONS ARE SHOWN IN MILLIMETERS ( INCHES ).
3. OUTLINE CONFORMS TO EIA-481 & EIA-541.




NOTES :
1. OUTLINE CONFORMS TO EIA-481.

Note: For the most current drawing please refer to IR website at http://www.irf.com/package/

**Qualification Information**

| | | | |
|---|---|---|---|
| **Qualification Level** | | Automotive (per AEC-Q101) | |
| | | Comments: This part number(s) passed Automotive qualification. Infineon's Industrial and Consumer qualification level is granted by extension of the higher Automotive level. | |
| **Moisture Sensitivity Level** | | D-Pak | MSL1 |
| **ESD** | Machine Model | Class M3 (+/- 250V)† AEC-Q101-002 | |
| | Human Body Model | Class H1A (+/- 500V)† AEC-Q101-001 | |
| | Charged Device Model | Class C5 (+/- 2000V)† AEC-Q101-005 | |
| **RoHS Compliant** | | Yes | |

† Highest passing voltage.

**Revision History**

| Date | Comments |
|---|---|
| 11/23/2015 | • Updated datasheet with corporate template<br>• Corrected ordering table on page 1.<br>• Corrected typo on test condition Coss eff. $V_{DS}$ from "60V" to "48V" on page 2.<br>• Updated typo on the fig.19 and fig.20, unit of y-axis from "A" to "nC" on page 6.<br>• Corrected typo from Rthcs to RthJA (PCB Mount) on page 1.<br>• Corrected typo RthJA from "62C/W" to "110C/W" on page 1. |

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