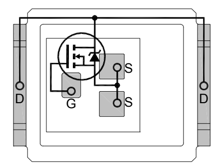
Automotive DirectFET® Power MOSFET ②

- Advanced Process Technology
- Optimized for Class D Audio Amplifier Applications
- Low Rds(on) for Improved Efficiency
- Low Qg for Better THD and Improved Efficiency
- Low Qrr for Better THD and Lower EMI
- Low Parasitic Inductance for Reduced Ringing and Lower EMI
- Delivers up to 250W per Channel into 4Ω with No Heat sink
- Dual Sided Cooling
- 175°C Operating Temperature
- Repetitive Avalanche Capability for Robustness and Reliability
- Lead free, RoHS and Halogen free
- Automotive Qualified *

| | | |
|---|---|---|
| $V_{(BR)DSS}$ | | **150V** |
| $R_{DS(on)}$ | typ. | **47mΩ** |
| | max. | **56mΩ** |
| $R_g$ (typical) | | **1.2Ω** |
| $Q_g$ (typical) | | **21nC** |




M2

DirectFET® ISOMETRIC

Applicable DirectFET® Outline and Substrate Outline ①

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| SB | SC | | | M2 | M4 | | L4 | L6 | L8 | |

## Description

The AUIRF7675M2TR/TR1 combines the latest Automotive HEXFET® Power MOSFET Silicon technology with the advanced DirectFET packaging platform to produce a best in class part for Automotive Class D audio amplifier applications. The DirectFET package is compatible with existing layout geometries used in power applications, PCB assembly equipment and vapor phase, infra-red or convection soldering techniques, when application note AN-1035 is followed regarding the manufacturing methods and processes. The DirectFET package allows dual sided cooling to maximize thermal transfer in automotive power systems.

This HEXFET Power MOSFET optimizes gate charge, body diode reverse recovery and internal gate resistance to improve key Class D audio amplifier performance factors such as efficiency, THD and EMI. Moreover the DirectFET packaging platform offers low parasitic inductance and resistance when compared to conventional wire bonded SOIC packages which improves EMI performance by reducing the voltage ringing that accompanies current transients.

These features combine to make this MOSFET a highly desirable component in Automotive Class D audio amplifier systems.

| Base Part Number | Package Type | Standard Pack | | Orderable Part Number |
|---|---|---|---|---|
| | | Form | Quantity | |
| AUIRF7675M2 | DirectFET Medium Can | Tape and Reel | 4800 | AUIRF7675M2TR |

## 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.

| | Parameter | Max. | Units |
|---|---|---|---|
| $V_{DS}$ | Drain-to-Source Voltage | 150 | V |
| $V_{GS}$ | Gate-to-Source Voltage | ±20 | |
| $I_D$ @ $T_C$ = 25°C | Continuous Drain Current, $V_{GS}$ @ 10V (Silicon Limited) ④ | 18 | A |
| $I_D$ @ $T_C$ = 100°C | Continuous Drain Current, $V_{GS}$ @ 10V (Silicon Limited) ④ | 13 | |
| $I_D$ @ $T_A$ = 25°C | Continuous Drain Current, $V_{GS}$ @ 10V (Silicon Limited) ③ | 4.4 | |
| $I_D$ @ $T_C$ = 25°C | Continuous Drain Current, $V_{GS}$ @ 10V (Package Limited) | 90 | |
| $I_{DM}$ | Pulsed Drain Current ⑤ | 72 | |
| $P_D$ @$T_C$ = 25°C | Power Dissipation ④ | 45 | W |
| $P_D$ @$T_A$ = 25°C | Power Dissipation ③ | 2.7 | |
| $E_{AS}$ | Single Pulse Avalanche Energy (Thermally Limited) ⑥ | 59 | mJ |
| $E_{AS}$ (Tested) | Single Pulse Avalanche Energy ⑥ | 170 | |
| $I_{AR}$ | Avalanche Current ⑤ | See Fig. 16, 17, 18a, 18b | A |
| $E_{AR}$ | Repetitive Avalanche Energy ⑤ | | mJ |
| $T_P$ | Peak Soldering Temperature | 270 | °C |
| $T_J$<br>$T_{STG}$ | Operating Junction and<br>Storage Temperature Range | -55 to + 175 | |

HEXFET® is a registered trademark of Infineon.
*Qualification standards can be found at www.infineon.com

### Thermal Resistance

| Symbol | Parameter | Typ. | Max. | Units |
|---|---|---|---|---|
| $R_{\theta JA}$ | Junction-to-Ambient ③ | —— | 60 | °C/W |
| $R_{\theta JA}$ | Junction-to-Ambient ⑧ | 12.5 | —— | |
| $R_{\theta JA}$ | Junction-to-Ambient ⑨ | 20 | —— | |
| $R_{\theta J\text{-}Can}$ | Junction-to-Can ④⑩ | —— | 3.3 | |
| $R_{\theta J\text{-}PCB}$ | Junction-to-PCB Mounted | 1.4 | —— | |
| | Linear Derating Factor ④ | 0.3 | | W/°C |

### Static Electrical Characteristics @ $T_J$ = 25°C (unless otherwise specified)

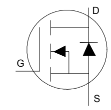
| Symbol | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| $V_{(BR)DSS}$ | Drain-to-Source Breakdown Voltage | 150 | —— | —— | V | $V_{GS}$ = 0V, $I_D$ = 250μA |
| $\Delta V_{(BR)DSS}/\Delta T_J$ | Breakdown Voltage Temp. Coefficient | —— | 0.16 | —— | V/°C | Reference to 25°C, $I_D$ = 1.0mA |
| $R_{DS(on)}$ | Static Drain-to-Source On-Resistance | —— | 47 | 56 | mΩ | $V_{GS}$ = 10V, $I_D$ = 11A ⑦ |
| $V_{GS(th)}$ | Gate Threshold Voltage | 3.0 | 4.0 | 5.0 | V | $V_{DS}$ = $V_{GS}$, $I_D$ = 100μA |
| $\Delta V_{GS(th)}/\Delta T_J$ | Gate Threshold Voltage Coefficient | —— | -11 | —— | mV/°C | |
| gfs | Forward Transconductance | 16 | —— | —— | S | $V_{DS}$ = 50V, $I_D$ = 11A |
| $R_G$ | Internal Gate Resistance | —— | 1.2 | 5.0 | Ω | |
| $I_{DSS}$ | Drain-to-Source Leakage Current | —— | —— | 20 | μA | $V_{DS}$ = 150V, $V_{GS}$ = 0V |
| | | —— | —— | 250 | | $V_{DS}$ = 150V, $V_{GS}$ = 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 |

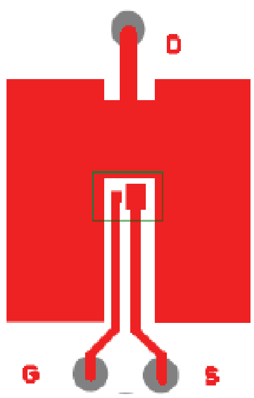
### Dynamic Electrical Characteristics @ $T_J$ = 25°C (unless otherwise specified)

| Symbol | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| $Q_g$ | Total Gate Charge | —— | 21 | 32 | nC | $V_{DS}$ = 75V |
| $Q_{gs1}$ | Gate-to-Source Charge | —— | 5.2 | —— | | $V_{GS}$ = 10V |
| $Q_{gs2}$ | Gate-to-Source Charge | —— | 1.6 | —— | | $I_D$ = 11A |
| $Q_{gd}$ | Gate-to-Drain ("Miller") Charge | —— | 7.1 | —— | | See Fig. 6 and 17 |
| $Q_{godr}$ | Gate Charge Overdrive | —— | 7.1 | —— | | |
| $Q_{sw}$ | Switch Charge ($Q_{gs2}$ + $Q_{gd}$) | —— | 8.7 | —— | | |
| $Q_{oss}$ | Output Charge | —— | 8.8 | —— | nC | $V_{DS}$ = 16V, $V_{GS}$ = 0V |
| $t_{d(on)}$ | Turn-On Delay Time | —— | 10 | —— | ns | $V_{DD}$ = 75V, $V_{GS}$ = 10V ⑦ |
| $t_r$ | Rise Time | —— | 13 | —— | | $I_D$ = 11A |
| $t_{d(off)}$ | Turn-Off Delay Time | —— | 14 | —— | | $R_G$ = 6.8Ω |
| $t_f$ | Fall Time | —— | 7.5 | —— | | |
| $C_{iss}$ | Input Capacitance | —— | 1360 | —— | pF | $V_{GS}$ = 0V |
| $C_{oss}$ | Output Capacitance | —— | 190 | —— | | $V_{DS}$ = 25V |
| $C_{rss}$ | Reverse Transfer Capacitance | —— | 41 | —— | | $f$ = 1.0 MHz |
| $C_{oss}$ | Output Capacitance | —— | 1210 | —— | | $V_{GS}$ = 0V, $V_{DS}$ = 1.0V, $f$ = 1.0 MHz |
| $C_{oss}$ | Output Capacitance | —— | 92 | —— | | $V_{GS}$ = 0V, $V_{DS}$ =120V, $f$ = 1.0MHz |

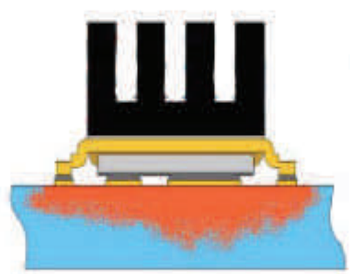
Notes ① through ⑩ are on page 3

**Diode Characteristics**

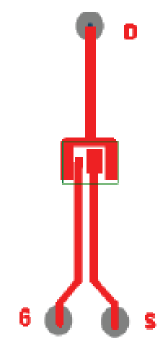
| Symbol | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| $I_S$ | Continuous Source Current (Body Diode) | — | — | 18 | A | MOSFET symbol showing the integral reverse p-n junction diode.  |
| $I_{SM}$ | Pulsed Source Current (Body Diode) ⑤ | — | — | 72 | | |
| $V_{SD}$ | Diode Forward Voltage | — | — | 1.3 | V | $T_J$ = 25°C, $I_S$ = 11A, $V_{GS}$ = 0V ⑦ |
| $t_{rr}$ | Reverse Recovery Time | — | 63 | 95 | ns | $T_J$ = 25°C, $I_F$ = 11A, $V_{DD}$ = 25V |
| $Q_{rr}$ | Reverse Recovery Charge | — | 180 | 270 | nC | dv/dt = 100A/μs ⑦ |




③ Surface mounted on 1 in. square Cu board (still air).



⑨ Mounted to a PCB with small clip heatsink (still air)




⑨ Mounted on minimum footprint full size board with metalized back and with small clip heatsink (still air).

① Click on this section to link to the appropriate technical paper.
② Click on this section to link to the DirectFET® Website.
③ Surface mounted on 1 in. square Cu board, steady state.
④ $T_C$ measured with thermocouple mounted to top (Drain) of part.
⑤ Repetitive rating; pulse width limited by max. junction temperature.
⑥ Starting $T_J$ = 25°C, L = 1.33mH, $R_G$ = 50Ω, $I_{AS}$ = 11A.
⑦ Pulse width ≤ 400μs; duty cycle ≤ 2%.
⑧ Used double sided cooling, mounting pad with large heatsink.
⑨ Mounted on minimum footprint full size board with metalized back and with small clip heat sink.
⑩ $R_\theta$ is measured at $T_J$ of approximately 90°C.

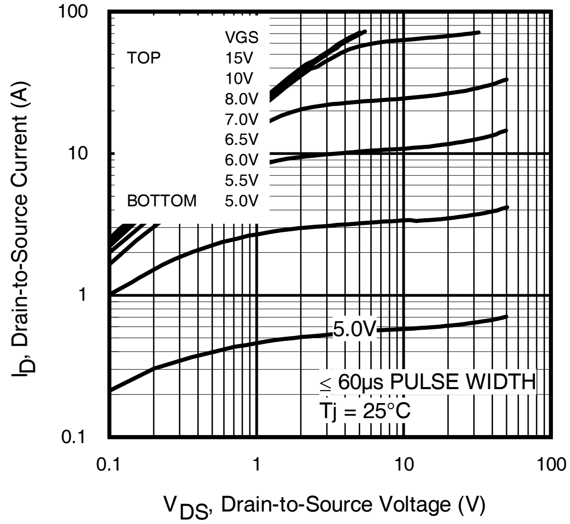



**Fig. 1** Typical Output Characteristics

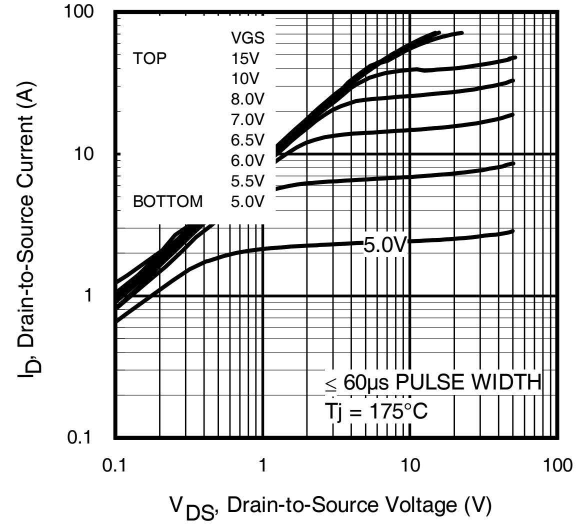



**Fig. 2** Typical Output Characteristics

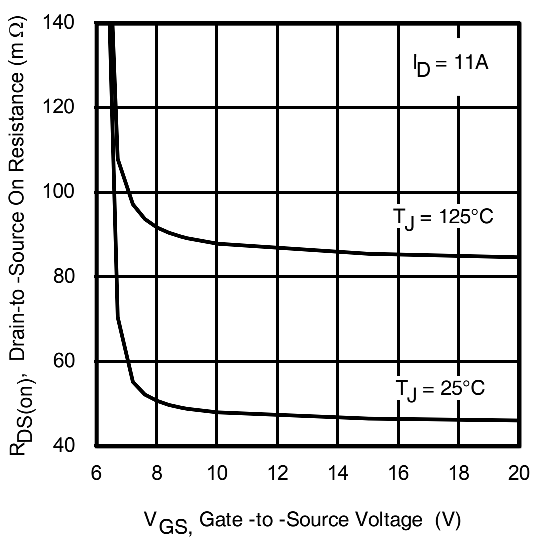



**Fig. 3** Typical On-Resistance vs. Gate Voltage

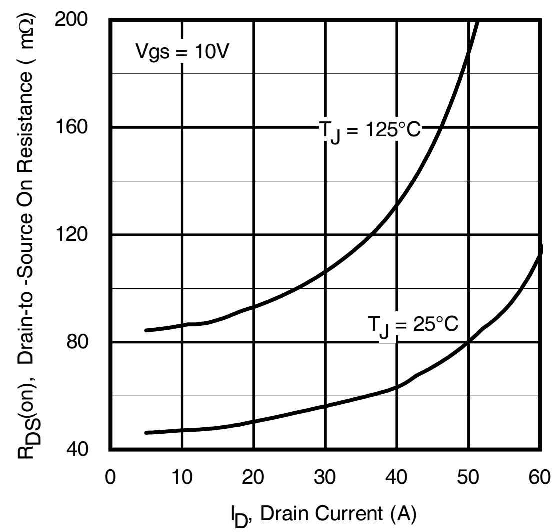



**Fig. 4** Typical On-Resistance vs. Drain Current

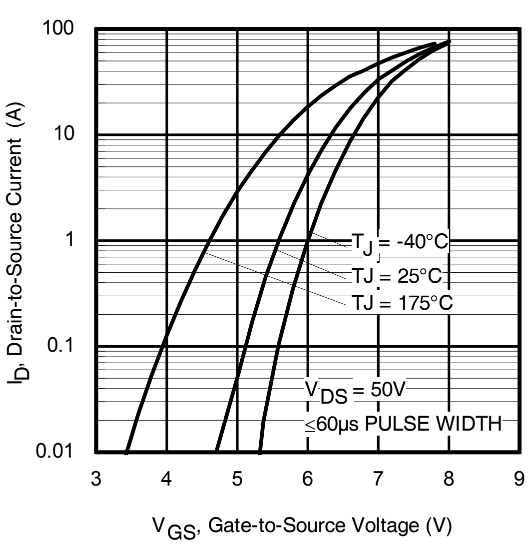



**Fig 5.** Transfer Characteristics

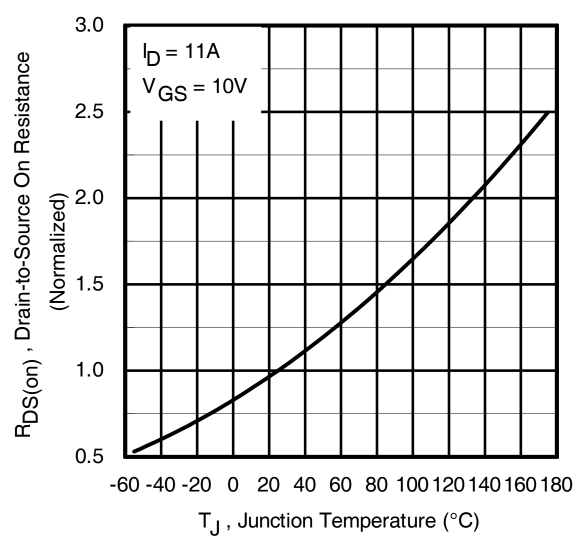



**Fig 6.** Normalized On-Resistance vs. Temperature

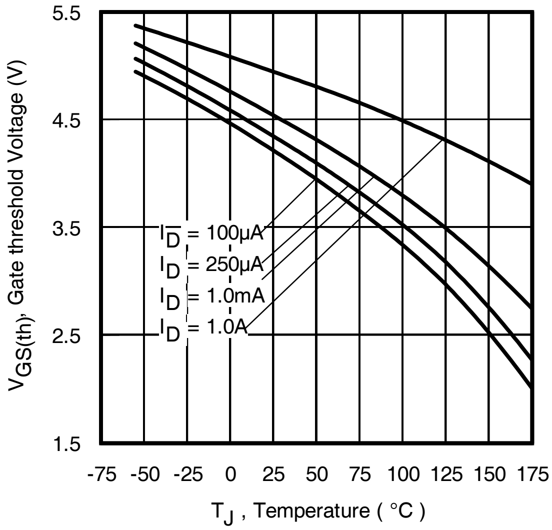



**Fig. 7** Typical Threshold Voltage vs. Junction Temperature

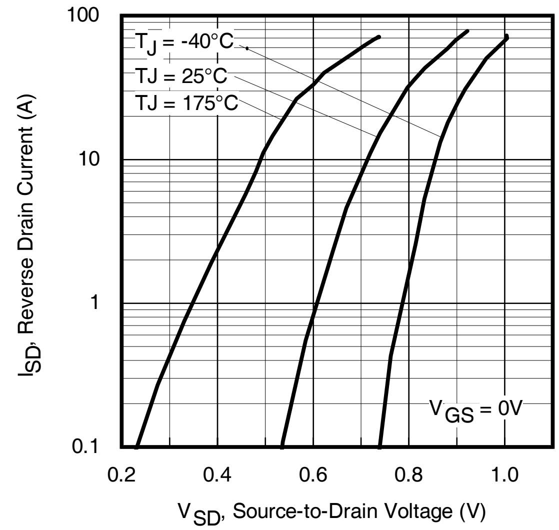



**Fig 8.** Typical Source-Drain Diode Forward Voltage

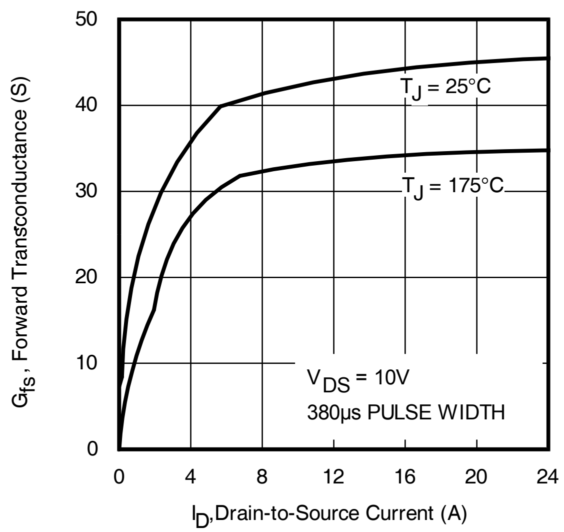



**Fig 9.** Typical Forward Trans conductance vs. Drain Current

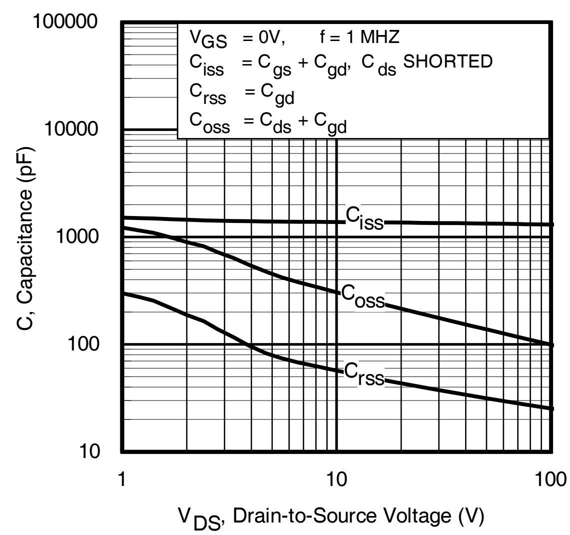



**Fig 10.** Typical Capacitance vs. Drain-to-Source Voltage

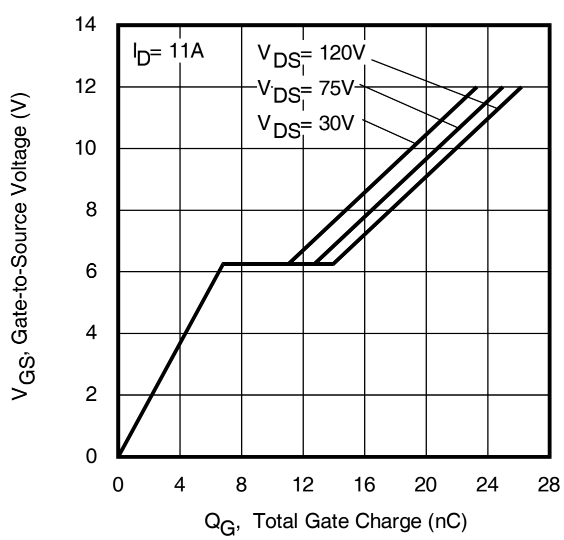



**Fig 11.** Typical Gate Charge vs. Gate-to-Source Voltage

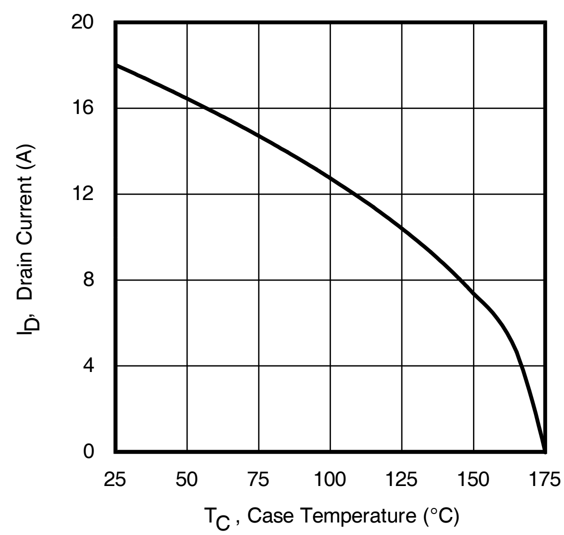



**Fig 12.** Maximum Drain Current vs. Case Temperature

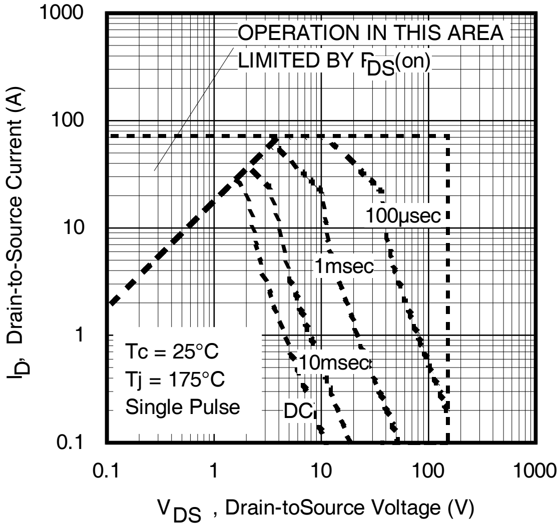



**Fig 13.** Maximum Safe Operating Area

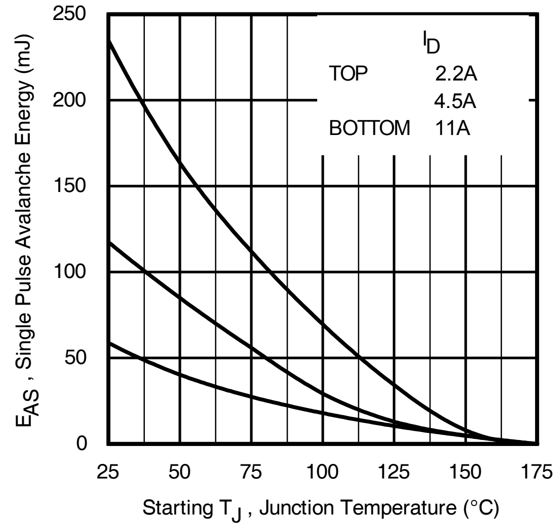
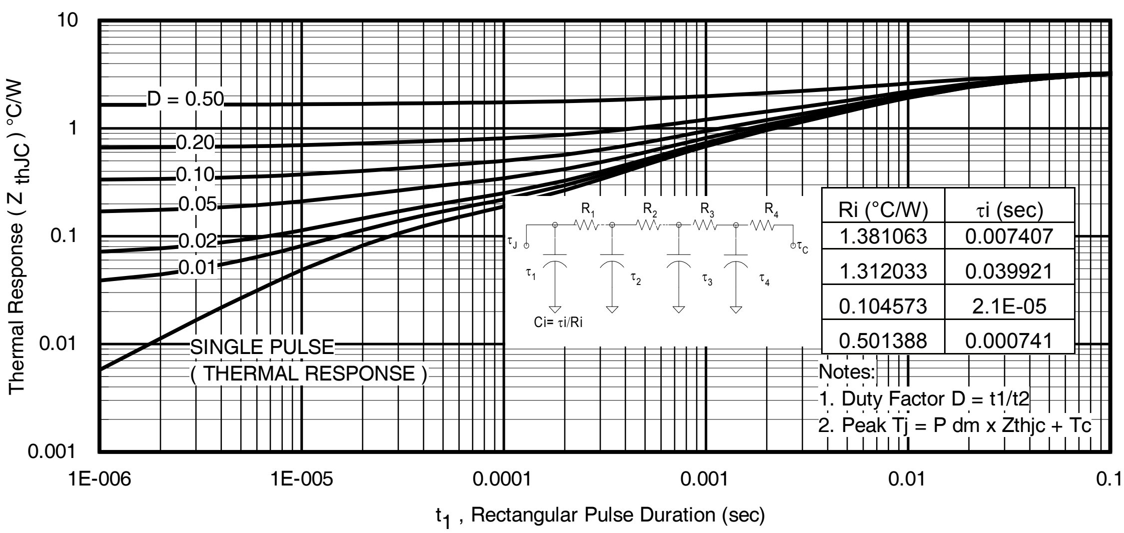



**Fig 14.** Maximum Avalanche Energy vs. Temperature




| Ri (°C/W) | τi (sec) |
|---|---|
| 1.381063 | 0.007407 |
| 1.312033 | 0.039921 |
| 0.104573 | 2.1E-05 |
| 0.501388 | 0.000741 |

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

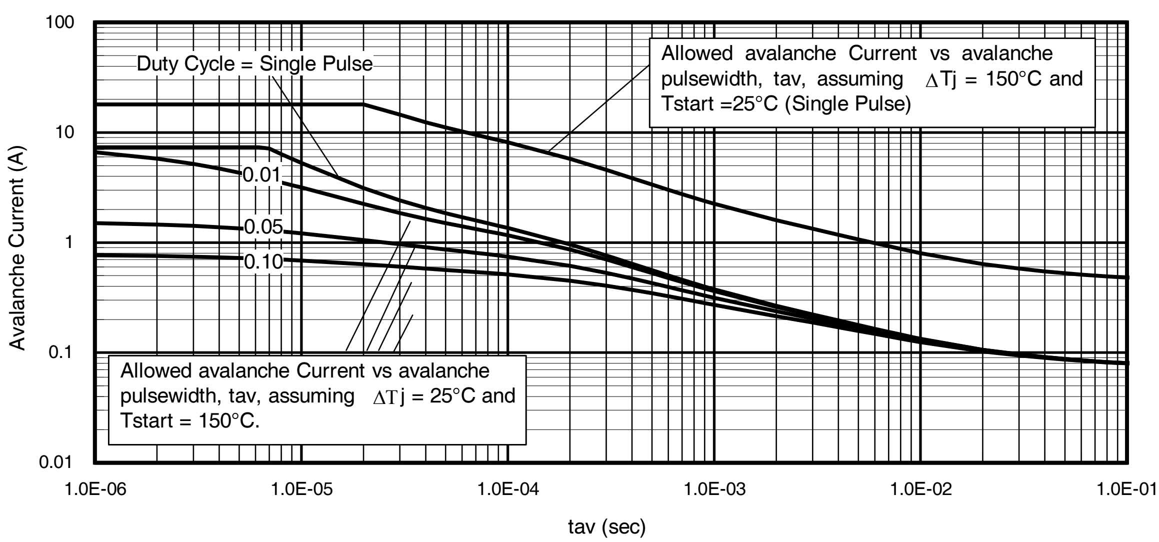



**Fig 16.** Typical Avalanche Current vs. Pulse Width

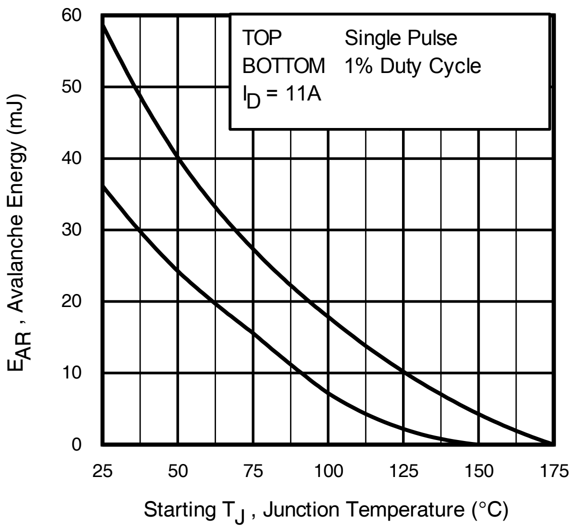



**Fig 17.** Maximum Avalanche Energy vs. Temperature

**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 18a, 18b.
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 16, 17).
   $t_{av}$ = Average time in avalanche.
   D = Duty cycle in avalanche = $t_{av} \cdot f$
   $Z_{thJC}(D, t_{av})$ = Transient thermal resistance, see Figures 15)

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

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

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

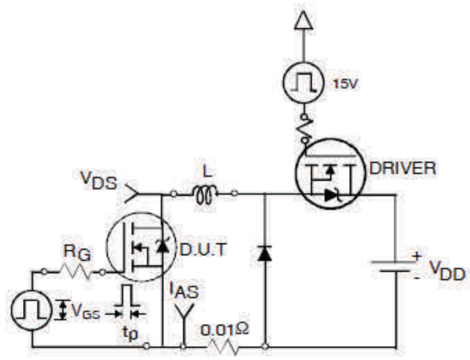



**Fig 18a.** Unclamped Inductive Test Circuit

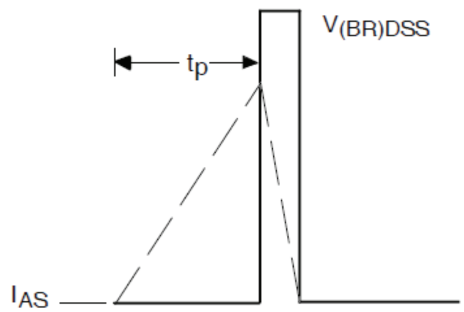



**Fig 18b.** Unclamped Inductive Waveforms

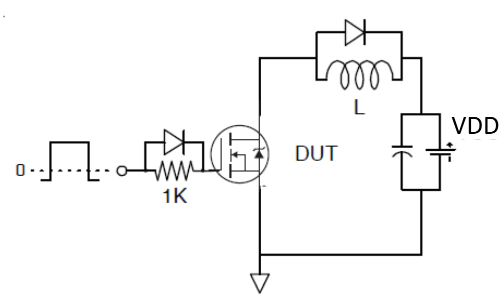



**Fig 19a.** Gate Charge Test Circuit

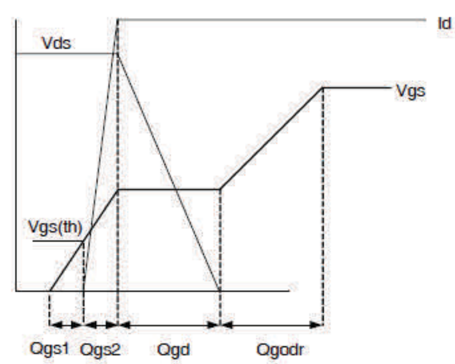



**Fig 19b.** Gate Charge Waveform

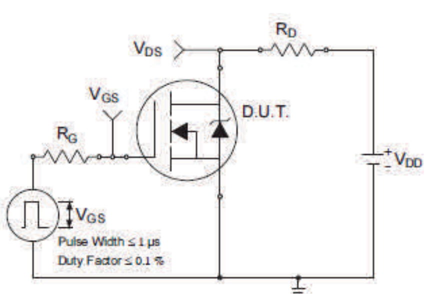



**Fig 20a.** Switching Time Test Circuit

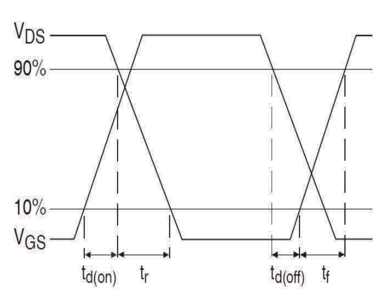
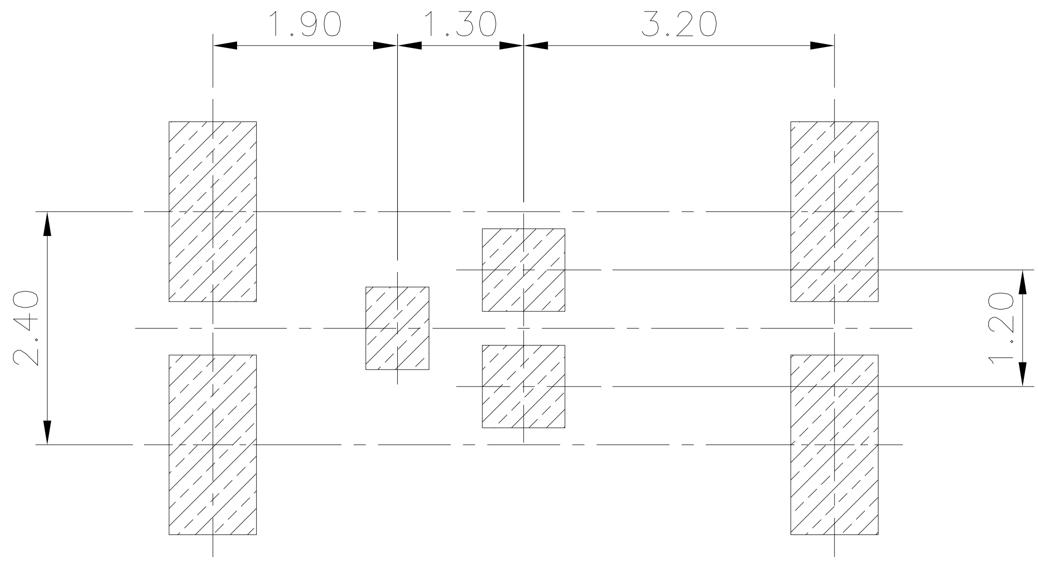
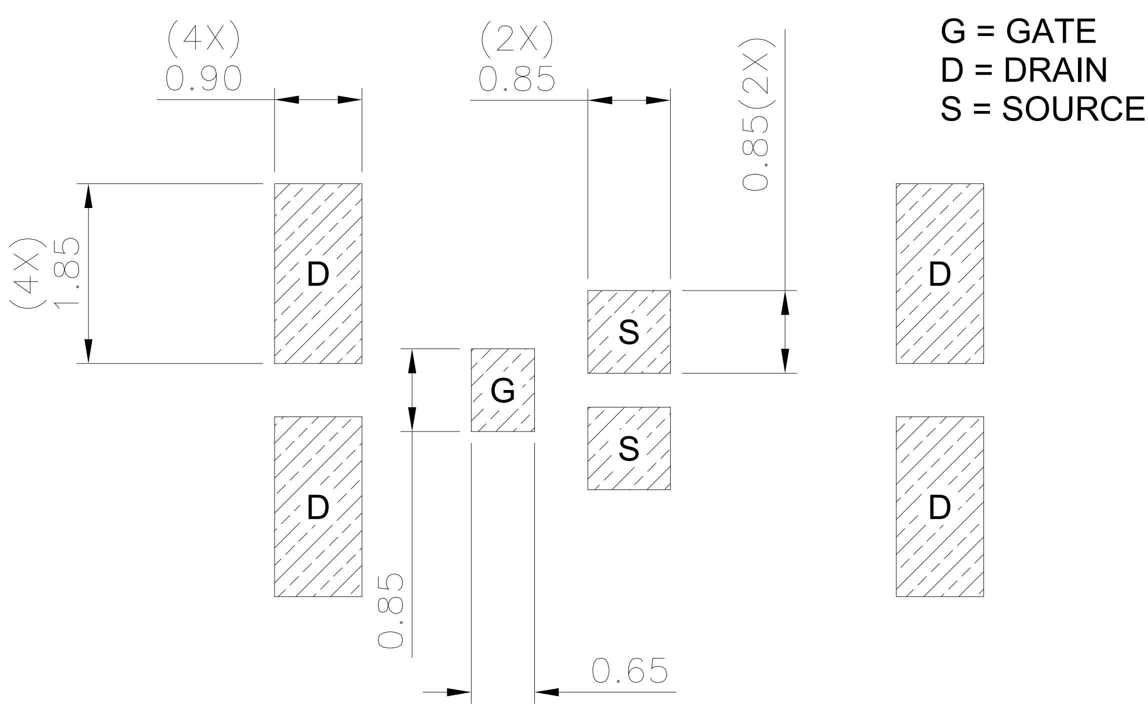



**Fig 20b.** Switching Time Waveforms

**DirectFET® Board Footprint, M2 (Medium Size Can).**
Please see DirectFET® application note AN-1035 for all details regarding the assembly of DirectFET®.
This includes all recommendations for stencil and substrate designs.

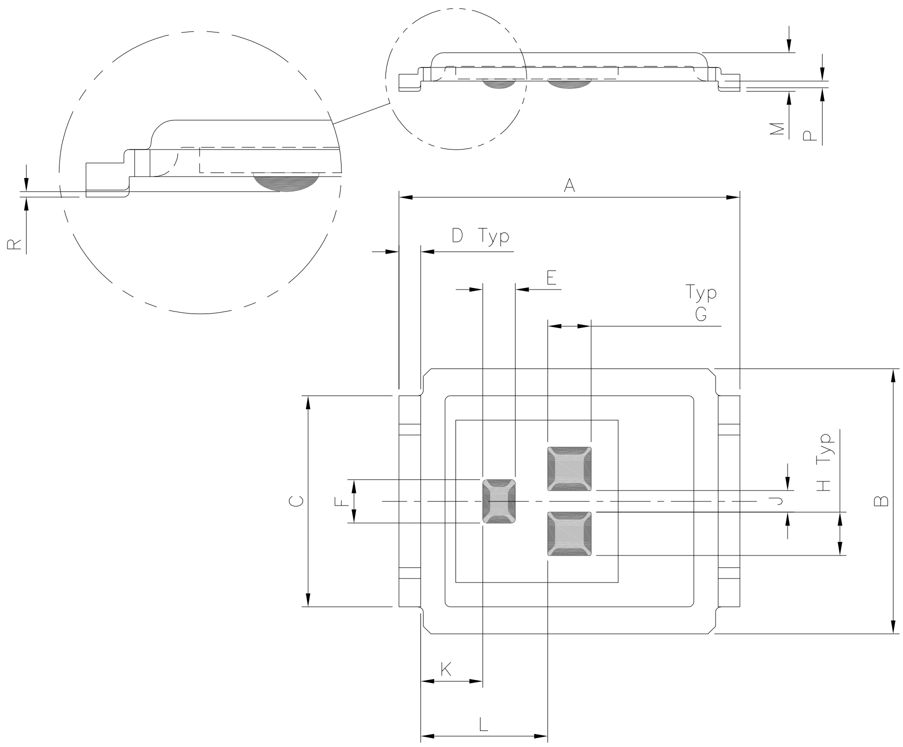



Note: For the most current drawing please refer to IR website at http://www.irf.com/package/

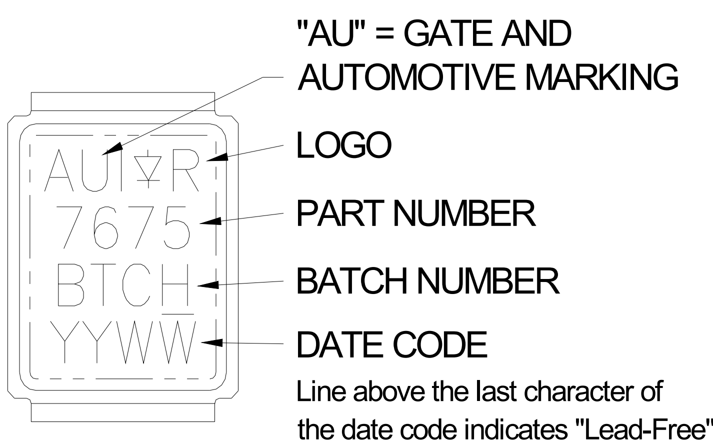
**DirectFET® Outline Dimension, M2 Outline (Medium Size Can).**

Please see DirectFET® application note AN-1035 for all details regarding the assembly of DirectFET® . This includes all recommendations for stencil and substrate designs.



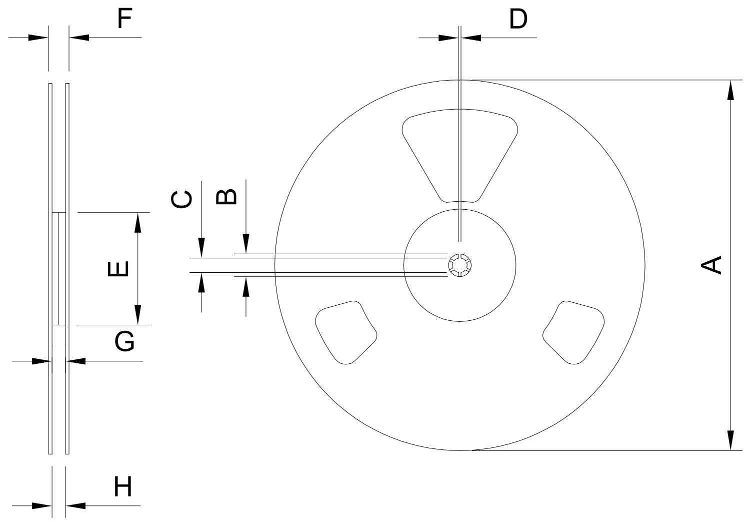

| DIMENSIONS | | | | |
|---|---|---|---|---|
| | METRIC | | IMPERIAL | |
| CODE | MIN | MAX | MIN | MAX |
| A | 6.25 | 6.35 | 0.246 | 0.250 |
| B | 4.80 | 5.05 | 0.189 | 0.199 |
| C | 3.85 | 3.95 | 0.152 | 0.156 |
| D | 0.35 | 0.45 | 0.014 | 0.018 |
| E | 0.58 | 0.62 | 0.023 | 0.024 |
| F | 0.78 | 0.82 | 0.031 | 0.032 |
| G | 0.78 | 0.82 | 0.031 | 0.032 |
| H | 0.78 | 0.82 | 0.031 | 0.032 |
| I | N/A | N/A | N/A | N/A |
| J | 0.38 | 0.42 | 0.015 | 0.017 |
| K | 1.10 | 1.20 | 0.043 | 0.047 |
| L | 2.30 | 2.40 | 0.090 | 0.094 |
| M | 0.68 | 0.74 | 0.027 | 0.029 |
| P | 0.09 | 0.17 | 0.003 | 0.007 |
| R | 0.02 | 0.08 | 0.001 | 0.003 |

**DirectFET® Part Marking**




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

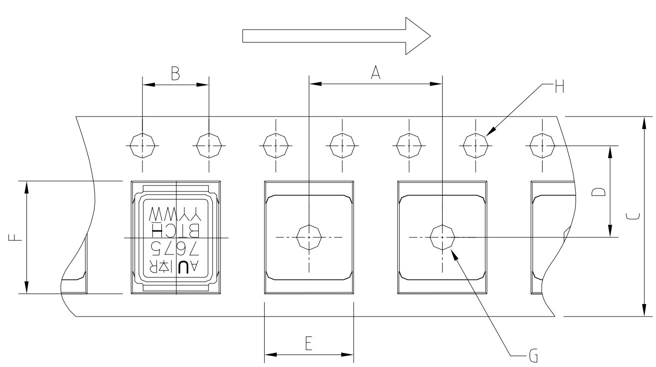
**DirectFET® Tape & Reel Di-**




NOTE: Controlling dimensions in mm
Std reel quantity is 4800 parts, order as AUIRF7675M2TR.

| REEL DIMENSIONS | | | | |
|---|---|---|---|---|
| STANDARD OPTION **(QTY 4800)** | | | | |
| | METRIC | | IMPERIAL | |
| CODE | MIN | MAX | MIN | MAX |
| A | 330.0 | N.C | 12.992 | N.C |
| B | 20.2 | N.C | 0.795 | N.C |
| C | 12.8 | 13.2 | 0.504 | 0.520 |
| D | 1.5 | N.C | 0.059 | N.C |
| E | 100.0 | N.C | 3.937 | N.C |
| F | N.C | 18.4 | N.C | 0.724 |
| G | 12.4 | 14.4 | 0.488 | 0.567 |
| H | 11.9 | 15.4 | 0.469 | 0.606 |

Loaded Tape Feed Direction




NOTE: CONTROLLING DIMENSIONS IN MM

| DIMENSIONS | | | | |
|---|---|---|---|---|
| | METRIC | | IMPERIAL | |
| CODE | MIN | MAX | MIN | MAX |
| A | 7.90 | 8.10 | 0.311 | 0.319 |
| B | 3.90 | 4.10 | 0.154 | 0.161 |
| C | 11.90 | 12.30 | 0.469 | 0.484 |
| D | 5.45 | 5.55 | 0.215 | 0.219 |
| E | 5.10 | 5.30 | 0.201 | 0.209 |
| F | 6.50 | 6.70 | 0.256 | 0.264 |
| G | 1.50 | N.C | 0.059 | N.C |
| H | 1.50 | 1.60 | 0.059 | 0.063 |

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** | | DFET2 Medium Can | MSL1, 260°C |
| **ESD** | Machine Model | Class M4 (+/- 400V)† AEC-Q101-002 | |
| | Human Body Model | Class H1B (+/- 1000V)† AEC-Q101-001 | |
| | Charged Device Model | Class C4 (+/- 1000V)† AEC-Q101-005 | |
| **RoHS Compliant** | | Yes | |

† Highest passing voltage.

**Revision History**

| Date | Comments |
|---|---|
| 12/14/2015 | • Updated datasheet with corporate template<br>• Corrected ordering table on page 1.<br>• Updated Tape and Reel option on page 10 |

**Published by**
**Infineon Technologies AG**
**81726 München, Germany**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