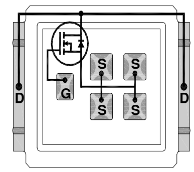
AUTOMOTIVE GRADE

# AUIRF7736M2TR

Automotive DirectFET® Power MOSFET ②

- Advanced Process Technology
- Optimized for Automotive Motor Drive, DC-DC and other Heavy Load Applications
- Exceptionally Small Footprint and Low Profile
- High Power Density
- Low Parasitic Parameters
- Dual Sided Cooling
- 175°C Operating Temperature
- Repetitive Avalanche Capability for Robustness and Reliability
- Lead free, RoHS and Halogen free
- Automotive Qualified *

| | | |
|---|---|---|
| $V_{(BR)DSS}$ | | **40V** |
| $R_{DS(on)}$ | typ. | **2.5mΩ** |
| | max. | **3.0mΩ** |
| $I_D$ (Silicon Limited) | | **108A** |
| $Q_g$ (typical) | | **72nC** |



M4

DirectFET® ISOMETRIC

Applicable DirectFET® Outline and Substrate Outline ①

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

## Description

The AUIRF7736M2 combines the latest Automotive HEXFET® Power MOSFET Silicon technology with the advanced DirectFET® packaging technology to achieve exceptional performance in a package that has the footprint of an SO-8 or 5X6mm PQFN and only 0.7mm profile. 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 is designed for applications where efficiency and power density are of value. The advanced DirectFET® packaging platform coupled with the latest silicon technology allows the AUIRF7736M2 to offer substantial system level savings and performance improvement specifically in motor drive, high frequency DC-DC and other heavy load applications on ICE, HEV and EV platforms. This MOSFET utilizes the latest processing techniques to achieve low on-resistance and low Qg per silicon area. Additional features of this MOSFET are 175°C operating junction temperature and high repetitive peak current capability. These features combine to make this MOSFET a highly efficient, robust and reliable device for high current automotive applications

| Base Part Number | Package Type | Standard Pack | | Orderable Part Number |
|---|---|---|---|---|
| | | Form | Quantity | |
| AUIRF7736M2 | DirectFET Medium Can | Tape and Reel | 4800 | AUIRF7736M2TR |

## 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 | 40 | V |
| $V_{GS}$ | Gate-to-Source Voltage | ±20 | |
| $I_D$ @ $T_C$ = 25°C | Continuous Drain Current, $V_{GS}$ @ 10V (Silicon Limited) ④ | 108 | A |
| $I_D$ @ $T_C$ = 100°C | Continuous Drain Current, $V_{GS}$ @ 10V (Silicon Limited) ④ | 77 | |
| $I_D$ @ $T_A$ = 25°C | Continuous Drain Current, $V_{GS}$ @ 10V (Silicon Limited) ③ | 22 | |
| $I_D$ @ $T_C$ = 25°C | Continuous Drain Current, $V_{GS}$ @ 10V (Package Limited) | 179 | |
| $I_{DM}$ | Pulsed Drain Current ⑤ | 432 | |
| $P_D$ @$T_C$ = 25°C | Power Dissipation ④ | 63 | W |
| $P_D$ @$T_A$ = 25°C | Power Dissipation ③ | 2.5 | |
| $E_{AS}$ | Single Pulse Avalanche Energy (Thermally Limited) ⑥ | 54 | mJ |
| $E_{AS}$ (Tested) | Single Pulse Avalanche Energy ⑥ | 286 | |
| $I_{AR}$ | 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 | —— | 2.4 | |
| $R_{\theta J\text{-}PCB}$ | Junction-to-PCB Mounted | 1.0 | —— | |
| | Linear Derating Factor ④ | 0.42 | | W/°C |

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

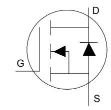
| Symbol | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| $V_{(BR)DSS}$ | Drain-to-Source Breakdown Voltage | 40 | —— | —— | V | $V_{GS}$ = 0V, $I_D$ = 250μA |
| $\Delta V_{(BR)DSS}/\Delta T_J$ | Breakdown Voltage Temp. Coefficient | —— | 0.03 | —— | V/°C | Reference to 25°C, $I_D$ = 1.0mA |
| $R_{DS(on)}$ | Static Drain-to-Source On-Resistance | —— | 2.5 | 3.0 | mΩ | $V_{GS}$ = 10V, $I_D$ = 65A ⑦ |
| $V_{GS(th)}$ | Gate Threshold Voltage | 2.0 | 3.0 | 4.0 | V | $V_{DS}$ = $V_{GS}$, $I_D$ = 150μA |
| $\Delta V_{GS(th)}/\Delta T_J$ | Gate Threshold Voltage Coefficient | —— | -9.0 | —— | mV/°C | |
| gfs | Forward Transconductance | 115 | —— | —— | S | $V_{DS}$ = 10V, $I_D$ = 65A |
| $R_G$ | Internal Gate Resistance | —— | 1.0 | —— | Ω | |
| $I_{DSS}$ | Drain-to-Source Leakage Current | —— | —— | 5.0 | μA | $V_{DS}$ = 40V, $V_{GS}$ = 0V |
| | | —— | —— | 250 | | $V_{DS}$ = 40V, $V_{GS}$ = 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 |

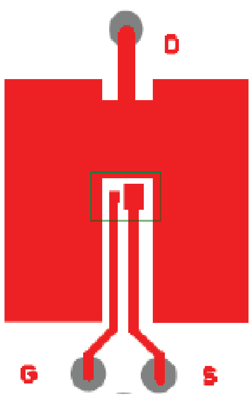
**Dynamic Electrical Characteristics @ $T_J$ = 25°C (unless otherwise specified)**

| Symbol | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| $Q_g$ | Total Gate Charge | —— | 72 | 108 | nC | $V_{DS}$ = 20V |
| $Q_{gs1}$ | Gate-to-Source Charge | —— | 15 | —— | | $V_{GS}$ = 10V |
| $Q_{gs2}$ | Gate-to-Source Charge | —— | 6.3 | —— | | $I_D$ = 65A |
| $Q_{gd}$ | Gate-to-Drain ("Miller") Charge | —— | 26 | —— | | See Fig.11 |
| $Q_{godr}$ | Gate Charge Overdrive | —— | 24.7 | —— | | |
| $Q_{sw}$ | Switch Charge ($Q_{gs2}$ + $Q_{gd}$) | —— | 32.3 | —— | | |
| $Q_{oss}$ | Output Charge | —— | 31 | —— | nC | $V_{DS}$ = 16V, $V_{GS}$ = 0V |
| $t_{d(on)}$ | Turn-On Delay Time | —— | 21 | —— | ns | $V_{DD}$ = 20V, $V_{GS}$ = 10V ⑦ |
| $t_r$ | Rise Time | —— | 43 | —— | | $I_D$ = 65A |
| $t_{d(off)}$ | Turn-Off Delay Time | —— | 39 | —— | | $R_G$ = 6.8Ω |
| $t_f$ | Fall Time | —— | 27 | —— | | |
| $C_{iss}$ | Input Capacitance | —— | 4267 | —— | pF | $V_{GS}$ = 0V |
| $C_{oss}$ | Output Capacitance | —— | 943 | —— | | $V_{DS}$ = 25V |
| $C_{rss}$ | Reverse Transfer Capacitance | —— | 422 | —— | | $f$ = 1.0 MHz |
| $C_{oss}$ | Output Capacitance | —— | 3489 | —— | | $V_{GS}$ = 0V, $V_{DS}$ = 1.0V, $f$ = 1.0 MHz |
| $C_{oss}$ | Output Capacitance | —— | 843 | —— | | $V_{GS}$ = 0V, $V_{DS}$ = 32V, $f$ = 1.0 MHz |
| $C_{oss}$ eff. | Effective Output Capacitance | —— | 1222 | —— | | $V_{GS}$ = 0V, $V_{DS}$ = 0V to 32V |

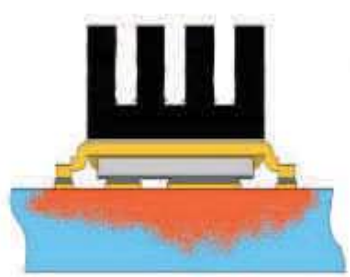
Notes ① through ⑩ are on page 3

**Diode Characteristics**

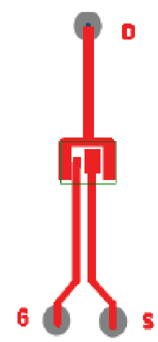
| Symbol | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| $I_S$ | Continuous Source Current (Body Diode) | — | — | 108 | A | MOSFET symbol showing the integral reverse p-n junction diode.  |
| $I_{SM}$ | Pulsed Source Current (Body Diode) ⑤ | — | — | 432 | | |
| $V_{SD}$ | Diode Forward Voltage | — | — | 1.3 | V | $T_J = 25°C$, $I_S = 65A$, $V_{GS} = 0V$ ⑦ |
| $t_{rr}$ | Reverse Recovery Time | — | 35 | 53 | ns | $T_J = 25°C$, $I_F = 65A$, $V_{DD} = 25V$ |
| $Q_{rr}$ | Reverse Recovery Charge | — | 38 | 57 | 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 $T_J = 25°C$, $L = 0.026mH$, $R_G = 50\Omega$, $I_{AS} = 65A$, $V_{GS} = 20V$.
⑦ Pulse width $\leq$ 400μs; duty cycle $\leq$ 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.

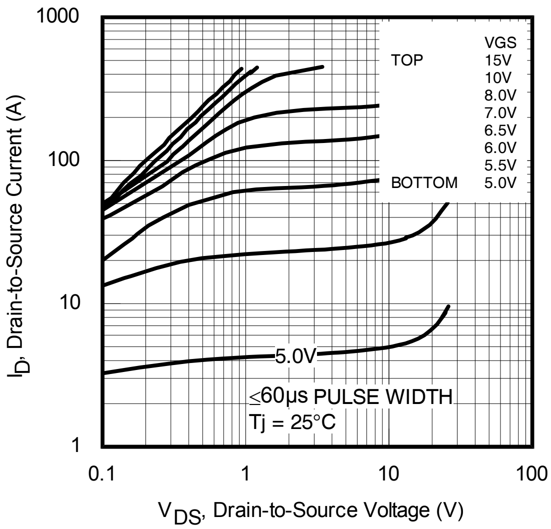



**Fig. 1** Typical Output Characteristics

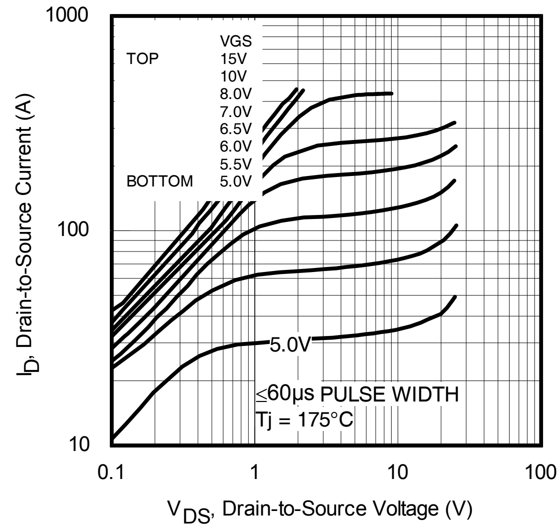



**Fig. 2** Typical Output Characteristics

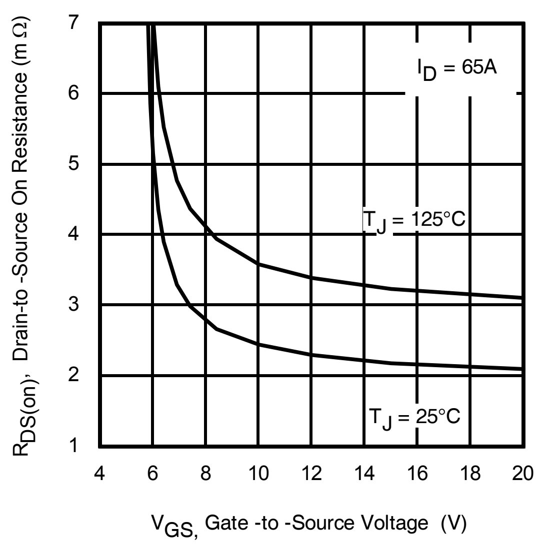



**Fig. 3** Typical On-Resistance vs. Gate Voltage

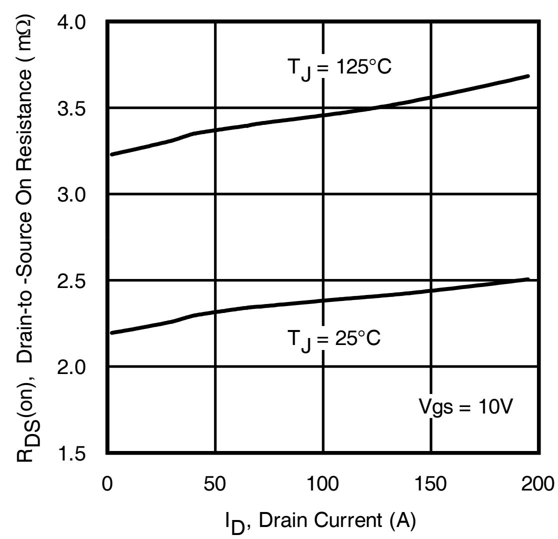



**Fig. 4** Typical On-Resistance vs. Drain Current

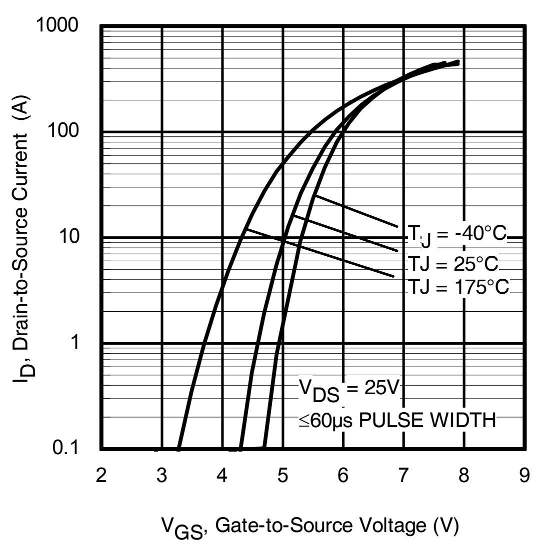



**Fig 5.** Transfer Characteristics

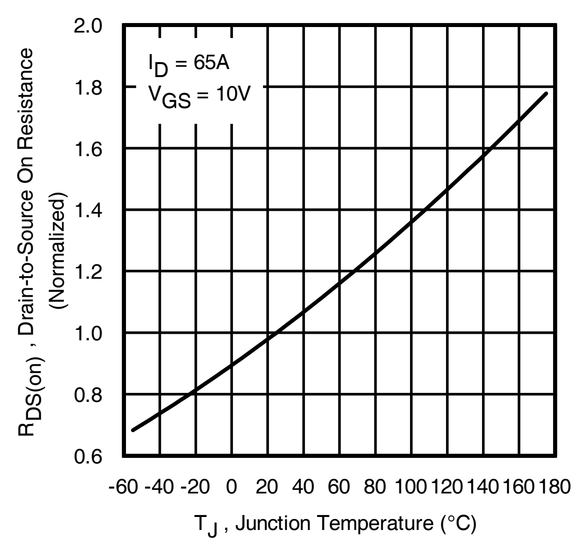



**Fig 6.** Normalized On-Resistance vs. Temperature

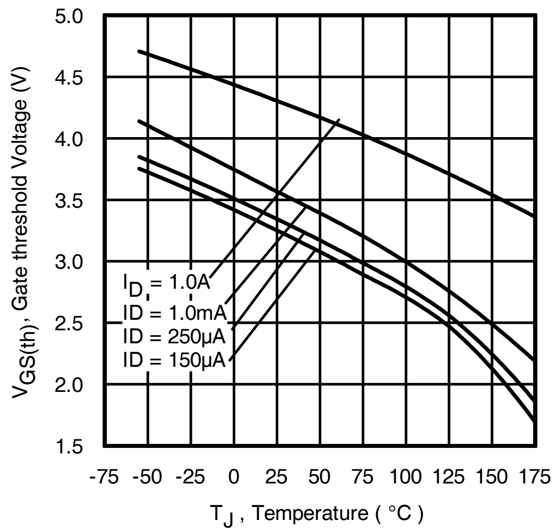



**Fig. 7** Typical Threshold Voltage vs. Junction Temperature

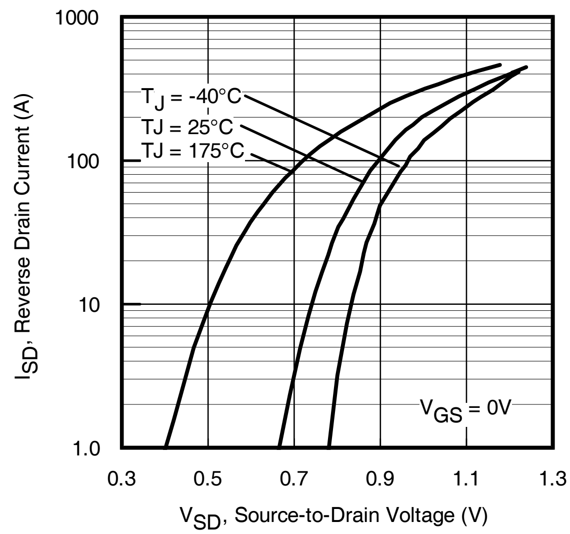



**Fig 8.** Typical Source-Drain Diode Forward Voltage

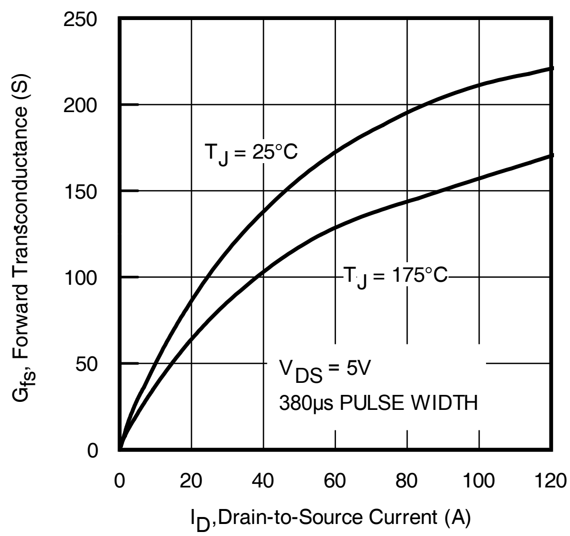



**Fig 9.** Typical Forward Trans conductance vs. Drain Current

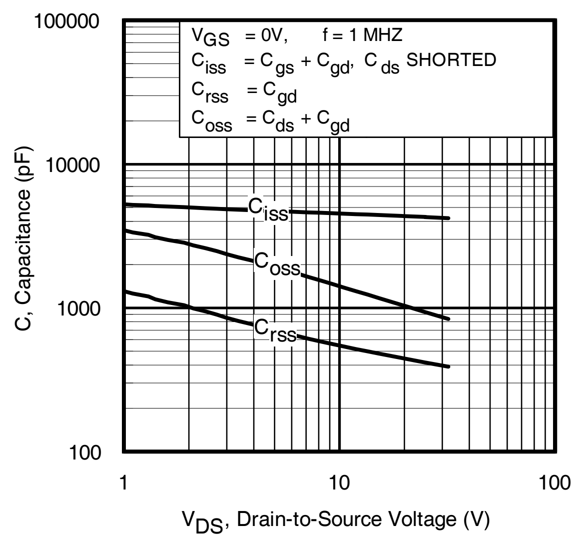



**Fig 10.** Typical Capacitance vs. Drain-to-Source Voltage

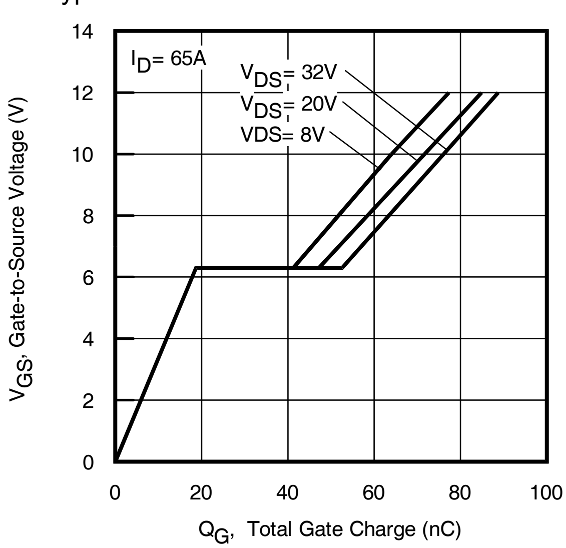



**Fig 11.** Typical Gate Charge vs. Gate-to-Source Voltage

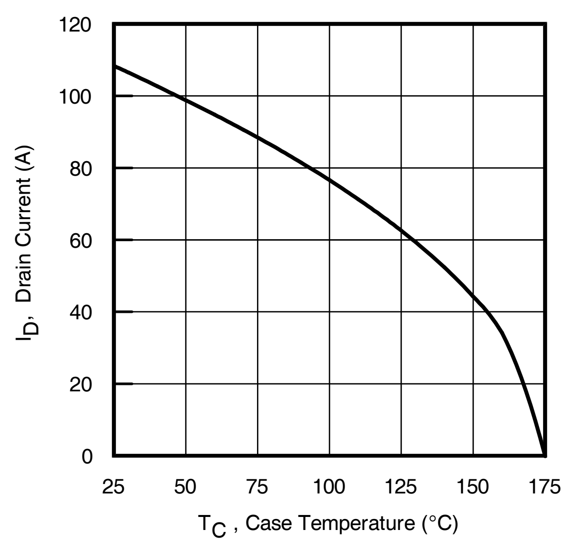



**Fig 12.** Maximum Drain Current vs. Case Temperature

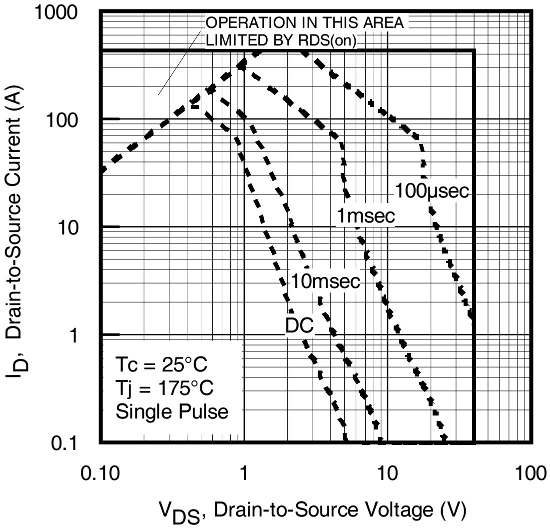



**Fig 13.** Maximum Safe Operating Area

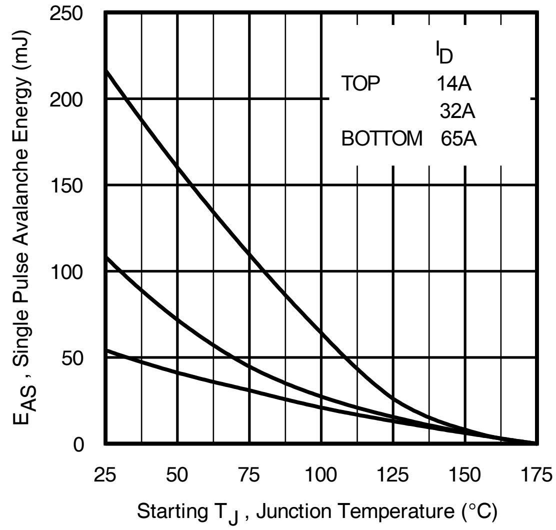
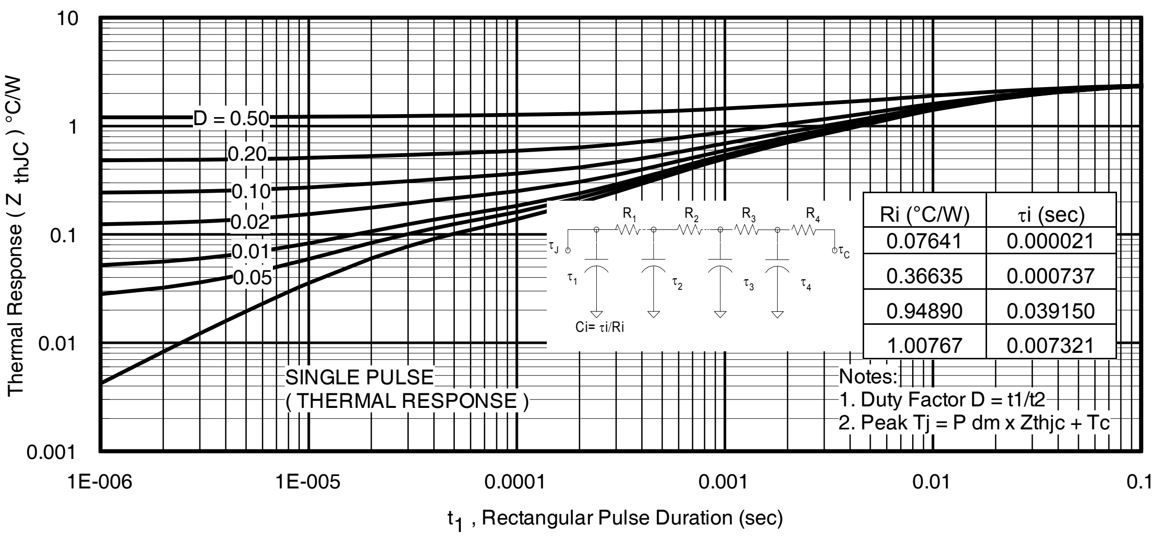



**Fig 14.** Maximum Avalanche Energy vs. Temperature




| Ri (°C/W) | τi (sec) |
|---|---|
| 0.07641 | 0.000021 |
| 0.36635 | 0.000737 |
| 0.94890 | 0.039150 |
| 1.00767 | 0.007321 |

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

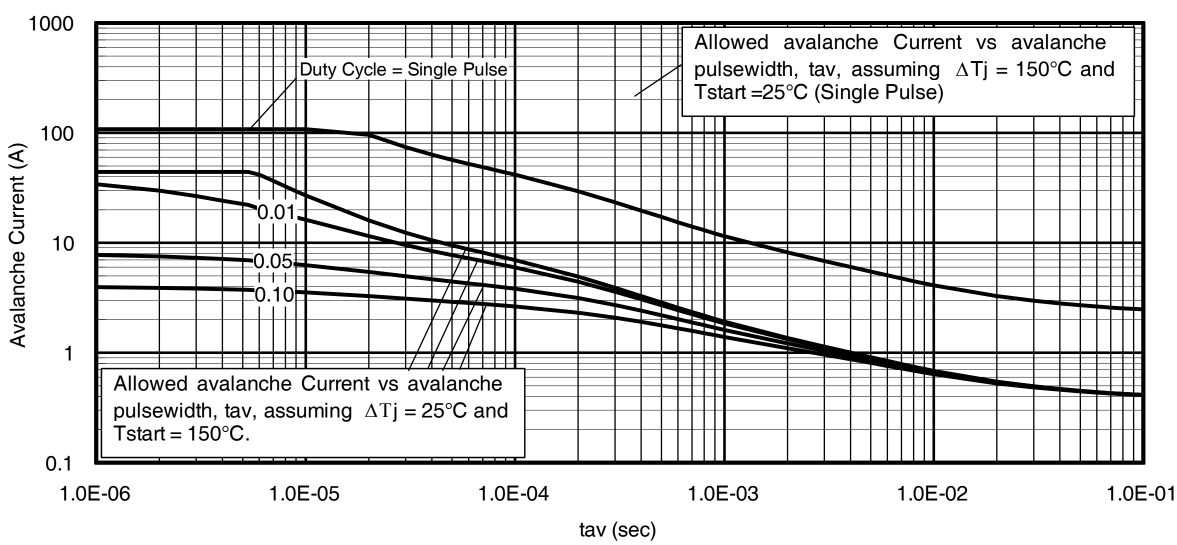



**Fig 16.** Typical Avalanche Current vs. Pulse Width

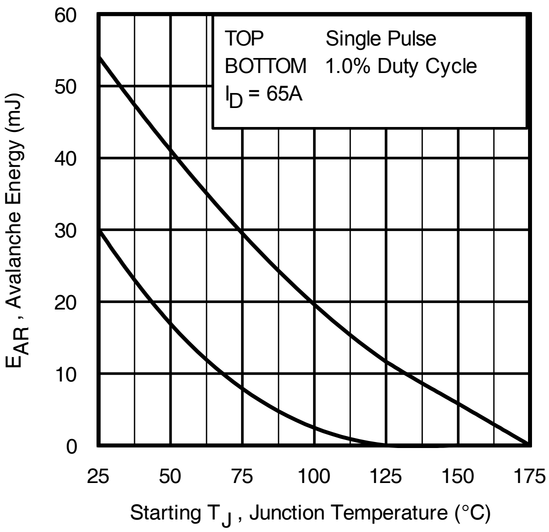



**Fig 17.** Maximum Avalanche Energy vs. Temperature

**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)

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

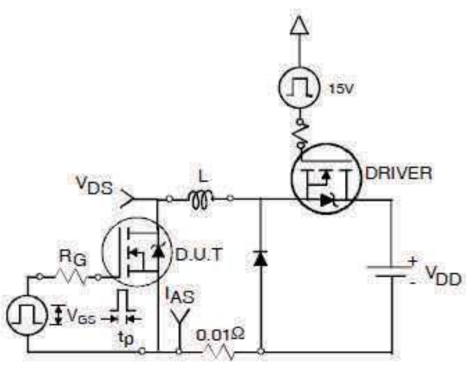



**Fig 18a.** Unclamped Inductive Test Circuit

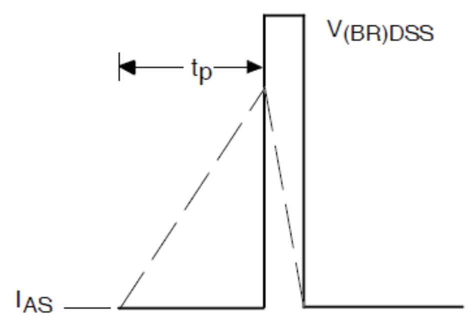



**Fig 18b.** Unclamped Inductive Waveforms

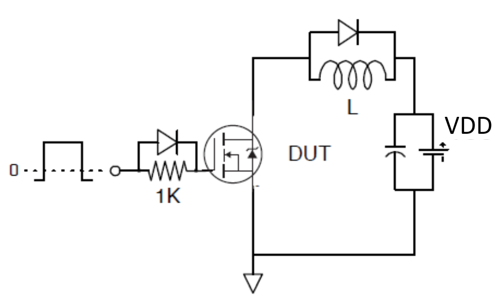



**Fig 19a.** Gate Charge Test Circuit

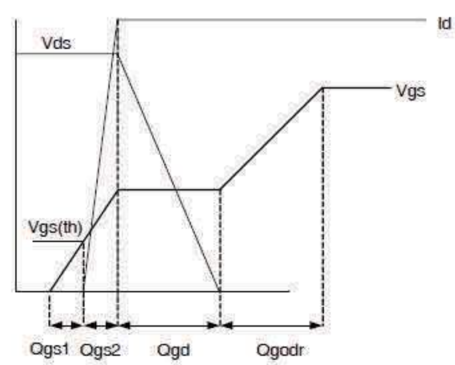



**Fig 19b.** Gate Charge Waveform

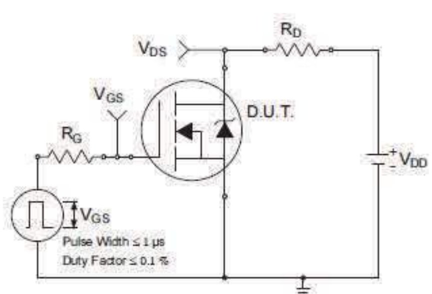



**Fig 20a.** Switching Time Test Circuit

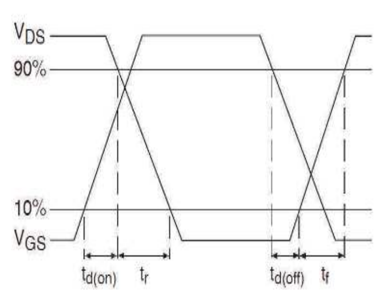
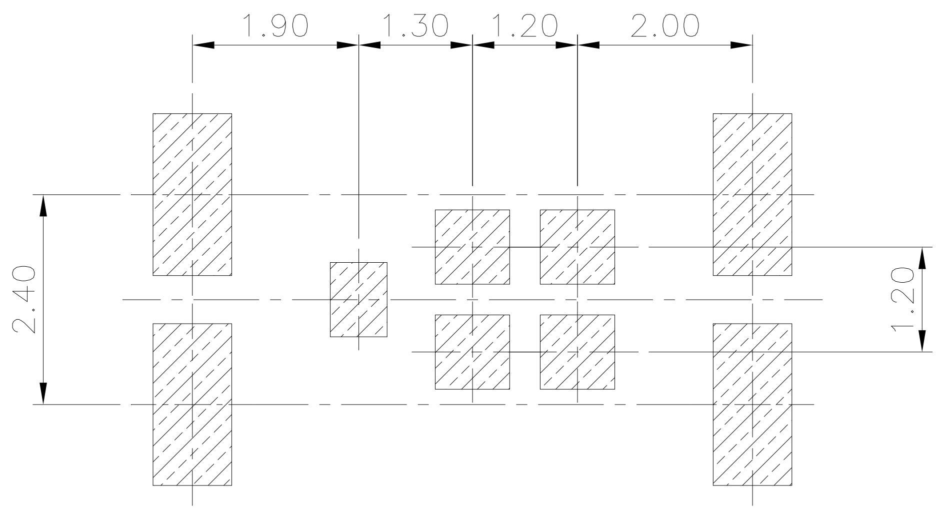
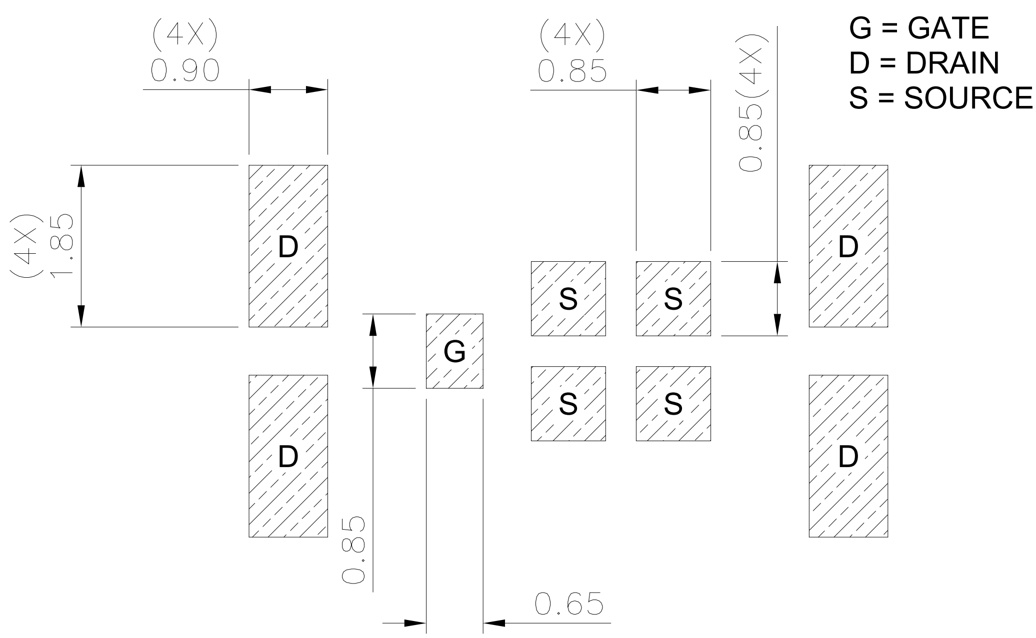



**Fig 20b.** Switching Time Waveforms

**DirectFET® Board Footprint, M4 (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.

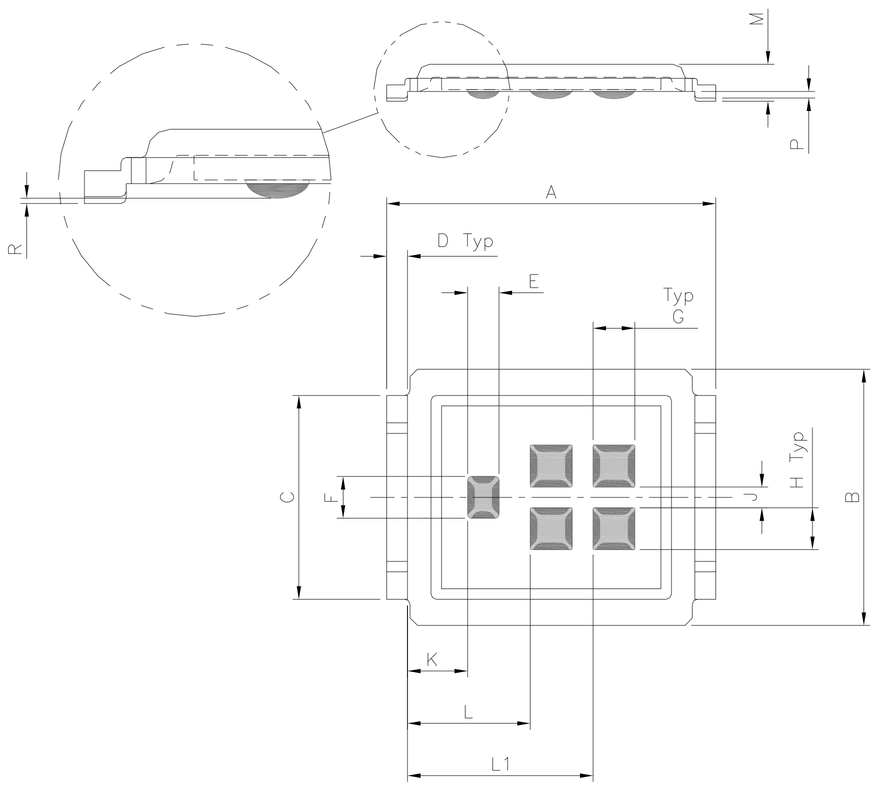



Note: For the most current drawing please refer to IR website at http://www.irf.com/package/

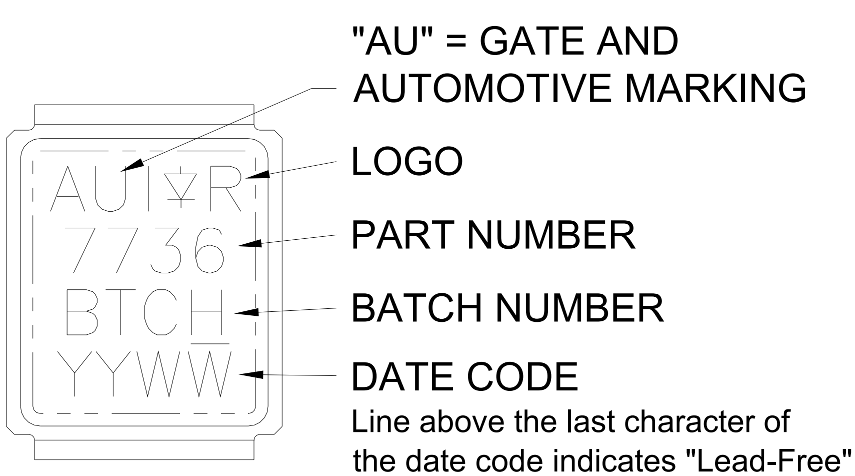
**DirectFET® Outline Dimension, M4 Outline (Medium Size Can).**

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



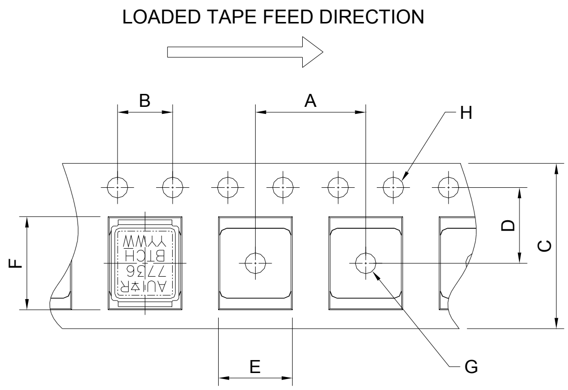

| DIMENSIONS | | | | |
|---|---|---|---|---|
| | METRIC | | IMPERIAL | |
| CODE | MIN | MAX | MIN | MAX |
| A | 6.25 | 6.35 | 0.246 | 0.250 |
| B | 4.80 | 5.05 | 0.189 | 0.199 |
| C | 3.85 | 3.95 | 0.152 | 0.156 |
| D | 0.35 | 0.45 | 0.014 | 0.018 |
| E | 0.58 | 0.62 | 0.023 | 0.024 |
| F | 0.78 | 0.82 | 0.031 | 0.032 |
| G | 0.78 | 0.82 | 0.031 | 0.032 |
| H | 0.78 | 0.82 | 0.031 | 0.032 |
| 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 |
| L1 | 3.50 | 3.60 | 0.138 | 0.142 |
| 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**



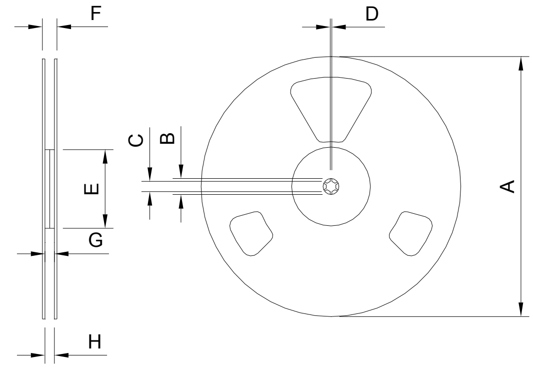

Note: For the most current drawing please refer to IR website at http://www.irf.com/package/

## DirectFET® Tape & Reel Dimension (Showing component orientation)




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: Controlling dimensions in mm
Std reel quantity is 4800 parts, ordered as AUIRF7736M2TR.

| 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 |

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

## Qualification Information

| | | | |
|---|---|---|---|
| **Qualification Level** | | Automotive<br>(per AEC-Q101)<br>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)†<br>AEC-Q101-002 | |
| | Human Body Model | Class H3B (+/- 8000V)†<br>AEC-Q101-001 | |
| | Charged Device Model | N/A<br>AEC-Q101-005 | |
| **RoHS Compliant** | | Yes | |

† Highest passing voltage.

## Revision History

| Date | Comments |
|---|---|
| 10/5/2015 | • Updated datasheet with corporate template<br>• Corrected ordering table on page 1.<br>• Updated Tape and Reel option on page 10 |

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