International
IOR Rectifier

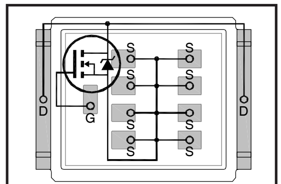
**AUTOMOTIVE GRADE**

# AUIRF7799L2TR
# AUIRF7799L2TR1

Automotive DirectFET® Power MOSFET ②

| | | |
|---|---|---|
| $V_{(BR)DSS}$ | | 250V |
| $R_{DS(on)}$ | typ. | 32mΩ |
| | max. | 38mΩ |
| $I_D$ (Silicon Limited) | | 35A |
| $Q_g$ | | 110nC |

- 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 Compliant and Halogen Free
- Automotive Qualified *



L8


DirectFET® ISOMETRIC

Applicable DirectFET® Outline and Substrate Outline ①

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

## Description

The AUIRF7799L2TR combines the latest Automotive HEXFET® Power MOSFET Silicon technology with the advanced DirectFET® packaging to achieve the lowest on-state resistance in a package that has the footprint of a DPak (TO-252AA) and only 0.7 mm 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 essential. The advanced DirectFET® packaging platform coupled with the latest silicon technology allows the AUIRF7799L2TR 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.

## 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 ($T_A$) is 25°C, unless otherwise specified.

| | Parameter | Max. | Units |
|---|---|---|---|
| $V_{DS}$ | Drain-to-Source Voltage | 250 | V |
| $V_{GS}$ | Gate-to-Source Voltage | ±30 | |
| $I_D$ @ $T_C$ = 25°C | Continuous Drain Current, $V_{GS}$ @ 10V (Silicon Limited) ④ | 35 | A |
| $I_D$ @ $T_C$ = 100°C | Continuous Drain Current, $V_{GS}$ @ 10V (Silicon Limited) ④ | 25 | |
| $I_D$ @ $T_A$ = 25°C | Continuous Drain Current, $V_{GS}$ @ 10V (Silicon Limited) ③ | 6.6 | |
| $I_D$ @ $T_C$ = 25°C | Continuous Drain Current, $V_{GS}$ @ 10V (Package Limited) ④ | 375 | |
| $I_{DM}$ | Pulsed Drain Current ⑤ | 140 | |
| $P_D$ @$T_C$ = 25°C | Power Dissipation ④ | 125 | W |
| $P_D$ @$T_C$ = 100°C | Power Dissipation ④ | 63 | |
| $P_D$ @$T_A$ = 25°C | Power Dissipation ① | 4.3 | |
| $E_{AS}$ | Single Pulse Avalanche Energy ⑥ | 325 | mJ |
| $I_{AR}$ | Avalanche Current ⑤ | See Fig.18a, 18b, 16, 17 | 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 | |

## Thermal Resistance

| | Parameter | Typ. | Max. | Units |
|---|---|---|---|---|
| $R_{\theta JA}$ | Junction-to-Ambient ③ | — | 35 | °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 | — | 1.2 | |
| $R_{\theta J\text{-}PCB}$ | Junction-to-PCB Mounted | — | 0.5 | |
| | Linear Derating Factor ④ | 0.83 | | W/°C |

HEXFET® is a registered trademark of International Rectifier.
*Qualification standards can be found at http://www.irf.com/

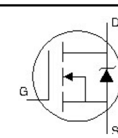
### Static Characteristics @ $T_J$ = 25°C (unless otherwise stated)

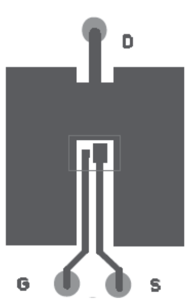
| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| $BV_{DSS}$ | Drain-to-Source Breakdown Voltage | 250 | — | — | V | $V_{GS}$ = 0V, $I_D$ = 250μA |
| $\Delta BV_{DSS}/\Delta T_J$ | Breakdown Voltage Temp. Coefficient | — | 0.12 | — | V/°C | Reference to 25°C, $I_D$ = 2mA |
| $R_{DS(on)}$ | Static Drain-to-Source On-Resistance | — | 32 | 38 | mΩ | $V_{GS}$ = 10V, $I_D$ = 21A ⑦ |
| $V_{GS(th)}$ | Gate Threshold Voltage | 3.0 | 4.0 | 5.0 | V | $V_{DS}$ = $V_{GS}$, $I_D$ = 250μA |
| $\Delta V_{GS(th)}/\Delta T_J$ | Gate Threshold Voltage Coefficient | — | -13 | — | mV/°C | |
| gfs | Forward Transconductance | 54 | — | — | S | $V_{DS}$ = 50V, $I_D$ = 21A |
| $I_{DSS}$ | Drain-to-Source Leakage Current | — | — | 20 | μA | $V_{DS}$ = 250V, $V_{GS}$ = 0V |
| | | — | — | 1 | 1mA | $V_{DS}$ = 250V, $V_{GS}$ = 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 Characteristics @ $T_J$ = 25°C (unless otherwise stated)

| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| $Q_g$ | Total Gate Charge | — | 110 | 165 | nC | $V_{DS}$ = 125V<br>$V_{GS}$ = 10V<br>$I_D$ = 21A<br>See Fig. 9 |
| $Q_{gs1}$ | Pre-Vth Gate-to-Source Charge | — | 26 | — | | |
| $Q_{gs2}$ | Post-Vth Gate-to-Source Charge | — | 5.7 | — | | |
| $Q_{gd}$ | Gate-to-Drain Charge | — | 39 | | | |
| $Q_{godr}$ | Gate Charge Overdrive | — | 39 | — | | |
| $Q_{sw}$ | Switch Charge ($Q_{gs2}$ + $Q_{gd}$) | — | 45 | — | | |
| $Q_{oss}$ | Output Charge | — | 33 | — | nC | $V_{DS}$ = 16V, $V_{GS}$ = 0V |
| $R_G$ | Gate Resistance | — | 0.73 | — | Ω | |
| $t_{d(on)}$ | Turn-On Delay Time | — | 36.3 | — | ns | $V_{DD}$ = 125V, $V_{GS}$ = 10V ⑦<br>$I_D$ = 21A<br>$R_G$=6.2Ω |
| $t_r$ | Rise Time | — | 33.5 | — | | |
| $t_{d(off)}$ | Turn-Off Delay Time | — | 73.9 | — | | |
| $t_f$ | Fall Time | — | 26.6 | — | | |
| $C_{iss}$ | Input Capacitance | — | 6714 | — | pF | $V_{GS}$ = 0V<br>$V_{DS}$ = 25V<br>$f$ = 1.0MHz |
| $C_{oss}$ | Output Capacitance | — | 606 | — | | |
| $C_{rss}$ | Reverse Transfer Capacitance | — | 157 | — | | |
| $C_{oss}$ | Output Capacitance | — | 5063 | — | | $V_{GS}$ = 0V, $V_{DS}$ = 1.0V, f=1.0MHz |
| $C_{oss}$ | Output Capacitance | — | 217 | — | | $V_{GS}$ = 0V, $V_{DS}$ = 80V, f=1.0MHz |

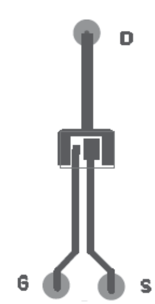
### Diode Characteristics @ $T_J$ = 25°C (unless otherwise stated)

| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| $I_S$ | Continuous Source Current (Body Diode) | — | — | 35 | A | MOSFET symbol showing the integral reverse p-n junction diode.  |
| $I_{SM}$ | Pulsed Source Current (Body Diode) ⑤ | — | — | 140 | | |
| $V_{SD}$ | Diode Forward Voltage | — | — | 1.3 | V | $T_J$ = 25°C, $I_S$ = 21A, $V_{GS}$ = 0V ⑦ |
| $t_{rr}$ | Reverse Recovery Time | — | 132 | 198 | ns | $T_J$ = 25°C, $I_F$ = 21A, $V_{DD}$ = 50V |
| $Q_{rr}$ | Reverse Recovery Charge | — | 1412 | 2118 | nC | di/dt = 100A/μs ⑦ |




③ Surface mounted on 1 in. square Cu (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)

Notes ① through ⑩ are on page 10

## Qualification Information†

<table>
<tr><td rowspan="2" colspan="2">Qualification Level</td><td colspan="2">Automotive<br>(per AEC-Q101) ††</td></tr>
<tr><td colspan="2">Comments: This part number(s) passed Automotive qualification. IR's Industrial and Consumer qualification level is granted by extension of the higher Automotive level.</td></tr>
<tr><td colspan="2">Moisture Sensitivity Level</td><td>LARGE-CAN</td><td>MSL1</td></tr>
<tr><td rowspan="3">ESD</td><td>Machine Model</td><td colspan="2">Class M4 (+/- 800V)†††<br>(per AEC-Q101-002)</td></tr>
<tr><td>Human Body Model</td><td colspan="2">Class H2 (+/- 4000V)†††<br>(per AEC-Q101-001)</td></tr>
<tr><td>Charged Device Model</td><td colspan="2">N/A<br>(per AEC-Q101-005)</td></tr>
<tr><td colspan="2">RoHS Compliant</td><td colspan="2">Yes</td></tr>
</table>

† Qualification standards can be found at International Rectifier's web site: http//www.irf.com/

†† Exceptions (if any) to AEC-Q101 requirements are noted in the qualification report.

††† Highest passing voltage

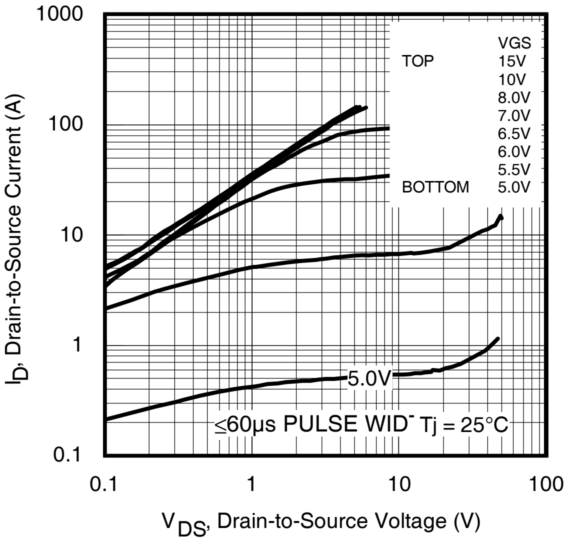



**Fig 1.** Typical Output Characteristics

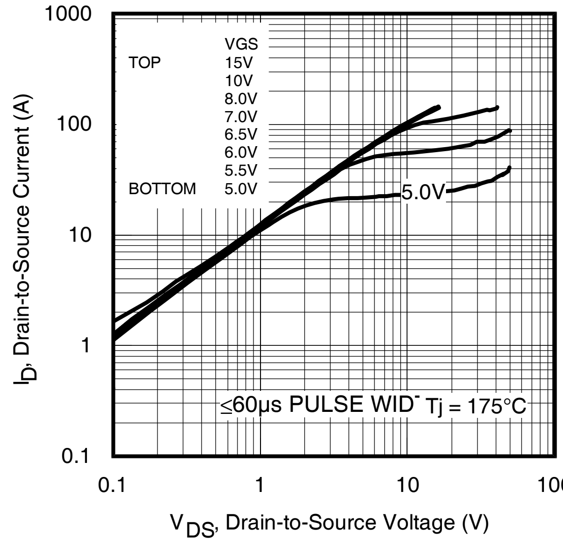



**Fig 2.** Typical Output Characteristics

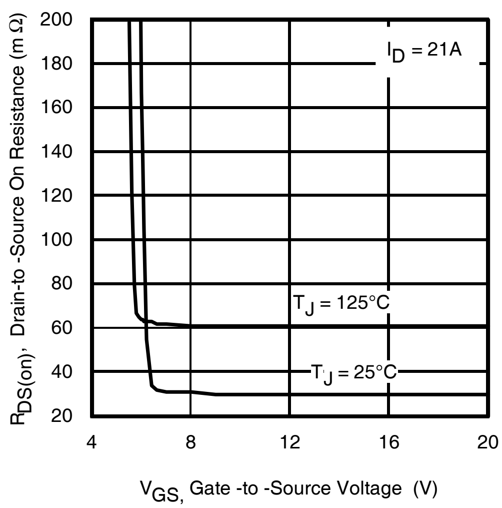



**Fig 3.** Typical On-Resistance vs. Gate Voltage

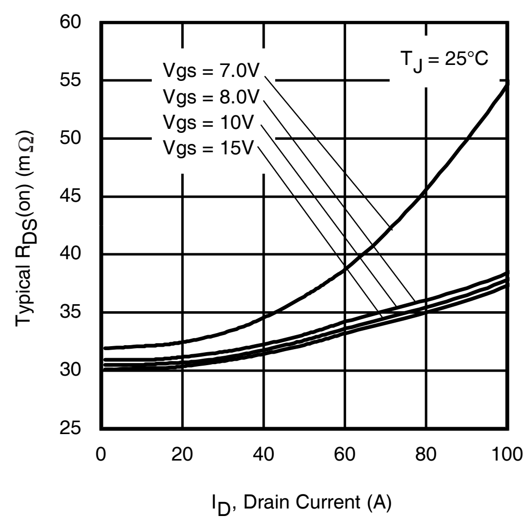



**Fig 4.** Typical On-Resistance vs. Drain Current

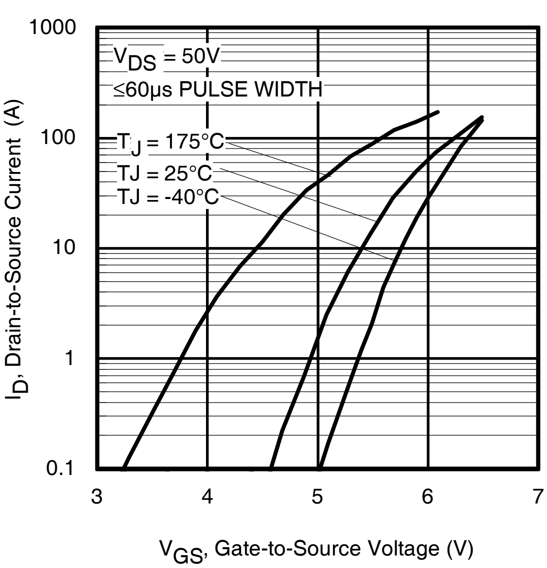



**Fig 5.** Typical Transfer Characteristics

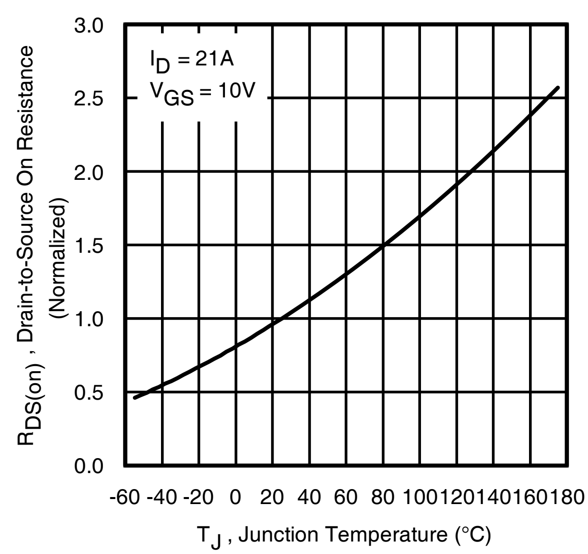



**Fig 6.** Normalized On-Resistance vs. Temperature

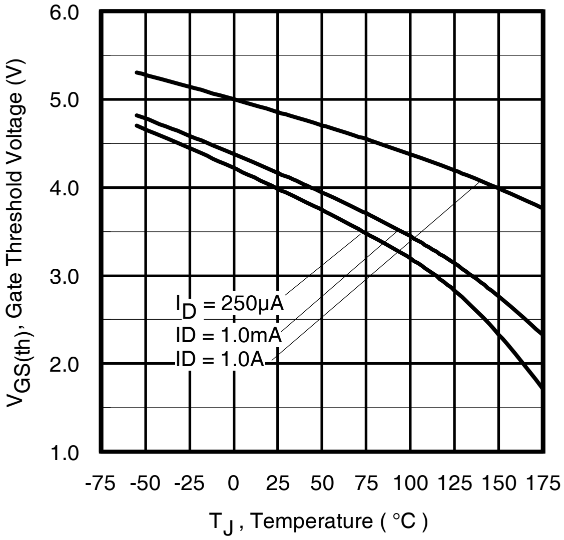



**Fig 7.** Typical Threshold Voltage vs. Junction Temperature

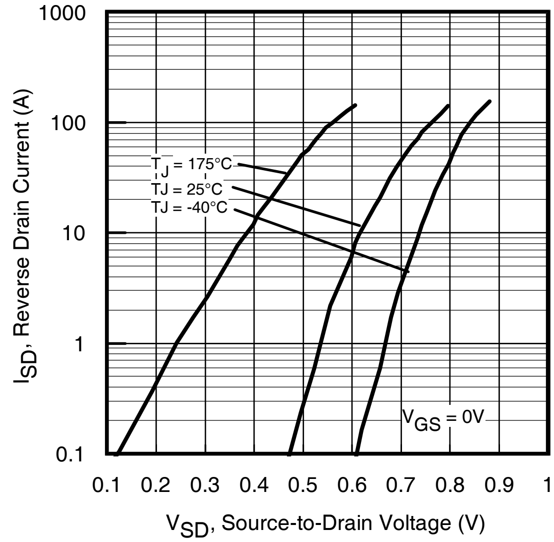



**Fig 8.** Typical Source-Drain Diode Forward Voltage

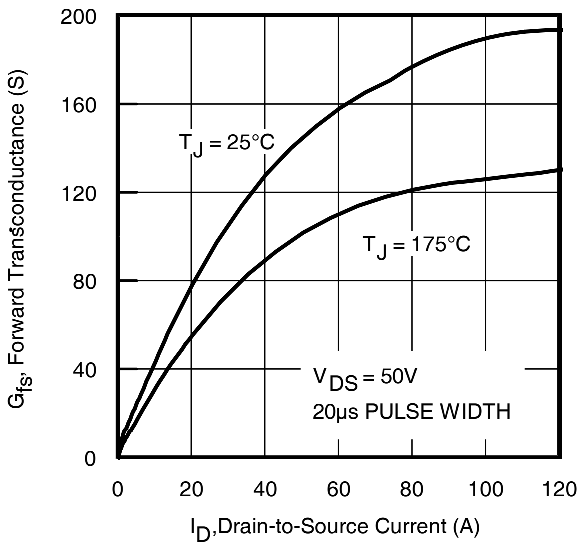



**Fig 9.** Typical Forward Transconductance vs. Drain Current

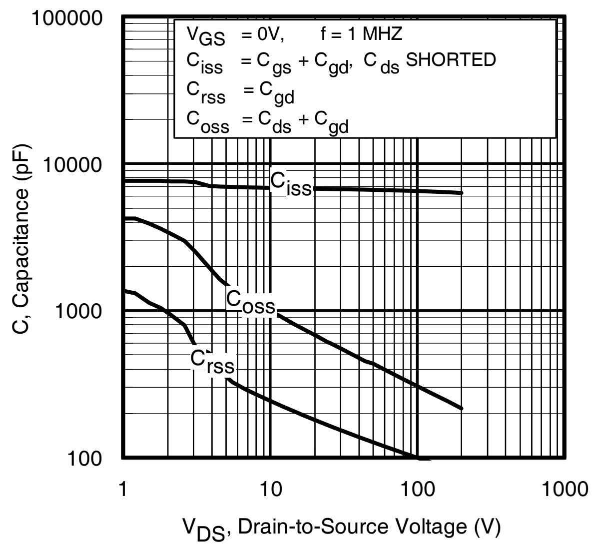



**Fig 10.** Typical Capacitance vs.Drain-to-Source Voltage

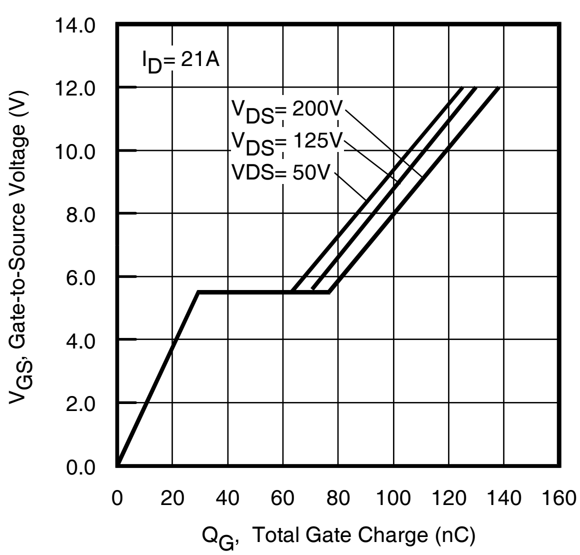



**Fig.11** Typical Gate Charge vs.Gate-to-Source Voltage

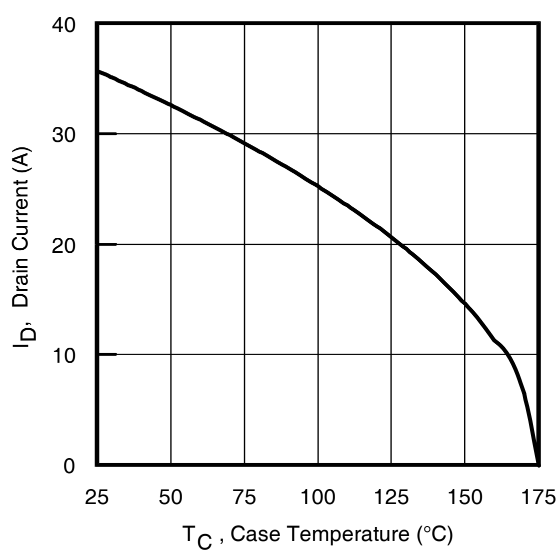



**Fig 12.** Maximum Drain Current vs. Case Temperature

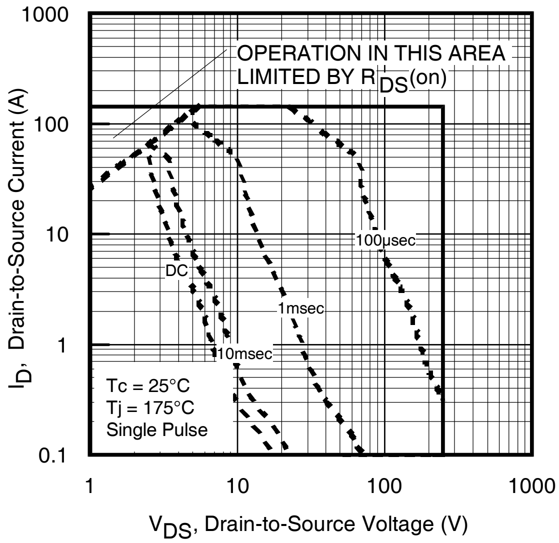



**Fig 13.** Maximum Safe Operating Area

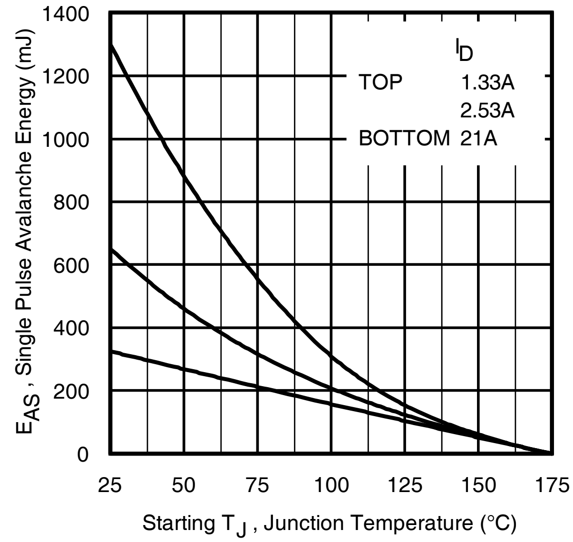



**Fig 14.** Maximum Avalanche Energy vs. Temperature

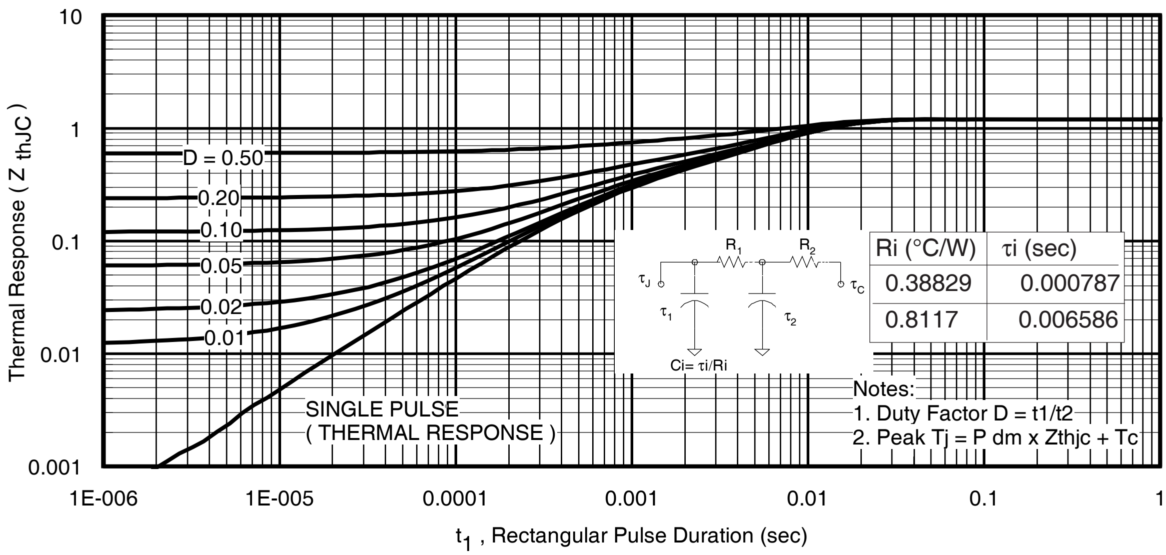



**Fig 15.** Maximum Effective Transient Thermal Impedance, Junction-to-Case

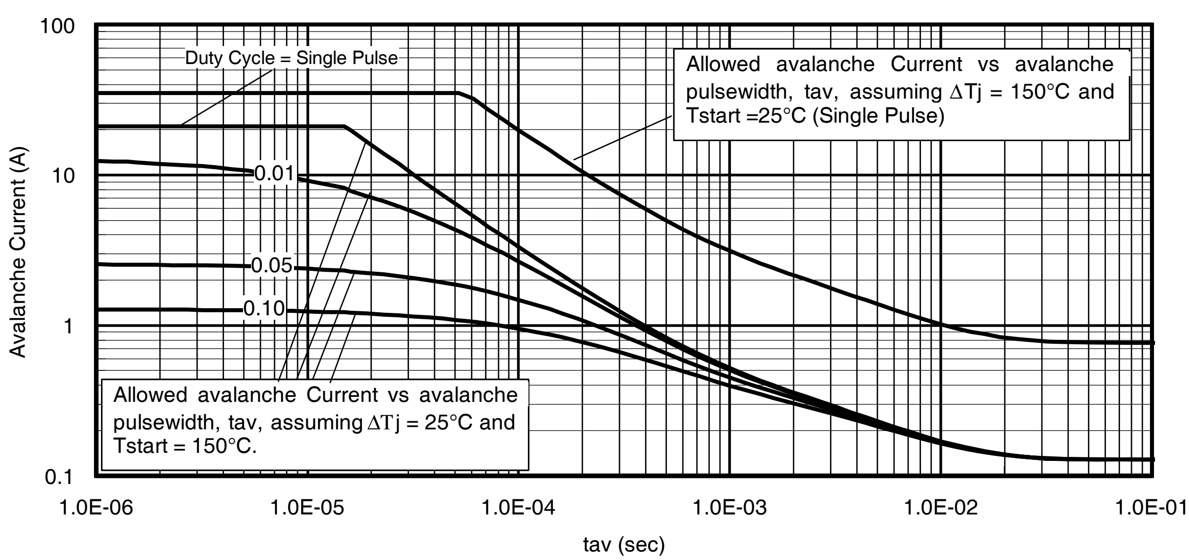



**Fig 16.** Typical Avalanche Current vs.Pulsewidth

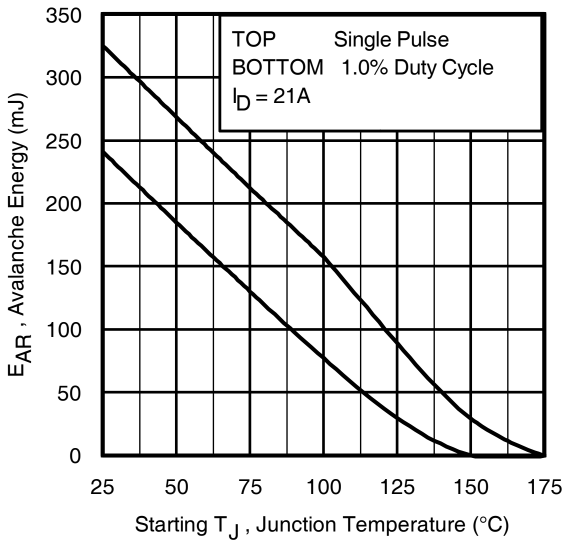



**Fig 17.** Maximum Avalanche Energy vs. Temperature

**Notes on Repetitive Avalanche Curves , Figures 14, 17:**
**(For further info, see AN-1005 at www.irf.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 15, 16).
   $t_{av}$ = Average time in avalanche.
   D = Duty cycle in avalanche = $t_{av} \cdot f$
   $Z_{thJC}(D, t_{av})$ = Transient thermal resistance, see figure 11)

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

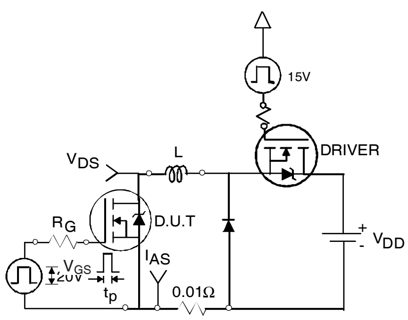



**Fig 18a.** Unclamped Inductive Test Circuit

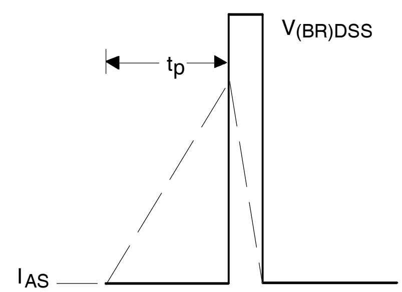



**Fig 18b.** Unclamped Inductive Waveforms

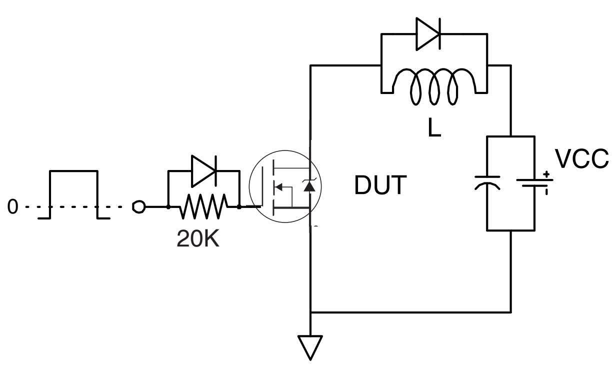



**Fig 19a.** Gate Charge Test Circuit

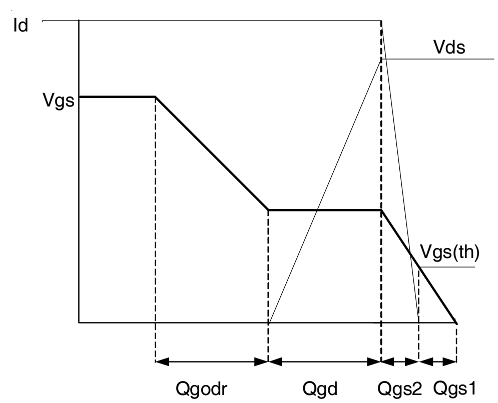



**Fig 19b.** Gate Charge Waveform

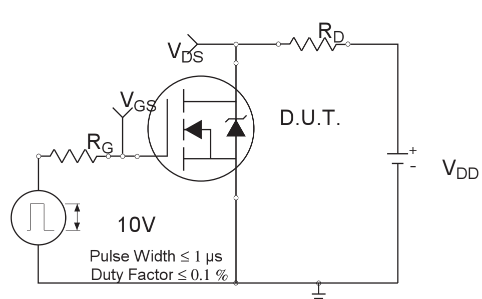



**Fig 20a.** Switching Time Test Circuit

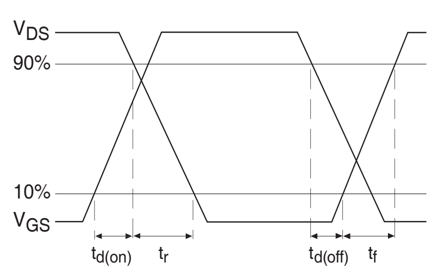



**Fig 20b.** Switching Time Waveforms

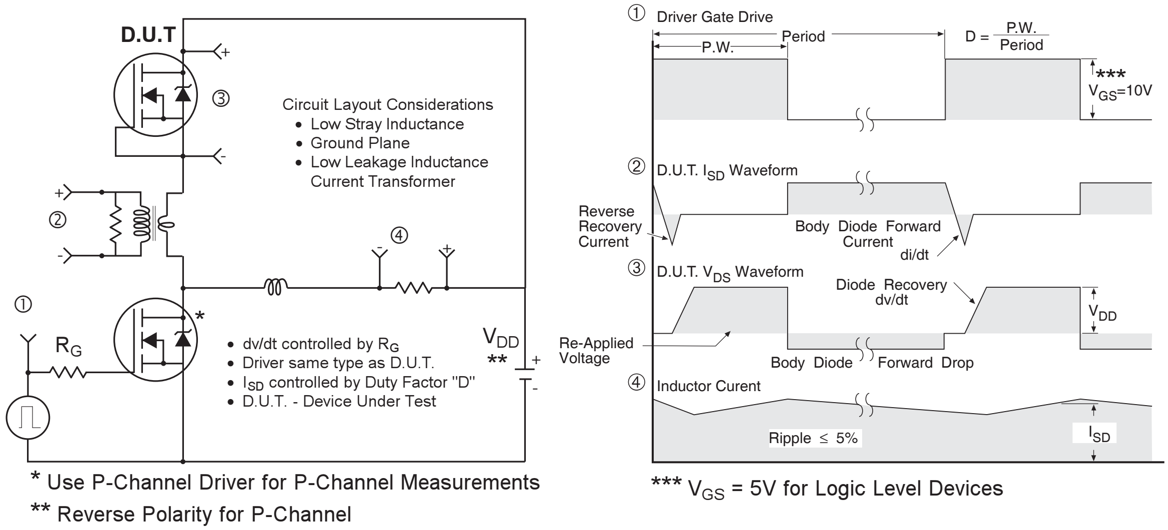
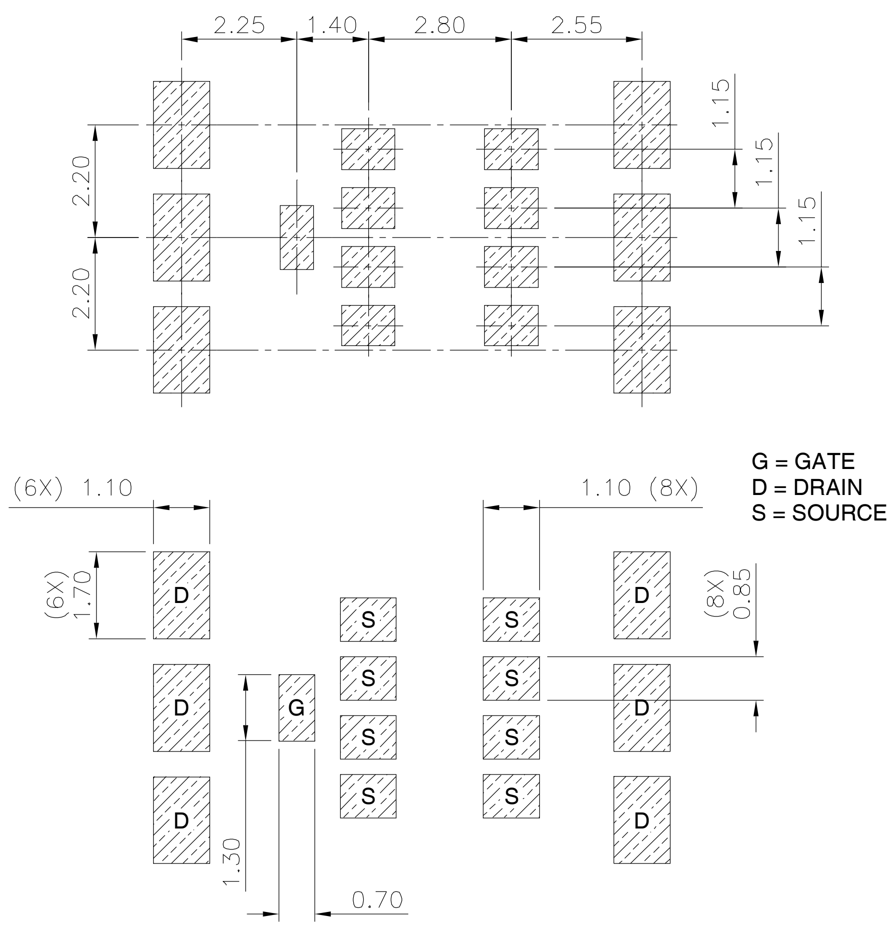



**Fig 21.** Diode Reverse Recovery Test Circuit for HEXFET® Power MOSFETs

## Automotive DirectFET® Board Footprint, L8 (Large Size Can).

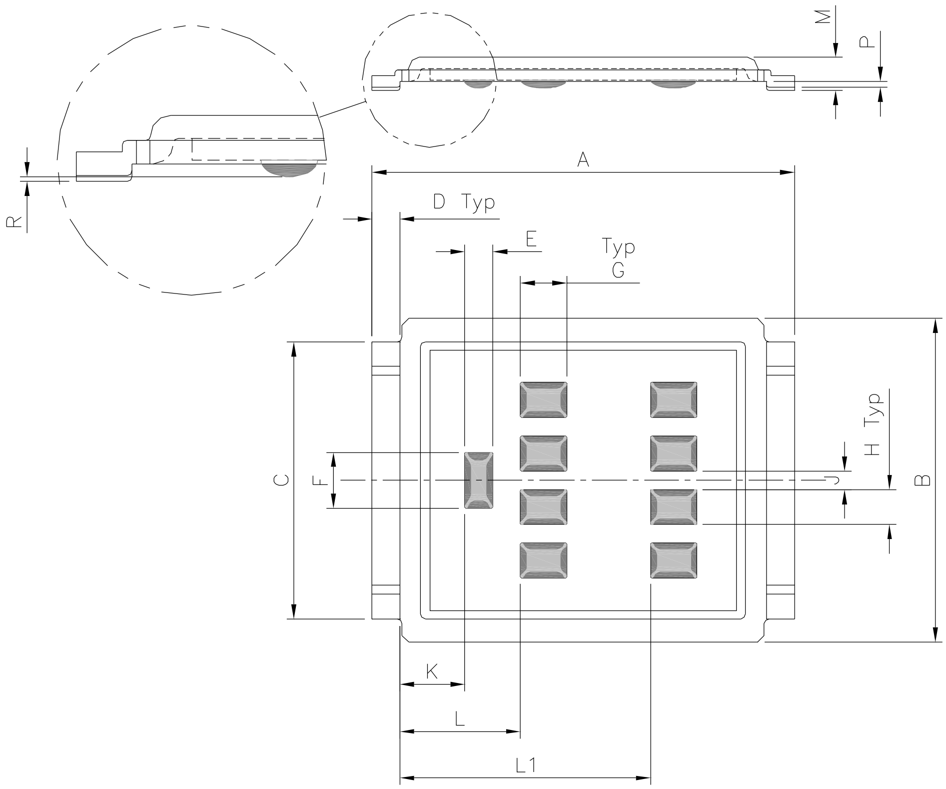
Please see AN-1035 for DirectFET® assembly details and stencil and substrate design recommendations




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

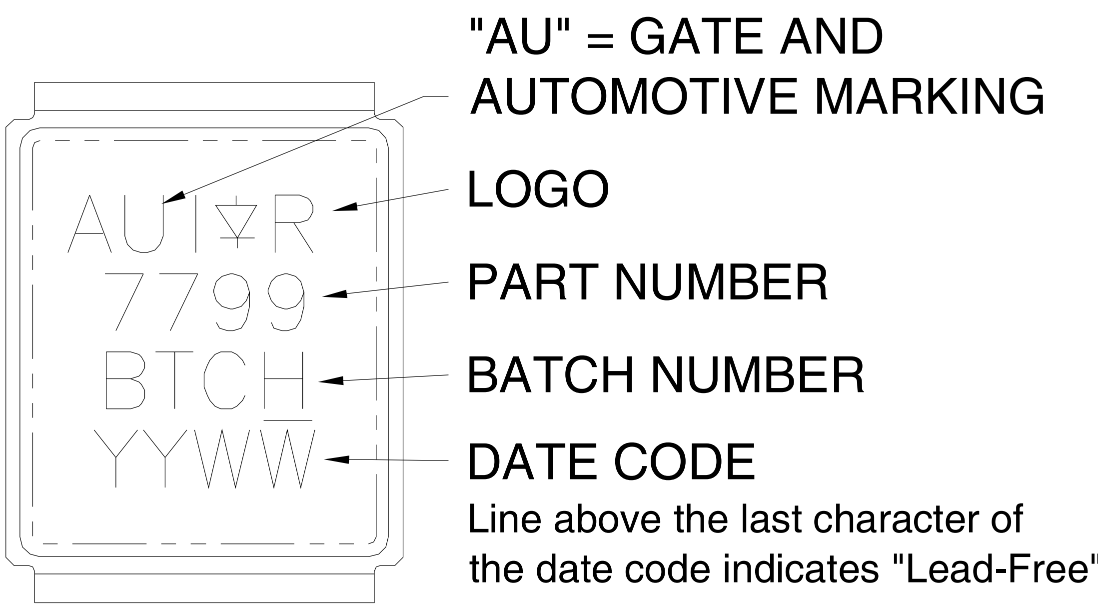
## Automotive DirectFET® Outline Dimension, L8 Outline (LargeSize Can).

Please see AN-1035 for DirectFET® assembly details and stencil and substrate design recommendations



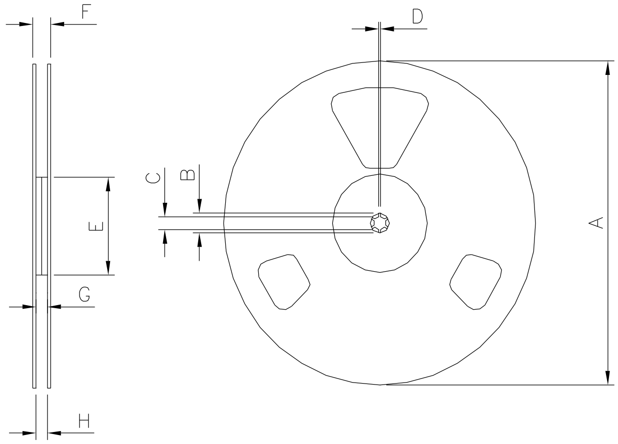

| DIMENSIONS | | | | |
|---|---|---|---|---|
| | METRIC | | IMPERIAL | |
| CODE | MIN | MAX | MIN | MAX |
| A | 9.05 | 9.15 | 0.356 | 0.360 |
| B | 6.85 | 7.10 | 0.270 | 0.280 |
| C | 5.90 | 6.00 | 0.232 | 0.236 |
| D | 0.55 | 0.65 | 0.022 | 0.026 |
| E | 0.58 | 0.62 | 0.023 | 0.024 |
| F | 1.18 | 1.22 | 0.046 | 0.048 |
| G | 0.98 | 1.02 | 0.039 | 0.040 |
| H | 0.73 | 0.77 | 0.029 | 0.030 |
| J | 0.38 | 0.42 | 0.015 | 0.017 |
| K | 1.35 | 1.45 | 0.053 | 0.057 |
| L | 2.55 | 2.65 | 0.100 | 0.104 |
| L1 | 5.35 | 5.45 | 0.211 | 0.215 |
| 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 |

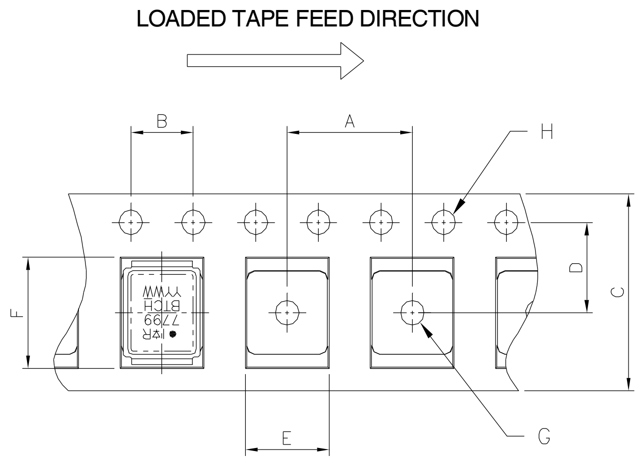
## Automotive DirectFET® Part Marking




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

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




NOTE: Controlling dimensions in mm
Std reel quantity is 4000 parts. (ordered as AUIRF7799L2TR). For 1000 parts on 7" reel, order AUIRF7799L2TR1

| REEL DIMENSIONS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | STANDARD OPTION **(QTY 4000)** | | | | TR1 OPTION **(QTY 1000)** | | | |
| | METRIC | | IMPERIAL | | METRIC | | IMPERIAL | |
| CODE | MIN | MAX | MIN | MAX | MIN | MAX | MIN | MAX |
| A | 330.00 | N.C | 12.992 | N.C | 177.80 | N.C | 7.000 | N.C |
| B | 20.20 | N.C | 0.795 | N.C | 20.20 | N.C | 0.795 | N.C |
| C | 12.80 | 13.20 | 0.504 | 0.520 | 12.98 | 13.50 | 0.331 | 0.50 |
| D | 1.50 | N.C | 0.059 | N.C | 1.50 | 2.50 | 0.059 | N.C |
| E | 99.00 | 100.00 | 3.900 | 3.940 | 62.48 | N.C | 2.460 | N.C |
| F | N.C | 22.40 | N.C | 0.880 | N.C | N.C | N.C | 0.53 |
| G | 16.40 | 18.40 | 0.650 | 0.720 | N.C | N.C | N.C | N.C |
| H | 15.90 | 19.40 | 0.630 | 0.760 | 16.00 | N.C | 0.630 | N.C |

NOTE: CONTROLLING DIMENSIONS IN MM

| DIMENSIONS | | | | |
|---|---|---|---|---|
| | METRIC | | IMPERIAL | |
| CODE | MIN | MAX | MIN | MAX |
| A | 11.90 | 12.10 | 4.69 | 0.476 |
| B | 3.90 | 4.10 | 0.154 | 0.161 |
| C | 15.90 | 16.30 | 0.623 | 0.642 |
| D | 7.40 | 7.60 | 0.291 | 0.299 |
| E | 7.20 | 7.40 | 0.283 | 0.291 |
| F | 9.90 | 10.10 | 0.390 | 0.398 |
| 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

Notes:

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 $T_J = 25°C$, $L = 1.42mH$, $R_G = 25\Omega$, $I_{AS} = 21A$.
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 heatsink.
⑩ $R_\theta$ is measured at $T_J$ of approximately 90°C.

## Ordering Information

| Base part number | Package Type | Standard Pack | | Complete Part Number |
|---|---|---|---|---|
| | | Form | Quantity | |
| AUIRF7799L2 | DirectFET2 Large Can | Tape and Reel | 4000 | AUIRF7799L2TR |
| | | Tape and Reel | 1000 | AUIRF7799L2TR1 |

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