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IR Rectifier

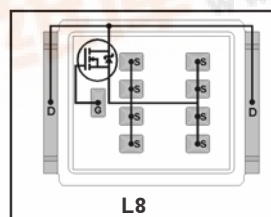
AUTOMOTIVE GRADE

AUIRF7739L2TR
AUIRF7739L2TR1

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

| | |
|--------------------------|--------------|
| $V_{(BR)DSS}$ | 40V |
| $R_{DS(on)}$ typ. | 700μΩ |
| | max. |
| I_D (Silicon Limited) | 270A |
| Q_g | 220nC |



Applicable DirectFET Outline and Substrate Outline ①

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

Description

The AUIRF7739L2TR(1) 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 AUIRF7739L2TR(1) 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 Q_g 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

| | 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 | 270 | A |
| I _D @ T _C = 100°C | Continuous Drain Current, V _{GS} @ 10V (Silicon Limited)④ | 190 | |
| I _D @ T _A = 25°C | Continuous Drain Current, V _{GS} @ 10V (Silicon Limited)③ | 46 | |
| I _D @ T _C = 25°C | Continuous Drain Current, V _{GS} @ 10V (Package Limited) | 375 | |
| I _{DM} | Pulsed Drain Current ④ | 1070 | |
| P _D @T _C = 25°C | Power Dissipation ④ | 125 | W |
| P _D @T _A = 25°C | Power Dissipation ③ | 3.8 | |
| E _{AS} | Single Pulse Avalanche Energy (Thermally Limited) ⑥ | 270 | mJ |
| E _{AS} (tested) | Single Pulse Avalanche Energy Tested Value ⑤ | 160 | |
| I _{AR} | Avalanche Current ⑤ | See Fig.12a, 12b, 15, 16 | A |
| E _{AR} | Repetitive Avalanche Energy ⑤ | | mJ |
| T _P | Peak Soldering Temperature | 270 | °C |
| T _J | Operating Junction and | -55 to + 175 | |
| T _{STG} | Storage Temperature Range | | |

Thermal Resistance

| | Parameter | Typ. | Max. | Units |
|--------------------|--------------------------|------|------|---------------------------|
| $R_{\theta JA}$ | Junction-to-Ambient ③ | — | 40 | $^\circ\text{C}/\text{W}$ |
| $R_{\theta JA}$ | Junction-to-Ambient ⑧ | 12.5 | — | |
| $R_{\theta JA}$ | Junction-to-Ambient ⑨ | 20 | — | |
| $R_{\theta JCan}$ | Junction-to-Can ④⑩ | — | 1.2 | |
| $R_{\theta J-PCB}$ | Junction-to-PCB Mounted | — | 0.5 | |
| | Linear Derating Factor ④ | 0.83 | | W/ $^\circ\text{C}$ |

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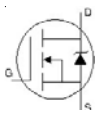
Static Characteristics @ $T_J = 25^\circ\text{C}$ (unless otherwise stated)

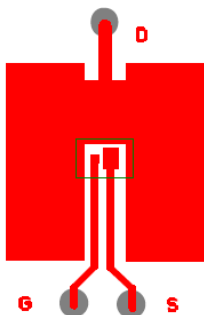
| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---------------------------------|--------------------------------------|------|-------|------|----------------------|--|
| $V_{(BR)DSS}$ | Drain-to-Source Breakdown Voltage | 40 | — | — | V | $V_{GS} = 0V, I_D = 250\mu A$ |
| $\Delta V_{(BR)DSS}/\Delta T_J$ | Breakdown Voltage Temp. Coefficient | — | 0.008 | — | V/ $^\circ\text{C}$ | Reference to $25^\circ\text{C}, I_D = 1mA$ |
| $R_{DS(on)}$ | Static Drain-to-Source On-Resistance | — | 700 | 1000 | $\mu\Omega$ | $V_{GS} = 10V, I_D = 160A$ ② |
| $V_{GS(th)}$ | Gate Threshold Voltage | 2.0 | 2.8 | 4.0 | V | $V_{DS} = V_{GS}, I_D = 250\mu A$ |
| $\Delta V_{GS(th)}/\Delta T_J$ | Gate Threshold Voltage Coefficient | — | -6.7 | — | mV/ $^\circ\text{C}$ | |
| g_{fs} | Forward Transconductance | 280 | — | — | S | $V_{DS} = 10V, I_D = 160A$ |
| R_G | Gate Resistance | — | 1.5 | — | Ω | |
| I_{DSS} | Drain-to-Source Leakage Current | — | — | 5.0 | μA | $V_{DS} = 40V, V_{GS} = 0V$ |
| | | — | — | 250 | | $V_{DS} = 40V, V_{GS} = 0V, T_J = 125^\circ\text{C}$ |
| I_{GSS} | Gate-to-Source Forward Leakage | — | — | 100 | nA | $V_{GS} = 20V$ |
| | Gate-to-Source Reverse Leakage | — | — | -100 | | $V_{GS} = -20V$ |

Dynamic Characteristics @ $T_J = 25^\circ\text{C}$ (unless otherwise stated)

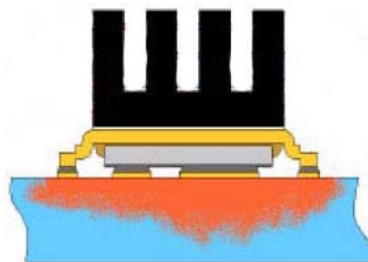
| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|------------------------|--|------|-------|------|-------|---|
| Q_g | Total Gate Charge | — | 220 | 330 | nC | $V_{DS} = 20V, V_{GS} = 10V$ $I_D = 160A$ See Fig. 11 |
| Q_{gs1} | Pre-V _{th} Gate-to-Source Charge | — | 46 | — | | |
| Q_{gs2} | Post-V _{th} Gate-to-Source Charge | — | 19 | — | | |
| Q_{gd} | Gate-to-Drain ("Miller") Charge | — | 81 | — | | |
| Q_{godr} | Gate Charge Overdrive | — | 74 | — | | |
| Q_{sw} | Switch Charge ($Q_{gs2} + Q_{gd}$) | — | 100 | — | nC | $V_{DS} = 16V, V_{GS} = 0V$ |
| Q_{oss} | Output Charge | — | 83 | — | | |
| $t_{d(on)}$ | Turn-On Delay Time | — | 21 | — | ns | $V_{DD} = 20V, V_{GS} = 10V$ ⑦ $I_D = 160A$ $R_G = 1.8\Omega$ |
| t_r | Rise Time | — | 71 | — | | |
| $t_{d(off)}$ | Turn-Off Delay Time | — | 56 | — | | |
| t_f | Fall Time | — | 42 | — | | |
| C_{iss} | Input Capacitance | — | 11880 | — | pF | $V_{GS} = 0V$ |
| C_{oss} | Output Capacitance | — | 2510 | — | | $V_{DS} = 25V$ |
| C_{rss} | Reverse Transfer Capacitance | — | 1240 | — | | $f = 1.0MHz$ |
| C_{oss} | Output Capacitance | — | 8610 | — | | $V_{GS} = 0V, V_{DS} = 1.0V, f = 1.0MHz$ |
| C_{oss} | Output Capacitance | — | 2230 | — | | $V_{GS} = 0V, V_{DS} = 32V, f = 1.0MHz$ |
| $C_{oss \text{ eff.}}$ | Effective Output Capacitance | — | 3040 | — | | $V_{GS} = 0V, V_{DS} = 0V \text{ to } 32V$ |

Diode Characteristics @ $T_J = 25^\circ\text{C}$ (unless otherwise stated)

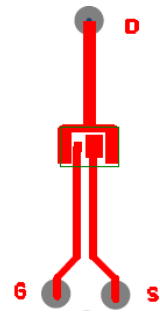
| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|----------|--|------|------|------|-------|--|
| I_S | Continuous Source Current (Body Diode) | — | — | 110 | A | MOSFET symbol showing the integral reverse p-n junction diode.  |
| I_{SM} | Pulsed Source Current (Body Diode) ③ | — | — | 1070 | | |
| V_{SD} | Diode Forward Voltage | — | — | 1.3 | V | $I_S = 160A, V_{GS} = 0V$ ⑦ |
| t_{rr} | Reverse Recovery Time | — | 87 | 130 | ns | $I_F = 160A, V_{DD} = 20V$ |
| Q_{rr} | Reverse Recovery Charge | — | 250 | 380 | nC | $di/dt = 100A/\mu s$ ⑦ |



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



④ Mounted to a PCB with small clip heatsink (still air)



⑤ 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[†]

| | | | |
|-----------------------------------|----------------------|---|------|
| Qualification Level | | Automotive (per AEC-Q101) ^{††} | |
| | | Comments: This part number(s) passed Automotive qualification. IR's Industrial and Consumer qualification level is granted by extension of the higher Automotive level. | |
| Moisture Sensitivity Level | | DFET2 | MSL1 |
| ESD | Machine Model | Class B AEC-Q101-002 | |
| | Human Body Model | Class 2 AEC-Q101-001 | |
| | Charged Device Model | Class IV AEC-Q101-005 | |
| RoHS Compliant | | Yes | |

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

†† Exceptions to AEC-Q101 requirements are noted in the qualification report.

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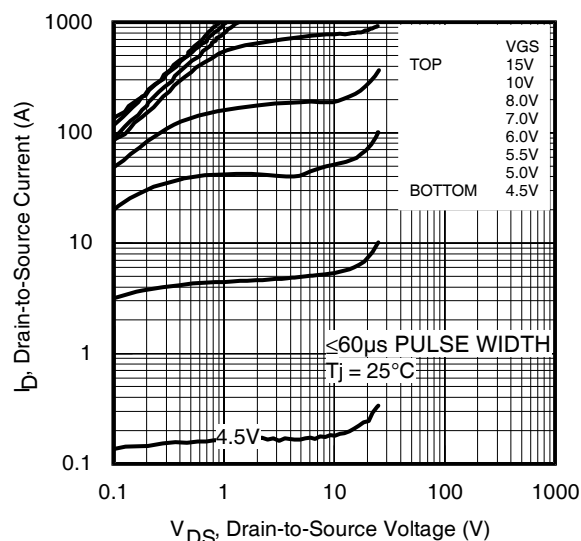


Fig 1. Typical Output Characteristics

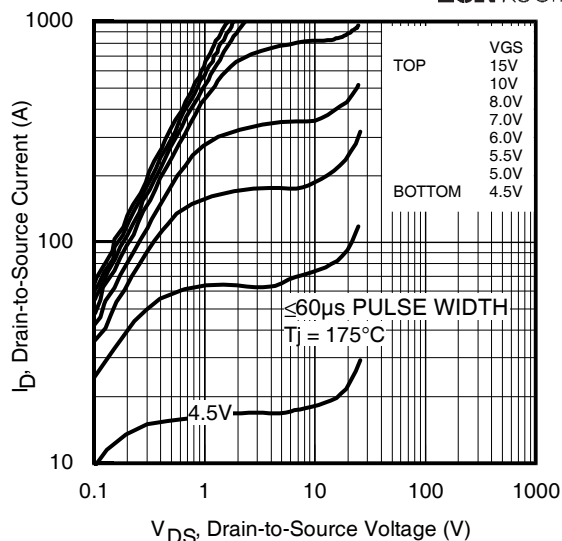


Fig 2. Typical Output Characteristics

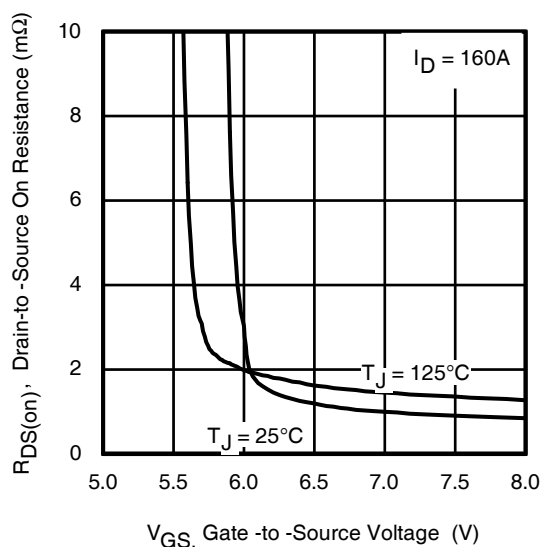


Fig 3. Typical On-Resistance vs. Gate Voltage

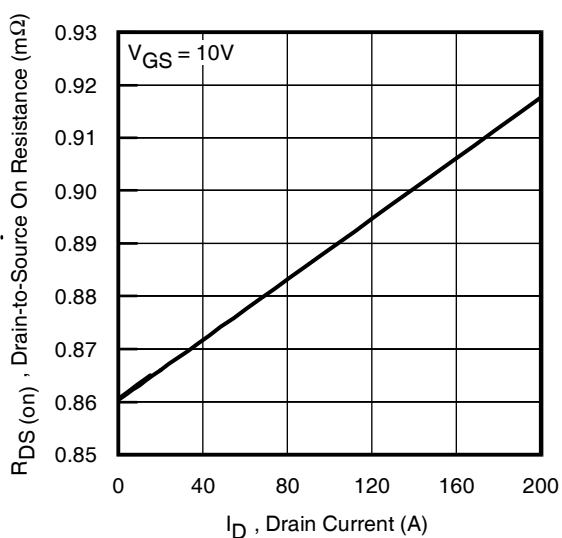


Fig 4. Typical On-Resistance vs. Drain Current

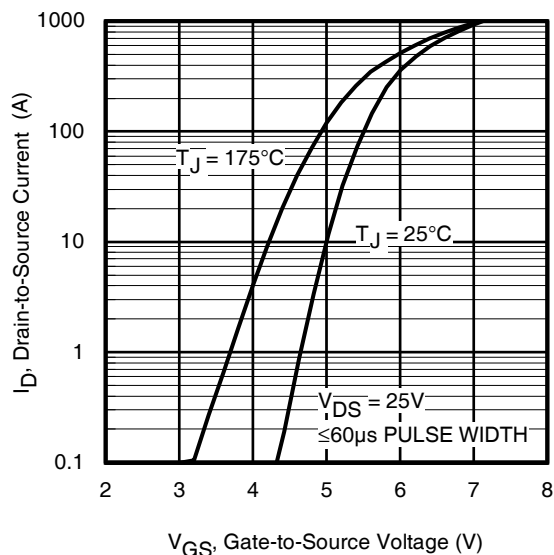


Fig 5. Typical Transfer Characteristics

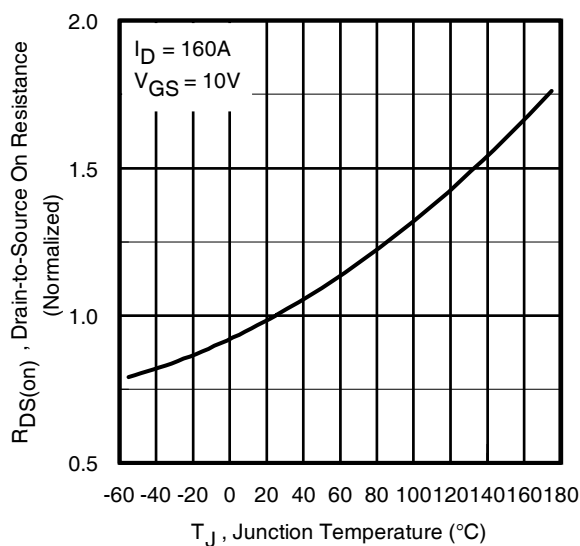


Fig 6. Normalized On-Resistance vs. Temperature

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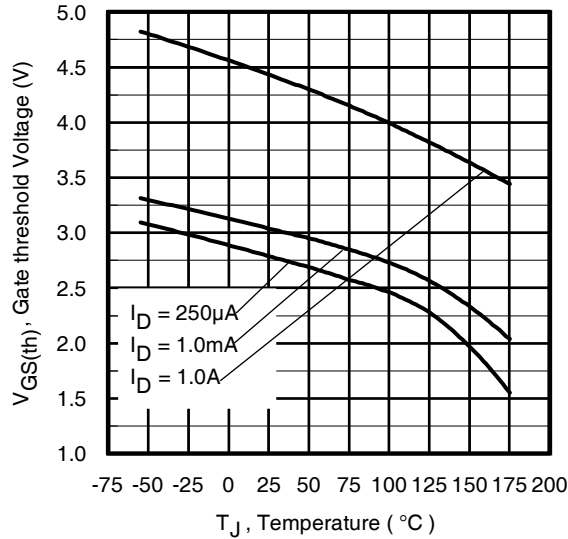


Fig 7. Typical Threshold Voltage vs. Junction Temperature

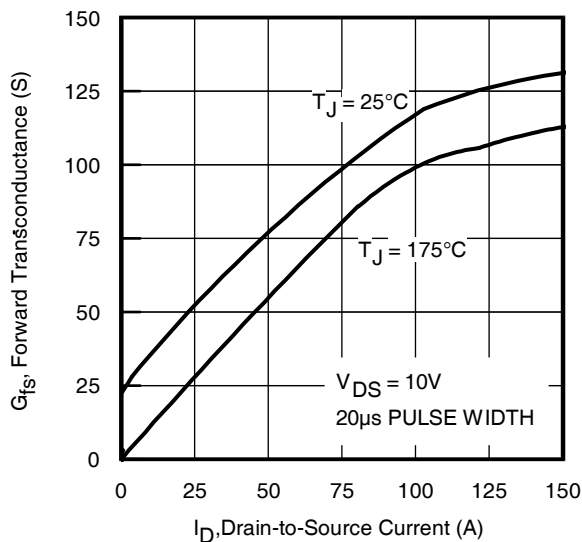


Fig 9. Typical Forward Transconductance vs. Drain Current

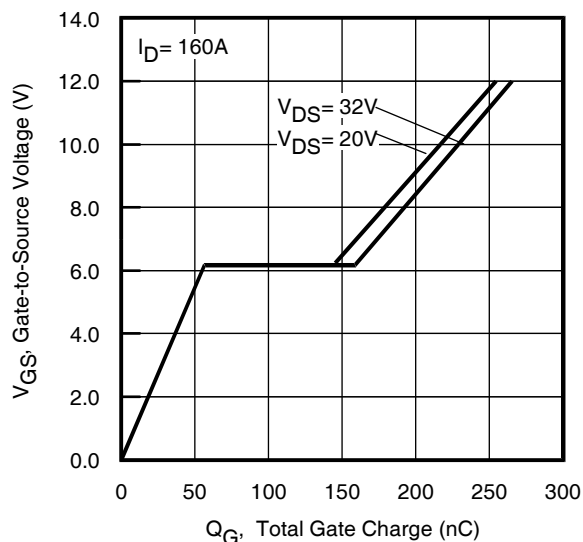


Fig.11 Typical Gate Charge vs. Gate-to-Source Voltage
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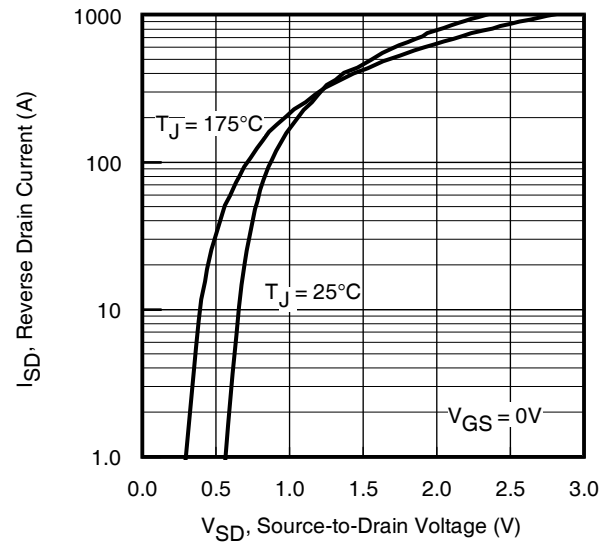


Fig 8. Typical Source-Drain Diode Forward Voltage

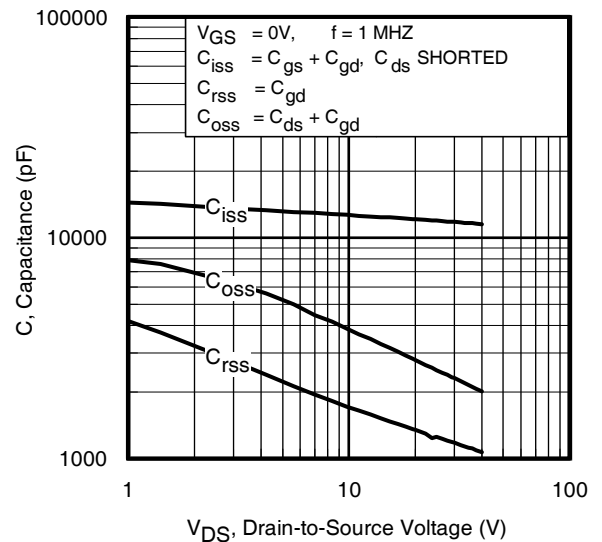


Fig 10. Typical Capacitance vs. Drain-to-Source Voltage

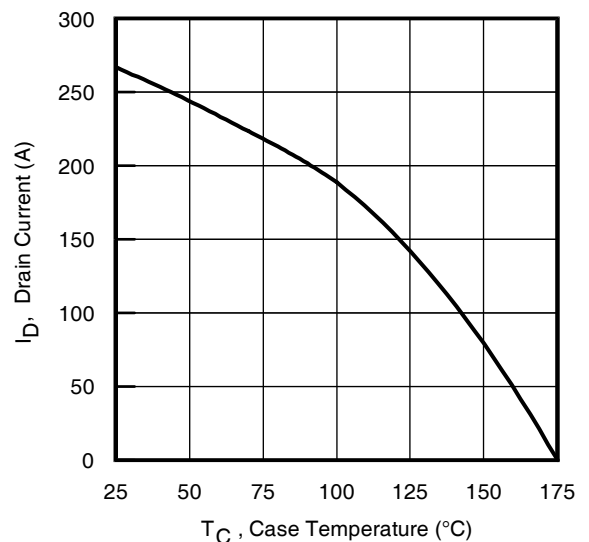


Fig 12. Maximum Drain Current vs. Case Temperature

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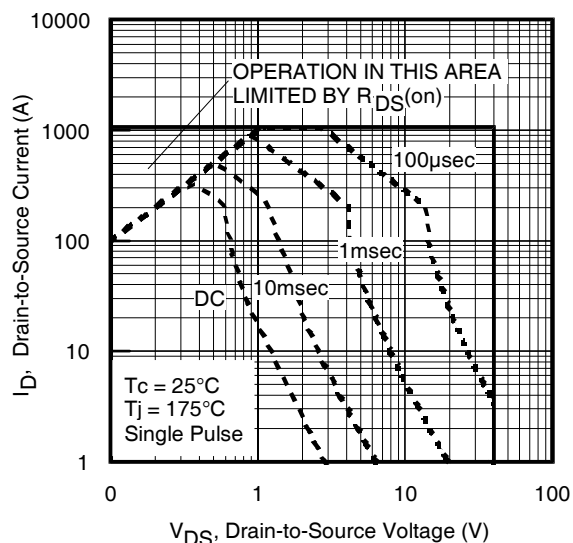


Fig 13. Maximum Safe Operating Area

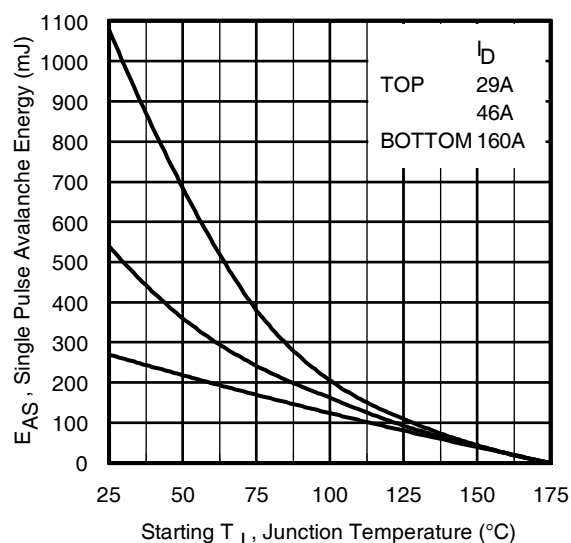


Fig 14. Maximum Avalanche Energy vs. Temperature

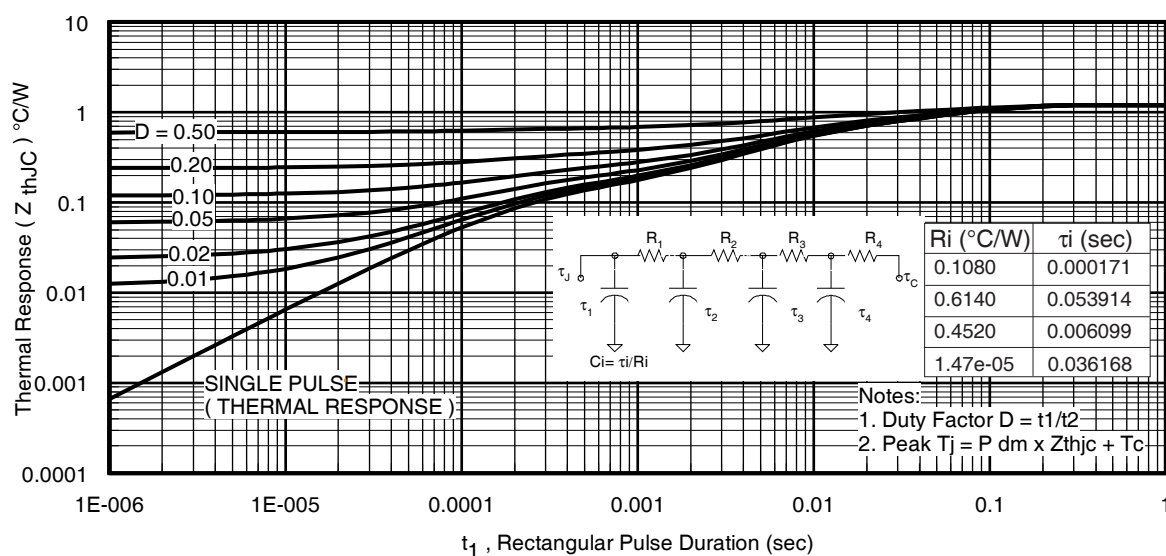


Fig 15. Maximum Effective Transient Thermal Impedance, Junction-to-Case

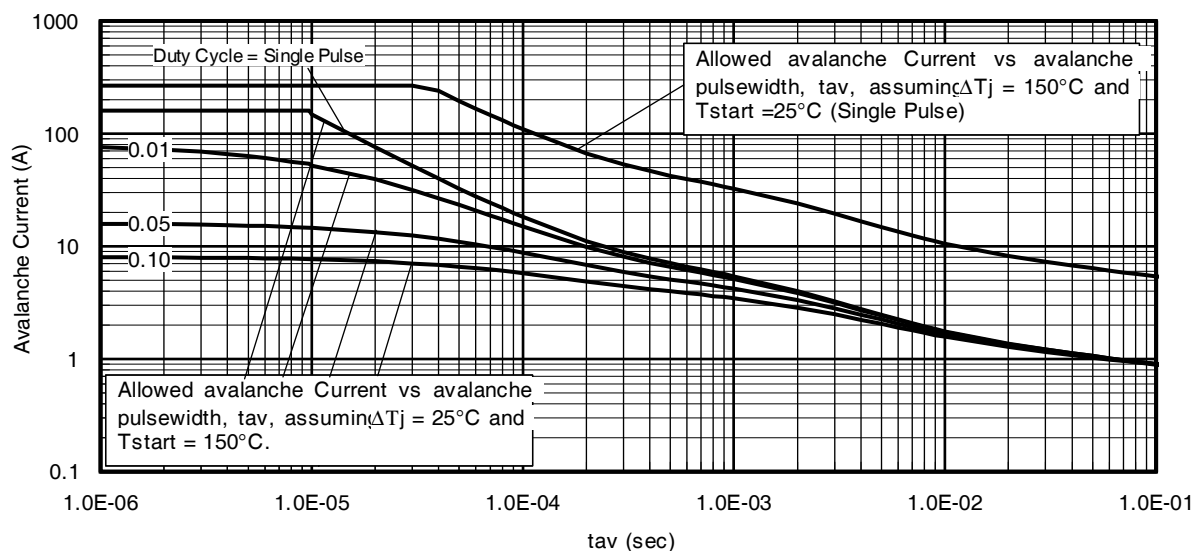


Fig 16. Typical Avalanche Current vs. Pulsewidth

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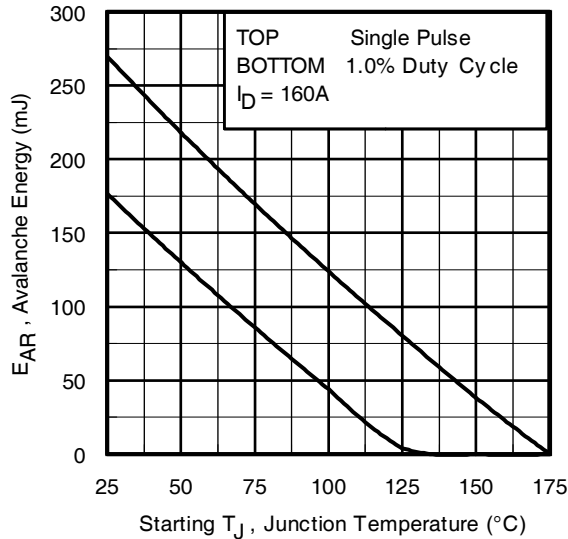


Fig 17. Maximum Avalanche Energy vs. Temperature

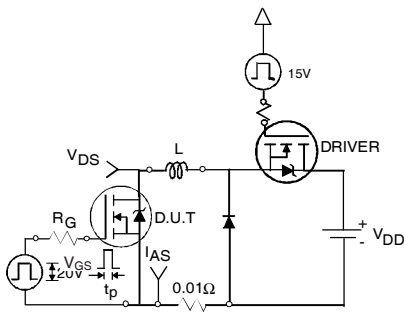


Fig 18a. Unclamped Inductive Test Circuit

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Notes on Repetitive Avalanche Curves , Figures 13, 14:
(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 16a, 16b.
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. ΔT = 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)

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

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

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

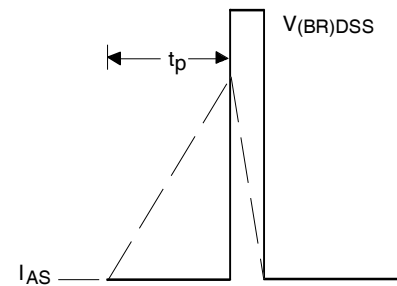


Fig 18b. Unclamped Inductive Waveforms

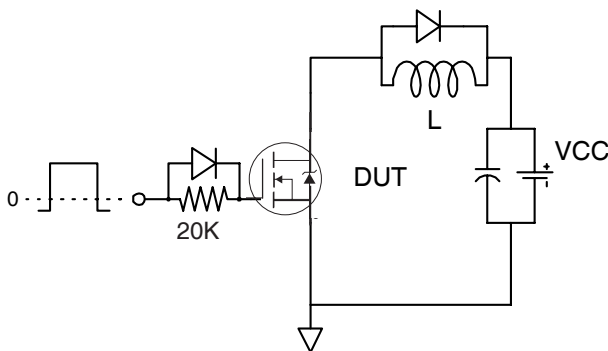


Fig 19a. Gate Charge Test Circuit

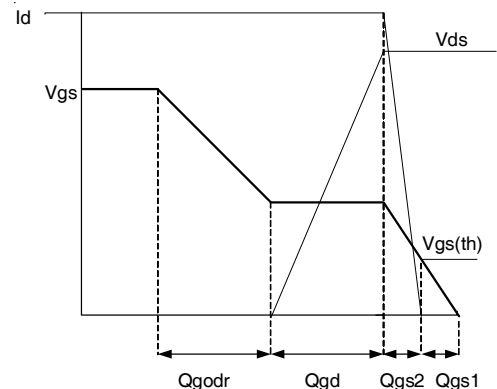


Fig 19b. Gate Charge Waveform

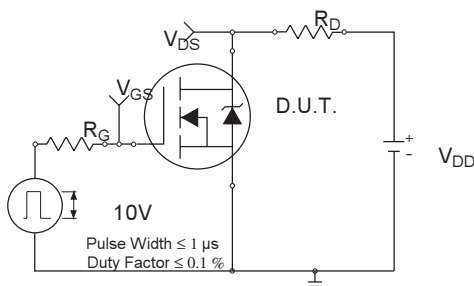


Fig 20a. Switching Time Test Circuit

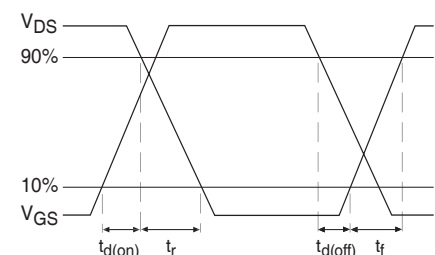


Fig 20b. Switching Time Waveforms

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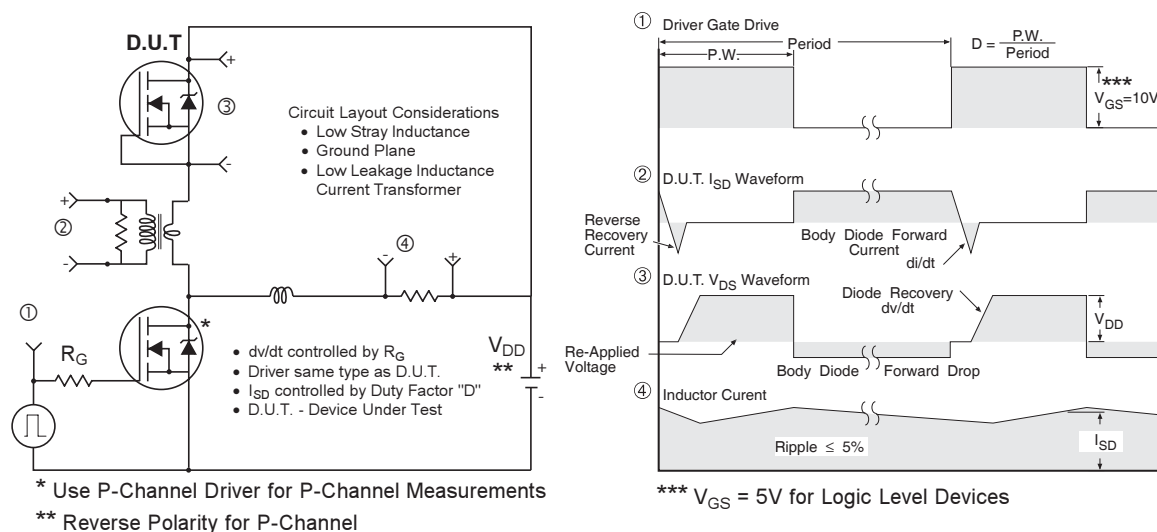
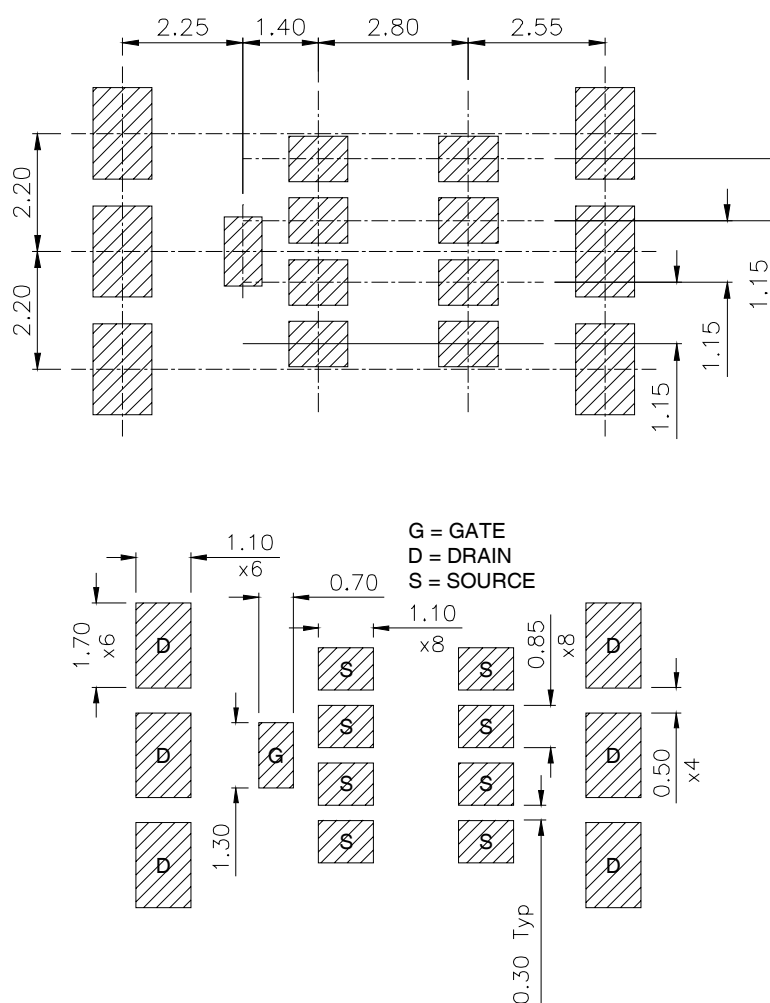


Fig 21. Diode Reverse Recovery Test Circuit for HEXFET® Power MOSFETs

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

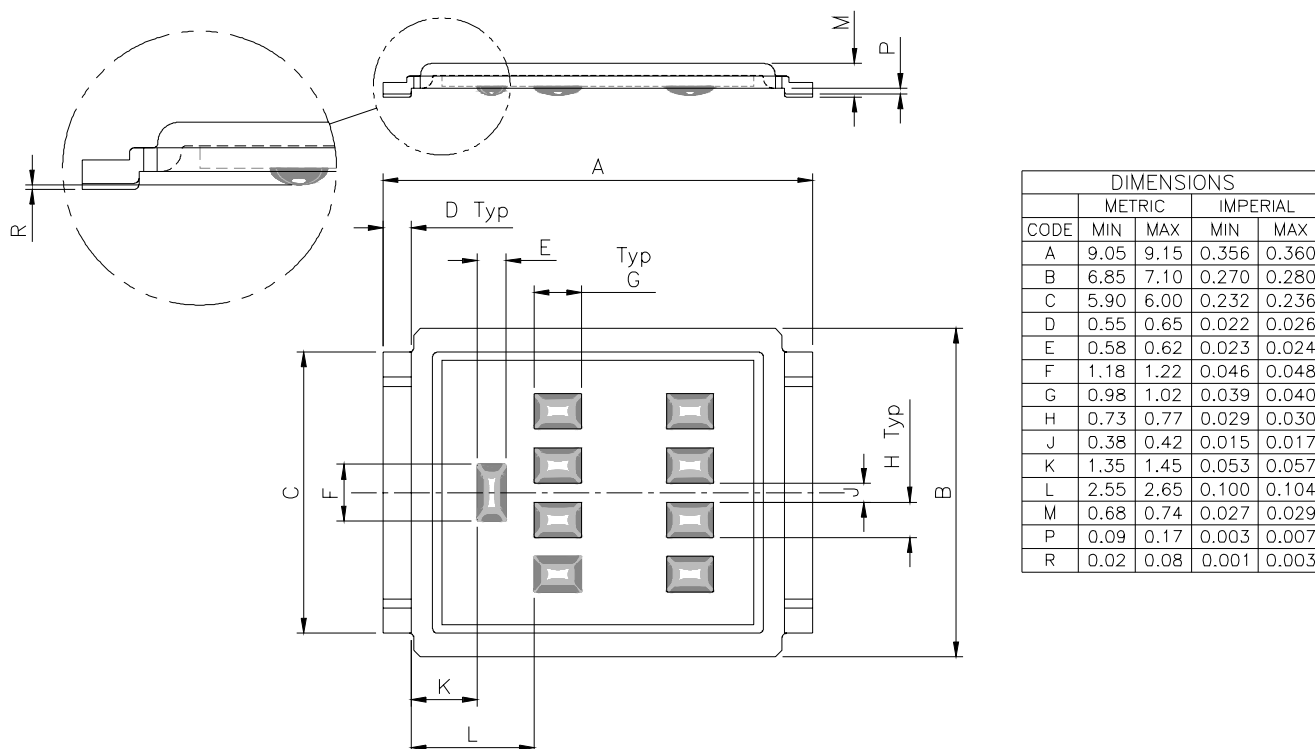
Please see AN-1035 for DirectFET assembly details and stencil and substrate design recommendations



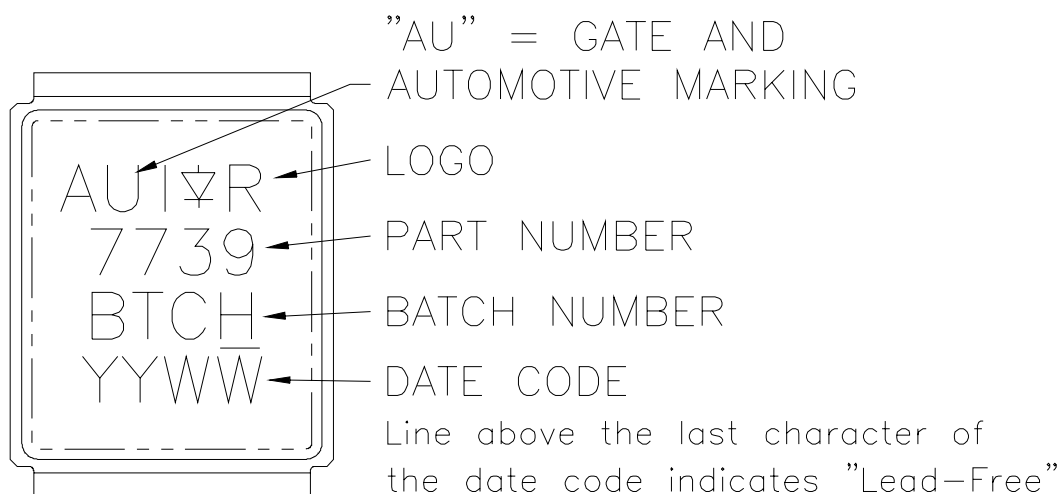
Note: For the most current drawing please refer to IR website at <http://www.irf.com/package>

Automotive DirectFET™ Outline Dimension, L8 Outline (LargeSize Can).

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



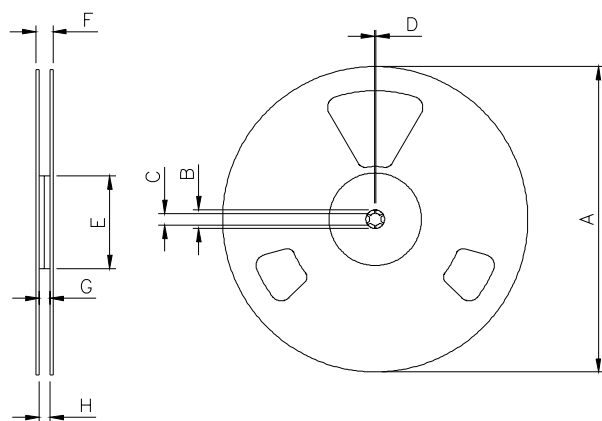
Automotive DirectFET™ Part Marking



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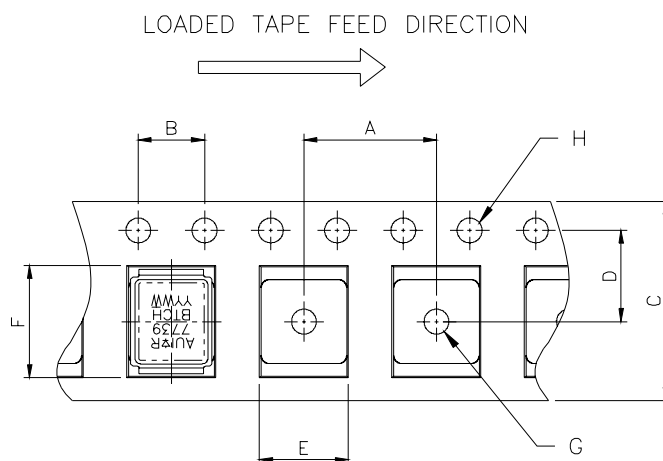
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Automotive DirectFET™ Tape & Reel Dimension (Showing component orientation).



NOTE: Controlling dimensions in mm
Std reel quantity is 4000 parts. (ordered as AUIRF7739L2TR). For 1000 parts on 7" reel, order AUIRF7739L2TR1

| REEL DIMENSIONS | | | | | | | | |
|----------------------------|--------|--------|----------|-----------------------|--------|-------|----------|------|
| STANDARD OPTION (QTY 4000) | | | | TR1 OPTION (QTY 1000) | | | | |
| CODE | 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 | | | | |
|------------|--------|-------|----------|-------|
| CODE | METRIC | | IMPERIAL | |
| | 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 $T_J = 25^\circ\text{C}$, $L = 0.021\text{mH}$, $R_G = 25\Omega$, $I_{AS} = 160\text{A}$.
- ⑦ Pulse width $\leq 400\mu\text{s}$; 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 heatsink.
- ⑩ R_θ is measured at T_J of approximately 90°C .

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IR warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with IR's standard warranty. Testing and other quality control techniques are used to the extent IR deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

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