

IRF9395MPbF
IRF9395MTRPbF

DirectFET™ dual P-Channel Power MOSFET ②

Typical values (unless otherwise specified)

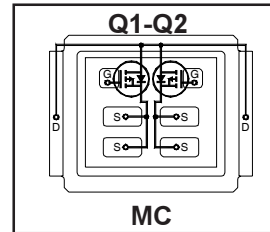
| | | | | |
|--------------------------|-----------------------|---------------------------|------------------------|---------------------------|
| V_{DSS} | V_{GS} | R_{DS(on)} | | |
| -30V max | ±20V max | 5.3mΩ@-10V | 9.0mΩ@-4.5V | |
| Q_{g tot} | Q_{gd} | Q_{gs2} | Q_{rr} | |
| 32nC | 15nC | 3.2nC | 62nC | |
| | | | Q_{oss} | |
| | | | 23nC | |
| | | | | V_{gs(th)} |
| | | | | -1.8V |

Applications

- Isolation Switch for Input Power or Battery Application

Features and Benefits

- Environmentally Friendly Product
- RoHs Compliant Containing no Lead, no Bromide and no Halogen
- Dual Common-Drain P-Channel MOSFETs Provides High Level of Integration and Very Low RDS(on)



Applicable DirectFET Outline and Substrate Outline (see p.7,8 for details)①

| | | | | | | | | | | |
|----|----|----|--|----|----|----|----|-----------|--|--|
| SQ | SX | ST | | MQ | MX | MT | MP | MC | | |
|----|----|----|--|----|----|----|----|-----------|--|--|

Description

The IRF9395MTRPbF combines the latest HEXFET® P-Channel 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 SO-8 and only 0.6 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 power systems, improving previous best thermal resistance by 80%.

| Orderable part number | Package Type | Standard Pack | | Note |
|-----------------------|----------------------|---------------|----------|------|
| | | Form | Quantity | |
| IRF9395MTRPbF | DirectFET Medium Can | Tape and Reel | 4800 | |
| IRF9395MTR1PbF | DirectFET Medium Can | Tape and Reel | 1000 | |

Absolute Maximum Ratings

| | Parameter | Max. | Units |
|--|---|------|-------|
| V _{DS} | Drain-to-Source Voltage | -30 | V |
| V _{GS} | Gate-to-Source Voltage | ±20 | V |
| I _D @ T _A = 25°C | Continuous Drain Current, V _{GS} @ 10V ③ | -14 | A |
| I _D @ T _A = 70°C | Continuous Drain Current, V _{GS} @ 10V ③ | -11 | |
| I _D @ T _C = 25°C | Continuous Drain Current, V _{GS} @ 10V ④ | -75 | |
| I _{DM} | Pulsed Drain Current ⑤ | -110 | |

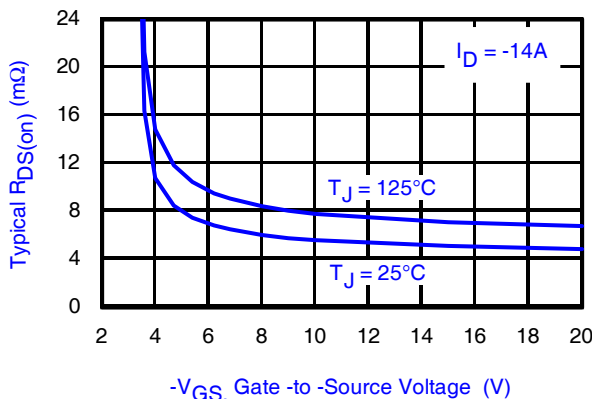


Fig 1. Typical On-Resistance vs. Gate Voltage

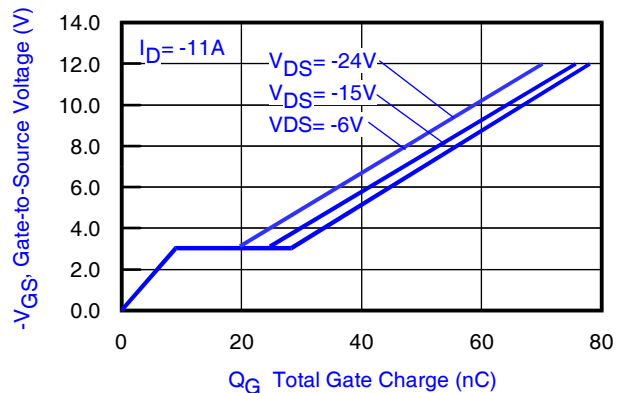


Fig 2. Typical Total Gate Charge vs. Gate-to-Source Voltage

Notes:

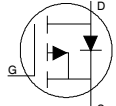
- ① Click on this section to link to the appropriate technical paper.
- ② Click on this section to link to the DirectFET Website.
- ③ Surface mounted on 1 in. square Cu board, steady state.

- ④ T_C measured with thermocouple mounted to top (Drain) of part.
- ⑤ Repetitive rating; pulse width limited by max. junction temperature.

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

| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---------------------------------------|---|------|-------|------|-------|---|
| BV _{DSS} | Drain-to-Source Breakdown Voltage | -30 | — | — | V | V _{GS} = 0V, I _D = -250μA |
| ΔBV _{DSS} /ΔT _J | Breakdown Voltage Temp. Coefficient | — | 0.012 | — | mV/°C | Reference to 25°C, I _D = -1.0mA |
| R _{DS(on)} | Static Drain-to-Source On-Resistance | — | 5.3 | 7.0 | mΩ | V _{GS} = -10V, I _D = -14A ⑥ |
| | | — | 9.0 | 11.9 | | V _{GS} = -4.5V, I _D = -11 A ⑥ |
| V _{GS(th)} | Gate Threshold Voltage | -1.3 | -1.8 | -2.4 | V | V _{DS} = V _{GS} , I _D = -50μA |
| ΔV _{GS(th)} /ΔT _J | Gate Threshold Voltage Coefficient | — | -6.1 | — | mV/°C | |
| I _{DSS} | Drain-to-Source Leakage Current | — | — | -1.0 | μA | V _{DS} = -24V, V _{GS} = 0V |
| | | — | — | -150 | | V _{DS} = -24V, 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 |
| gfs | Forward Transconductance | 40 | — | — | S | V _{DS} = -15V, I _D = -11A |
| Q _g | Total Gate Charge | — | 64 | — | nC | V _{DS} = -15V, V _{GS} = -10V, I _D = -11A V _{DS} = -15V V _{GS} = -4.5V I _D = -11A See Fig.15 |
| Q _g | Total Gate Charge | — | 32 | — | | |
| Q _{gs1} | Pre- V _{th} Gate-to-Source Charge | — | 6.5 | — | | |
| Q _{gs2} | Post -V _{th} Gate-to-Source Charge | — | 3.2 | — | | |
| Q _{gd} | Gate-to-Drain Charge | — | 15 | — | | |
| Q _{godr} | Gate Charge Overdrive | — | 7.3 | — | | |
| Q _{sw} | Switch charge (Q _{gs2} + Q _{gd}) | — | 18.2 | — | | |
| Q _{oss} | Output Charge | — | 23 | — | nC | V _{DS} = -16V, V _{GS} = 0V |
| R _G | Gate Resistance | — | 15 | — | Ω | |
| t _{d(on)} | Turn-On Delay Time | — | 16 | — | ns | V _{DD} = -15V, V _{GS} = -4.5V ⑥ I _D = -11A R _G = 1.8Ω See Fig.17 |
| t _r | Rise Time | — | 142 | — | | |
| t _{d(off)} | Turn-Off Delay Time | — | 76 | — | | |
| t _f | Fall Time | — | 121 | — | | |
| C _{iss} | Input Capacitance | — | 3241 | — | pF | V _{GS} = 0V V _{DS} = -15V f = 1.0KHz |
| C _{oss} | Output Capacitance | — | 820 | — | | |
| C _{rss} | Reverse Transfer Capacitance | — | 466 | — | | |

Diode Characteristics

| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|-----------------|---|------|------|------|-------|--|
| I _S | Continuous Source Current (Body Diode) | — | — | -57 | A | MOSFET symbol showing the integral reverse p-n junction diode.  |
| I _{SM} | Pulsed Source Current (Body Diode) ⑤ | — | — | -110 | | |
| V _{SD} | Diode Forward Voltage | — | — | -1.2 | V | T _J = 25°C, I _S = -11A, V _{GS} = 0V ⑥ |
| t _{rr} | Reverse Recovery Time | — | 43 | 65 | ns | T _J = 25°C, I _F = -11A, V _{DD} = -15V |
| Q _{rr} | Reverse Recovery Charge | — | 62 | 93 | nC | di/dt = 260A/μs ⑥ |

Notes:

⑥ Pulse width ≤ 400μs; duty cycle ≤ 2%.

Absolute Maximum Ratings

| | Parameter | Max. | Units |
|--------------------------------|----------------------------|--------------|------------------|
| $P_D @ T_A = 25^\circ\text{C}$ | Power Dissipation ③ | 2.1 | W |
| $P_D @ T_A = 70^\circ\text{C}$ | Power Dissipation ③ | 1.3 | |
| $P_D @ T_C = 25^\circ\text{C}$ | Power Dissipation ④ | 57 | |
| T_P | Peak Soldering Temperature | 270 | $^\circ\text{C}$ |
| T_J | Operating Junction and | -40 to + 150 | |
| T_{STG} | Storage Temperature Range | | |

Thermal Resistance

| | Parameter | Typ. | Max. | Units |
|--------------------|--------------------------|------|------|---------------------------|
| $R_{\theta JA}$ | Junction-to-Ambient ③ | — | 60 | $^\circ\text{C/W}$ |
| $R_{\theta JA}$ | Junction-to-Ambient ⑦ | 12.5 | — | |
| $R_{\theta JA}$ | Junction-to-Ambient ⑧ | 20 | — | |
| $R_{\theta JC}$ | Junction-to-Case ④,⑨ | — | 2.2 | |
| $R_{\theta J-PCB}$ | Junction-to-PCB Mounted | 1.0 | — | |
| | Linear Derating Factor ③ | 0.02 | | $\text{W}/^\circ\text{C}$ |

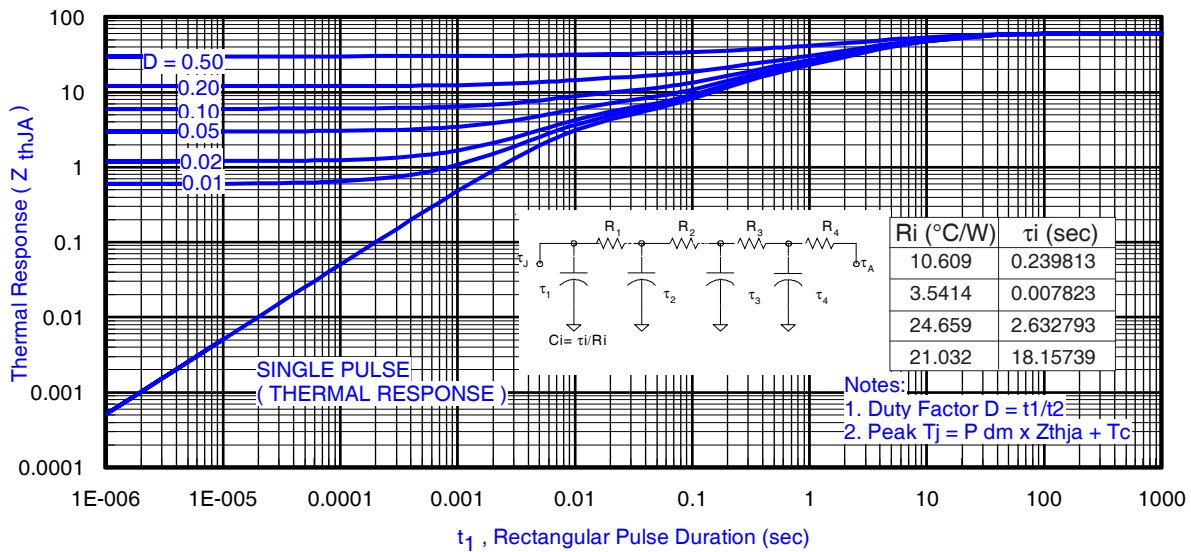
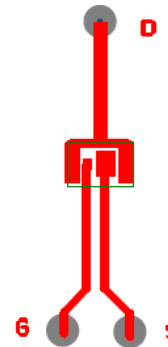
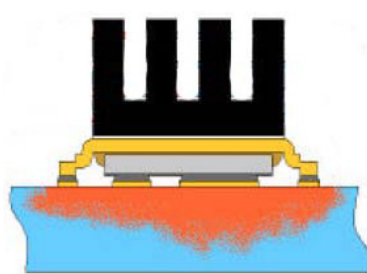
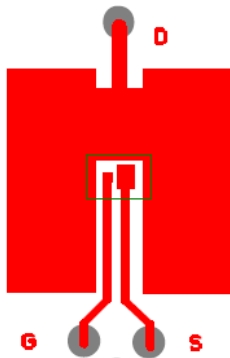


Fig 3. Maximum Effective Transient Thermal Impedance, Junction-to-Ambient ①

Notes:

- ⑦ Used double sided cooling, mounting pad with large heatsink.
- ⑧ Mounted on minimum footprint full size board with metalized back and with small clip heatsink.
- ⑨ R_{θ} is measured at T_J of approximately 90°C .



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

⑧ 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)

IRF9395MTRPbF

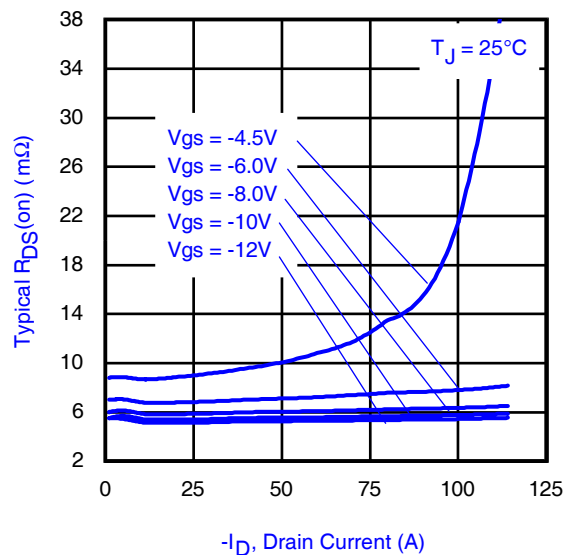
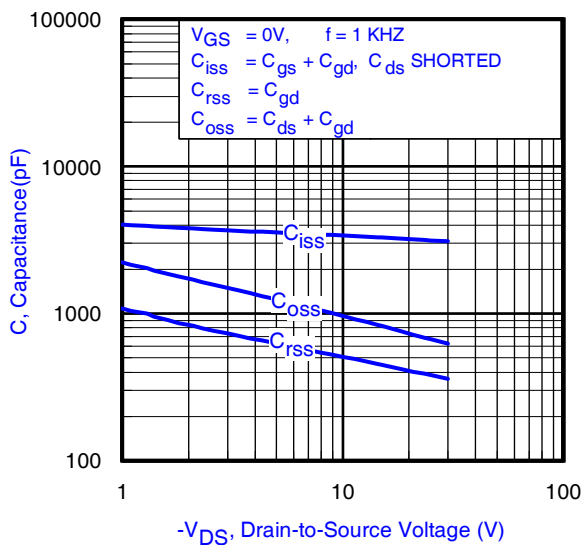
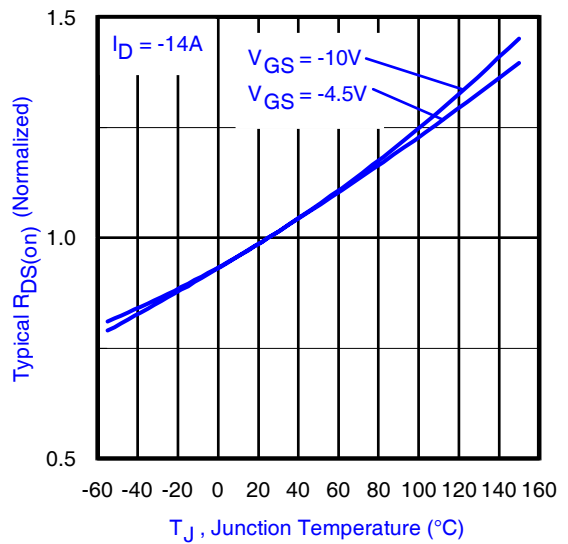
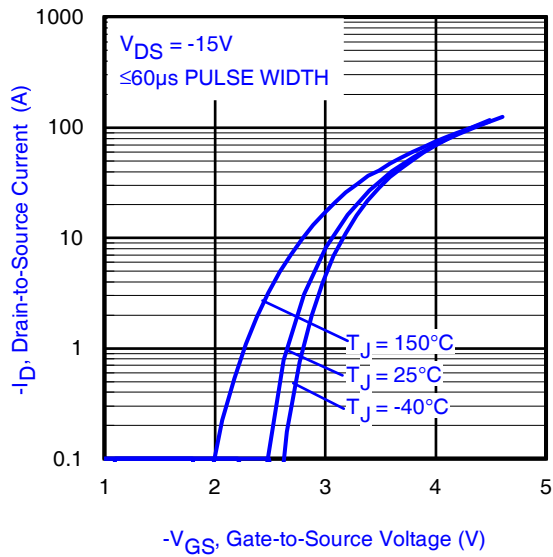
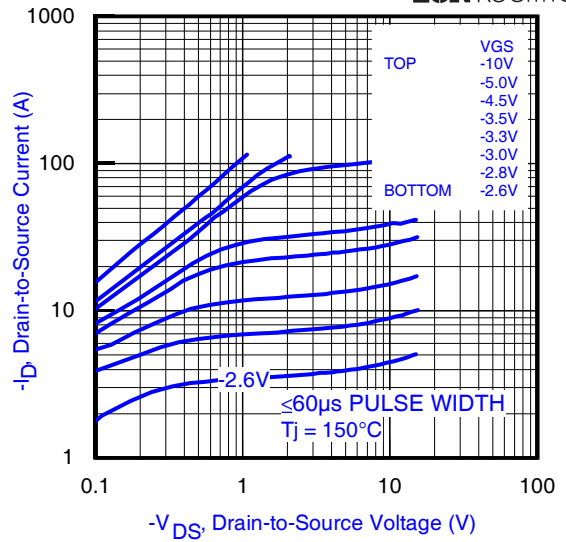
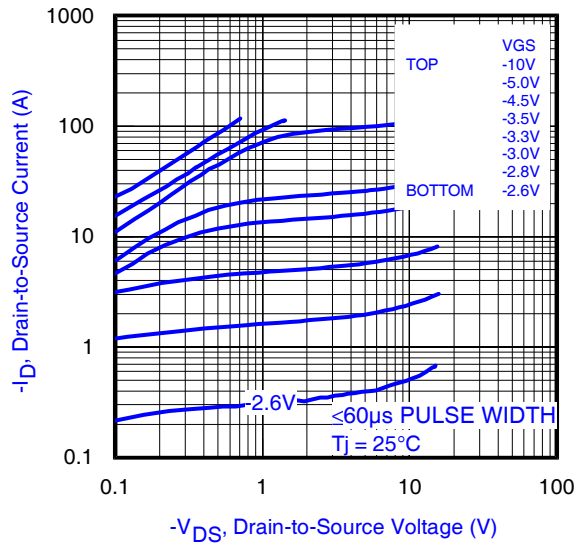


Fig 8. Typical Capacitance vs. Drain-to-Source Voltage

Fig 9. Typical On-Resistance vs. Drain Current and Gate Voltage

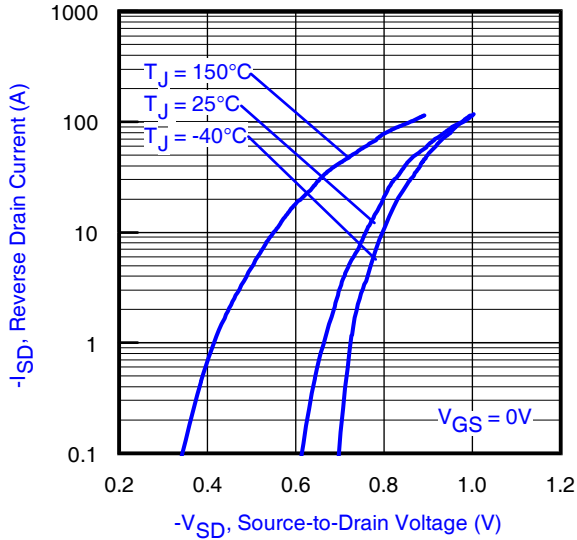


Fig 10. Typical Source-Drain Diode Forward Voltage

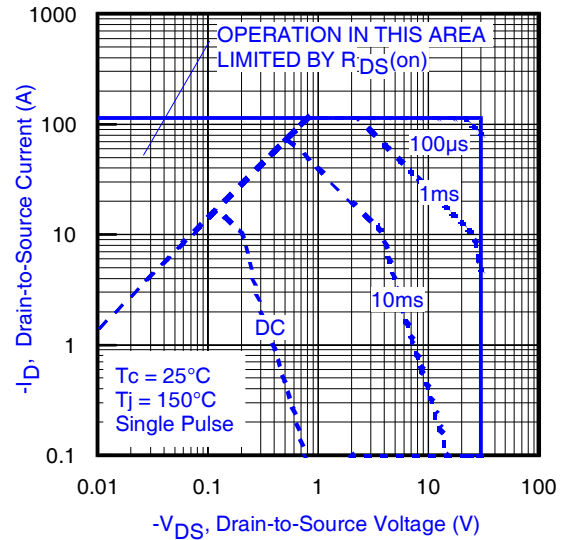


Fig 11. Maximum Safe Operating Area

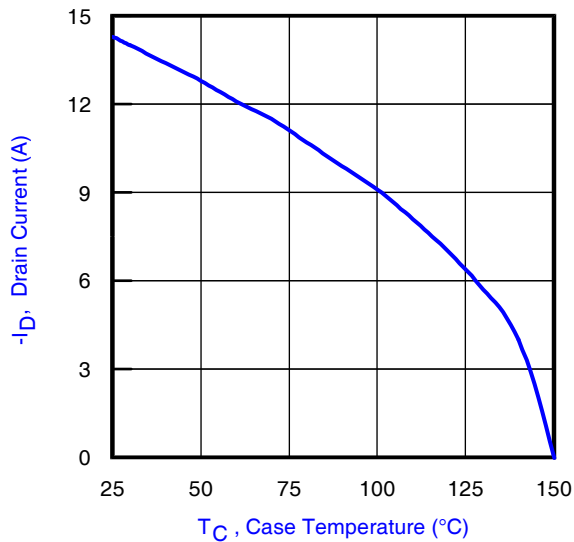


Fig 12. Maximum Drain Current vs. Case Temperature

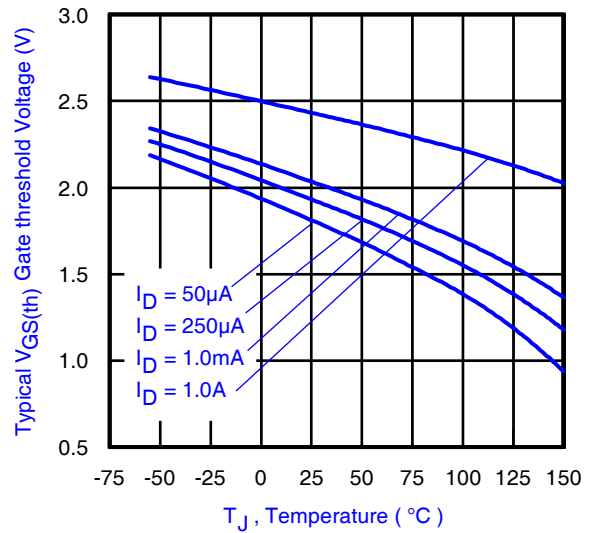


Fig 13. Typical Threshold Voltage vs. Junction Temperature

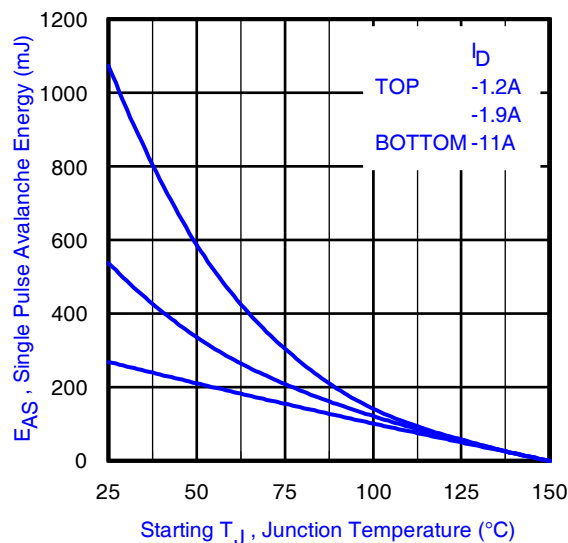


Fig 14. Maximum Avalanche Energy vs. Drain Current

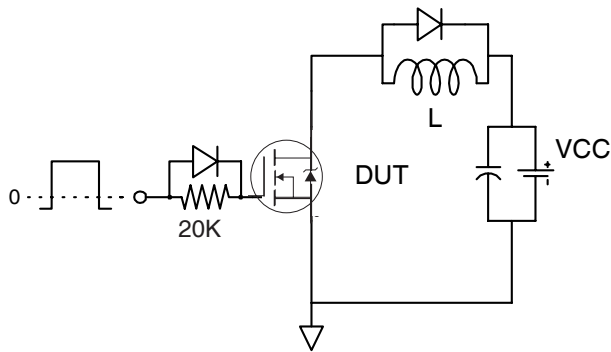


Fig 15a. Gate Charge Test Circuit

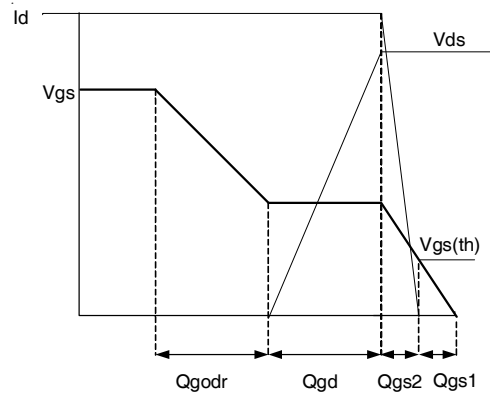


Fig 15b. Gate Charge Waveform

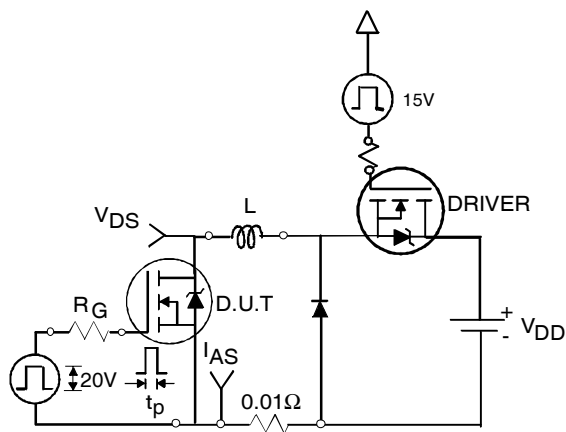


Fig 16a. Unclamped Inductive Test Circuit

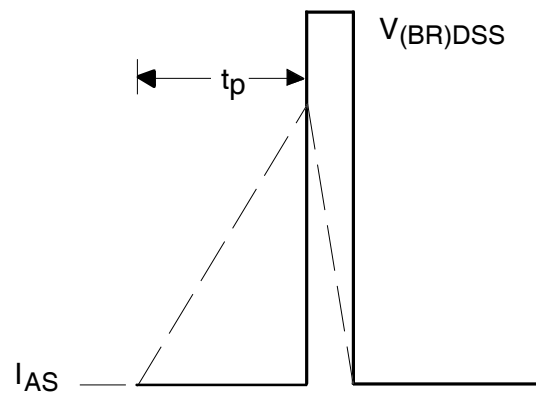


Fig 16b. Unclamped Inductive Waveforms

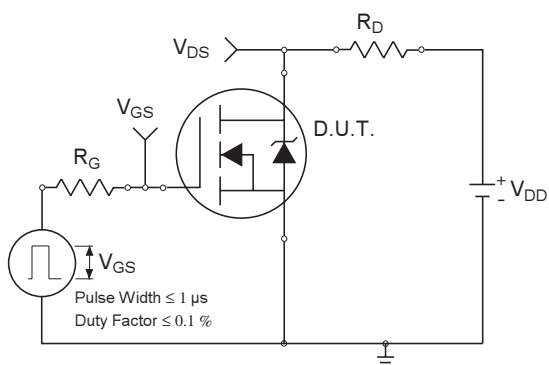


Fig 17a. Switching Time Test Circuit

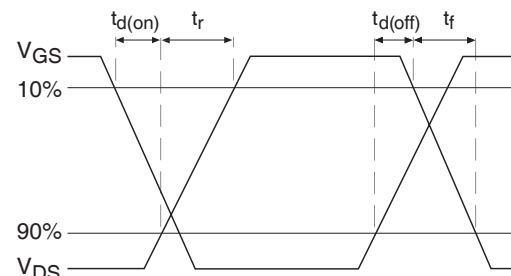


Fig 17b. Switching Time Waveforms

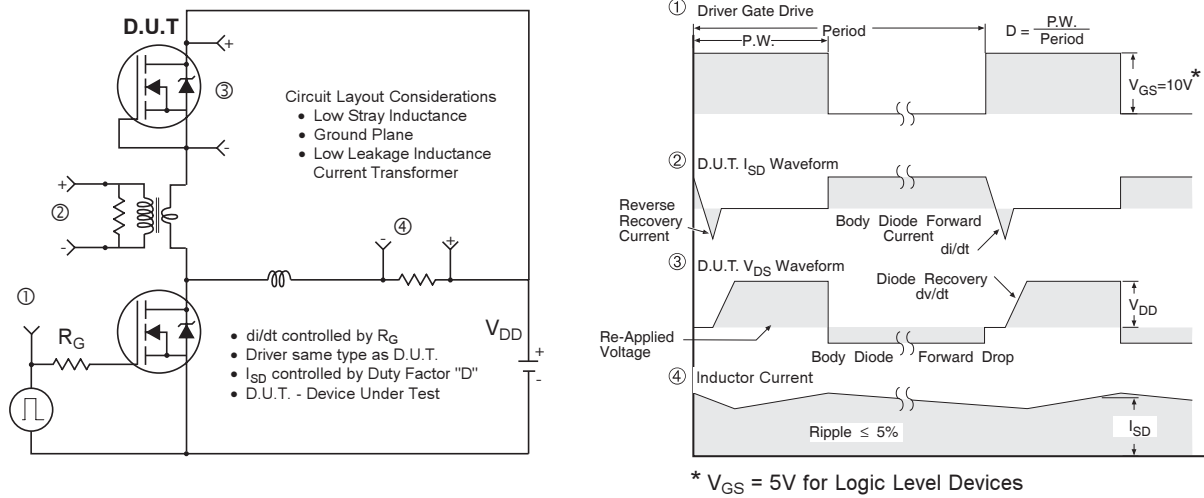
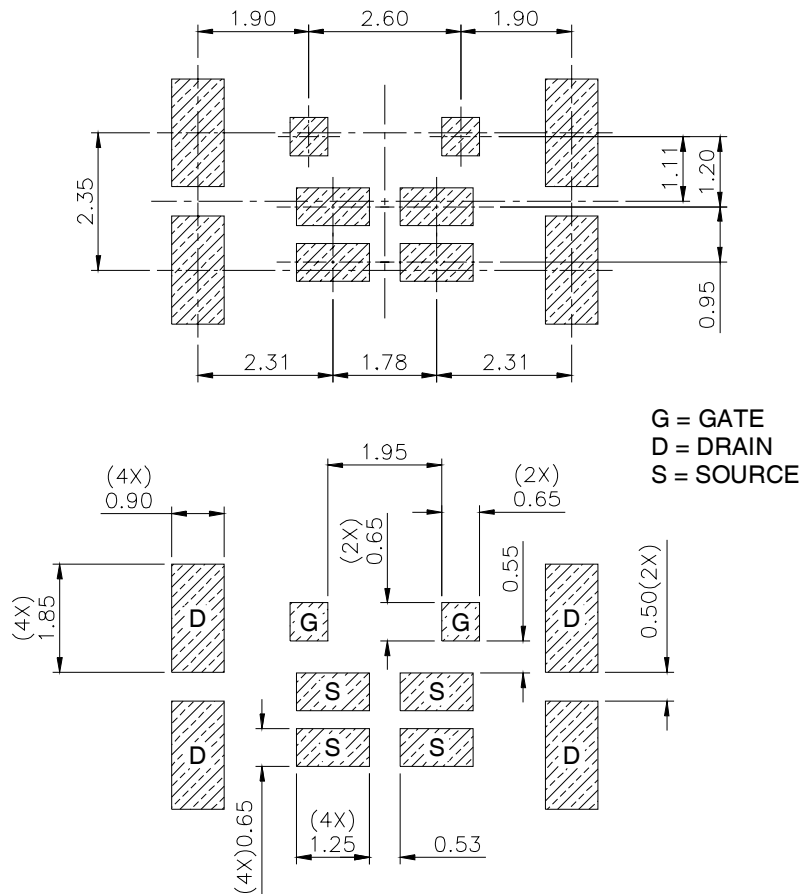


Fig 18. Diode Reverse Recovery Test Circuit for N-Channel HEXFET® Power MOSFETs

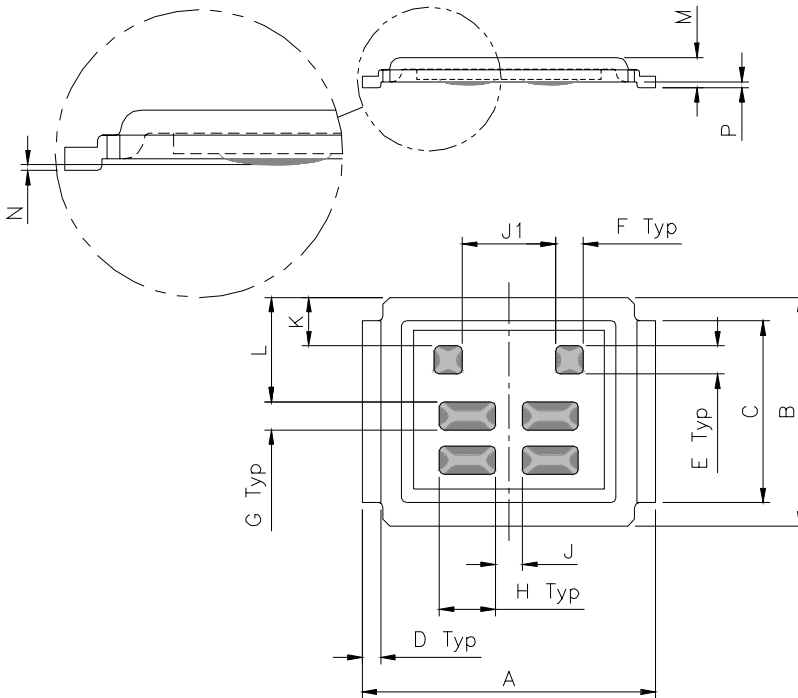
DirectFET™ Board Footprint, MC Outline (Medium Size Can, C-Designation).

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



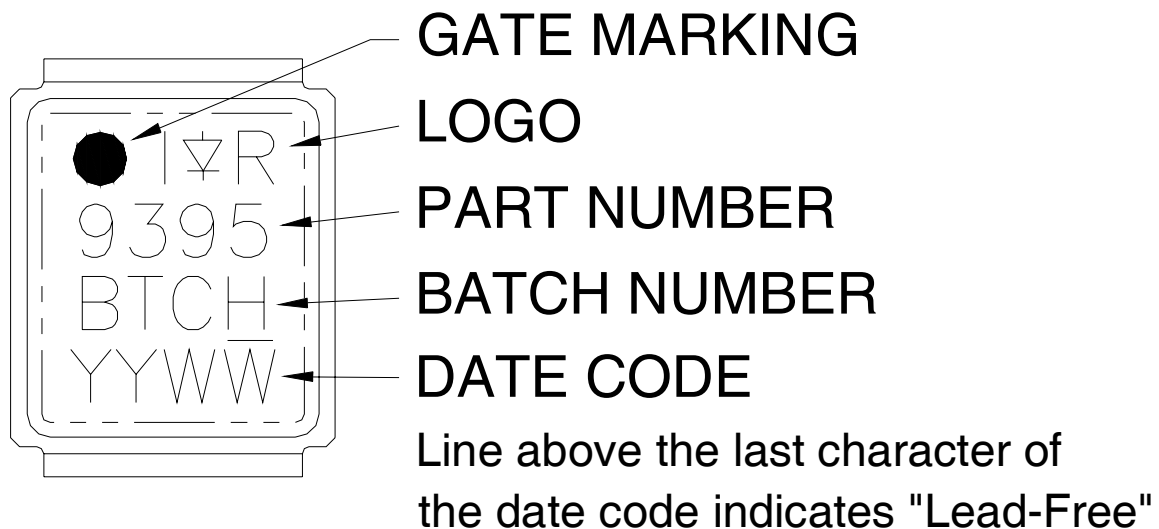
DirectFET™ Outline Dimension, MC Outline (Medium Size Can, C-Designation).

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

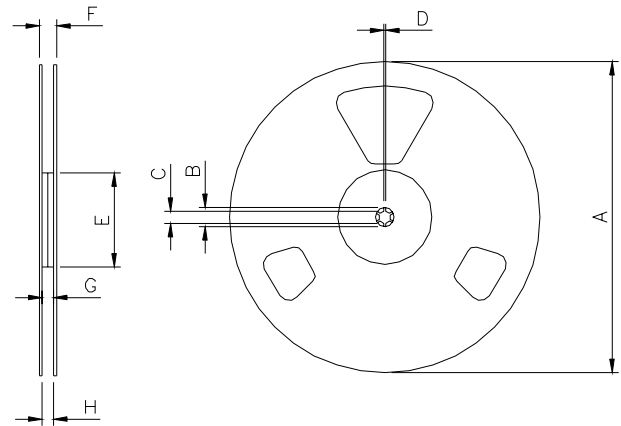
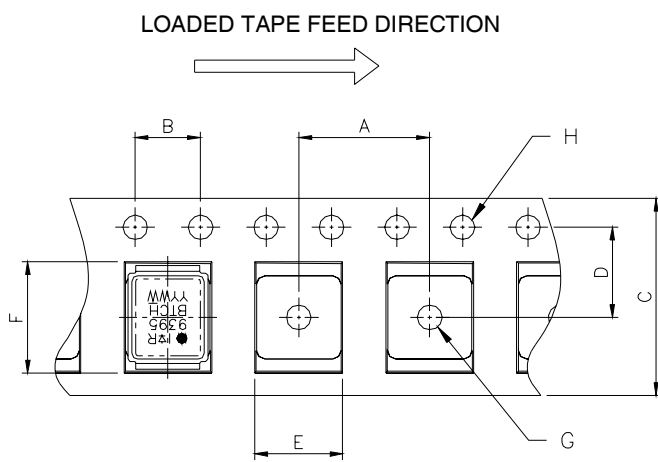


| CODE | METRIC | | IMPERIAL | |
|------|--------|------|----------|-------|
| | MIN | MAX | MIN | MAX |
| A | 6.25 | 6.35 | 0.246 | 0.250 |
| B | 4.80 | 5.05 | 0.189 | 0.201 |
| C | 3.85 | 3.95 | 0.152 | 0.156 |
| D | 0.35 | 0.45 | 0.014 | 0.018 |
| E | 0.58 | 0.62 | 0.023 | 0.024 |
| F | 0.58 | 0.62 | 0.023 | 0.024 |
| G | 0.58 | 0.62 | 0.023 | 0.024 |
| H | 1.18 | 1.22 | 0.047 | 0.048 |
| J | 0.56 | 0.60 | 0.022 | 0.023 |
| J1 | 1.98 | 2.02 | 0.078 | 0.079 |
| K | 1.02 | 1.06 | 0.040 | 0.041 |
| L | 2.22 | 2.26 | 0.088 | 0.089 |
| M | 0.59 | 0.70 | 0.023 | 0.028 |
| N | 0.03 | 0.08 | 0.001 | 0.003 |
| P | 0.08 | 0.17 | 0.003 | 0.007 |

DirectFET™ Part Marking



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



NOTE: Controlling dimensions in mm
Std reel quantity is 4800 parts. (ordered as IRF9395MTRPBF). For 1000 parts on 7" reel, order IRF9395MTR1PBF

NOTE: CONTROLLING DIMENSIONS IN MM

| CODE | DIMENSIONS | | | |
|------|------------|-------|----------|-------|
| | METRIC | | IMPERIAL | |
| | 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 |

| CODE | REEL DIMENSIONS | | | | | | | |
|------|----------------------------|------|----------|-------|-----------------------|-------|----------|------|
| | STANDARD OPTION (QTY 4800) | | | | TR1 OPTION (QTY 1000) | | | |
| | METRIC | | IMPERIAL | | METRIC | | IMPERIAL | |
| | MIN | MAX | MIN | MAX | MIN | MAX | MIN | MAX |
| A | 330.0 | N.C | 12.992 | N.C | 177.77 | N.C | 6.9 | N.C |
| B | 20.2 | N.C | 0.795 | N.C | 19.06 | N.C | 0.75 | N.C |
| C | 12.8 | 13.2 | 0.504 | 0.520 | 13.5 | 12.8 | 0.53 | 0.50 |
| D | 1.5 | N.C | 0.059 | N.C | 1.5 | N.C | 0.059 | N.C |
| E | 100.0 | N.C | 3.937 | N.C | 58.72 | N.C | 2.31 | N.C |
| F | N.C | 18.4 | N.C | 0.724 | N.C | 13.50 | N.C | 0.53 |
| G | 12.4 | 14.4 | 0.488 | 0.567 | 11.9 | 12.01 | 0.47 | N.C |
| H | 11.9 | 15.4 | 0.469 | 0.606 | 11.9 | 12.01 | 0.47 | N.C |

Qualification Information†

| | | |
|----------------------------|-----------------------------------|-----------------------------------|
| Qualification level | Consumer†† | |
| | (per JEDEC JESD47F††† guidelines) | |
| Moisture Sensitivity Level | DirectFET | MSL3 (per JEDEC J-STD-020D†††) |
| RoHS Compliant | Yes | |

† Qualification standards can be found at International Rectifier's web site

<http://www.irf.com/product-info/reliability>

†† Higher qualification ratings may be available should the user have such requirements.

Please contact your International Rectifier sales representative for further information:

<http://www.irf.com/whoto-call/salesrep/>

††† Applicable version of JEDEC standard at the time of product release.

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

Data and specifications subject to change without notice.

International
IR Rectifier

IR WORLD HEADQUARTERS: 233 Kansas St., El Segundo, California 90245, USA Tel: (310) 252-7105

TAC Fax: (310) 252-7903

Visit us at www.irf.com for sales contact information.12/2010