# Strong*IR*FET™
# IRF7480MTRPbF

DirectFET® N-Channel Power MOSFET

## Application

- Brushed Motor drive applications
- BLDC Motor drive applications
- Battery powered circuits
- Half-bridge and full-bridge topologies
- Synchronous rectifier applications
- Resonant mode power supplies
- OR-ing and redundant power switches
- DC/DC and AC/DC converters
- DC/AC Inverters

## Benefits

- Improved Gate, Avalanche and Dynamic dv/dt Ruggedness
- Fully Characterized Capacitance and Avalanche SOA
- Enhanced body diode dv/dt and di/dt Capability
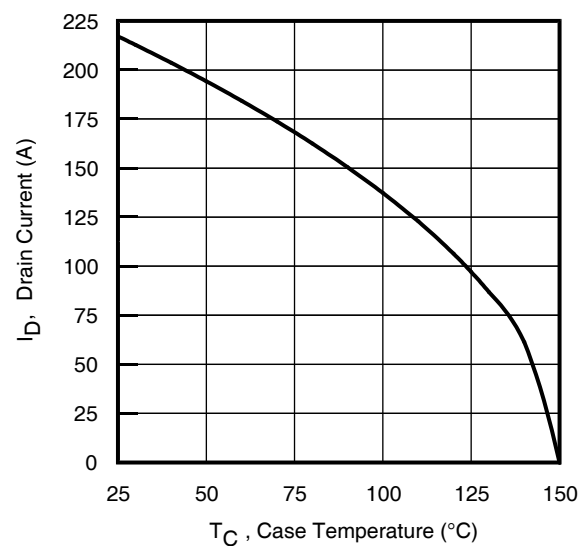- Lead-Free, RoHS Compliant

| | |
|---|---|
| $V_{DSS}$ | 40V |
| $R_{DS(on)}$ typ. | 0.95m$\Omega$ |
| max | 1.20m$\Omega$ |
| $I_D$ (Silicon Limited) | 217A |
| $I_D$ (double-sided cooling) | 330A |



ME



DirectFET® ISOMETRIC
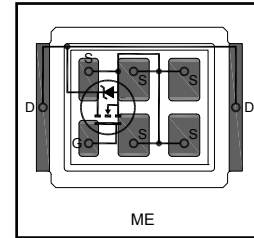
| Base part number | Package Type | Standard Pack | | Orderable Part Number |
|---|---|---|---|---|
| | | Form | Quantity | |
| IRF7480MPbF | DirectFET® ME | Tape and Reel | 4800 | IRF7480MTRPbF |
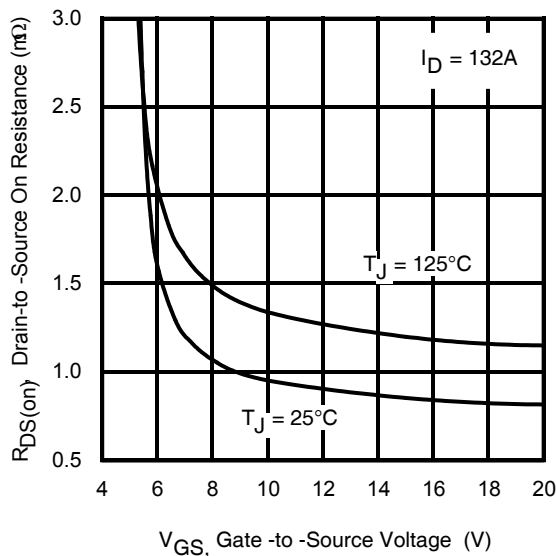


**Fig 1.** Typical On-Resistance vs. Gate Voltage



**Fig 2.** Maximum Drain Current vs. Case Temperature

## Absolute Maximum Ratings

| Symbol | Parameter | Max. | Units |
|---|---|---|---|
| $I_D$ @ $T_C$ (top)= 25°C $T_C$ (bottom)= 25°C | Continuous Drain Current, $V_{GS}$ @ 10V (double-sided cooling) | 330 | |
| $I_D$ @ $T_C$ = 25°C | Continuous Drain Current, $V_{GS}$ @ 10V (Silicon Limited) | 217 | |
| $I_D$ @ $T_C$ = 100°C | Continuous Drain Current, $V_{GS}$ @ 10V (Silicon Limited) | 137 | A |
| $I_{DM}$ | Pulsed Drain Current ① | 868 | |
| $P_D$ @$T_C$ = 25°C | Maximum Power Dissipation | 96 | W |
| | Linear Derating Factor | 0.77 | W/°C |
| $V_{GS}$ | Gate-to-Source Voltage | ± 20 | V |
| $T_J$ $T_{STG}$ | Operating Junction and Storage Temperature Range | -55 to + 150 | °C |

## Avalanche Characteristics

| | | | |
|---|---|---|---|
| $E_{AS}$ (Thermally limited) | Single Pulse Avalanche Energy ② | 81 | mJ |
| $E_{AS}$ (Thermally limited) | Single Pulse Avalanche Energy ⑨ | 206 | |
| $I_{AR}$ | Avalanche Current ① | See Fig.15,16, 23a, 23b | A |
| $E_{AR}$ | Repetitive Avalanche Energy ① | | mJ |

## Thermal Resistance

| Symbol | Parameter | Typ. | Max. | Units |
|---|---|---|---|---|
| $R_{\theta JA}$ | Junction-to-Ambient ❶ | —— | 45 | |
| $R_{\theta JA}$ | Junction-to-Ambient ❸ | 12.5 | —— | |
| $R_{\theta JA}$ | Junction-to-Ambient ❷ | 20 | —— | °C/W |
| $R_{\theta JC}$ | Junction-to-Case ❹⑧ | —— | 1.3 | |
| $R_{\theta J\text{-}PCB}$ | Junction-to-PCB Mounted | 0.75 | —— | |

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

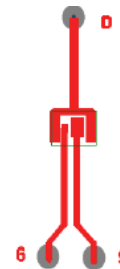| Symbol | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| $V_{(BR)DSS}$ | Drain-to-Source Breakdown Voltage | 40 | —— | —— | V | $V_{GS}$ = 0V, $I_D$ = 250µA |
| $\Delta V_{(BR)DSS}/\Delta T_J$ | Breakdown Voltage Temp. Coefficient | —— | 30 | —— | mV/°C | Reference to 25°C, $I_D$ = 1.0mA① |
| $R_{DS(on)}$ | Static Drain-to-Source On-Resistance | —— | 0.95 | 1.20 | mΩ | $V_{GS}$ = 10V, $I_D$ = 132A ④ |
| | | —— | 1.60 | —— | | $V_{GS}$ = 6.0V, $I_D$ = 66A ④ |
| $V_{GS(th)}$ | Gate Threshold Voltage | 2.1 | 3.0 | 3.9 | V | $V_{DS}$ = $V_{GS}$, $I_D$ = 150µA |
| $I_{DSS}$ | Drain-to-Source Leakage Current | —— | —— | 1.0 | µA | $V_{DS}$ = 40V, $V_{GS}$ = 0V |
| | | —— | —— | 150 | | $V_{DS}$ = 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 |
| $R_G$ | Internal Gate Resistance | —— | 0.81 | —— | Ω | |

**Notes:**

❷ Mounted on minimum footprint full size board with metalized back and with small clip heatsink.

❸ Used double sided cooling , mounting pad with large heatsink.

❹ TC measured with thermocouple mounted to top (Drain) of part.



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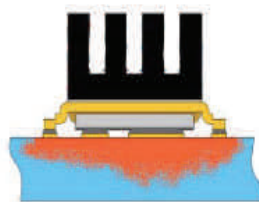


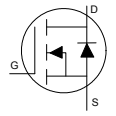❷ Mounted to a PCB with small clip heatsink (still air)



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

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

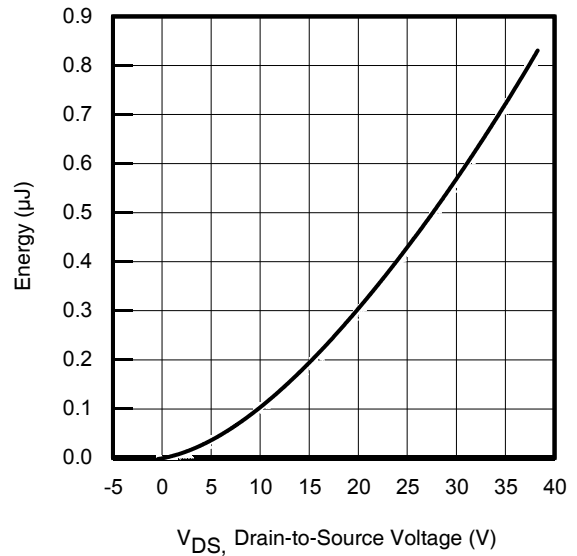| Symbol | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| gfs | Forward Transconductance | 370 | —— | —— | S | $V_{DS}$ = 10V, $I_D$ = 132A |
| $Q_g$ | Total Gate Charge | —— | 123 | 185 | | $I_D$ = 132A |
| $Q_{gs}$ | Gate-to-Source Charge | —— | 31 | —— | nC | $V_{DS}$ =20V |
| $Q_{gd}$ | Gate-to-Drain ("Miller") Charge | —— | 44 | —— | | $V_{GS}$ = 10V ④ |
| $Q_{sync}$ | Total Gate Charge Sync. ($Q_g$ - $Q_{gd}$) | —— | 79 | —— | | $I_D$ = 132A, $V_{DS}$ =0V, $V_{GS}$ = 10V |
| $t_{d(on)}$ | Turn-On Delay Time | —— | 21 | —— | | $V_{DD}$ = 20V |
| $t_r$ | Rise Time | —— | 70 | —— | ns | $I_D$ = 30A |
| $t_{d(off)}$ | Turn-Off Delay Time | —— | 68 | —— | | $R_G$ = 2.7Ω |
| $t_f$ | Fall Time | —— | 58 | —— | | $V_{GS}$ = 10V ④ |
| $C_{iss}$ | Input Capacitance | —— | 6680 | —— | | $V_{GS}$ = 0V |
| $C_{oss}$ | Output Capacitance | —— | 1035 | —— | | $V_{DS}$ = 25V |
| $C_{rss}$ | Reverse Transfer Capacitance | —— | 700 | —— | pF | $f$ = 1.0MHz |
| $C_{oss}$ eff. (ER) | Effective Output Capacitance (Energy Related) | —— | 1240 | —— | | $V_{GS}$ = 0V, $V_{DS}$ = 0V to 32V ⑥ |
| $C_{oss}$ eff. (TR) | Effective Output Capacitance (Time Related) | —— | 1515 | —— | | $V_{GS}$ = 0V, $V_{DS}$ = 0V to 32V ⑤ |

**Diode Characteristics**

| Symbol | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| $I_S$ | Continuous Source Current (Body Diode) | —— | —— | 87 | A | MOSFET symbol showing the integral reverse p-n junction diode. |
| $I_{SM}$ | Pulsed Source Current (Body Diode) ① | —— | —— | 868 | | |
| $V_{SD}$ | Diode Forward Voltage | —— | —— | 1.2 | V | $T_J$= 25°C,$I_S$ =132A, $V_{GS}$ = 0V④ |
| dv/dt | Peak Diode Recovery ③ | —— | 2.4 | —— | V/ns | $T_J$ =150°C,$I_S$ =132A, $V_{DS}$ = 40V |
| $t_{rr}$ | Reverse Recovery Time | —— | 44 | —— | ns | $T_J$ = 25° C   $V_R$ = 34V, |
| | | —— | 46 | —— | | $T_J$ = 125°C $I_F$ = 132A |
| $Q_{rr}$ | Reverse Recovery Charge | —— | 56 | —— | nC | $T_J$ = 25°C   di/dt = 100A/µs ④ |
| | | —— | 63 | —— | | $T_J$ = 125°C |
| $I_{RRM}$ | Reverse Recovery Current | —— | 2.1 | —— | A | $T_J$ = 25°C |

**Notes:**

① Repetitive rating;  pulse width limited by max. junction temperature.

② Limited by $T_J$max, starting $T_J$ = 25°C, L = 0.009mH, $R_G$ = 50Ω, $I_{AS}$ = 132A, $V_{GS}$ =10V.

③ $I_{SD}$ ≤ 132A, di/dt ≤ 920A/µs, $V_{DD}$ ≤ V$_{(BR)DSS}$, $T_J$ ≤ 150°C.

④ Pulse width ≤ 400µs; duty cycle ≤ 2%.

⑤ $C_{oss}$ eff. (TR) is a fixed capacitance that gives the same charging time as $C_{oss}$ while $V_{DS}$ is rising from 0 to 80% $V_{DSS}$.

⑥ $C_{oss}$ eff. (ER) is a fixed capacitance that gives the same energy as $C_{oss}$ while $V_{DS}$ is rising from 0 to 80% $V_{DSS}$.

⑦ When mounted on 1" square PCB (FR-4 or G-10 Material). For recommended footprint and soldering techniques refer to application note # AN-994. http://www.irf.com/technical-info/appnotes/an-994.pdf

⑧ $R_θ$ is measured at $T_J$ approximately 90°C.

⑨ Limited by $T_{Jmax}$, starting $T_J$ = 25°C, L = 1mH, $R_G$ = 50Ω, $I_{AS}$ = 20A, $V_{GS}$ =10V.
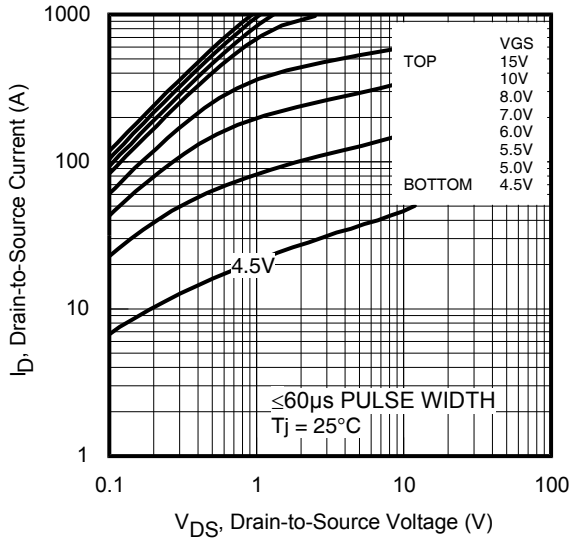
**Fig 3.** Typical Output Characteristics
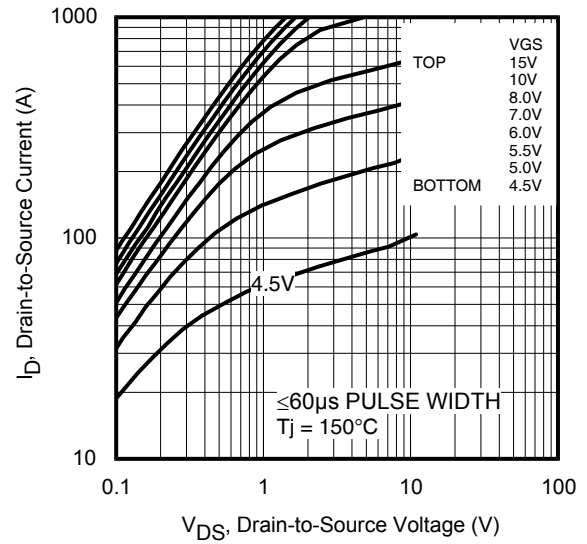


**Fig 4.** Typical Output Characteristics
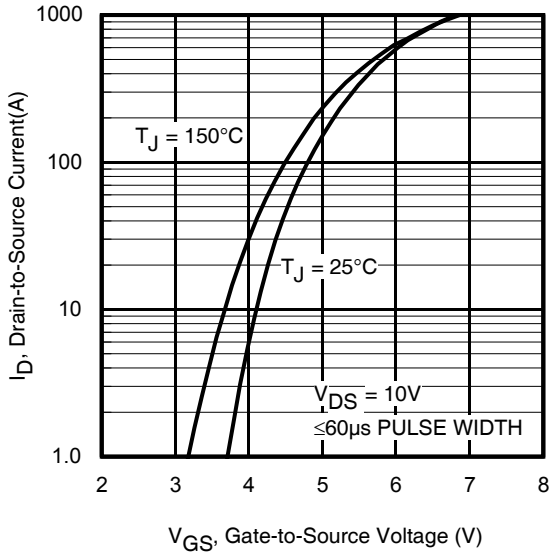


**Fig 5.** Typical Transfer Characteristics
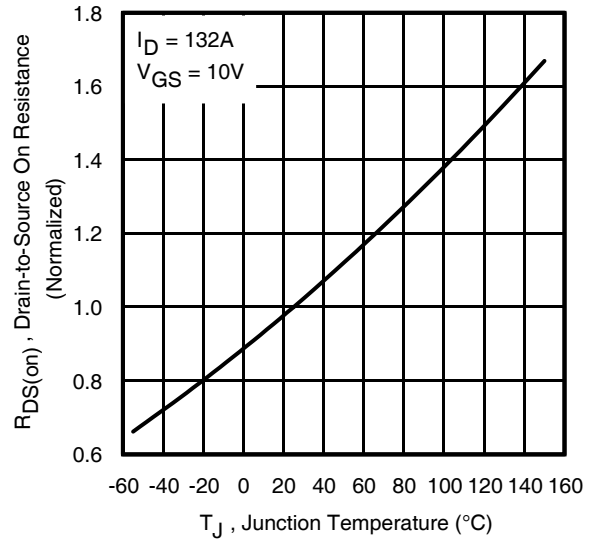


**Fig 6.** Normalized On-Resistance vs. Temperature
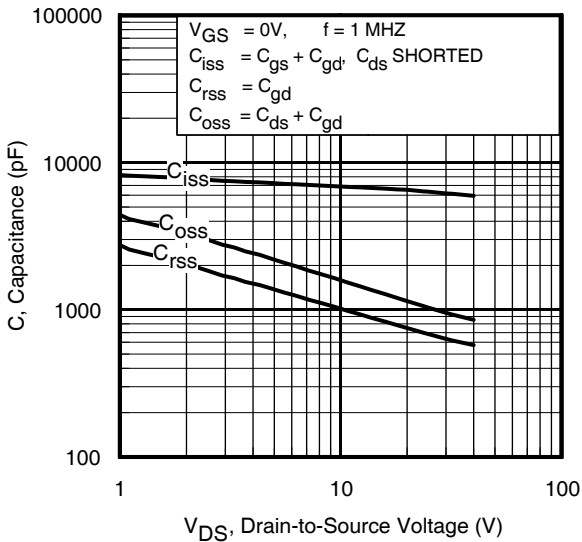


**Fig 7.** Typical Capacitance vs. Drain-to-Source Voltage
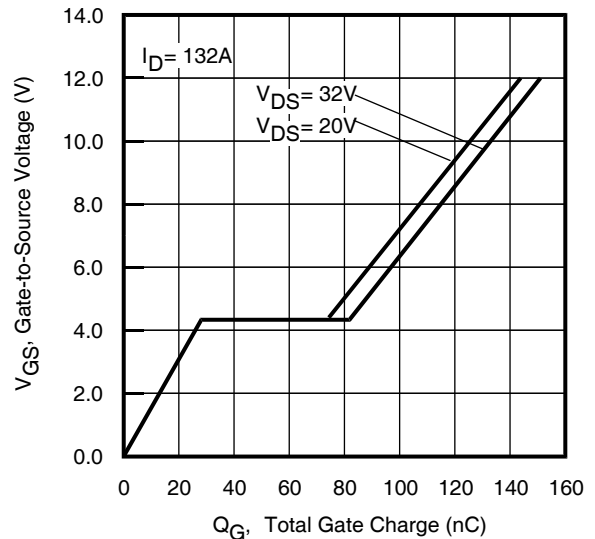


**Fig 8.** Typical Gate Charge vs. Gate-to-Source Voltage
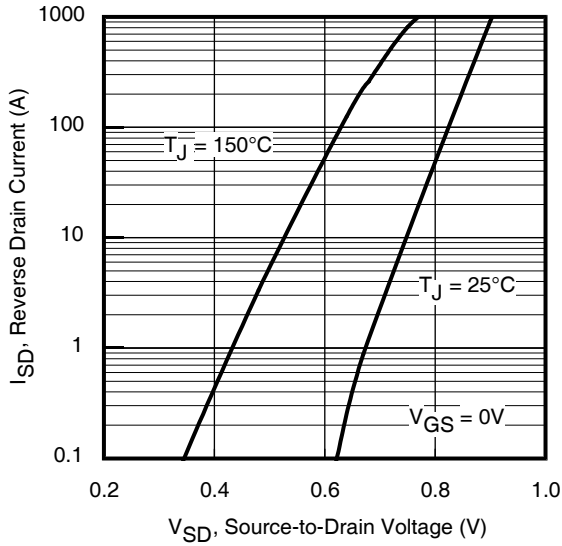
**Fig 9.** Typical Source-Drain Diode Forward Voltage
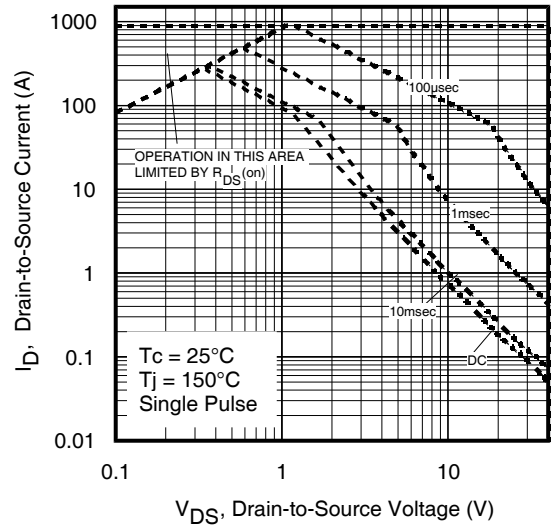


**Fig 10.** Maximum Safe Operating Area
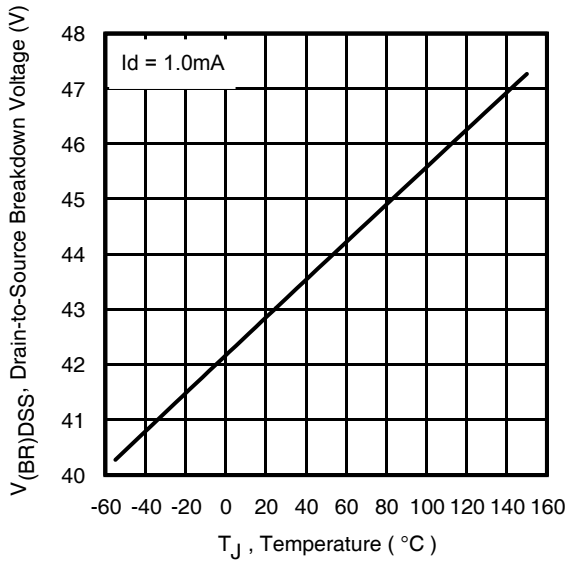


**Fig 11.** Drain-to-Source Breakdown Voltage



**Fig 12.** Typical $C_{oss}$ Stored Energy
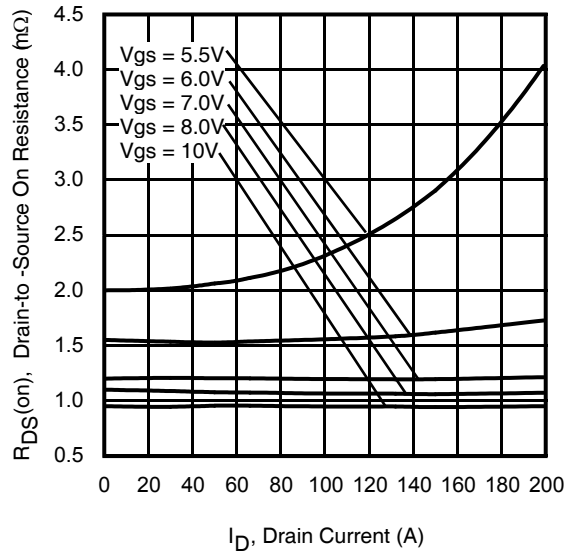


**Fig 13.** Typical On-Resistance vs. Drain Current

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Notes:
1. Duty Factor D = t1/t2
2. Peak Tj = P dm x Zthjc + Tc

SINGLE PULSE
( THERMAL RESPONSE )
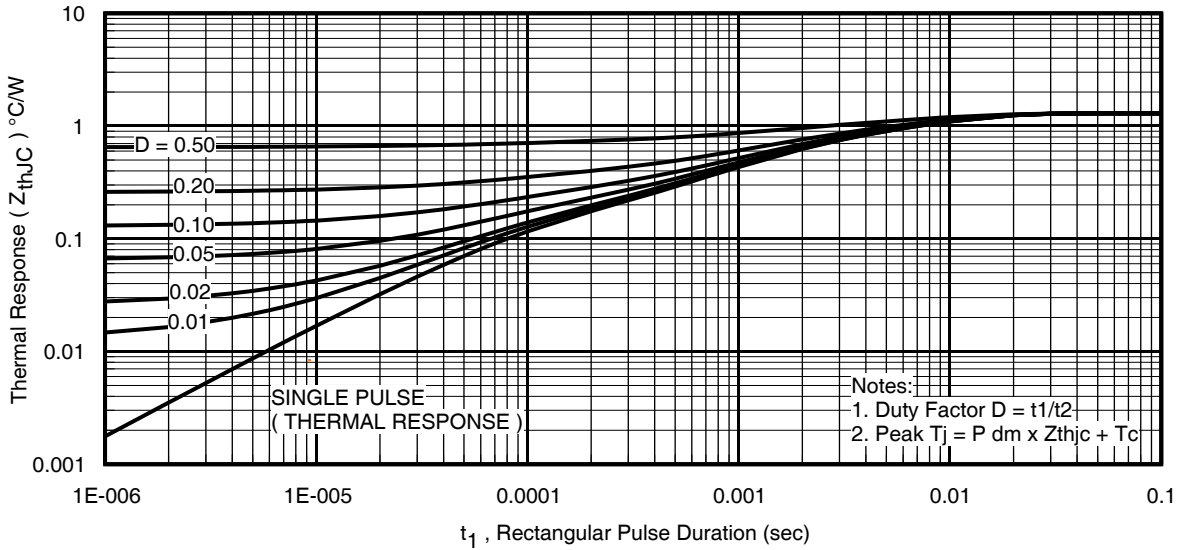
**Fig 14.** Maximum Effective Transient Thermal Impedance, Junction-to-Case



Allowed avalanche Current vs avalanche pulsewidth, tav, assuming $\Delta$Tj = 125°C and Tstart =25°C (Single Pulse)

Allowed avalanche Current vs avalanche pulsewidth, tav, assuming $\Delta$T j = 25°C and Tstart = 125°C.
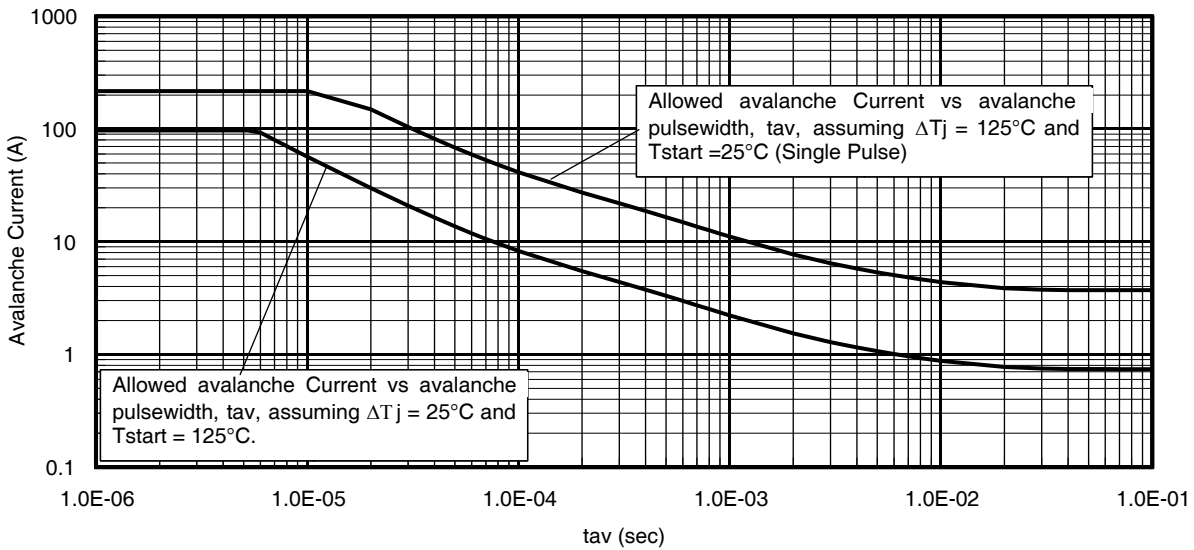
**Fig 15.** Avalanche Current vs. Pulse Width



TOP          Single Pulse
BOTTOM    1.0% Duty Cycle
$I_D$ = 132A
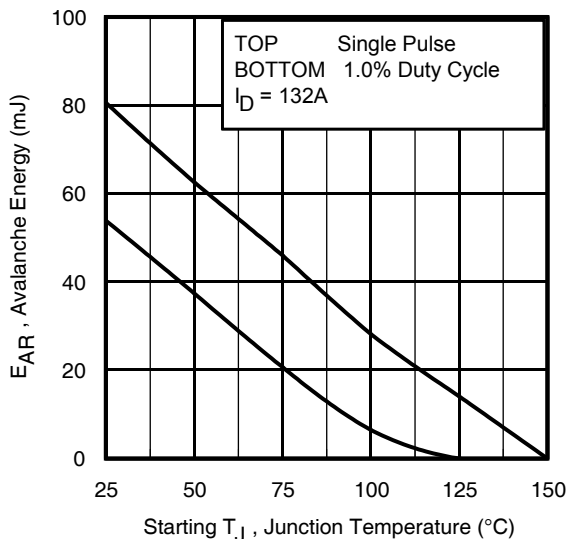
**Fig 16.** Maximum Avalanche Energy vs. Temperature

**Notes on Repetitive Avalanche Curves , Figures 15, 16:**
**(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 23a, 23b.
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 14, 15).
      $t_{av}$ = Average time in avalanche.
      D = Duty cycle in avalanche =  tav ·f
      $Z_{thJC}$(D, $t_{av}$) = Transient thermal resistance, see Figures 13)
$$PD (ave) = 1/2 ( 1.3 \cdot BV \cdot I_{av}) = \Delta T / Z_{thJC}$$
$$I_{av} = 2\Delta T / [1.3 \cdot BV \cdot Z_{th}]$$
$$E_{AS (AR)} = P_{D (ave)} \cdot t_{av}$$

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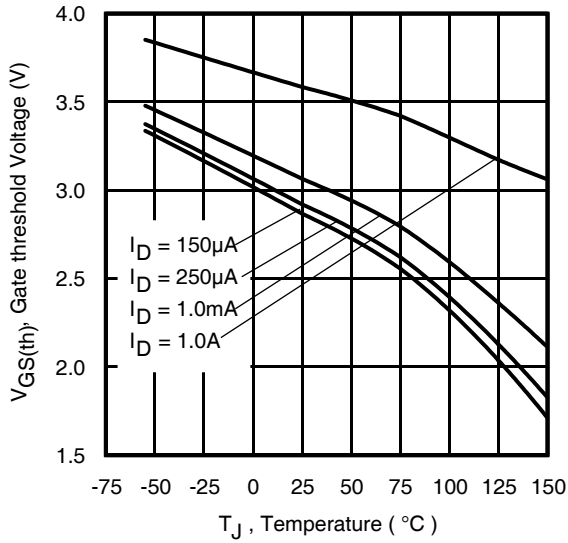
**Fig 17.** Threshold Voltage vs. Temperature
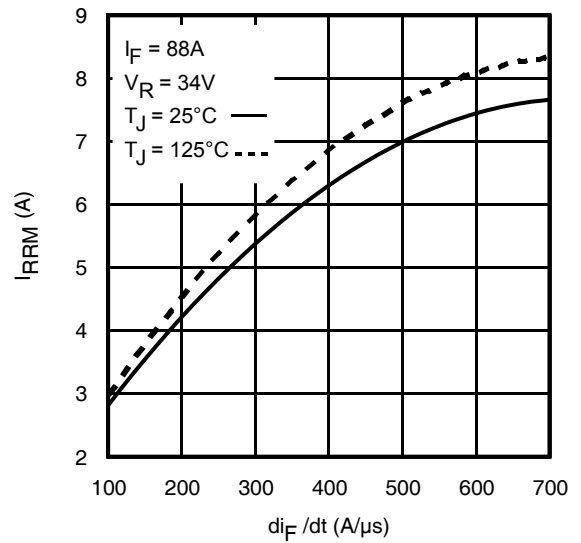


**Fig 18.** Typical Recovery Current vs. dif/dt
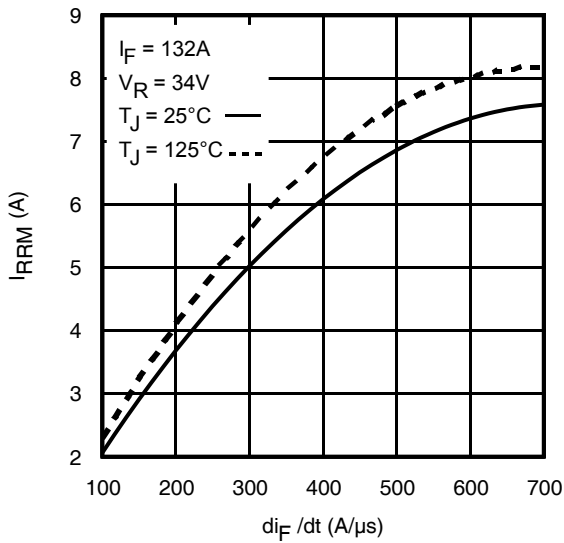


**Fig 19.** Typical Recovery Current vs. dif/dt
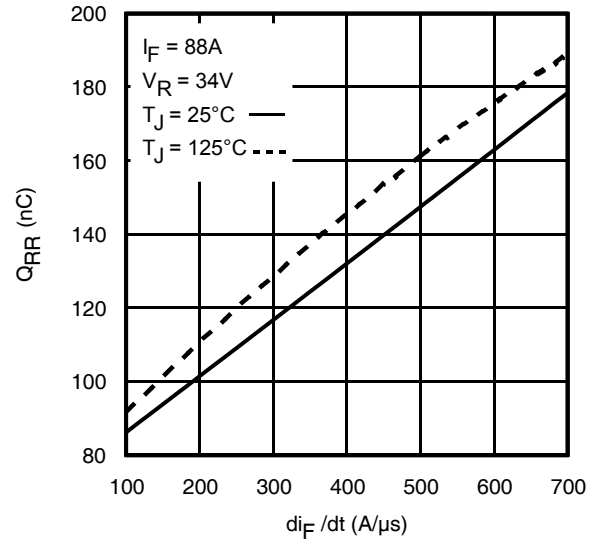


**Fig 20.** Typical Stored Charge vs. dif/dt
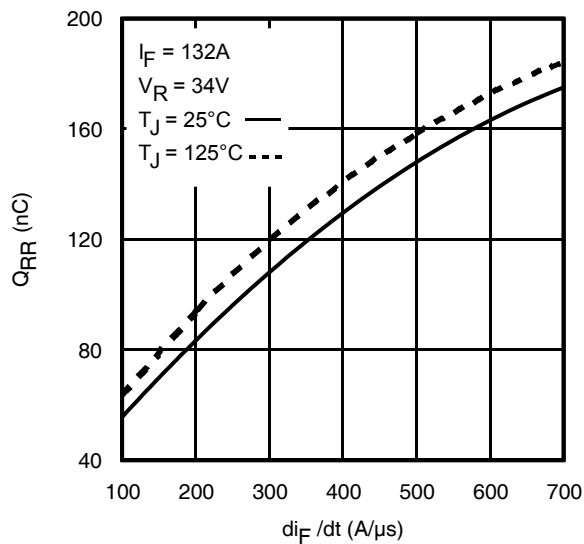


**Fig 21.** Typical Stored Charge vs. dif/dt
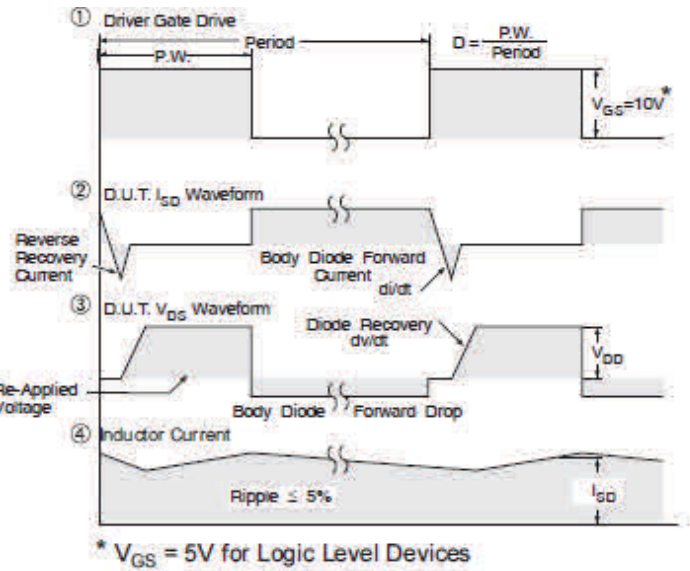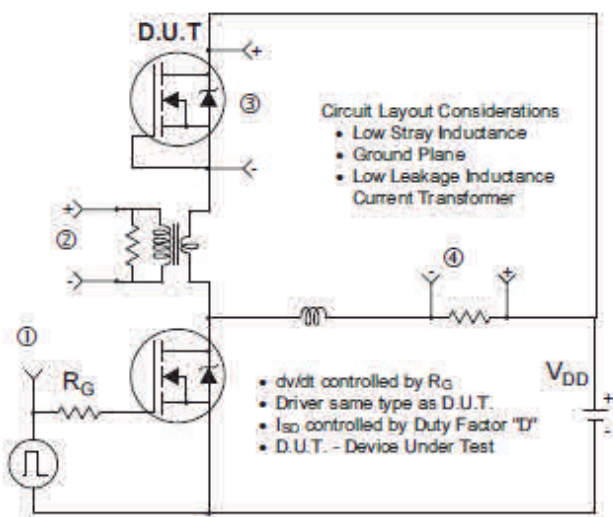
**Fig 22.** Peak Diode Recovery dv/dt Test Circuit for N-Channel HEXFET® Power MOSFETs
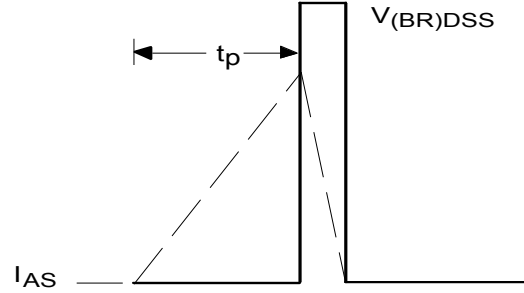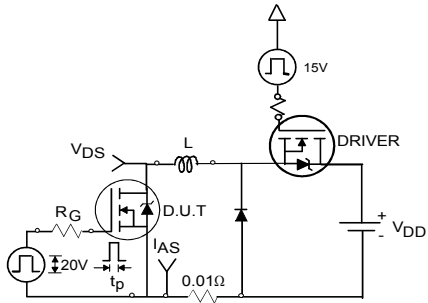


**Fig 23a.** Unclamped Inductive Test Circuit



**Fig 23b.** Unclamped Inductive Waveforms
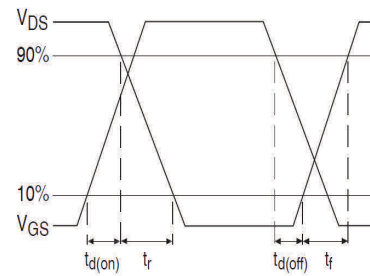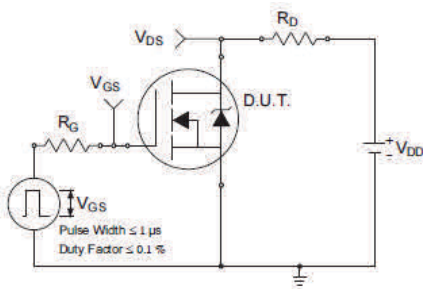


**Fig 24a.** Switching Time Test Circuit



**Fig 24b.** Switching Time Waveforms
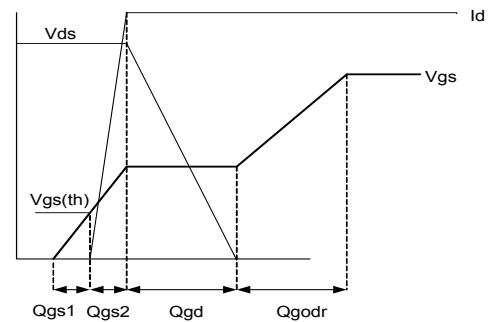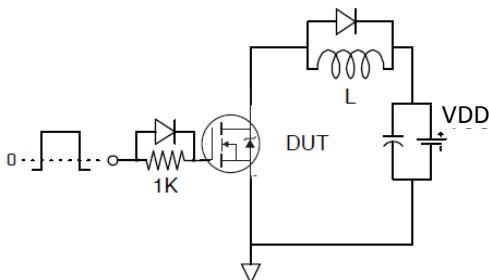


**Fig 25a.** Gate Charge Test Circuit
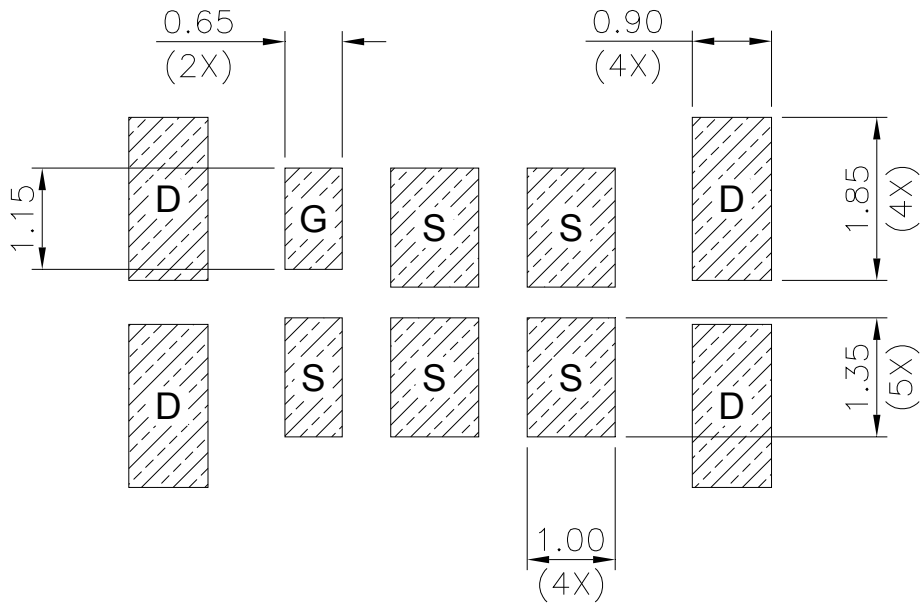


**Fig 25b.** Gate Charge Waveform

**DirectFET® Board Footprint, ME Outline
(Medium Size Can, E-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.
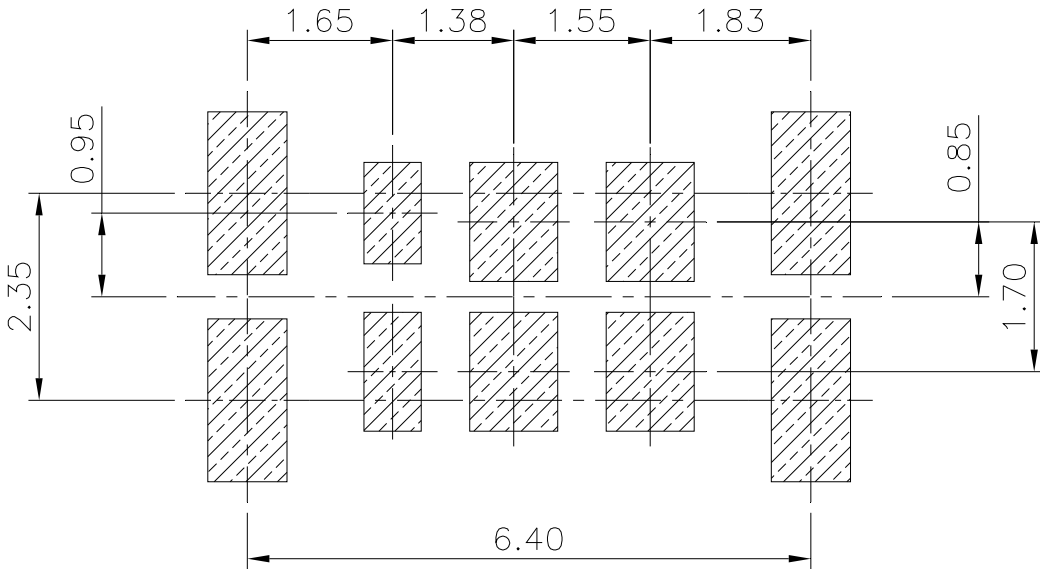


G = GATE
D = DRAIN
S = SOURCE

Note: For the most current drawing please refer to IR website at http://www.irf.com/package/
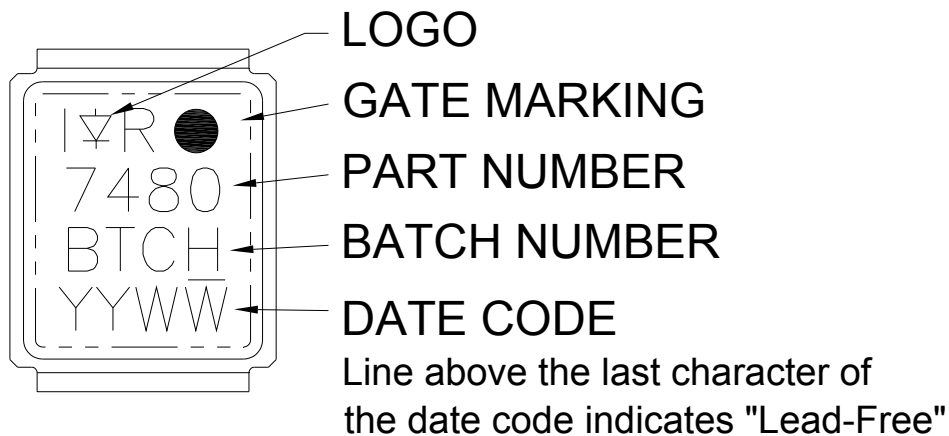
**DirectFET® Outline Dimension, ME Outline
(Medium Size Can, E-Designation)**

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



Dimensions are shown in millimeters (inches)
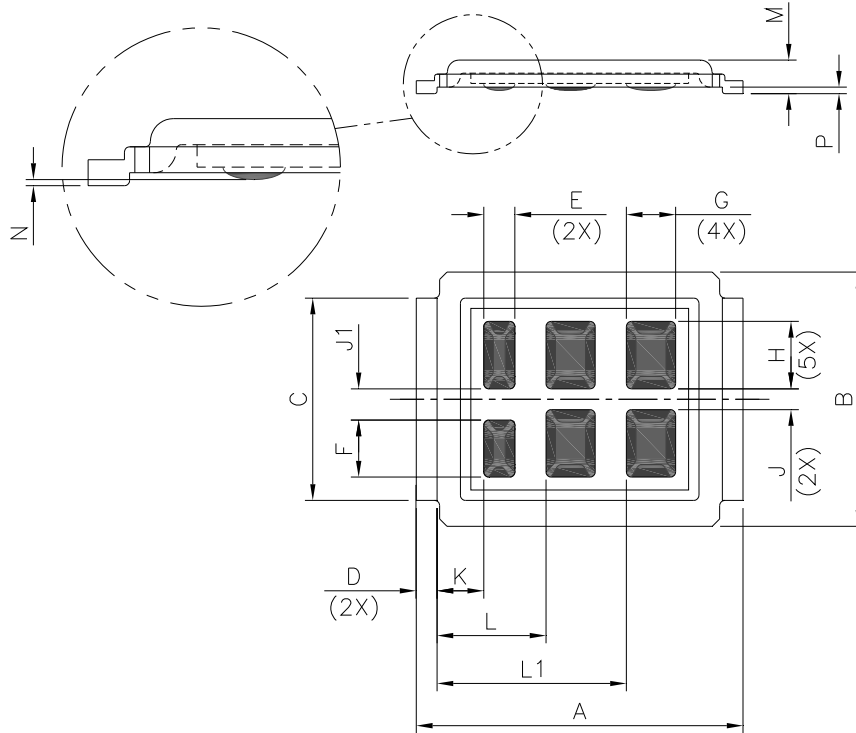
| DIMENSIONS | | | | |
|---|---|---|---|---|
| | METRIC | | IMPERIAL | |
| CODE | MIN | MAX | MIN | MAX |
| A | 6.25 | 6.35 | 0.246 | 0.250 |
| B | 4.80 | 5.05 | 0.189 | 0.199 |
| C | 3.85 | 3.95 | 0.152 | 0.156 |
| D | 0.35 | 0.45 | 0.014 | 0.018 |
| E | 0.58 | 0.62 | 0.023 | 0.024 |
| F | 1.08 | 1.12 | 0.043 | 0.044 |
| G | 0.93 | 0.97 | 0.037 | 0.038 |
| H | 1.28 | 1.32 | 0.050 | 0.052 |
| J | 0.38 | 0.42 | 0.015 | 0.017 |
| J1 | 0.58 | 0.62 | 0.023 | 0.024 |
| K | 0.88 | 0.92 | 0.035 | 0.036 |
| L | 2.08 | 2.12 | 0.082 | 0.083 |
| L1 | 3.63 | 3.67 | 0.143 | 0.144 |
| M | 0.59 | 0.70 | 0.023 | 0.028 |
| N | 0.02 | 0.08 | 0.0008 | 0.003 |
| P | 0.08 | 0.17 | 0.003 | 0.007 |

**DirectFET® Part Marking**



LOGO
GATE MARKING
PART NUMBER
BATCH NUMBER
DATE CODE
Line above the last character of the date code indicates "Lead-Free"

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

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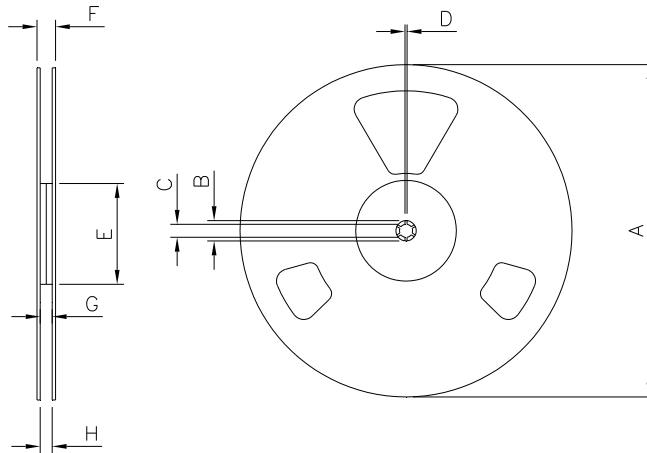


NOTE: Controlling dimensions in mm
Std reel quantity is 4800 parts. (ordered as IRF7480MTRPBF). For 1000 parts on 7"
reel, order   IRF7480MTR1PBF

| REEL DIMENSIONS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | STANDARD OPTION **(QTY 4800)** | | | | TR1 OPTION **(QTY 1000)** | | | |
| | METRIC | | IMPERIAL | | METRIC | | IMPERIAL | |
| CODE | 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 |

LOADED TAPE FEED DIRECTION
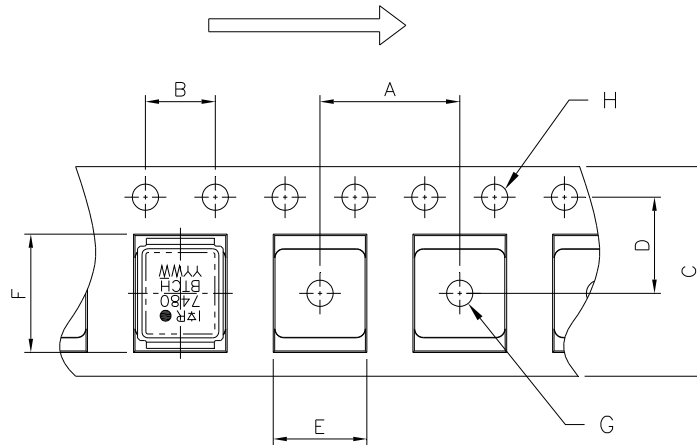


NOTE: CONTROLLING
DIMENSIONS IN MM

| 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 | Industrial *<br>(per JEDEC JESD47F†† guidelines) | |
|---|---|---|
| **Moisture Sensitivity Level** | DFET 1.5 | MSL1<br>(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

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


\* Industrial qualification standards except autoclave test conditions.


**Revision History**

| Date | Comments |
|---|---|
| 11/07/2014 | • Updated $E_{AS\ (L=1mH)}$ = 206mJ on page 2<br>• Updated note 9 "Limited by $T_{Jmax}$, starting $T_J$ = 25°C, L = 1mH, $R_G$ = 50Ω, $I_{AS}$ = 20A, $V_{GS}$ =10V" on page 3<br>• Updated $R\theta JA$ from "60°C/W" to "45°C/W" on page 2. |
| 05/14/2015 | • Updated registered trademark from DirectFET$^{TM}$ to DirectFET$^{®}$ on page 1,9 and 10. |
| 05/04/2016 | • Updated datasheet with corporate template.<br>• Added ID (double- sided cooling) = 300A on pages1 and 2. |

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