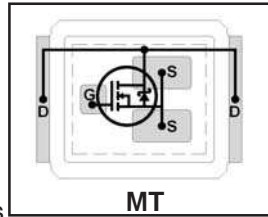


IRF6691

HEXFET® Power MOSFET plus Schottky Diode

- Application Specific MOSFETs
- Integrates Monolithic Trench Schottky Diode
- Ideal for CPU Core DC-DC Converters
- Low Conduction Losses
- Low Reverse Recovery Losses
- Low Switching Losses
- Low Reverse Recovery Charge and Low Vf
- Low Profile (<0.7 mm)
- Dual Sided Cooling Compatible
- Compatible with existing Surface Mount Techniques

| V _{DSS} | R _{DS(on)} max | Qg(typ.) |
|------------------|--------------------------------|----------|
| 20V | 2.5mΩ @ V _{GS} = 4.5V | 47nC |
| | 1.8mΩ @ V _{GS} = 10V | |



Applicable DirectFET Package/Layout Pad (see p.8,9 for details)

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

Description

The IRF6691 combines IR's industry leading DirectFET package technology with the latest monolithic die technology, which integrates MOSFET plus free-wheeling Schottky diode. 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%.

The IRF6691 is characterized with reduced on resistance (R_{DS(on)}), reverse recovery charge (Q_r) and source to drain voltage (V_{SD}) to reduce conduction, reverse recovery and deadtime losses. These reduced total losses along with high Cdv/dt immunity make this product ideal for high efficiency DC-DC converters that power the latest generation of processors operating at higher frequencies. The IRF6691 has been optimized for parameters that are critical for synchronous MOSFET sockets operating in 12 volt buss converters.

Absolute Maximum Ratings

| | Parameter | Max. | Units |
|--|---|--------------|-------|
| V _{DS} | Drain-to-Source Voltage | 20 | V |
| V _{GS} | Gate-to-Source Voltage | ±12 | |
| I _D @ T _C = 25°C | Continuous Drain Current, V _{GS} @ 10V | 180 | A |
| I _D @ T _A = 25°C | Continuous Drain Current, V _{GS} @ 10V | 32 | |
| I _D @ T _A = 70°C | Continuous Drain Current, V _{GS} @ 10V | 26 | |
| I _{DM} | Pulsed Drain Current ① | 260 | |
| P _D @ T _A = 25°C | Power Dissipation ⑤ | 2.8 | W |
| P _D @ T _A = 70°C | Power Dissipation ⑤ | 1.8 | |
| P _D @ T _C = 25°C | Power Dissipation | 89 | |
| | Linear Derating Factor | 0.022 | W/°C |
| T _J | Operating Junction and | -40 to + 150 | °C |
| T _{STG} | Storage Temperature Range | | |

Thermal Resistance

| | Parameter | Typ. | Max. | Units |
|---------------------|-------------------------|------|------|-------|
| R _{θJA} | Junction-to-Ambient ④⑥ | — | 45 | °C/W |
| R _{θJA} | Junction-to-Ambient ⑤⑥ | 12.5 | — | |
| R _{θJA} | Junction-to-Ambient ⑥⑥ | 20 | — | |
| R _{θJC} | Junction-to-Case ⑦⑧ | — | 1.4 | |
| R _{θJ-PCB} | Junction-to-PCB Mounted | 1.0 | — | |

Notes ① through ⑧ are on page 10

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

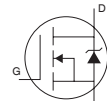
| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|--------------------------------|--|------|------|------|------------|--|
| BV_{DSS} | Drain-to-Source Breakdown Voltage | 20 | — | — | V | $V_{GS} = 0V, I_D = 1.0mA$ |
| $\Delta BV_{DSS}/\Delta T_J$ | Breakdown Voltage Temp. Coefficient | — | 12 | — | mV/°C | Reference to $25^\circ\text{C}, I_D = 10mA$ |
| $R_{DS(on)}$ | Static Drain-to-Source On-Resistance | — | 1.8 | 2.5 | m Ω | $V_{GS} = 4.5V, I_D = 12A$ ③ |
| | | — | 1.2 | 1.8 | | $V_{GS} = 10V, I_D = 15A$ ③ |
| $V_{GS(th)}$ | Gate Threshold Voltage | 1.6 | — | 2.5 | V | $V_{DS} = V_{GS}, I_D = 250\mu A$ |
| $\Delta V_{GS(th)}/\Delta T_J$ | Gate Threshold Voltage Coefficient | — | -4.1 | — | mV/°C | $I_D = 10mA$, reference to 25°C |
| I_{DSS} | Drain-to-Source Leakage Current | — | — | 1.4 | mA | $V_{DS} = 20V, V_{GS} = 0V$ |
| | | — | — | 500 | μA | $V_{DS} = 16V, V_{GS} = 0V$ |
| | | — | — | 5 | mA | $V_{DS} = 16V, V_{GS} = 0V, T_J = 125^\circ\text{C}$ |
| I_{GSS} | Gate-to-Source Forward Leakage | — | — | 100 | nA | $V_{GS} = 12V$ |
| | Gate-to-Source Reverse Leakage | — | — | -100 | nA | $V_{GS} = -12V$ |
| g_{fs} | Forward Transconductance | 110 | — | — | S | $V_{DS} = 10V, I_D = 26A$ |
| Q_g | Total Gate Charge | — | 47 | 71 | nC | $V_{DS} = 10V$ $V_{GS} = 4.5V$ $I_D = 17A$ See Fig. 17 |
| Q_{gs1} | Pre-V _{th} Gate-to-Source Charge | — | 14 | — | | |
| Q_{gs2} | Post-V _{th} Gate-to-Source Charge | — | 4.4 | — | | |
| Q_{gd} | Gate-to-Drain Charge | — | 15 | — | | |
| Q_{godr} | Gate Charge Overdrive | — | 14 | — | | |
| Q_{sw} | Switch Charge ($Q_{gs2} + Q_{gd}$) | — | 19 | — | | |
| Q_{oss} | Output Charge | — | 30 | — | nC | $V_{DS} = 10V, V_{GS} = 0V$ |
| R_G | Gate Resistance | — | 0.60 | 1.5 | Ω | |
| $t_{d(on)}$ | Turn-On Delay Time | — | 23 | — | ns | $V_{DD} = 16V, V_{GS} = 4.5V$ ③ $I_D = 26A$ Clamped Inductive Load |
| t_r | Rise Time | — | 95 | — | | |
| $t_{d(off)}$ | Turn-Off Delay Time | — | 25 | — | | |
| t_f | Fall Time | — | 10 | — | | |
| C_{iss} | Input Capacitance | — | 6580 | — | pF | $V_{GS} = 0V$ $V_{DS} = 10V$ $f = 1.0MHz$ |
| C_{oss} | Output Capacitance | — | 2070 | — | | |
| C_{rss} | Reverse Transfer Capacitance | — | 840 | — | | |

Avalanche Characteristics

| | Parameter | Typ. | Max. | Units |
|----------|--|------|------|-------|
| E_{AS} | Single Pulse Avalanche Energy ^② | — | 230 | mJ |
| I_{AR} | Avalanche Current ^① | — | 26 | A |

Diode Characteristics

| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|----------|--|------|------|------|-------|---|
| I_S | Continuous Source Current (Body Diode) | — | — | 200 | A | MOSFET symbol showing the integral reverse p-n junction diode. |
| I_{SM} | Pulsed Source Current (Body Diode) ^① | — | — | 260 | | |
| V_{SD} | Diode Forward Voltage | — | — | 0.65 | V | $T_J = 25^\circ\text{C}, I_S = 25A, V_{GS} = 0V$ ③ |
| t_{rr} | Reverse Recovery Time | — | 32 | 48 | ns | $T_J = 25^\circ\text{C}, I_F = 25A$ |
| Q_{rr} | Reverse Recovery Charge | — | 26 | 39 | nC | $di/dt = 100A/\mu s$ ③ |



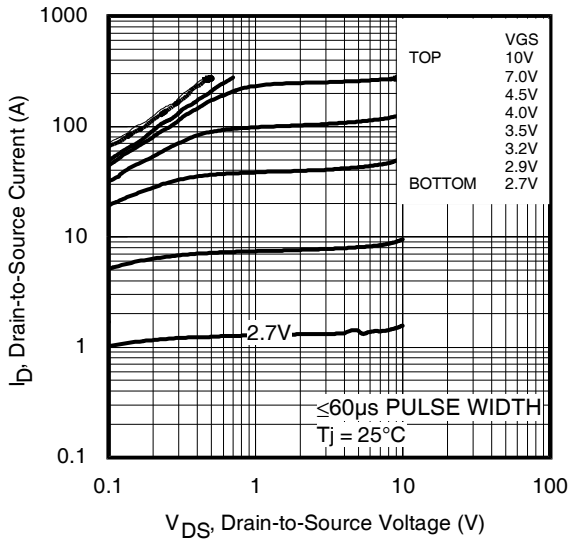


Fig 1. Typical Output Characteristics

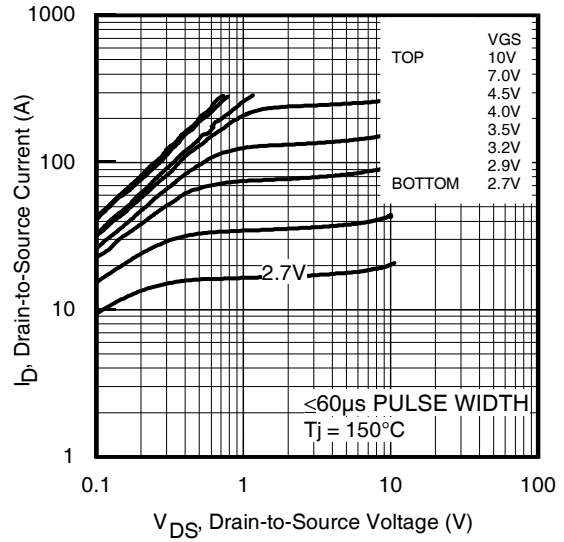


Fig 2. Typical Output Characteristics

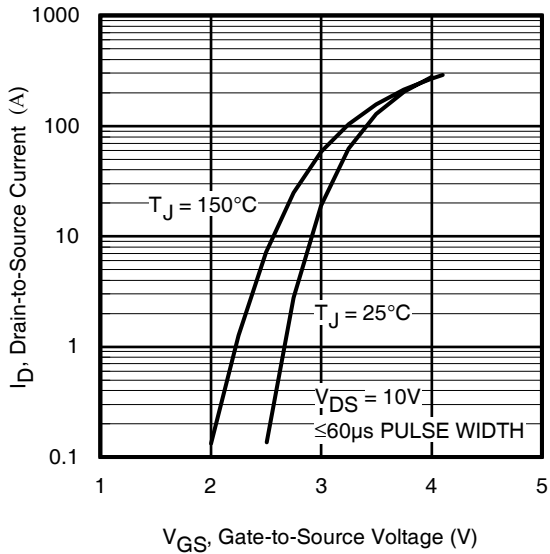


Fig 3. Typical Transfer Characteristics

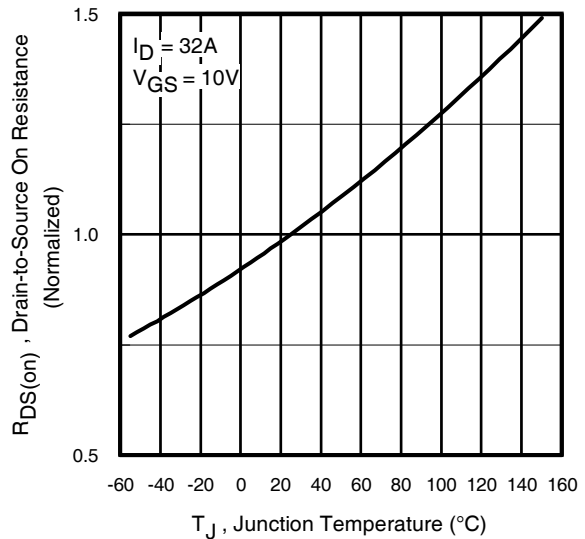


Fig 4. Normalized On-Resistance vs. Temperature

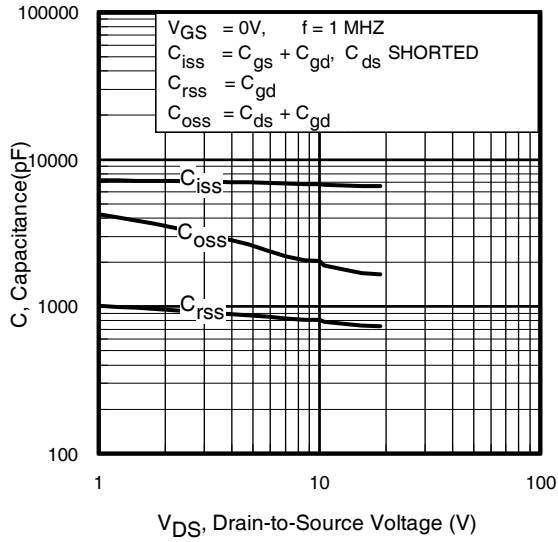


Fig 5. Typical Capacitance vs. Drain-to-Source Voltage

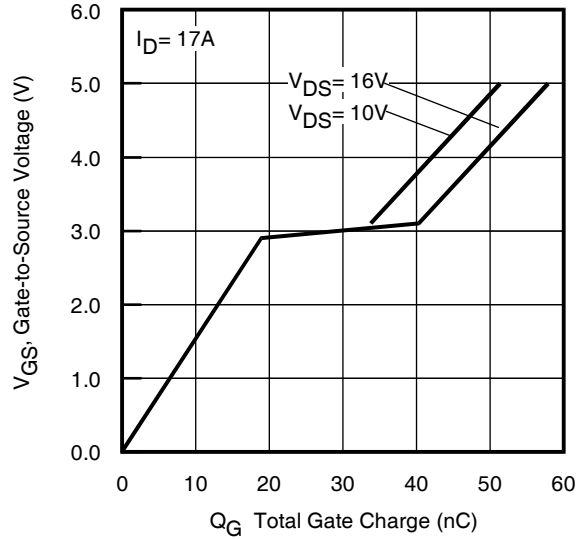


Fig 6. Typical Gate Charge vs. Gate-to-Source Voltage

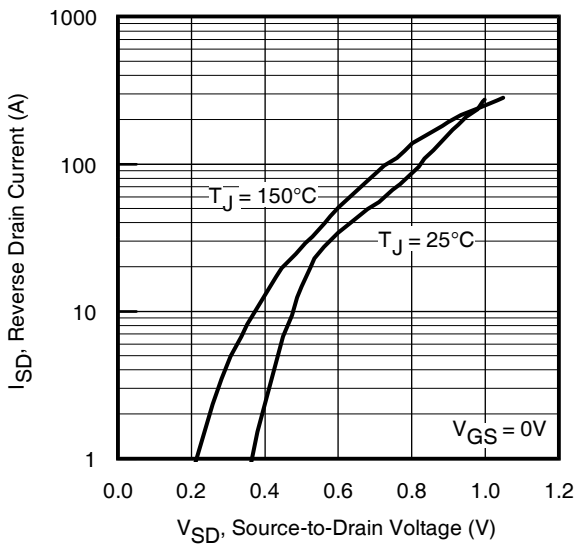


Fig 7. Typical Source-Drain Diode Forward Voltage

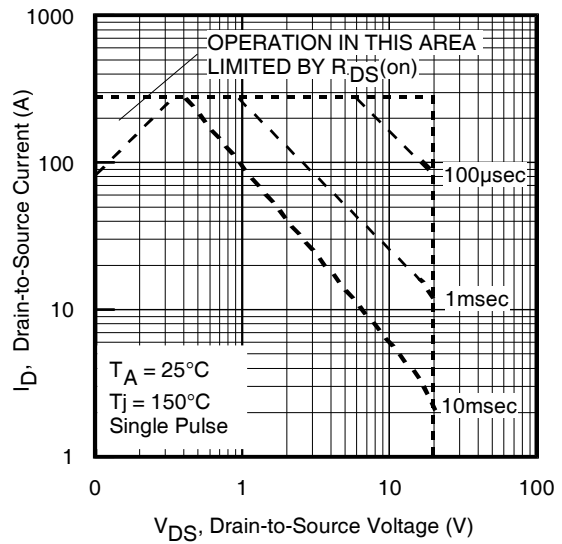


Fig 8. Maximum Safe Operating Area

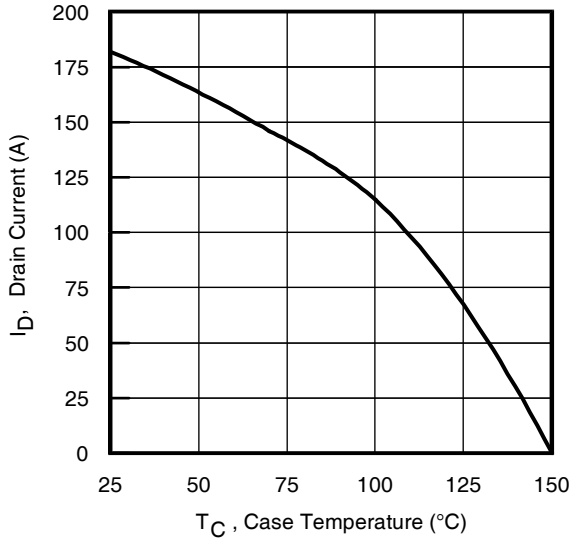


Fig 9. Maximum Drain Current vs. Case Temperature

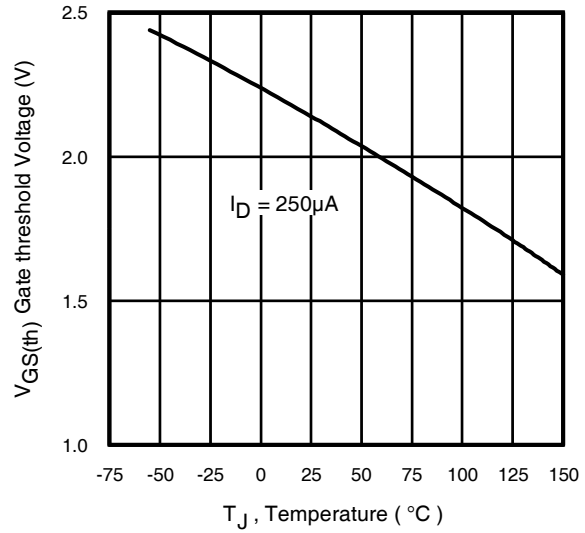


Fig 10. Threshold Voltage vs. Temperature

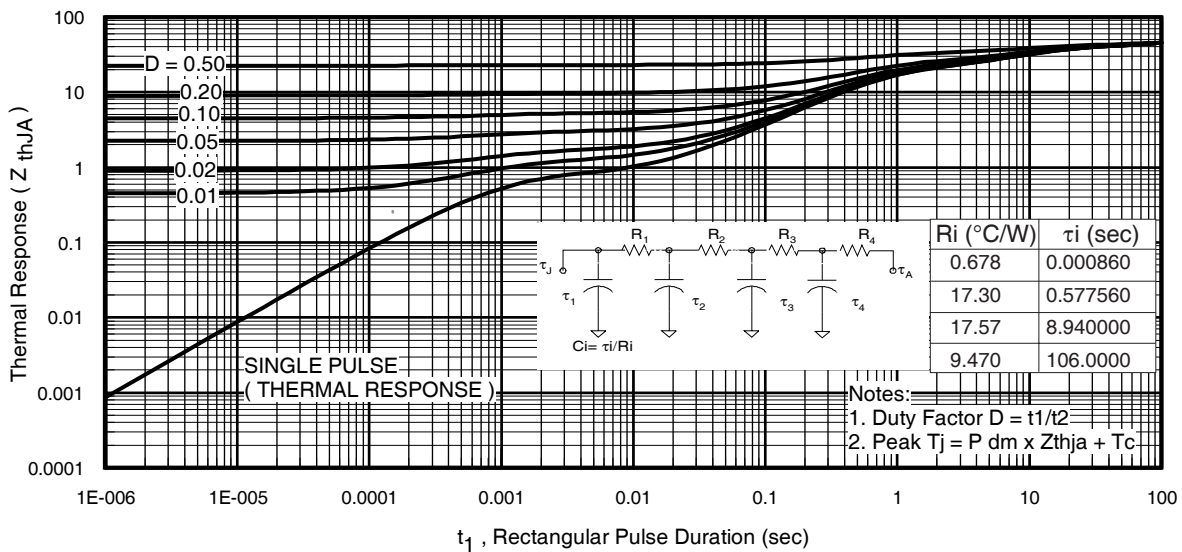


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Ambient

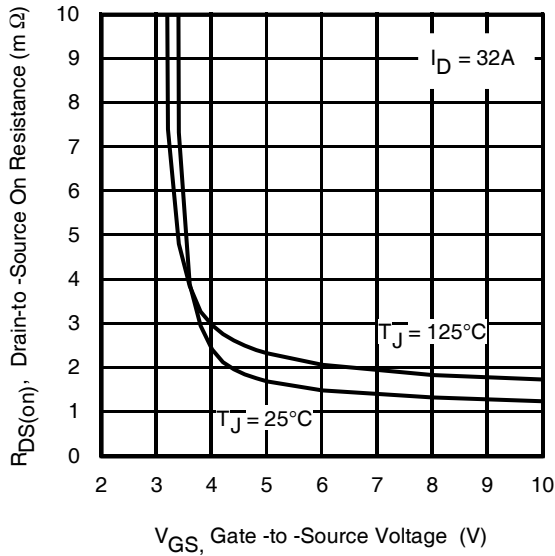


Fig 12. On-Resistance vs. Gate Voltage

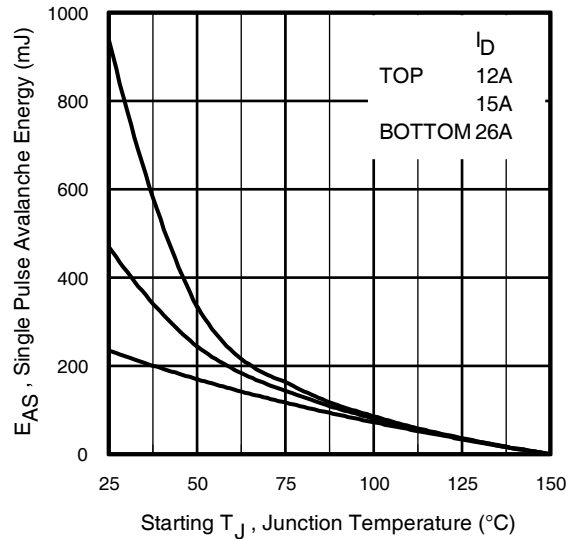


Fig 13. Maximum Avalanche Energy vs. Drain Current

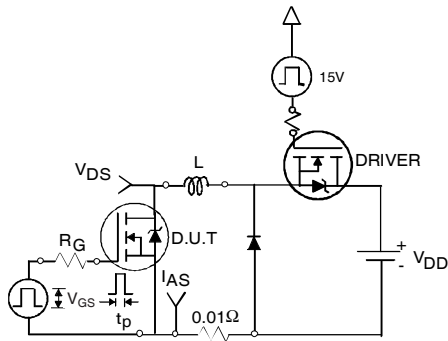


Fig 14a. Unclamped Inductive Test Circuit

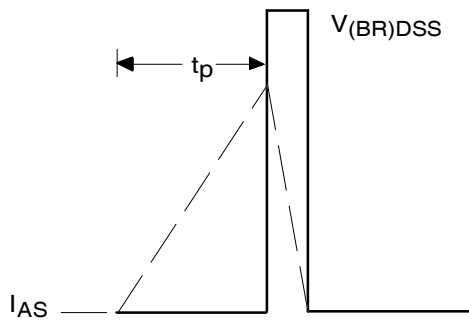


Fig 14b. Unclamped Inductive Waveforms

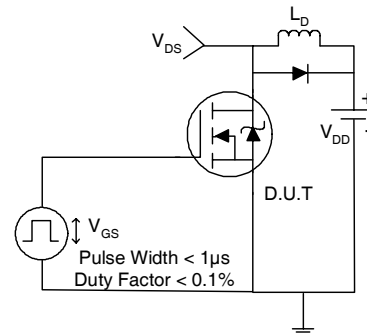


Fig 15a. Switching Time Test Circuit

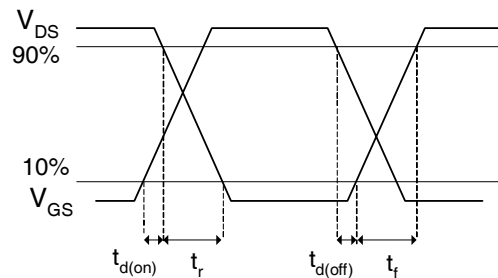


Fig 15b. Switching Time Waveforms

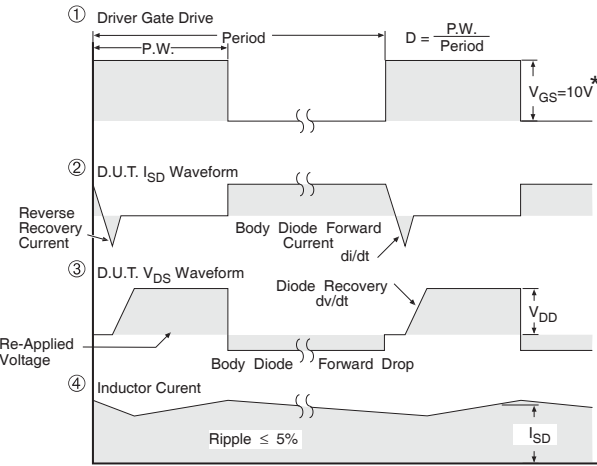
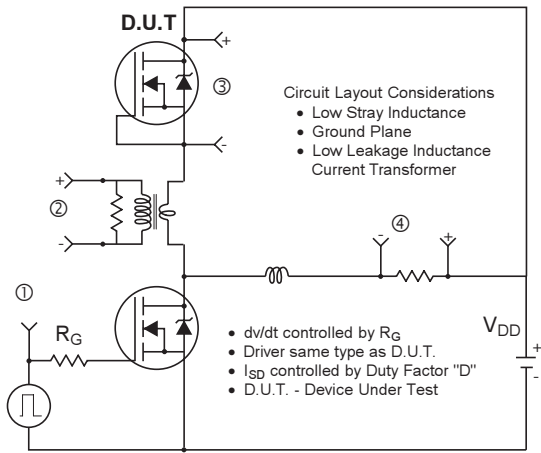


Fig 16. Peak Diode Recovery dv/dt Test Circuit for N-Channel HEXFET® Power MOSFETs

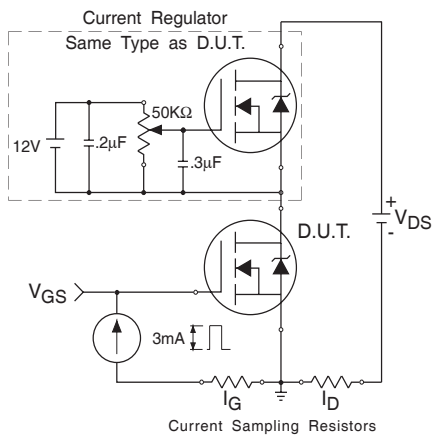


Fig 17. Gate Charge Test Circuit

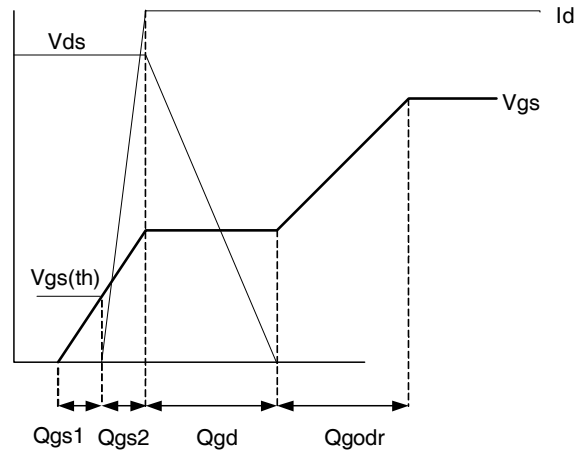
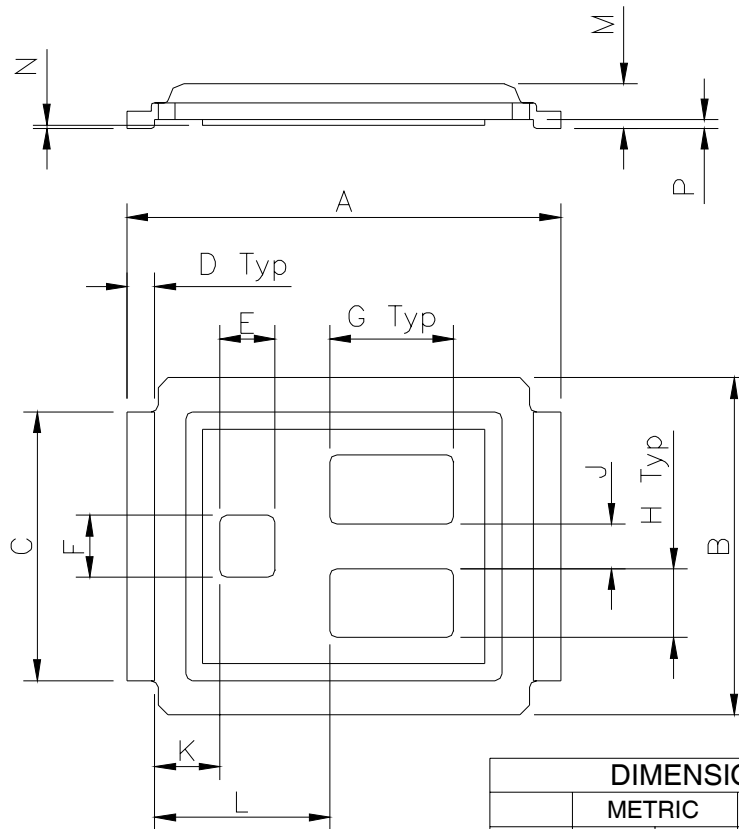


Fig 18. Gate Charge Waveform

DirectFET™ Outline Dimension, MT Outline (Medium Size Can, T-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.

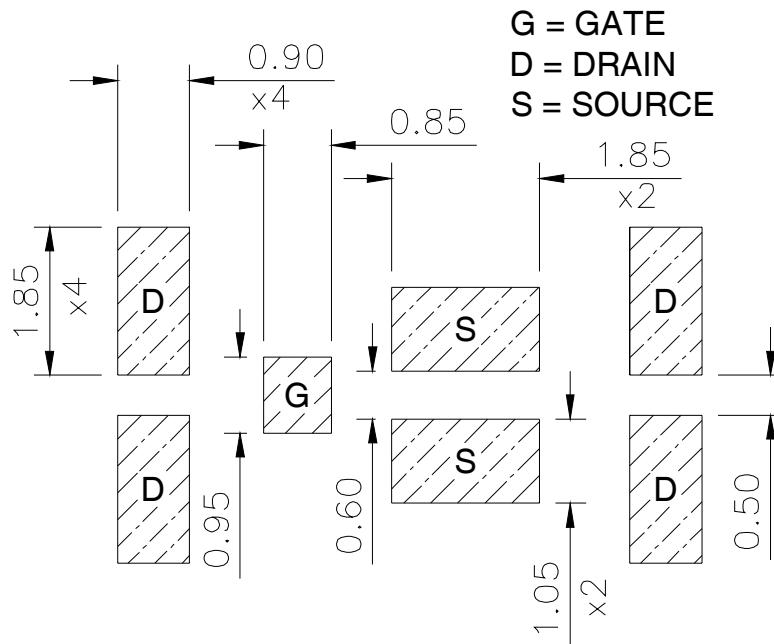
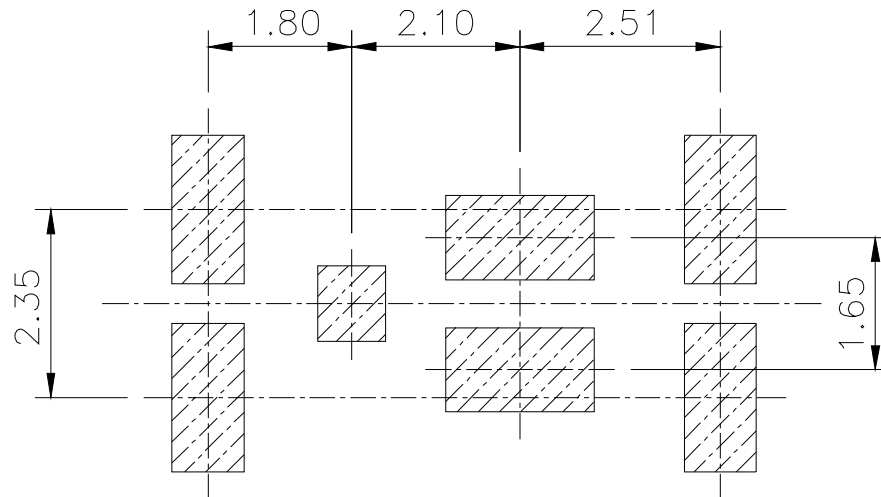


**NOTE: CONTROLLING
DIMENSIONS ARE IN MM**

| DIMENSIONS | | | | |
|------------|--------|------|----------|-------|
| CODE | METRIC | | IMPERIAL | |
| | 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 | 0.78 | 0.82 | 0.031 | 0.032 |
| F | 0.88 | 0.92 | 0.035 | 0.036 |
| G | 1.78 | 1.82 | 0.070 | 0.072 |
| H | 0.98 | 1.02 | 0.039 | 0.040 |
| J | 0.63 | 0.67 | 0.025 | 0.026 |
| K | 0.88 | 1.01 | 0.035 | 0.039 |
| L | 2.46 | 2.63 | 0.097 | 0.104 |
| 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™ Board Footprint, MT Outline
 (Medium Size Can, T-Designation).**

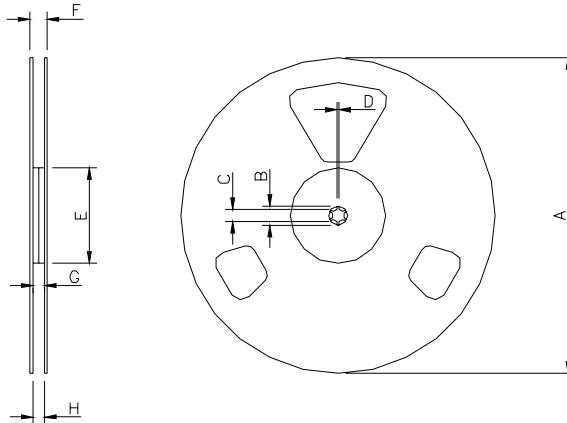
Please see DirectFET application note AN-1035 for all details regarding the assembly of DirectFET.
 This includes all recommendations for stencil and substrate designs.



IRF6691

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

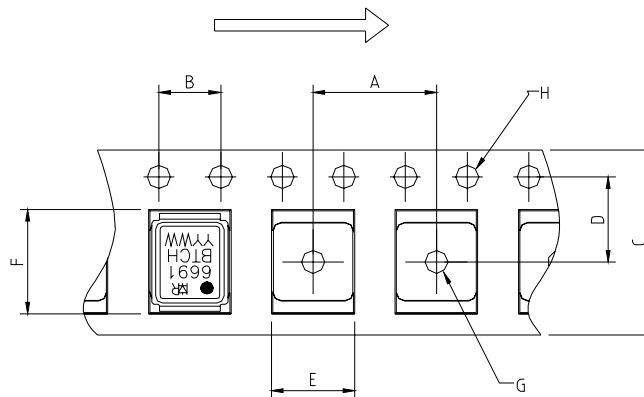
International
IR Rectifier



NOTE: Controlling dimensions in mm
Std reel quantity is 4800 parts. (ordered as IRF6691). For 1000 parts on 7" reel,
order IRF6691TR1

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

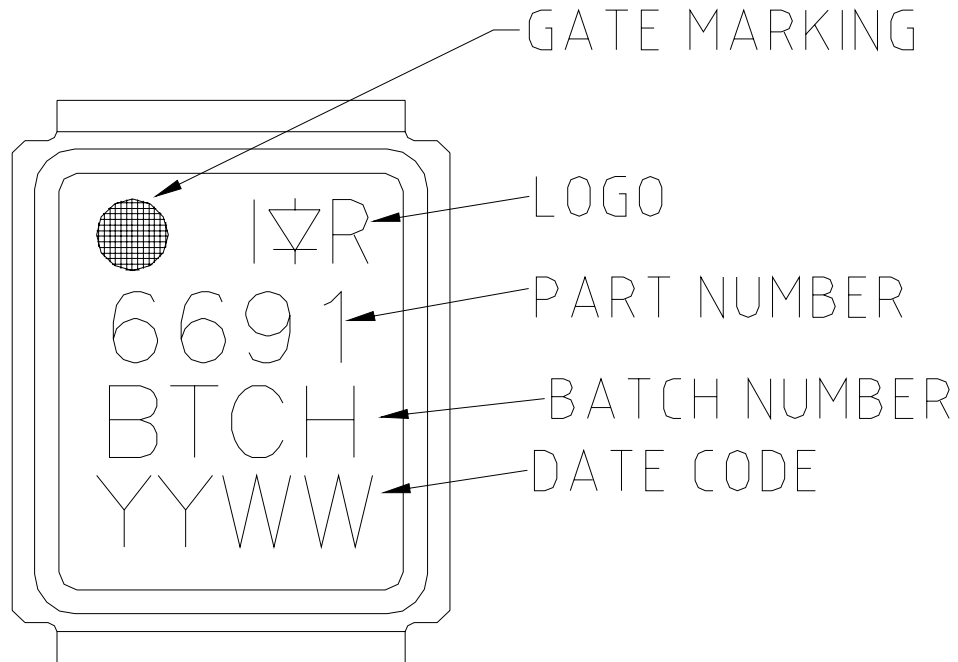
LOADED TAPE FEED DIRECTION



NOTE: CONTROLLING
DIMENSIONS IN MM

| CODE | 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 |

DirectFET™ Part Marking



Notes:

- ① Repetitive rating; pulse width limited by max. junction temperature.
- ② Starting $T_J = 25^\circ\text{C}$, $L = 0.72\text{mH}$, $R_G = 25\Omega$, $I_{AS} = 26\text{A}$.
- ③ Pulse width $\leq 400\mu\text{s}$; duty cycle $\leq 2\%$.
- ④ Surface mounted on 1 in. square Cu board.
- ⑤ Used double sided cooling , mounting pad.
- ⑥ Mounted on minimum footprint full size board with metalized back and with small clip heatsink.
- ⑦ T_C measured with thermal couple mounted to top (Drain) of part.
- ⑧ R_θ is measured at T_J of approximately 90°C .

Data and specifications subject to change without notice.
This product has been designed and qualified for the Industrial market.
Qualification Standards can be found on IR's Web site.

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.11/05

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