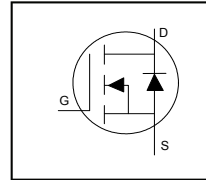


- Logic - Level Gate Drive
- Advanced Process Technology
- Dynamic dv/dt Rating
- 175°C Operating Temperature
- Fast Switching
- Fully Avalanche Rated
- Lead-Free



| | |
|--------------------------------|------------------------|
| V_{DSS} | 55V |
| R_{DS(on) max.} | 0.01Ω |
| I_D | 89A[Ⓔ] |



| | | |
|----------|----------|----------|
| G | D | S |
| Gate | Drain | Source |

Description

Fifth Generation HEXFETs utilize advanced processing techniques to achieve extremely low on-resistance per silicon area. This benefit, combined with the fast switching speed and ruggedized device design that HEXFET Power MOSFETs are well known for, provides the designer with an extremely efficient and reliable device for use in a wide variety of applications.

The TO-220 package is universally preferred for all commercial industrial applications at power dissipation levels to approximately 50 watts. The low thermal resistance and low package cost of the TO-220 contribute to its wide acceptance throughout the industry.

| Base part number | Package Type | Standard Pack | | Orderable Part Number |
|------------------|--------------|---------------|----------|-----------------------|
| | | Form | Quantity | |
| IRL3705NPbF | TO-220 | Tube | 50 | IRL3705NPbF |

Absolute Maximum Ratings

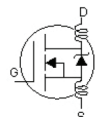
| Symbol | Parameter | Max. | Units |
|---|---|--------------------|-------|
| I _D @ T _C = 25°C | Continuous Drain Current, V _{GS} @ 10V | 89 [Ⓔ] | A |
| I _D @ T _C = 100°C | Continuous Drain Current, V _{GS} @ 10V | 63 | |
| I _{DM} | Pulsed Drain Current ^① | 310 | |
| P _D @ T _C = 25°C | Maximum Power Dissipation | 170 | W |
| | Linear Derating Factor | 1.1 | W/°C |
| V _{GS} | Gate-to-Source Voltage | ± 16 | V |
| E _{AS} | Single Pulse Avalanche Energy ^② | 340 | mJ |
| I _{AR} | Avalanche Current ^① | 46 | A |
| E _{AR} | Repetitive Avalanche Energy ^① | 17 | mJ |
| dv/dt | Peak Diode Recovery dv/dt ^③ | 5.0 | V/ns |
| T _J | Operating Junction and | -55 to + 175 | °C |
| T _{STG} | Storage Temperature Range | | |
| | Soldering Temperature, for 10 seconds (1.6mm from case) | | |
| | Mounting torque, 6-32 or M3 screw | 10 lbf•in (1.1N•m) | |

Thermal Resistance

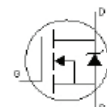
| Symbol | Parameter | Typ. | Max. | Units |
|------------------|-------------------------------------|------|------|-------|
| R _{θJC} | Junction-to-Case | — | 0.90 | °C/W |
| R _{θCS} | Case-to-Sink, Flat, Greased Surface | 0.50 | — | |
| R _{θJA} | Junction-to-Ambient | — | 62 | |

Electrical Characteristics @ T_J = 25°C (unless otherwise specified)

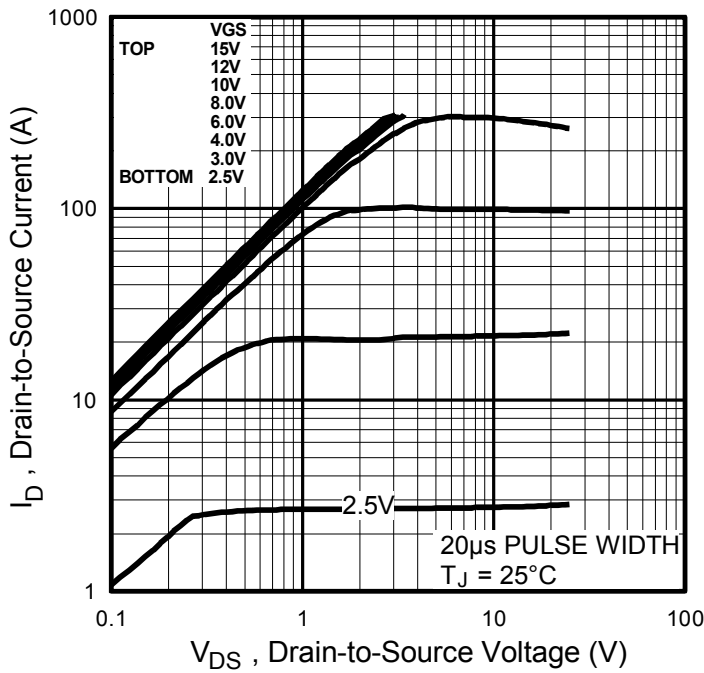
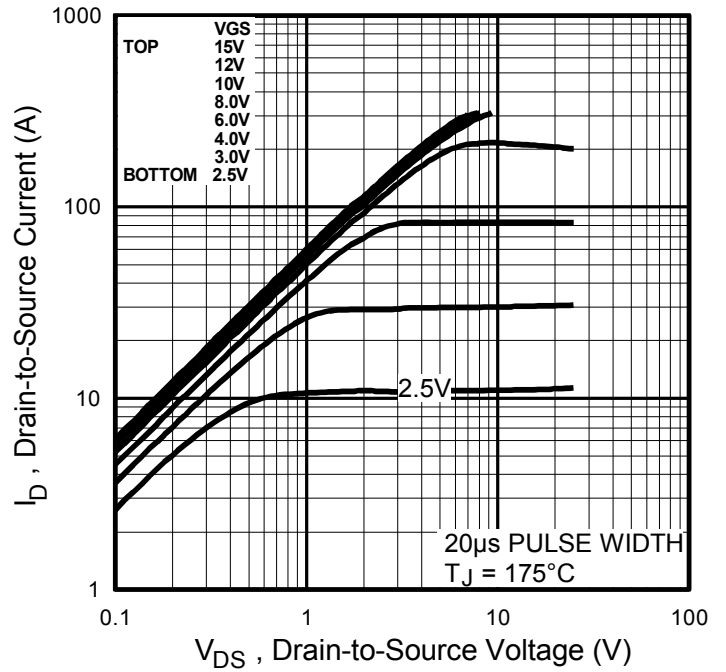
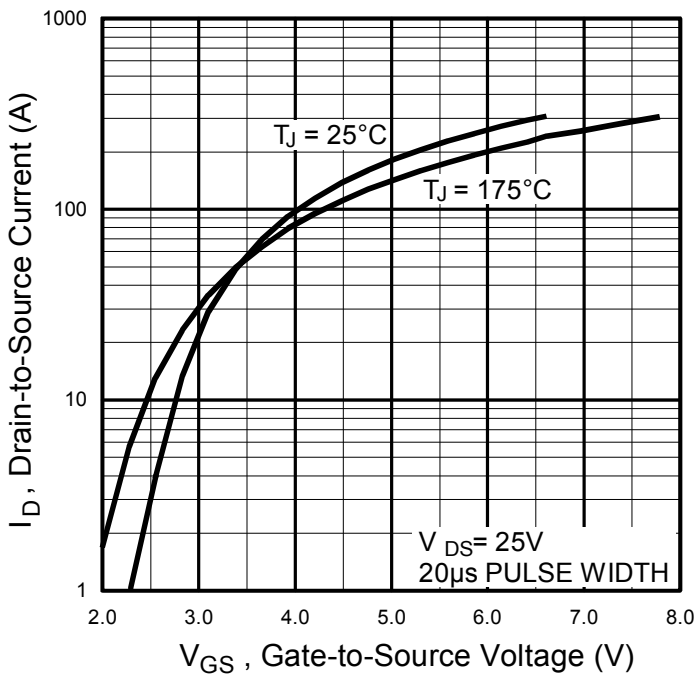
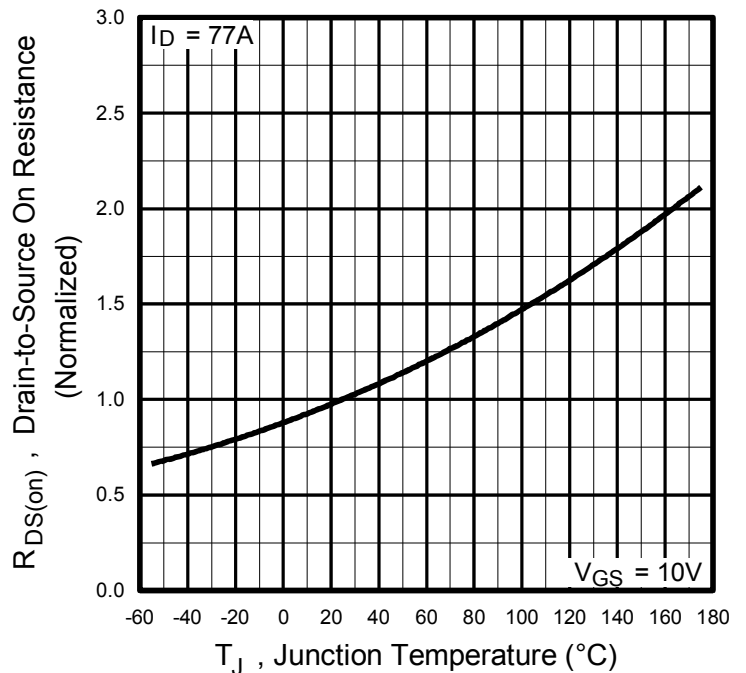
| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|--|--------------------------------------|------|-------|-------|-------|---|
| V _{(BR)DSS} | Drain-to-Source Breakdown Voltage | 55 | — | — | V | V _{GS} = 0V, I _D = 250μA |
| ΔV _{(BR)DSS} /ΔT _J | Breakdown Voltage Temp. Coefficient | — | 0.056 | — | V/°C | Reference to 25°C, I _D = 1mA |
| R _{DS(on)} | Static Drain-to-Source On-Resistance | — | — | 0.010 | Ω | V _{GS} = 10V, I _D = 46A ^④ |
| | | — | — | 0.012 | | V _{GS} = 5.0V, I _D = 46A ^④ |
| | | — | — | 0.018 | | V _{GS} = 4.0V, I _D = 39A ^④ |
| V _{GS(th)} | Gate Threshold Voltage | 1.0 | — | 2.0 | V | V _{DS} = V _{GS} , I _D = 250μA |
| g _{fs} | Forward Trans conductance | 50 | — | — | S | V _{DS} = 25V, I _D = 46A |
| I _{DSS} | Drain-to-Source Leakage Current | — | — | 25 | μA | V _{DS} = 55V, V _{GS} = 0V |
| | | — | — | 250 | | V _{DS} = 44V, V _{GS} = 0V, T _J = 150°C |
| I _{GSS} | Gate-to-Source Forward Leakage | — | — | 100 | nA | V _{GS} = 16V |
| | Gate-to-Source Reverse Leakage | — | — | -100 | | V _{GS} = -16V |
| Q _g | Total Gate Charge | — | — | 98 | nC | I _D = 46A |
| Q _{gs} | Gate-to-Source Charge | — | — | 19 | | V _{DS} = 44V |
| Q _{gd} | Gate-to-Drain Charge | — | — | 49 | | V _{GS} = 5.0V, See Fig. 6 and 13 ^④ |
| t _{d(on)} | Turn-On Delay Time | — | 12 | — | ns | V _{DD} = 28V |
| t _r | Rise Time | — | 140 | — | | I _D = 46A |
| t _{d(off)} | Turn-Off Delay Time | — | 37 | — | | R _G = 1.8Ω, V _{GS} = 5.0V |
| t _f | Fall Time | — | 78 | — | | R _D = 0.59Ω, See Fig. 10 ^④ |
| L _D | Internal Drain Inductance | — | 4.5 | — | nH | Between lead, 6mm (0.25in.) |
| L _S | Internal Source Inductance | — | 7.5 | — | | from package and center of die contact |
| C _{iss} | Input Capacitance | — | 3600 | — | pF | V _{GS} = 0V |
| C _{oss} | Output Capacitance | — | 870 | — | | V _{DS} = 25V |
| C _{rss} | Reverse Transfer Capacitance | — | 320 | — | | f = 1.0MHz, See Fig. 5 |


Source-Drain Ratings and Characteristics

| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|-----------------|---|---|------|-----------------|-------|--|
| I _S | Continuous Source Current (Body Diode) | — | — | 89 ^⑤ | A | MOSFET symbol showing the integral reverse p-n junction diode. |
| I _{SM} | Pulsed Source Current (Body Diode) ^① | — | — | 310 | | |
| V _{SD} | Diode Forward Voltage | — | — | 1.3 | V | T _J = 25°C, I _S = 46A, V _{GS} = 0V ^④ |
| t _{rr} | Reverse Recovery Time | — | 94 | 140 | ns | T _J = 25°C, I _F = 46A |
| Q _{rr} | Reverse Recovery Charge | — | 290 | 440 | nC | di/dt = 100A/μs ^④ |
| t _{on} | Forward Turn-On Time | Intrinsic turn-on time is negligible (turn-on is dominated by L _S + L _D) | | | | |


Notes:

- ① Repetitive rating; pulse width limited by max. junction temperature. (See fig.11)
- ② V_{DD} = 25V, starting T_J = 25°C, L = 320μH, R_G = 25Ω, I_{AS} = 46A.(See fig.12)
- ③ I_{SD} ≤ 46A, di/dt ≤ 250A/μs, V_{DD} ≤ V_{(BR)DSS}, T_J ≤ 175°C.
- ④ Pulse width ≤ 300μs; duty cycle ≤ 2%.
- ⑤ Calculated continuous current based on maximum allowable junction temperature; for recommended current- handling of the package refer to Design TIP # 93-4


Fig. 1 Typical Output Characteristics

Fig. 2 Typical Output Characteristics

Fig. 3 Typical Transfer Characteristics

Fig. 4 Normalized On-Resistance vs. Temperature

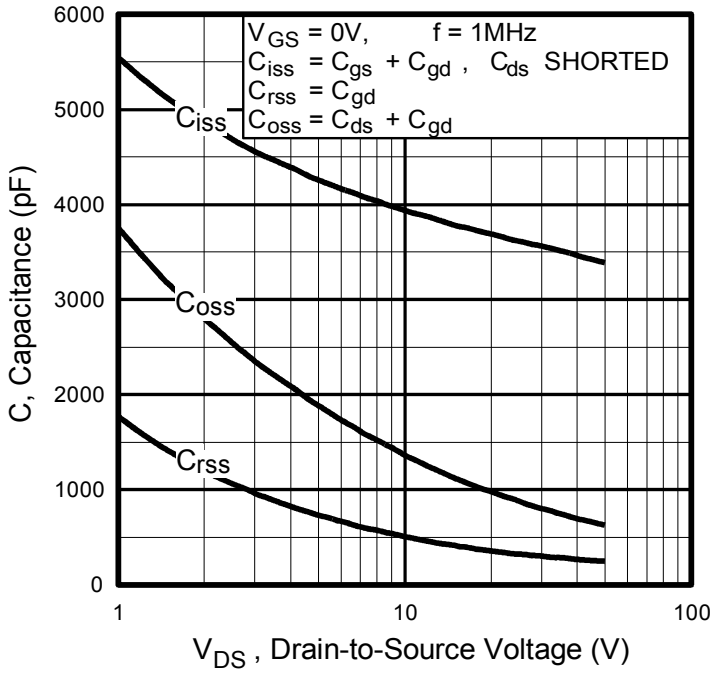


Fig 5. Typical Capacitance vs. Drain-to-Source Voltage

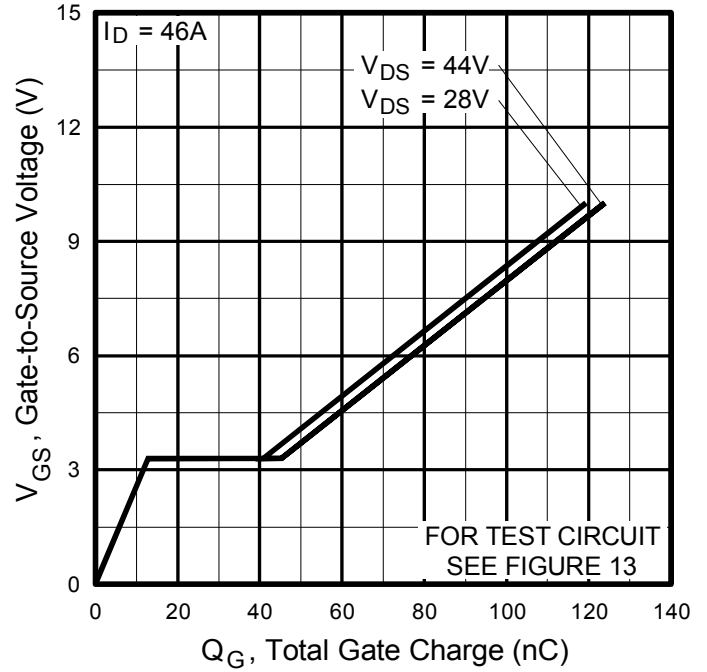


Fig 6. Typical Gate Charge vs. Gate-to-Source Voltage

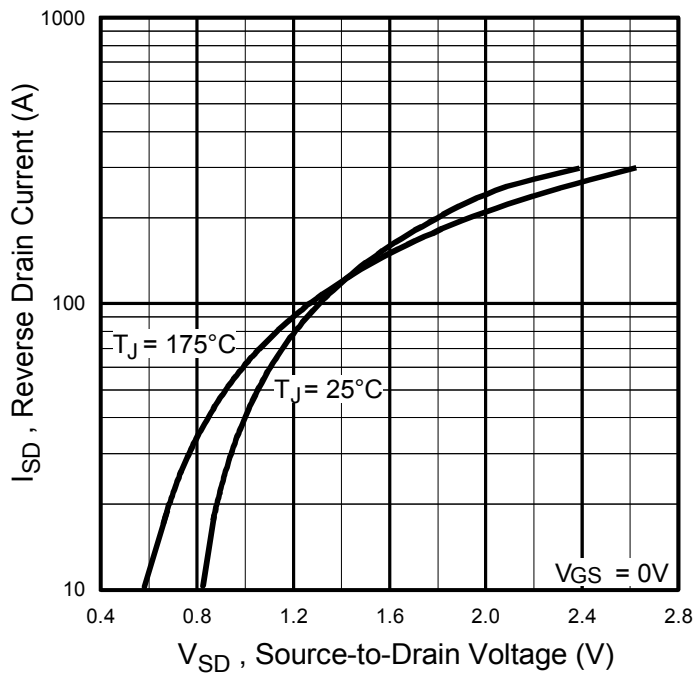


Fig 7. Typical Source-to-Drain Diode Forward Voltage

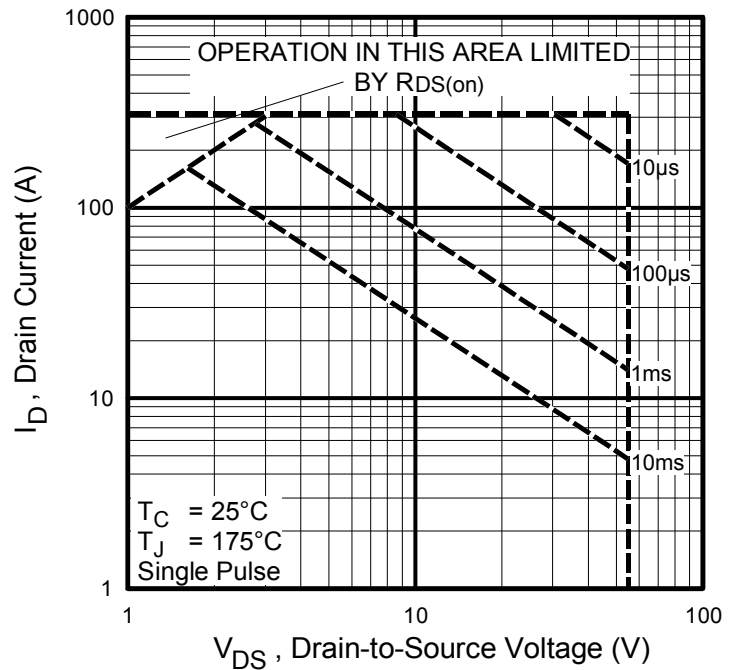
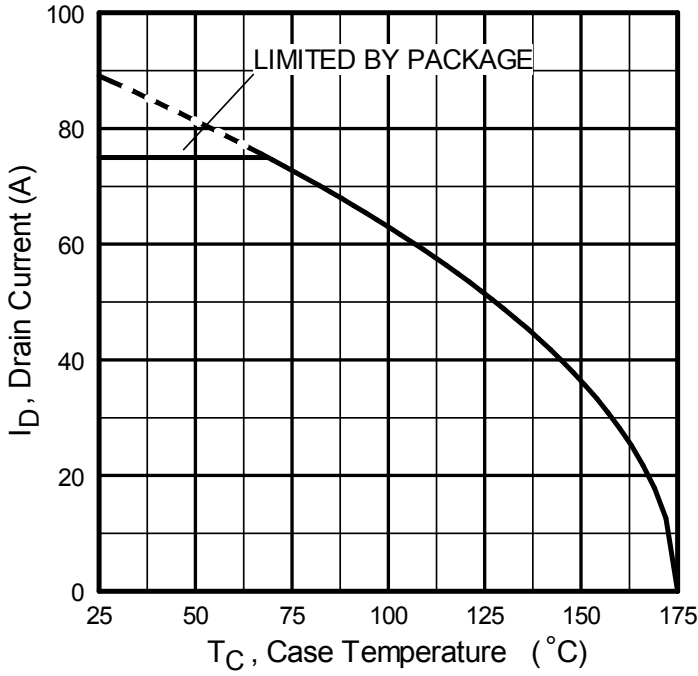
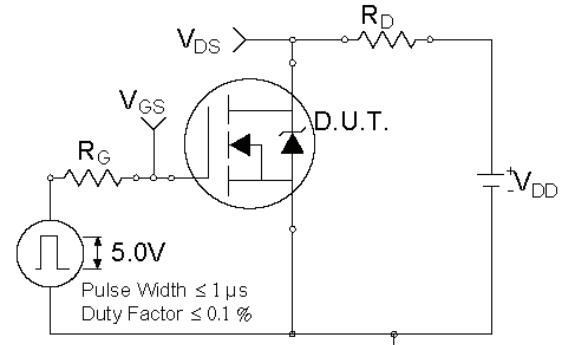
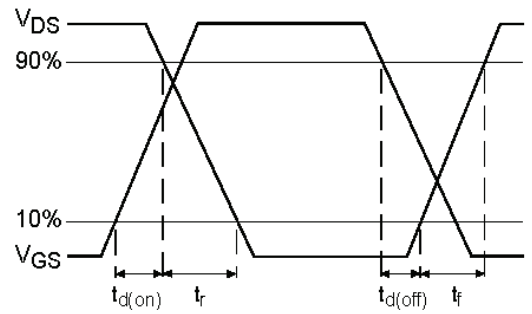
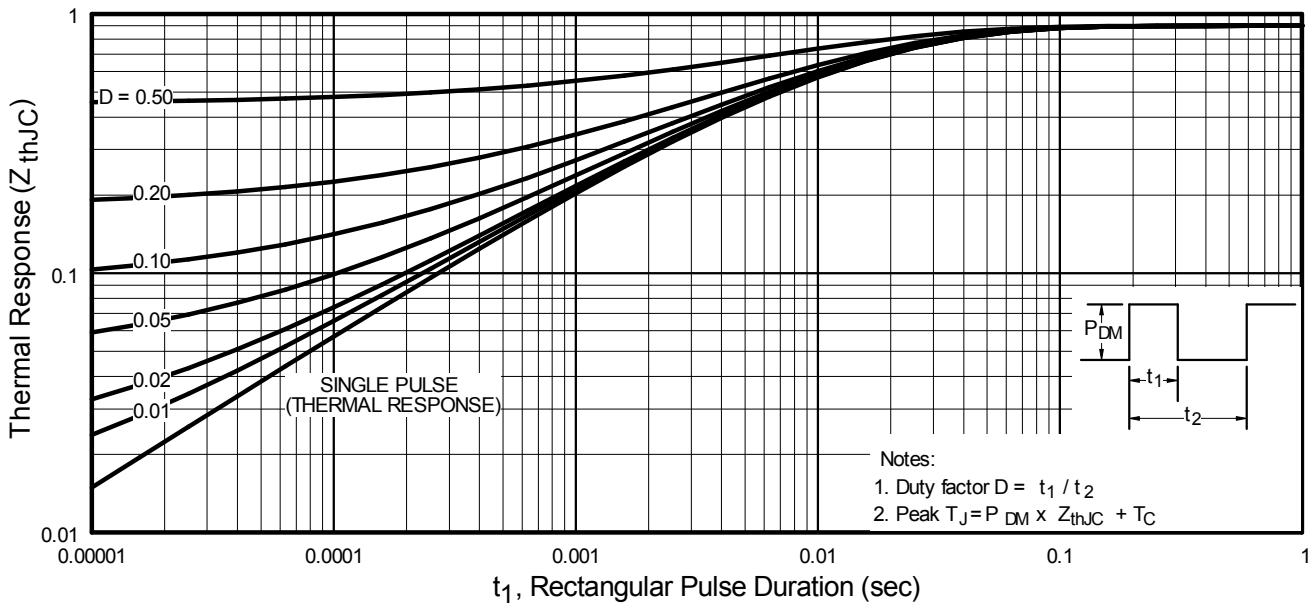
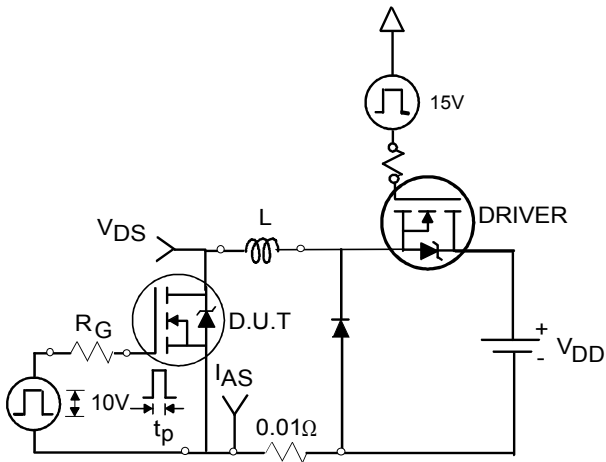
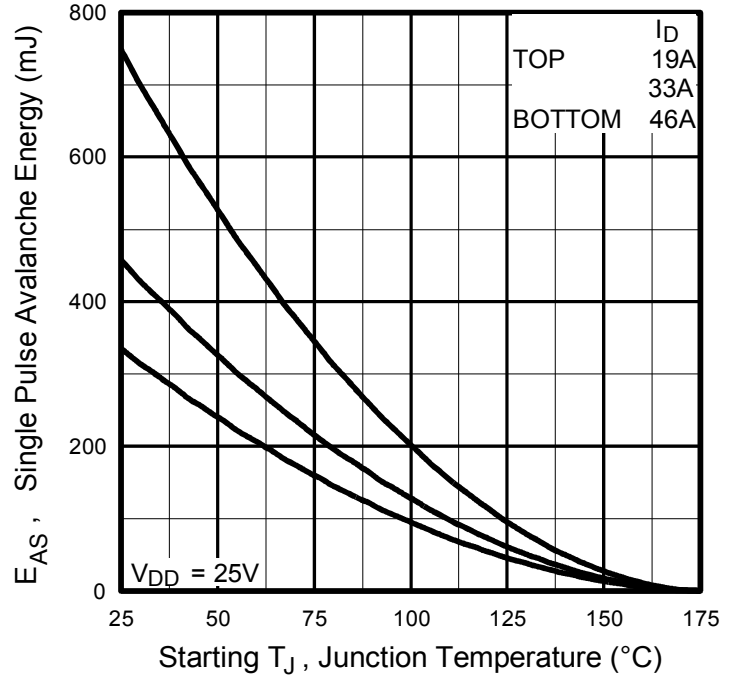
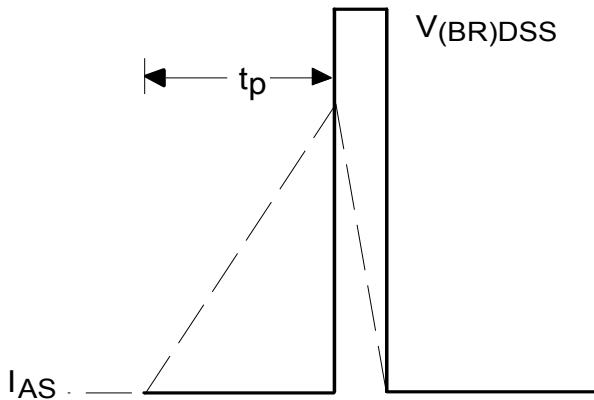
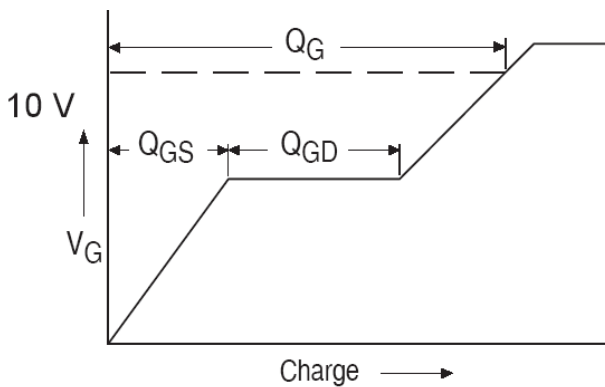
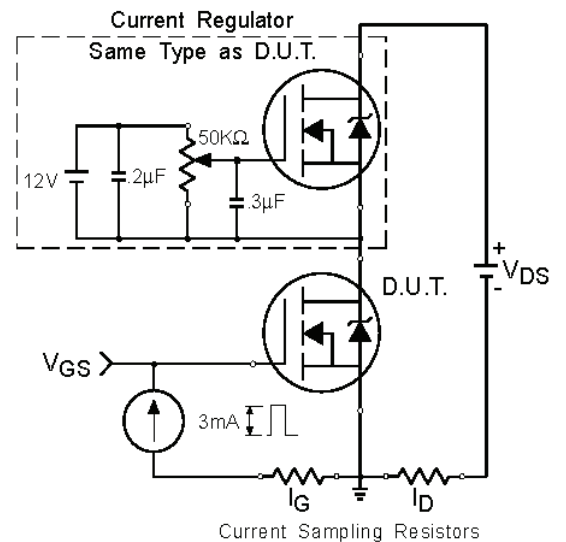
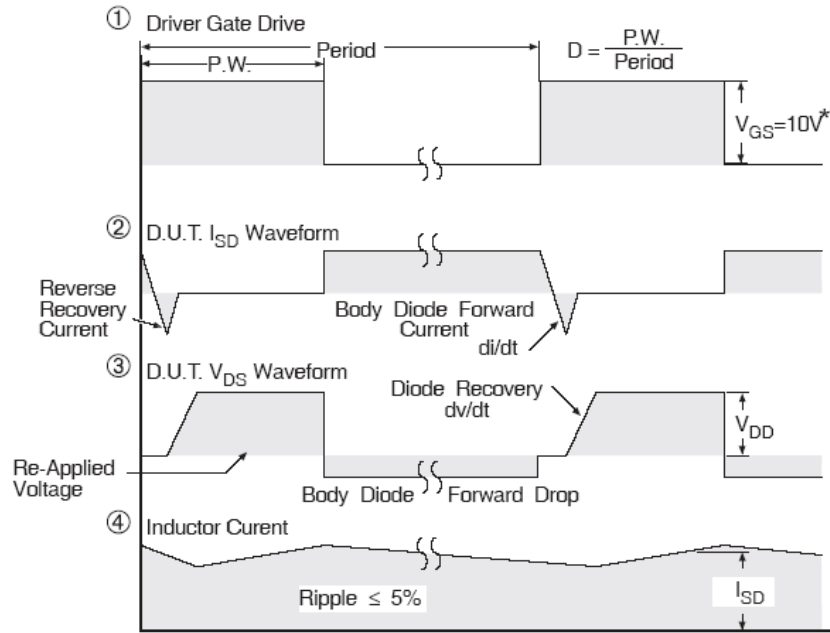
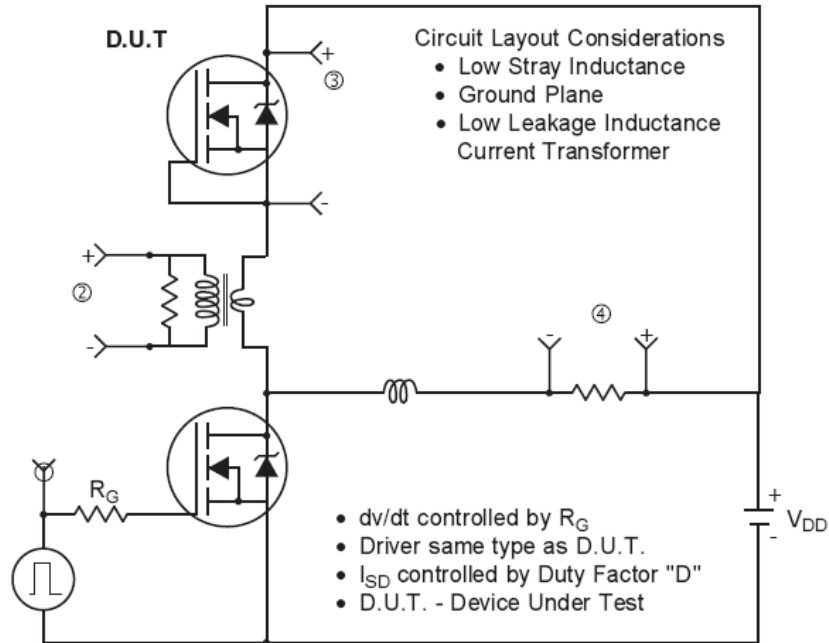


Fig 8. Maximum Safe Operating Area


Fig 9. Maximum Drain Current vs. Case Temperature

Fig 10a. Switching Time Test Circuit

Fig 10b. Switching Time Waveforms

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

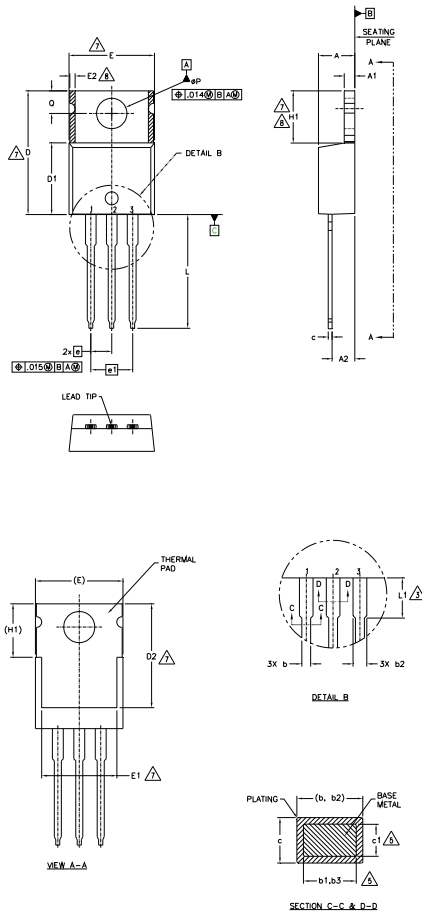

Fig 12a. Unclamped Inductive Test Circuit

Fig 12c. Maximum Avalanche Energy vs. Drain Current

Fig 12b. Unclamped Inductive Waveforms

Fig 13a. Gate Charge Waveform

Fig 13b. Gate Charge Test Circuit

Peak Diode Recovery dv/dt Test Circuit



* $V_{GS} = 5V$ for Logic Level Devices

Fig 14. Peak Diode Recovery dv/dt Test Circuit for N-Channel HEXFET® Power MOSFETs

TO-220 Package Outline (Dimensions are shown in millimeters (inches))

NOTES:

- 1.- DIMENSIONING AND TOLERANCING AS PER ASME Y14.5 M- 1994.
- 2.- DIMENSIONS ARE SHOWN IN INCHES [MILLIMETERS].
- 3.- LEAD DIMENSION AND FINISH UNCONTROLLED IN L1.
- 4.- DIMENSION D, D1 & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED .005" (0.127) PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY.
- 5.- DIMENSION b1, b3 & c1 APPLY TO BASE METAL ONLY.
- 6.- CONTROLLING DIMENSION : INCHES.
- 7.- THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSIONS E,H1,D2 & E1
- 8.- DIMENSION E2 X H1 DEFINE A ZONE WHERE STAMPING AND SINGULATION IRREGULARITIES ARE ALLOWED.
- 9.- OUTLINE CONFORMS TO JEDEC TO-220, EXCEPT A2 (max.) AND D2 (min.) WHERE DIMENSIONS ARE DERIVED FROM THE ACTUAL PACKAGE OUTLINE.

| SYMBOL | DIMENSIONS | | | | NOTES |
|--------|-------------|-------|----------|------|-------|
| | MILLIMETERS | | INCHES | | |
| | MIN. | MAX. | MIN. | MAX. | |
| A | 3.56 | 4.83 | .140 | .190 | |
| A1 | 1.14 | 1.40 | .045 | .055 | |
| A2 | 2.03 | 2.92 | .080 | .115 | |
| b | 0.38 | 1.01 | .015 | .040 | |
| b1 | 0.38 | 0.97 | .015 | .038 | 5 |
| b2 | 1.14 | 1.78 | .045 | .070 | |
| b3 | 1.14 | 1.73 | .045 | .068 | 5 |
| c | 0.36 | 0.61 | .014 | .024 | |
| c1 | 0.36 | 0.56 | .014 | .022 | 5 |
| D | 14.22 | 16.51 | .560 | .650 | 4 |
| D1 | 8.38 | 9.02 | .330 | .355 | |
| D2 | 11.68 | 12.88 | .460 | .507 | 7 |
| E | 9.65 | 10.67 | .380 | .420 | 4,7 |
| E1 | 6.86 | 8.89 | .270 | .350 | 7 |
| E2 | - | 0.76 | - | .030 | 8 |
| e | 2.54 BSC | | .100 BSC | | |
| e1 | 5.08 BSC | | .200 BSC | | |
| H1 | 5.84 | 6.86 | .230 | .270 | 7,8 |
| L | 12.70 | 14.73 | .500 | .580 | |
| L1 | 3.56 | 4.06 | .140 | .160 | 3 |
| øP | 3.54 | 4.08 | .139 | .161 | |
| Q | 2.54 | 3.42 | .100 | .135 | |

LEAD ASSIGNMENTS
HEXFET

- 1- GATE
- 2- DRAIN
- 3- SOURCE

IGBTs, CoPACK

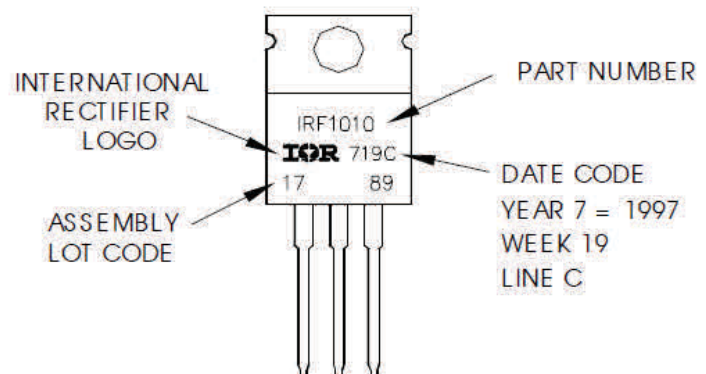
- 1- GATE
- 2- COLLECTOR
- 3- EMITTER

DIODES

- 1- ANODE
- 2- CATHODE
- 3- ANODE

TO-220 Part Marking Information

EXAMPLE: THIS IS AN IRF1010
 LOT CODE 1789
 ASSEMBLED ON WW 19, 1997
 IN THE ASSEMBLY LINE "C"
Note: "P" in assembly line position indicates "Lead-Free"



TO-220AB packages are not recommended for Surface Mount Application.

Qualification Information

| | | |
|-----------------------------------|--|-----|
| Qualification Level | Industrial (per JEDEC JESD47F) [†] | |
| Moisture Sensitivity Level | TO-220 | N/A |
| RoHS Compliant | Yes | |

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

Revision History

| Date | Comments |
|------------|--|
| 05/25/2018 | <ul style="list-style-type: none"> Changed datasheet with Infineon logo - all pages. Corrected TO-220 Package outline on page 8. Added disclaimer on last page. |

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[SSM6P54TU,LF](#) [SSM6P69NU,LF](#) [DMP22D4UFO-7B](#)