International Rectifier

**SMPS MOSFET**

PD - 95902

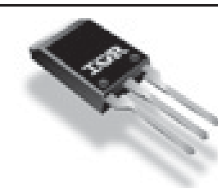
# IRFBA90N20DPbF

HEXFET® Power MOSFET

### Applications
- High frequency DC-DC converters
- Lead-Free

| $V_{DSS}$ | $R_{DS(on)}$ max | $I_D$ |
|---|---|---|
| **200V** | **0.023Ω** | **98A⑥** |

### Benefits
- Low Gate-to-Drain Charge to Reduce Switching Losses
- Fully Characterized Capacitance Including Effective $C_{OSS}$ to Simplify Design, (See App. Note AN1001)
- Fully Characterized Avalanche Voltage and Current



**Super-220™**

### Absolute Maximum Ratings

| | Parameter | Max. | Units |
|---|---|---|---|
| $I_D$ @ $T_C$ = 25°C | Continuous Drain Current, $V_{GS}$ @ 10V | 98⑥ | A |
| $I_D$ @ $T_C$ = 100°C | Continuous Drain Current, $V_{GS}$ @ 10V | 71⑥ | |
| $I_{DM}$ | Pulsed Drain Current ① | 390 | |
| $P_D$ @$T_C$ = 25°C | Power Dissipation | 650 | W |
| | Linear Derating Factor | 4.3 | W/°C |
| $V_{GS}$ | Gate-to-Source Voltage | ± 30 | V |
| dv/dt | Peak Diode Recovery dv/dt ③ | 6.3 | V/ns |
| $T_J$<br>$T_{STG}$ | Operating Junction and<br>Storage Temperature Range | -55 to + 175 | °C |
| | Soldering Temperature, for 10 seconds | 300 (1.6mm from case ) | |
| | Recommended Clip Force | 20 | N |

### Thermal Resistance

| | Parameter | Typ. | Max. | Units |
|---|---|---|---|---|
| $R_{\theta JC}$ | Junction-to-Case | —— | 0.23 | °C/W |
| $R_{\theta CS}$ | Case-to-Sink, Flat, Greased Surface | 0.50 | —— | |
| $R_{\theta JA}$ | Junction-to-Ambient | —— | 58 | |

Notes ① through ⑥ are on page 8

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

| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| $V_{(BR)DSS}$ | Drain-to-Source Breakdown Voltage | 200 | ––– | ––– | V | $V_{GS}$ = 0V, $I_D$ = 250µA |
| $\Delta V_{(BR)DSS}/\Delta T_J$ | Breakdown Voltage Temp. Coefficient | ––– | 0.22 | ––– | V/°C | Reference to 25°C, $I_D$ = 1mA |
| $R_{DS(on)}$ | Static Drain-to-Source On-Resistance | ––– | ––– | 0.023 | Ω | $V_{GS}$ = 10V, $I_D$ = 59A ④ |
| $V_{GS(th)}$ | Gate Threshold Voltage | 3.0 | ––– | 5.0 | V | $V_{DS}$ = $V_{GS}$, $I_D$ = 250µA |
| $I_{DSS}$ | Drain-to-Source Leakage Current | ––– | ––– | 25 | µA | $V_{DS}$ = 200V, $V_{GS}$ = 0V |
| | | ––– | ––– | 250 | | $V_{DS}$ = 160V, $V_{GS}$ = 0V, $T_J$ = 150°C |
| $I_{GSS}$ | Gate-to-Source Forward Leakage | ––– | ––– | 100 | nA | $V_{GS}$ = 30V |
| | Gate-to-Source Reverse Leakage | ––– | ––– | -100 | | $V_{GS}$ = -30V |

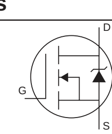
## Dynamic @ $T_J$ = 25°C (unless otherwise specified)

| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| $g_{fs}$ | Forward Transconductance | 41 | ––– | ––– | S | $V_{DS}$ = 50V, $I_D$ = 59A |
| $Q_g$ | Total Gate Charge | ––– | 160 | 240 | nC | $I_D$ = 59A |
| $Q_{gs}$ | Gate-to-Source Charge | ––– | 45 | 67 | | $V_{DS}$ = 160V |
| $Q_{gd}$ | Gate-to-Drain ("Miller") Charge | ––– | 75 | 110 | | $V_{GS}$ = 10V ④ |
| $t_{d(on)}$ | Turn-On Delay Time | ––– | 23 | ––– | ns | $V_{DD}$ = 100V |
| $t_r$ | Rise Time | ––– | 160 | ––– | | $I_D$ = 59A |
| $t_{d(off)}$ | Turn-Off Delay Time | ––– | 39 | ––– | | $R_G$ = 1.2Ω |
| $t_f$ | Fall Time | ––– | 77 | ––– | | $V_{GS}$ = 10V ④ |
| $C_{iss}$ | Input Capacitance | ––– | 6080 | ––– | pF | $V_{GS}$ = 0V |
| $C_{oss}$ | Output Capacitance | ––– | 1040 | ––– | | $V_{DS}$ = 25V |
| $C_{rss}$ | Reverse Transfer Capacitance | ––– | 150 | ––– | | $f$ = 1.0MHz |
| $C_{oss}$ | Output Capacitance | ––– | 7500 | ––– | | $V_{GS}$ = 0V, $V_{DS}$ = 1.0V, $f$ = 1.0MHz |
| $C_{oss}$ | Output Capacitance | ––– | 410 | ––– | | $V_{GS}$ = 0V, $V_{DS}$ = 160V, $f$ = 1.0MHz |
| $C_{oss}$ eff. | Effective Output Capacitance | ––– | 790 | ––– | | $V_{GS}$ = 0V, $V_{DS}$ = 0V to 160V ⑤ |

## Avalanche Characteristics

| | Parameter | Typ. | Max. | Units |
|---|---|---|---|---|
| $E_{AS}$ | Single Pulse Avalanche Energy② | ––– | 960 | mJ |
| $I_{AR}$ | Avalanche Current① | ––– | 59 | A |
| $E_{AR}$ | Repetitive Avalanche Energy① | ––– | 65 | mJ |

## Diode Characteristics

| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| $I_S$ | Continuous Source Current (Body Diode) | ––– | ––– | 98 | A | MOSFET symbol showing the integral reverse p-n junction diode.  |
| $I_{SM}$ | Pulsed Source Current (Body Diode) ① | ––– | ––– | 390 | | |
| $V_{SD}$ | Diode Forward Voltage | ––– | ––– | 1.5 | V | $T_J$ = 25°C, $I_S$ = 59A, $V_{GS}$ = 0V ④ |
| $t_{rr}$ | Reverse Recovery Time | ––– | 220 | 340 | nS | $T_J$ = 25°C, $I_F$ = 59A |
| $Q_{rr}$ | Reverse RecoveryCharge | ––– | 1.9 | 2.8 | µC | di/dt = 100A/µs ④ |
| $t_{on}$ | Forward Turn-On Time | Intrinsic turn-on time is negligible (turn-on is dominated by $L_S$+$L_D$) | | | | |

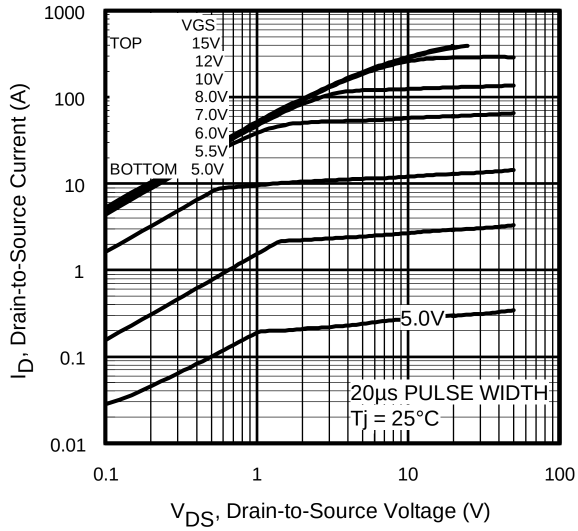



**Fig 1.** Typical Output Characteristics

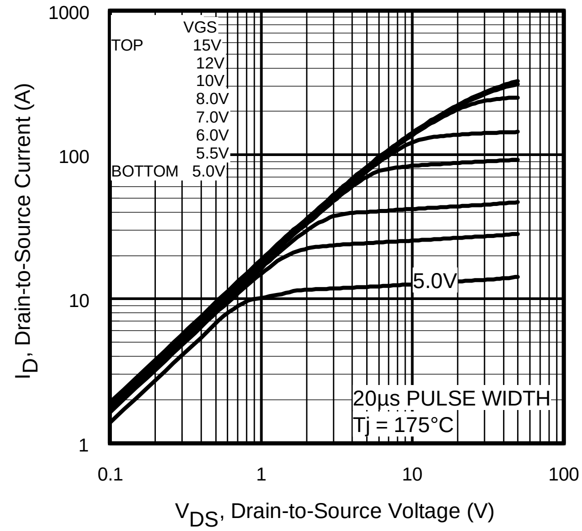



**Fig 2.** Typical Output Characteristics

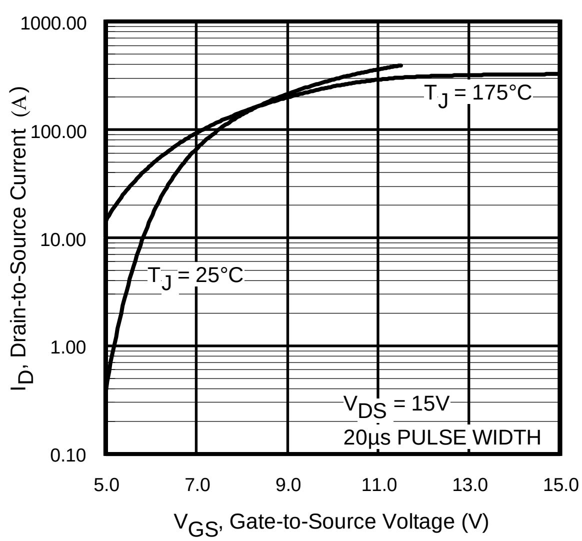



**Fig 3.** Typical Transfer Characteristics

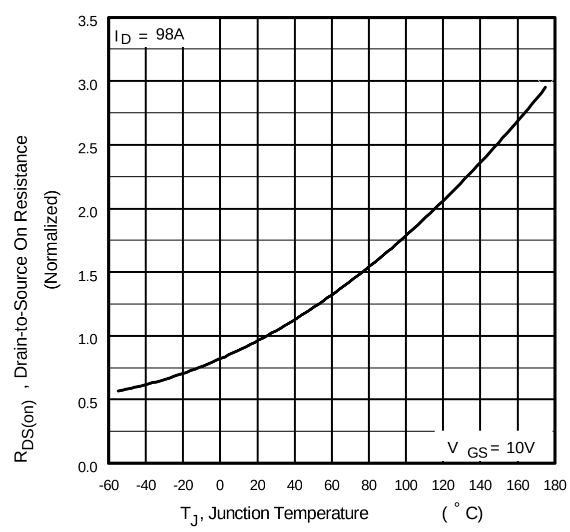



**Fig 4.** Normalized On-Resistance Vs. Temperature

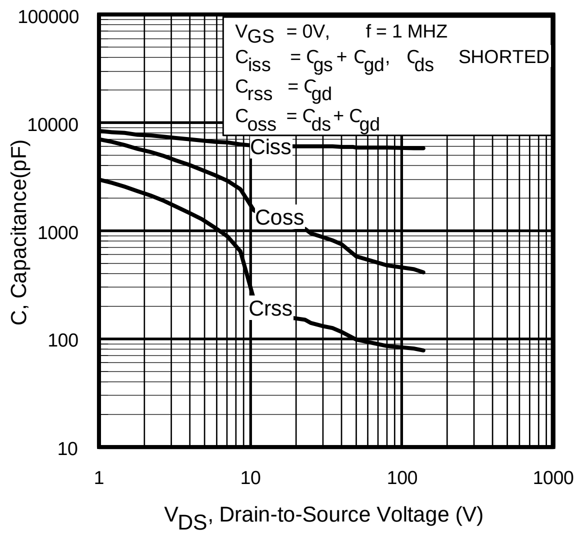



**Fig 5.** Typical Capacitance Vs. Drain-to-Source Voltage

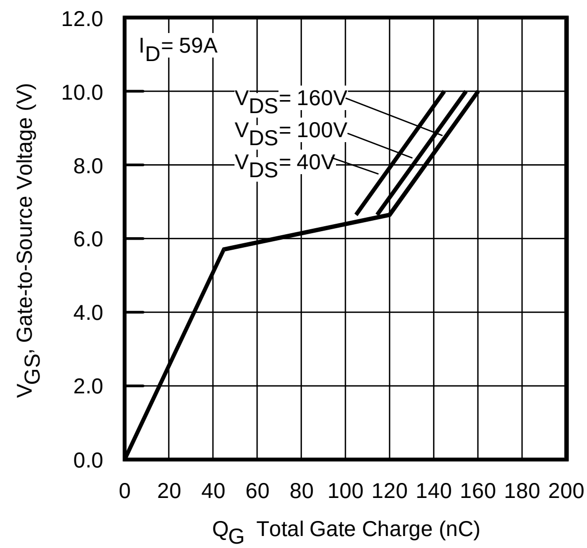



**Fig 6.** Typical Gate Charge Vs. Gate-to-Source Voltage

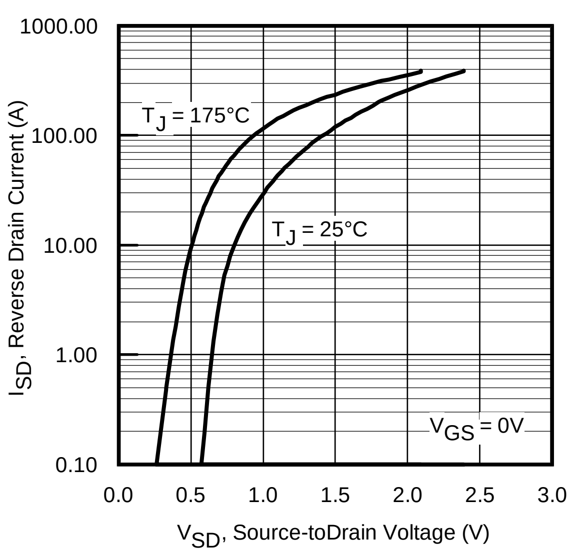



**Fig 7.** Typical Source-Drain Diode Forward Voltage

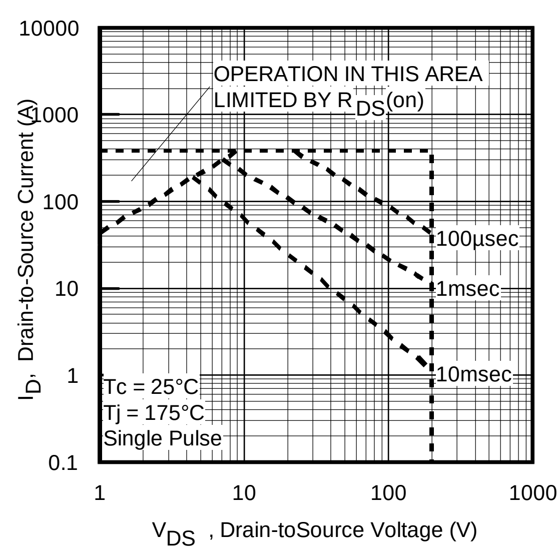



**Fig 8.** Maximum Safe Operating Area

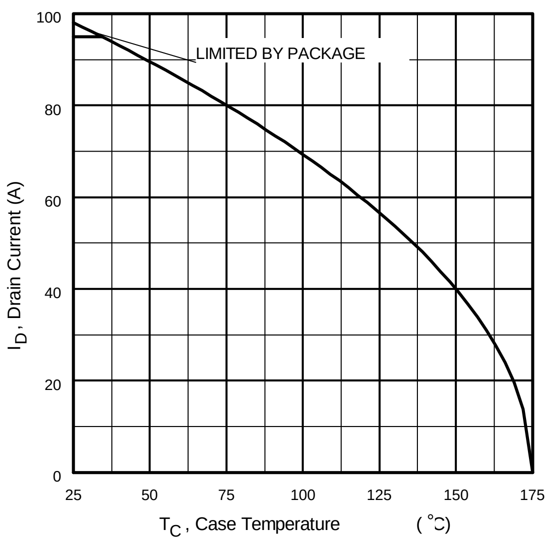



**Fig 9.** Maximum Drain Current Vs. Case Temperature

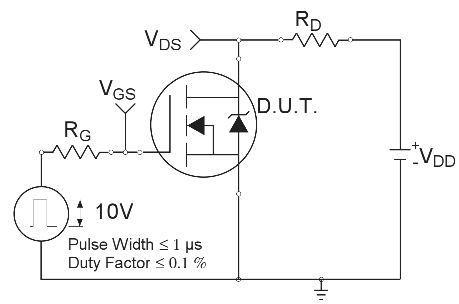



**Fig 10a.** Switching Time Test Circuit

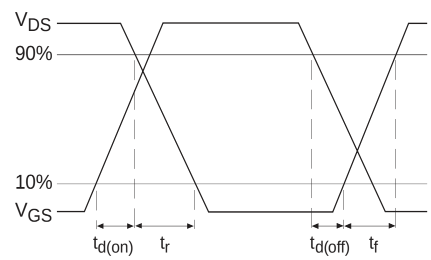



**Fig 10b.** Switching Time Waveforms

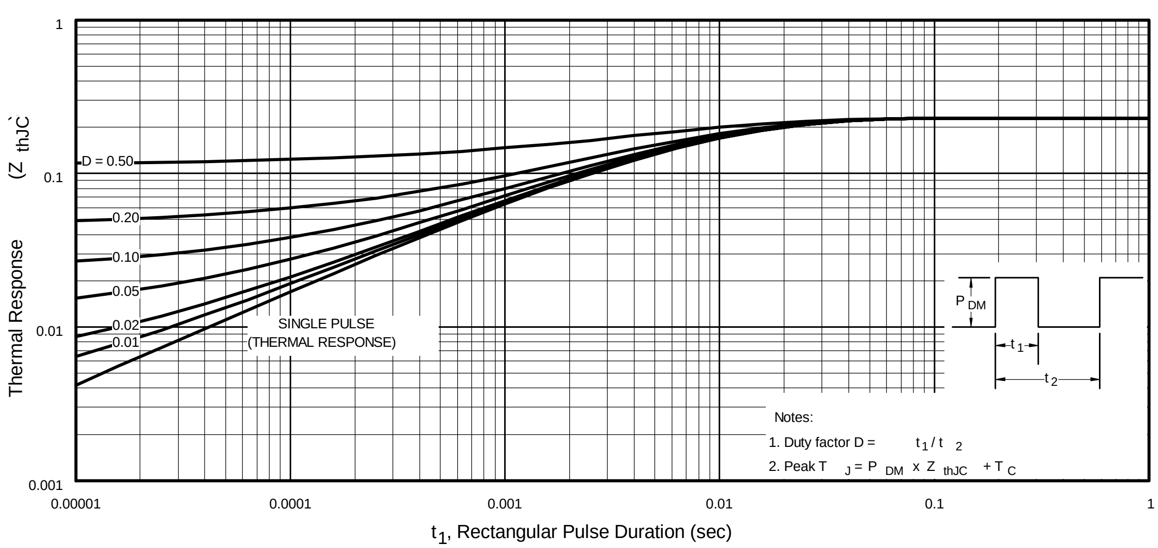



**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Case

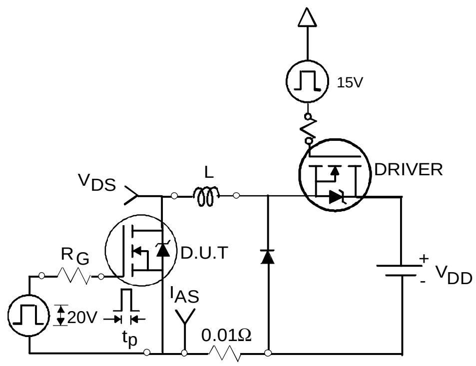



**Fig 12a.** Unclamped Inductive Test Circuit

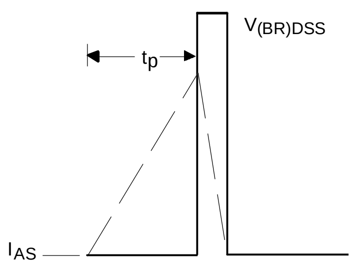



**Fig 12b.** Unclamped Inductive Waveforms

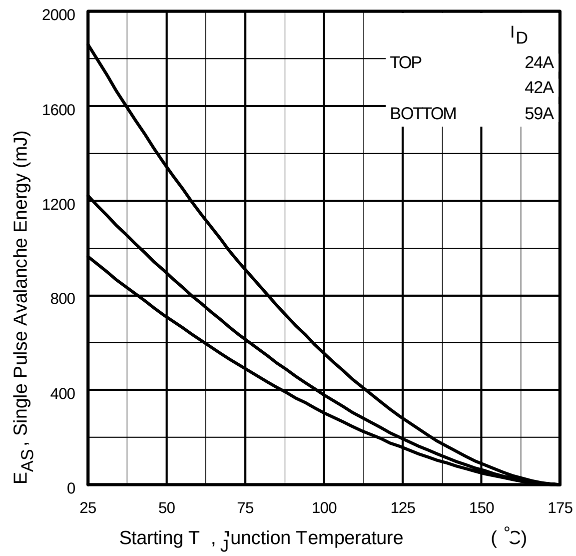



**Fig 12c.** Maximum Avalanche Energy
Vs. Drain Current

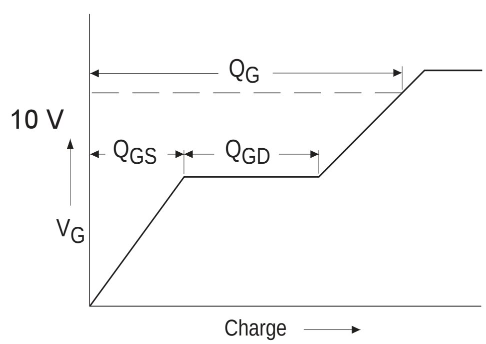



**Fig 13a.** Basic Gate Charge Waveform

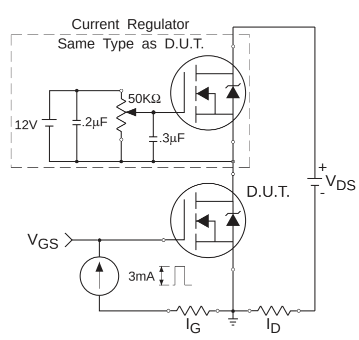
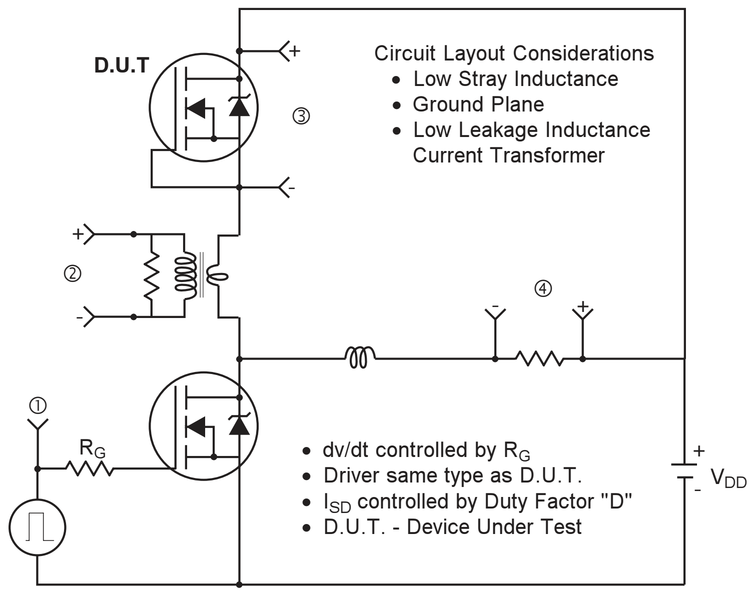
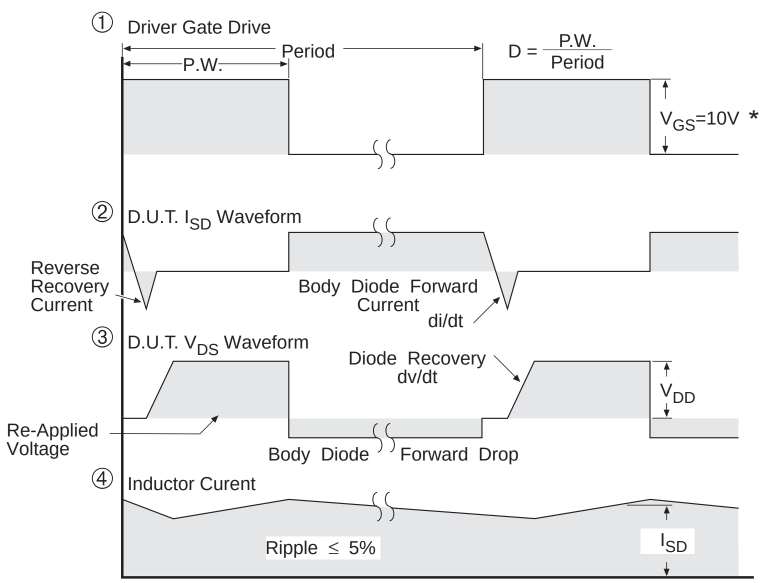



**Fig 13b.** Gate Charge Test Circuit

## Peak Diode Recovery dv/dt Test Circuit

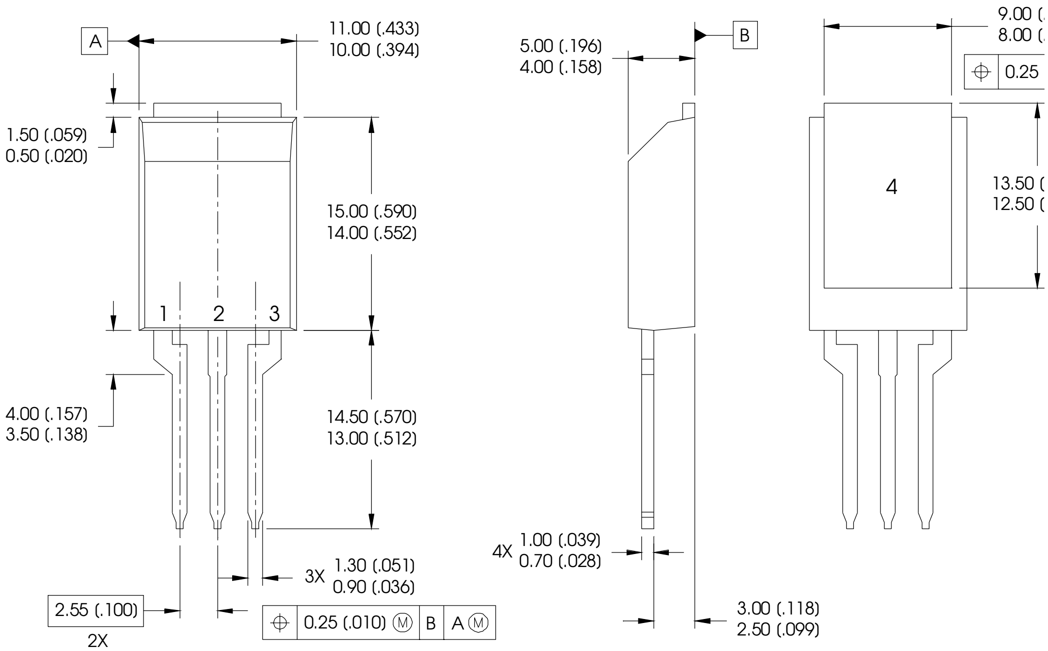



* $V_{GS}$ = 5V for Logic Level Devices

**Fig 14.** For N-Channel HEXFET® Power MOSFETs

## Super-220™ ( TO-273AA ) Package Outline




NOTES:

1. DIMENSIONING & TOLERANCING PER ASME Y14.5M-1994.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
4. OUTLINE CONFORMS TO JEDEC OUTLINE TO-273AA.

LEAD ASSIGNMENTS

| MOSFET | IGBT |
|---|---|
| 1 - GATE | 1 - GATE |
| 2 - DRAIN | 2 - COLLECTOR |
| 3 - SOURCE | 3 - EMITTER |
| 4 - DRAIN | 4 - COLLECTOR |

**Notes:**

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

② Starting $T_J = 25°C$, L = 0.55mH $R_G = 25\Omega$, $I_{AS} = 59A$.

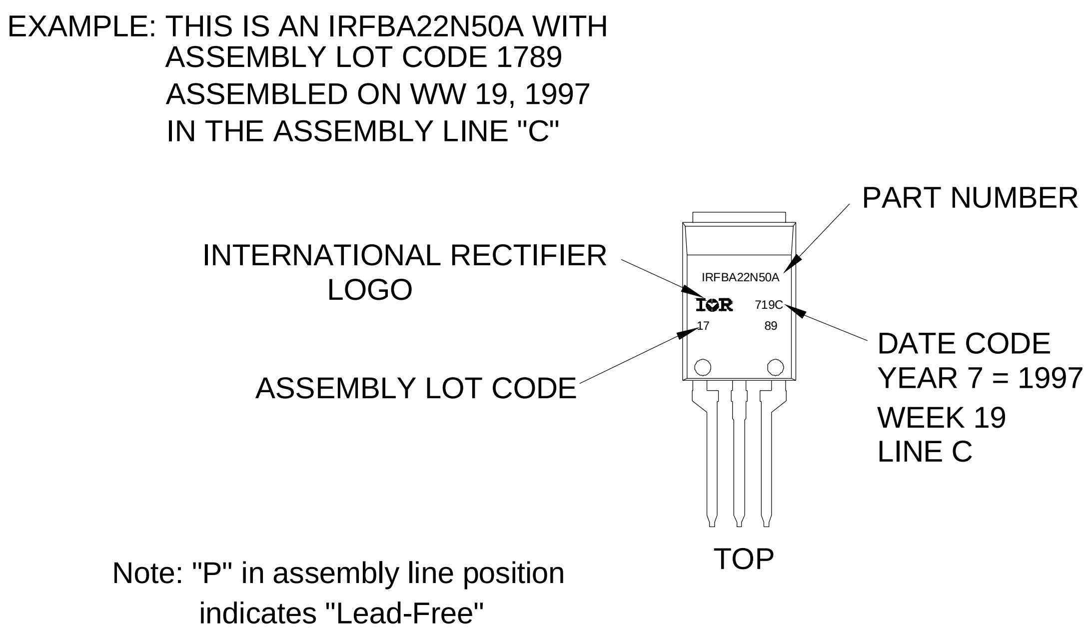
③ $I_{SD} \leq 59A$, $di/dt \leq 170A/\mu s$, $V_{DD} \leq V_{(BR)DSS}$, $T_J \leq 175°C$

④ Pulse width ≤ 300µs; duty cycle ≤ 2%.

⑤ $C_{oss}$ eff. 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 Calculated continuous current based on maximum allowable junction temperature. Package limitation current is 95A.

## Super-220 (TO-273AA) Part Marking Information




**Super-220™ not recommended for surface mount application.**

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.

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