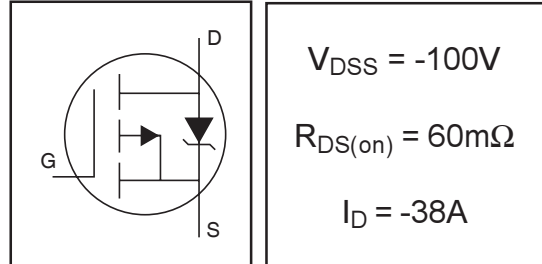


**IRF5210SPbF**  
**IRF5210LPbF**

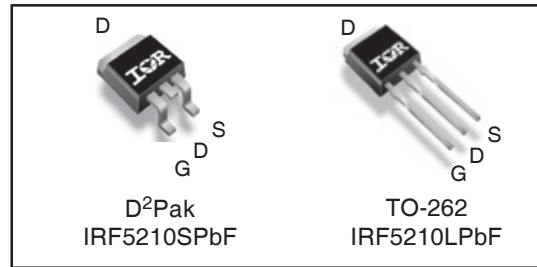
HEXFET® Power MOSFET

- Advanced Process Technology
- Ultra Low On-Resistance
- 150°C Operating Temperature
- Fast Switching
- Repetitive Avalanche Allowed up to  $T_{jmax}$
- Some Parameters are Different from IRF5210S/L
- P-Channel
- Lead-Free



**Description**

Features of this design are a 150°C junction operating temperature, fast switching speed and improved repetitive avalanche rating. These features combine to make this design an extremely efficient and reliable device for use in a wide variety of other applications.



|          |          |          |
|----------|----------|----------|
| <b>G</b> | <b>D</b> | <b>S</b> |
| Gate     | Drain    | Source   |

**Absolute Maximum Ratings**

|                           | Parameter   | Max.                   | Units |
|---------------------------|---|------------------------|-------|
| $I_D @ T_C = 25^\circ C$  | Continuous Drain Current, $V_{GS} @ -10V$           | -38                    | A     |
| $I_D @ T_C = 100^\circ C$ | Continuous Drain Current, $V_{GS} @ -10V$           | -24                    |       |
| $I_{DM}$                  | Pulsed Drain Current ①                              | -140                   |       |
| $P_D @ T_A = 25^\circ C$  | Maximum Power Dissipation                           | 3.1                    | W     |
| $P_D @ T_C = 25^\circ C$  | Maximum Power Dissipation                           | 170                    |       |
|                           | Linear Derating Factor                              | 1.3                    | W/°C  |
| $V_{GS}$                  | Gate-to-Source Voltage                              | $\pm 20$               | V     |
| $E_{AS}$                  | Single Pulse Avalanche Energy ②                     | 120                    | mJ    |
| $I_{AR}$                  | Avalanche Current ①                                 | -23                    | A     |
| $E_{AR}$                  | Repetitive Avalanche Energy ①                       | 17                     | mJ    |
| dv/dt                     | Peak Diode Recovery dv/dt ③                         | -7.4                   | V/ns  |
| $T_J$<br>$T_{STG}$        | Operating Junction and<br>Storage Temperature Range | -55 to + 150           | °C    |
|                           | Soldering Temperature, for 10 seconds               | 300 (1.6mm from case ) |       |

**Thermal Resistance**

|                 | Parameter                                       | Typ. | Max. | Units |
|-----------------|---|------|------|-------|
| $R_{\theta JC}$ | Junction-to-Case                                | —    | 0.75 | °C/W  |
| $R_{\theta JA}$ | Junction-to-Ambient (PCB Mount, steady state) ⑤ | —    | 40   |       |

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

|                              | Parameter                            | Min. | Typ.  | Max. | Units      | Conditions   |
|------------------------------|--------------------------------------|------|-------|------|------------|--|
| $V_{(BR)DSS}$                | Drain-to-Source Breakdown Voltage    | -100 | —     | —    | V          | $V_{GS} = 0V, I_D = -250\mu A$   |
| $\Delta BV_{DSS}/\Delta T_J$ | Breakdown Voltage Temp. Coefficient  | —    | -0.11 | —    | V/°C       | Reference to $25^\circ\text{C}, I_D = -1\text{mA}$                                     |
| $R_{DS(on)}$                 | Static Drain-to-Source On-Resistance | —    | —     | 60   | m $\Omega$ | $V_{GS} = 10V, I_D = -38A$ ④   |
| $V_{GS(th)}$                 | Gate Threshold Voltage               | -2.0 | —     | -4.0 | V          | $V_{DS} = V_{GS}, I_D = -250\mu A$   |
| gfs                          | Forward Transconductance             | 9.5  | —     | —    | S          | $V_{DS} = -50V, I_D = -23A$  |
| $I_{DSS}$                    | Drain-to-Source Leakage Current      | —    | —     | -50  | $\mu A$    | $V_{DS} = -100V, V_{GS} = 0V$<br>$V_{DS} = -80V, V_{GS} = 0V, T_J = 125^\circ\text{C}$ |
| $I_{GSS}$                    | Gate-to-Source Forward Leakage       | —    | —     | 100  | nA         | $V_{GS} = 20V$   |
|                              | Gate-to-Source Reverse Leakage       | —    | —     | -100 | nA         | $V_{GS} = -20V$  |
| $Q_g$                        | Total Gate Charge                    | —    | 150   | 230  | nC         | $I_D = -23A$   |
| $Q_{gs}$                     | Gate-to-Source Charge                | —    | 22    | 33   | nC         | $V_{DS} = -80V$  |
| $Q_{gd}$                     | Gate-to-Drain ("Miller") Charge      | —    | 81    | 120  | nC         | $V_{GS} = -10V$ ④  |
| $t_{d(on)}$                  | Turn-On Delay Time                   | —    | 14    | —    | ns         | $V_{DD} = -50V$  |
| $t_r$                        | Rise Time                            | —    | 63    | —    | ns         | $I_D = -23A$   |
| $t_{d(off)}$                 | Turn-Off Delay Time                  | —    | 72    | —    | ns         | $R_G = 2.4\Omega$  |
| $t_f$                        | Fall Time                            | —    | 55    | —    | ns         | $V_{GS} = -10V$ ④  |
| $L_D$                        | Internal Drain Inductance            | —    | 4.5   | —    | nH         | Between lead,<br>6mm (0.25in.)<br>from package<br>and center of die contact            |
| $L_S$                        | Internal Source Inductance           | —    | 7.5   | —    | nH         |  |
| $C_{iss}$                    | Input Capacitance                    | —    | 2780  | —    | pF         | $V_{GS} = 0V$  |
| $C_{oss}$                    | Output Capacitance                   | —    | 800   | —    | pF         | $V_{DS} = -25V$  |
| $C_{rss}$                    | Reverse Transfer Capacitance         | —    | 430   | —    | pF         | $f = 1.0\text{MHz}$ , See Fig. 5   |

## Source-Drain Ratings and Characteristics

|          | Parameter                                 | Min.  | Typ. | Max. | Units | Conditions  |
|----------|---|---|------|------|-------|---|
| $I_S$    | Continuous Source Current<br>(Body Diode) | —   | —    | -38  | A     | MOSFET symbol<br>showing the<br>integral reverse<br>p-n junction diode. |
| $I_{SM}$ | Pulsed Source Current<br>(Body Diode) ①   | —   | —    | -140 | A     |   |
| $V_{SD}$ | Diode Forward Voltage                     | —   | —    | -1.6 | V     | $T_J = 25^\circ\text{C}, I_S = -23A, V_{GS} = 0V$ ④                     |
| $t_{rr}$ | Reverse Recovery Time                     | —   | 170  | 260  | ns    | $T_J = 25^\circ\text{C}, I_F = -23A, V_{DD} = -25V$                     |
| $Q_{rr}$ | Reverse Recovery Charge                   | —   | 1180 | 1770 | nC    | $di/dt = -100A/\mu s$ 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 Starting  $T_J = 25^\circ\text{C}$ ,  $L = 0.46\text{mH}$   
 $R_G = 25\Omega, I_{AS} = -23A$ . (See Figure 12)
- ③  $I_{SD} \leq -23A, di/dt \leq -650A/\mu s, V_{DD} \leq V_{(BR)DSS}, T_J \leq 150^\circ\text{C}$ .

- ④ Pulse width  $\leq 300\mu s$ ; duty cycle  $\leq 2\%$ .
- ⑤ When mounted on 1" square PCB (FR-4 or G-10 Material). For recommended footprint and soldering techniques refer to application note #AN-994.

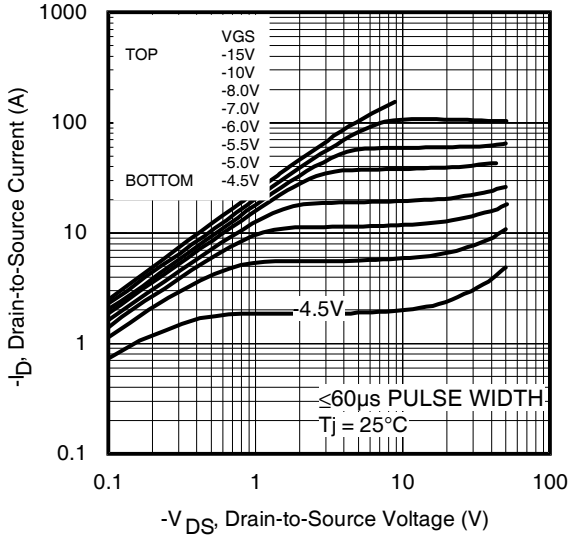


Fig 1. Typical Output Characteristics

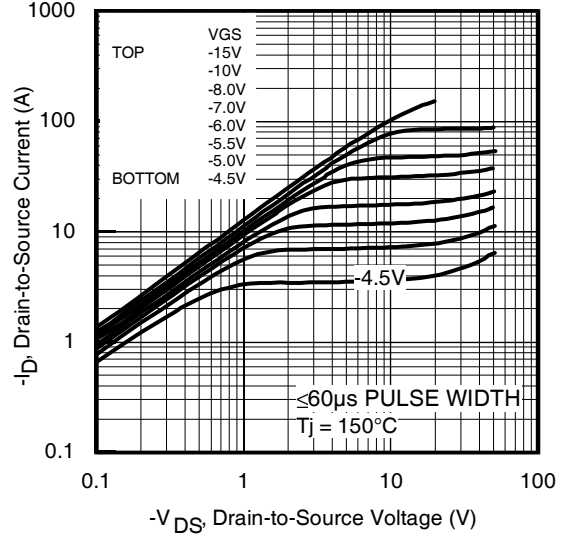


Fig 2. Typical Output Characteristics

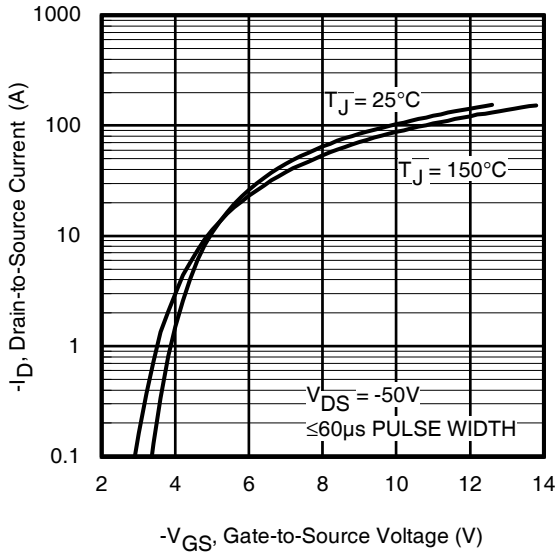


Fig 3. Typical Transfer Characteristics

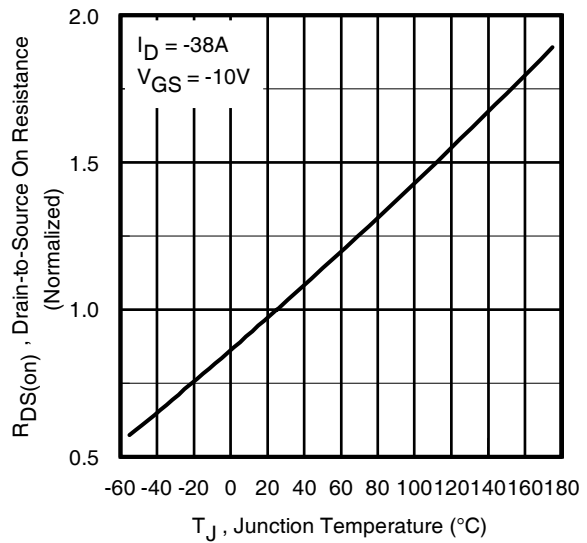
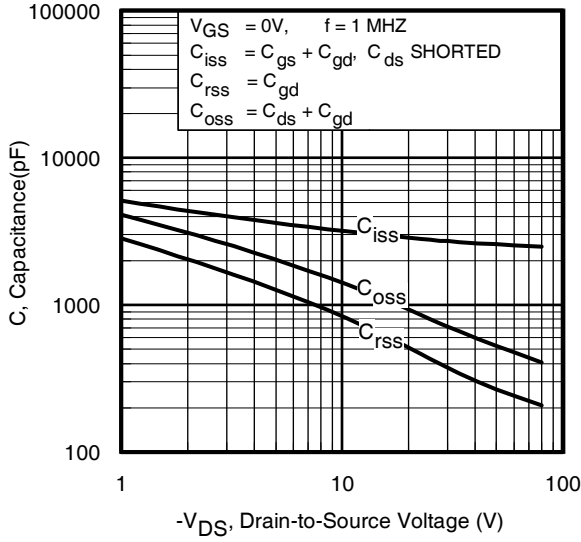
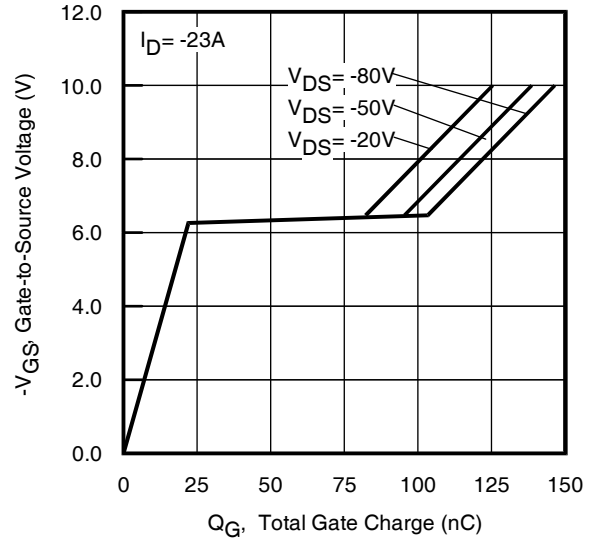


Fig 4. Normalized On-Resistance vs. Temperature

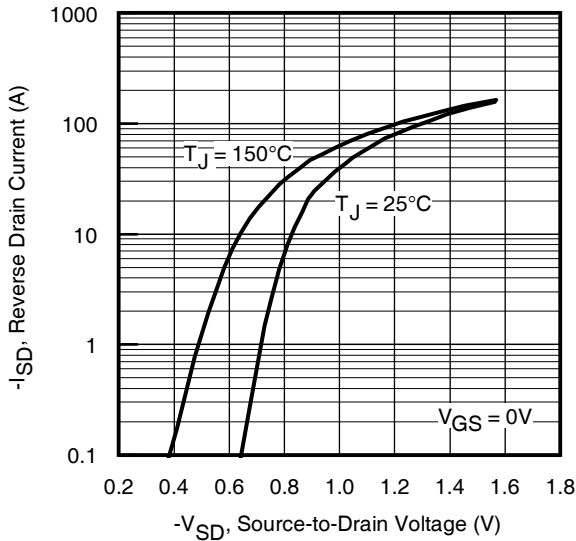
# IRF5210S/LPbF



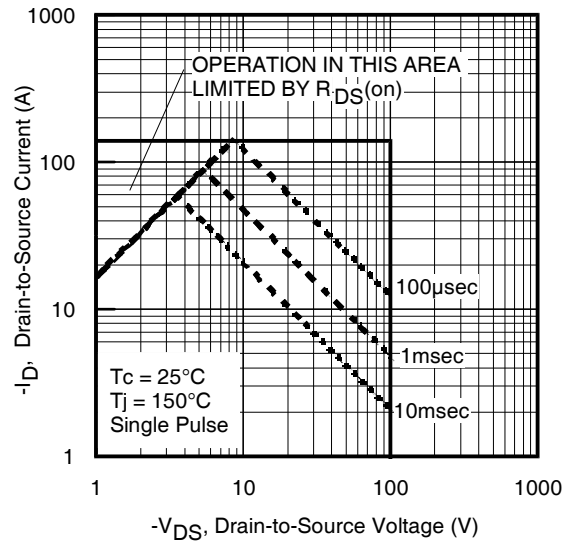
**Fig 5.** Typical Capacitance vs. Drain-to-Source Voltage



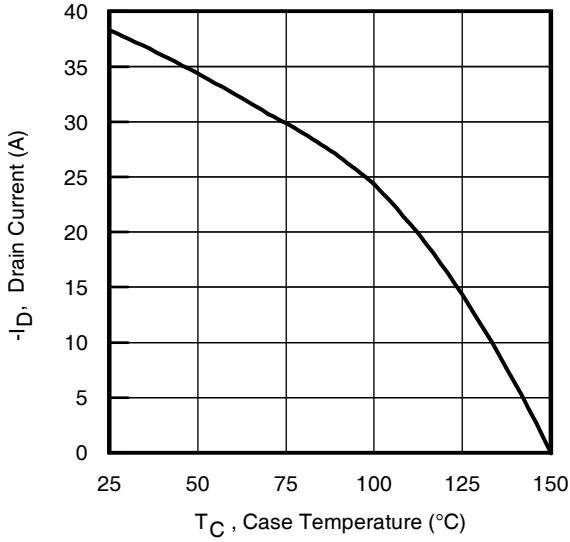
**Fig 6.** Typical Gate Charge vs. Gate-to-Source Voltage



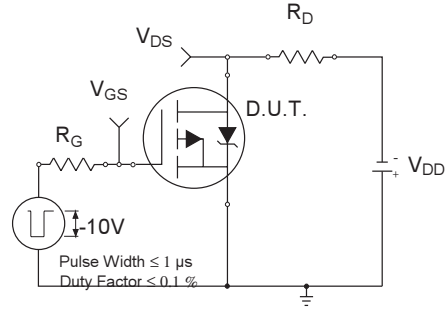
**Fig 7.** Typical Source-Drain Diode Forward Voltage



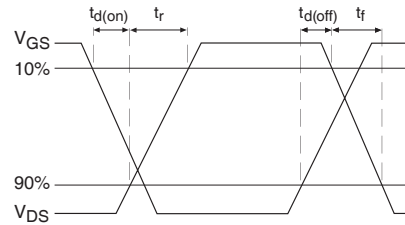
**Fig 8.** Maximum Safe Operating Area



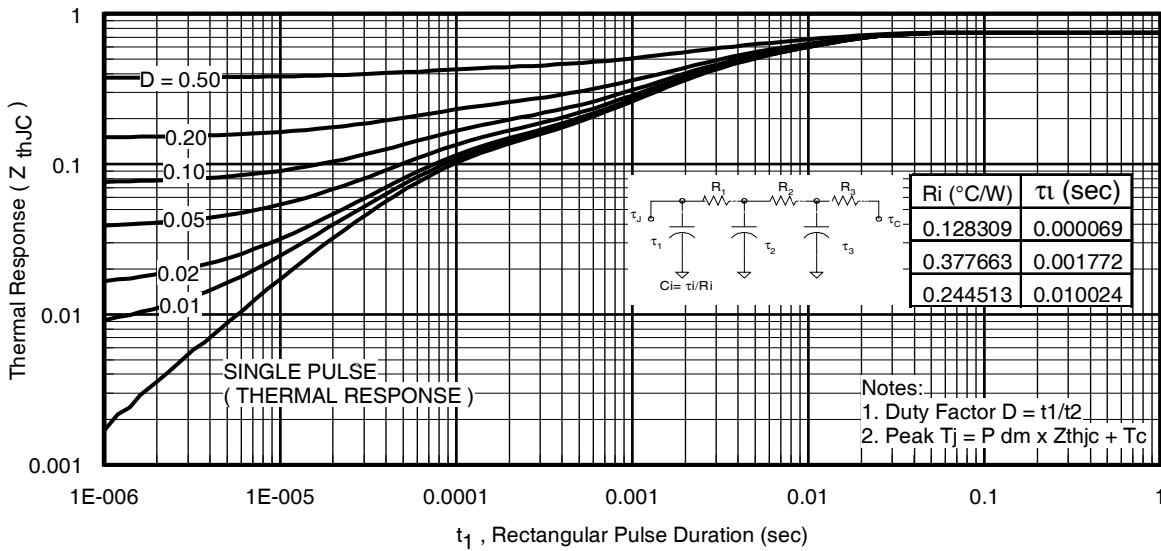
**Fig 9.** Maximum Drain Current vs. Case Temperature



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

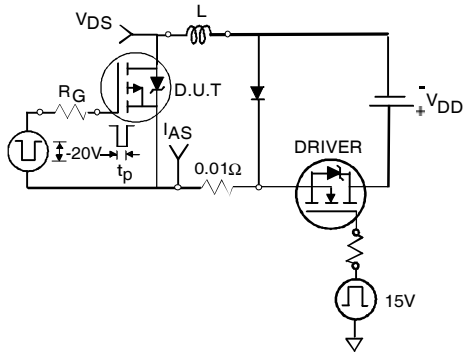


**Fig 10b.** Switching Time Waveforms

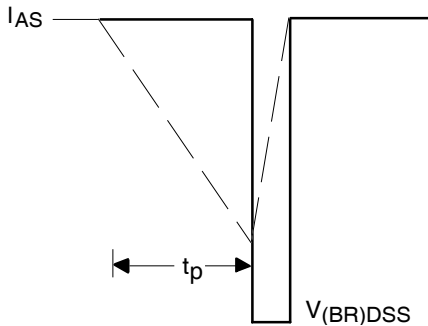


**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Case

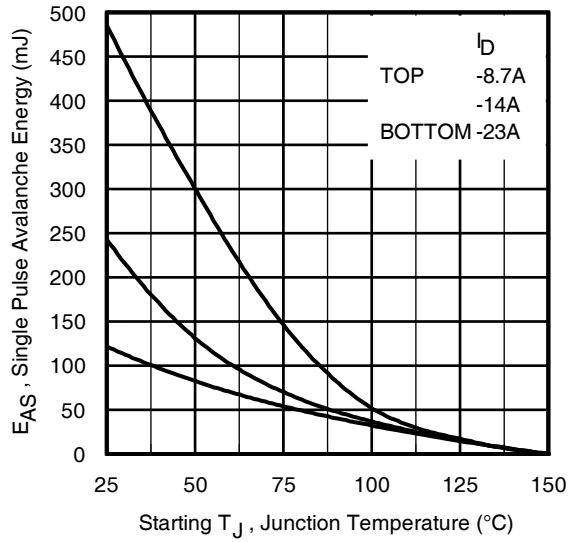
# IRF5210S/LPbF



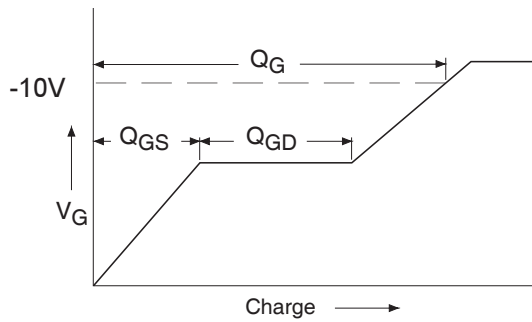
**Fig 12a.** Unclamped Inductive Test Circuit



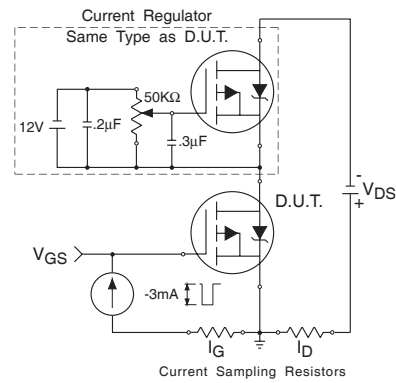
**Fig 12b.** Unclamped Inductive Waveforms



**Fig 13.** Maximum Avalanche Energy vs. Drain Current

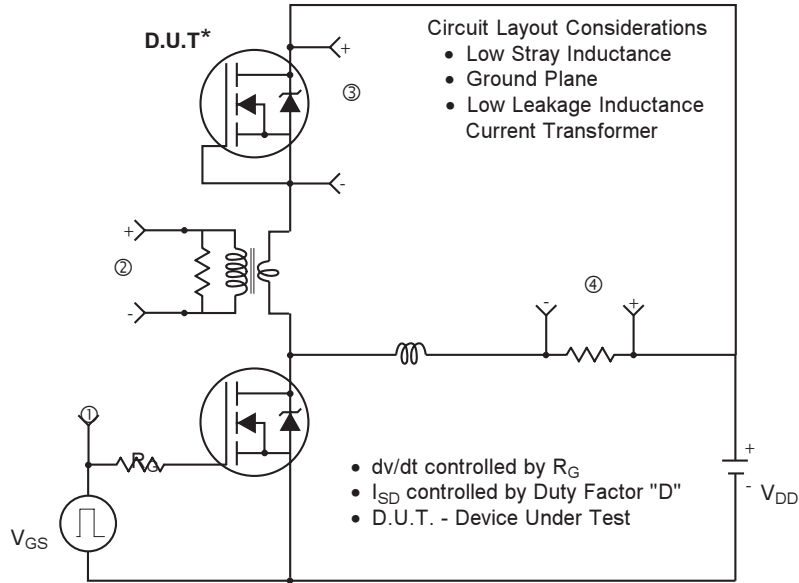


**Fig 14a.** Basic Gate Charge Waveform

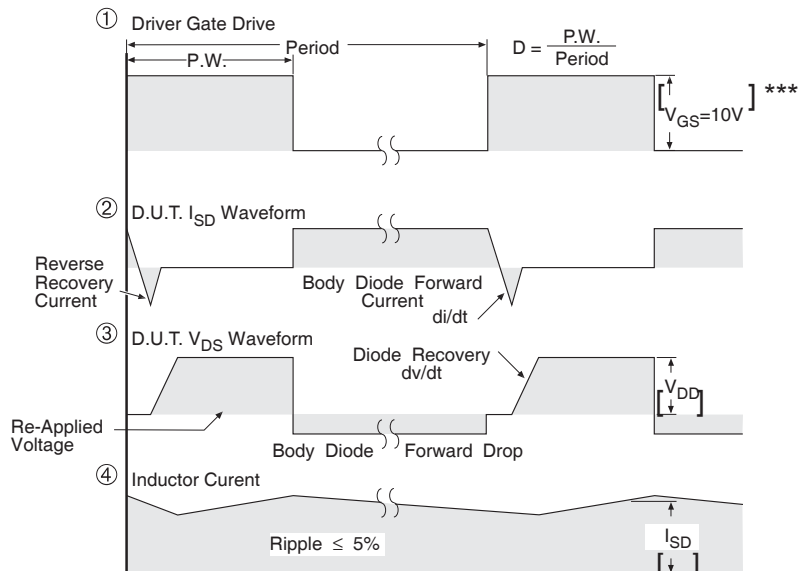


**Fig 14b.** Gate Charge Test Circuit

## Peak Diode Recovery dv/dt Test Circuit



\* Reverse Polarity of D.U.T for P-Channel



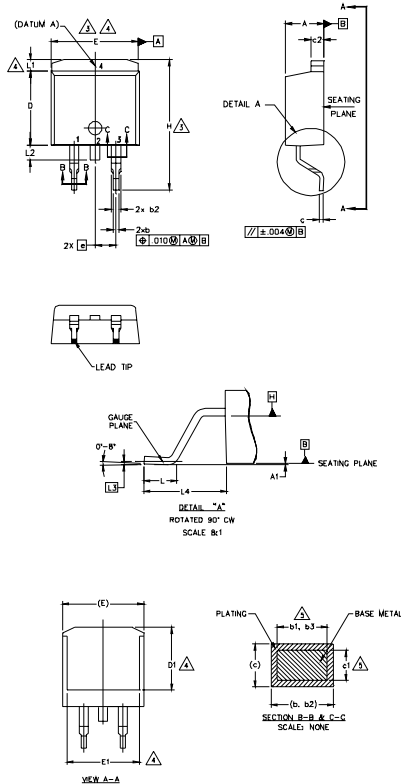
\*\*\*  $V_{GS} = 5.0V$  for Logic Level and 3V Drive Devices

**Fig 15.** For P-Channel HEXFETS

# IRF5210S/LPbF

## D<sup>2</sup>Pak (TO-263AB) Package Outline

Dimensions are shown in millimeters (inches)



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994
  2. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES]
  3. DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.127 [0.005"] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY AT DATUM H.
  4. THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSION E, L1, D1 & E1.
  5. DIMENSION b1 AND c1 APPLY TO BASE METAL ONLY.
  6. DATUM A & B TO BE DETERMINED AT DATUM PLANE H.
  7. CONTROLLING DIMENSION: INCH.
  8. OUTLINE CONFORMS TO JEDEC OUTLINE TO-263AB.

| SYMBOL | DIMENSIONS  |       |          |      | NOTES |
|--------|-------------|-------|----------|------|-------|
|        | MILLIMETERS |       | INCHES   |      |       |
| A      | 4.06        | 4.83  | .160     | .190 |       |
| A1     | 0.00        | 0.254 | .000     | .010 |       |
| b      | 0.51        | 0.99  | .020     | .039 |       |
| b1     | 0.51        | 0.89  | .020     | 0.35 | 5     |
| b2     | 1.14        | 1.78  | .045     | .070 |       |
| b3     | 1.14        | 1.73  | .045     | .068 | 6     |
| c      | 0.38        | 0.74  | .015     | .029 |       |
| c1     | 0.38        | 0.58  | .015     | 0.23 | 5     |
| c2     | 1.14        | 1.65  | .045     | .065 |       |
| D      | 8.36        | 9.65  | .330     | .380 | 3     |
| D1     | 6.86        | -     | .270     | -    | 4     |
| E      | 9.65        | 10.67 | .380     | .420 | 3,4   |
| E1     | 6.22        | -     | .245     | -    | 4     |
| e      | 2.54 BSC    |       | .100 BSC |      |       |
| H      | 14.61       | 15.08 | .575     | .625 |       |
| L      | 1.78        | 2.79  | .070     | .110 |       |
| L1     | -           | 1.65  | -        | .066 | 4     |
| L2     | 1.27        | 1.78  | -        | .070 |       |
| L3     | 0.25 BSC    |       | .010 BSC |      |       |
| L4     | 4.78        | 5.28  | .188     | .208 |       |

LEAD ASSIGNMENTS

- HEXFET  
 1.- GATE  
 2. 4.- DRAIN  
 3.- SOURCE

- IGBTs, COPACK  
 1.- GATE  
 2. 4.- COLLECTOR  
 3.- EMITTER

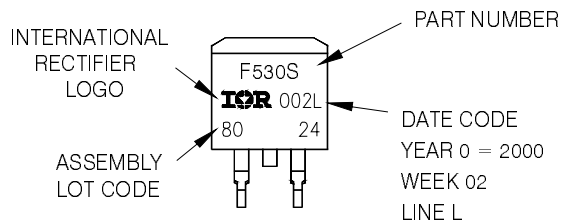
- DIODES  
 1.- ANODE \*  
 2. 4.- CATHODE  
 3.- ANODE

\* PART DEPENDENT.

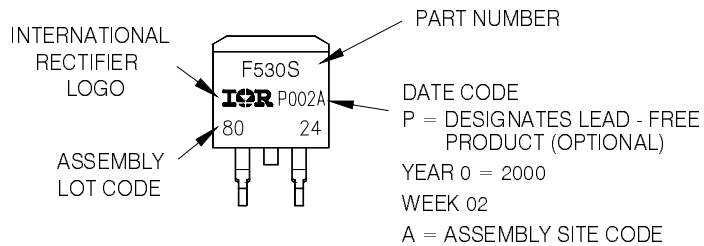
## D<sup>2</sup>Pak (TO-263AB) Part Marking Information

EXAMPLE: THIS IS AN IRF530S WITH  
 LOT CODE 8024  
 ASSEMBLED ON WW 02, 2000  
 IN THE ASSEMBLY LINE "L"

Note: "P" in assembly line position indicates "Lead - Free"



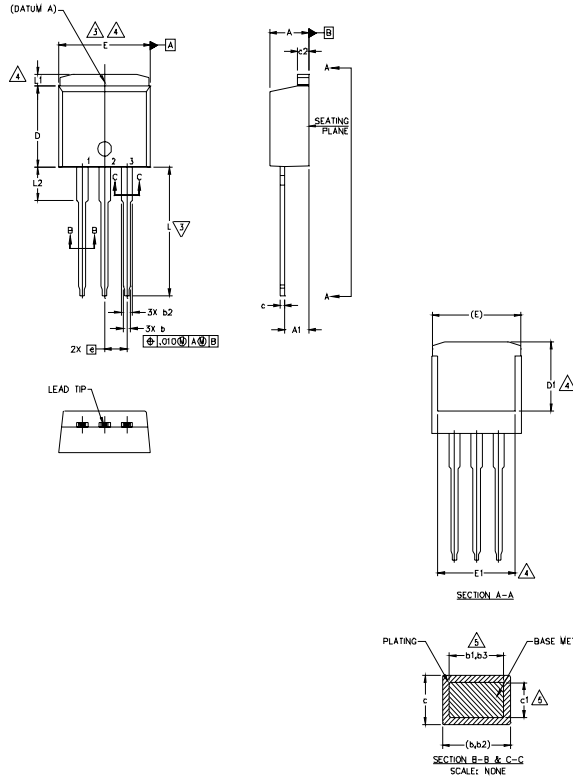
OR



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

## TO-262 Package Outline

Dimensions are shown in millimeters (inches)



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994
  2. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
  3. DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.127 [0.005"] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY.
  4. THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSION E, L1, D1 & E1.
  5. DIMENSION b1 AND c1 APPLY TO BASE METAL ONLY.
  6. CONTROLLING DIMENSION: INCH.
  7. OUTLINE CONFORM TO JEDEC TO-262 EXCEPT A1(max.), b(min.), AND D1(min.) WHERE DIMENSIONS DERIVED THE ACTUAL PACKAGE OUTLINE.

| SYMBOL | DIMENSIONS  |       |          |      | NOTES |
|--------|-------------|-------|----------|------|-------|
|        | MILLIMETERS |       | INCHES   |      |       |
|        | MIN.        | MAX.  | MIN.     | MAX. |       |
| A      | 4.06        | 4.83  | .160     | .190 |       |
| A1     | 2.03        | 3.02  | .080     | .119 |       |
| b      | 0.51        | 0.99  | .020     | .039 |       |
| b1     | 0.51        | 0.89  | .020     | .035 | 5     |
| b2     | 1.14        | 1.78  | .045     | .070 |       |
| b3     | 1.14        | 1.73  | .045     | .068 | 5     |
| c      | 0.38        | 0.74  | .015     | .029 |       |
| c1     | 0.38        | 0.58  | .015     | .023 | 5     |
| c2     | 1.14        | 1.65  | .045     | .065 |       |
| D      | 8.38        | 9.65  | .330     | .380 | 3     |
| D1     | 6.86        | -     | .270     | -    | 4     |
| E      | 9.65        | 10.67 | .380     | .420 | 3,4   |
| E1     | 6.22        | -     | .245     | -    | 4     |
| e      | 2.54 BSC    |       | .100 BSC |      |       |
| L      | 13.46       | 14.10 | .530     | .555 |       |
| L1     | -           | 1.65  | -        | .065 | 4     |
| L2     | 3.56        | 3.71  | .140     | .146 |       |

**LEAD ASSIGNMENTS**

- HEXFET**
- 1.- GATE
  - 2.- DRAIN
  - 3.- SOURCE
  - 4.- DRAIN

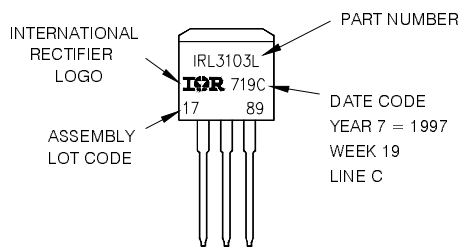
**IGBTs, CoPACK**

- 1.- GATE
- 2.- COLLECTOR
- 3.- EMITTER
- 4.- COLLECTOR

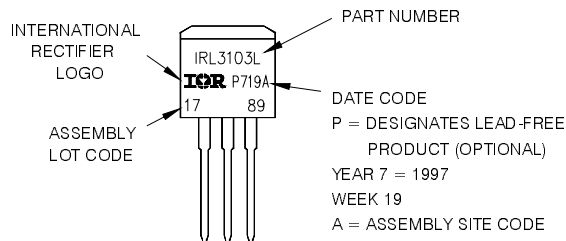
## TO-262 Part Marking Information

EXAMPLE: THIS IS AN IRL3103L  
LOT CODE 1789  
ASSEMBLED ON WW 19, 1997  
IN THE ASSEMBLY LINE 'C'

Note: "P" in assembly line position indicates "Lead - Free"



OR



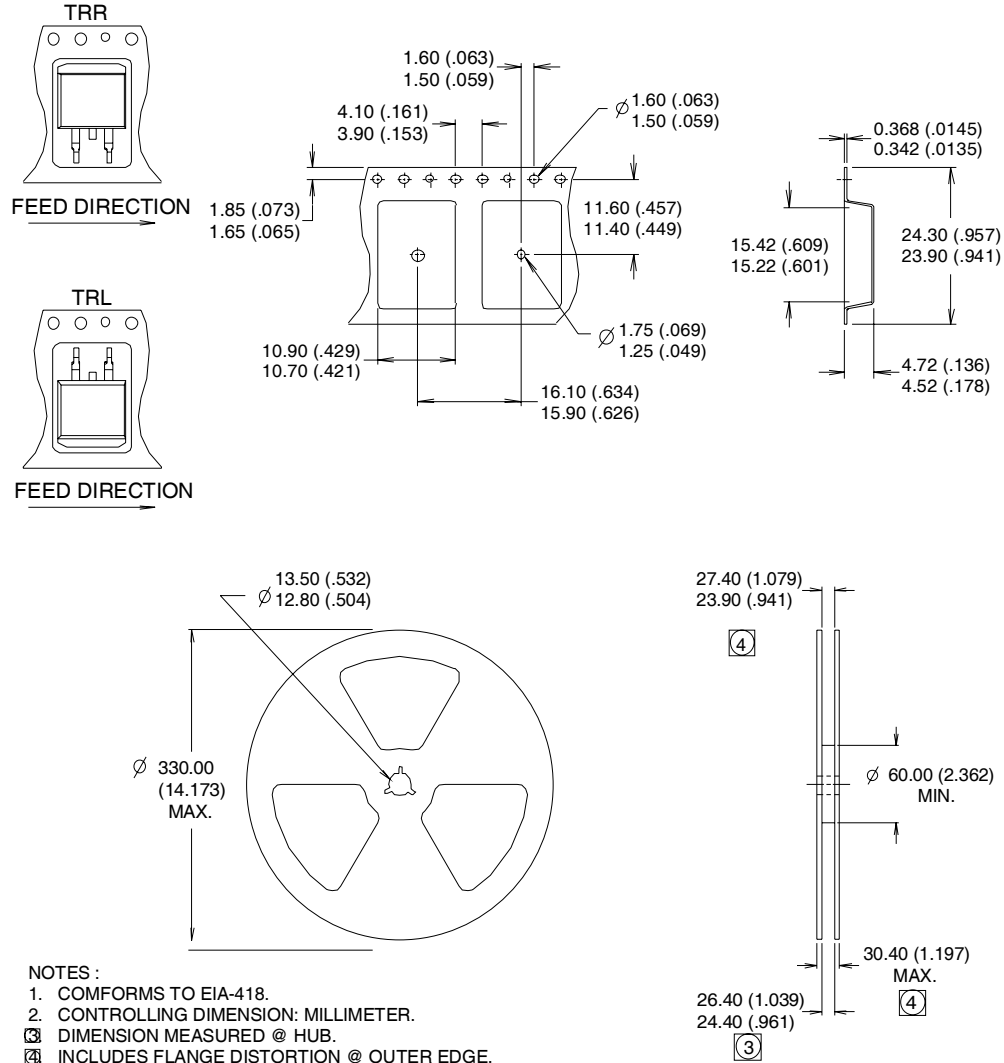
Note: For the most current drawing please refer to IR website at <http://www.irf.com/package/>

# IRF5210S/LPbF

International  
**IR** Rectifier

## D<sup>2</sup>Pak (TO-263AB) Tape & Reel Information

Dimensions are shown in millimeters (inches)



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.  
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](http://www.irf.com) for sales contact information. 08/09

[www.irf.com](http://www.irf.com)

## Данный компонент на территории Российской Федерации

### Вы можете приобрести в компании MosChip.

Для оперативного оформления запроса Вам необходимо перейти по данной ссылке:

<http://moschip.ru/get-element>

Вы можете разместить у нас заказ для любого Вашего проекта, будь то серийное производство или разработка единичного прибора.

В нашем ассортименте представлены ведущие мировые производители активных и пассивных электронных компонентов.

Нашей специализацией является поставка электронной компонентной базы двойного назначения, продукции таких производителей как XILINX, Intel (ex.ALTERA), Vicor, Microchip, Texas Instruments, Analog Devices, Mini-Circuits, Amphenol, Glenair.

Сотрудничество с глобальными дистрибьюторами электронных компонентов, предоставляет возможность заказывать и получать с международных складов практически любой перечень компонентов в оптимальные для Вас сроки.

На всех этапах разработки и производства наши партнеры могут получить квалифицированную поддержку опытных инженеров.

Система менеджмента качества компании отвечает требованиям в соответствии с ГОСТ Р ИСО 9001, ГОСТ РВ 0015-002 и ЭС РД 009

### Офис по работе с юридическими лицами:

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Факс: +7 495 668-12-70 (доб.304)

E-mail: [info@moschip.ru](mailto:info@moschip.ru)

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