

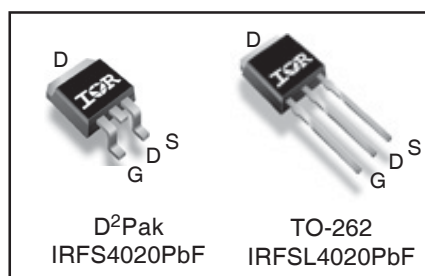
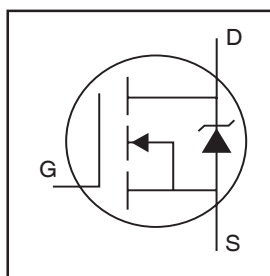
DIGITAL AUDIO MOSFET

IRFS4020PbF
IRFSL4020PbF

Features

- Key parameters optimized for Class-D audio amplifier applications
- Low $R_{DS(ON)}$ for improved efficiency
- Low Q_G and Q_{SW} for better THD and improved efficiency
- Low Q_{RR} for better THD and lower EMI
- 175°C operating junction temperature for ruggedness
- Can deliver up to 300W per channel into 8Ω load in half-bridge configuration amplifier

| Key Parameters | | |
|-------------------------|-----|----|
| V_{DS} | 200 | V |
| $R_{DS(ON)}$ typ. @ 10V | 85 | mΩ |
| Q_g typ. | 18 | nC |
| Q_{sw} typ. | 6.7 | nC |
| $R_{G(int)}$ typ. | 3.2 | Ω |
| T_J max | 175 | °C |



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

Description

This Digital Audio MOSFET is specifically designed for Class-D audio amplifier applications. This MOSFET utilizes the latest processing techniques to achieve low on-resistance per silicon area. Furthermore, Gate charge, body-diode reverse recovery and internal Gate resistance are optimized to improve key Class-D audio amplifier performance factors such as efficiency, THD and EMI. Additional features of this MOSFET are 175°C operating junction temperature and repetitive avalanche capability. These features combine to make this MOSFET a highly efficient, robust and reliable device for ClassD audio amplifier applications.

Absolute Maximum Ratings

| | Parameter | Max. | Units |
|---------------------------|---|--------------|-------|
| V_{DS} | Drain-to-Source Voltage | 200 | V |
| V_{GS} | Gate-to-Source Voltage | ±20 | |
| $I_D @ T_C = 25^\circ C$ | Continuous Drain Current, $V_{GS} @ 10V$ | 18 | A |
| $I_D @ T_C = 100^\circ C$ | Continuous Drain Current, $V_{GS} @ 10V$ | 13 | |
| I_{DM} | Pulsed Drain Current ① | 52 | |
| $P_D @ T_C = 25^\circ C$ | Power Dissipation ④ | 100 | W |
| $P_D @ T_C = 100^\circ C$ | Power Dissipation ④ | 52 | |
| | Linear Derating Factor | 0.70 | W/°C |
| T_J | Operating Junction and Storage Temperature Range | -55 to + 175 | °C |
| T_{STG} | | | |
| | Soldering Temperature, for 10 seconds (1.6mm from case) | 300 | |

Thermal Resistance

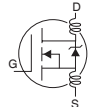
| | Parameter | Typ. | Max. | Units |
|-----------------|-----------------------------------|------|------|-------|
| $R_{\theta JC}$ | Junction-to-Case ④ | — | 1.43 | °C/W |
| $R_{\theta JA}$ | Junction-to-Ambient (PCB Mount) ④ | — | 40 | |

Notes ① through ⑤ are on page 2

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

| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|--------------------------------|--------------------------------------|------|------|------|----------------------|--|
| BV_{DSS} | Drain-to-Source Breakdown Voltage | 200 | — | — | V | $V_{GS} = 0V, I_D = 250\mu A$ |
| $\Delta BV_{DSS}/\Delta T_J$ | Breakdown Voltage Temp. Coefficient | — | 0.23 | — | V/ $^\circ\text{C}$ | Reference to $25^\circ\text{C}, I_D = 1\text{mA}$ |
| $R_{DS(on)}$ | Static Drain-to-Source On-Resistance | — | 85 | 105 | m Ω | $V_{GS} = 10V, I_D = 11A$ ③ |
| $V_{GS(th)}$ | Gate Threshold Voltage | 3.0 | — | 4.9 | V | $V_{DS} = V_{GS}, I_D = 100\mu A$ |
| $\Delta V_{GS(th)}/\Delta T_J$ | Gate Threshold Voltage Coefficient | — | -13 | — | mV/ $^\circ\text{C}$ | |
| I_{DSS} | Drain-to-Source Leakage Current | — | — | 20 | μA | $V_{DS} = 200V, V_{GS} = 0V$ |
| | | — | — | 250 | | $V_{DS} = 200V, V_{GS} = 0V, T_J = 125^\circ\text{C}$ |
| I_{GSS} | Gate-to-Source Forward Leakage | — | — | 100 | nA | $V_{GS} = 20V$ |
| | Gate-to-Source Reverse Leakage | — | — | -100 | | $V_{GS} = -20V$ |
| g_{fs} | Forward Transconductance | 24 | — | — | S | $V_{DS} = 50V, I_D = 11A$ |
| Q_g | Total Gate Charge | — | 18 | 29 | nC | $V_{DS} = 100V$ $V_{GS} = 10V$ $I_D = 11A$ See Fig. 6 and 18 |
| Q_{gs1} | Pre-Vth Gate-to-Source Charge | — | 4.5 | — | | |
| Q_{gs2} | Post-Vth Gate-to-Source Charge | — | 1.4 | — | | |
| Q_{gd} | Gate-to-Drain Charge | — | 5.3 | — | | |
| Q_{godr} | Gate Charge Overdrive | — | 6.8 | — | | |
| Q_{sw} | Switch Charge ($Q_{gs2} + Q_{gd}$) | — | 6.7 | — | | |
| $R_{G(int)}$ | Internal Gate Resistance | — | 3.2 | — | Ω | |
| $t_{d(on)}$ | Turn-On Delay Time | — | 7.8 | — | ns | $V_{DD} = 100V, V_{GS} = 10V$ ③ $I_D = 11A$ $R_G = 2.4\Omega$ |
| t_r | Rise Time | — | 12 | — | | |
| $t_{d(off)}$ | Turn-Off Delay Time | — | 16 | — | | |
| t_f | Fall Time | — | 6.3 | — | | |
| C_{iss} | Input Capacitance | — | 1200 | — | pF | $V_{GS} = 0V$ $V_{DS} = 50V$ $f = 1.0\text{MHz}$, See Fig.5 $V_{GS} = 0V, V_{DS} = 0V$ to $160V$ |
| C_{oss} | Output Capacitance | — | 91 | — | | |
| C_{rss} | Reverse Transfer Capacitance | — | 20 | — | | |
| $C_{oss\ eff.}$ | Effective Output Capacitance | — | 110 | — | | |
| L_D | Internal Drain Inductance | — | 4.5 | — | nH | Between lead, 6mm (0.25in.) from package and center of die contact |
| L_S | Internal Source Inductance | — | 7.5 | — | | |

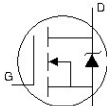


Avalanche Characteristics

| | Parameter | Typ. | Max. | Units |
|----------|---------------------------------|---------------------------|------|-------|
| E_{AS} | Single Pulse Avalanche Energy ② | — | 94 | mJ |
| I_{AR} | Avalanche Current ⑤ | See Fig. 14, 15, 16a, 16b | | A |
| E_{AR} | Repetitive Avalanche Energy ⑤ | | | mJ |

Diode Characteristics

| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|--------------------------------|---|------|------|------|-------|---|
| $I_S @ T_C = 25^\circ\text{C}$ | Continuous Source Current (Body Diode) | — | — | 18 | A | MOSFET symbol showing the integral reverse p-n junction diode. |
| I_{SM} | Pulsed Source Current (Body Diode) ① | — | — | 52 | | |
| V_{SD} | Diode Forward Voltage | — | — | 1.3 | V | $T_J = 25^\circ\text{C}, I_S = 11A, V_{GS} = 0V$ ③ |
| t_{rr} | Reverse Recovery Time | — | 82 | 120 | ns | $T_J = 25^\circ\text{C}, I_F = 11A$ |
| Q_{rr} | Reverse Recovery Charge | — | 280 | 420 | nC | $di/dt = 100A/\mu s$ ③ |



Notes:

- ① Repetitive rating; pulse width limited by max. junction temperature.
- ② Starting $T_J = 25^\circ\text{C}$, $L = 1.62\text{mH}$, $R_G = 25\Omega$, $I_{AS} = 11A$.
- ③ Pulse width $\leq 400\mu s$; duty cycle $\leq 2\%$.
- ④ R_{θ} is measured at T_J of approximately 90°C .
- ⑤ Limited by T_{jmax} . See Figs. 14, 15, 17a, 17b for repetitive avalanche information.

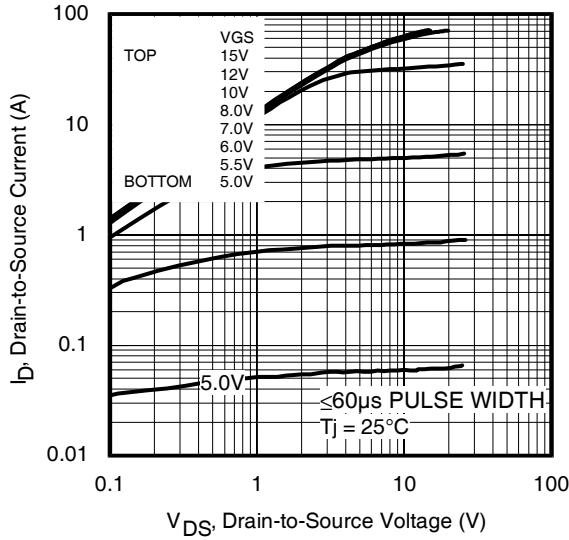


Fig 1. Typical Output Characteristics

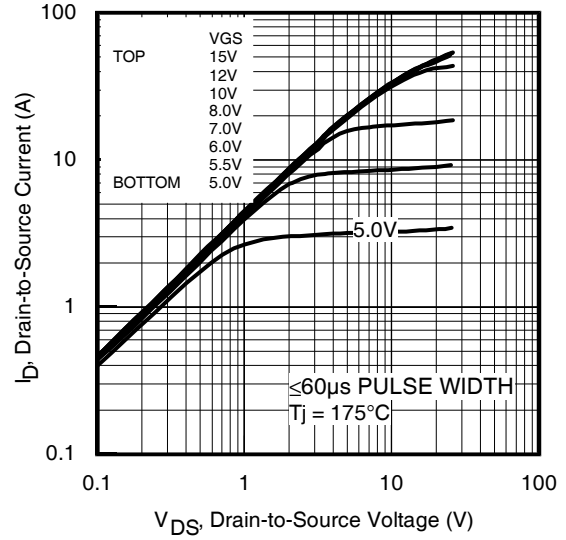


Fig 2. Typical Output Characteristics

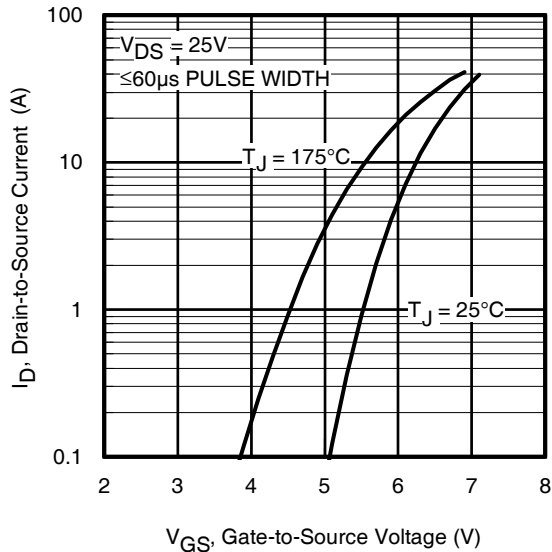


Fig 3. Typical Transfer Characteristics

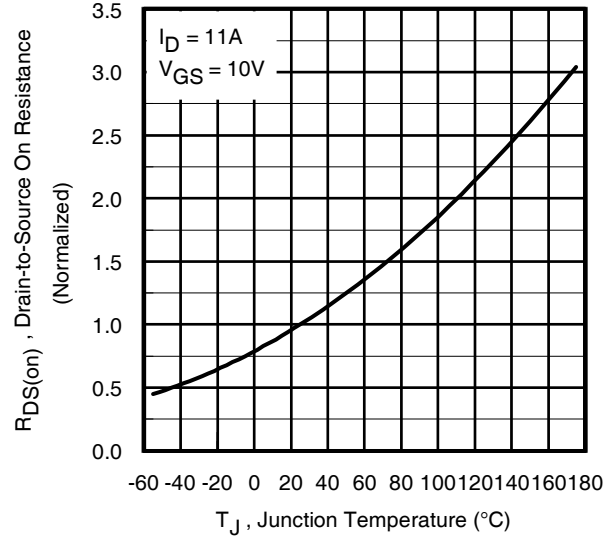


Fig 4. Normalized On-Resistance vs. Temperature

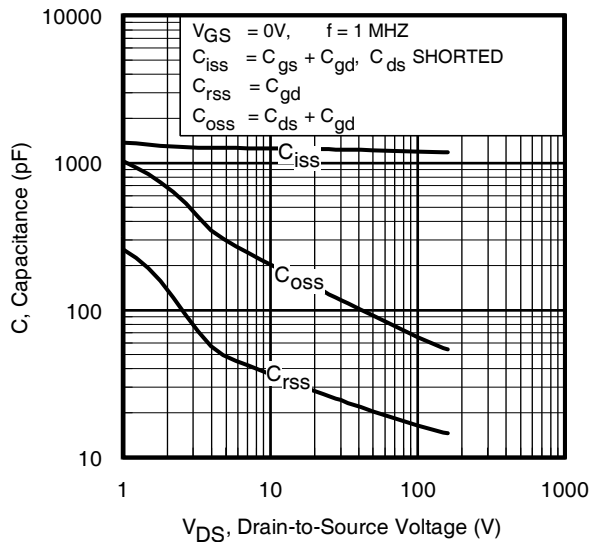


Fig 5. Typical Capacitance vs. Drain-to-Source Voltage
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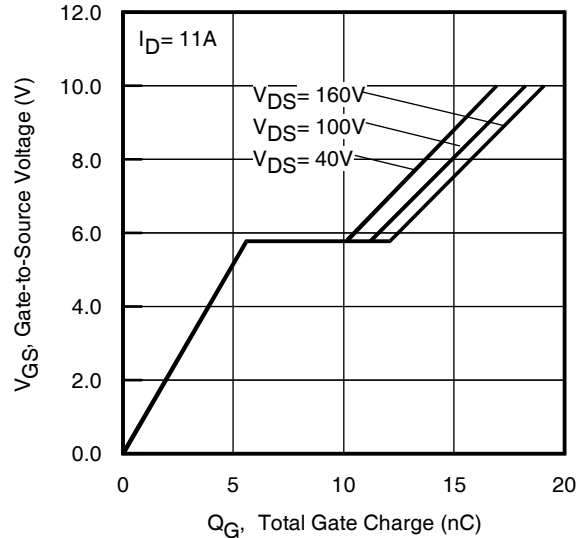


Fig 6. Typical Gate Charge vs. Gate-to-Source Voltage

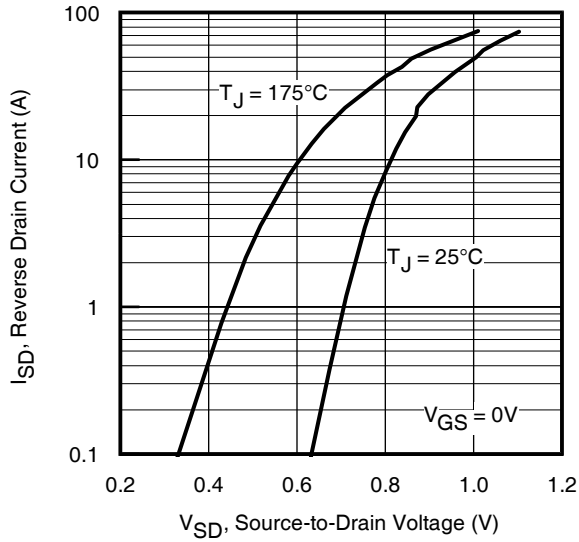


Fig 7. Typical Source-Drain Diode Forward Voltage

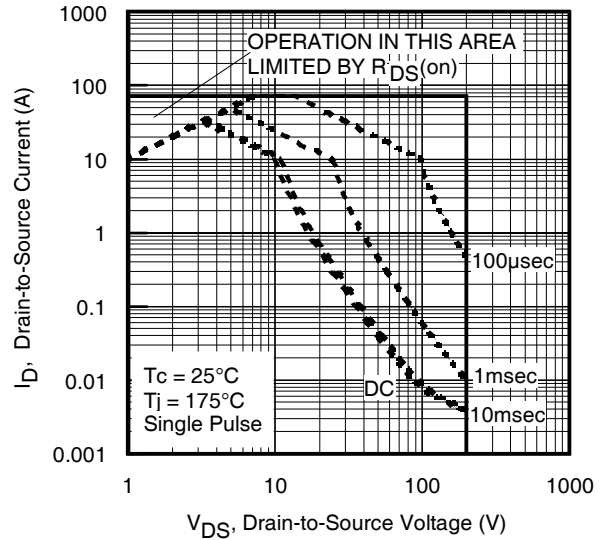


Fig 8. Maximum Safe Operating Area

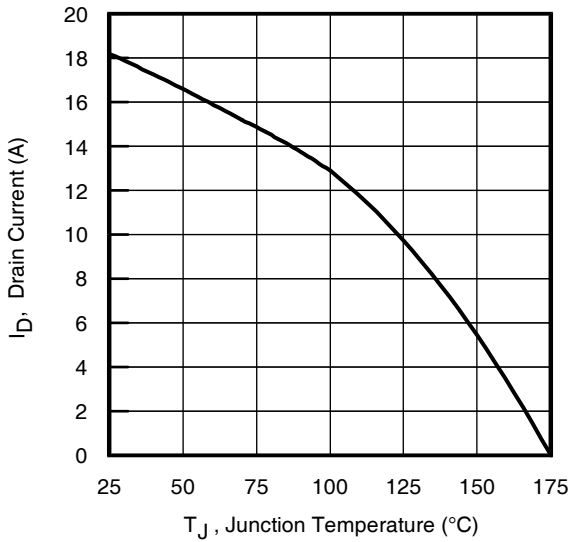


Fig 9. Maximum Drain Current vs. Junction Temperature

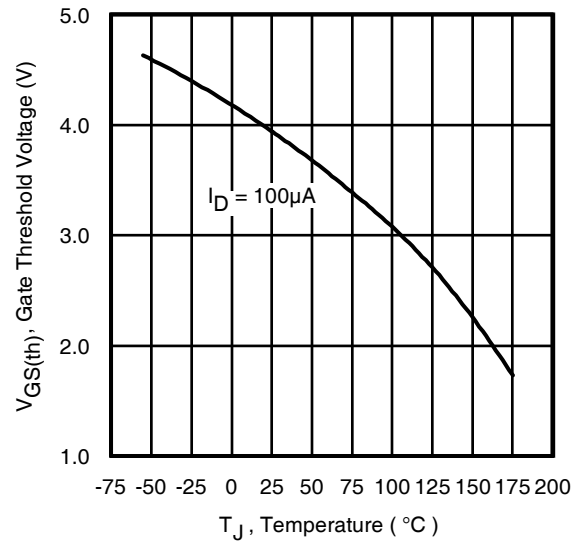


Fig 10. Threshold Voltage vs. Temperature

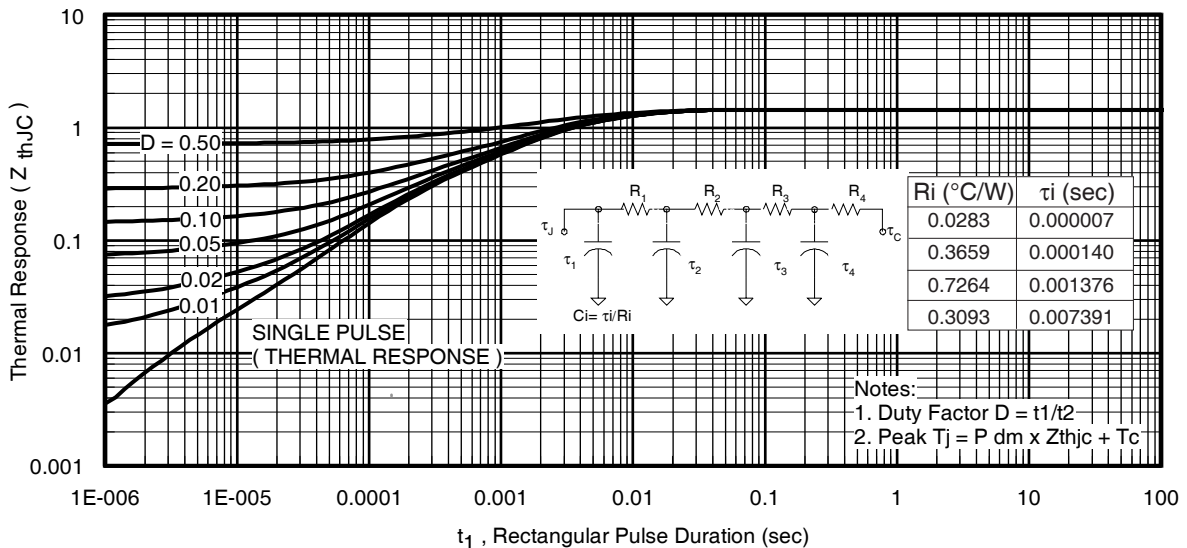


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case

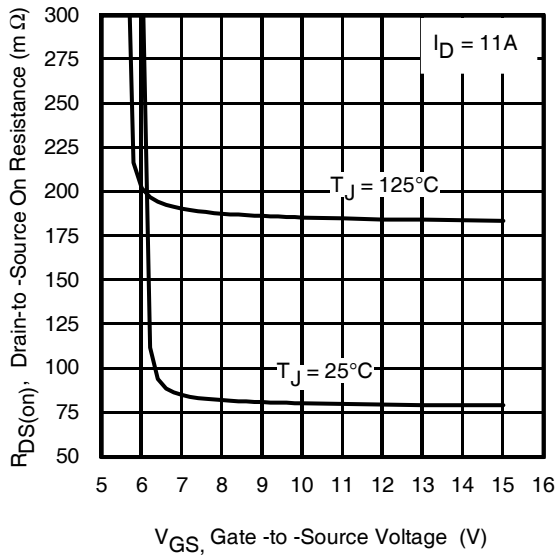


Fig 12. On-Resistance vs. Gate Voltage

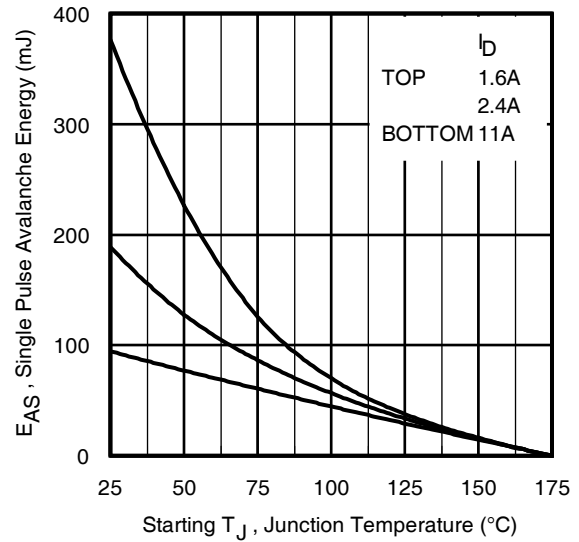


Fig 13. Maximum Avalanche Energy vs. Drain Current

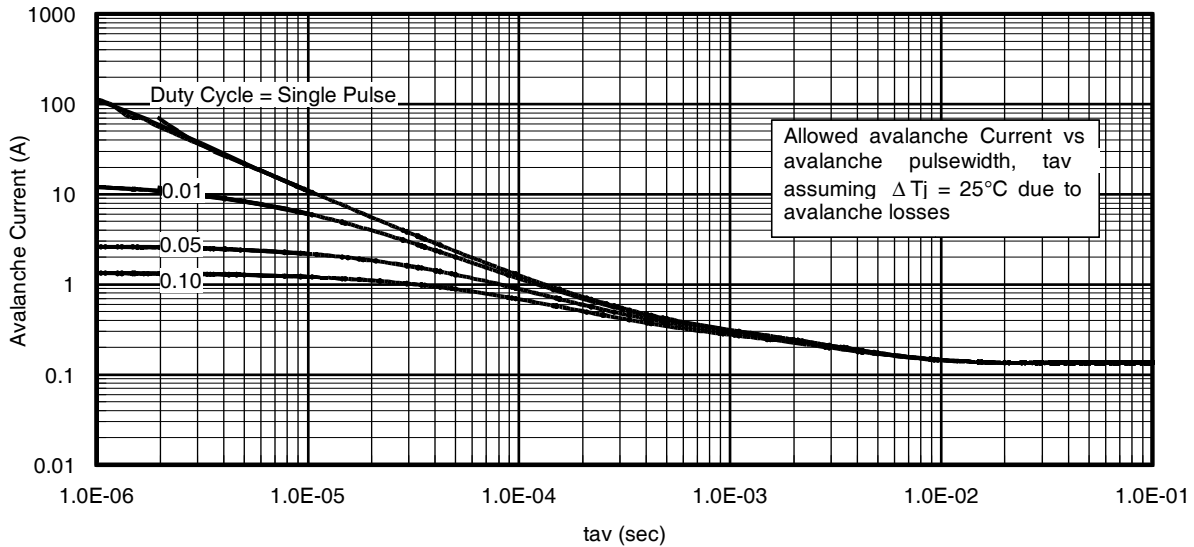


Fig 14. Typical Avalanche Current Vs. Pulsewidth

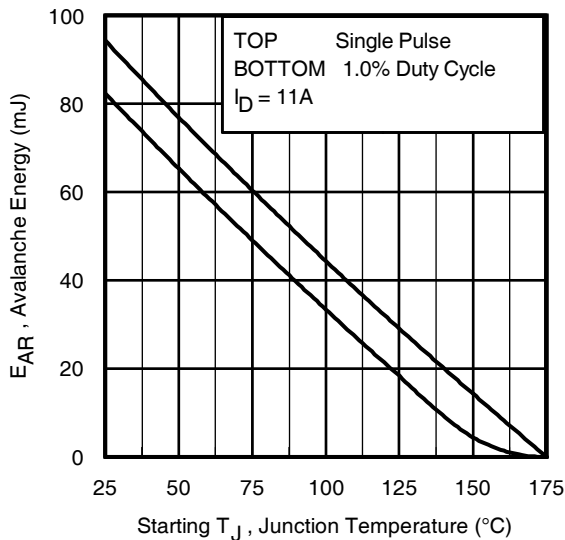


Fig 15. Maximum Avalanche Energy vs. Temperature

Notes on Repetitive Avalanche Curves , Figures 14, 15:
(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 17a, 17b.
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. ΔT = 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 = $t_{av} \cdot f$
 $Z_{thJC}(D, t_{av})$ = Transient thermal resistance, see figure 11)

$$P_D(ave) = 1/2 (1.3 \cdot BV \cdot I_{av}) = \Delta T / Z_{thJC}$$

$$I_{av} = 2\Delta T / [1.3 \cdot BV \cdot Z_{thJC}]$$

$$E_{AS}(AR) = P_D(ave) \cdot t_{av}$$

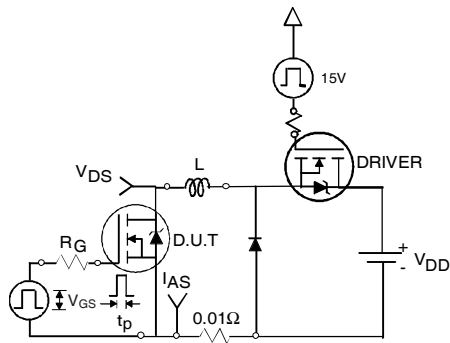


Fig 16a. Unclamped Inductive Test Circuit

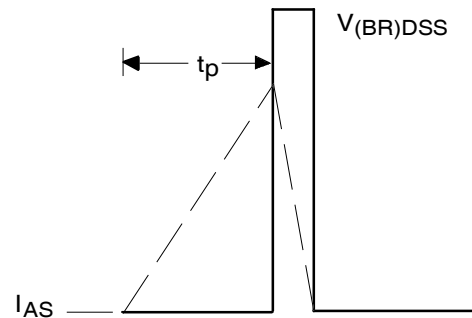


Fig 16b. Unclamped Inductive Waveforms

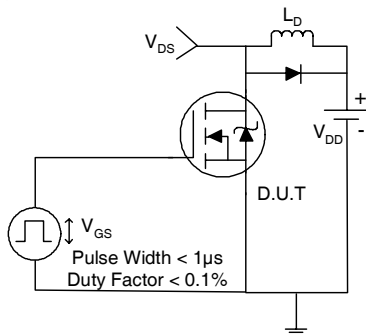


Fig 17a. Switching Time Test Circuit

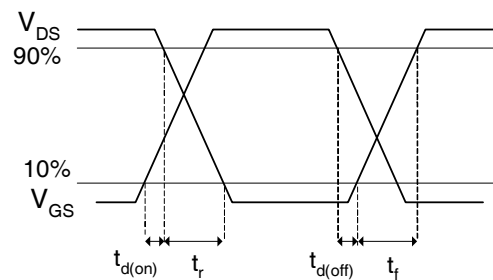


Fig 17b. Switching Time Waveforms

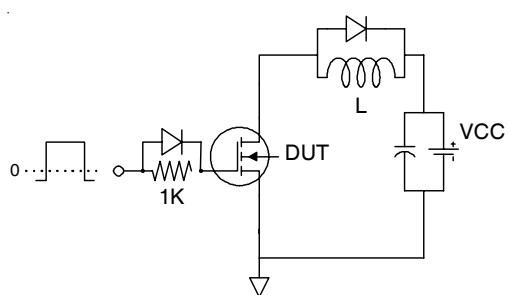


Fig 18a. Gate Charge Test Circuit

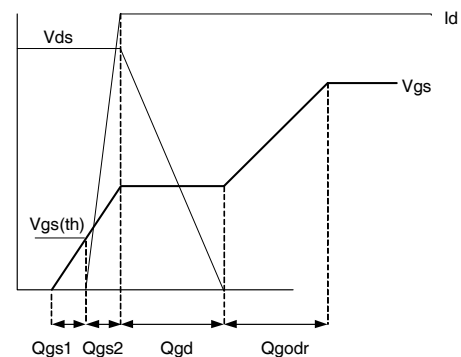
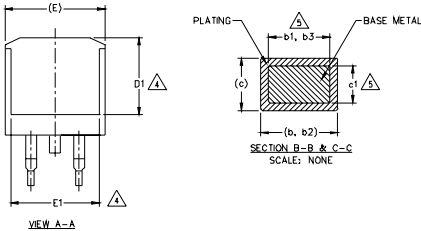
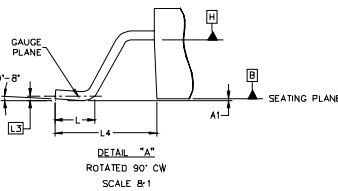
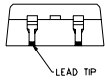
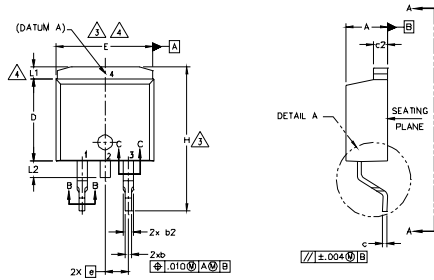


Fig 18b Gate Charge Waveform

D²Pak (TO-263AB) Package Outline

Dimensions are shown in millimeters (inches)



LEAD ASSIGNMENTS

DIODES

- 1.- ANODE (TWO DIE) / OPEN (ONE DIE)
2. 4.- CATHODE
- 3.- ANODE

HEXFET

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

IGBTs, CoPACK

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

NOTES:

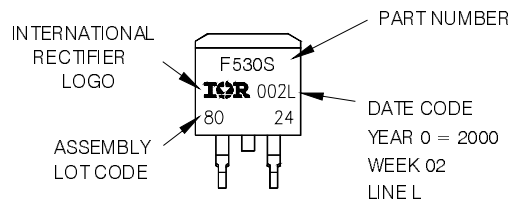
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994
2. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
3. DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.127 [0.005"] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY AT DATUM H.
4. THERMAL PAD 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 | | |
| | MIN. | MAX. | MIN. | MAX. | |
| A | 4.06 | 4.83 | .160 | .190 | 5 |
| A1 | 0.00 | 0.254 | .000 | .010 | |
| b | 0.51 | 0.99 | .020 | .039 | |
| b1 | 0.51 | 0.89 | .020 | .035 | |
| b2 | 1.14 | 1.78 | .045 | .070 | |
| b3 | 1.14 | 1.73 | .045 | .068 | 5 |
| c | 0.38 | 0.74 | .015 | .029 | 5 |
| c1 | 0.38 | 0.58 | .015 | .023 | |
| 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 | | |
| H | 14.61 | 15.88 | .575 | .625 | 4 |
| L | 1.78 | 2.79 | .070 | .110 | |
| L1 | - | 1.65 | - | .066 | |
| L2 | - | 1.78 | - | .070 | |
| L3 | 0.25 BSC | | .010 BSC | | |
| L4 | 4.78 | 5.28 | .188 | .208 | |

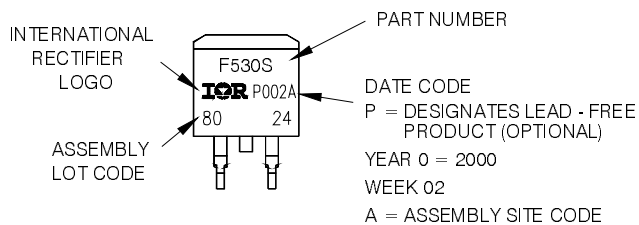
D²Pak (TO-263AB) Part Marking Information

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

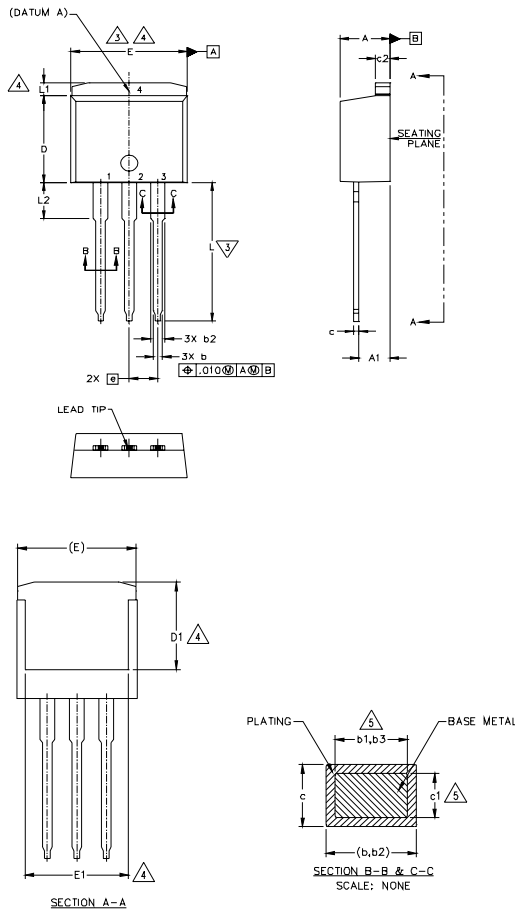


Note: For the most current drawing please refer to IR website at <http://www.irf.com/package/>

IRFS/SL4020PbF

TO-262 Package Outline

Dimensions are shown in millimeters (inches)



| SYMBOL | DIMENSIONS | | | | NOTES |
|--------|-------------|-------|----------|------|-------|
| | MILLIMETERS | | INCHES | | |
| | MIN. | MAX. | MIN. | MAX. | |
| A | 4.06 | 4.83 | .160 | .190 | 5 |
| A1 | 2.03 | 3.02 | .080 | .119 | |
| b | 0.51 | 0.99 | .020 | .039 | |
| b1 | 0.51 | 0.89 | .020 | .035 | |
| 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 | — | |
| e | 2.54 BSC | | .100 BSC | | 4 |
| L | 13.46 | 14.10 | .530 | .555 | |
| L1 | — | 1.65 | — | .065 | 4 |
| L2 | 3.56 | 3.71 | .140 | .146 | |

- 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.), c(min.) AND D1(min.) WHERE DIMENSIONS DERIVED THE ACTUAL PACKAGE OUTLINE.

LEAD ASSIGNMENTS

- IRBTA Co-PACK
- 1.- GATE
 - 2.- COLLECTOR
 - 3.- EMITTER
 - 4.- COLLECTOR

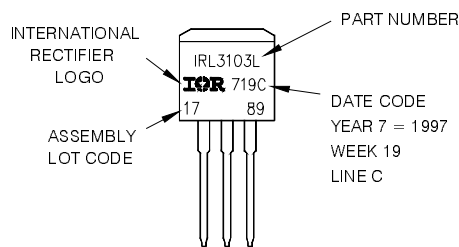
HEXLET DICES

- 1.- GATE
- 2.- DRAIN
- 3.- SOURCE
- 4.- DRAIN
- 1.- ANODE (NO DIE) / OPEN (NO DIE)
- 2.- CATHODE
- 3.- ANODE

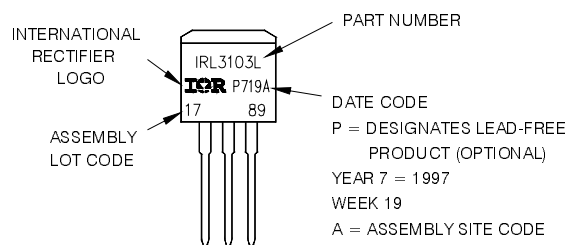
TO-262 Part Marking Information

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"



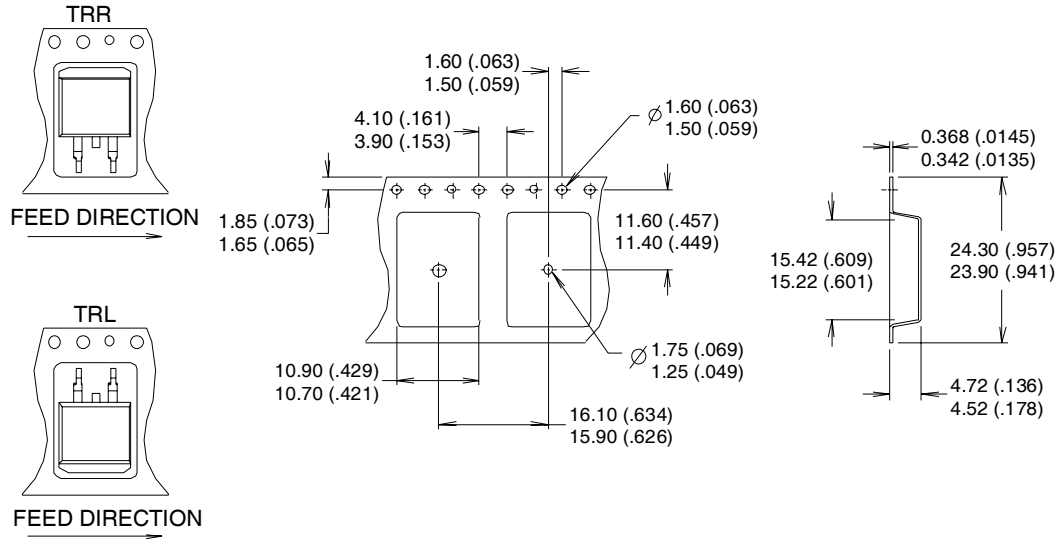
OR



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

D²Pak (TO-263AB) Tape & Reel Information

Dimensions are shown in millimeters (inches)



NOTES :

1. COMFORMS TO EIA-418.
2. CONTROLLING DIMENSION: MILLIMETER.
- ③ DIMENSION MEASURED @ HUB.
- ④ INCLUDES FLANGE DISTORTION @ OUTER EDGE.

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

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 TAC Fax: (310) 252-7903

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