International
IOR Rectifier

PROVISIONAL

**SMPS MOSFET**

PD - 97002

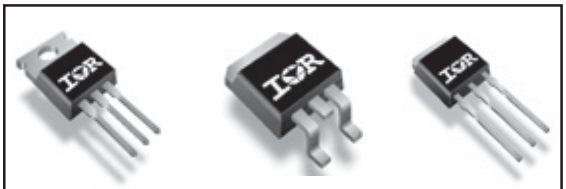
# IRFB52N15DPbF
# IRFS52N15DPbF
# IRFSL52N15DPbF

HEXFET® Power MOSFET

### Applications
- High frequency DC-DC converters
- Plasma Display Panel
- Lead-Free

### 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

| Key Parameters | | |
|---|---|---|
| $V_{DS}$ | 150 | V |
| $V_{DS\ (Avalanche)}$ min. | 200 | V |
| $R_{DS(ON)}$ max @ 10V | 32 | mΩ |
| $T_J$ max | 175 | °C |



TO-220AB IRFB52N15DPbF | D²Pak IRFS52N15DPbF | TO-262 IRFSL52N15DPbF

### Absolute Maximum Ratings

| | Parameter | Max. | Units |
|---|---|---|---|
| $I_D$ @ $T_C$ = 25°C | Continuous Drain Current, $V_{GS}$ @ 10V ⑦ | 51* | A |
| $I_D$ @ $T_C$ = 100°C | Continuous Drain Current, $V_{GS}$ @ 10V ⑦ | 36* | |
| $I_{DM}$ | Pulsed Drain Current ① | 240 | |
| $P_D$ @$T_A$ = 25°C | Power Dissipation ⑦ | 3.8 | W |
| $P_D$ @$T_C$ = 25°C | Power Dissipation ⑦ | 230* | |
| | Linear Derating Factor ⑦ | 1.5* | W/°C |
| $V_{GS}$ | Gate-to-Source Voltage | ± 30 | V |
| dv/dt | Peak Diode Recovery dv/dt ③ | 5.5 | V/ns |
| $T_J$ | Operating Junction and | -55 to + 175 | °C |
| $T_{STG}$ | Storage Temperature Range | | |
| | Soldering Temperature, for 10 seconds | 300 (1.6mm from case ) | |
| | Mounting torqe, 6-32 or M3 screw⑥ | 10 lbf•in (1.1N•m) | |

### Thermal Resistance

| | Parameter | Typ. | Max. | Units |
|---|---|---|---|---|
| $R_{\theta JC}$ | Junction-to-Case | —— | 0.47* | °C/W |
| $R_{\theta CS}$ | Case-to-Sink, Flat, Greased Surface ⑥ | 0.50 | —— | |
| $R_{\theta JA}$ | Junction-to-Ambient⑥ | —— | 62 | |
| $R_{\theta JA}$ | Junction-to-Ambient⑦ | —— | 40 | |

* $R_{\theta JC}$ (end of life) for D²Pak and TO-262 = 0.65°C/W. This is the maximum measured value after 1000 temperature cycles from -55 to 150°C and is accounted for by the physical wearout of the die attach medium.

Notes ① through ⑦ are on page 11

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

| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| $V_{(BR)DSS}$ | Drain-to-Source Breakdown Voltage | 150 | — | — | V | $V_{GS}$ = 0V, $I_D$ = 250µA |
| $\Delta V_{(BR)DSS}/\Delta T_J$ | Breakdown Voltage Temp. Coefficient | — | 0.16 | — | V/°C | Reference to 25°C, $I_D$ = 1mA |
| $R_{DS(on)}$ | Static Drain-to-Source On-Resistance | — | — | 32 | mΩ | $V_{GS}$ = 10V, $I_D$ = 36A 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 | $V_{DS}$ = 150V, $V_{GS}$ = 0V |
| | | — | — | 250 | | $V_{DS}$ = 120V, $V_{GS}$ = 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 | 19 | — | — | S | $V_{DS}$ = 50V, $I_D$ = 36A |
| $Q_g$ | Total Gate Charge | — | 60 | 89 | nC | $I_D$ = 36A |
| $Q_{gs}$ | Gate-to-Source Charge | — | 18 | 27 | | $V_{DS}$ = 75V |
| $Q_{gd}$ | Gate-to-Drain ("Miller") Charge | — | 28 | 42 | | $V_{GS}$ = 10V, ④ |
| $t_{d(on)}$ | Turn-On Delay Time | — | 16 | — | ns | $V_{DD}$ = 75V |
| $t_r$ | Rise Time | — | 47 | — | | $I_D$ = 36A |
| $t_{d(off)}$ | Turn-Off Delay Time | — | 28 | — | | $R_G$ = 2.5Ω |
| $t_f$ | Fall Time | — | 25 | — | | $V_{GS}$ = 10V ④ |
| $C_{iss}$ | Input Capacitance | — | 2770 | — | pF | $V_{GS}$ = 0V |
| $C_{oss}$ | Output Capacitance | — | 590 | — | | $V_{DS}$ = 25V |
| $C_{rss}$ | Reverse Transfer Capacitance | — | 110 | — | | $f$ = 1.0MHz |
| $C_{oss}$ | Output Capacitance | — | 3940 | — | | $V_{GS}$ = 0V, $V_{DS}$ = 1.0V, $f$ = 1.0MHz |
| $C_{oss}$ | Output Capacitance | — | 260 | — | | $V_{GS}$ = 0V, $V_{DS}$ = 120V, $f$ = 1.0MHz |
| $C_{oss}$ eff. | Effective Output Capacitance | — | 550 | — | | $V_{GS}$ = 0V, $V_{DS}$ = 0V to 120V ⑤ |

## Avalanche Characteristics

| | Parameter | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|
| $E_{AS}$ | Single Pulse Avalanche Energy②⑥ | — | — | 470 | mJ |
| $I_{AR}$ | Avalanche Current ① | — | — | 36 | A |
| $E_{AR}$ | Repetitive Avalanche Energy ① | — | 450 | — | mJ |
| $V_{DS\ (Avalanche)}$ | Repetitive Avalanche Voltage ① | 200 | — | — | V |

## Diode Characteristics

| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| $I_S$ | Continuous Source Current (Body Diode) | — | — | 60 | A | MOSFET symbol showing the integral reverse p-n junction diode. |
| $I_{SM}$ | Pulsed Source Current (Body Diode) ①⑥ | — | — | 240 | | |
| $V_{SD}$ | Diode Forward Voltage | — | — | 1.5 | V | $T_J$ = 25°C, $I_S$ = 36A, $V_{GS}$ = 0V ④ |
| $t_{rr}$ | Reverse Recovery Time | — | 140 | 210 | nS | $T_J$ = 25°C, $I_F$ = 36A |
| $Q_{rr}$ | Reverse RecoveryCharge | — | 780 | 1170 | nC | di/dt = 100A/µs ④ |
| $t_{on}$ | Forward Turn-On Time | Intrinsic turn-on time is negligible (turn-on is dominated by $L_S$+$L_D$) | | | | |

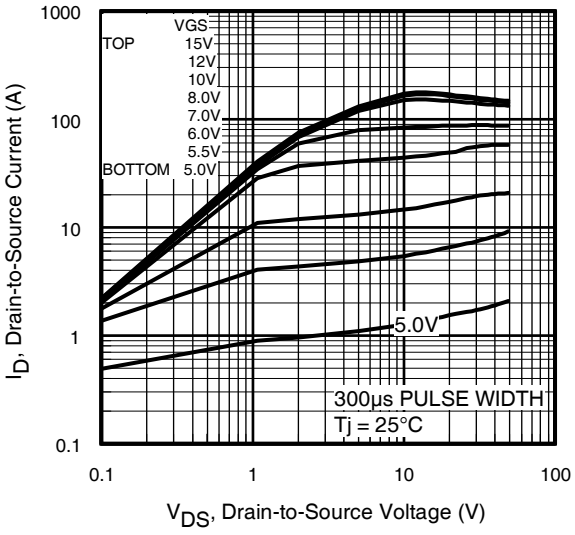



**Fig 1.** Typical Output Characteristics

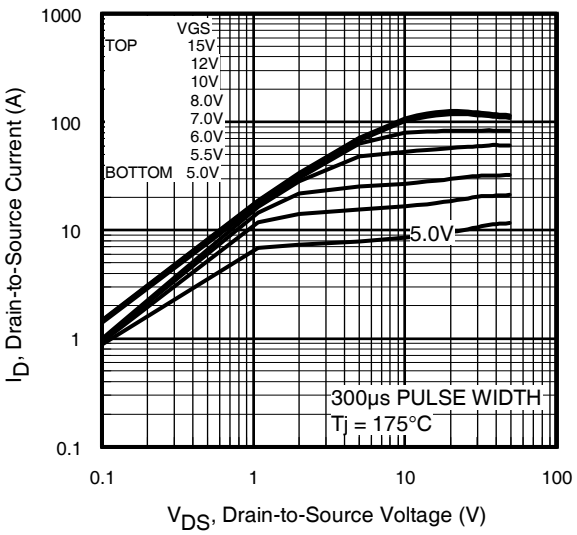



**Fig 2.** Typical Output Characteristics

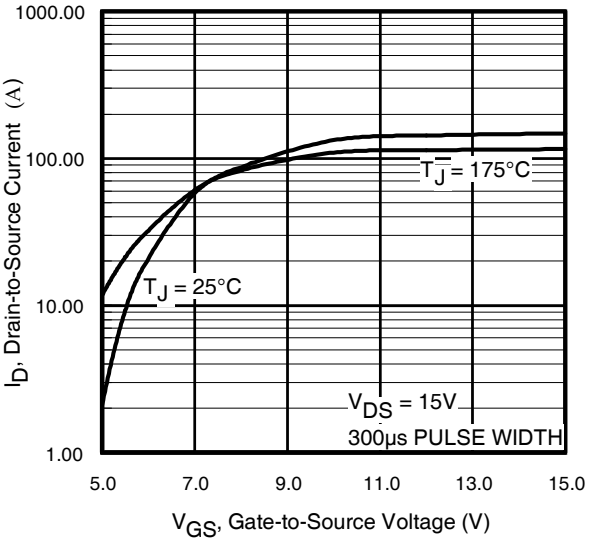



**Fig 3.** Typical Transfer Characteristics

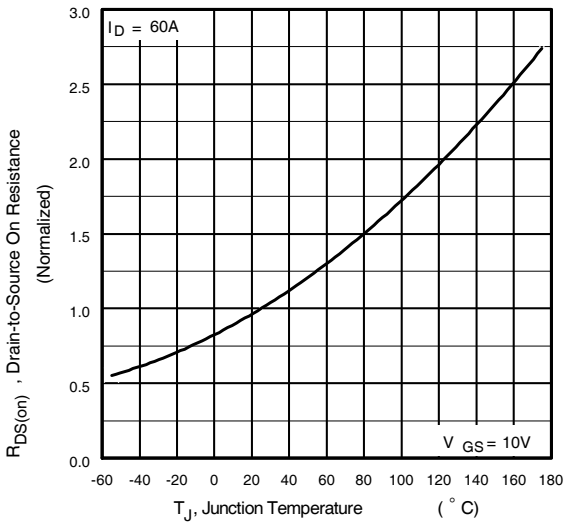



**Fig 4.** Normalized On-Resistance Vs. Temperature

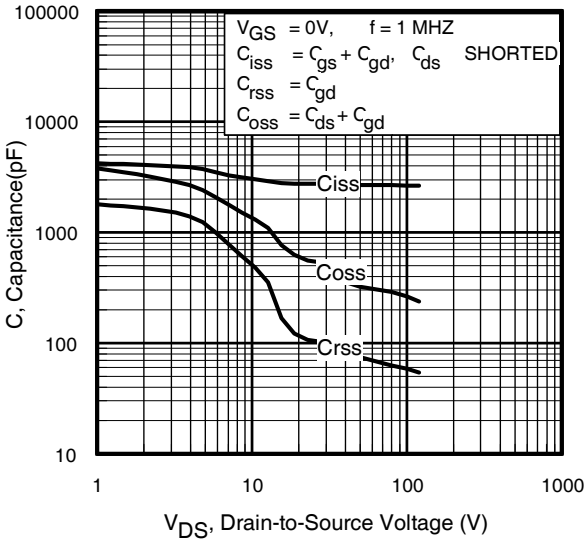



**Fig 5.** Typical Capacitance Vs. Drain-to-Source Voltage

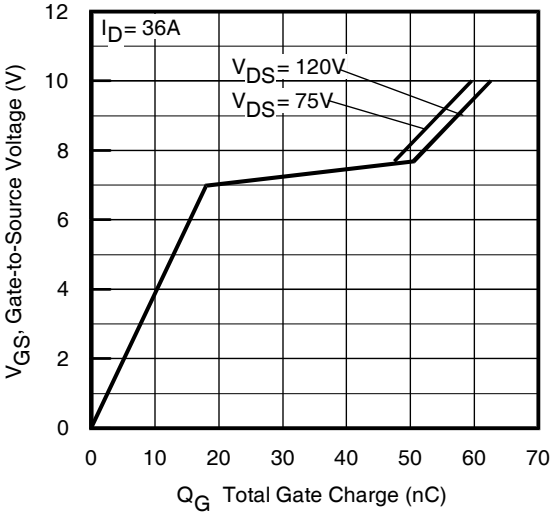



**Fig 6.** Typical Gate Charge Vs. Gate-to-Source Voltage

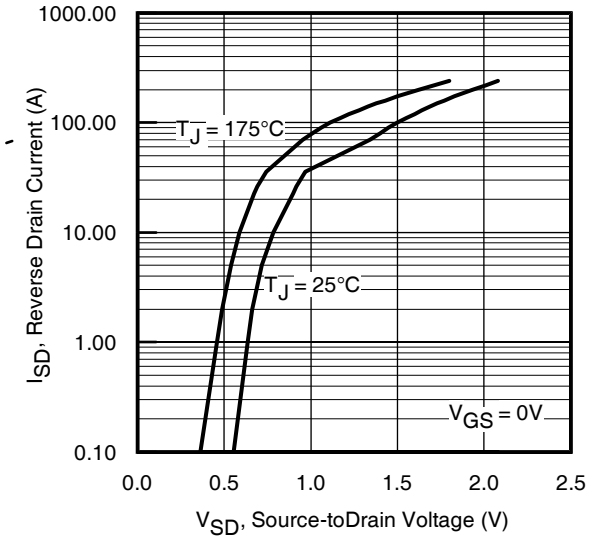



**Fig 7.** Typical Source-Drain Diode Forward Voltage

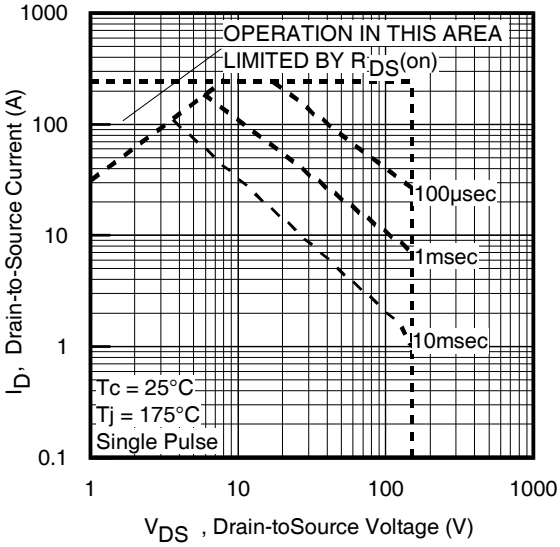



**Fig 8.** Maximum Safe Operating Area

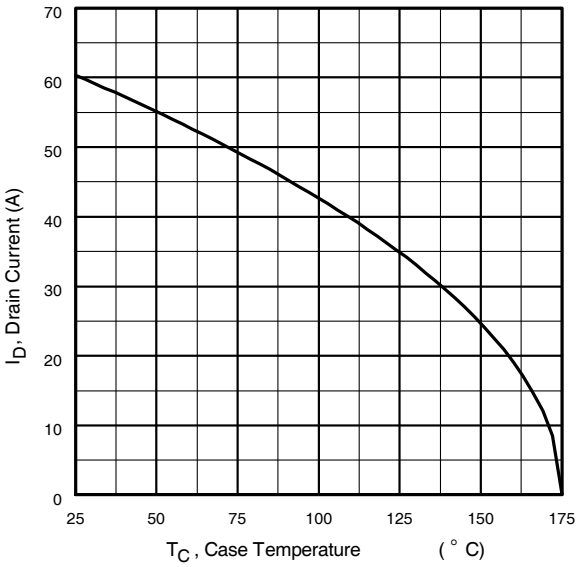



**Fig 9.** Maximum Drain Current Vs. Case Temperature

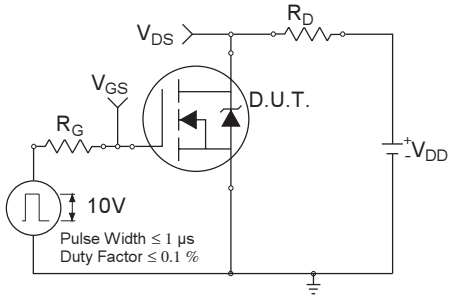



**Fig 10a.** Switching Time Test Circuit

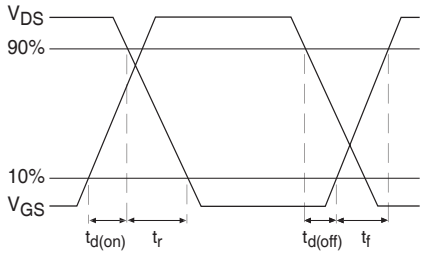



**Fig 10b.** Switching Time Waveforms

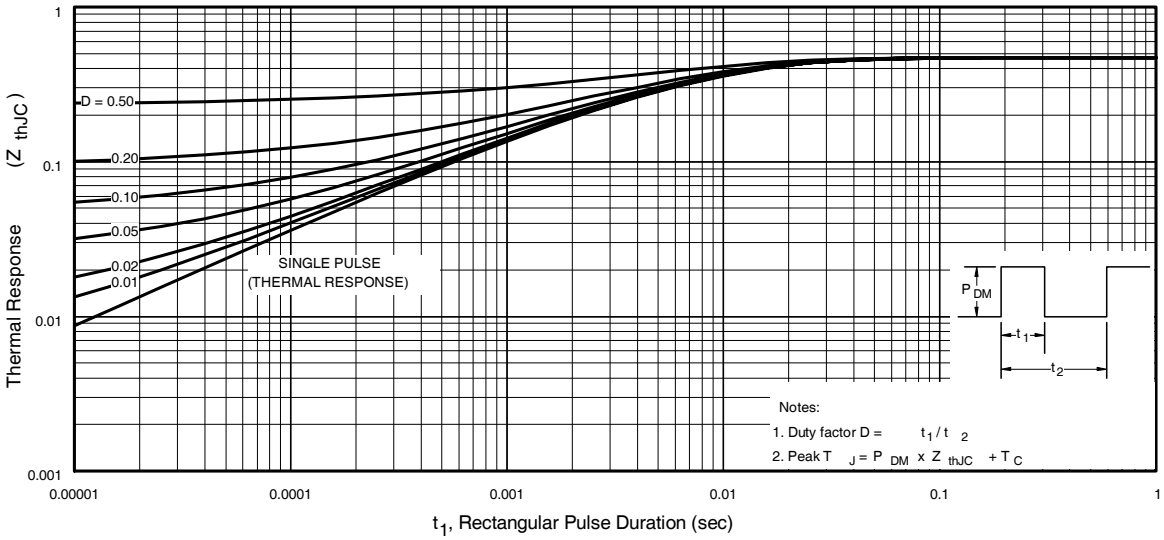



**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Case

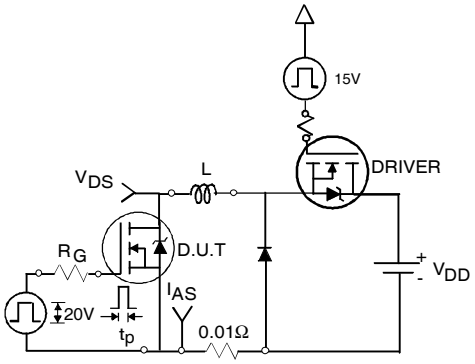



**Fig 12a.** Unclamped Inductive Test Circuit

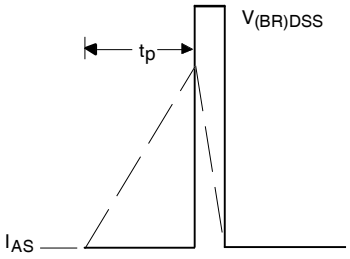



**Fig 12b.** Unclamped Inductive Waveforms

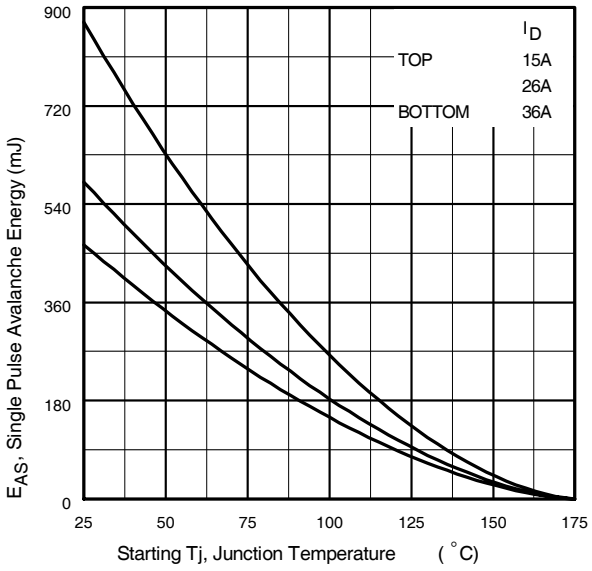



**Fig 12c.** Maximum Avalanche Energy Vs. Drain Current

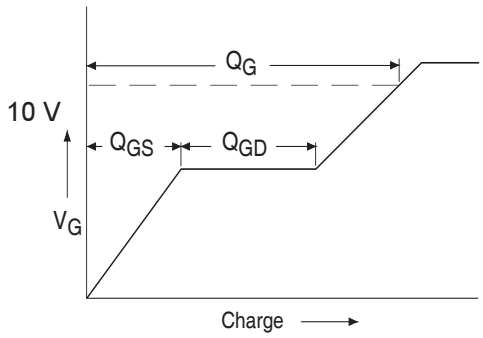



**Fig 13a.** Basic Gate Charge Waveform

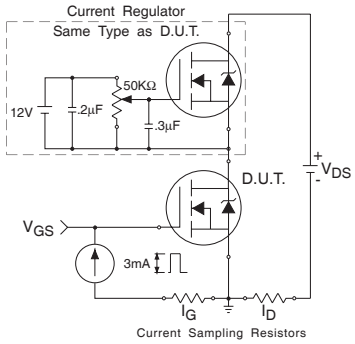
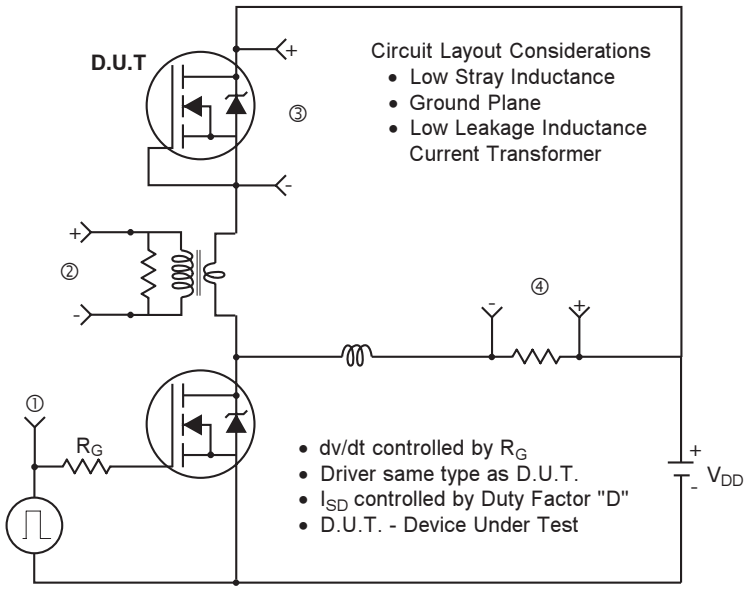
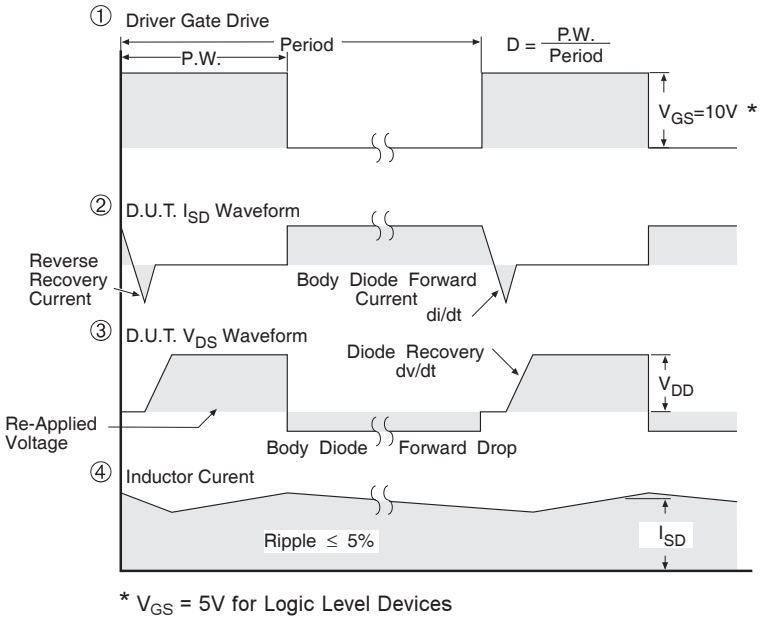



**Fig 13b.** Gate Charge Test Circuit

## Peak Diode Recovery dv/dt Test Circuit



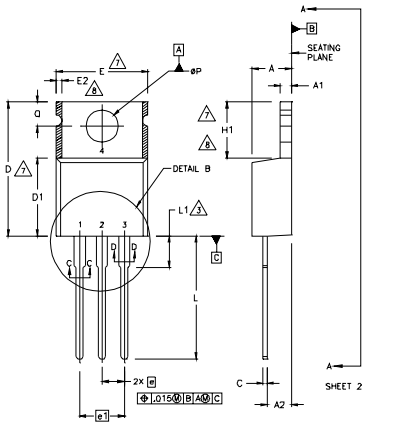



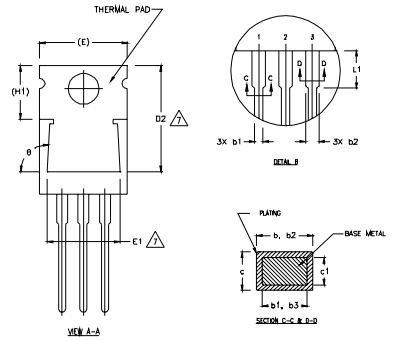

* $V_{GS}$ = 5V for Logic Level Devices

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

# TO-220AB Package Outline

Dimensions are shown in millimeters (inches)




NOTES:

1 DIMENSIONING AND TOLERANCING PER ASME Y14.5 M- 1994.
2 DIMENSIONS ARE SHOWN IN INCHES [MILLIMETERS].
3 LEAD DIMENSION AND FINISH UNCONTROLLED IN L1.
4 DIMENSION D & 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 & 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.

| SYMBOL | DIMENSIONS | | | | NOTES |
|---|---|---|---|---|---|
| | MILLIMETERS | | INCHES | | |
| | MIN. | MAX. | MIN. | MAX. | |
| A | 3.56 | 4.82 | .140 | .190 | |
| A1 | 0.51 | 1.40 | .020 | .055 | |
| A2 | 2.04 | 2.92 | .080 | .115 | |
| b | 0.38 | 1.01 | .015 | .040 | |
| b1 | 0.38 | 0.96 | .015 | .038 | 5 |
| b2 | 1.15 | 1.77 | .045 | .070 | |
| b3 | 1.15 | 1.73 | .045 | .068 | |
| 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 | 12.19 | 12.88 | .480 | .507 | 7 |
| E | 9.66 | 10.66 | .380 | .420 | 4,7 |
| E1 | 8.38 | 8.89 | .330 | .350 | 7 |
| e | 2.54 BSC | | .100 BSC | | |
| e1 | 5.08 | | .200 BSC | | |
| H1 | 5.85 | 6.55 | .230 | .270 | 7,8 |
| L | 12.70 | 14.73 | .500 | .580 | |
| L1 | – | 6.35 | – | .250 | 3 |
| øP | 3.54 | 4.08 | .139 | .161 | |
| Q | 2.54 | 3.42 | .100 | .135 | |
| ø | 90°-93° | | 90°-93° | | |

LEAD ASSIGNMENTS

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

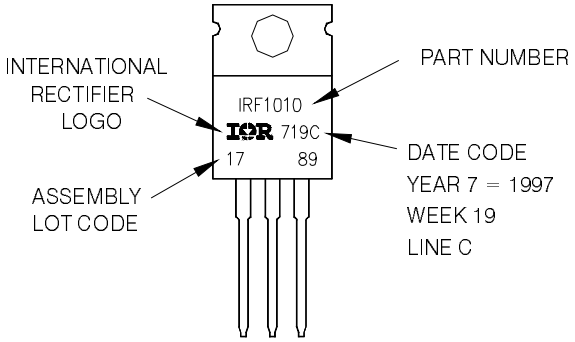
IGBTs, CoPACK
1.- GATE
2.- COLLECTOR
3.- EMITTER

DIODES
1.- ANODE/OPEN
2.- CATHODE
3.- ANODE

# TO-220AB Part Marking Information

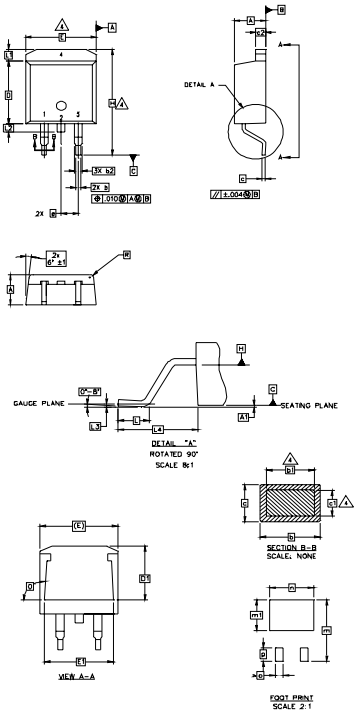
EXAMPLE: THIS IS AN IRF1010
LOT CODE 1789
ASSEMBLED ON WW 19, 1997
IN THE ASSEMBLY LINE "C"

Note: "P" inassembly line position indicates "Lead - Free"



# D²Pak 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 [.005"] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY.
4. DIMENSION b1 AND c1 APPLY TO BASE METAL ONLY.
5. CONTROLLING DIMENSION: INCH.

| SYMBOL | DIMENSIONS | | | | NOTES |
|---|---|---|---|---|---|
| | MILLIMETERS | | INCHES | | |
| | MIN. | MAX. | MIN. | MAX. | |
| 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 | .035 | 4 |
| b2 | 1.14 | 1.78 | .045 | .070 | |
| c | 0.38 | 0.74 | .015 | .029 | |
| c1 | 0.38 | 0.58 | .015 | .023 | 4 |
| c2 | 1.14 | 1.65 | .045 | .065 | |
| D | 8.51 | 9.65 | .335 | .380 | 3 |
| D1 | 6.86 | | .270 | | |
| E | 9.65 | 10.67 | .380 | .420 | 3 |
| E1 | 6.22 | | .245 | | |
| e | 2.54 BSC | | .100 BSC | | |
| H | 14.61 | 15.88 | .575 | .625 | |
| L | 1.78 | 2.79 | .070 | .110 | |
| L1 | | 1.65 | | .065 | |
| L2 | 1.27 | 1.78 | .050 | .070 | |
| L3 | 0.25 BSC | | .010 BSC | | |
| L4 | 4.78 | 5.28 | .188 | .208 | |
| m | 17.78 | | .700 | | |
| m1 | 8.89 | | .350 | | |
| n | 11.43 | | .450 | | |
| o | 2.08 | | .082 | | |
| p | 3.81 | | .150 | | |
| R | 0.51 | 0.71 | .020 | .028 | |
| θ | 90° | 93° | 90° | 93° | |

LEAD ASSIGNMENTS

HEXFET

1.– GATE
2, 4.– DRAIN
3.– SOURCE

IGBTs, CoPACK

1.– GATE
2, 4.– COLLECTOR
3.– EMITTER

DIODES

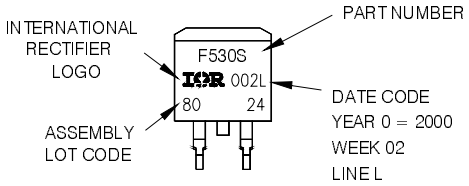
1.– ANODE *
2, 4.– CATHODE
3.– ANODE

* PART DEPENDENT.

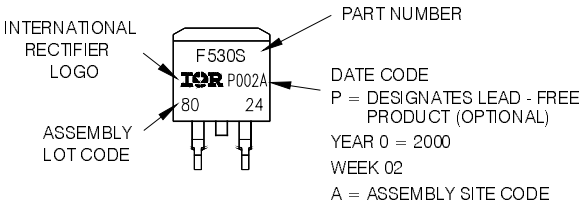
# D²Pak Part Marking Information

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"

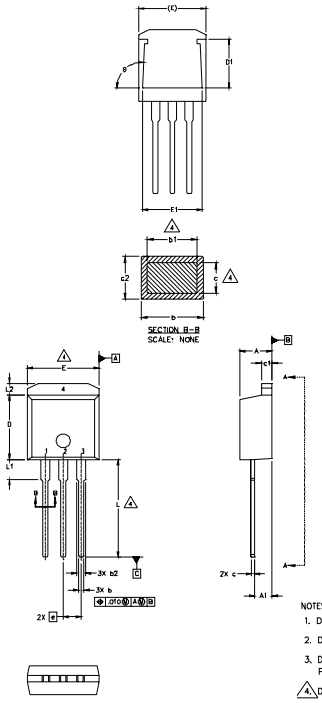



OR



# 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 | |
| A1 | 2.03 | 2.92 | .080 | .115 | |
| b | 0.51 | 0.99 | .020 | .039 | |
| b1 | 0.51 | 0.89 | .020 | .035 | 4 |
| b2 | 1.14 | 1.40 | .045 | .055 | |
| c | 0.38 | 0.63 | .015 | .025 | 4 |
| c1 | 1.14 | 1.40 | .045 | .055 | |
| c2 | 0.43 | .063 | .017 | .029 | |
| D | 8.51 | 9.65 | .335 | .380 | 3 |
| D1 | 5.33 | | .210 | | |
| E | 9.65 | 10.67 | .380 | .420 | 3 |
| E1 | 6.22 | | .245 | | |
| e | 2.54 BSC | | .100 BSC | | |
| L | 13.46 | 14.09 | .530 | .555 | |
| L1 | 3.56 | 3.71 | .140 | .146 | |
| L2 | | 1.65 | | .065 | |

LEAD ASSIGNMENTS

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

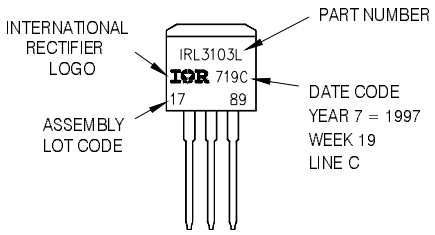
~~IGBT~~
1- GATE

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 [.005"] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY.
4. DIMENSION b1 AND c1 APPLY TO BASE METAL ONLY.
5. CONTROLLING DIMENSION: INCH.

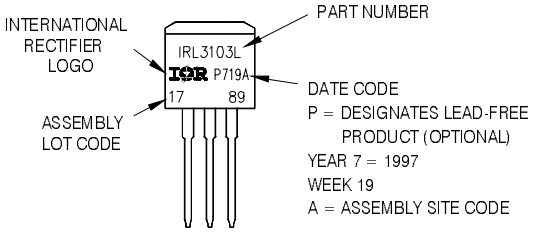
# TO-262 Part Marking Information

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

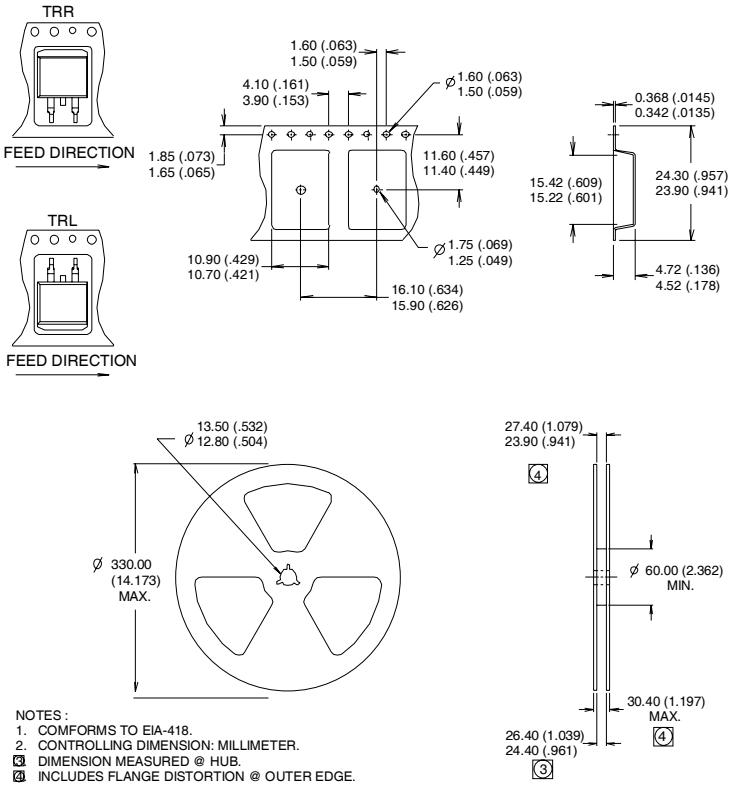
Note: "P" in assembly line position indicates "Lead – Free"




OR



# D²Pak Tape & Reel Information




**Notes:**

① 1% Duty cycle, 100 pulses, limited by max. junction temperature.

② Starting $T_J$ = 25°C, L = 0.72mH $R_G$ = 25Ω, $I_{AS}$ = 36A.

③ $I_{SD} \leq$ 36A, di/dt ≤ 400A/µs, $V_{DD} \leq V_{(BR)DSS}$, $T_J \leq$ 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 This is only applied to TO-220AB package.

⑦ This is applied to D²Pak, when mounted on 1" square PCB (FR-4 or G-10 Material ). For recommended footprint and soldering techniques refer to application note #AN-994.

**TO-220 package is not recommended for Surface Mount Application.**

Data and specifications subject to change without notice.
This product has been designed and qualified for the Automotive [Q101] (IRFB52N15DPbF), & Industrial (IRFS52N15DPbF/IRFSL52N15DPbF) market.
Qualification Standards can be found on IR's Web site.

International
IOR Rectifier

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