

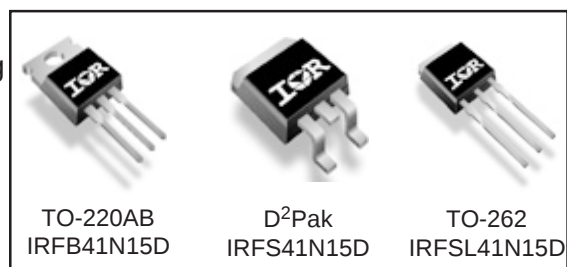
### Applications

- High frequency DC-DC converters

| $V_{DSS}$ | $R_{DS(on)}$ max | $I_D$ |
|-----------|------------------|-------|
| 150V      | 0.045Ω           | 41A   |

### 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



### Absolute Maximum Ratings

|                                   | Parameter                                | Max.                   | Units |
|-----------------------------------|------------------------------------------|------------------------|-------|
| $I_D$ @ $T_C = 25^\circ\text{C}$  | Continuous Drain Current, $V_{GS}$ @ 10V | 41                     | A     |
| $I_D$ @ $T_C = 100^\circ\text{C}$ | Continuous Drain Current, $V_{GS}$ @ 10V | 29                     |       |
| $I_{DM}$                          | Pulsed Drain Current ①                   | 164                    |       |
| $P_D$ @ $T_A = 25^\circ\text{C}$  | Power Dissipation ②                      | 3.1                    | W     |
| $P_D$ @ $T_C = 25^\circ\text{C}$  | Power Dissipation                        | 200                    |       |
|                                   | Linear Derating Factor                   | 1.3                    | W/°C  |
| $V_{GS}$                          | Gate-to-Source Voltage                   | ± 30                   | V     |
| $dv/dt$                           | Peak Diode Recovery $dv/dt$ ③            | 2.7                    | 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 torque, 6-32 or M3 screw④       | 10 lbf•in (1.1N•m)     |       |

### Typical SMPS Topologies

- Telecom 48V input DC-DC Active Clamp Reset Forward Converter

Notes ① through ⑤ are on page 11

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# IRFB/IRFS/IRFSL41N15D

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**IR** Rectifier

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

|                                 | Parameter                            | Min. | Typ. | Max.  | Units               | Conditions                                            |
|---------------------------------|--------------------------------------|------|------|-------|---------------------|-------------------------------------------------------|
| $V_{(BR)DSS}$                   | Drain-to-Source Breakdown Voltage    | 150  | —    | —     | V                   | $V_{GS} = 0V, I_D = 250\mu A$                         |
| $\Delta V_{(BR)DSS}/\Delta T_J$ | Breakdown Voltage Temp. Coefficient  | —    | 0.17 | —     | V/ $^\circ\text{C}$ | Reference to $25^\circ\text{C}$ , $I_D = 1mA$         |
| $R_{DS(on)}$                    | Static Drain-to-Source On-Resistance | —    | —    | 0.045 | $\Omega$            | $V_{GS} = 10V, I_D = 25A$ ④                           |
| $V_{GS(th)}$                    | Gate Threshold Voltage               | 3.0  | —    | 5.5   | V                   | $V_{DS} = V_{GS}, I_D = 250\mu A$                     |
| $I_{DSS}$                       | Drain-to-Source Leakage Current      | —    | —    | 25    | $\mu A$             | $V_{DS} = 150V, V_{GS} = 0V$                          |
|                                 |                                      | —    | —    | 250   |                     | $V_{DS} = 120V, V_{GS} = 0V, T_J = 150^\circ\text{C}$ |
| $I_{GSS}$                       | Gate-to-Source Forward Leakage       | —    | —    | 100   | nA                  | $V_{GS} = 30V$                                        |
|                                 | Gate-to-Source Reverse Leakage       | —    | —    | -100  |                     | $V_{GS} = -30V$                                       |

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

|                        | Parameter                       | Min. | Typ. | Max. | Units | Conditions                                    |
|------------------------|---------------------------------|------|------|------|-------|-----------------------------------------------|
| $g_{fs}$               | Forward Transconductance        | 18   | —    | —    | S     | $V_{DS} = 50V, I_D = 25A$                     |
| $Q_g$                  | Total Gate Charge               | —    | 72   | 110  | nC    | $I_D = 25A$                                   |
| $Q_{gs}$               | Gate-to-Source Charge           | —    | 21   | 31   |       | $V_{DS} = 120V$                               |
| $Q_{gd}$               | Gate-to-Drain ("Miller") Charge | —    | 35   | 52   |       | $V_{GS} = 10V$ , ④                            |
| $t_{d(on)}$            | Turn-On Delay Time              | —    | 16   | —    | ns    | $V_{DD} = 75V$                                |
| $t_r$                  | Rise Time                       | —    | 63   | —    |       | $I_D = 25A$                                   |
| $t_{d(off)}$           | Turn-Off Delay Time             | —    | 25   | —    |       | $R_G = 2.5\Omega$                             |
| $t_f$                  | Fall Time                       | —    | 14   | —    |       | $V_{GS} = 10V$ ④                              |
| $C_{iss}$              | Input Capacitance               | —    | 2520 | —    | pF    | $V_{GS} = 0V$                                 |
| $C_{oss}$              | Output Capacitance              | —    | 510  | —    |       | $V_{DS} = 25V$                                |
| $C_{rss}$              | Reverse Transfer Capacitance    | —    | 110  | —    |       | $f = 1.0MHz$ ⑥                                |
| $C_{oss}$              | Output Capacitance              | —    | 3090 | —    |       | $V_{GS} = 0V, V_{DS} = 1.0V, f = 1.0MHz$      |
| $C_{oss}$              | Output Capacitance              | —    | 230  | —    |       | $V_{GS} = 0V, V_{DS} = 120V, f = 1.0MHz$      |
| $C_{oss \text{ eff.}}$ | Effective Output Capacitance    | —    | 250  | —    |       | $V_{GS} = 0V, V_{DS} = 0V \text{ to } 120V$ ⑤ |

## Avalanche Characteristics

|          | Parameter                      | Typ. | Max. | Units |
|----------|--------------------------------|------|------|-------|
| $E_{AS}$ | Single Pulse Avalanche Energy② | —    | 470  | mJ    |
| $I_{AR}$ | Avalanche Current①             | —    | 25   | A     |
| $E_{AR}$ | Repetitive Avalanche Energy①   | —    | 20   | mJ    |

## Thermal Resistance

|                 | Parameter                             | Typ. | Max. | Units              |
|-----------------|---------------------------------------|------|------|--------------------|
| $R_{\theta JC}$ | Junction-to-Case                      | —    | 0.75 | $^\circ\text{C/W}$ |
| $R_{\theta CS}$ | Case-to-Sink, Flat, Greased Surface ⑥ | 0.50 | —    |                    |
| $R_{\theta JA}$ | Junction-to-Ambient⑦                  | —    | 62   |                    |
| $R_{\theta JA}$ | Junction-to-Ambient⑦                  | —    | 40   |                    |

## Diode Characteristics

|          | Parameter                              | Min.                                                                        | Typ. | Max. | Units   | Conditions                                                     |
|----------|----------------------------------------|-----------------------------------------------------------------------------|------|------|---------|----------------------------------------------------------------|
| $I_S$    | Continuous Source Current (Body Diode) | —                                                                           | —    | 41   | A       | MOSFET symbol showing the integral reverse p-n junction diode. |
| $I_{SM}$ | Pulsed Source Current (Body Diode) ①   | —                                                                           | —    | 164  |         |                                                                |
| $V_{SD}$ | Diode Forward Voltage                  | —                                                                           | —    | 1.3  | V       | $T_J = 25^\circ\text{C}, I_S = 25A, V_{GS} = 0V$ ④             |
| $t_{rr}$ | Reverse Recovery Time                  | —                                                                           | 170  | 260  | ns      | $T_J = 25^\circ\text{C}, I_F = 25A$                            |
| $Q_{rr}$ | Reverse Recovery Charge                | —                                                                           | 1.3  | 1.9  | $\mu C$ | $di/dt = 100A/\mu s$ ④                                         |
| $t_{on}$ | Forward Turn-On Time                   | Intrinsic turn-on time is negligible (turn-on is dominated by $L_S + L_D$ ) |      |      |         |                                                                |

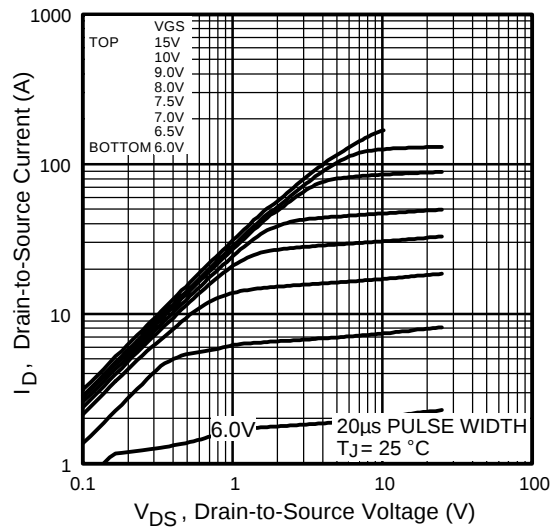


Fig 1. Typical Output Characteristics

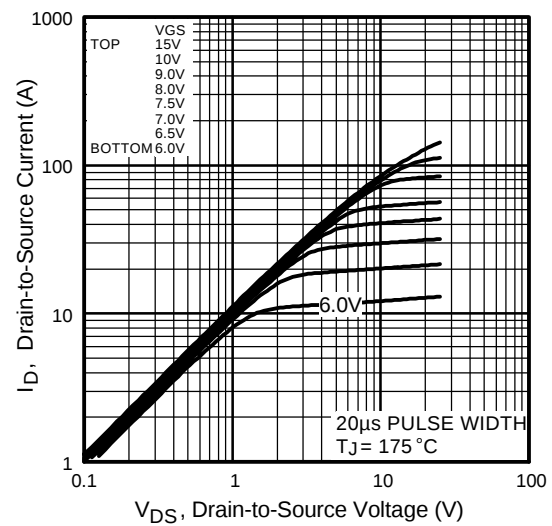


Fig 2. Typical Output Characteristics

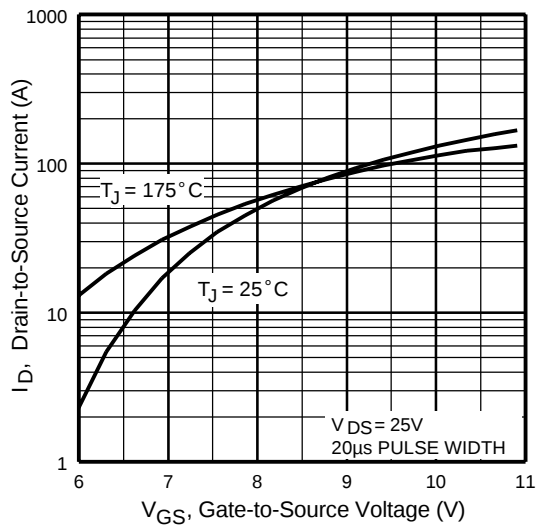


Fig 3. Typical Transfer Characteristics

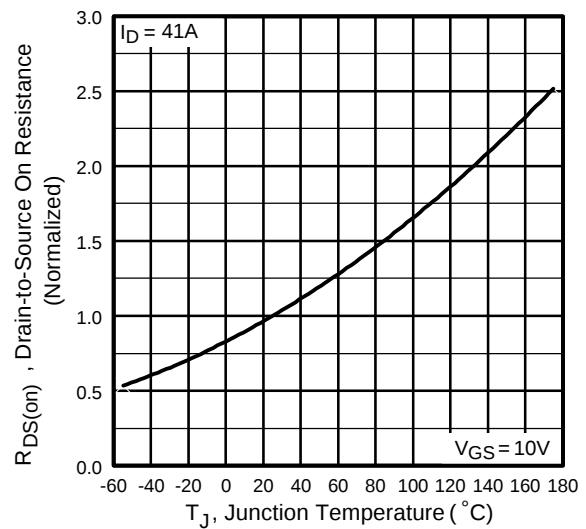
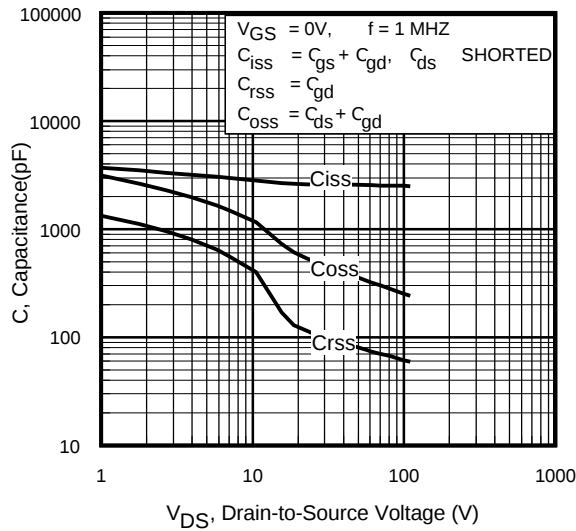


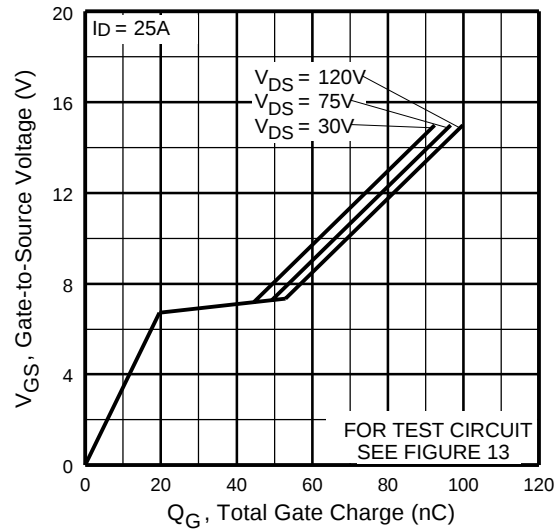
Fig 4. Normalized On-Resistance Vs. Temperature

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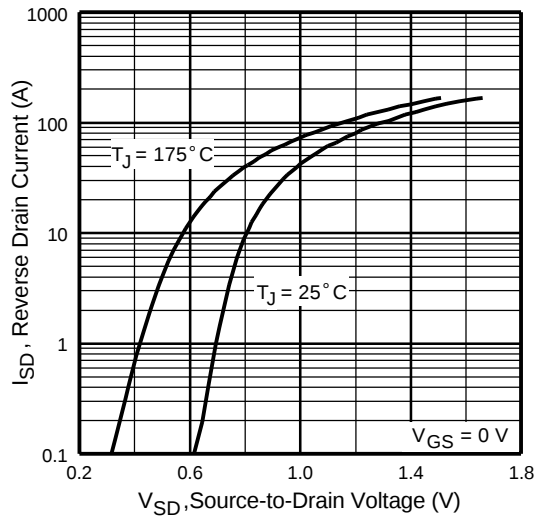
International  
**IR** Rectifier



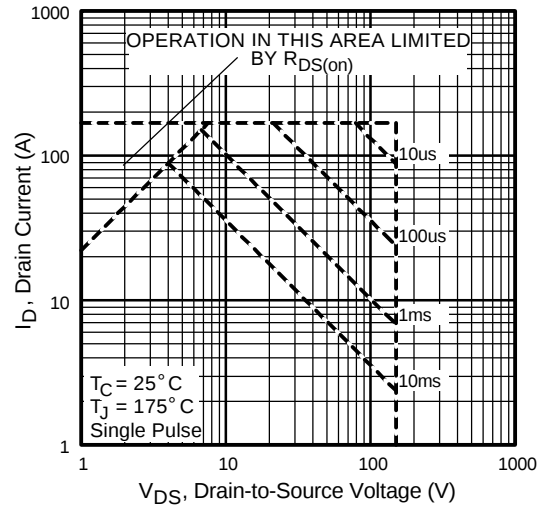
**Fig 5.** Typical Capacitance Vs. Drain-to-Source Voltage



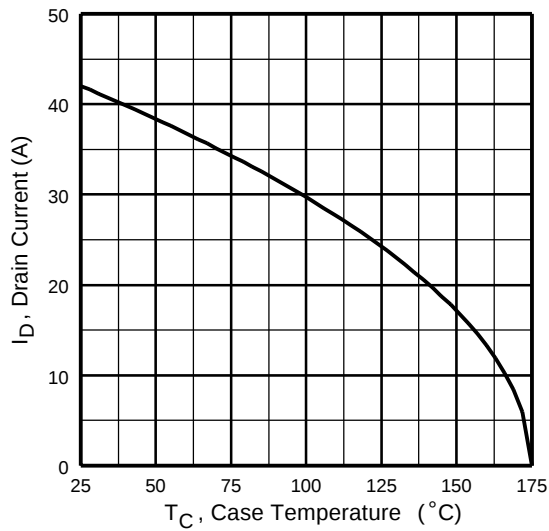
**Fig 6.** Typical Gate Charge Vs. Gate-to-Source Voltage



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



**Fig 8.** Maximum Safe Operating Area



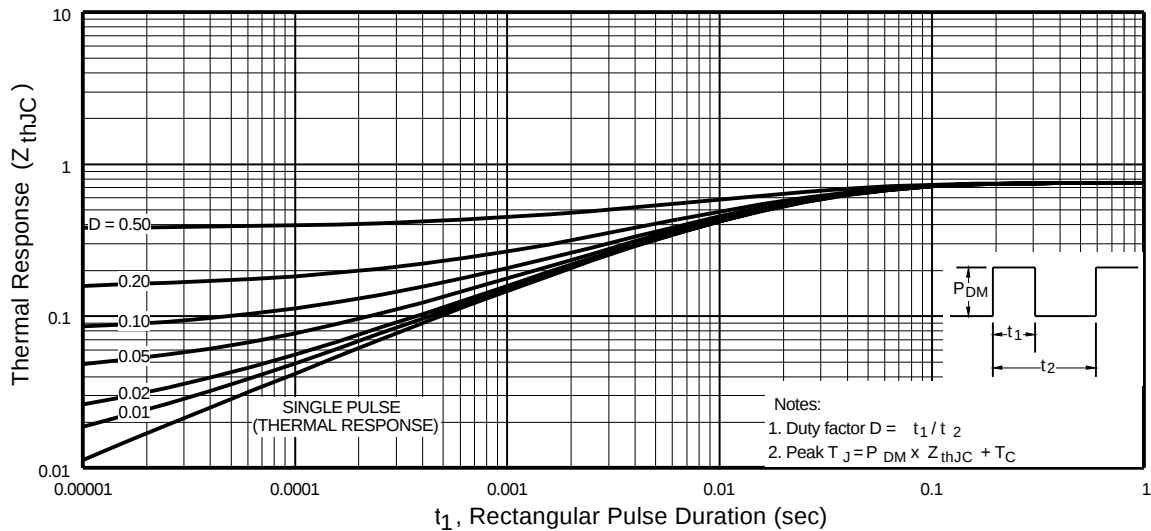
**Fig 9.** Maximum Drain Current Vs. Case Temperature



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



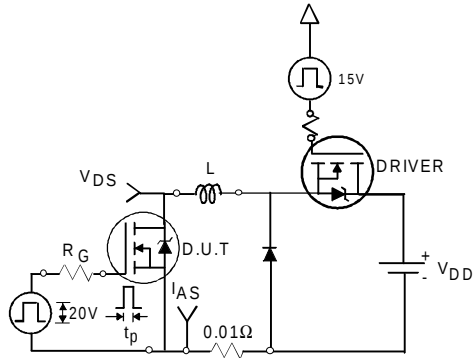
**Fig 10b.** Switching Time Waveforms



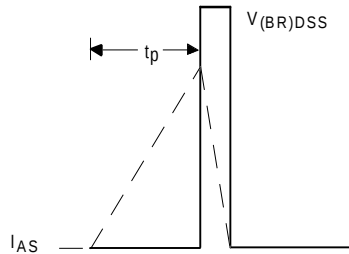
**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Case

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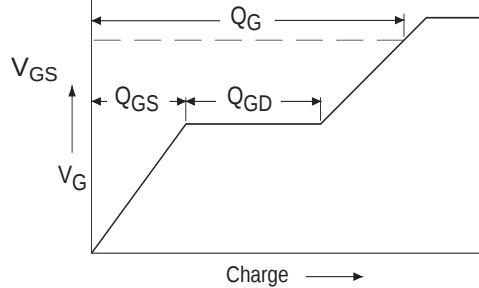
International  
**IR** Rectifier



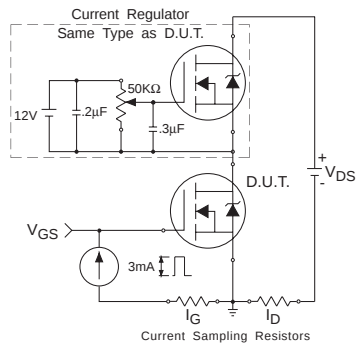
**Fig 12a.** Unclamped Inductive Test Circuit



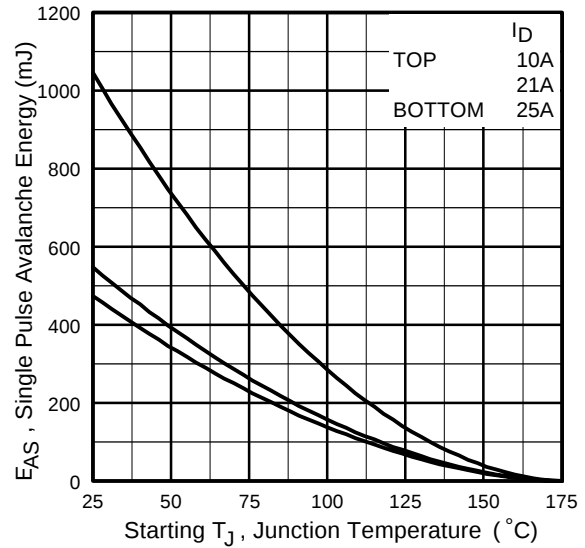
**Fig 12b.** Unclamped Inductive Waveforms



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



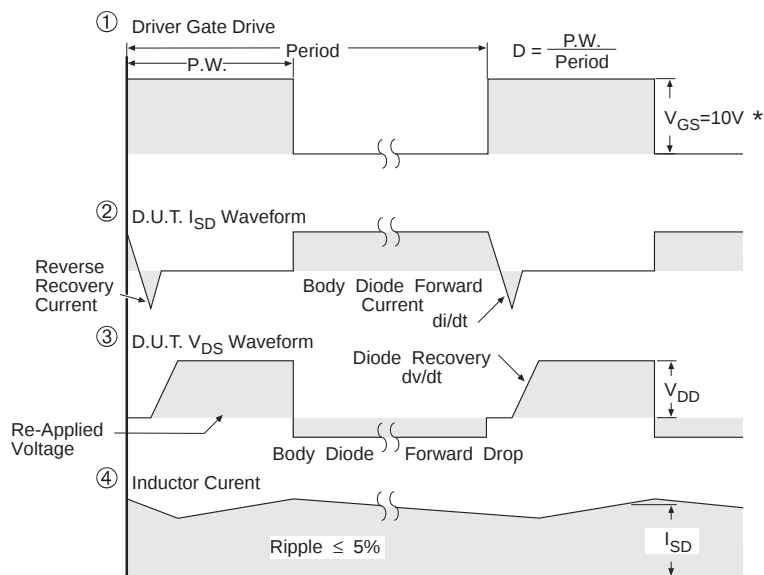
**Fig 13b.** Gate Charge Test Circuit



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

**Circuit Layout Considerations**

- Low Stray Inductance
- Ground Plane
- Low Leakage Inductance Current Transformer



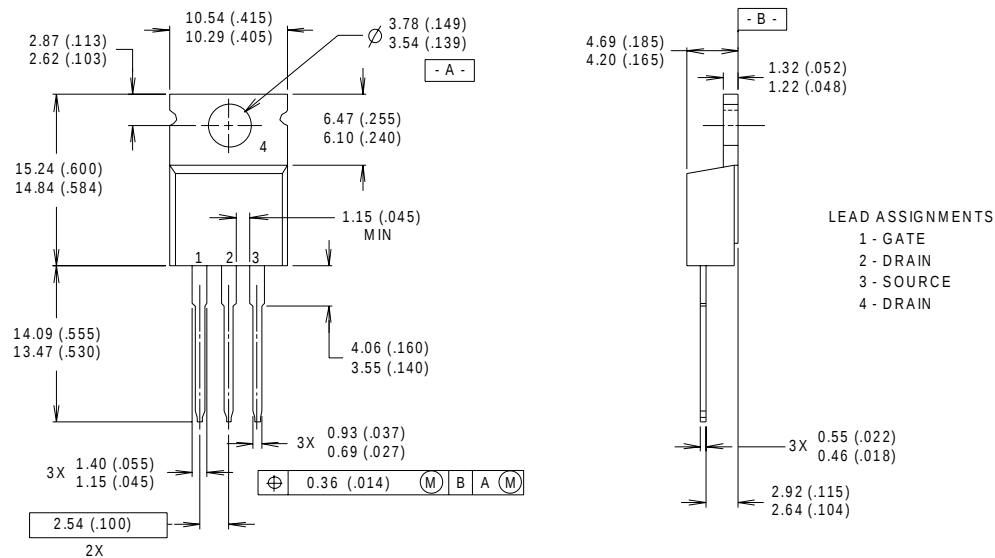
**Fig 14.** For N-Channel HEXFET<sup>®</sup> Power MOSFETs

# IRFB/IRFS/IRFSL41N15D

International  
**IR** Rectifier

## TO-220AB Package Outline

Dimensions are shown in millimeters (inches)

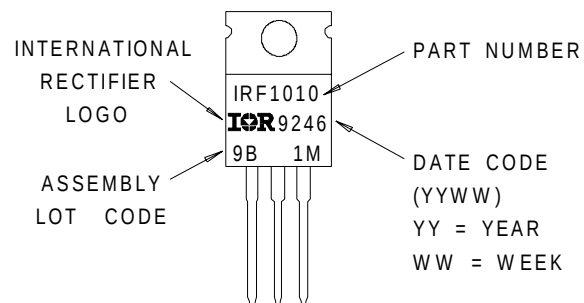


### NOTES:

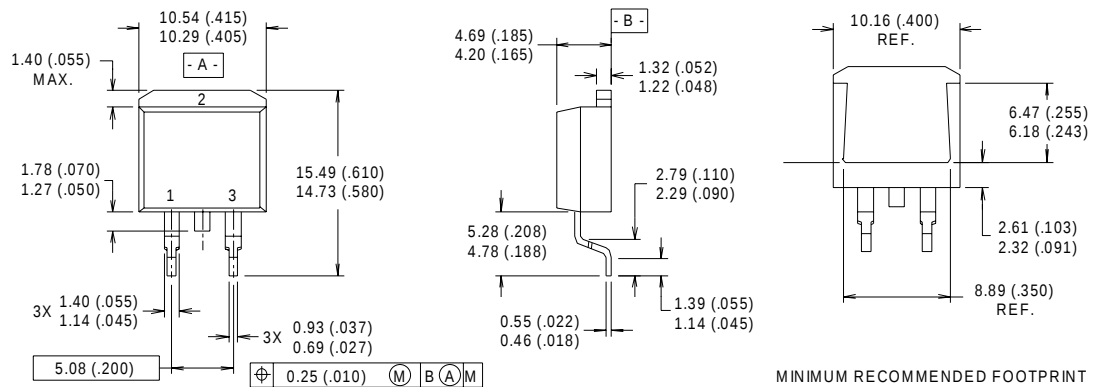
- 1 DIMENSIONING & TOLERANCING PER ANSI Y14.5M, 1982.
- 2 CONTROLLING DIMENSION : INCH
- 3 OUTLINE CONFORMS TO JEDEC OUTLINE TO-220AB.
- 4 HEATSINK & LEAD MEASUREMENTS DO NOT INCLUDE BURRS.

## TO-220AB Part Marking Information

EXAMPLE : THIS IS AN IRF1010  
WITH ASSEMBLY  
LOT CODE 9B1M



## D<sup>2</sup>Pak Package Outline



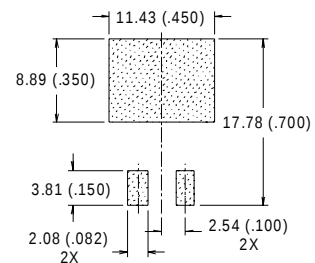
### NOTES:

- 1 DIMENSIONS AFTER SOLDER DIP.
- 2 DIMENSIONING & TOLERANCING PER ANSI Y14.5M, 1982.
- 3 CONTROLLING DIMENSION : INCH.
- 4 HEATSINK & LEAD DIMENSIONS DO NOT INCLUDE BURRS.

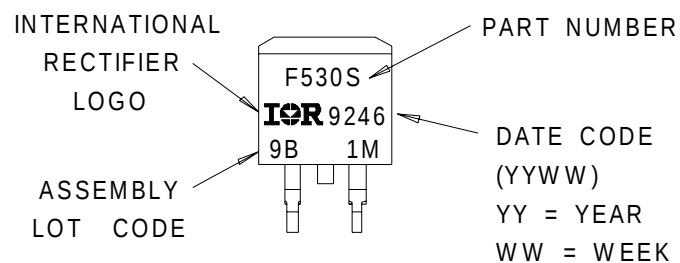
### LEAD ASSIGNMENTS

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

### MINIMUM RECOMMENDED FOOTPRINT



## D<sup>2</sup>Pak Part Marking Information



International  
**IOR** Rectifier

Technical drawing of a 3-flute end mill. The drawing shows the tool with dimensions in inches and millimeters in brackets. Key dimensions include:

- Overall length: 10.54 [.415]
- Length to start of flutes: 10.29 [.405]
- Flute length: 1.15 [.045] MIN.
- Flute width: 1.40 [.055] (3X) and 1.15 [.045] (2X)
- Flute depth: 4.06 [.160] and 3.55 [.140]
- Flute tip radius: 0.93 [.037] and 0.69 [.027] (3X)
- Flute tip chamfer: 2.54 [.100]
- Flute tip chamfer angle: 14.09 [.555] and 13.47 [.530]
- Flute tip chamfer width: 0.36 [.014] (3X)
- Flute tip chamfer angle: 1.40 [.055] (3X) and 1.15 [.045] (2X)
- Flute tip chamfer width: 0.93 [.037] and 0.69 [.027] (3X)
- Flute tip chamfer angle: 14.09 [.555] and 13.47 [.530]
- Flute tip chamfer width: 0.36 [.014] (3X)

Technical drawing of a mechanical part with dimensions and tolerances:

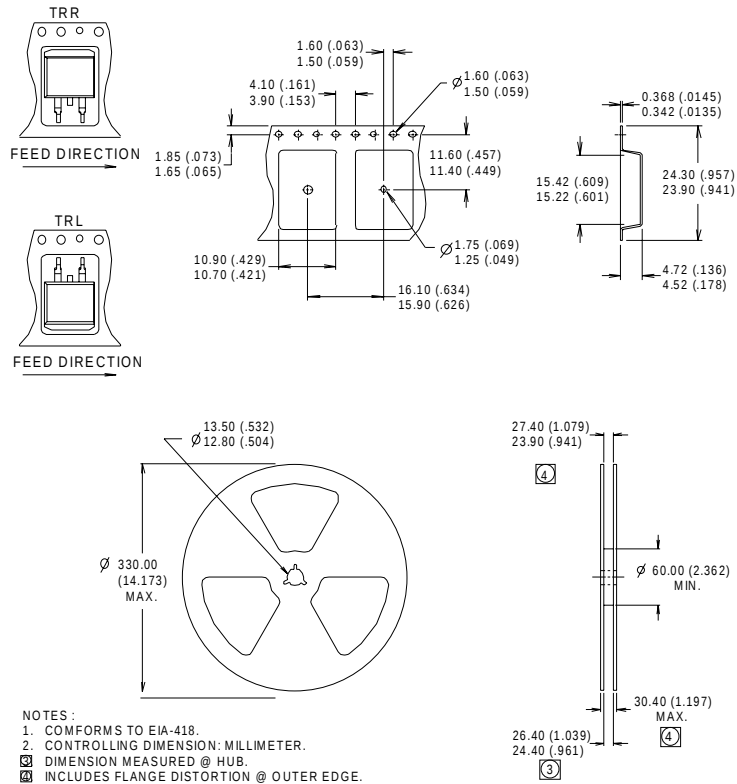
- Top dimensions: 4.69 [.185] and 4.20 [.165]
- Right side dimensions: 1.32 [.052] and 1.22 [.048]
- Feature label: -B-
- Bottom left dimensions: 3X 0.55 [.022] and 0.46 [.018]
- Bottom right dimensions: 2.92 [.115] and 2.64 [.104]

1. DIMENSIONING & TOLERANCING PER ANSI Y14.5M-1982
2. CONTROLLING DIMENSION: INCH.
3. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
4. HEATSINK & LEAD DIMENSIONS DO NOT INCLUDE BURRS.

Diagram illustrating the markings on a MOSFET package (IRL3103L) and their corresponding labels:

- INTERNATIONAL RECTIFIER LOGO**: Points to the "IR" logo on the package.
- PART NUMBER**: Points to the "IRL3103L" marking.
- DATE CODE**: Points to the "719C" marking.
- YEAR 7 = 1997**: Points to the "7" in the date code.
- WEEK 19**: Points to the "19" in the date code.
- LINE C**: Points to the "C" in the date code.
- ASSEMBLY LOT CODE**: Points to the "17" marking.
- 89**: Points to the "89" marking.

## D<sup>2</sup>Pak Tape & Reel Information



### Notes:

- ① Repetitive rating; pulse width limited by max. junction temperature.
- ② Starting  $T_J = 25^\circ\text{C}$ ,  $L = 1.5\text{mH}$   
 $R_G = 25\Omega$ ,  $I_{AS} = 25\text{A}$ .
- ③  $I_{SD} \leq 25\text{A}$ ,  $di/dt \leq 340\text{A}/\mu\text{s}$ ,  $V_{DD} \leq V_{(BR)DSS}$ ,  
 $T_J \leq 175^\circ\text{C}$
- ④ Pulse width  $\leq 300\mu\text{s}$ ; duty cycle  $\leq 2\%$ .
- 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 D<sup>2</sup>Pak, when mounted on 1" square PCB ( FR-4 or G-10 Material ).  
For recommended footprint and soldering techniques refer to application note #AN-994.