

International  
**IR** Rectifier

SMPS MOSFET

PD-91897A  
**IRFBC40AS**

HEXFET® Power MOSFET

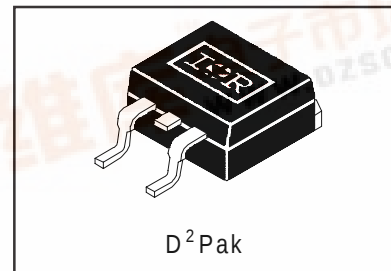
#### Applications

- Switch Mode Power Supply ( SMPS )
- Uninterruptable Power Supply
- High speed power switching

| $V_{DSS}$ | $R_{ds(on)}$ max | $I_D$ |
|-----------|------------------|-------|
| 600V      | 1.2Ω             | 6.2A  |

#### Benefits

- Low Gate Charge  $Q_g$  results in Simple Drive Requirement
- Improved Gate, Avalanche and dynamic  $dv/dt$  Ruggedness
- Fully Characterized Capacitance and Avalanche Voltage and Current
- Effective  $C_{oss}$  Specified ( See AN 1001)



#### Absolute Maximum Ratings

|                                   | Parameter                                 | Max.                   | Units |
|-----------------------------------|-------------------------------------------|------------------------|-------|
| $I_D$ @ $T_C = 25^\circ\text{C}$  | Continuous Drain Current, $V_{GS}$ @ 10V⑥ | 6.2                    | A     |
| $I_D$ @ $T_C = 100^\circ\text{C}$ | Continuous Drain Current, $V_{GS}$ @ 10V⑥ | 3.9                    |       |
| $I_{DM}$                          | Pulsed Drain Current ①⑥                   | 25                     |       |
| $P_D$ @ $T_C = 25^\circ\text{C}$  | Power Dissipation                         | 125                    | W     |
|                                   | Linear Derating Factor                    | 1.0                    | W/°C  |
| $V_{GS}$                          | Gate-to-Source Voltage                    | ± 30                   | V     |
| $dv/dt$                           | Peak Diode Recovery $dv/dt$ ③⑥            | 6.0                    | V/ns  |
| $T_J$                             | Operating Junction and                    | -55 to + 150           | °C    |
| $T_{STG}$                         | Storage Temperature Range                 |                        |       |
|                                   | Soldering Temperature, for 10 seconds     | 300 (1.6mm from case ) |       |

#### Typical SMPS Topology:

- Single transistor Forward

Notes ① through ⑤ are on page 9

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

|                                 | Parameter                            | Min. | Typ. | Max.      | Units               | Conditions                                                                            |
|---------------------------------|--------------------------------------|------|------|-----------|---------------------|---------------------------------------------------------------------------------------|
| $V_{(BR)DSS}$                   | Drain-to-Source Breakdown Voltage    | 600  | —    | —         | V                   | $V_{GS} = 0V, I_D = 250\mu A$                                                         |
| $\Delta V_{(BR)DSS}/\Delta T_J$ | Breakdown Voltage Temp. Coefficient  | —    | 0.66 | —         | V/ $^\circ\text{C}$ | Reference to $25^\circ\text{C}$ , $I_D = 1mA$ ⑥                                       |
| $R_{DS(on)}$                    | Static Drain-to-Source On-Resistance | —    | —    | 1.2       | $\Omega$            | $V_{GS} = 10V, I_D = 3.7A$ ④                                                          |
| $V_{GS(th)}$                    | Gate Threshold Voltage               | 2.0  | —    | 4.0       | V                   | $V_{DS} = V_{GS}, I_D = 250\mu A$                                                     |
| $I_{DSS}$                       | Drain-to-Source Leakage Current      | —    | —    | 25<br>250 | $\mu A$             | $V_{DS} = 600V, V_{GS} = 0V$<br>$V_{DS} = 480V, V_{GS} = 0V, T_J = 125^\circ\text{C}$ |
| $I_{GSS}$                       | 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        | 3.4  | —    | —    | S     | $V_{DS} = 50V, I_D = 3.7A$                                                               |
| $Q_g$                  | Total Gate Charge               | —    | —    | 42   | nC    | $I_D = 6.2A$<br>$V_{DS} = 480V$<br>$V_{GS} = 10V$ , See Fig. 6 and 13 ④                  |
| $Q_{gs}$               | Gate-to-Source Charge           | —    | —    | 10   |       |                                                                                          |
| $Q_{gd}$               | Gate-to-Drain ("Miller") Charge | —    | —    | 20   |       |                                                                                          |
| $t_{d(on)}$            | Turn-On Delay Time              | —    | 13   | —    | ns    | $V_{DD} = 300V$<br>$I_D = 6.2A$<br>$R_G = 9.1\Omega$<br>$R_D = 47\Omega$ , See Fig. 10 ④ |
| $t_r$                  | Rise Time                       | —    | 23   | —    |       |                                                                                          |
| $t_{d(off)}$           | Turn-Off Delay Time             | —    | 31   | —    |       |                                                                                          |
| $t_f$                  | Fall Time                       | —    | 18   | —    |       |                                                                                          |
| $C_{iss}$              | Input Capacitance               | —    | 1036 | —    | pF    | $V_{GS} = 0V$<br>$V_{DS} = 25V$<br>$f = 1.0MHz$ , See Fig. 5                             |
| $C_{oss}$              | Output Capacitance              | —    | 136  | —    |       | $V_{GS} = 0V, V_{DS} = 1.0V, f = 1.0MHz$                                                 |
| $C_{rss}$              | Reverse Transfer Capacitance    | —    | 7.0  | —    |       | $V_{GS} = 0V, V_{DS} = 480V, f = 1.0MHz$                                                 |
| $C_{oss}$              | Output Capacitance              | —    | 1487 | —    |       |                                                                                          |
| $C_{oss}$              | Output Capacitance              | —    | 36   | —    |       |                                                                                          |
| $C_{oss \text{ eff.}}$ | Effective Output Capacitance    | —    | 48   | —    |       | $V_{GS} = 0V, V_{DS} = 0V \text{ to } 480V$ ⑤                                            |

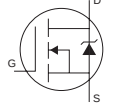
## Avalanche Characteristics

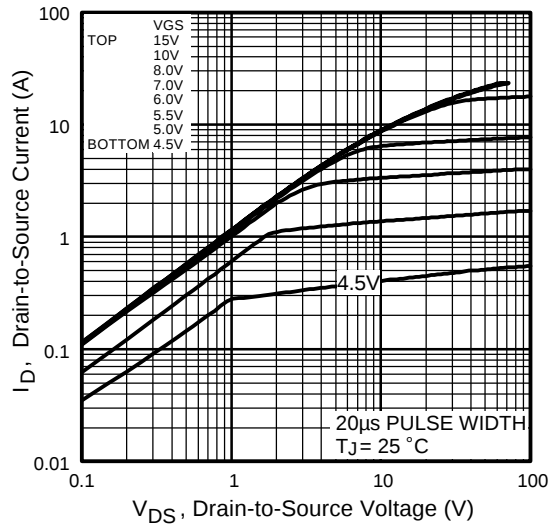
|          | Parameter                      | Typ. | Max. | Units |
|----------|--------------------------------|------|------|-------|
| $E_{AS}$ | Single Pulse Avalanche Energy② | —    | 570  | mJ    |
| $I_{AR}$ | Avalanche Current①             | —    | 6.2  | A     |
| $E_{AR}$ | Repetitive Avalanche Energy①   | —    | 13   | mJ    |

## Thermal Resistance

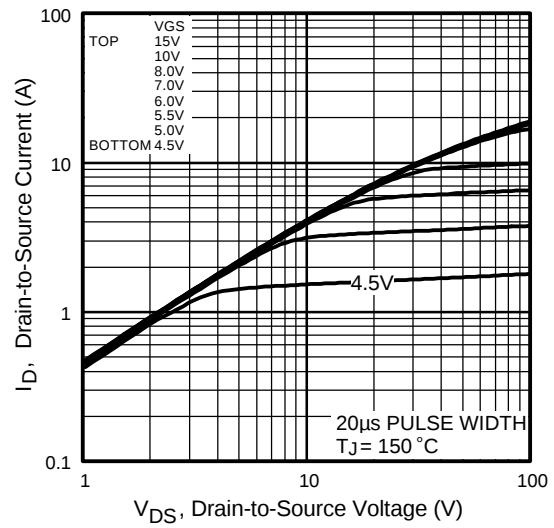
|                 | Parameter                                        | Typ. | Max. | Units              |
|-----------------|--------------------------------------------------|------|------|--------------------|
| $R_{\theta JC}$ | Junction-to-Case                                 | —    | 1.0  | $^\circ\text{C/W}$ |
| $R_{\theta JA}$ | Junction-to-Ambient (PCB Mounted, steady-state)* | —    | 40   |                    |

## Diode Characteristics

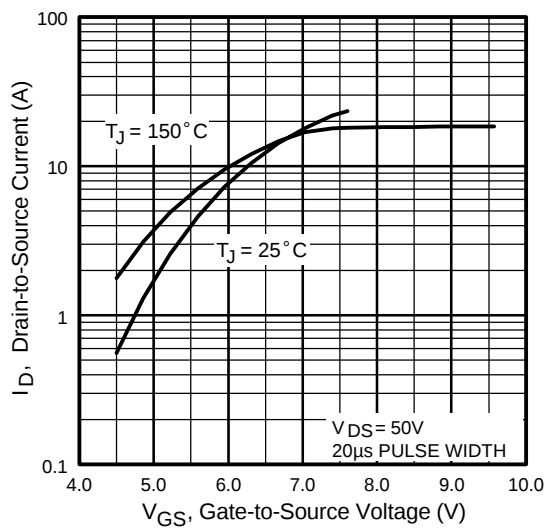
|          | Parameter                              | Min.                                                                        | Typ. | Max. | Units   | Conditions                                                                                                                                           |
|----------|----------------------------------------|-----------------------------------------------------------------------------|------|------|---------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| $I_S$    | Continuous Source Current (Body Diode) | —                                                                           | —    | 6.2  | A       | MOSFET symbol showing the integral reverse p-n junction diode.  |
| $I_{SM}$ | Pulsed Source Current (Body Diode) ①   | —                                                                           | —    | 25   |         |                                                                                                                                                      |
| $V_{SD}$ | Diode Forward Voltage                  | —                                                                           | —    | 1.5  | V       | $T_J = 25^\circ\text{C}, I_S = 6.2A, V_{GS} = 0V$ ④                                                                                                  |
| $t_{rr}$ | Reverse Recovery Time                  | —                                                                           | 431  | 647  | ns      | $T_J = 25^\circ\text{C}, I_F = 6.2A$                                                                                                                 |
| $Q_{rr}$ | Reverse Recovery Charge                | —                                                                           | 1.8  | 2.8  | $\mu C$ | $di/dt = 100A/\mu s$ ④                                                                                                                               |
| $t_{on}$ | Forward Turn-On Time                   | Intrinsic turn-on time is negligible (turn-on is dominated by $L_S + L_D$ ) |      |      |         |                                                                                                                                                      |



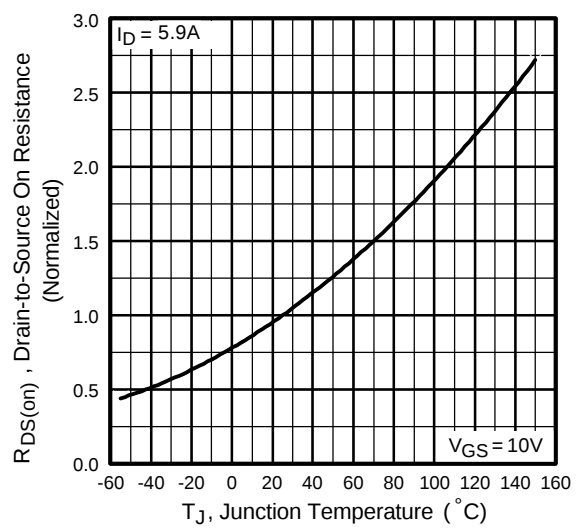
**Fig 1.** Typical Output Characteristics,



**Fig 2.** Typical Output Characteristics,



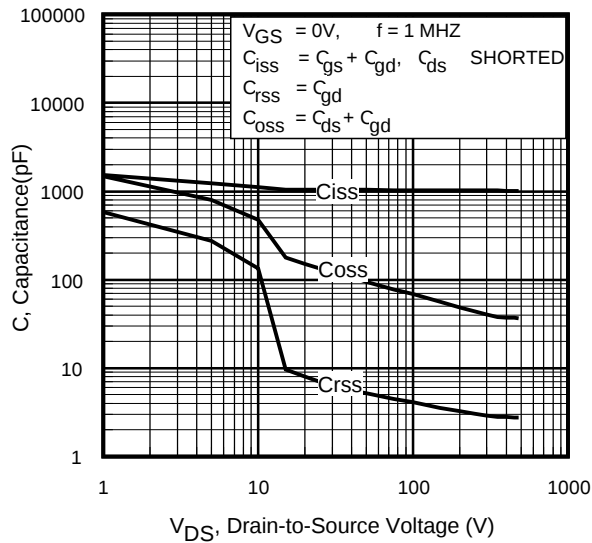
**Fig 3.** Typical Transfer Characteristics



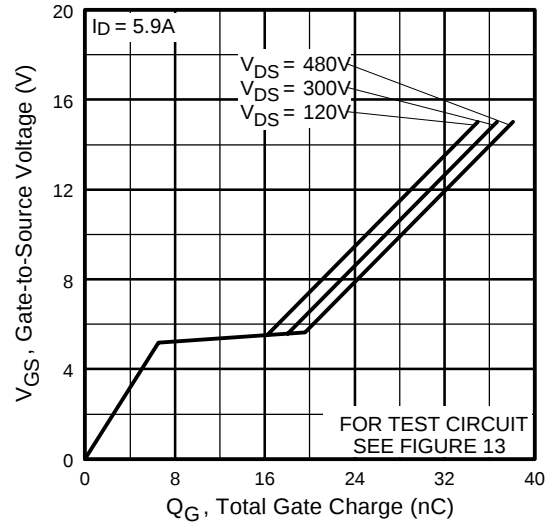
**Fig 4.** Normalized On-Resistance  
Vs. Temperature

# IRFBC40AS

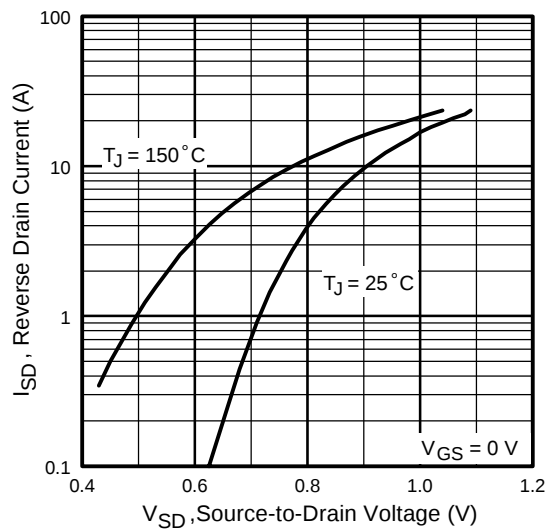
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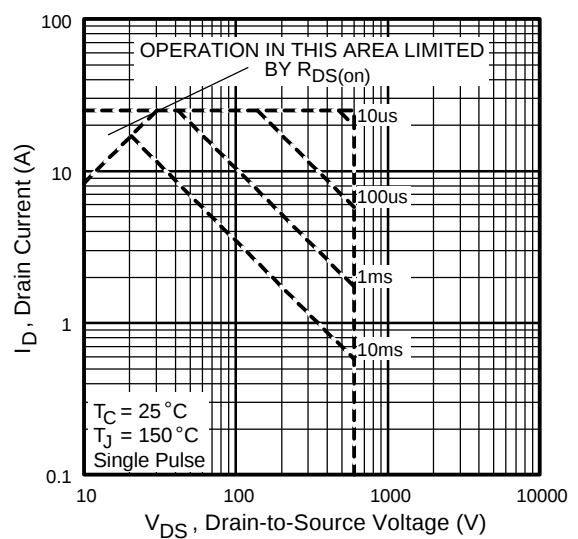
**Fig 5.** Typical Capacitance Vs. Drain-to-Source Voltage



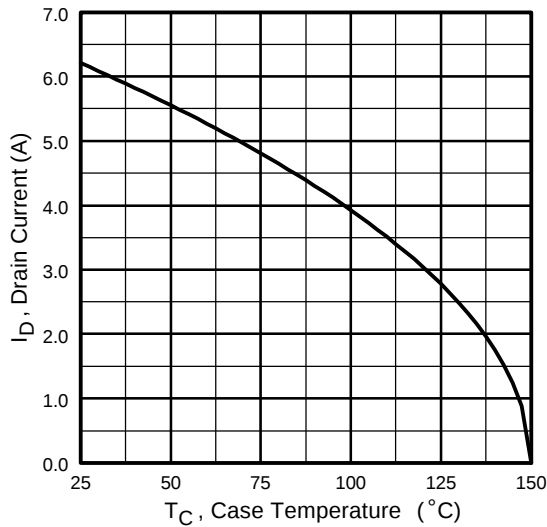
**Fig 6.** Typical Gate Charge Vs. Gate-to-Source Voltage



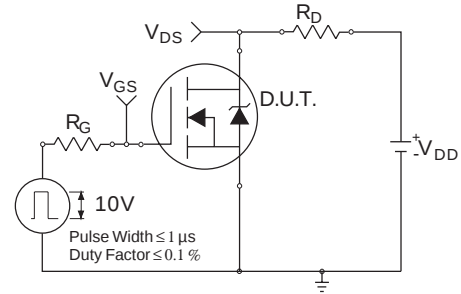
**Fig 7.** Typical Source-Drain Diode Forward Voltage



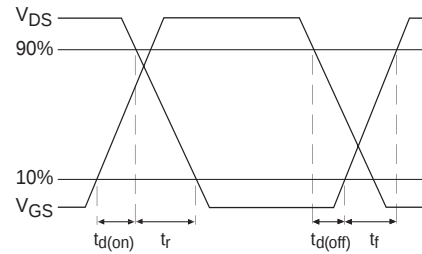
**Fig 8.** Maximum Safe Operating Area



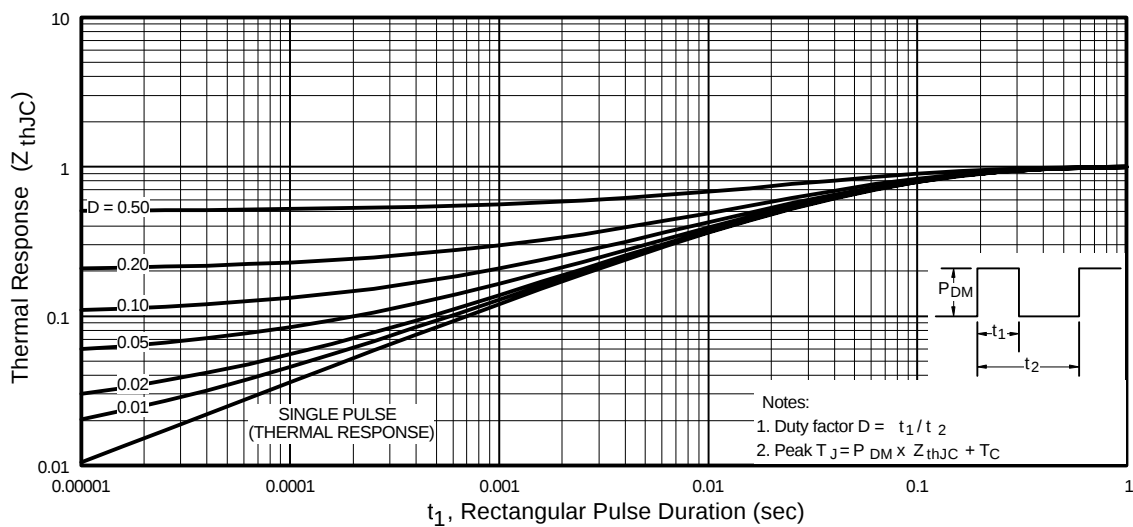
**Fig 9.** Maximum Drain Current Vs. Case Temperature



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



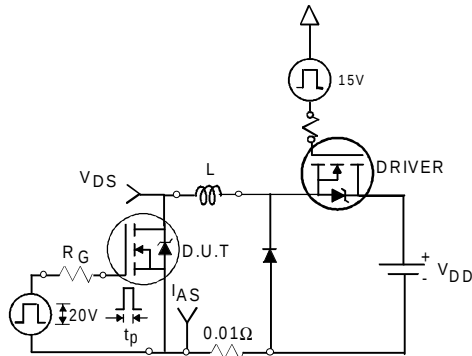
**Fig 10b.** Switching Time Waveforms



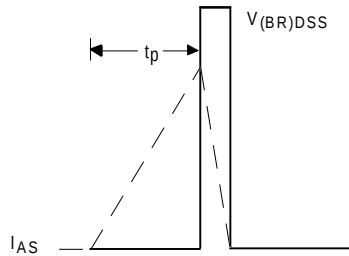
**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Case

# IRFBC40AS

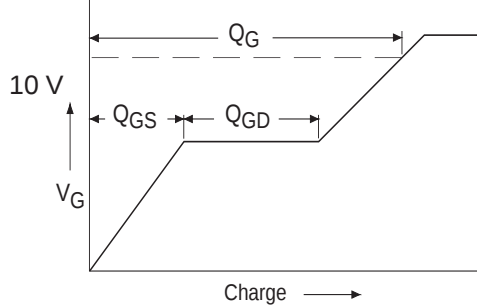
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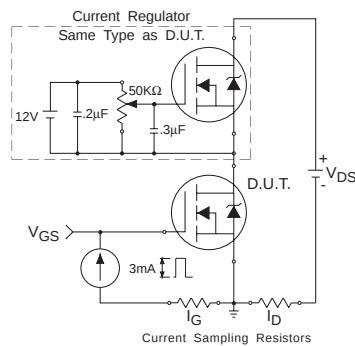
**Fig 12a.** Unclamped Inductive Test Circuit



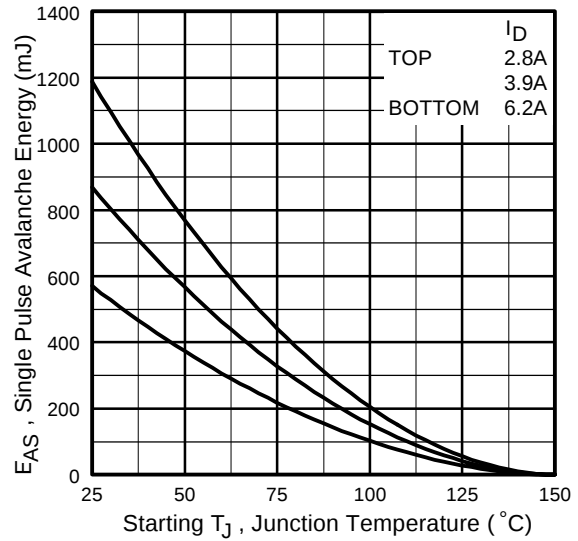
**Fig 12b.** Unclamped Inductive Waveforms



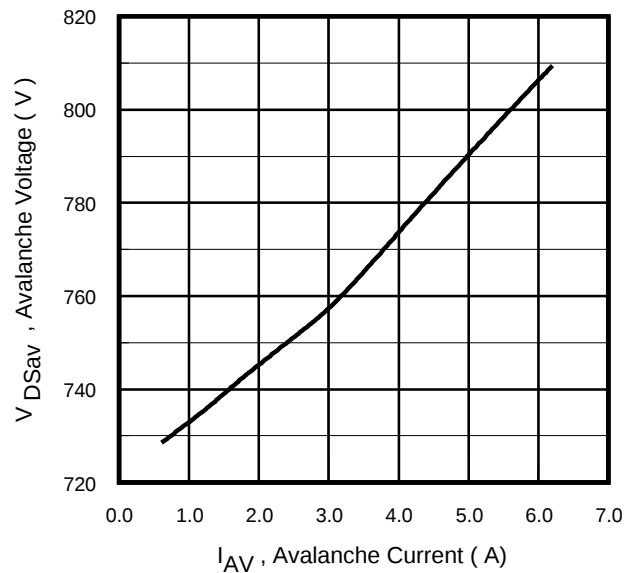
**Fig 13a.** Basic Gate Charge Test Circuit



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



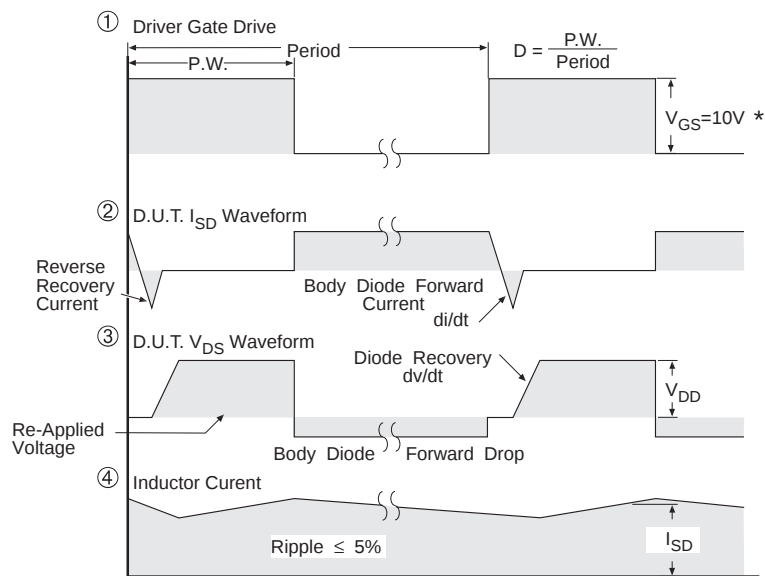
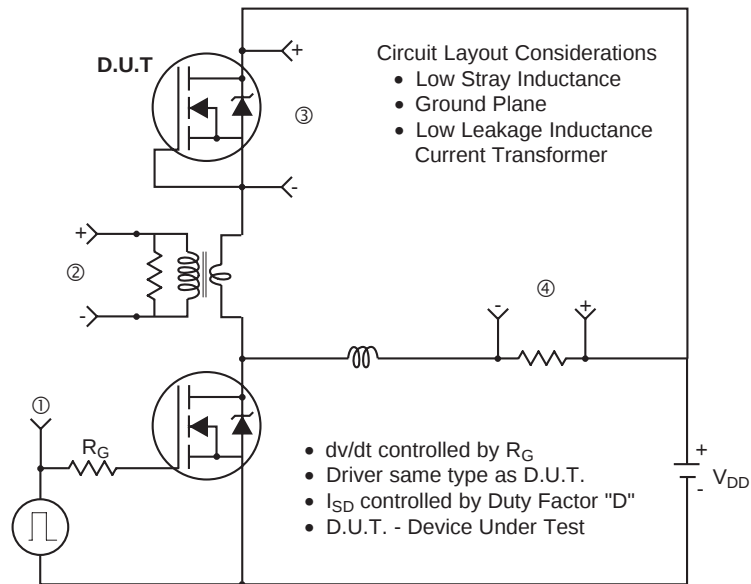
**Fig 12c.** Maximum Avalanche Energy Vs. Drain Current



**Fig 12d.** Typical Drain-to-Source Voltage Vs. Avalanche Current

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## Peak Diode Recovery dv/dt Test Circuit



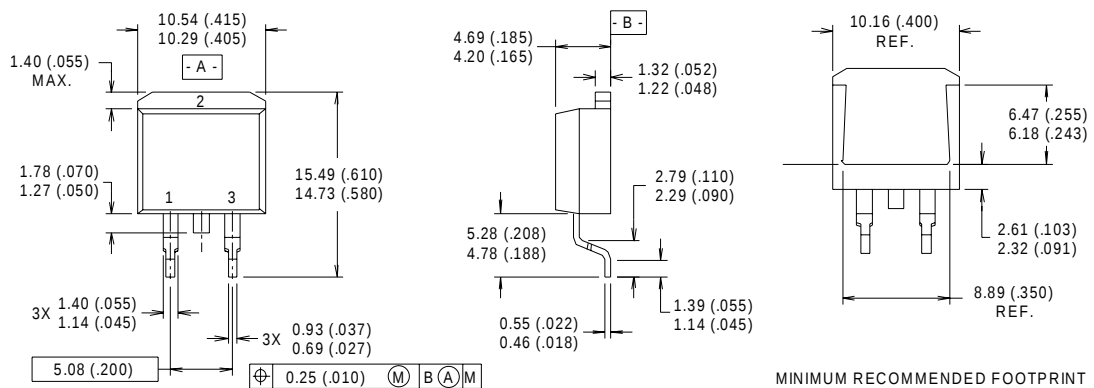
\*  $V_{GS} = 5V$  for Logic Level Devices

**Fig 14.** For N-Channel HEXFETS

# IRFBC40AS

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



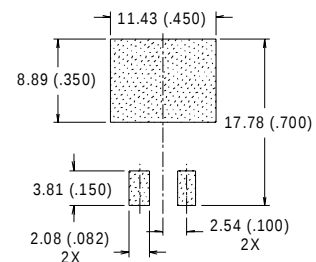
### NOTES:

- 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

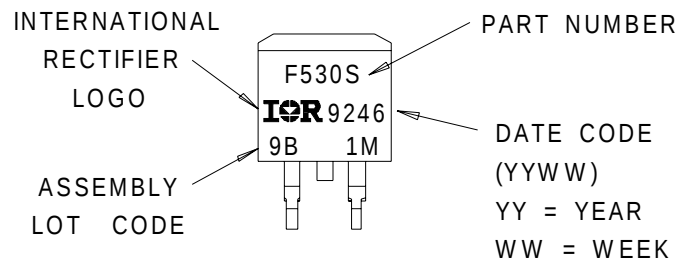
- 1 - GATE
- 2 - DRAIN
- 3 - SOURCE

### MINIMUM RECOMMENDED FOOTPRINT



## Part Marking Information

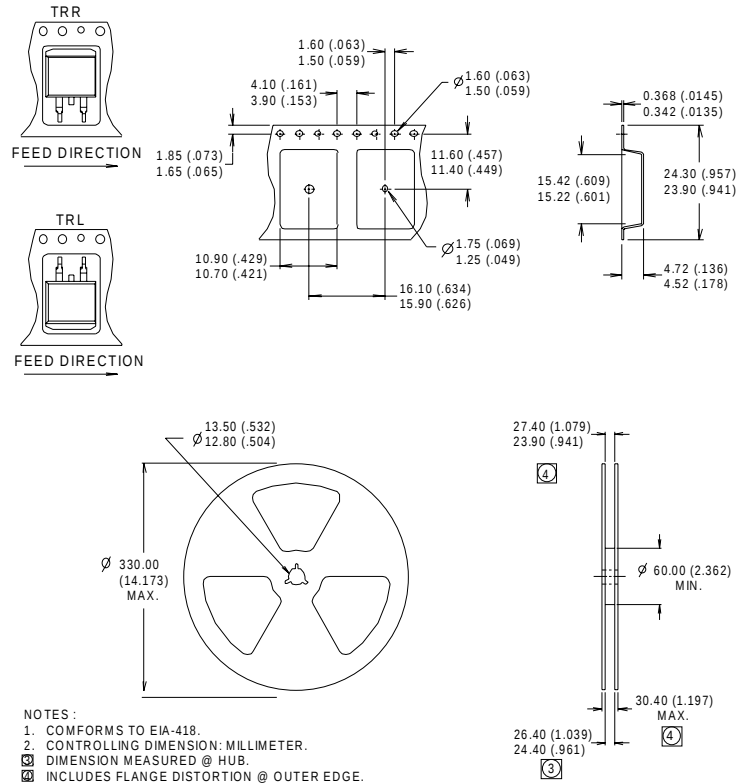
### D<sup>2</sup>Pak



## Tape & Reel Information

**D<sup>2</sup>Pak**

# IRFBC40AS



### Notes:

- ① Repetitive rating; pulse width limited by max. junction temperature. ( See fig. 11 )
- ② Starting  $T_J = 25^\circ\text{C}$ ,  $L = 29.6\text{mH}$ ,  $R_G = 25\Omega$ ,  $I_{AS} = 6.2\text{A}$ . (See Figure 12)
- ③  $I_{SD} \leq 6.2\text{A}$ ,  $di/dt \leq 88\text{A}/\mu\text{s}$ ,  $V_{DD} \leq V_{(BR)DSS}$ ,  $T_J \leq 150^\circ\text{C}$
- 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 Uses IRFBC40A data and test conditions

\* When mounted on FR-4 board using minimum recommended footprint.

For recommended footprint and soldering techniques refer to application note #AN-994.