

## Power MOSFET



N-Channel MOSFET

### FEATURES

- Dynamic dV/dt rating
- Repetitive avalanche rated
- Fast switching
- Ease of paralleling
- Simple drive requirements
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)


**RoHS\***  
Available

### Note

\* This datasheet provides information about parts that are RoHS-compliant and / or parts that are non RoHS-compliant. For example, parts with lead (Pb) terminations are not RoHS-compliant. Please see the information / tables in this datasheet for details

### DESCRIPTION

Third generation power MOSFETs from Vishay provide the designer with the best combination of fast switching, ruggedized device design, low on-resistance and cost-effectiveness.

The TO-220AB package is universally preferred for commercial-industrial applications at power dissipation levels to approximately 50 W. The low thermal resistance and low package cost of the TO-220AB contribute to its wide acceptance throughout the industry.

### PRODUCT SUMMARY

|                           |                 |     |
|---------------------------|-----------------|-----|
| $V_{DS}$ (V)              | 500             |     |
| $R_{DS(on)}$ ( $\Omega$ ) | $V_{GS} = 10$ V | 3.0 |
| $Q_g$ max. (nC)           | 24              |     |
| $Q_{gs}$ (nC)             | 3.3             |     |
| $Q_{gd}$ (nC)             | 13              |     |
| Configuration             | Single          |     |

### ORDERING INFORMATION

|                                 |               |
|---------------------------------|---------------|
| Package                         | TO-220AB      |
| Lead (Pb)-free                  | IRF820PbF     |
| Lead (Pb)-free and halogen-free | IRF820PbF-BE3 |

### ABSOLUTE MAXIMUM RATINGS ( $T_C = 25$ °C, unless otherwise noted)



| PARAMETER   | SYMBOL           | LIMIT          | UNIT     |
|---|------------------|----------------|----------|
| Drain-source voltage                                      | $V_{DS}$         | 500            | V        |
| Gate-source voltage                                       | $V_{GS}$         | $\pm 20$       |          |
| Continuous drain current                                  | $I_D$            | $T_C = 25$ °C  | 2.5      |
|   |                  | $T_C = 100$ °C | 1.6      |
| Pulsed drain current <sup>a</sup>                         | $I_{DM}$         | 8.0            | A        |
| Linear derating factor                                    |                  | 0.40           | W/°C     |
| Single pulse avalanche energy <sup>b</sup>                | $E_{AS}$         | 210            | mJ       |
| Repetitive avalanche current <sup>a</sup>                 | $I_{AR}$         | 2.5            | A        |
| Repetitive avalanche energy <sup>a</sup>                  | $E_{AR}$         | 5.0            | mJ       |
| Maximum power dissipation                                 | $P_D$            | 50             | W        |
| Peak diode recovery dV/dt <sup>c</sup>                    | dV/dt            | 3.5            | V/ns     |
| Operating junction and storage temperature range          | $T_J, T_{stg}$   | -55 to +150    | °C       |
| Soldering recommendations (peak temperature) <sup>d</sup> | For 10 s         | 300            |          |
| Mounting torque   | 6-32 or M3 screw |                | 10       |
|   |                  |                | 1.1      |
|   |                  |                | lbf · in |
|   |                  |                | N · m    |

### Notes

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11)
- $V_{DD} = 50$  V, starting  $T_J = 25$  °C,  $L = 60$  mH,  $R_g = 25$   $\Omega$ ,  $I_{AS} = 2.5$  A (see fig. 12)
- $I_{SD} \leq 2.5$  A,  $dI/dt \leq 50$  A/ $\mu$ s,  $V_{DD} \leq V_{DS}$ ,  $T_J \leq 150$  °C
- 1.6 mm from case



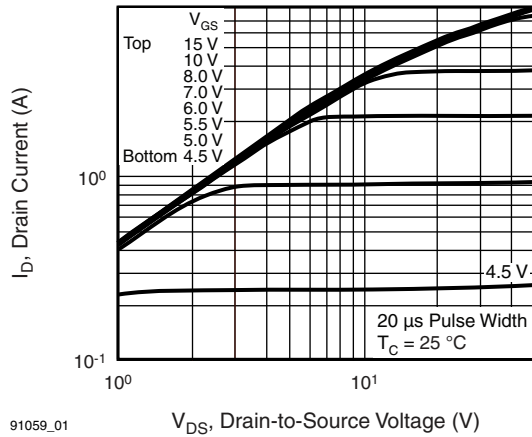
| THERMAL RESISTANCE RATINGS          |            |      |      |      |
|-------------------------------------|------------|------|------|------|
| PARAMETER                           | SYMBOL     | TYP. | MAX. | UNIT |
| Maximum junction-to-ambient         | $R_{thJA}$ | -    | 62   | °C/W |
| Case-to-sink, flat, greased surface | $R_{thCS}$ | 0.50 | -    |      |
| Maximum junction-to-case (drain)    | $R_{thJC}$ | -    | 2.5  |      |

| SPECIFICATIONS ( $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted) |                     |   |  |      |      |           |               |
|---|---------------------|---|--|------|------|-----------|---------------|
| PARAMETER   | SYMBOL              | TEST CONDITIONS   |  | MIN. | TYP. | MAX.      | UNIT          |
| <b>Static</b>   |                     |   |  |      |      |           |               |
| Drain-source breakdown voltage  | $V_{DS}$            | $V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$   |  | 500  | -    | -         | V             |
| $V_{DS}$ temperature coefficient  | $\Delta V_{DS}/T_J$ | Reference to $25\text{ }^\circ\text{C}, I_D = 1\text{ mA}$  |  | -    | 0.59 | -         | V/°C          |
| Gate-source threshold voltage   | $V_{GS(th)}$        | $V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$   |  | 2.0  | -    | 4.0       | V             |
| Gate-source leakage   | $I_{GSS}$           | $V_{GS} = \pm 20\text{ V}$  |  | -    | -    | $\pm 100$ | nA            |
| Zero gate voltage drain current   | $I_{DSS}$           | $V_{DS} = 500\text{ V}, V_{GS} = 0\text{ V}$  |  | -    | -    | 25        | $\mu\text{A}$ |
|   |                     | $V_{DS} = 400\text{ V}, V_{GS} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$   |  | -    | -    | 250       |               |
| Drain-source on-state resistance  | $R_{DS(on)}$        | $V_{GS} = 10\text{ V}$  | $I_D = 1.5\text{ A}^b$   | -    | -    | 3.0       | $\Omega$      |
| Forward transconductance  | $g_{fs}$            | $V_{DS} = 50\text{ V}, I_D = 1.5\text{ A}$  |  | 1.5  | -    | -         | S             |
| <b>Dynamic</b>  |                     |   |  |      |      |           |               |
| Input capacitance   | $C_{iss}$           | $V_{GS} = 0\text{ V}, V_{DS} = 25\text{ V}, f = 1.0\text{ MHz}, \text{ see fig. 5}$   |  | -    | 360  | -         | pF            |
| Output capacitance  | $C_{oss}$           |   |  | -    | 92   | -         |               |
| Reverse transfer capacitance  | $C_{rss}$           |   |  | -    | 37   | -         |               |
| Total gate charge   | $Q_g$               | $V_{GS} = 10\text{ V}$  | $I_D = 2.1\text{ A}, V_{DS} = 400\text{ V}, \text{ see fig. 6 and 13}^b$ | -    | -    | 24        | nC            |
| Gate-source charge  | $Q_{gs}$            |   |  | -    | -    | 3.3       |               |
| Gate-drain charge   | $Q_{gd}$            |   |  | -    | -    | 13        |               |
| Turn-on delay time  | $t_{d(on)}$         | $V_{DD} = 250\text{ V}, I_D = 2.1\text{ A}, R_g = 18\text{ }\Omega, R_D = 100\text{ }\Omega, \text{ see fig. 10}^b$                                     |  | -    | 8.0  | -         | ns            |
| Rise time   | $t_r$               |   |  | -    | 8.6  | -         |               |
| Turn-off delay time   | $t_{d(off)}$        |   |  | -    | 33   | -         |               |
| Fall time   | $t_f$               |   |  | -    | 16   | -         |               |
| Gate input resistance   | $R_g$               | $f = 1\text{ MHz}, \text{ open drain}$  |  | 1.8  | -    | 12.6      | $\Omega$      |
| Internal drain inductance   | $L_D$               | Between lead, 6 mm (0.25") from package and center of die contact  |  | -    | 4.5  | -         | nH            |
| Internal source inductance  | $L_S$               |   |  | -    | 7.5  | -         |               |
| <b>Drain-Source Body Diode Characteristics</b>                              |                     |   |  |      |      |           |               |
| Continuous source-drain diode current                                       | $I_S$               | MOSFET symbol showing the integral reverse p - n junction diode    |  | -    | -    | 2.5       | A             |
| Pulsed diode forward current <sup>a</sup>                                   | $I_{SM}$            |   |  | -    | -    | 8.0       |               |
| Body diode voltage  | $V_{SD}$            | $T_J = 25\text{ }^\circ\text{C}, I_S = 2.5\text{ A}, V_{GS} = 0\text{ V}^b$   |  | -    | -    | 1.6       | V             |
| Body diode reverse recovery time  | $t_{rr}$            | $T_J = 25\text{ }^\circ\text{C}, I_F = 2.1\text{ A}, di/dt = 100\text{ A}/\mu\text{s}$  |  | -    | 260  | 520       | ns            |
| Body diode reverse recovery charge  | $Q_{rr}$            |   |  | -    | 0.7  | 1.4       | nC            |
| Forward turn-on time  | $t_{on}$            | Intrinsic turn-on time is negligible (turn-on is dominated by $L_S$ and $L_D$ )   |  |      |      |           |               |

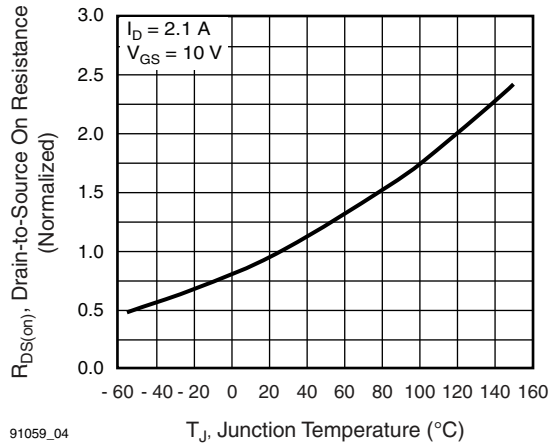
**Notes**

- a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11)
- b. Pulse width  $\leq 300\text{ }\mu\text{s}$ ; duty cycle  $\leq 2\%$

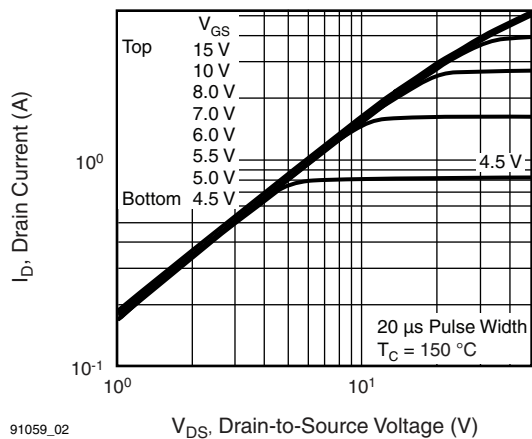
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



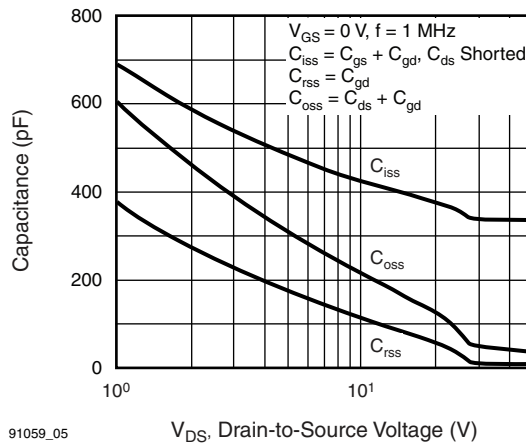
**Fig. 1 - Typical Output Characteristics,  $T_C = 25\text{ }^\circ\text{C}$**



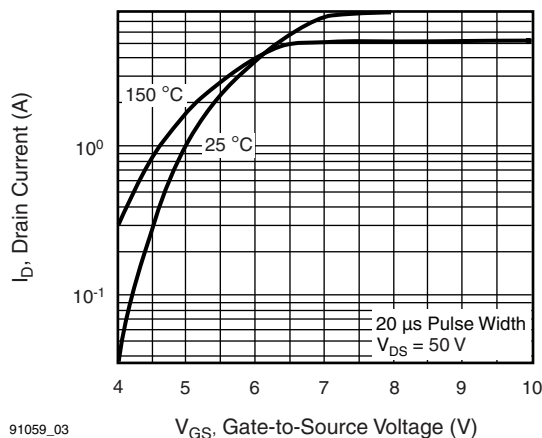
**Fig. 4 - Normalized On-Resistance vs. Temperature**



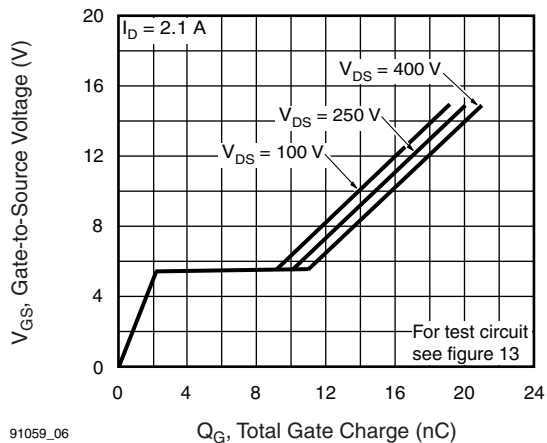
**Fig. 2 - Typical Output Characteristics,  $T_C = 150\text{ }^\circ\text{C}$**



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



**Fig. 3 - Typical Transfer Characteristics**



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

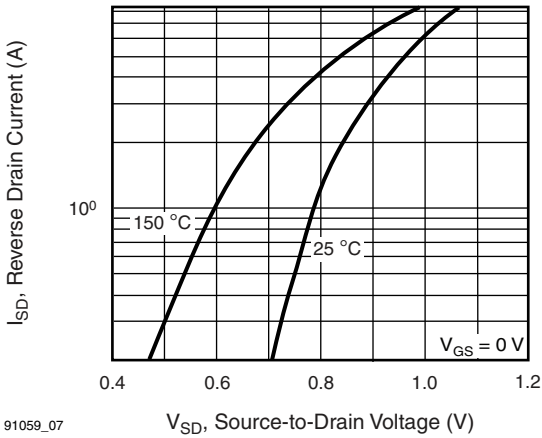


Fig. 7 - Typical Source-Drain Diode Forward Voltage

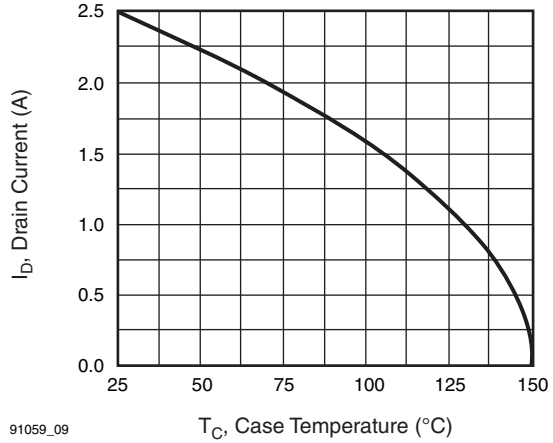


Fig. 9 - Maximum Drain Current vs. Case Temperature

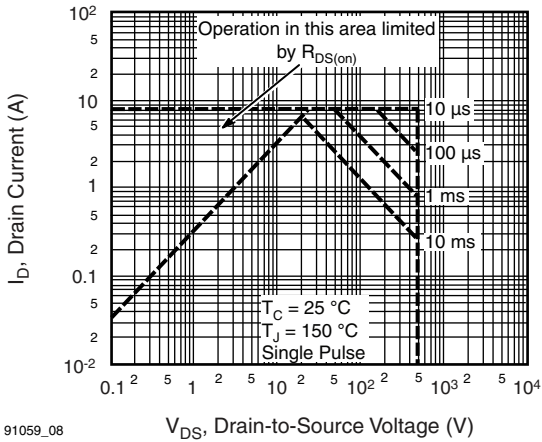


Fig. 8 - Maximum Safe Operating Area

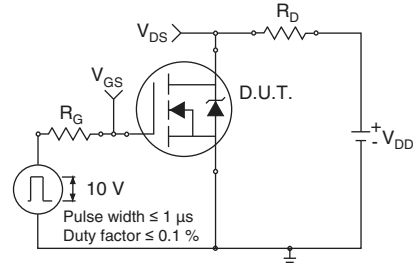


Fig. 10a - Switching Time Test Circuit

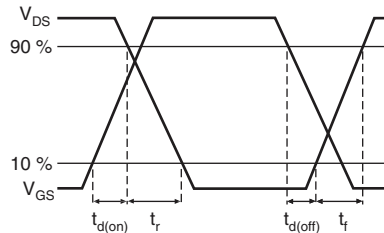


Fig. 10b - Switching Time Waveforms

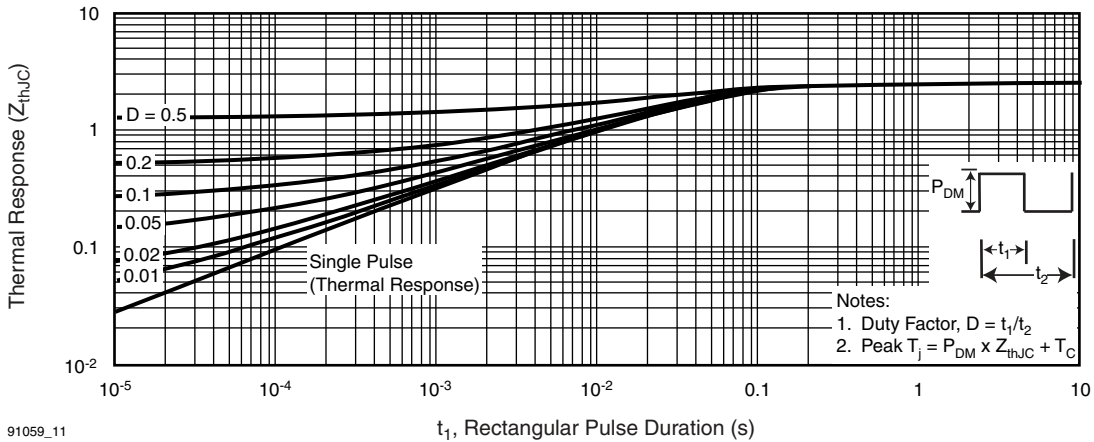


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

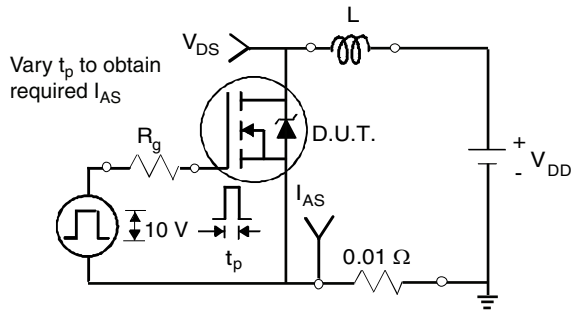


Fig. 12a - Unclamped Inductive Test Circuit

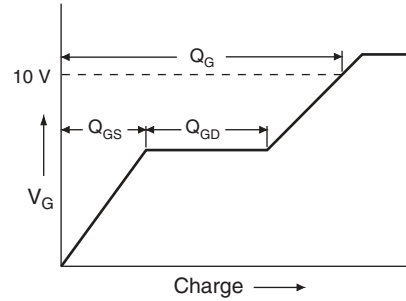


Fig. 13a - Basic Gate Charge Waveform

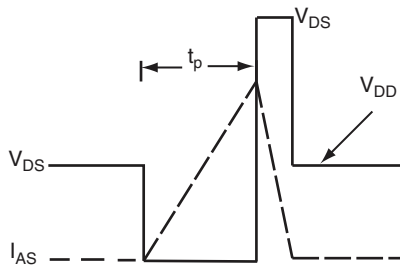


Fig. 12b - Unclamped Inductive Waveforms

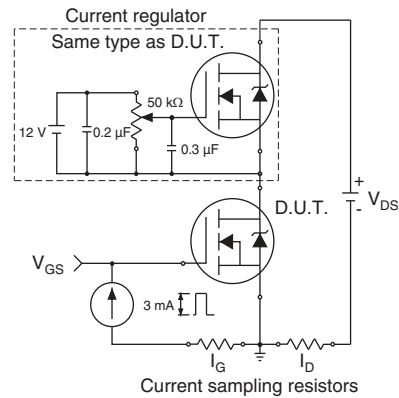
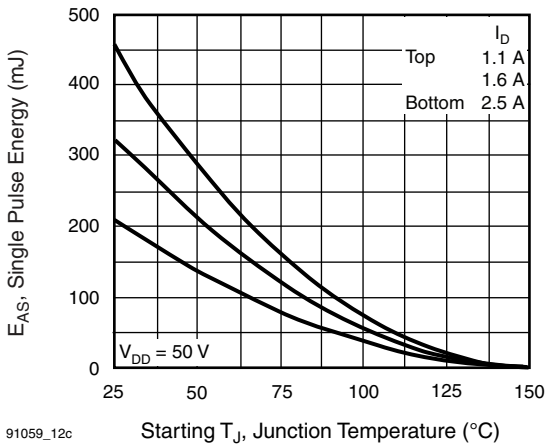
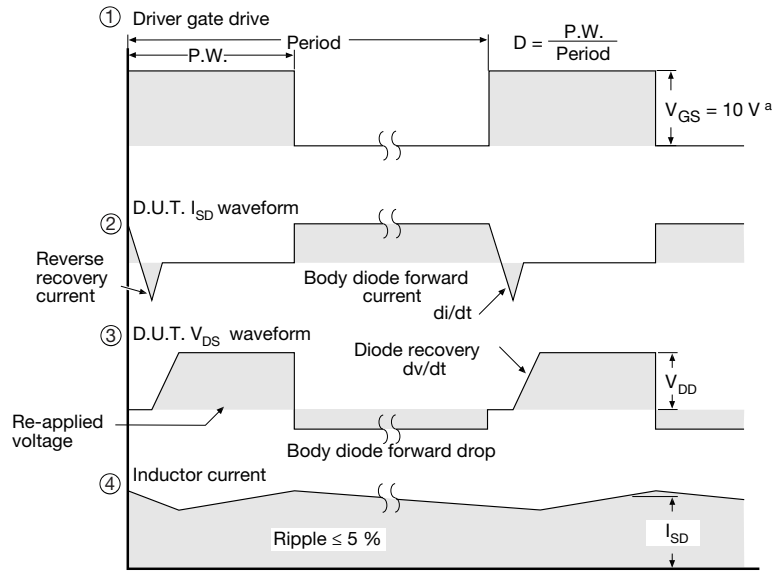
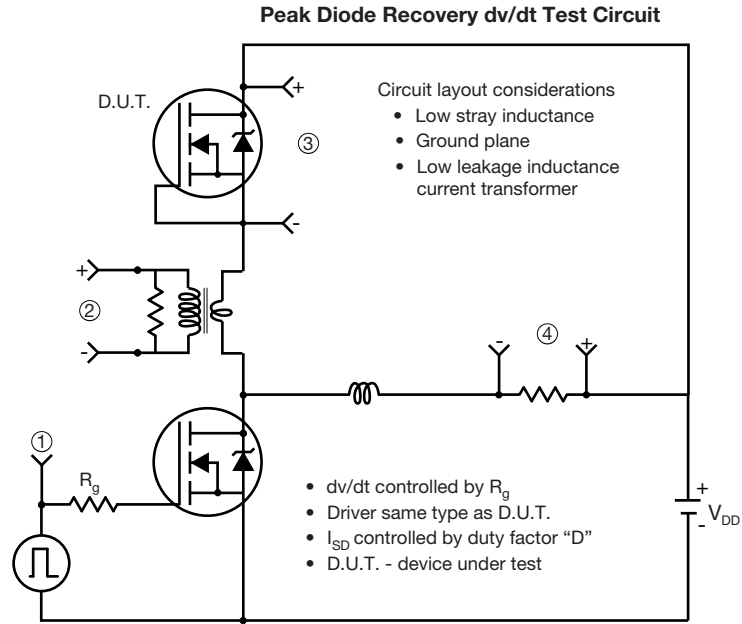


Fig. 13b - Gate Charge Test



91059\_12c

Fig. 12c - Maximum Avalanche Energy vs. Drain Current



**Note**  
a.  $V_{GS} = 5\text{ V}$  for logic level devices

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

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# TO-220-1



| DIM. | MILLIMETERS |       | INCHES |       |
|------|-------------|-------|--------|-------|
|      | MIN.        | MAX.  | MIN.   | MAX.  |
| A    | 4.24        | 4.65  | 0.167  | 0.183 |
| b    | 0.69        | 1.02  | 0.027  | 0.040 |
| b(1) | 1.14        | 1.78  | 0.045  | 0.070 |
| c    | 0.36        | 0.61  | 0.014  | 0.024 |
| D    | 14.33       | 15.85 | 0.564  | 0.624 |
| E    | 9.96        | 10.52 | 0.392  | 0.414 |
| e    | 2.41        | 2.67  | 0.095  | 0.105 |
| e(1) | 4.88        | 5.28  | 0.192  | 0.208 |
| F    | 1.14        | 1.40  | 0.045  | 0.055 |
| H(1) | 6.10        | 6.71  | 0.240  | 0.264 |
| J(1) | 2.41        | 2.92  | 0.095  | 0.115 |
| L    | 13.36       | 14.40 | 0.526  | 0.567 |
| L(1) | 3.33        | 4.04  | 0.131  | 0.159 |
| Ø P  | 3.53        | 3.94  | 0.139  | 0.155 |
| Q    | 2.54        | 3.00  | 0.100  | 0.118 |

ECN: E21-0621-Rev. D, 04-Nov-2021  
 DWG: 6031

**Note**

- M\* = 0.052 inches to 0.064 inches (dimension including protrusion), heatsink hole for HVM



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