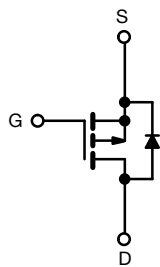
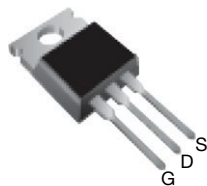


# Power MOSFET

**TO-220AB**


P-Channel MOSFET

## PRODUCT SUMMARY

|                                |                  |      |
|--------------------------------|------------------|------|
| $V_{DS}$ (V)                   | -200             |      |
| $R_{DS(on)}$ max. ( $\Omega$ ) | $V_{GS} = -10$ V | 0.80 |
| $Q_g$ max. (nC)                | 29               |      |
| $Q_{gs}$ (nC)                  | 5.4              |      |
| $Q_{gd}$ (nC)                  | 15               |      |
| Configuration                  | Single           |      |

## FEATURES

- Dynamic dV/dt rating
- Repetitive avalanche rated
- P-channel
- 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 all 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.

## ORDERING INFORMATION

|                                 |                |
|---------------------------------|----------------|
| Package                         | TO-220AB       |
| Lead (Pb)-free                  | IRF9630PbF     |
| Lead (Pb)-free and halogen-free | IRF9630PbF-BE3 |

## ABSOLUTE MAXIMUM RATINGS ( $T_C = 25^\circ\text{C}$ , unless otherwise noted)

| PARAMETER                                                 |                         |                         | SYMBOL                            | LIMIT       | UNIT     |
|-----------------------------------------------------------|-------------------------|-------------------------|-----------------------------------|-------------|----------|
| Drain-source voltage                                      |                         |                         | V <sub>DS</sub>                   | -200        | V        |
| Gate-source voltage                                       |                         |                         | V <sub>GS</sub>                   | ± 20        |          |
| Continuous drain current                                  | V <sub>GS</sub> at 10 V | T <sub>C</sub> = 25 °C  | I <sub>D</sub>                    | -6.5        | A        |
|                                                           |                         | T <sub>C</sub> = 100 °C |                                   | -4.0        |          |
| Pulsed drain current <sup>a</sup>                         |                         |                         | I <sub>DM</sub>                   | -26         |          |
| Linear derating factor                                    |                         |                         |                                   | 0.59        | W/°C     |
| Single pulse avalanche energy <sup>b</sup>                |                         |                         | E <sub>AS</sub>                   | 500         | mJ       |
| Repetitive avalanche current <sup>a</sup>                 |                         |                         | I <sub>AR</sub>                   | -6.4        | A        |
| Repetitive avalanche energy <sup>a</sup>                  |                         |                         | E <sub>AR</sub>                   | 7.4         | mJ       |
| Maximum power dissipation                                 | T <sub>C</sub> = 25 °C  |                         | P <sub>D</sub>                    | 74          | W        |
| Peak diode recovery dV/dt <sup>c</sup>                    |                         |                         | dV/dt                             | -5.0        | V/ns     |
| Operating junction and storage temperature range          |                         |                         | T <sub>J</sub> , T <sub>stg</sub> | -55 to +150 | °C       |
| Soldering recommendations (peak temperature) <sup>d</sup> | For 10 s                |                         |                                   | 300         |          |
| Mounting torque                                           | 6-32 or M3 screw        |                         |                                   | 10          | lbf · in |
|                                                           |                         |                         |                                   | 1.1         | N · m    |

## Notes

a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11)

b.  $V_{DD} = -50$  V, starting  $T_J = 25^\circ\text{C}$ ,  $L = 17$  mH,  $R_g = 25\ \Omega$ ,  $I_{AS} = -6.5$  A (see fig. 12)

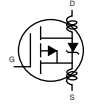
c.  $I_{SD} \leq -6.5$  A,  $dI/dt \leq 120$  A/ $\mu\text{s}$ ,  $V_{DD} \leq V_{DS}$ ,  $T_J \leq 150^\circ\text{C}$

d. 1.6 mm from case

**THERMAL RESISTANCE RATINGS**

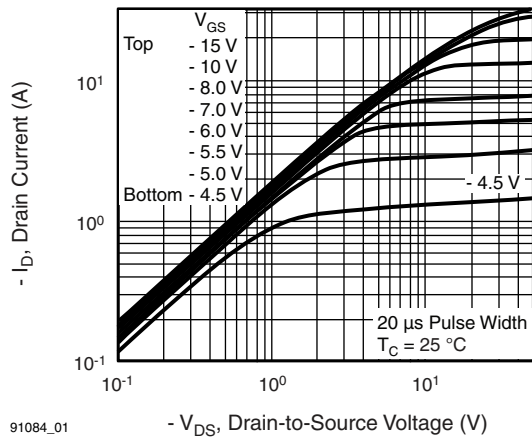
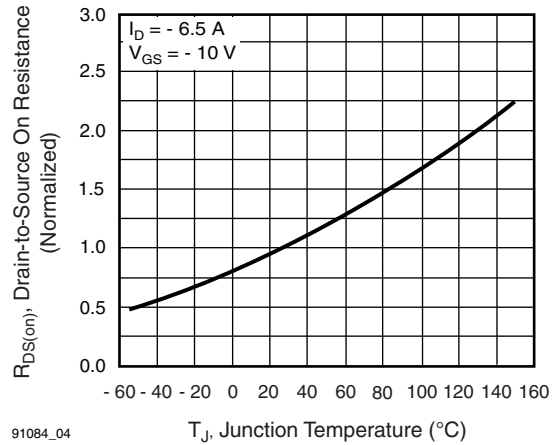
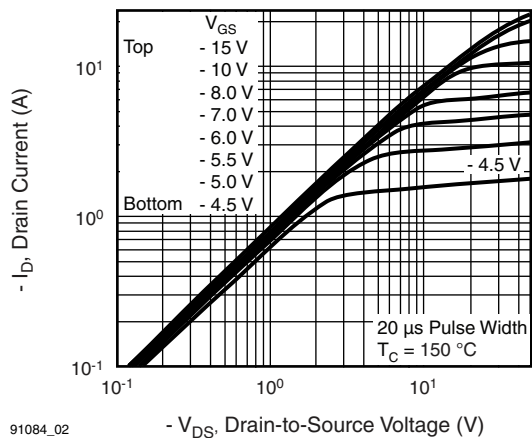
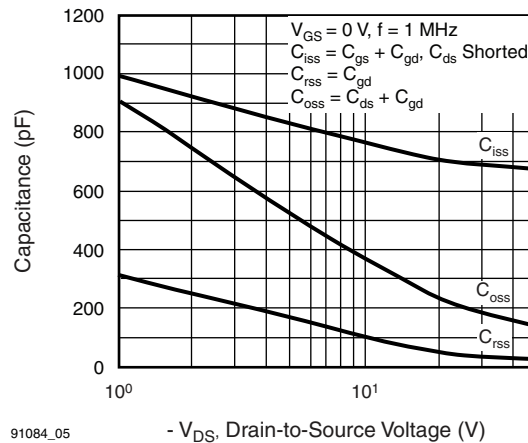
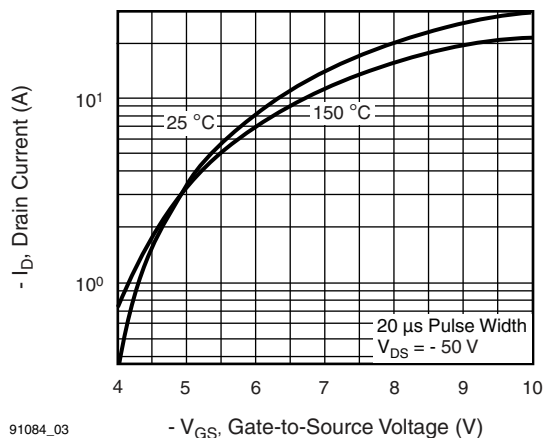
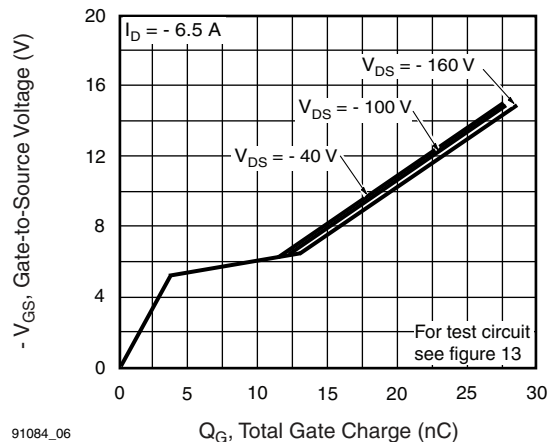
| PARAMETER                           | SYMBOL     | TYP. | MAX. | UNIT |
|-------------------------------------|------------|------|------|------|
| Maximum junction-to-ambient         | $R_{thJA}$ | -    | 62   | °C/W |
| Case-to-sink, flat, greased surface | $R_{thCS}$ | 0.50 | -    |      |
| Maximum junction-to-case (drain)    | $R_{thJC}$ | -    | 1.7  |      |

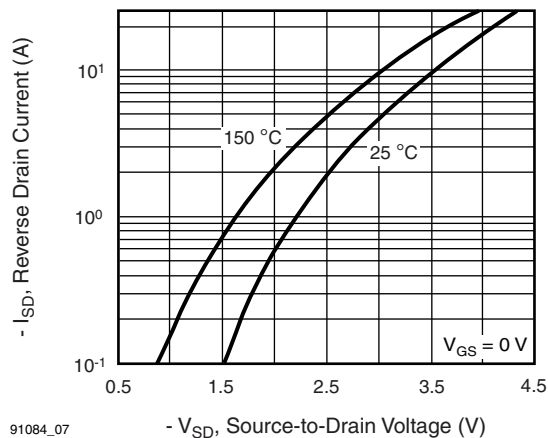
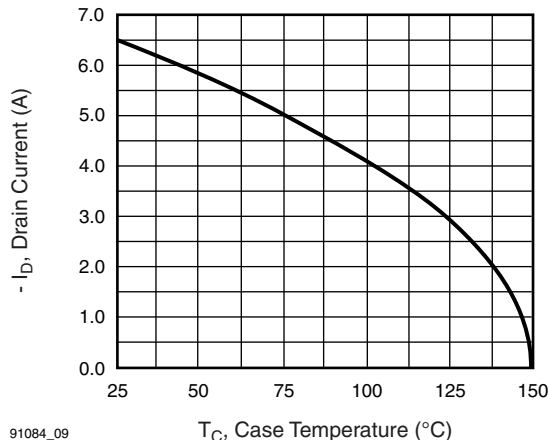
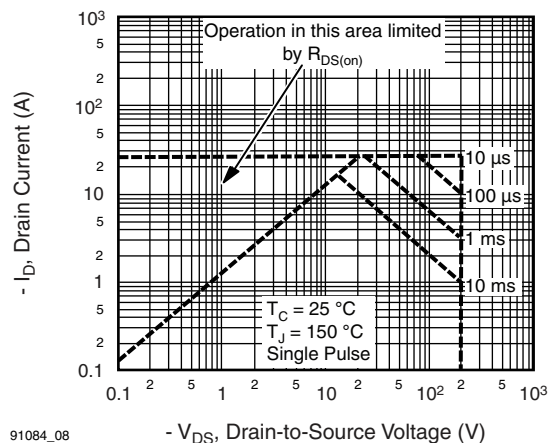
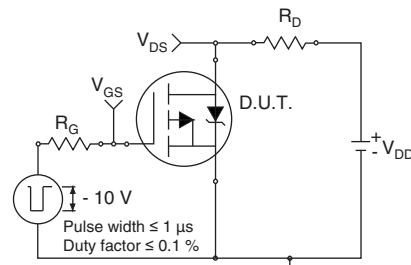
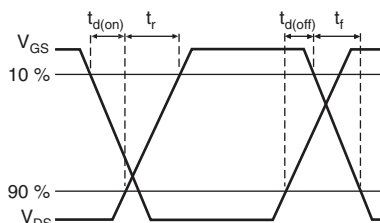
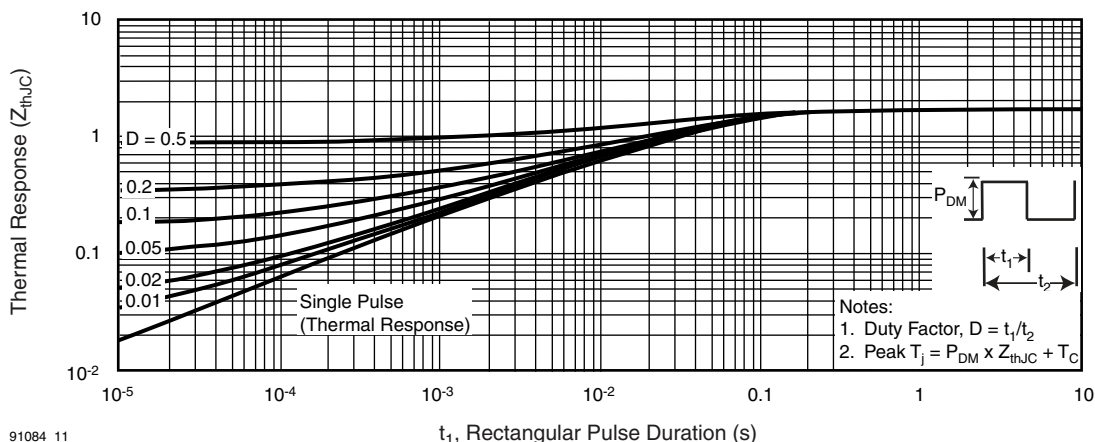
**SPECIFICATIONS** ( $T_J = 25\text{ }^{\circ}\text{C}$ , unless otherwise noted)

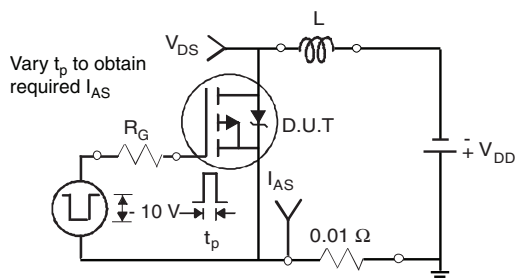
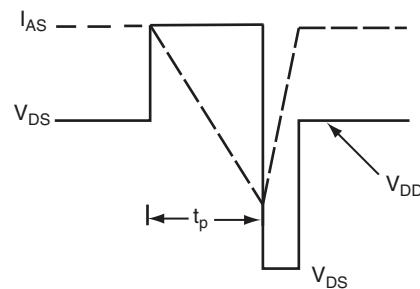
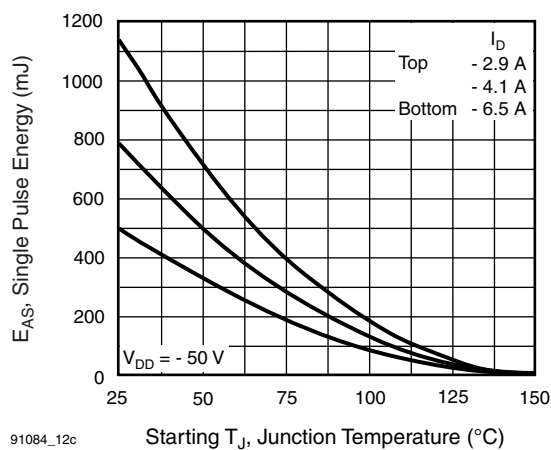
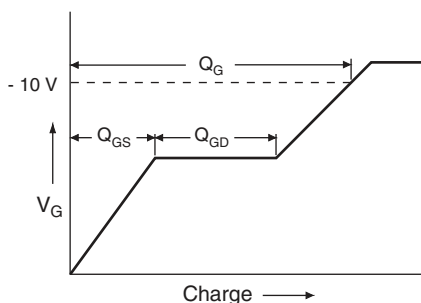
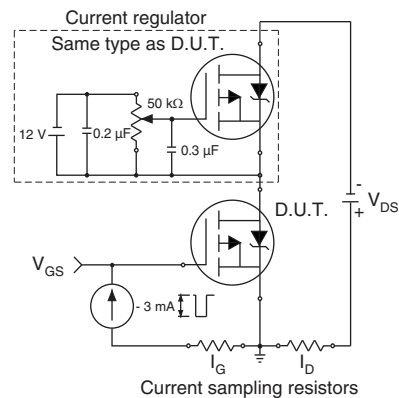
| PARAMETER                                      | SYMBOL              | TEST CONDITIONS                                                                                                                                                     | MIN. | TYP.  | MAX.      | UNIT          |
|------------------------------------------------|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------|-----------|---------------|
| <b>Static</b>                                  |                     |                                                                                                                                                                     |      |       |           |               |
| Drain-source breakdown voltage                 | $V_{DS}$            | $V_{GS} = 0\text{ V}$ , $I_D = -250\text{ }\mu\text{A}$                                                                                                             | -200 | -     | -         | V             |
| $V_{DS}$ temperature coefficient               | $\Delta V_{DS}/T_J$ | Reference to $25\text{ }^{\circ}\text{C}$ , $I_D = -1\text{ mA}$                                                                                                    | -    | -0.24 | -         | 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                | $I_{DSS}$           | $V_{DS} = -200\text{ V}$ , $V_{GS} = 0\text{ V}$                                                                                                                    | -    | -     | -100      | $\mu\text{A}$ |
|                                                |                     | $V_{DS} = -160\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_J = 125\text{ }^{\circ}\text{C}$                                                                              | -    | -     | -500      |               |
| Drain-source on-state resistance               | $R_{DS(on)}$        | $V_{GS} = -10\text{ V}$ , $I_D = -3.9\text{ A}^b$                                                                                                                   | -    | -     | 0.80      | $\Omega$      |
| Forward transconductance                       | $g_{fs}$            | $V_{DS} = -50\text{ V}$ , $I_D = -3.9\text{ A}^b$                                                                                                                   | 2.8  | -     | -         | S             |
| <b>Dynamic</b>                                 |                     |                                                                                                                                                                     |      |       |           |               |
| Input capacitance                              | $C_{iss}$           | $V_{GS} = 0\text{ V}$ ,<br>$V_{DS} = -25\text{ V}$ ,<br>$f = 1.0\text{ MHz}$ , see fig. 5                                                                           | -    | 700   | -         | pF            |
| Output capacitance                             | $C_{oss}$           |                                                                                                                                                                     | -    | 200   | -         |               |
| Reverse transfer capacitance                   | $C_{rss}$           |                                                                                                                                                                     | -    | 40    | -         |               |
| Total gate charge                              | $Q_g$               | $V_{GS} = -10\text{ V}$ ,<br>$I_D = -6.5\text{ A}$ ,<br>$V_{DS} = -160\text{ V}$ ,<br>see fig. 6 and 13 <sup>b</sup>                                                | -    | -     | 29        | nC            |
| Gate-source charge                             | $Q_{gs}$            |                                                                                                                                                                     | -    | -     | 5.4       |               |
| Gate-drain charge                              | $Q_{gd}$            |                                                                                                                                                                     | -    | -     | 15        |               |
| Turn-on delay time                             | $t_{d(on)}$         | $V_{DD} = -100\text{ V}$ , $I_D = -6.5\text{ A}$ ,<br>$R_g = 12\text{ }\Omega$ , $R_D = 15\text{ }\Omega$ , see fig. 10 <sup>b</sup>                                | -    | 12    | -         | ns            |
| Rise time                                      | $t_r$               |                                                                                                                                                                     | -    | 27    | -         |               |
| Turn-off delay time                            | $t_{d(off)}$        |                                                                                                                                                                     | -    | 28    | -         |               |
| Fall time                                      | $t_f$               |                                                                                                                                                                     | -    | 24    | -         |               |
| Gate input resistance                          | $L_D$               | Between lead,<br>6 mm (0.25") from<br>package and center of<br>die contact<br> | -    | 4.5   | -         | nH            |
| Internal drain inductance                      | $L_S$               |                                                                                                                                                                     | -    | 7.5   | -         |               |
| Internal source inductance                     | $R_g$               | $f = 1\text{ MHz}$ , open drain                                                                                                                                     | 0.6  | -     | 3.7       | $\Omega$      |
| <b>Drain-Source Body Diode Characteristics</b> |                     |                                                                                                                                                                     |      |       |           |               |
| Continuous source-drain diode current          | $I_S$               | MOSFET symbol<br>showing the<br>integral reverse<br>p-n junction diode<br>     | -    | -     | -6.5      | A             |
| Pulsed diode forward current <sup>a</sup>      | $I_{SM}$            |                                                                                                                                                                     | -    | -     | -26       |               |
| Body diode voltage                             | $V_{SD}$            | $T_J = 25\text{ }^{\circ}\text{C}$ , $I_S = -6.5\text{ A}$ , $V_{GS} = 0\text{ V}^b$                                                                                | -    | -     | -6.5      | V             |
| Body diode reverse recovery time               | $t_{rr}$            | $T_J = 25\text{ }^{\circ}\text{C}$ , $I_F = -6.5\text{ A}$ , $dI/dt = 100\text{ A}/\mu\text{s}^b$                                                                   | -    | 200   | 300       | ns            |
| Body diode reverse recovery charge             | $Q_{rr}$            |                                                                                                                                                                     | -    | 1.9   | 2.9       | $\mu\text{C}$ |
| Forward turn-on time                           | $t_{on}$            | Intrinsic turn-on time is negligible (turn-on is dominated by $L_S$ and $L_D$ )                                                                                     |      |       |           |               |

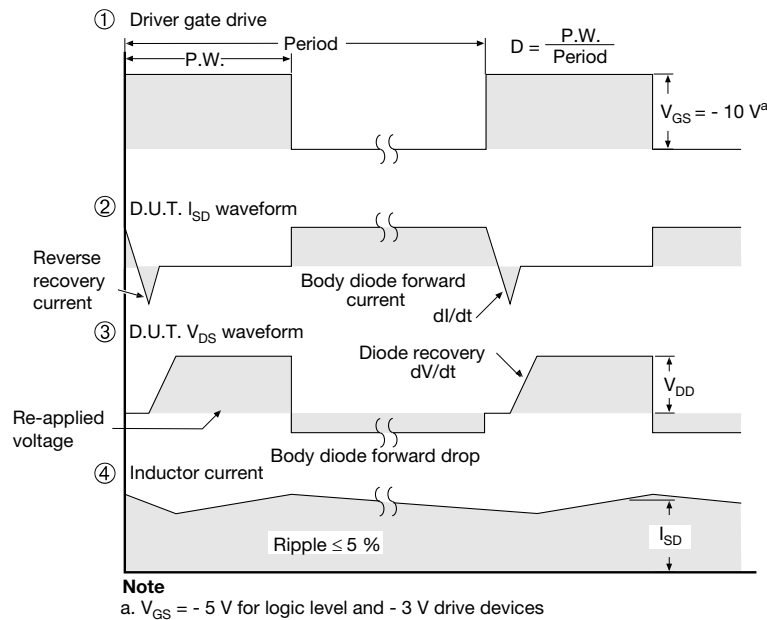
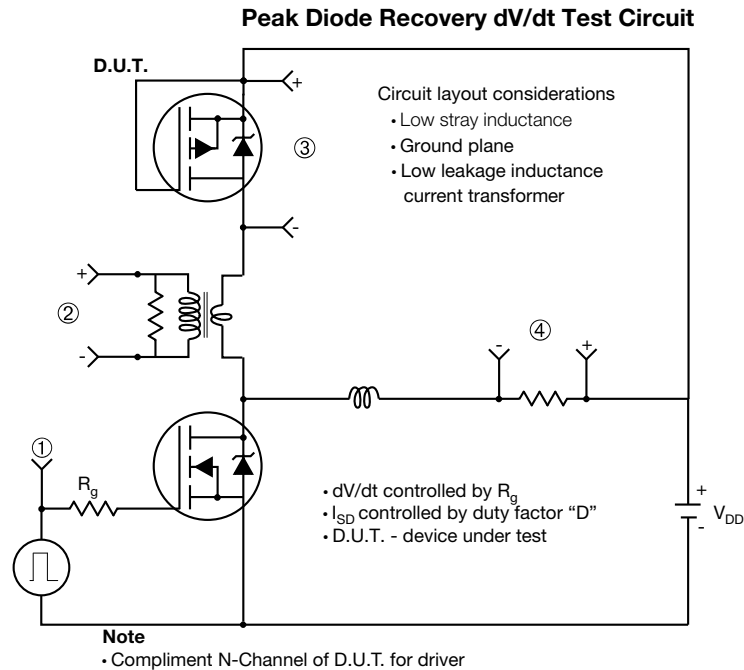
**Notes**

- 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. 12b - Unclamped Inductive Waveforms**

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

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

**Fig. 13c - Gate Charge Test Circuit**



**Fig. 14 - For P-Channel**

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