

## FD9220-VB Datasheet

### Power MOSFET

#### PRODUCT SUMMARY

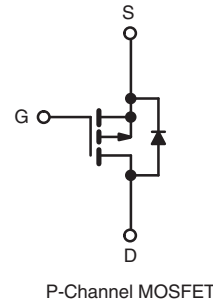
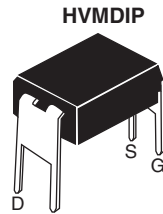
|                           |                         |      |
|---------------------------|-------------------------|------|
| $V_{DS}$ (V)              | - 200                   |      |
| $R_{DS(on)}$ ( $\Omega$ ) | $V_{GS} = -10\text{ V}$ | 0.50 |
| $Q_g$ (Max.) (nC)         | 18                      |      |
| $Q_{gs}$ (nC)             | 3.0                     |      |
| $Q_{gd}$ (nC)             | 9.0                     |      |
| Configuration             | Single                  |      |

#### FEATURES

- Dynamic dV/dt Rating
- Repetitive Avalanche Rated
- For Automatic Insertion
- End Stackable
- P-Channel
- 175 °C Operating Temperature
- Fast Switching
- Compliant to RoHS Directive 2002/95/EC



Available  
**RoHS\***  
 COMPLIANT



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

| PARAMETER                                        |                                    |                                     | SYMBOL         | LIMIT            | UNIT                  |
|--------------------------------------------------|------------------------------------|-------------------------------------|----------------|------------------|-----------------------|
| Drain-Source Voltage                             |                                    |                                     | $V_{DS}$       | - 200            | V                     |
| Gate-Source Voltage                              |                                    |                                     | $V_{GS}$       | $\pm 20$         |                       |
| Continuous Drain Current                         | $V_{GS}$ at - 10 V                 | $T_A = 25\text{ }^{\circ}\text{C}$  | $I_D$          | - 1.5            | A                     |
|                                                  |                                    | $T_A = 100\text{ }^{\circ}\text{C}$ |                | - 1.05           |                       |
| Pulsed Drain Current <sup>a</sup>                |                                    |                                     | $I_{DM}$       | - 8.0            |                       |
| Linear Derating Factor                           |                                    |                                     |                | 0.0083           | W/ $^{\circ}\text{C}$ |
| Single Pulse Avalanche Energy <sup>b</sup>       |                                    |                                     | $E_{AS}$       | 140              | mJ                    |
| Repetitive Avalanche Current <sup>a</sup>        |                                    |                                     | $I_{AR}$       | - 1.0            | A                     |
| Repetitive Avalanche Energy <sup>a</sup>         |                                    |                                     | $E_{AR}$       | 0.13             | mJ                    |
| Maximum Power Dissipation                        | $T_A = 25\text{ }^{\circ}\text{C}$ |                                     | $P_D$          | 1.3              | W                     |
| Peak Diode Recovery $dV/dt^c$                    |                                    |                                     | $dV/dt$        | - 5.5            | V/ns                  |
| Operating Junction and Storage Temperature Range |                                    |                                     | $T_J, T_{stg}$ | - 55 to + 175    | $^{\circ}\text{C}$    |
| Soldering Recommendations (Peak Temperature)     | for 10 s                           |                                     |                | 300 <sup>d</sup> |                       |

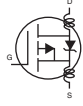
#### Notes

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- $V_{DD} = -25\text{ V}$ , starting  $T_J = 25\text{ }^\circ\text{C}$ ,  $L = 52\text{ mH}$ ,  $R_g = 25\text{ }\Omega$ ,  $I_{AS} = -2.0\text{ A}$  (see fig. 12).
- $I_{SD} \leq -6.8\text{ A}$ ,  $dI/dt \leq 110\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq V_{DS}$ ,  $T_J \leq 175\text{ }^\circ\text{C}$ .
- 1.6 mm from case.

**THERMAL RESISTANCE RATINGS**

| PARAMETER                   | SYMBOL     | TYP. | MAX. | UNIT |
|-----------------------------|------------|------|------|------|
| Maximum Junction-to-Ambient | $R_{thJA}$ | -    | 120  | °C/W |

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

| PARAMETER                                 | SYMBOL                           | TEST CONDITIONS                                                                                                                                                    |                                                                                       | MIN.  | TYP.   | MAX.  | UNIT |
|-------------------------------------------|----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|-------|--------|-------|------|
| Static                                    |                                  |                                                                                                                                                                    |                                                                                       |       |        |       |      |
| Drain-Source Breakdown Voltage            | V <sub>DS</sub>                  | V <sub>GS</sub> = 0 V, I <sub>D</sub> = - 250 μA                                                                                                                   |                                                                                       | - 200 | -      | -     | V    |
| V <sub>DS</sub> Temperature Coefficient   | ΔV <sub>DS</sub> /T <sub>J</sub> | Reference to 25 °C, I <sub>D</sub> = - 1 mA                                                                                                                        |                                                                                       | -     | - 0.10 | -     | V/°C |
| Gate-Source Threshold Voltage             | V <sub>GS(th)</sub>              | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = - 250 μA                                                                                                      |                                                                                       | - 2.0 | -      | - 4.0 | V    |
| Gate-Source Leakage                       | I <sub>GSS</sub>                 | V <sub>GS</sub> = ± 20 V                                                                                                                                           |                                                                                       | -     | -      | ± 100 | nA   |
| Zero Gate Voltage Drain Current           | I <sub>DSS</sub>                 | V <sub>DS</sub> = - 200 V, V <sub>GS</sub> = 0 V                                                                                                                   |                                                                                       | -     | -      | - 100 | μA   |
|                                           |                                  | V <sub>DS</sub> = - 160 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 150 °C                                                                                          |                                                                                       | -     | -      | - 500 |      |
| Drain-Source On-State Resistance          | R <sub>DS(on)</sub>              | V <sub>GS</sub> = - 10 V                                                                                                                                           | I <sub>D</sub> = - 0.6 A <sup>b</sup>                                                 | -     | 0.50   | -     | Ω    |
| Forward Transconductance                  | g <sub>fs</sub>                  | V <sub>DS</sub> = - 50 V, I <sub>D</sub> = - 0.60 A <sup>b</sup>                                                                                                   |                                                                                       | 0.71  | -      | -     | S    |
| Dynamic                                   |                                  |                                                                                                                                                                    |                                                                                       |       |        |       |      |
| Input Capacitance                         | C <sub>iss</sub>                 | V <sub>GS</sub> = 0 V<br>V <sub>DS</sub> = - 25 V<br>f = 1.0 MHz, see fig. 5                                                                                       |                                                                                       | -     | 390    | -     | pF   |
| Output Capacitance                        | C <sub>oss</sub>                 |                                                                                                                                                                    |                                                                                       | -     | 170    | -     |      |
| Reverse Transfer Capacitance              | C <sub>rss</sub>                 |                                                                                                                                                                    |                                                                                       | -     | 45     | -     |      |
| Total Gate Charge                         | Q <sub>g</sub>                   | V <sub>GS</sub> = - 10 V                                                                                                                                           | I <sub>D</sub> = - 6.8 A, V <sub>DS</sub> = - 160 V<br>see fig. 6 and 13 <sup>b</sup> | -     | -      | 18    | nC   |
| Gate-Source Charge                        | Q <sub>gs</sub>                  |                                                                                                                                                                    |                                                                                       | -     | -      | 3.0   |      |
| Gate-Drain Charge                         | Q <sub>gd</sub>                  |                                                                                                                                                                    |                                                                                       | -     | -      | 9.0   |      |
| Turn-On Delay Time                        | t <sub>d(on)</sub>               | V <sub>DD</sub> = -100 V, I <sub>D</sub> = - 6.8 A<br>R <sub>g</sub> = 18 Ω, R <sub>D</sub> = 7.1 Ω, see fig. 10 <sup>b</sup>                                      |                                                                                       | -     | 9.6    | -     | ns   |
| Rise Time                                 | t <sub>r</sub>                   |                                                                                                                                                                    |                                                                                       | -     | 29     | -     |      |
| Turn-Off Delay Time                       | t <sub>d(off)</sub>              |                                                                                                                                                                    |                                                                                       | -     | 21     | -     |      |
| Fall Time                                 | t <sub>f</sub>                   |                                                                                                                                                                    |                                                                                       | -     | 25     | -     |      |
| Internal Drain Inductance                 | L <sub>D</sub>                   | Between lead,<br>6 mm (0.25") from<br>package and center of<br>die contact<br> |                                                                                       | -     | 4.0    | -     | nH   |
| Internal Source Inductance                | L <sub>S</sub>                   |                                                                                                                                                                    |                                                                                       | -     | 6.0    | -     |      |
| Drain-Source Body Diode Characteristics   |                                  |                                                                                                                                                                    |                                                                                       |       |        |       |      |
| Continuous Source-Drain Diode Current     | I <sub>S</sub>                   | MOSFET symbol<br>showing the<br>integral reverse<br>p - n junction diode<br>   |                                                                                       | -     | -      | - 1.0 | A    |
| Pulsed Diode Forward Current <sup>a</sup> | I <sub>SM</sub>                  |                                                                                                                                                                    |                                                                                       | -     | -      | - 8.0 |      |
| Body Diode Voltage                        | V <sub>SD</sub>                  | T <sub>J</sub> = 25 °C, I <sub>S</sub> = - 1.0 A, V <sub>GS</sub> = 0 V <sup>b</sup>                                                                               |                                                                                       | -     | -      | - 6.3 | V    |
| Body Diode Reverse Recovery Time          | t <sub>rr</sub>                  | T <sub>J</sub> = 25 °C, I <sub>F</sub> = - 6.8 A, dI/dt = 100 A/μs <sup>b</sup>                                                                                    |                                                                                       | -     | 98     | 200   | ns   |
| Body Diode Reverse Recovery Charge        | Q <sub>rr</sub>                  |                                                                                                                                                                    |                                                                                       | -     | 0.33   | 0.66  | μC   |
| Forward Turn-On Time                      | t <sub>on</sub>                  | Intrinsic turn-on time is negligible (turn-on is dominated by L <sub>S</sub> and L <sub>D</sub> )                                                                  |                                                                                       |       |        |       |      |

**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)

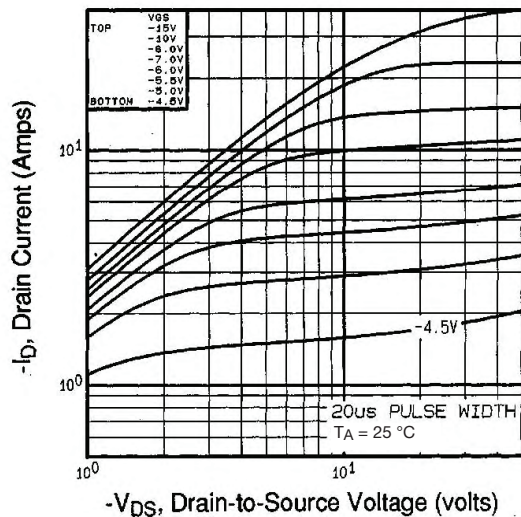


Fig. 1 - Typical Output Characteristics,  $T_A = 25\text{ }^{\circ}\text{C}$

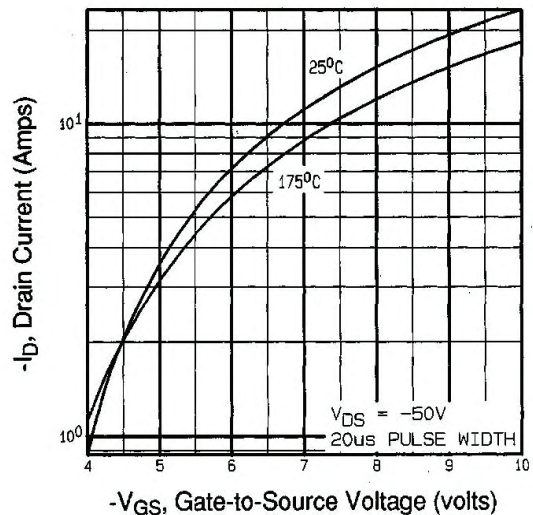


Fig. 3 - Typical Transfer Characteristics

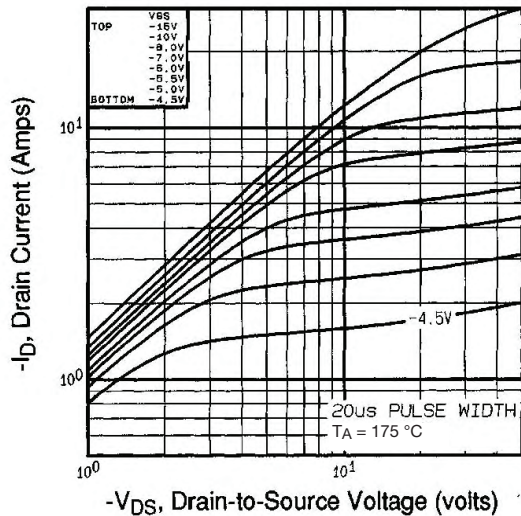


Fig. 2 - Typical Output Characteristics,  $T_A = 175\text{ }^{\circ}\text{C}$

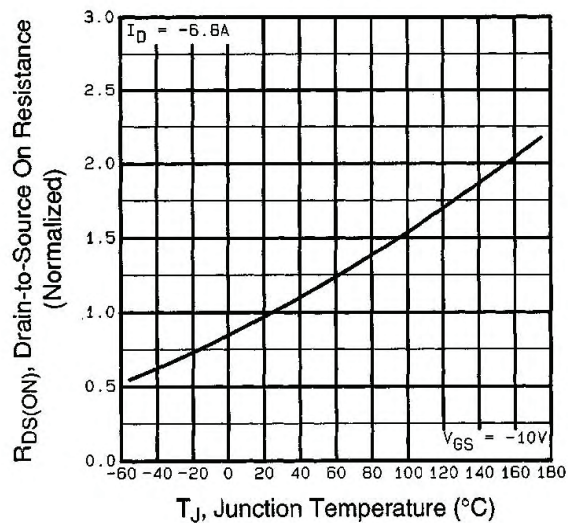


Fig. 4 - Normalized On-Resistance vs. Temperature

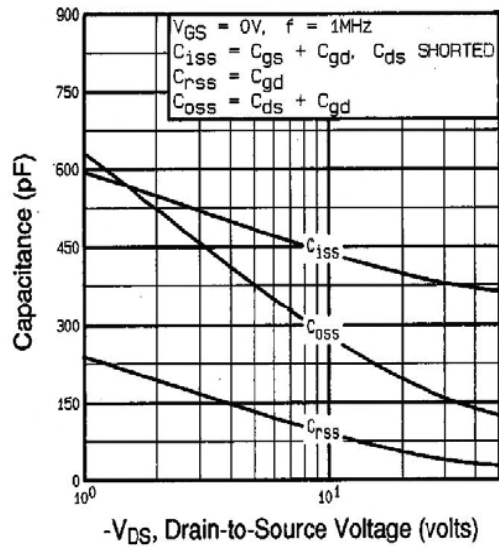


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

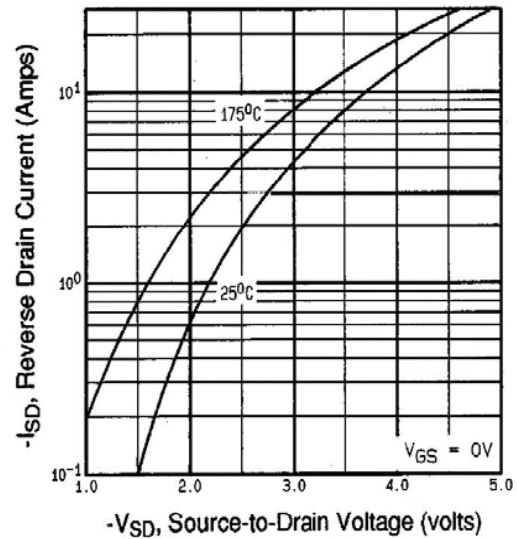


Fig. 7 - Typical Source-Drain Diode Forward Voltage

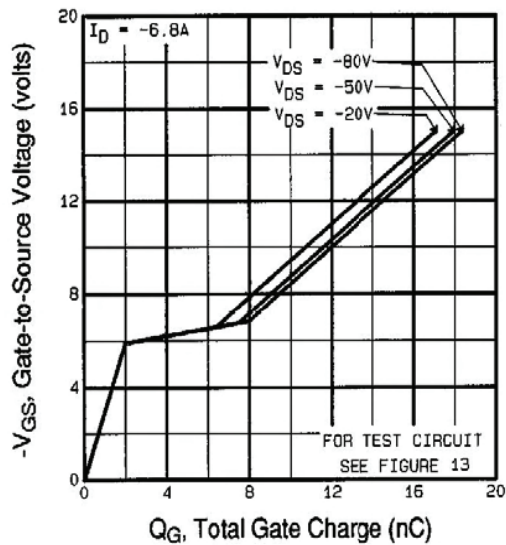


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

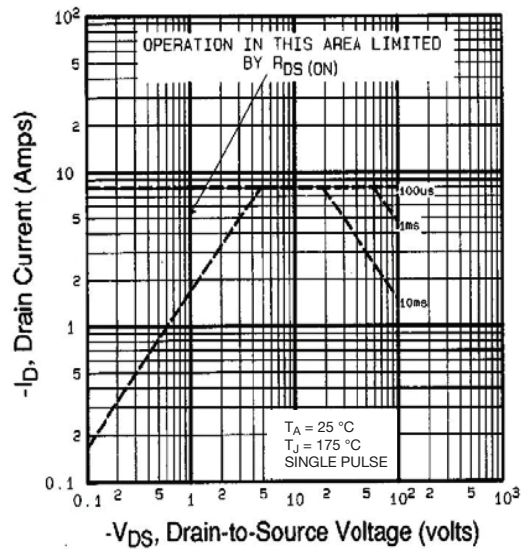


Fig. 8 - Maximum Safe Operating Area

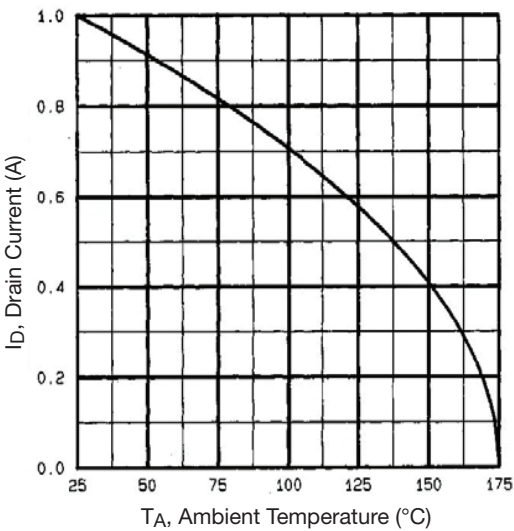


Fig. 9 - Maximum Drain Current vs. Ambient Temperature

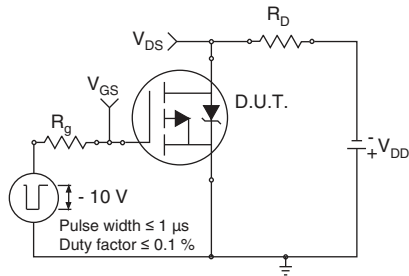


Fig. 10a - Switching Time Test Circuit

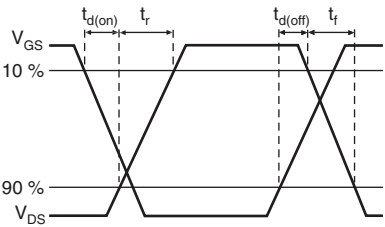


Fig. 10b - Switching Time Waveforms

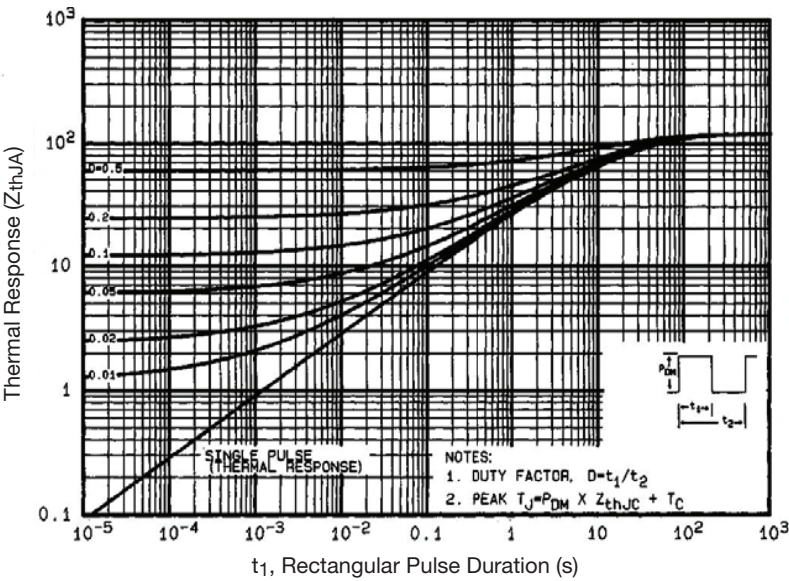


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Ambient

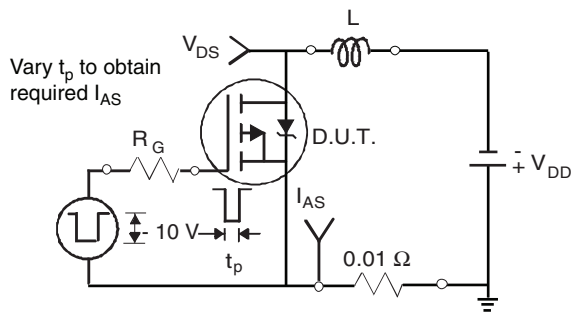


Fig. 12a - Unclamped Inductive Test Circuit

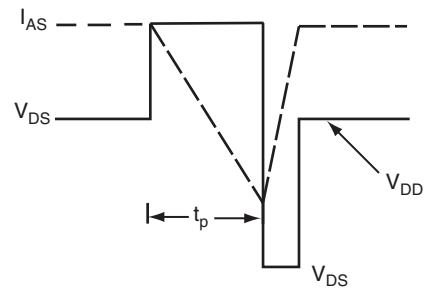


Fig. 12b - Unclamped Inductive Waveforms

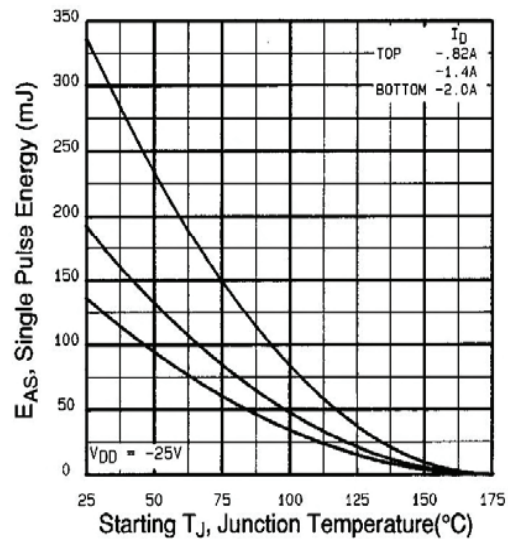


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

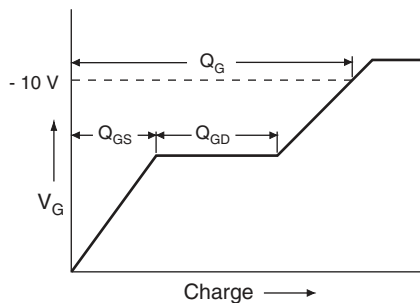


Fig. 13a - Basic Gate Charge Waveform

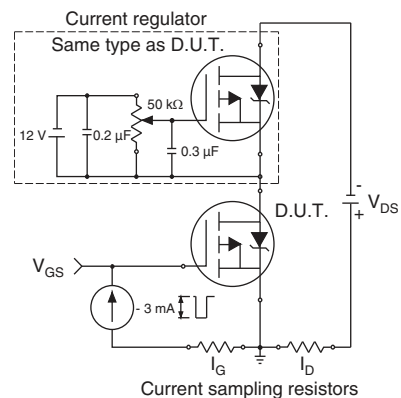
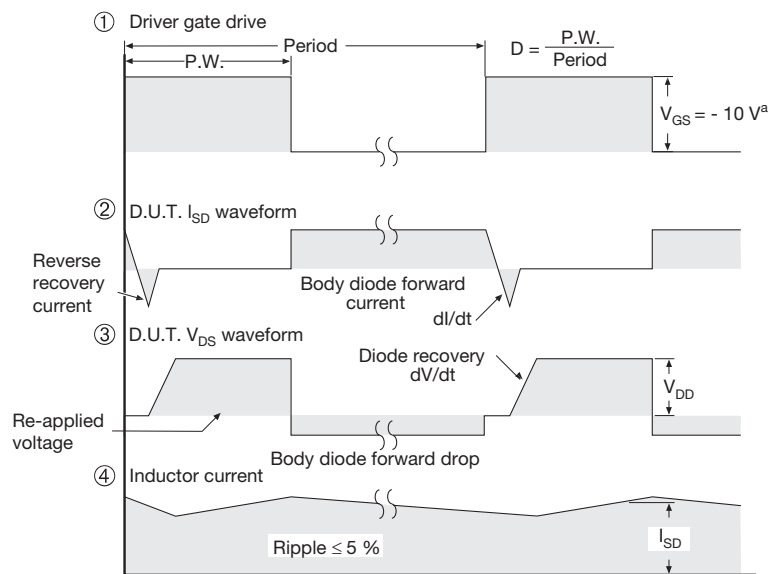
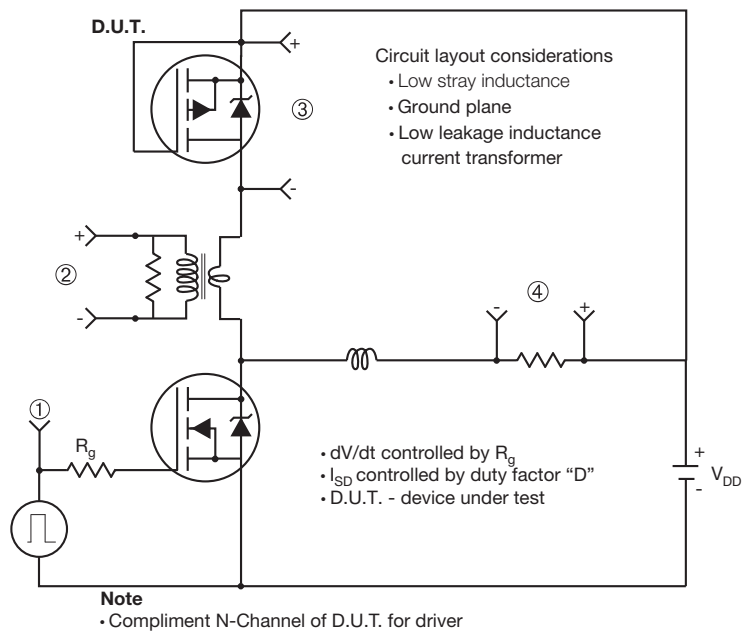


Fig. 13b - Gate Charge Test Circuit

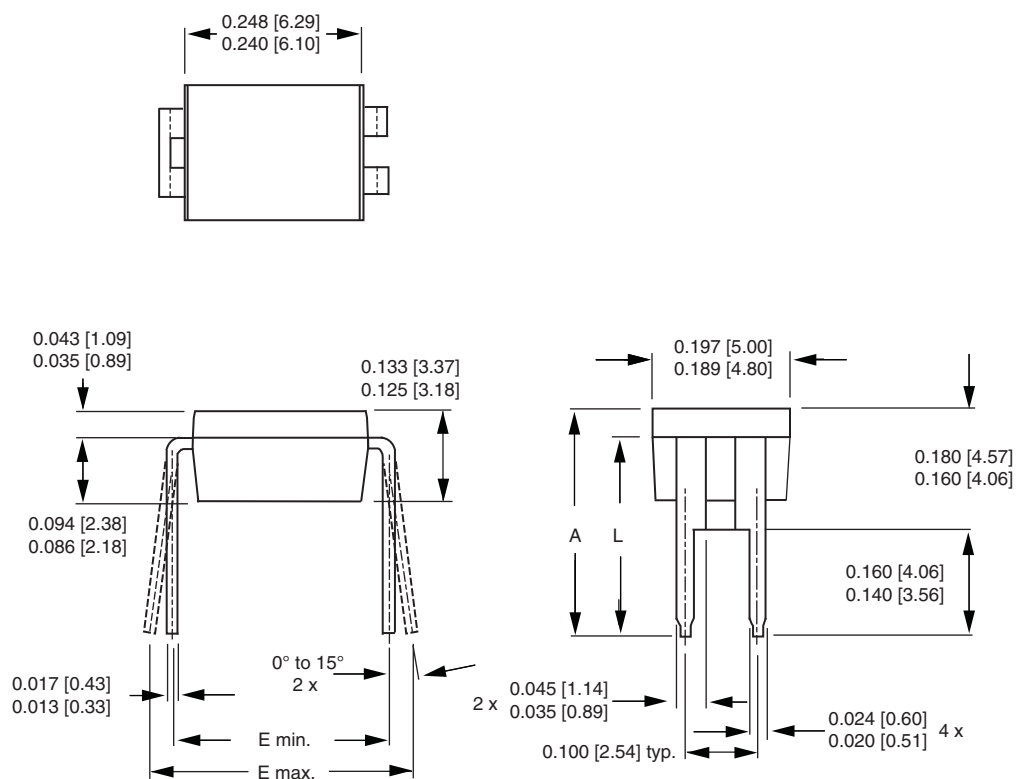
### Peak Diode Recovery dV/dt Test Circuit



**Note**

a.  $V_{GS} = -5\text{ V}$  for logic level and  $-3\text{ V}$  drive devices

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

**HVM DIP** (High voltage)

| DIM. | INCHES |       | MILLIMETERS |       |
|------|--------|-------|-------------|-------|
|      | MIN.   | MAX.  | MIN.        | MAX.  |
| A    | 0.310  | 0.330 | 7.87        | 8.38  |
| E    | 0.300  | 0.425 | 7.62        | 10.79 |
| L    | 0.270  | 0.290 | 6.86        | 7.36  |

ECN: X10-0386-Rev. B, 06-Sep-10  
DWG: 5974

**Note**

- Package length does not include mold flash, protrusions or gate burrs. Package width does not include interlead flash or protrusions.

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