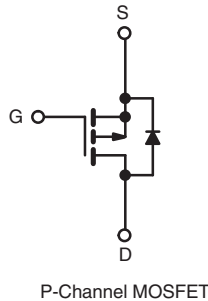
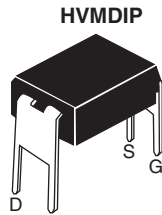


## Power MOSFET

| PRODUCT SUMMARY           |                         |
|---------------------------|-------------------------|
| $V_{DS}$ (V)              | - 200                   |
| $R_{DS(on)}$ ( $\Omega$ ) | $V_{GS} = - 10$ V   1.5 |
| $Q_g$ (Max.) (nC)         | 15                      |
| $Q_{gs}$ (nC)             | 3.2                     |
| $Q_{gd}$ (nC)             | 8.4                     |
| Configuration             | Single                  |



### FEATURES

- Dynamic dV/dt Rating
- Repetitive Avalanche Rated
- For Automatic Insertion
- End Stackable
- P-Channel
- Fast Switching
- Ease of Paralleling
- Material categorization: For definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)


**RoHS\***  
COMPLIANT

### Note

\* Lead (Pb)-containing terminations are not RoHS-compliant. Exemptions may apply.

### 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 4 pin DIP package is a low cost machine-insertable case style which can be stacked in multiple combinations on standard 0.1" pin centers. The dual drain serves as a thermal link to the mounting surface for power dissipation levels up to 1 W.

| ORDERING INFORMATION |              |
|----------------------|--------------|
| Package              | HVMDIP       |
| Lead (Pb)-free       | IRFD9220PbF  |
|                      | SiHFD9220-E3 |
| SnPb                 | IRFD9220     |
|                      | SiHFD9220    |

| ABSOLUTE MAXIMUM RATINGS ( $T_A = 25$ °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 | $T_A = 25$ °C  | - 0.56           | A    |
|   |                    | $T_A = 100$ °C | - 0.36           |      |
| Pulsed Drain Current <sup>a</sup>                                 | $I_{DM}$           | - 4.5          |                  |      |
| Linear Derating Factor  |                    | 0.0083         | W/°C             |      |
| Single Pulse Avalanche Energy <sup>b</sup>                        | $E_{AS}$           | 80             | mJ               |      |
| Avalanche Current <sup>a</sup>                                    | $I_{AR}$           | - 0.56         | A                |      |
| Repetitive Avalanche Energy <sup>a</sup>                          | $E_{AR}$           | 0.10           | mJ               |      |
| Maximum Power Dissipation   | $T_A = 25$ °C      | $P_D$          | 1.0              | W    |
| Peak Diode Recovery dV/dt <sup>c</sup>                            |                    | dV/dt          | - 5.0            | V/ns |
| Operating Junction and Storage Temperature Range                  | $T_J, T_{stg}$     |                | - 55 to + 150    | °C   |
| Soldering Recommendations (Peak Temperature)                      | for 10 s           |                | 300 <sup>d</sup> |      |

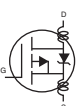

### Notes

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- $V_{DD} = - 50$  V, starting  $T_J = 25$  °C,  $L = 17.8$  mH,  $R_g = 25$   $\Omega$ ,  $I_{AS} = - 3$  A (see fig. 12).
- $I_{SD} \leq - 3.9$  A,  $dI/dt \leq 95$  A/ $\mu$ s,  $V_{DD} \leq V_{DS}$ ,  $T_J \leq 150$  °C.



d. 1.6 mm from case.

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

| SPECIFICATIONS ( $T_J = 25\text{ }^\circ\text{C}$ , 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 $25\text{ }^\circ\text{C}$ , $I_D = -1\text{ mA}$  | -    | -0.22 | -         | 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  | $R_{DS(on)}$        | $V_{GS} = -10\text{ V}, I_D = -0.34\text{ A}^b$   | -    | -     | 1.5       | $\Omega$      |
| Forward Transconductance  | $g_{fs}$            | $V_{DS} = -50\text{ V}, I_D = -0.35\text{ A}^b$   | 0.55 | -     | -         | S             |
| <b>Dynamic</b>  |                     |   |      |       |           |               |
| Input Capacitance   | $C_{iss}$           | $V_{GS} = 0\text{ V}, V_{DS} = -25\text{ V}, f = 1.0\text{ MHz}$ , see fig. 5   | -    | 340   | -         | $\mu\text{F}$ |
| Output Capacitance  | $C_{oss}$           |   | -    | 110   | -         |               |
| Reverse Transfer Capacitance  | $C_{rss}$           |   | -    | 33    | -         |               |
| Total Gate Charge   | $Q_g$               | $V_{GS} = -10\text{ V}, I_D = -2.1\text{ A}, V_{DS} = -160\text{ V}$ , see fig. 6 and 13 <sup>b</sup>   | -    | -     | 15        | nC            |
| Gate-Source Charge  | $Q_{gs}$            |   | -    | -     | 3.2       |               |
| Gate-Drain Charge   | $Q_{gd}$            |   | -    | -     | 8.4       |               |
| Turn-On Delay Time  | $t_{d(on)}$         | $V_{DD} = -100\text{ V}, I_D = -3.9\text{ A}, R_g = 18\text{ }\Omega, R_D = 24\text{ }\Omega$ , see fig. 10 <sup>b</sup>                                | -    | 8.8   | -         | ns            |
| Rise Time   | $t_r$               |   | -    | 27    | -         |               |
| Turn-Off Delay Time   | $t_{d(off)}$        |   | -    | 7.3   | -         |               |
| Fall Time   | $t_f$               |   | -    | 19    | -         |               |
| Internal Drain Inductance   | $L_D$               | Between lead, 6 mm (0.25") from package and center of die contact  | -    | 4.0   | -         | nH            |
| Internal Source Inductance  | $L_S$               |   | -    | 6.0   | -         |               |
| <b>Drain-Source Body Diode Characteristics</b>                              |                     |   |      |       |           |               |
| Continuous Source-Drain Diode Current                                       | $I_S$               | MOSFET symbol showing the integral reverse p-n junction diode      | -    | -     | -0.56     | A             |
| Pulsed Diode Forward Current <sup>a</sup>                                   | $I_{SM}$            |   | -    | -     | -4.5      |               |
| Body Diode Voltage  | $V_{SD}$            | $T_J = 25\text{ }^\circ\text{C}, I_S = -0.56\text{ A}, V_{GS} = 0\text{ V}^b$   | -    | -     | -6.3      | V             |
| Body Diode Reverse Recovery Time  | $t_{rr}$            | $T_J = 25\text{ }^\circ\text{C}, I_F = -3.9\text{ A}, di/dt = 100\text{ A}/\mu\text{s}^b$   | -    | 150   | 300       | ns            |
| Body Diode Reverse Recovery Charge  | $Q_{rr}$            |   | -    | 0.97  | 2.0       | $\mu\text{C}$ |

**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  $\leq 2\text{ }\%$ .



TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

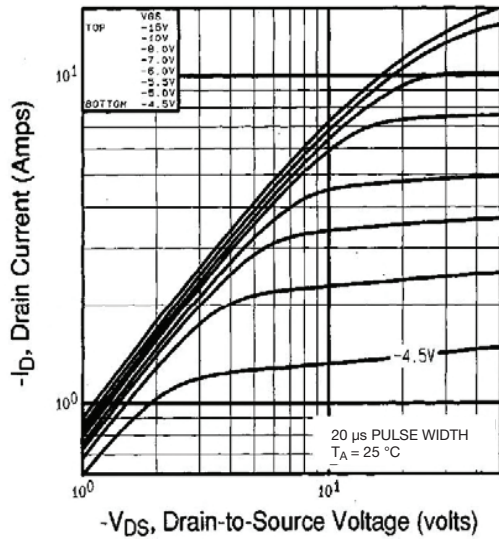


Fig. 1 - Typical Output Characteristics,  $T_A = 25\text{ }^\circ\text{C}$

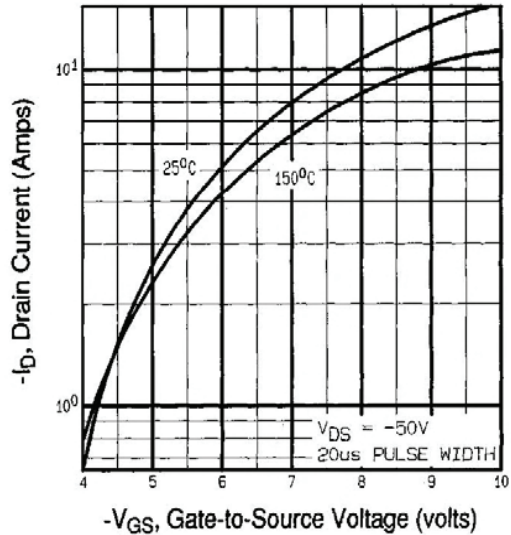


Fig. 3 - Typical Transfer Characteristics

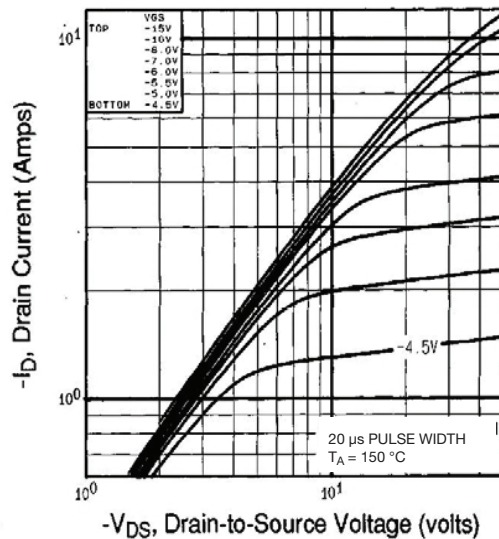


Fig. 2 - Typical Output Characteristics,  $T_A = 150\text{ }^\circ\text{C}$

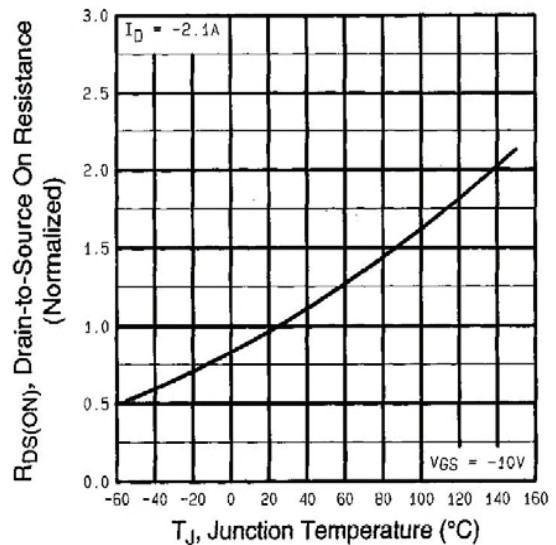


Fig. 4 - Normalized On-Resistance vs. Temperature

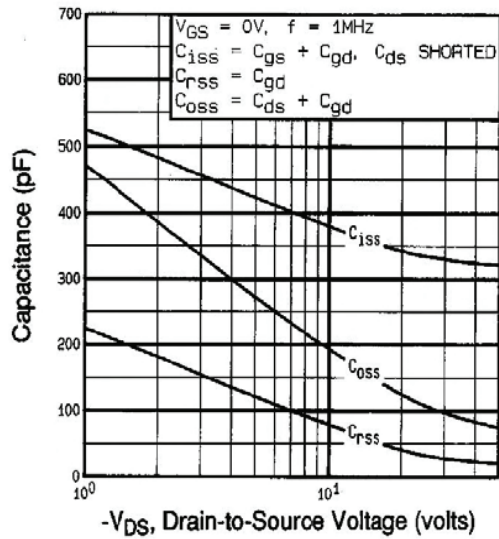


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

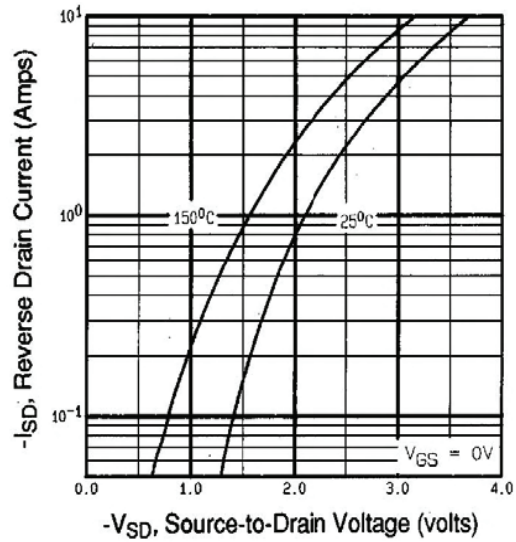


Fig. 7 - Typical Source-Drain Diode Forward Voltage

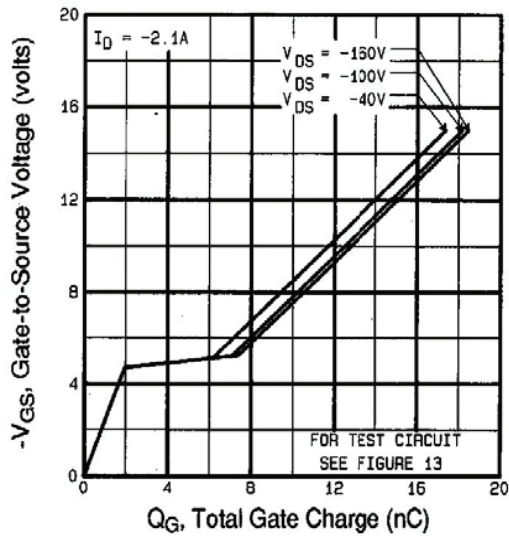


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

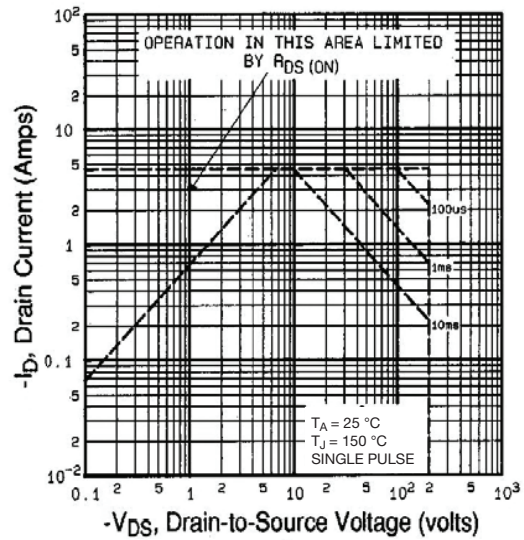


Fig. 8 - Maximum Safe Operating Area

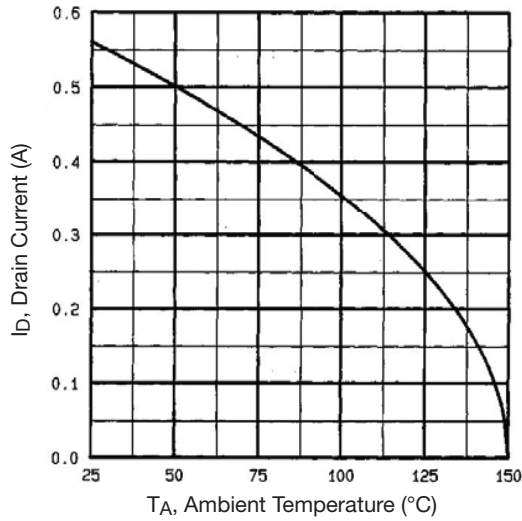


Fig. 9 - Maximum Drain Current vs. Ambient Temperature

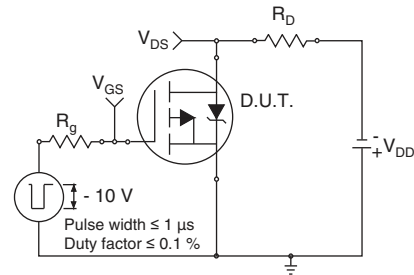


Fig. 10 - Switching Time Test Circuit

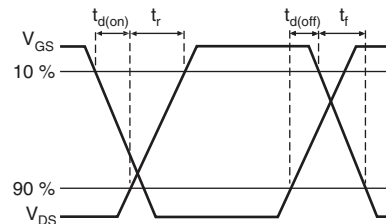


Fig. 11 - Switching Time Waveforms

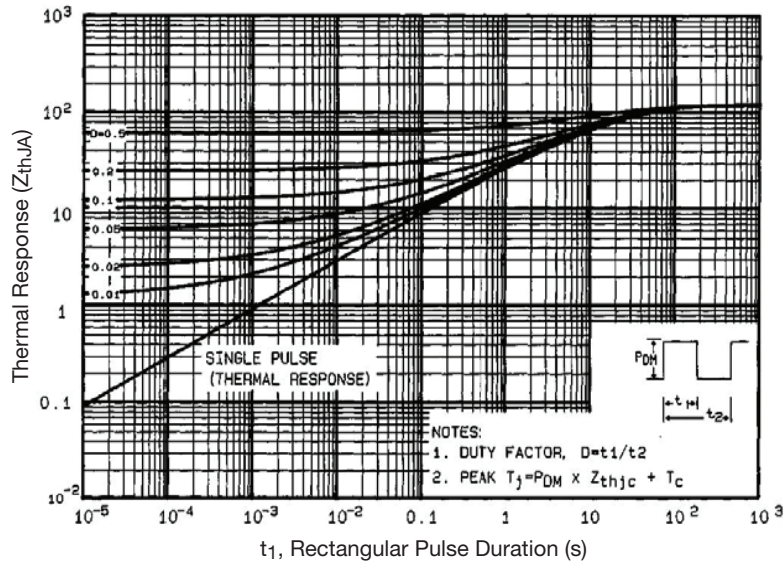


Fig. 12 - Maximum Effective Transient Thermal Impedance, Junction-to-Ambient

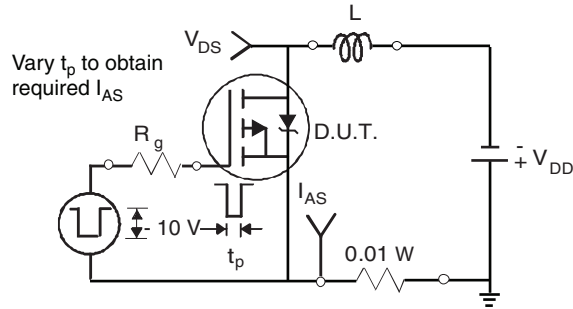


Fig. 13 - Unclamped Inductive Test Circuit

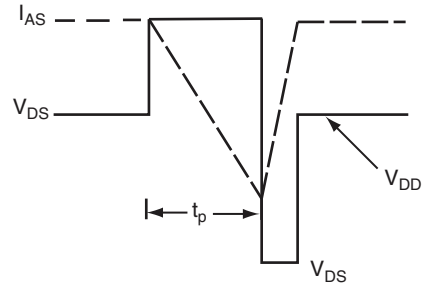


Fig. 14 - Unclamped Inductive Waveforms

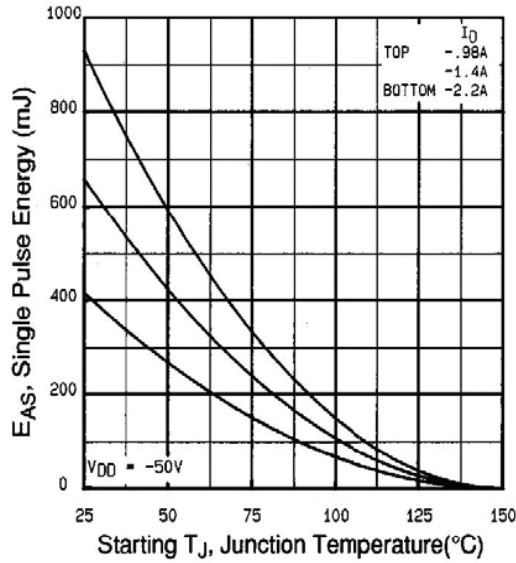


Fig. 15 - Maximum Avalanche Energy vs. Drain Current

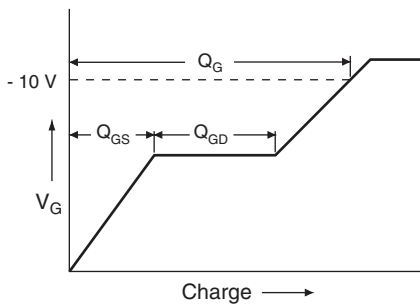


Fig. 16 - Basic Gate Charge Waveform

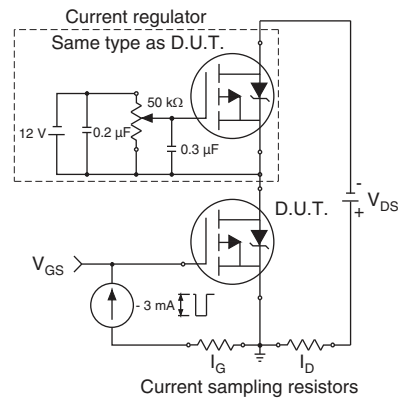
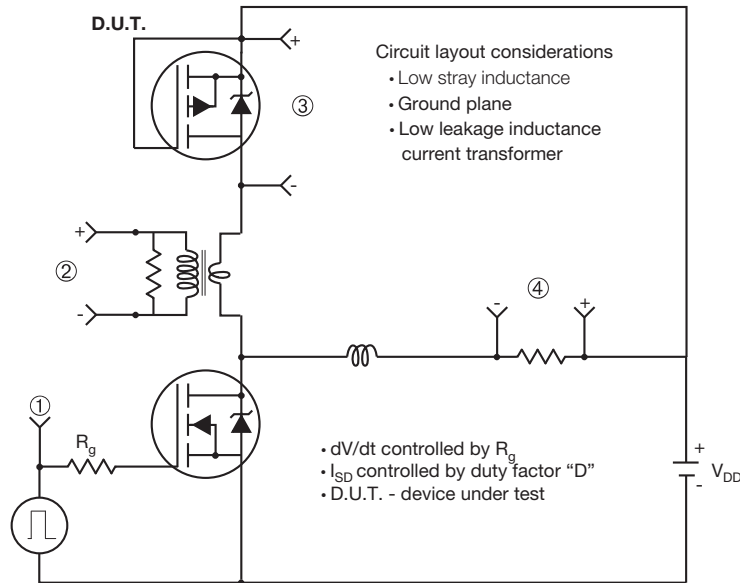
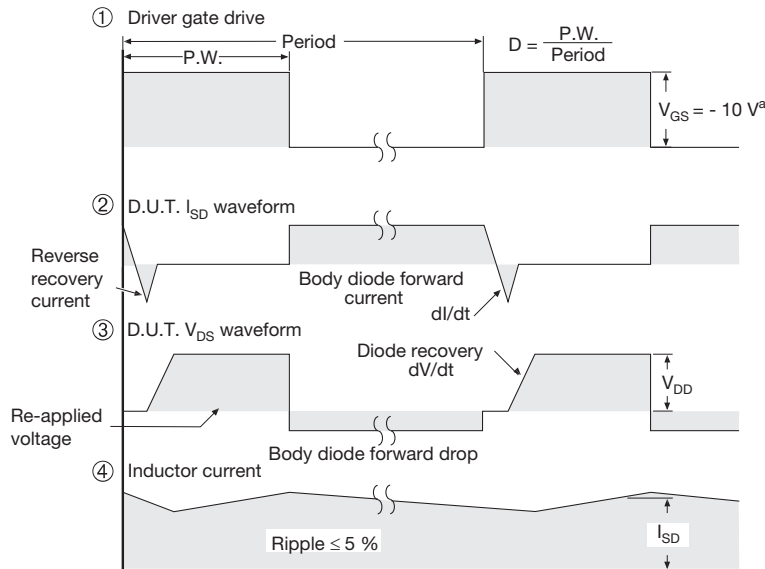


Fig. 17 - Gate Charge Test Circuit

Peak Diode Recovery dV/dt Test Circuit



**Note**  
 • Compliment N-Channel of D.U.T. for driver



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

Fig. 18 - For P-Channel

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## 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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