

Power MOSFET

| PRODUCT SUMMARY | | |
|---------------------------|------------------|------|
| V_{DS} (V) | - 60 | |
| $R_{DS(on)}$ (Ω) | $V_{GS} = -10$ V | 0.50 |
| Q_g (Max.) (nC) | 12 | |
| Q_{gs} (nC) | 3.8 | |
| Q_{gd} (nC) | 5.1 | |
| Configuration | Single | |

FEATURES

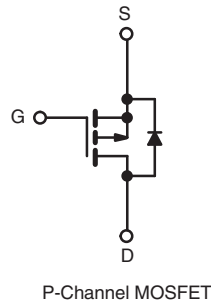
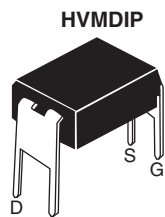
- Dynamic dV/dt Rating
- Repetitive Avalanche Rated
- For Automatic Insertion
- End Stackable
- P-Channel
- 175 °C Operating Temperature
- Fast Switching
- Compliant to RoHS Directive 2002/95/EC


RoHS*
COMPLIANT

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 servers as a thermal link to the mounting surface for power dissipation levels up to 1 W.



| ORDERING INFORMATION | |
|----------------------|--------------|
| Package | HVMDIP |
| Lead (Pb)-free | IRFD9014PbF |
| | SiHFD9014-E3 |
| SnPb | IRFD9014 |
| | SiHFD9014 |

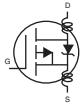

| ABSOLUTE MAXIMUM RATINGS ($T_A = 25$ °C, unless otherwise noted) | | | | |
|---|--------------------|------------------|--------|---|
| PARAMETER | SYMBOL | LIMIT | UNIT | |
| Drain-Source Voltage | V_{DS} | - 60 | V | |
| Gate-Source Voltage | V_{GS} | ± 20 | | |
| Continuous Drain Current | V_{GS} at - 10 V | $T_A = 25$ °C | - 1.1 | A |
| | | $T_A = 100$ °C | - 0.80 | |
| Pulsed Drain Current ^a | I_{DM} | - 8.8 | | |
| Linear Derating Factor | | 0.0083 | W/°C | |
| Single Pulse Avalanche Energy ^b | E_{AS} | 140 | mJ | |
| Avalanche Current ^a | I_{AR} | - 1.1 | A | |
| Repetitive Avalanche Energy ^a | E_{AR} | 0.13 | mJ | |
| Maximum Power Dissipation | $T_A = 25$ °C | P_D | 1.3 | W |
| Peak Diode Recovery dV/dt ^c | dV/dt | - 4.5 | V/ns | |
| Operating Junction and Storage Temperature Range | T_J, T_{stg} | - 55 to + 175 | °C | |
| Soldering Recommendations (Peak Temperature) | for 10 s | 300 ^d | | |

Notes

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- $V_{DD} = -25$ V, starting $T_J = 25$ °C, $L = 33$ mH, $R_g = 25$ Ω , $I_{AS} = -2.2$ A (see fig. 12).
- $I_{SD} \leq -6.7$ A, $dI/dt \leq 90$ A/ μ s, $V_{DD} \leq V_{DS}$, $T_J \leq 175$ °C.
- 1.6 mm from case.

* Pb containing terminations are not RoHS compliant, exemptions may apply

| 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 |
| Static | | | | | | |
| Drain-Source Breakdown Voltage | V_{DS} | $V_{GS} = 0\text{ V}, I_D = -250\text{ }\mu\text{A}$ | -60 | - | - | V |
| V_{DS} Temperature Coefficient | $\Delta V_{DS}/T_J$ | Reference to $25\text{ }^\circ\text{C}$, $I_D = -1\text{ mA}$ | - | -0.060 | - | 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} | $V_{GS} = \pm 20\text{ V}$ | - | - | ± 100 | nA |
| Zero Gate Voltage Drain Current | I_{DSS} | $V_{DS} = -60\text{ V}, V_{GS} = 0\text{ V}$ | - | - | -100 | μA |
| | | $V_{DS} = -48\text{ V}, V_{GS} = 0\text{ V}, T_J = 150\text{ }^\circ\text{C}$ | - | - | -500 | |
| Drain-Source On-State Resistance | $R_{DS(on)}$ | $V_{GS} = -10\text{ V}, I_D = -0.66\text{ A}^b$ | - | - | 0.50 | Ω |
| Forward Transconductance | g_{fs} | $V_{DS} = -25\text{ V}, I_D = -0.66\text{ A}^b$ | 0.70 | - | - | S |
| Dynamic | | | | | | |
| Input Capacitance | C_{iss} | $V_{GS} = 0\text{ V}, V_{DS} = -25\text{ V}, f = 1.0\text{ MHz}$, see fig. 5 | - | 270 | - | pF |
| Output Capacitance | C_{oss} | | - | 170 | - | |
| Reverse Transfer Capacitance | C_{rss} | | - | 31 | - | |
| Total Gate Charge | Q_g | $V_{GS} = -10\text{ V}, I_D = -6.7\text{ A}, V_{DS} = -48\text{ V}$, see fig. 6 and 13 ^b | - | - | 12 | nC |
| Gate-Source Charge | Q_{gs} | | - | - | 3.8 | |
| Gate-Drain Charge | Q_{gd} | | - | - | 5.1 | |
| Turn-On Delay Time | $t_{d(on)}$ | $V_{DD} = -30\text{ V}, I_D = -6.7\text{ A}, R_g = 24\text{ }\Omega, R_D = 4.0\text{ }\Omega$, see fig. 10 ^b | - | 11 | - | ns |
| Rise Time | t_r | | - | 63 | - | |
| Turn-Off Delay Time | $t_{d(off)}$ | | - | 10 | - | |
| Fall Time | t_f | | - | 31 | - | |
| 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 | - | |
| Drain-Source Body Diode Characteristics | | | | | | |
| Continuous Source-Drain Diode Current | I_S | MOSFET symbol showing the integral reverse p - n junction diode  | - | - | -1.1 | A |
| Pulsed Diode Forward Current ^a | I_{SM} | | - | - | -8.8 | |
| Body Diode Voltage | V_{SD} | $T_J = 25\text{ }^\circ\text{C}, I_S = -1.1\text{ A}, V_{GS} = 0\text{ V}^b$ | - | - | -5.5 | V |
| Body Diode Reverse Recovery Time | t_{rr} | $T_J = 25\text{ }^\circ\text{C}, I_F = -6.7\text{ A}, di/dt = 100\text{ A}/\mu\text{s}^b$ | - | 80 | 160 | ns |
| Body Diode Reverse Recovery Charge | Q_{rr} | | - | 0.096 | 0.19 | μC |
| 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 $\leq 2\%$.

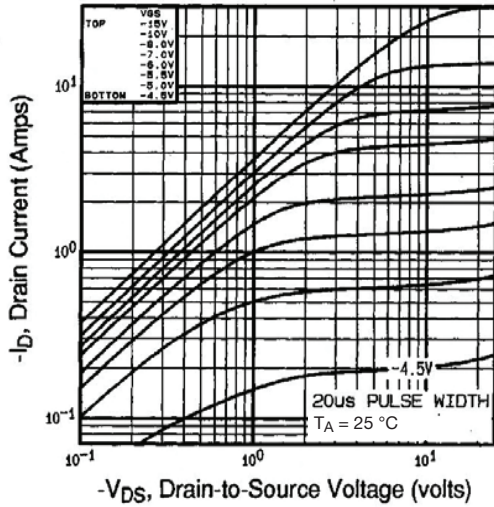
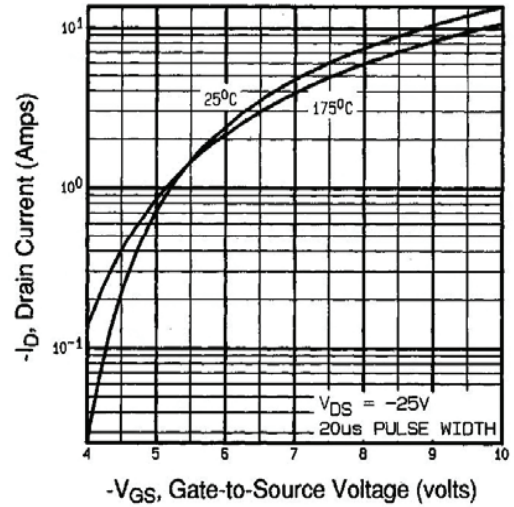
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

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


Fig. 3 - Typical Transfer Characteristics

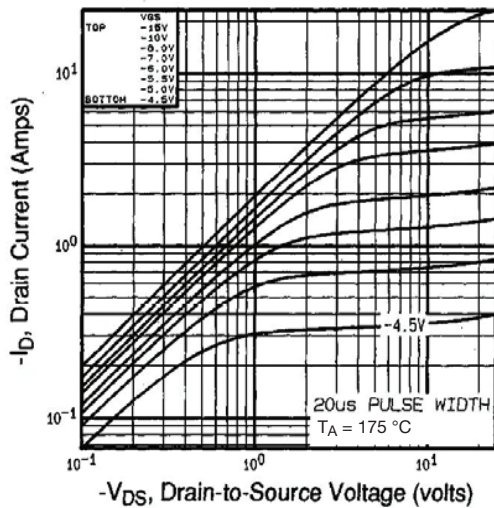
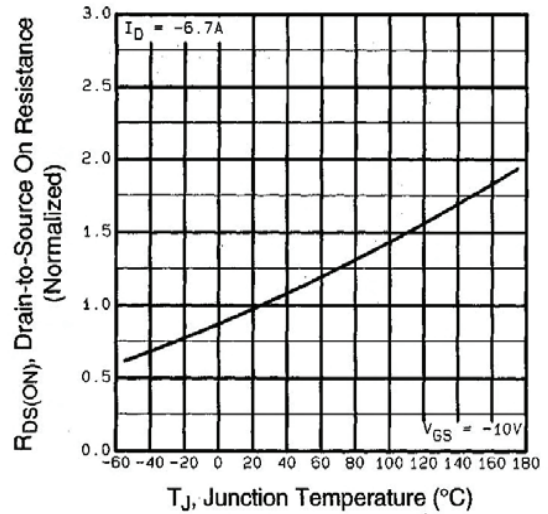

 Fig. 2 - Typical Output Characteristics, $T_A = 175\text{ }^\circ\text{C}$


Fig. 4 - Normalized On-Resistance vs. Temperature

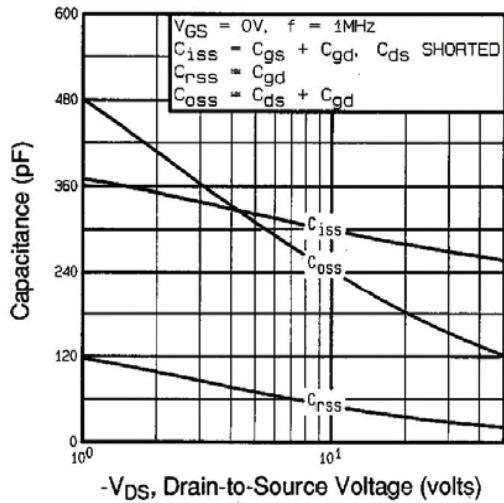


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

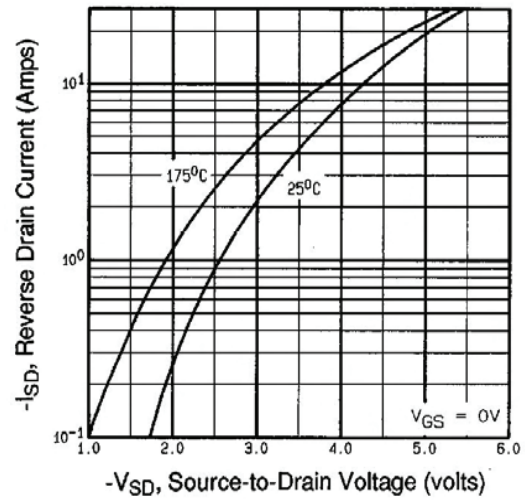


Fig. 7 - Typical Source-Drain Diode Forward Voltage

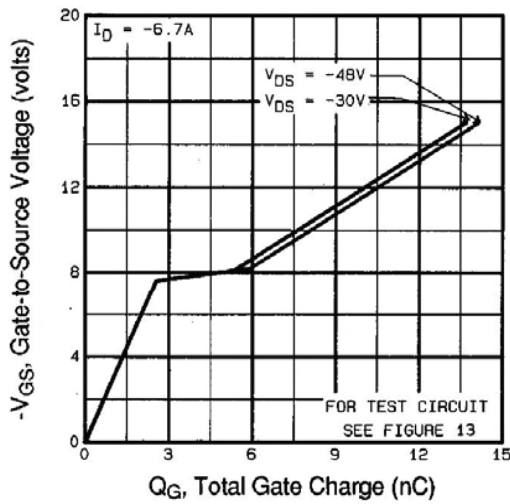


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

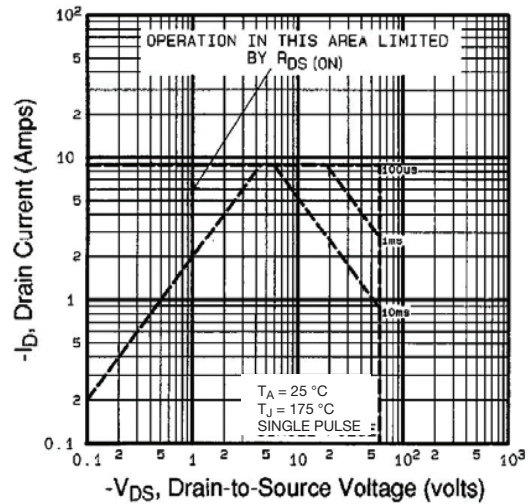


Fig. 8 - Maximum Safe Operating Area

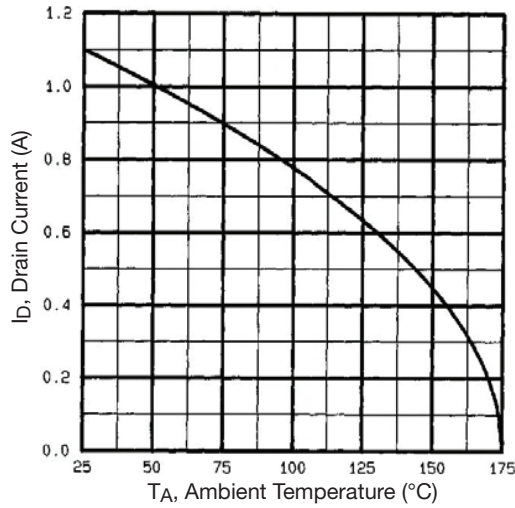


Fig. 9 - Maximum Drain Current vs. Ambient Temperature

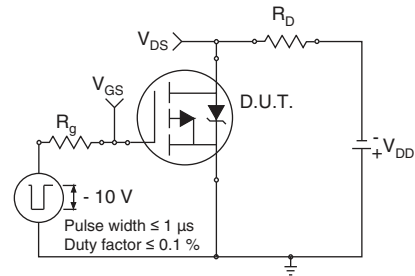


Fig. 10a - Switching Time Test Circuit

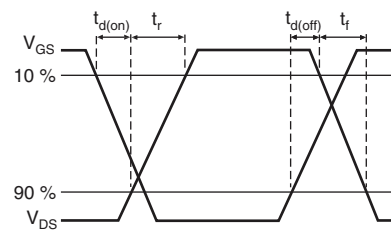


Fig. 10b - Switching Time Waveforms

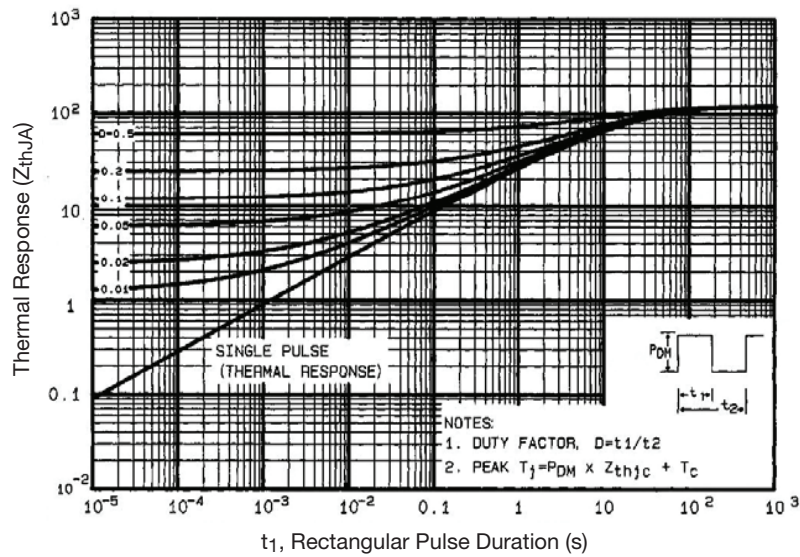


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Ambient

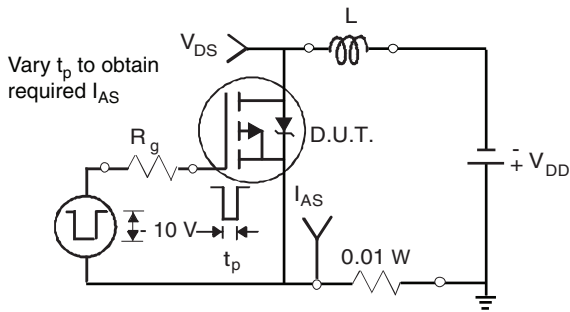


Fig. 12a - Unclamped Inductive Test Circuit

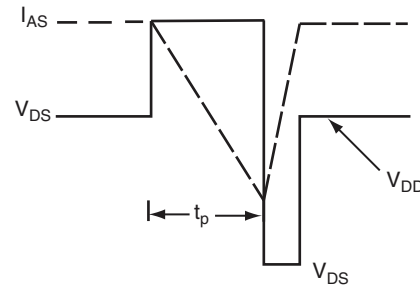


Fig. 12b - Unclamped Inductive Waveforms

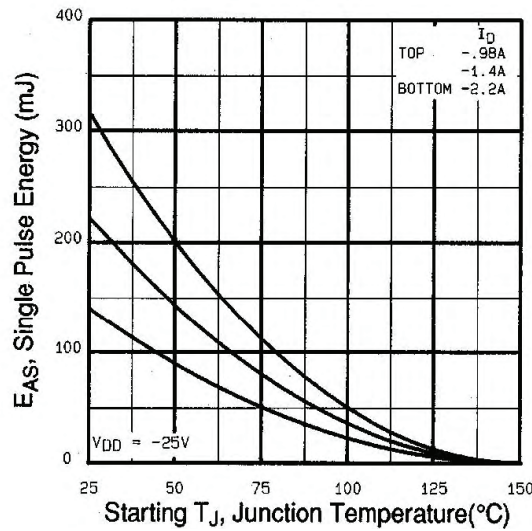


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

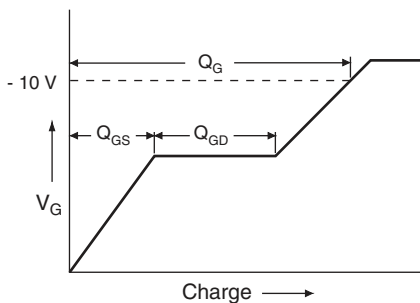


Fig. 13a - Basic Gate Charge Waveform

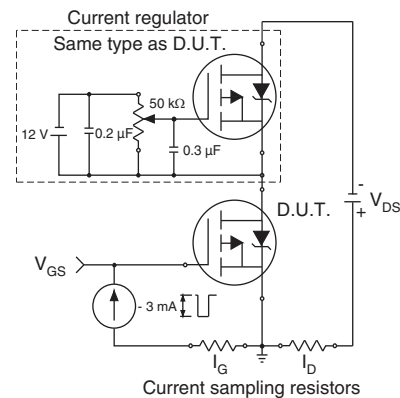
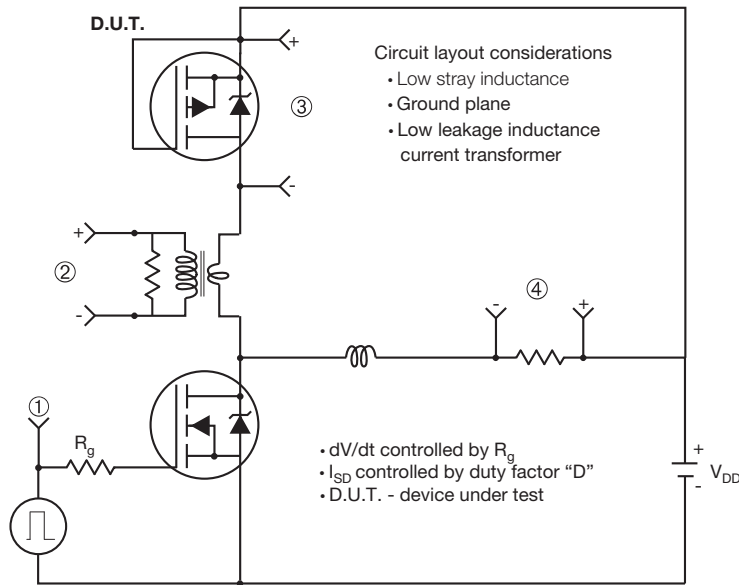


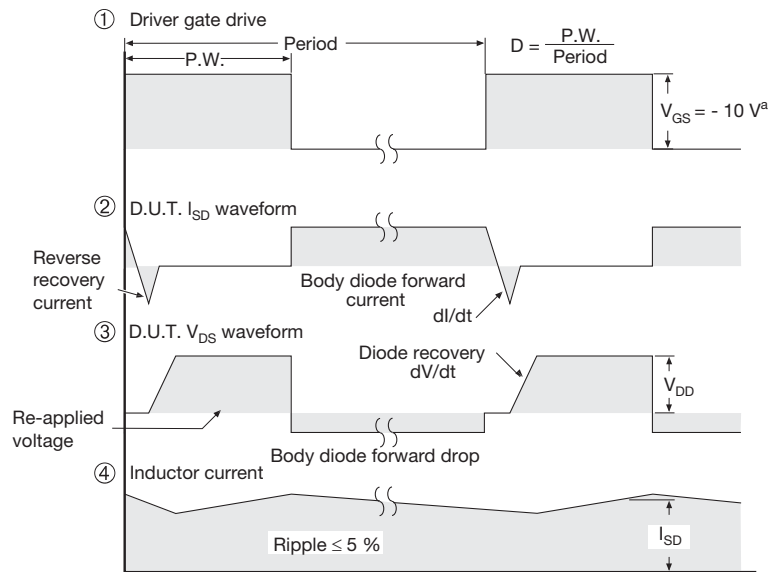
Fig. 13b - Gate Charge Test Circuit

Peak Diode Recovery dV/dt Test Circuit



Note

- Compliment N-Channel of D.U.T. for driver



Note

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

Fig. 14 - 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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