

Power MOSFET


RoHS
COMPLIANT

| PRODUCT SUMMARY | | |
|---------------------------|------------------------|-----|
| V_{DS} (V) | 400 | |
| $R_{DS(on)}$ (Ω) | $V_{GS} = 10\text{ V}$ | 1.8 |
| Q_g (Max.) (nC) | 20 | |
| Q_{gs} (nC) | 3.3 | |
| Q_{gd} (nC) | 11 | |
| Configuration | Single | |

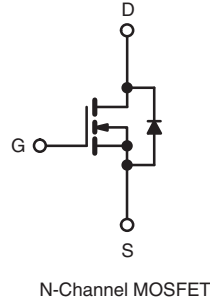
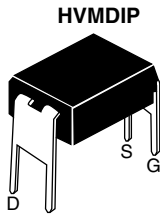
FEATURES

- Dynamic dV/dt rating
- Repetitive avalanche rated
- For automatic insertion
- End stackable
- Fast switching
- Ease of paralleling
- Simple drive requirements
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

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-insertible 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 | IRFD320PbF |
| | SiHFD320-E3 |
| SnPb | IRFD320 |
| | SiHFD320 |

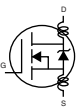

| ABSOLUTE MAXIMUM RATINGS ($T_A = 25\text{ }^\circ\text{C}$, unless otherwise noted) | | | | | |
|---|----------------------------------|----------------|-----------------------------------|---------------------|---|
| PARAMETER | | SYMBOL | LIMIT | UNIT | |
| Drain-Source Voltage | | V_{DS} | 400 | V | |
| Gate-Source Voltage | | V_{GS} | ± 20 | | |
| Continuous Drain Current | V_{GS} at 10 V | I_D | $T_A = 25\text{ }^\circ\text{C}$ | 0.49 | A |
| | | | $T_A = 100\text{ }^\circ\text{C}$ | 0.31 | |
| Pulsed Drain Current ^a | | I_{DM} | 3.9 | | |
| Linear Derating Factor | | | 0.0083 | W/ $^\circ\text{C}$ | |
| Single Pulse Avalanche Energy ^b | | E_{AS} | 48 | mJ | |
| Avalanche Current ^a | | I_{AR} | 0.49 | A | |
| Repetitive Avalanche Energy ^a | | E_{AR} | 0.10 | mJ | |
| Maximum Power Dissipation | $T_A = 25\text{ }^\circ\text{C}$ | P_D | 1.0 | W | |
| Peak Diode Recovery dV/dt ^c | | dV/dt | 4.0 | V/ns | |
| Operating Junction and Storage Temperature Range | | T_J, T_{stg} | -55 to +150 | $^\circ\text{C}$ | |
| Soldering Recommendations (Peak Temperature) ^d | for 10 s | | 300 | | |

Notes

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- $V_{DD} = 50\text{ V}$, starting $T_J = 25\text{ }^\circ\text{C}$, $L = 21\text{ mH}$, $R_g = 25\text{ }\Omega$, $I_{AS} = 2.0\text{ A}$ (see fig. 12).
- $I_{SD} \leq 2.0\text{ A}$, $dI/dt \leq 40\text{ A}/\mu\text{s}$, $V_{DD} \leq V_{DS}$, $T_J \leq 150\text{ }^\circ\text{C}$.
- 1.6 mm from case.



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

| SPECIFICATIONS ($T_J = 25\text{ }^\circ\text{C}$, unless otherwise noted) | | | | | | | |
|---|---------------------|---|--|------|------|-----------|---------------|
| PARAMETER | SYMBOL | TEST CONDITIONS | | MIN. | TYP. | MAX. | UNIT |
| Static | | | | | | | |
| Drain-Source Breakdown Voltage | V_{DS} | $V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$ | | 400 | - | - | V |
| V_{DS} Temperature Coefficient | $\Delta V_{DS}/T_J$ | Reference to $25\text{ }^\circ\text{C}, I_D = 1\text{ mA}$ | | - | 0.51 | - | 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} | $V_{DS} = 400\text{ V}, V_{GS} = 0\text{ V}$ | | - | - | 25 | μA |
| | | $V_{DS} = 320\text{ V}, V_{GS} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$ | | - | - | 250 | |
| Drain-Source On-State Resistance | $R_{DS(on)}$ | $V_{GS} = 10\text{ V}$ | $I_D = 0.21\text{ A}^b$ | - | - | 1.8 | Ω |
| Forward Transconductance | g_{fs} | $V_{DS} = 50\text{ V}, I_D = 1.2\text{ A}$ | | 1.7 | - | - | S |
| Dynamic | | | | | | | |
| Input Capacitance | C_{iss} | $V_{GS} = 0\text{ V}, V_{DS} = 25\text{ V}, f = 1.0\text{ MHz}, \text{ see fig. 5}$ | | - | 410 | - | pF |
| Output Capacitance | C_{oss} | | | - | 120 | - | |
| Reverse Transfer Capacitance | C_{riss} | | | - | 47 | - | |
| Total Gate Charge | Q_g | $V_{GS} = 10\text{ V}$ | $I_D = 2.0\text{ A}, V_{DS} = 320\text{ V}, \text{ see fig. 6 and 13}^b$ | - | - | 20 | nC |
| Gate-Source Charge | Q_{gs} | | | - | - | 3.3 | |
| Gate-Drain Charge | Q_{gd} | | | - | - | 11 | |
| Turn-On Delay Time | $t_{d(on)}$ | $V_{DD} = 200\text{ V}, I_D = 3.3\text{ A}, R_g = 18\text{ }\Omega, R_D = 56\text{ }\Omega, \text{ see fig. 10}^b$ | | - | 10 | - | ns |
| Rise Time | t_r | | | - | 14 | - | |
| Turn-Off Delay Time | $t_{d(off)}$ | | | - | 30 | - | |
| Fall Time | t_f | | | - | 13 | - | |
| 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  | | - | - | 0.49 | A |
| Pulsed Diode Forward Current ^a | I_{SM} | | | - | - | 3.9 | |
| Body Diode Voltage | V_{SD} | $T_J = 25\text{ }^\circ\text{C}, I_S = 0.49\text{ A}, V_{GS} = 0\text{ V}^b$ | | - | - | 1.6 | V |
| Body Diode Reverse Recovery Time | t_{rr} | $T_J = 25\text{ }^\circ\text{C}, I_F = 3.3\text{ A}, di/dt = 100\text{ A}/\mu\text{s}^b$ | | - | 270 | 600 | ns |
| Body Diode Reverse Recovery Charge | Q_{rr} | | | - | 1.4 | 3.0 | 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)

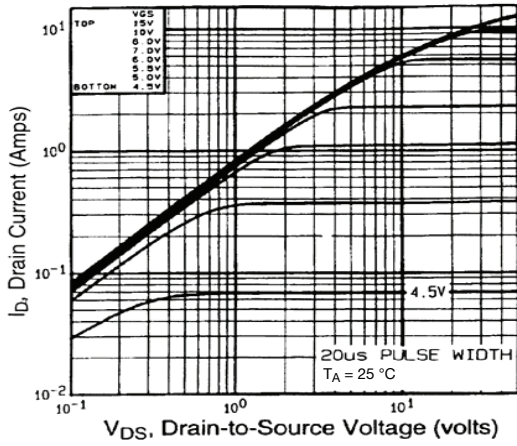


Fig. 1 - Typical Output Characteristics, $T_A = 25\text{ }^\circ\text{C}$

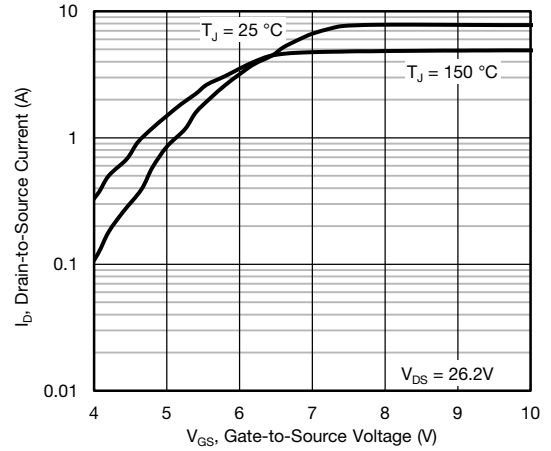


Fig. 3 - Typical Transfer Characteristics

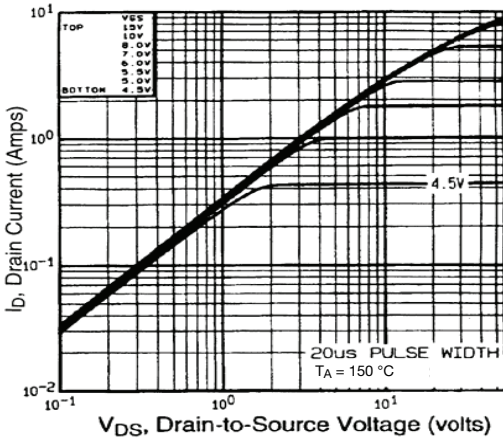


Fig. 2 - Typical Output Characteristics, $T_A = 150\text{ }^\circ\text{C}$

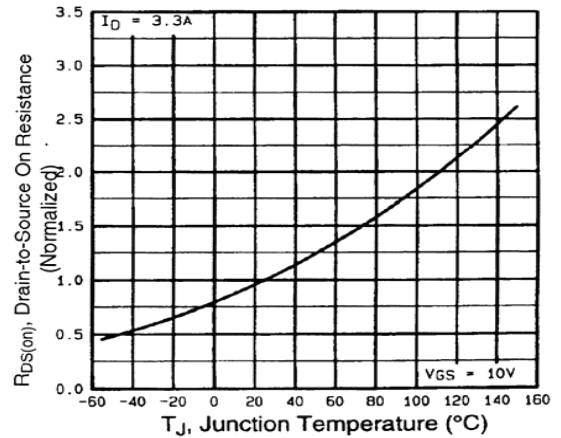


Fig. 4 - Normalized On-Resistance vs. Temperature

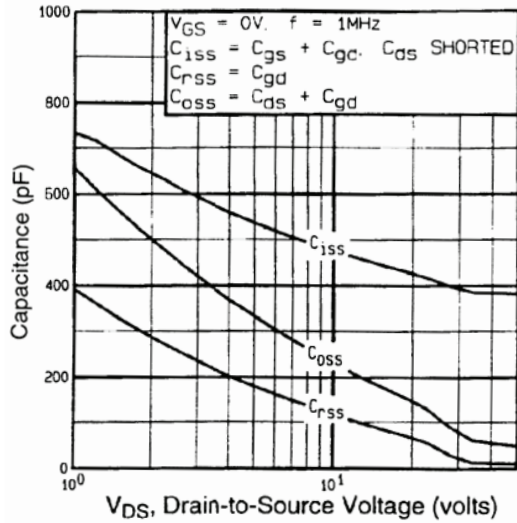


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

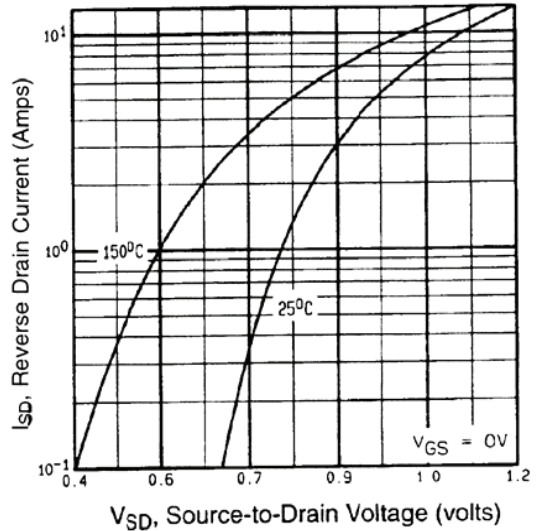


Fig. 7 - Typical Source-Drain Diode Forward Voltage

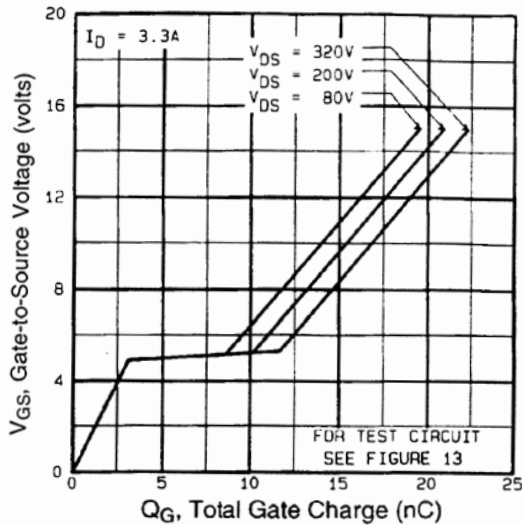


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

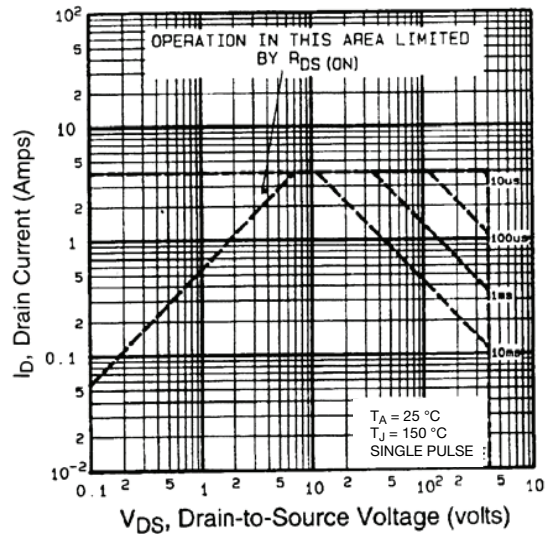


Fig. 8 - Maximum Safe Operating Area

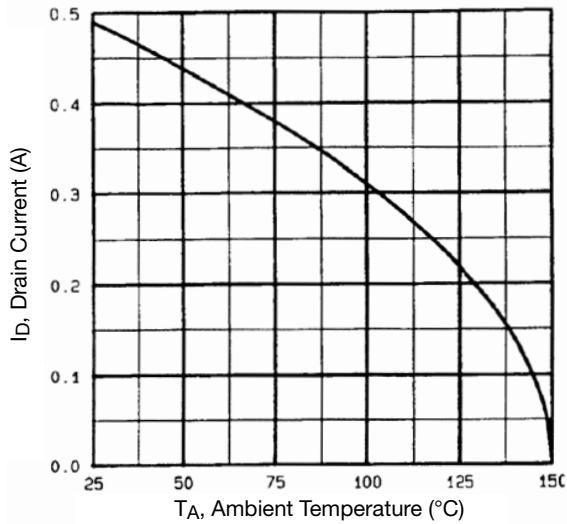


Fig. 9 - Maximum Drain Current vs. Ambient Temperature

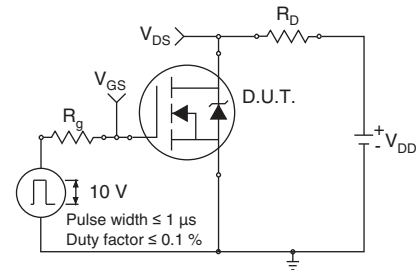


Fig. 10a - Switching Time Test Circuit



Fig. 10b - Switching Time Waveforms

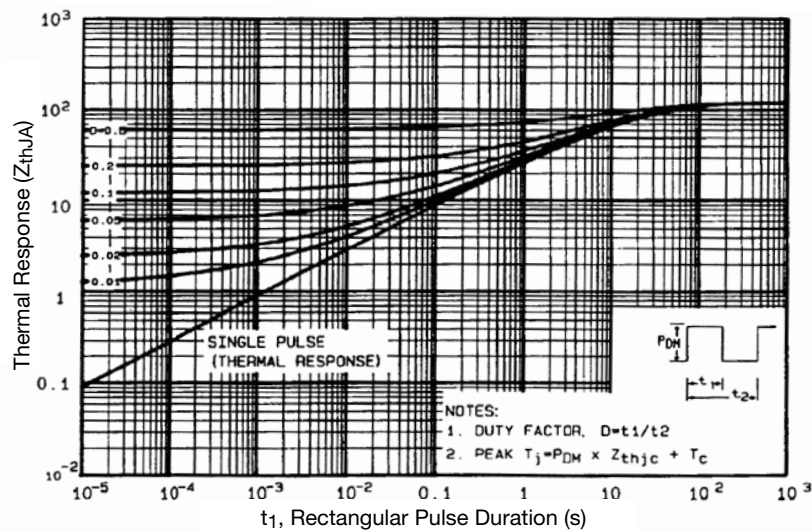


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Ambient

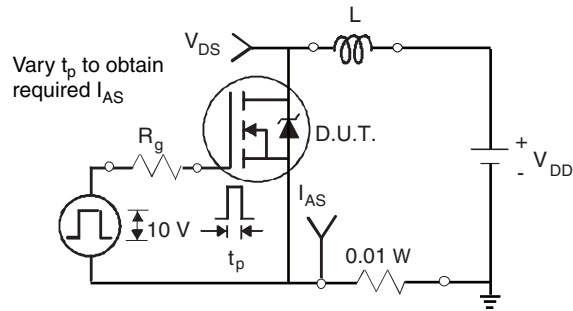


Fig. 12a - Unclamped Inductive Test Circuit

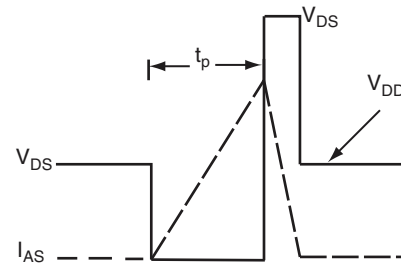


Fig. 12b - Unclamped Inductive Waveforms

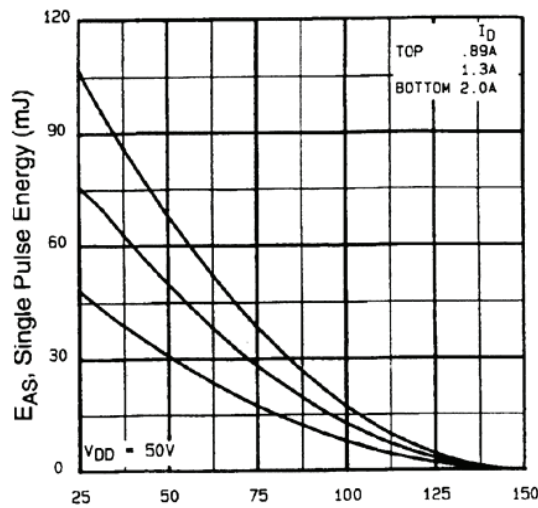


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

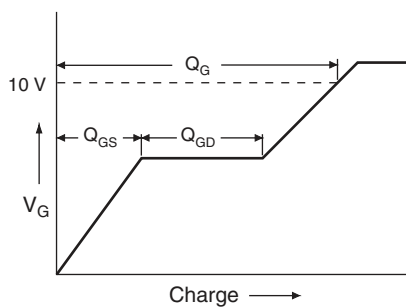


Fig. 13a - Basic Gate Charge Waveform

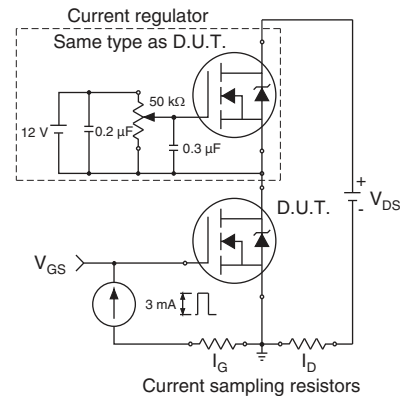
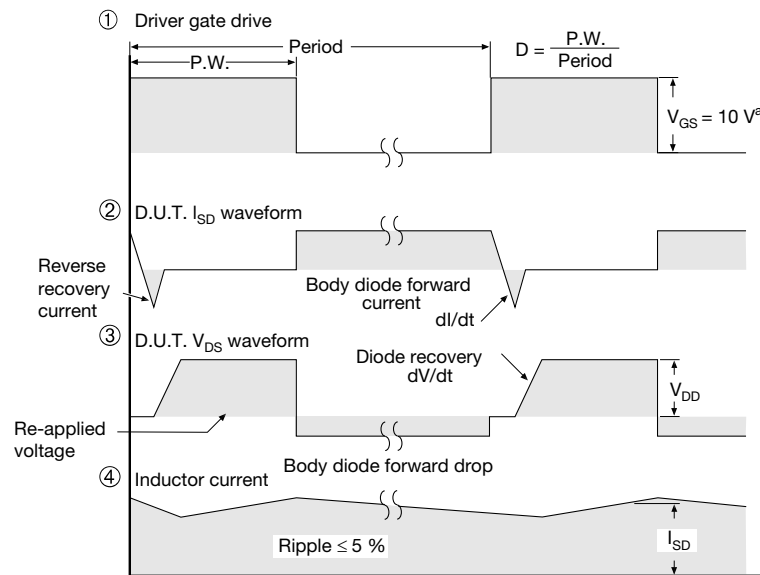
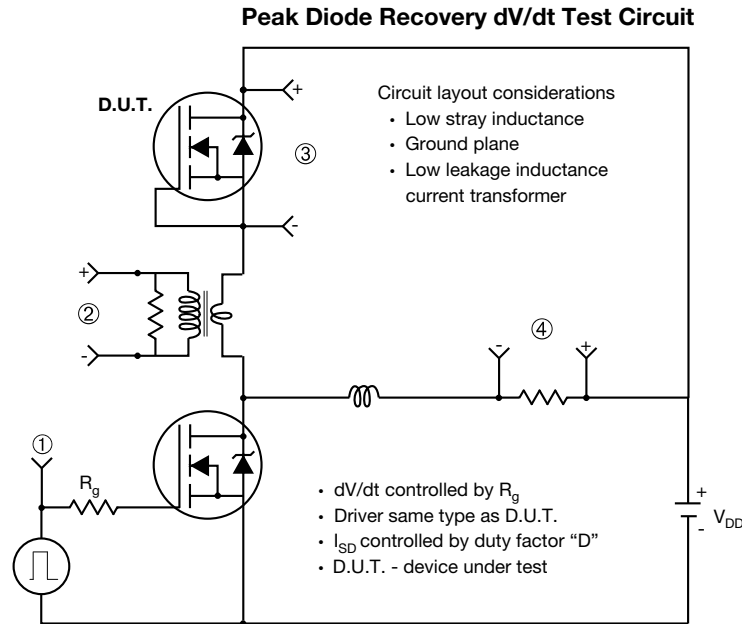


Fig. 13b - Gate Charge Test Circuit



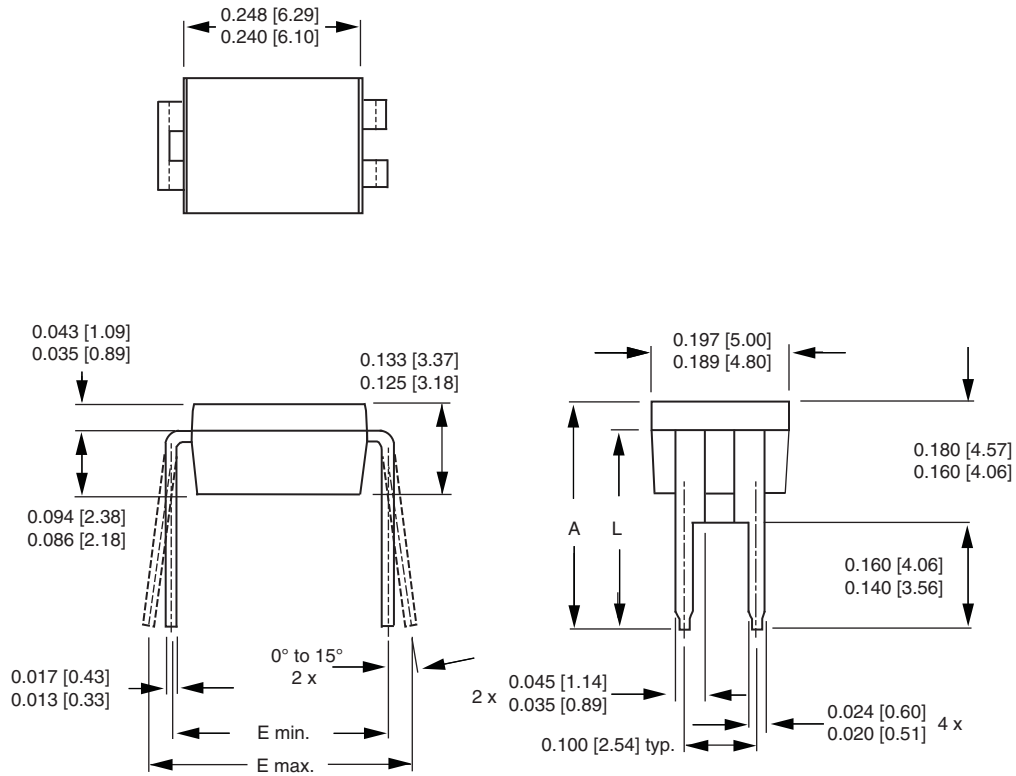
Note

a. $V_{GS} = 5 V$ for logic level devices

Fig. 14 - For N-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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