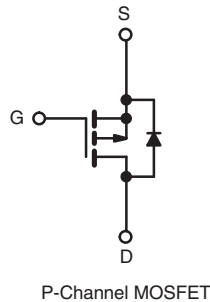
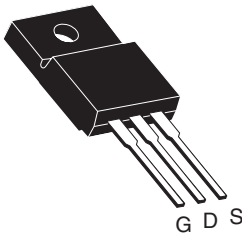


Power MOSFET

| PRODUCT SUMMARY | | |
|---------------------------|------------------|------|
| V_{DS} (V) | - 60 | |
| $R_{DS(on)}$ (Ω) | $V_{GS} = -10$ V | 0.28 |
| Q_g (Max.) (nC) | 19 | |
| Q_{gs} (nC) | 5.4 | |
| Q_{gd} (nC) | 11 | |
| Configuration | Single | |

TO-220 FULLPAK


FEATURES

- Isolated Package
- High Voltage Isolation = 2.5 kV_{RMS} (t = 60 s; f = 60 Hz)
- Sink to Lead Creepage Distance = 4.8 mm
- P-Channel
- 175 °C Operating Temperature
- Dynamic dV/dt Rating
- Low Thermal Resistance
- Lead (Pb)-free Available


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 TO-220 FULLPAK eliminates the need for additional insulating hardware in commercial-industrial applications. The molding compound used provides a high isolation capability and a low thermal resistance between the tab and external heatsink. This isolation is equivalent to using a 100 micron mica barrier with standard TO-220 product. The FULLPAK is mounted to a heatsink using a single clip or by a single screw fixing.

ORDERING INFORMATION

| | |
|----------------|----------------|
| Package | TO-220 FULLPAK |
| Lead (Pb)-free | IRFI9Z24GPbF |
| | SiHF19Z24G-E3 |
| SnPb | IRFI9Z24G |
| | SiHF19Z24G |

ABSOLUTE MAXIMUM RATINGS $T_C = 25$ °C, unless otherwise noted


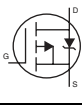
| PARAMETER | SYMBOL | LIMIT | UNIT |
|--|------------------|---------------------------------|-------|
| Drain-Source Voltage | V_{DS} | - 60 | V |
| Gate-Source Voltage | V_{GS} | ± 20 | |
| Continuous Drain Current | I_D | V_{GS} at -10 V $T_C = 25$ °C | - 8.5 |
| | | $T_C = 100$ °C | - 6.0 |
| Pulsed Drain Current ^a | I_{DM} | - 34 | A |
| Linear Derating Factor | | 0.24 | |
| Single Pulse Avalanche Energy ^b | E_{AS} | 200 | mJ |
| Repetitive Avalanche Current ^a | I_{AR} | - 8.5 | A |
| Repetitive Avalanche Energy ^a | E_{AR} | 3.7 | mJ |
| Maximum Power Dissipation | P_D | 37 | 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 | |
| Mounting Torque | 6-32 or M3 screw | 10 | |
| | | 1.1 | |

Notes

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- $V_{DD} = -25$ V, starting $T_J = 25$ °C, L = 3.2 mH, $R_G = 25$ Ω , $I_{AS} = -8.5$ A (see fig. 12).
- $I_{SD} \leq -11$ A, $di/dt \leq 140$ 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} | - | 65 | °C/W |
| Maximum Junction-to-Case (Drain) | R_{thJC} | - | 4.1 | |

| 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 $25\text{ }^\circ\text{C}$, $I_D = -1\text{ mA}$ | - | -0.056 | - | 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 | $R_{DS(on)}$ | $V_{GS} = -10\text{ V}$, $I_D = -5.1\text{ A}^b$ | - | - | 0.28 | Ω |
| Forward Transconductance | g_{fs} | $V_{DS} = -25\text{ V}$, $I_D = -5.1\text{ A}^b$ | 3.2 | - | - | S |
| Dynamic | | | | | | |
| Input Capacitance | C_{iss} | $V_{GS} = 0\text{ V}$, $V_{DS} = -25\text{ V}$, $f = 1.0\text{ MHz}$, see fig. 5 | - | 570 | - | pF |
| Output Capacitance | C_{oss} | | - | 360 | - | |
| Reverse Transfer Capacitance | C_{rss} | | - | 65 | - | |
| Drain to Sink Capacitance | C | | $f = 1.0\text{ MHz}$ | - | 12 | |
| Total Gate Charge | Q_g | $V_{GS} = -10\text{ V}$, $I_D = -11\text{ A}$, $V_{DS} = -48\text{ V}$, see fig. 6 and 13 ^b | - | - | 19 | nC |
| Gate-Source Charge | Q_{gs} | | - | - | 5.4 | |
| Gate-Drain Charge | Q_{gd} | | - | - | 11 | |
| Turn-On Delay Time | $t_{d(on)}$ | $V_{DD} = -30\text{ V}$, $I_D = -11\text{ A}$, $R_G = 18\text{ }\Omega$, $R_D = 2.5\text{ }\Omega$, see fig. 10 ^b | - | 13 | - | ns |
| Rise Time | t_r | | - | 68 | - | |
| Turn-Off Delay Time | $t_{d(off)}$ | | - | 15 | - | |
| Fall Time | t_f | | - | 29 | - | |
| Internal Drain Inductance | L_D | Between lead, 6 mm (0.25") from package and center of die contact  | - | 4.5 | - | nH |
| Internal Source Inductance | L_S | | - | 7.5 | - | |
| Drain-Source Body Diode Characteristics | | | | | | |
| Continuous Source-Drain Diode Current | I_S | MOSFET symbol showing the integral reverse p - n junction diode  | - | - | -8.5 | A |
| Pulsed Diode Forward Current ^a | I_{SM} | | - | - | -34 | |
| Body Diode Voltage | V_{SD} | $T_J = 25\text{ }^\circ\text{C}$, $I_S = -8.5\text{ A}$, $V_{GS} = 0\text{ V}^b$ | - | - | -6.3 | V |
| Body Diode Reverse Recovery Time | t_{rr} | $T_J = 25\text{ }^\circ\text{C}$, $I_F = -11\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}^b$ | - | 100 | 200 | ns |
| Body Diode Reverse Recovery Charge | Q_{rr} | | - | 0.32 | 0.64 | 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

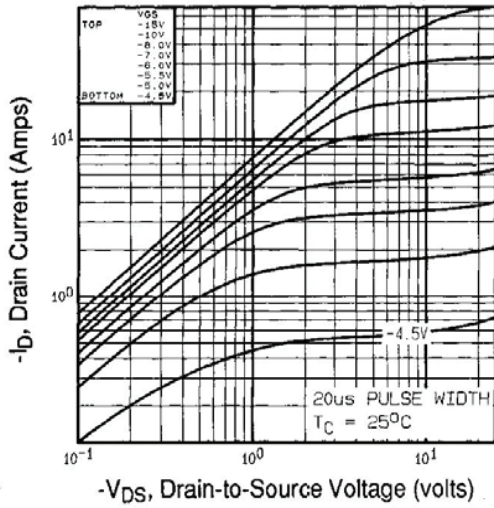


Fig. 1 - Typical Output Characteristics, $T_C = 25^\circ\text{C}$

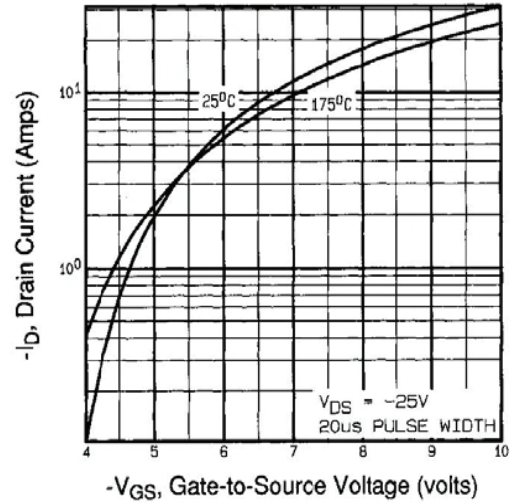


Fig. 3 - Typical Transfer Characteristics

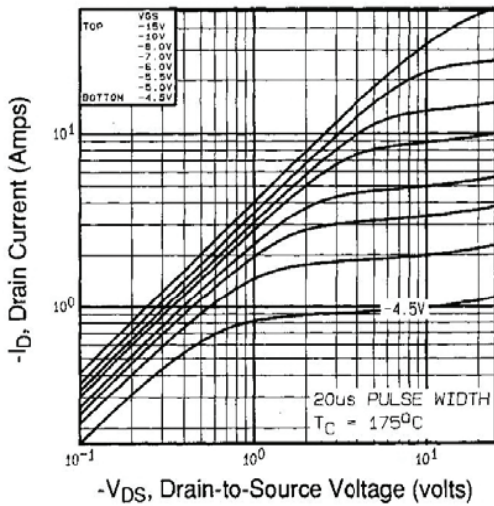


Fig. 2 - Typical Output Characteristics, $T_C = 175^\circ\text{C}$

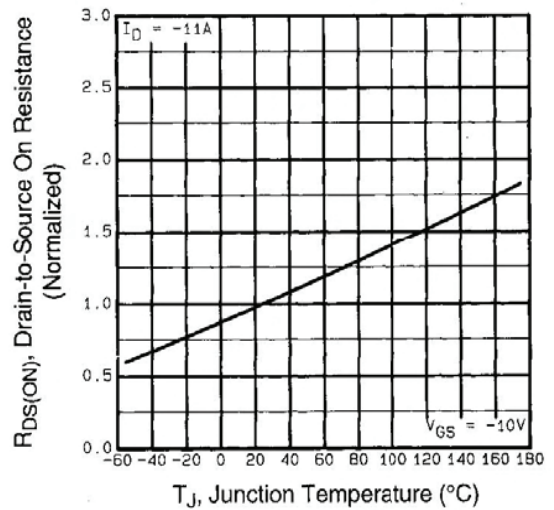


Fig. 4 - Normalized On-Resistance vs. Temperature

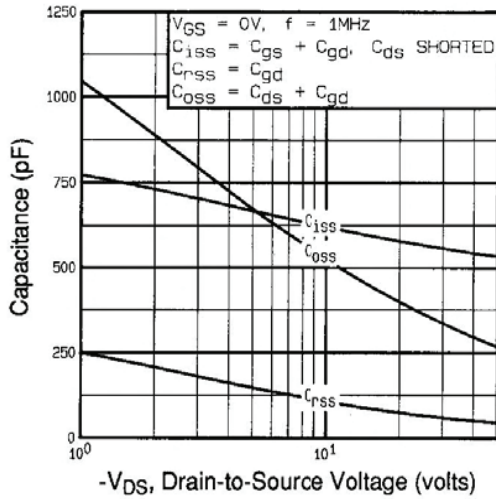


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

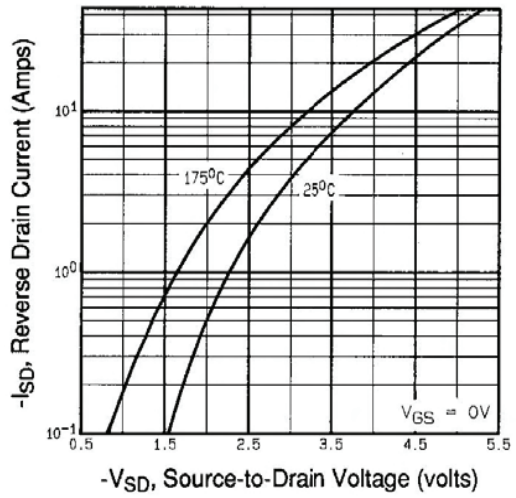


Fig. 7 - Typical Source-Drain Diode Forward Voltage

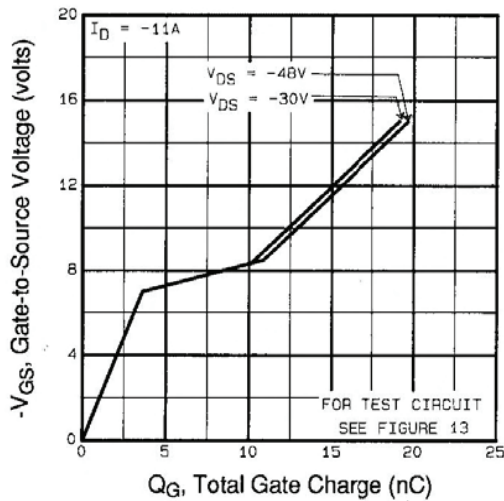


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

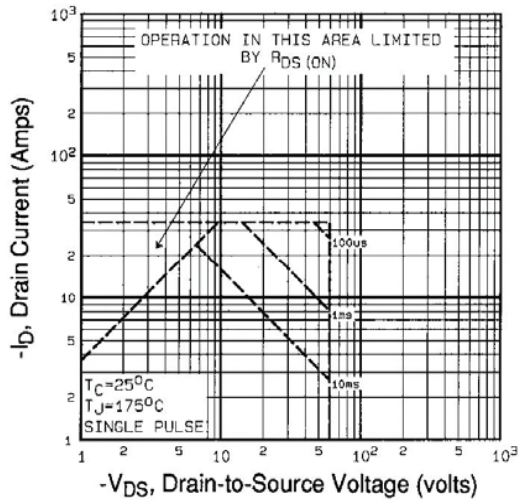


Fig. 8 - Maximum Safe Operating Area

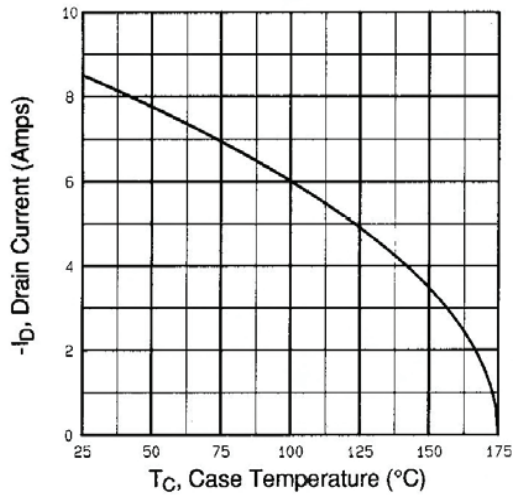


Fig. 9 - Maximum Drain Current vs. Case Temperature

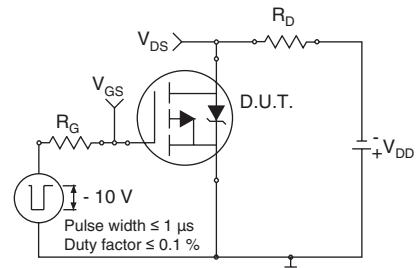


Fig. 10a - Switching Time Test Circuit

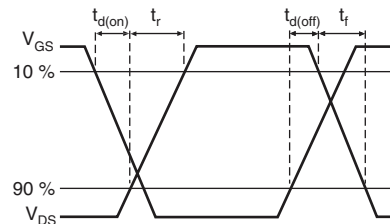


Fig. 10b - Switching Time Waveforms

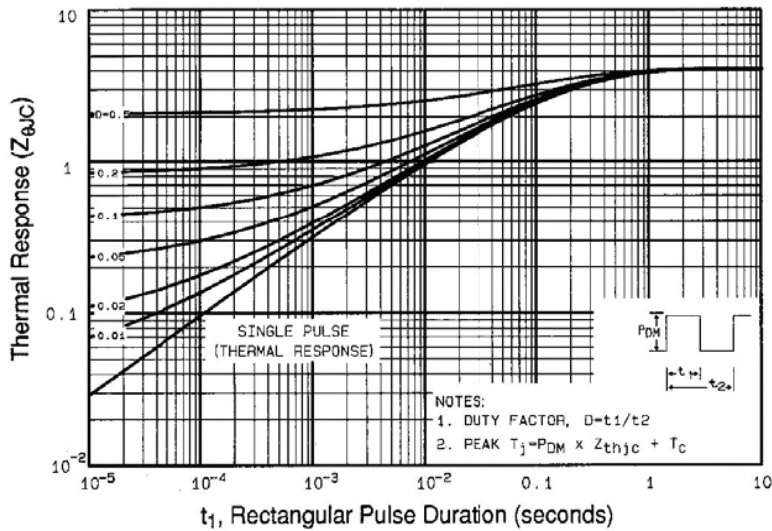


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

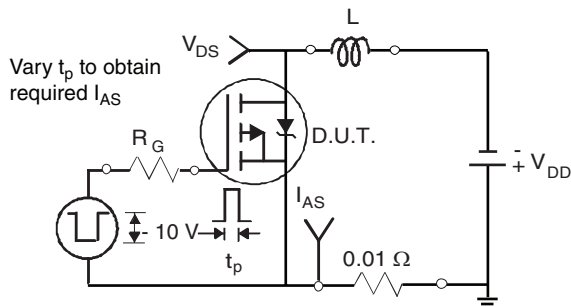


Fig. 12a - Unclamped Inductive Test Circuit

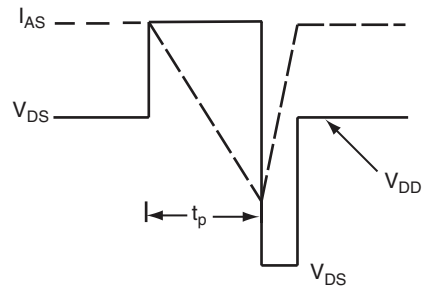


Fig. 12b - Unclamped Inductive Waveforms

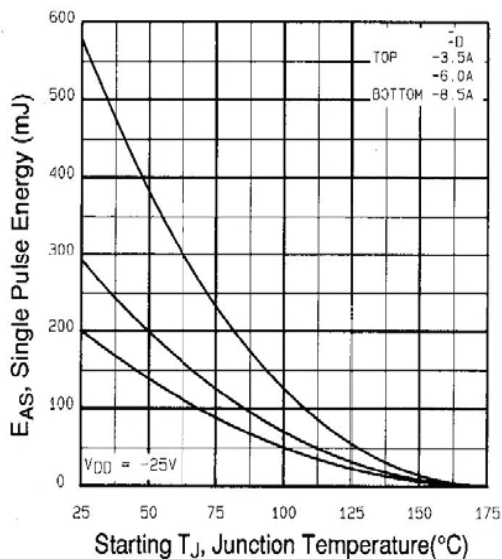


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

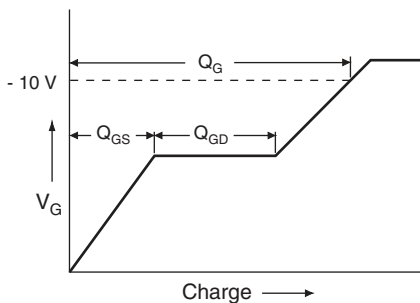


Fig. 13a - Basic Gate Charge Waveform

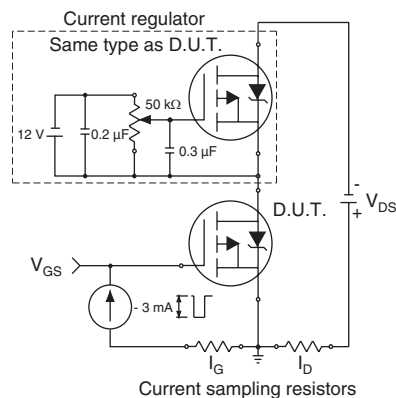
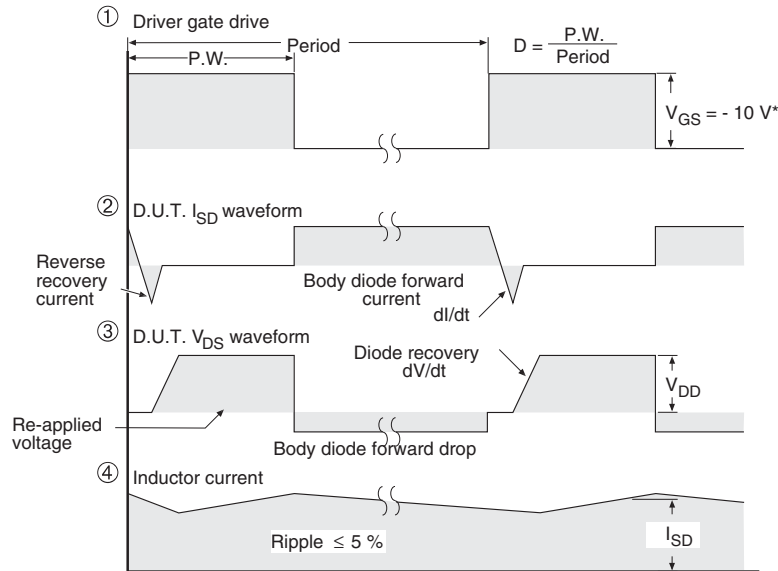
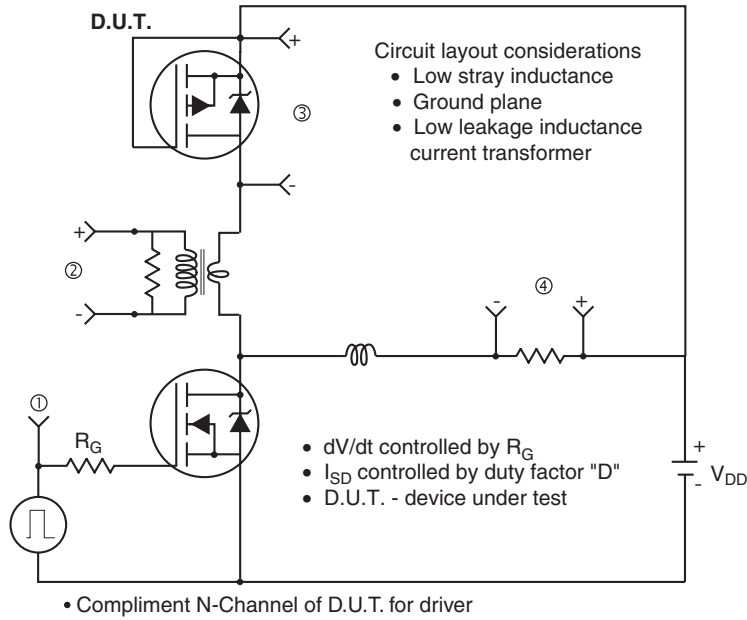


Fig. 13b - Gate Charge Test Circuit

Peak Diode Recovery dV/dt Test Circuit



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

Fig. 14 - For P-Channel

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