

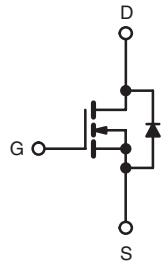
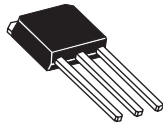
Power MOSFET

| PRODUCT SUMMARY | |
|---------------------------|-----------------------------|
| V_{DS} (V) | 60 |
| $R_{DS(on)}$ (Ω) | $V_{GS} = 10\text{ V}$ 0.20 |
| Q_g (Max.) (nC) | 11 |
| Q_{gs} (nC) | 3.1 |
| Q_{gd} (nC) | 5.8 |
| Configuration | Single |

DPAK
(TO-252)



IPAK
(TO-251)



N-Channel MOSFET

FEATURES

- Dynamic dV/dt Rating
- Surface Mount (IRFR014/SiHFR014)
- Straight Lead (IRFU014/SiHFU014)
- Available in Tape and Reel
- Fast Switching
- Ease of Paralleling
- Simple Drive Requirements
- Lead (Pb)-free Available



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 DPAK is designed for surface mounting using vapor phase, infrared, or wave soldering techniques. The straight lead version (IRFU/SiHFU series) is for through-hole mounting applications. Power dissipation levels up to 1.5 W are possible in typical surface mount applications.

| ORDERING INFORMATION | | | | |
|----------------------|---------------|----------------------------|---------------------------|---------------|
| Package | DPAK (TO-252) | DPAK (TO-252) | DPAK (TO-252) | IPAK (TO-251) |
| Lead (Pb)-free | IRFR014PbF | IRFR014TRLPbF ^a | IRFR014TRPbF ^a | IRFU014PbF |
| | SiHFR014-E3 | SiHFR014TL-E3 ^a | SiHFR014T-E3 ^a | SiHFU014-E3 |
| SnPb | IRFR014 | IRFR014TRL ^a | IRFR014TR ^a | IRFU014 |
| | SiHFR014 | SiHFR014TL ^a | SiHFR014T ^a | SiHFU014 |

Note

a. See device orientation.

| ABSOLUTE MAXIMUM RATINGS $T_C = 25\text{ }^\circ\text{C}$, 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 | $T_C = 25\text{ }^\circ\text{C}$ | I_D | 7.7 | A |
| | | $T_C = 100\text{ }^\circ\text{C}$ | | 4.9 | |
| Pulsed Drain Current ^a | | | I_{DM} | 31 | |
| Linear Derating Factor | | | | 0.20 | W/ $^\circ\text{C}$ |
| Linear Derating Factor (PCB Mount) ^e | | | | 0.020 | |
| Single Pulse Avalanche Energy ^b | | | E_{AS} | 47 | mJ |
| Maximum Power Dissipation | $T_C = 25\text{ }^\circ\text{C}$ | | P_D | 25 | W |
| Maximum Power Dissipation (PCB Mount) ^e | $T_A = 25\text{ }^\circ\text{C}$ | | | 2.5 | |
| Peak Diode Recovery dV/dt ^c | | | dV/dt | 4.5 | V/ns |

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

| ABSOLUTE MAXIMUM RATINGS $T_C = 25\text{ }^\circ\text{C}$, unless otherwise noted | | | |
|---|----------------|------------------|------|
| PARAMETER | SYMBOL | LIMIT | UNIT |
| Operating Junction and Storage Temperature Range | T_J, T_{stg} | - 55 to + 150 | °C |
| Soldering Recommendations (Peak Temperature) | for 10 s | 260 ^d | |

Notes

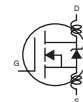
- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- $V_{DD} = 25\text{ V}$, starting $T_J = 25\text{ }^\circ\text{C}$, $L = 924\text{ }\mu\text{H}$, $R_G = 25\text{ }\Omega$, $I_{AS} = 7.7\text{ A}$ (see fig. 12).
- $I_{SD} \leq 10\text{ A}$, $dI/dt \leq 90\text{ A}/\mu\text{s}$, $V_{DD} \leq V_{DS}$, $T_J \leq 150\text{ }^\circ\text{C}$.
- 1.6 mm from case.
- When mounted on 1" square PCB (FR-4 or G-10 material).


| THERMAL RESISTANCE RATINGS | | | | | |
|--|------------|------|------|------|------|
| PARAMETER | SYMBOL | MIN. | TYP. | MAX. | UNIT |
| Maximum Junction-to-Ambient | R_{thJA} | - | - | 110 | °C/W |
| Maximum Junction-to-Ambient (PCB Mount) ^a | R_{thJA} | - | - | 50 | |
| Maximum Junction-to-Case (Drain) | R_{thJC} | - | - | 5.0 | |

Note

- When mounted on 1" square PCB (FR-4 or G-10 material).

| 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 $25\text{ }^\circ\text{C}$, $I_D = 1\text{ mA}$ | | - | 0.068 | - | 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} | $V_{DS} = 60\text{ V}$, $V_{GS} = 0\text{ V}$ | | - | - | 25 | μA |
| | | $V_{DS} = 48\text{ V}$, $V_{GS} = 0\text{ V}$, $T_J = 125\text{ }^\circ\text{C}$ | | - | - | 250 | |
| Drain-Source On-State Resistance | $R_{DS(on)}$ | $V_{GS} = 10\text{ V}$ | $I_D = 4.6\text{ A}^b$ | - | - | 0.20 | Ω |
| Forward Transconductance | g_{fs} | $V_{DS} = 25\text{ V}$, $I_D = 4.6\text{ A}$ | | 2.4 | - | - | S |
| Dynamic | | | | | | | |
| Input Capacitance | C_{iss} | $V_{GS} = 0\text{ V}$, $V_{DS} = 25\text{ V}$, $f = 1.0\text{ MHz}$, see fig. 5 | | - | 300 | - | pF |
| Output Capacitance | C_{oss} | | | - | 160 | - | |
| Reverse Transfer Capacitance | C_{rss} | | | - | 29 | - | |
| Total Gate Charge | Q_g | $V_{GS} = 10\text{ V}$ | $I_D = 10\text{ A}$, $V_{DS} = 48\text{ V}$, see fig. 6 and 13 ^b | - | - | 11 | nC |
| Gate-Source Charge | Q_{gs} | | | - | - | 3.1 | |
| Gate-Drain Charge | Q_{gd} | | | - | - | 5.8 | |
| Turn-On Delay Time | $t_{d(on)}$ | $V_{DD} = 30\text{ V}$, $I_D = 10\text{ A}$, $R_G = 24\text{ }\Omega$, $R_D = 2.7\text{ }\Omega$, see fig. 10 ^b | | - | 10 | - | ns |
| Rise Time | t_r | | | - | 50 | - | |
| Turn-Off Delay Time | $t_{d(off)}$ | | | - | 13 | - | |
| Fall Time | t_f | | | - | 19 | - | |
| Internal Drain Inductance | L_D | Between lead, 6 mm (0.25") from package and center of die contact ^c | | - | 4.5 | - | nH |
| Internal Source Inductance | L_S | | | - | 7.5 | - | |



| SPECIFICATIONS $T_J = 25^\circ\text{C}$, unless otherwise noted | | | | | | |
|--|----------|---|------|------|------|---------------|
| PARAMETER | SYMBOL | TEST CONDITIONS | MIN. | TYP. | MAX. | UNIT |
| Drain-Source Body Diode Characteristics | | | | | | |
| Continuous Source-Drain Diode Current | I_S | MOSFET symbol showing the integral reverse p - n junction diode  | - | - | 7.7 | A |
| Pulsed Diode Forward Current ^a | I_{SM} | | - | - | 31 | |
| Body Diode Voltage | V_{SD} | $T_J = 25^\circ\text{C}$, $I_S = 7.7\text{ A}$, $V_{GS} = 0\text{ V}^b$ | - | - | 1.6 | V |
| Body Diode Reverse Recovery Time | t_{rr} | $T_J = 25^\circ\text{C}$, $I_F = 10\text{ A}$, $dI/dt = 100\text{ A}/\mu\text{s}^b$ | - | 70 | 140 | ns |
| Body Diode Reverse Recovery Charge | Q_{rr} | | - | 0.20 | 0.40 | 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 $\leq 300\ \mu\text{s}$; duty cycle $\leq 2\%$.

TYPICAL CHARACTERISTICS 25°C , unless otherwise noted

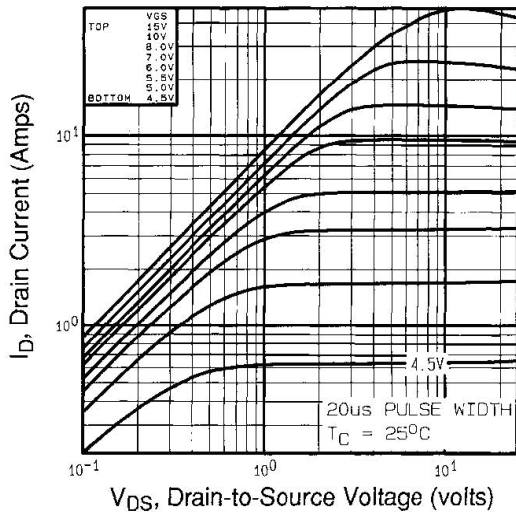


Fig. 1 - Typical Output Characteristics, $T_C = 25^\circ\text{C}$

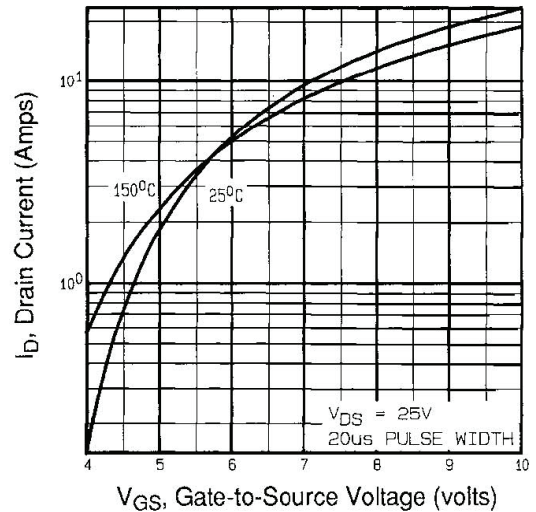


Fig. 3 - Typical Transfer Characteristics

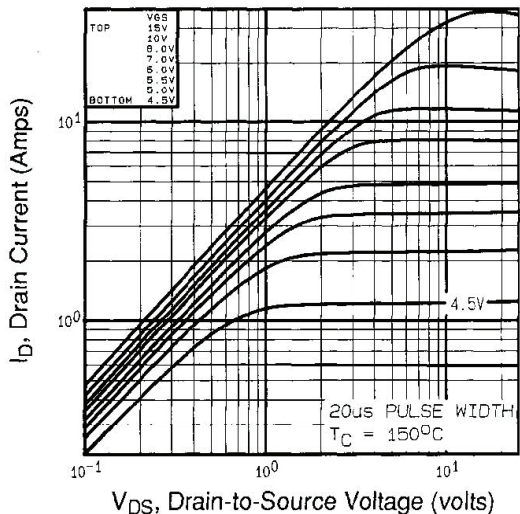


Fig. 2 - Typical Output Characteristics, $T_C = 150^\circ\text{C}$

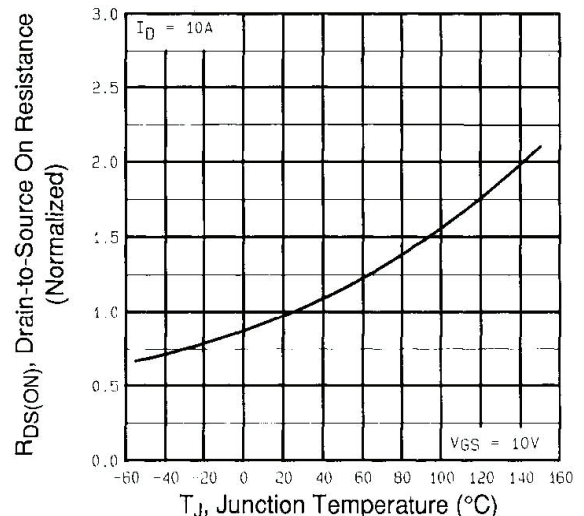


Fig. 4 - Normalized On-Resistance vs. Temperature

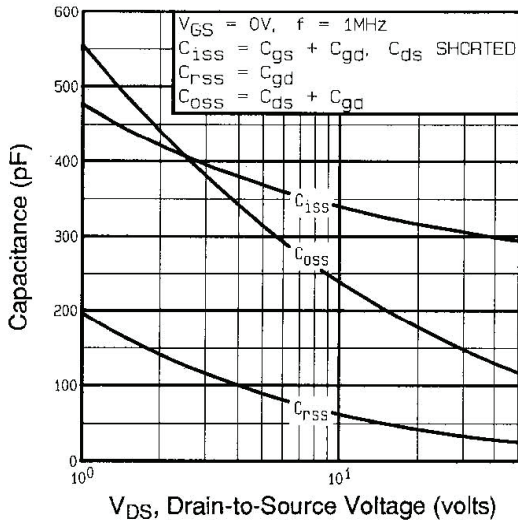


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

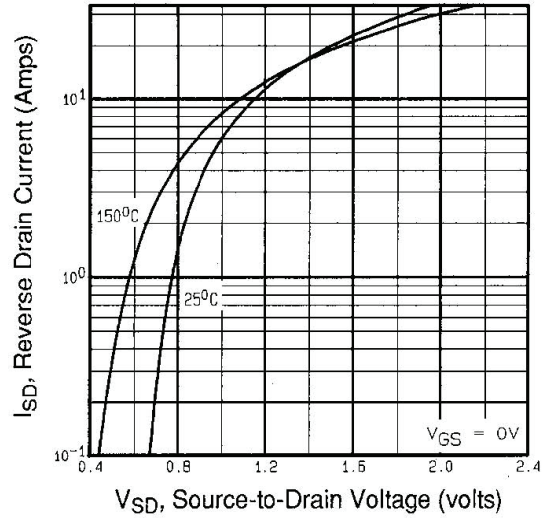


Fig. 7 - Typical Source-Drain Diode Forward Voltage

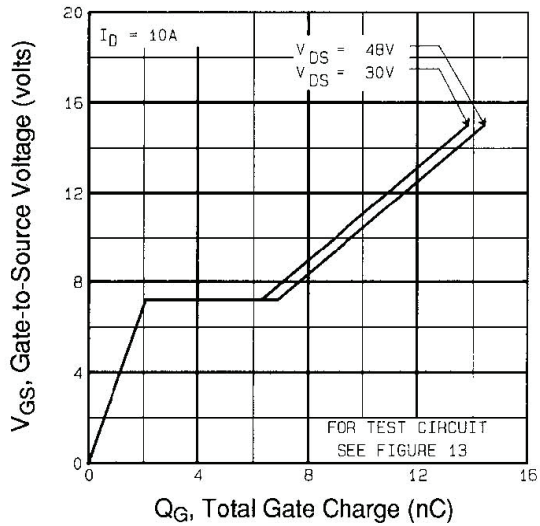


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

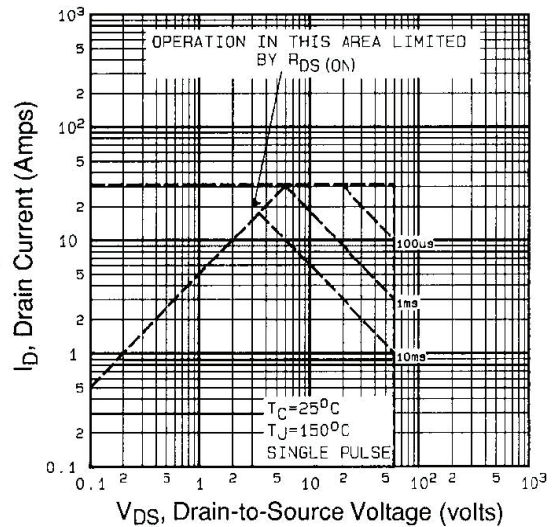


Fig. 8 - Maximum Safe Operating Area

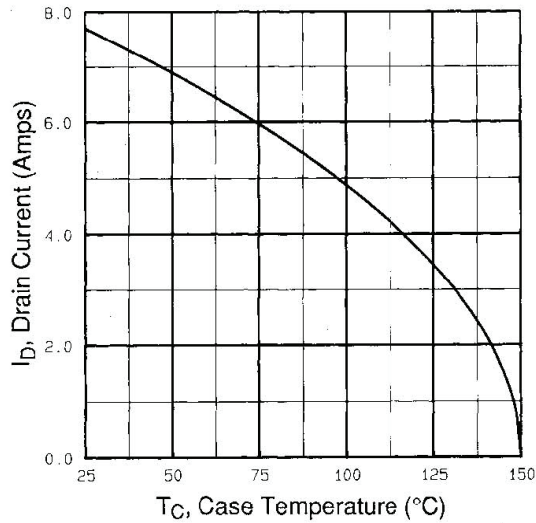


Fig. 9 - Maximum Drain Current vs. Case Temperature

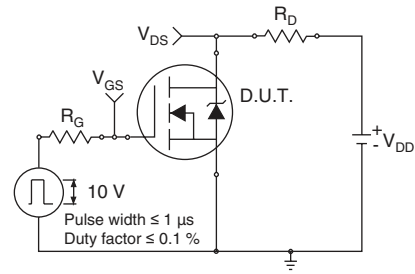


Fig. 10a - Switching Time Test Circuit

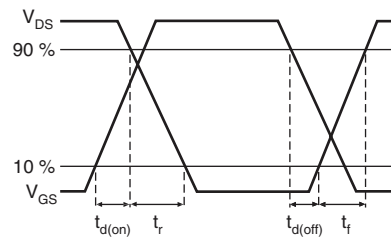


Fig. 10b - Switching Time Waveforms

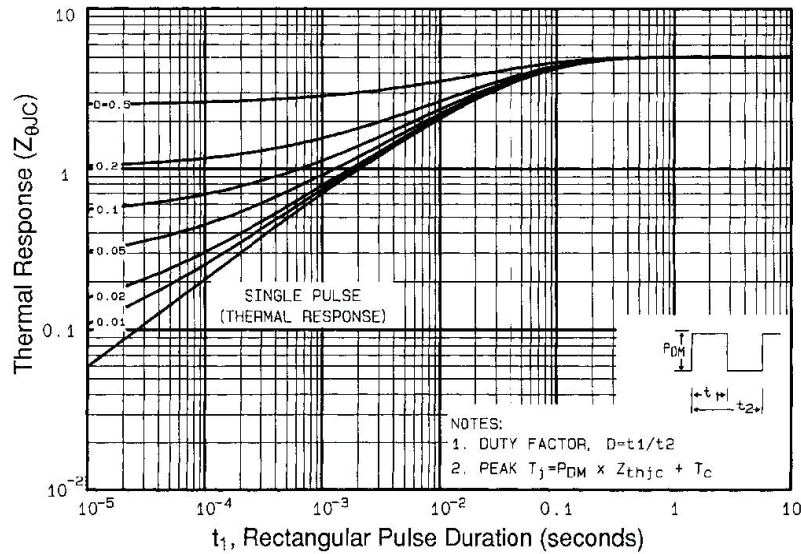


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

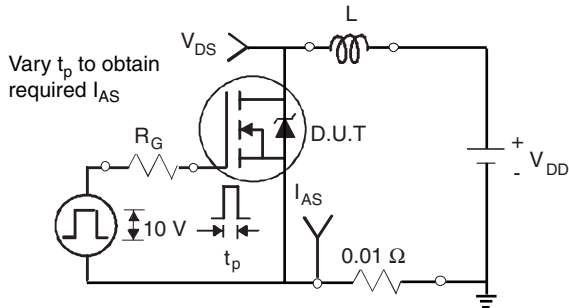


Fig. 12a - Unclamped Inductive Test Circuit

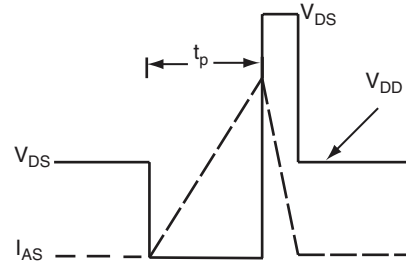


Fig. 12b - Unclamped Inductive Waveforms

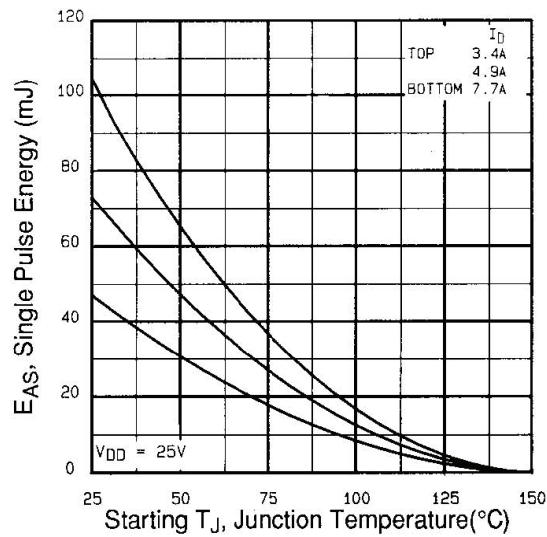


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

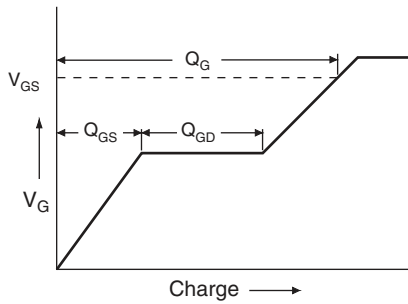
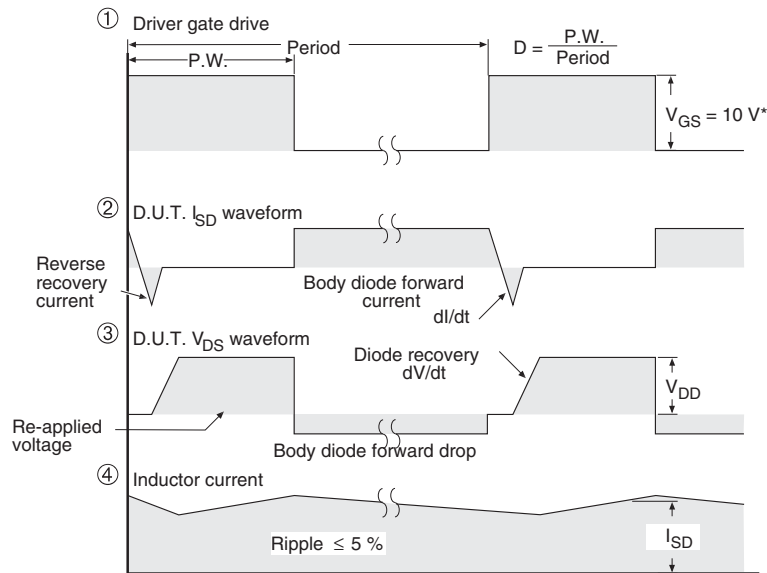
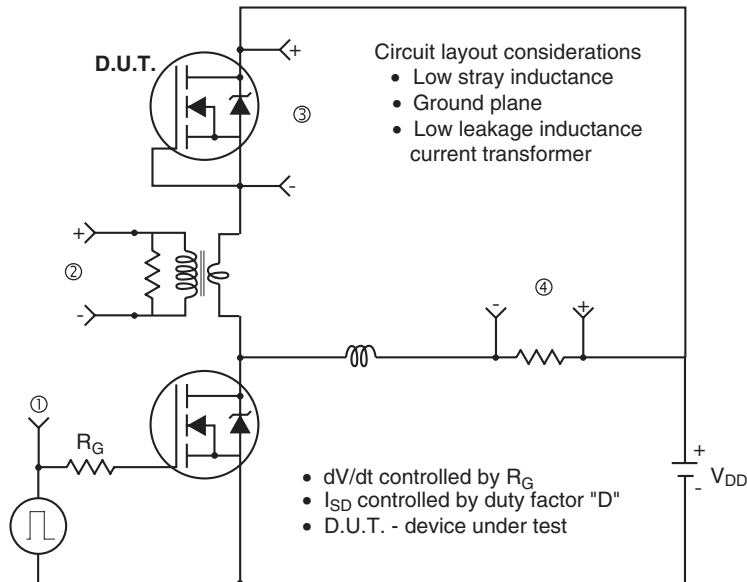


Fig. 13a - Basic Gate Charge Waveform



Fig. 13b - Gate Charge Test Circuit

Peak Diode Recovery dV/dt Test Circuit



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

Fig. 14 - For N-Channel

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