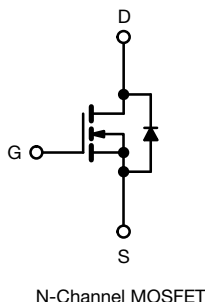
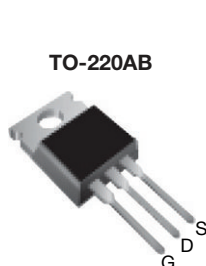


EF Series Power MOSFET with Fast Body Diode

PRODUCT SUMMARY

| | | |
|---|-----------------|-------|
| V_{DS} (V) at T_J max. | 650 | |
| $R_{DS(on)}$ max. at 25 °C (Ω) | $V_{GS} = 10$ V | 0.123 |
| Q_g (Max.) (nC) | 120 | |
| Q_{gs} (nC) | 17 | |
| Q_{gd} (nC) | 33 | |
| Configuration | Single | |



FEATURES

- Fast body diode MOSFET using E series technology
- Reduced t_{rr} , Q_{rr} , and I_{RRM}
- Low figure-of-merit (FOM): $R_{on} \times Q_g$
- Low input capacitance (C_{iss})
- Low switching losses due to reduced Q_{rr}
- Ultra low gate charge (Q_g)
- Avalanche energy rated (UIS)
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912



RoHS
COMPLIANT
HALOGEN
FREE

APPLICATIONS

- Telecommunications
 - Server and telecom power supplies
- Lighting
 - High intensity discharge (HID)
 - Light emitting diodes (LEDs)
- Consumer and computing
 - ATX power supplies
- Industrial
 - Welding
 - Battery chargers
- Renewable energy
 - Solar (PV inverters)
- Switch mode power supplies (SMPS)
 - LLC
 - Phase shifted bridge (ZVS)
 - 3-level inverter
 - AC/DC bridge

ORDERING INFORMATION

| | |
|---------------------------------|-----------------|
| Package | TO-220AB |
| Lead (Pb)-free and Halogen-free | SiHP28N60EF-GE3 |

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

| PARAMETER | SYMBOL | LIMIT | UNIT |
|---|------------------|----------------|------|
| Drain-Source Voltage | V_{DS} | 600 | V |
| Gate-Source Voltage | V_{GS} | ± 30 | |
| Continuous Drain Current ($T_J = 150$ °C) | V_{GS} at 10 V | $T_C = 25$ °C | A |
| | | $T_C = 100$ °C | |
| Pulsed Drain Current ^a | I_{DM} | 75 | |
| Linear Derating Factor | | 2 | W/°C |
| Single Pulse Avalanche Energy ^b | E_{AS} | 691 | mJ |
| Maximum Power Dissipation | P_D | 250 | W |
| Operating Junction and Storage Temperature Range | T_J, T_{stg} | -55 to +150 | °C |
| Drain-Source Voltage Slope | dV/dt | $T_J = 125$ °C | V/ns |
| Reverse Diode dV/dt ^d | | | |
| Soldering Recommendations (Peak Temperature) ^c | | for 10 s | °C |


Notes

- Repetitive rating; pulse width limited by maximum junction temperature
- $V_{DD} = 50$ V, starting $T_J = 25$ °C, $L = 28.2$ mH, $R_g = 25$ Ω , $I_{AS} = 7$ A
- 1.6 mm from case
- $I_{SD} \leq I_D$, $dI/dt = 900$ A/ μ s, starting $T_J = 25$ °C

**THERMAL RESISTANCE RATINGS**

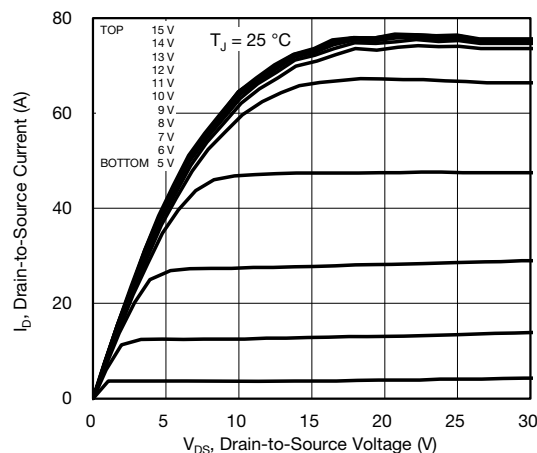
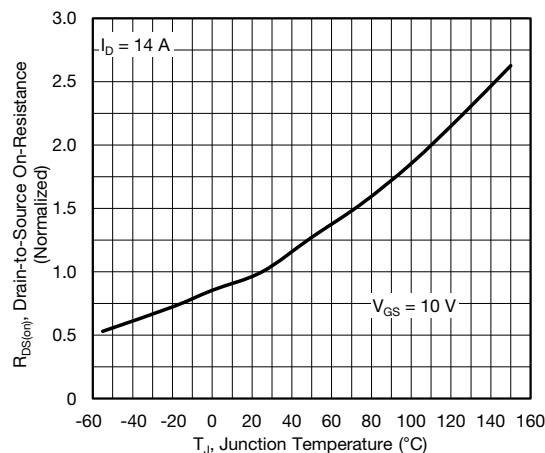
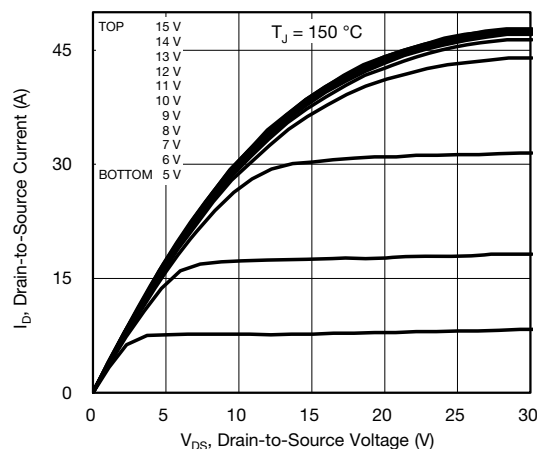
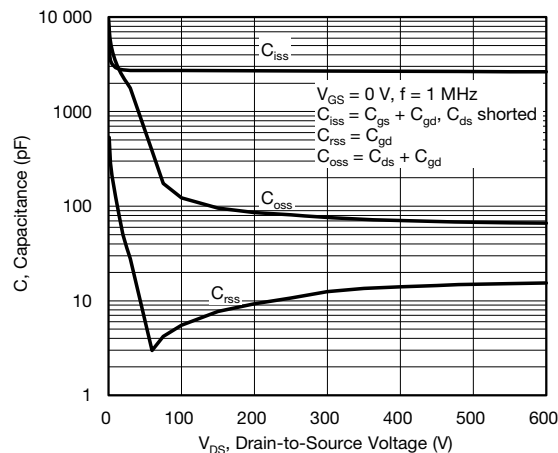
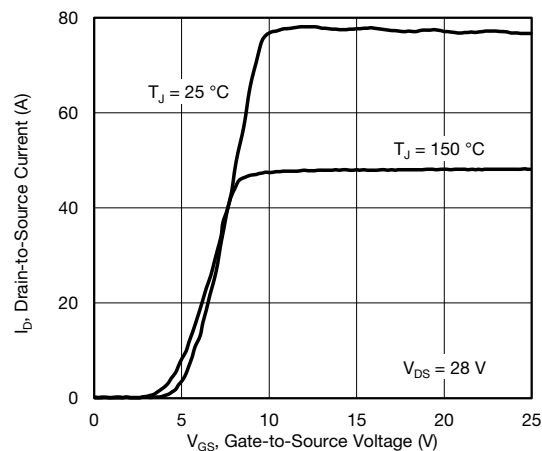
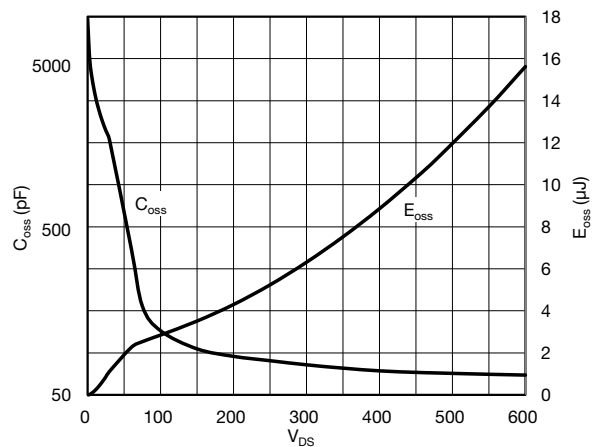
| PARAMETER | SYMBOL | TYP. | MAX. | UNIT |
|----------------------------------|------------|------|------|------|
| Maximum Junction-to-Ambient | R_{thJA} | - | 62 | °C/W |
| Maximum Junction-to-Case (Drain) | R_{thJC} | - | 0.5 | |

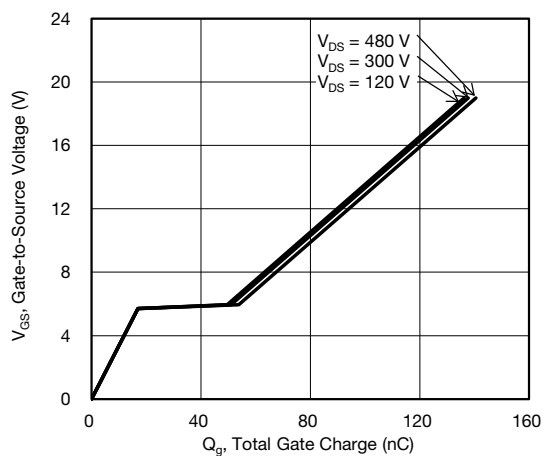
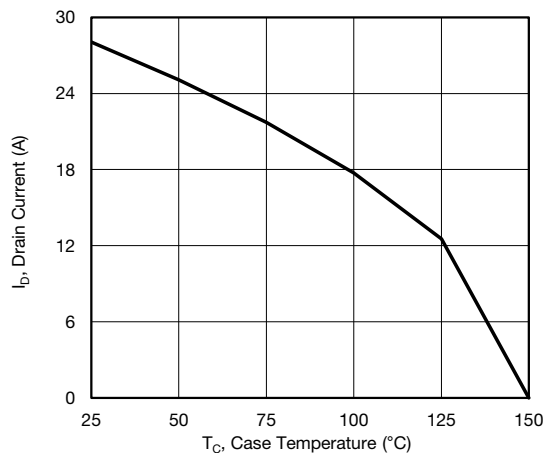
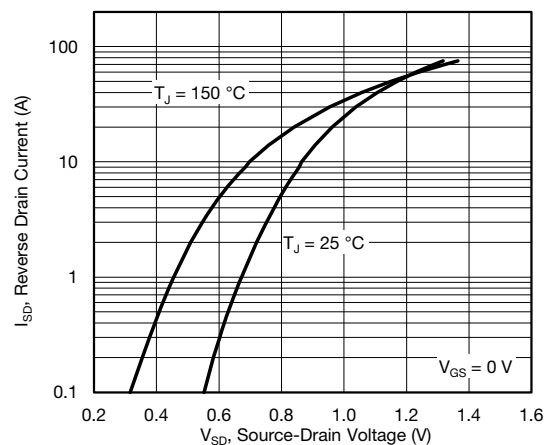
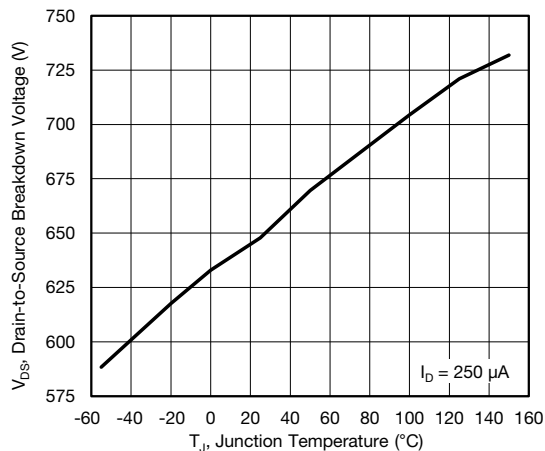
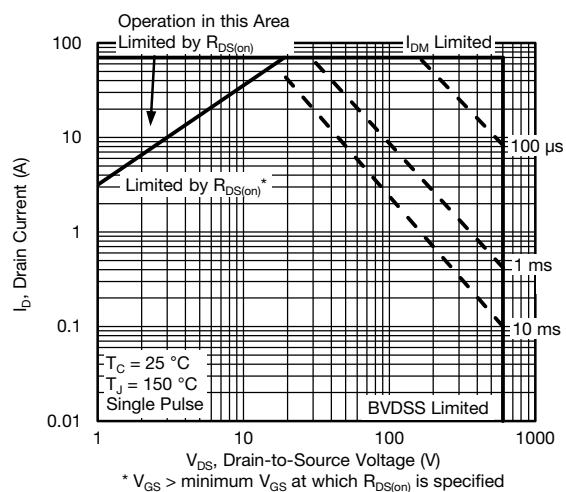
SPECIFICATIONS ($T_J = 25\text{ }^{\circ}\text{C}$, unless otherwise noted)

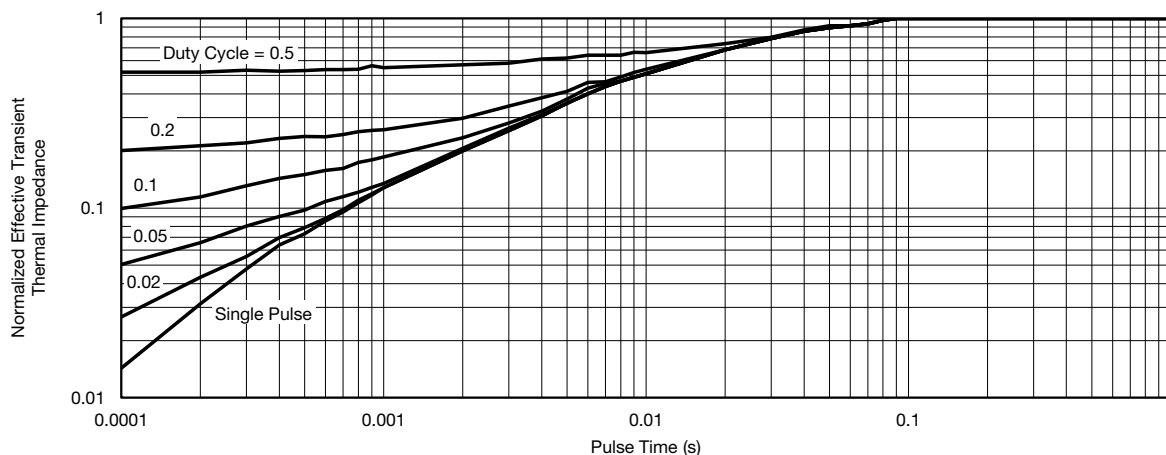
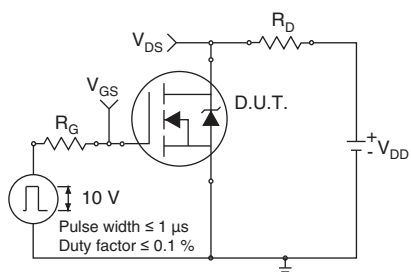
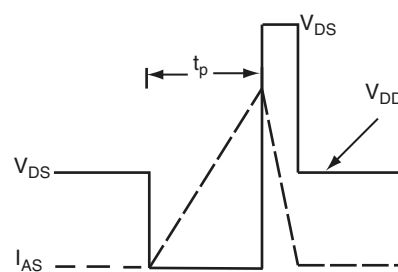
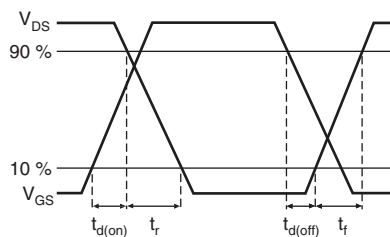
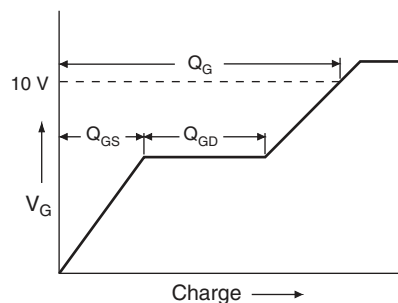
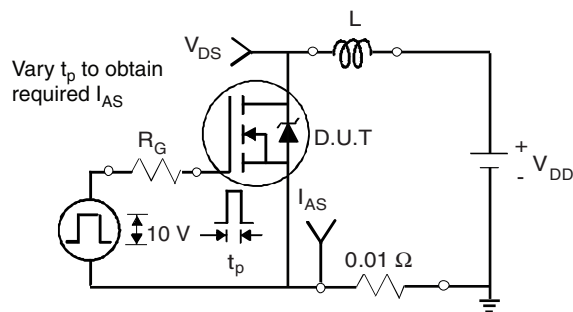
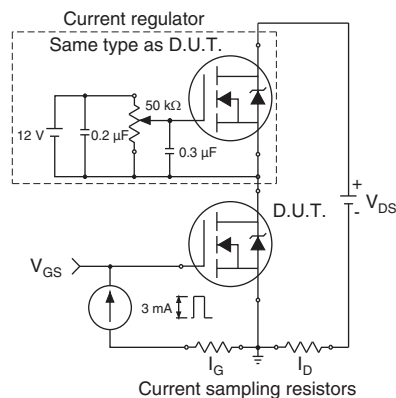
| PARAMETER | SYMBOL | TEST CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|---------------------|---|------|-------|-----------|-----------------------|
| Static | | | | | | |
| Drain-Source Breakdown Voltage | V_{DS} | $V_{GS} = 0\text{ V}$, $I_D = 250\text{ }\mu\text{A}$ | 600 | - | - | V |
| V_{DS} Temperature Coefficient | $\Delta V_{DS}/T_J$ | Reference to $25\text{ }^{\circ}\text{C}$, $I_D = 1\text{ mA}$ | - | 0.76 | - | V/ $^{\circ}\text{C}$ |
| Gate-Source Threshold Voltage (N) | $V_{GS(th)}$ | $V_{DS} = V_{GS}$, $I_D = 250\text{ }\mu\text{A}$ | 2.0 | - | 4.0 | V |
| Gate-Source Leakage | I_{GSS} | $V_{GS} = \pm 20\text{ V}$ | - | - | ± 100 | nA |
| | | $V_{GS} = \pm 30\text{ V}$ | - | - | ± 1 | μA |
| Zero Gate Voltage Drain Current | I_{DSS} | $V_{DS} = 480\text{ V}$, $V_{GS} = 0\text{ V}$ | - | - | 1 | μA |
| | | $V_{DS} = 480\text{ V}$, $V_{GS} = 0\text{ V}$, $T_J = 125\text{ }^{\circ}\text{C}$ | - | - | 2 | mA |
| Drain-Source On-State Resistance | $R_{DS(on)}$ | $V_{GS} = 10\text{ V}$, $I_D = 14\text{ A}$ | - | 0.107 | 0.123 | Ω |
| Forward Transconductance | g_{fs} | $V_{DS} = 30\text{ V}$, $I_D = 14\text{ A}$ | - | 9.7 | - | S |
| Dynamic | | | | | | |
| Input Capacitance | C_{iss} | $V_{GS} = 0\text{ V}$, $V_{DS} = 100\text{ V}$, $f = 1\text{ MHz}$ | - | 2714 | - | pF |
| Output Capacitance | C_{oss} | | - | 123 | - | |
| Reverse Transfer Capacitance | C_{rss} | | - | 6 | - | |
| Effective output capacitance, energy related ^a | $C_{o(er)}$ | $V_{GS} = 0\text{ V}$, $V_{DS} = 0\text{ V to } 480\text{ V}$ | - | 98 | - | |
| Effective output capacitance, time related ^b | $C_{o(tr)}$ | | - | 356 | - | |
| Total Gate Charge | Q_g | $V_{GS} = 10\text{ V}$, $I_D = 14\text{ A}$, $V_{DS} = 480\text{ V}$ | - | 80 | 120 | nC |
| Gate-Source Charge | Q_{gs} | | - | 17 | - | |
| Gate-Drain Charge | Q_{gd} | | - | 33 | - | |
| Turn-On Delay Time | $t_{d(on)}$ | $V_{DD} = 480\text{ V}$, $I_D = 14\text{ A}$, $R_g = 9.1\text{ }\Omega$, $V_{GS} = 10\text{ V}$ | - | 24 | 48 | ns |
| Rise Time | t_r | | - | 40 | 80 | |
| Turn-Off Delay Time | $t_{d(off)}$ | | - | 82 | 123 | |
| Fall Time | t_f | | - | 39 | 78 | |
| Gate Input Resistance | R_g | $f = 1\text{ MHz}$, open drain | 0.2 | 0.5 | 1.0 | Ω |
| Drain-Source Body Diode Characteristics | | | | | | |
| Continuous Source-Drain Diode Current | I_S | MOSFET symbol showing the integral reverse p - n junction diode  | - | - | 28 | A |
| Pulsed Diode Forward Current | I_{SM} | | - | - | 70 | |
| Diode Forward Voltage | V_{SD} | $T_J = 25\text{ }^{\circ}\text{C}$, $I_S = 11\text{ A}$, $V_{GS} = 0\text{ V}$ | - | 0.9 | 1.2 | V |
| Reverse Recovery Time | t_{rr} | $T_J = 25\text{ }^{\circ}\text{C}$, $I_F = I_S = 14\text{ A}$, $dI/dt = 100\text{ A}/\mu\text{s}$, $V_R = 400\text{ V}$ | - | 142 | 284 | ns |
| Reverse Recovery Charge | Q_{rr} | | - | 0.97 | 1.94 | μC |
| Reverse Recovery Current | I_{RRM} | | - | 13.2 | - | A |

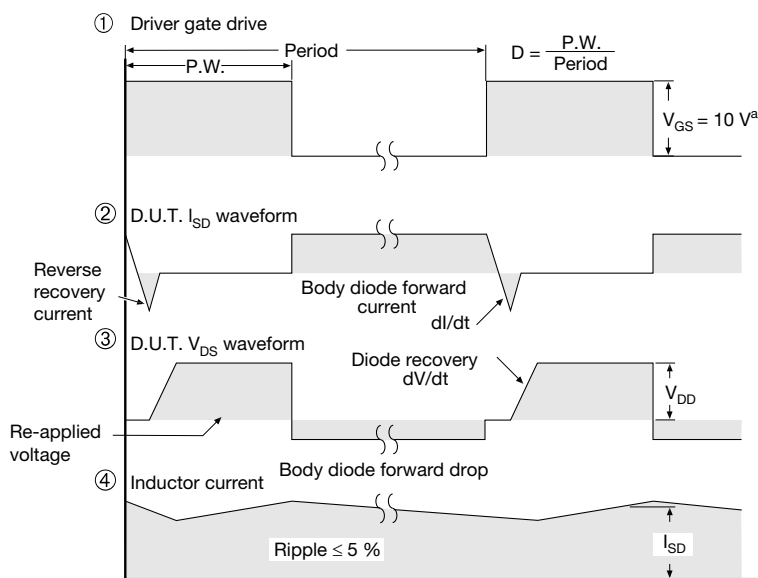
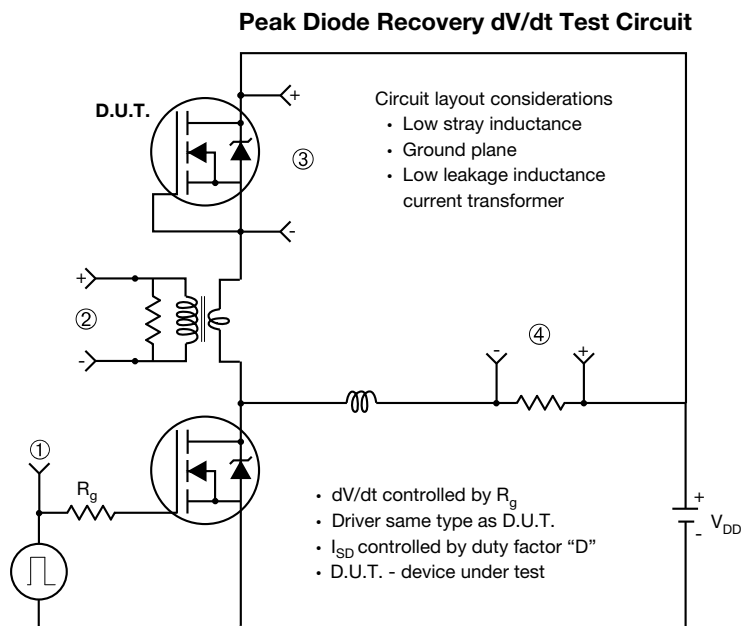
Notes

- a. $C_{oss(er)}$ is a fixed capacitance that gives the same energy as C_{oss} while V_{DS} is rising from 0 % to 80 % V_{DS}
b. $C_{oss(tr)}$ is a fixed capacitance that gives the charging time as C_{oss} while V_{DS} is rising from 0 % to 80 % V_{DS}

TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

Fig. 1 - Typical Output Characteristics

Fig. 4 - Normalized On-Resistance vs. Temperature

Fig. 2 - Typical Output Characteristics

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

Fig. 3 - Typical Transfer Characteristics

Fig. 6 - C_{oss} and E_{oss} vs. V_{DS}


Fig. 7 - Typical Gate Charge vs. Gate-to-Source Voltage

Fig. 10 - Maximum Drain Current vs. Case Temperature

Fig. 8 - Typical Source-Drain Diode Forward Voltage

Fig. 11 - Typical Drain-to-Source Voltage vs. Temperature

Fig. 9 - Maximum Safe Operating Area


Fig. 12 - Normalized Thermal Transient Impedance, Junction-to-Case

Fig. 13 - Switching Time Test Circuit

Fig. 16 - Unclamped Inductive Waveforms

Fig. 14 - Switching Time Waveforms

Fig. 17 - Basic Gate Charge Waveform

Fig. 15 - Unclamped Inductive Test Circuit

Fig. 18 - Gate Charge Test Circuit


Note

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

Fig. 19 - For N-Channel

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