

Power MOSFET

| PRODUCT SUMMARY | |
|---------------------------|-----------------------------|
| V_{DS} (V) | 100 |
| $R_{DS(on)}$ (Ω) | $V_{GS} = 10\text{ V}$ 0.54 |
| Q_g max. (nC) | 8.3 |
| Q_{gs} (nC) | 2.3 |
| Q_{gd} (nC) | 3.8 |
| Configuration | Single |



FEATURES

- Dynamic dV/dt rating
- Repetitive avalanche rated
- 175 °C operating temperature
- Fast switching
- Ease of paralleling
- Simple drive requirements
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912



Note

* This datasheet provides information about parts that are RoHS-compliant and / or parts that are non-RoHS-compliant. For example, parts with lead (Pb) terminations are not RoHS-compliant. Please see the information / tables in this datasheet for details.

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-220AB package is universally preferred for all commercial-industrial applications at power dissipation levels to approximately 50 W. The low thermal resistance and low package cost of the TO-220AB contribute to its wide acceptance throughout the industry.

| ORDERING INFORMATION | |
|----------------------|------------|
| Package | TO-220AB |
| Lead (Pb)-free | IRF510PbF |
| | SiHF510-E3 |
| SnPb | IRF510 |
| | SiHF510 |

| ABSOLUTE MAXIMUM RATINGS ($T_C = 25\text{ }^\circ\text{C}$, unless otherwise noted) | | | | |
|---|----------------------------------|----------------|-----------------------------------|----------|
| PARAMETER | | SYMBOL | LIMIT | UNIT |
| Drain-Source Voltage | | V_{DS} | 100 | V |
| Gate-Source Voltage | | V_{GS} | ± 20 | |
| Continuous Drain Current | V_{GS} at 10 V | I_D | $T_C = 25\text{ }^\circ\text{C}$ | 5.6 |
| | | | $T_C = 100\text{ }^\circ\text{C}$ | 4.0 |
| Pulsed Drain Current ^a | | I_{DM} | 20 | A |
| Linear Derating Factor | | | 0.29 | W/°C |
| Single Pulse Avalanche Energy ^b | | E_{AS} | 75 | mJ |
| Repetitive Avalanche Current ^a | | I_{AR} | 5.6 | A |
| Repetitive Avalanche Energy ^a | | E_{AR} | 4.3 | mJ |
| Maximum Power Dissipation | $T_C = 25\text{ }^\circ\text{C}$ | P_D | 43 | W |
| Peak Diode Recovery dV/dt ^c | | dV/dt | 5.5 | V/ns |
| Operating Junction and Storage Temperature Range | | T_J, T_{stg} | -55 to +175 | °C |
| Soldering Recommendations (Peak temperature) ^d | for 10 s | | 300 | |
| Mounting Torque | 6-32 or M3 screw | | 10 | lbf · in |
| | | | 1.1 | N · m |

Notes

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- $V_{DD} = 25\text{ V}$, starting $T_J = 25\text{ }^\circ\text{C}$, $L = 4.8\text{ mH}$, $R_g = 25\text{ }\Omega$, $I_{AS} = 5.6\text{ A}$ (see fig. 12).
- $I_{SD} \leq 5.6\text{ A}$, $dI/dt \leq 75\text{ A}/\mu\text{s}$, $V_{DD} \leq V_{DS}$, $T_J \leq 175\text{ }^\circ\text{C}$.
- 1.6 mm from case.



| THERMAL RESISTANCE RATINGS | | | | |
|-------------------------------------|------------|------|------|------|
| PARAMETER | SYMBOL | TYP. | MAX. | UNIT |
| Maximum Junction-to-Ambient | R_{thJA} | - | 62 | °C/W |
| Case-to-Sink, Flat, Greased Surface | R_{thCS} | 0.50 | - | |
| Maximum Junction-to-Case (Drain) | R_{thJC} | - | 3.5 | |

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} | $V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$ | 100 | - | - | V |
| V_{DS} Temperature Coefficient | $\Delta V_{DS}/T_J$ | Reference to $25\text{ }^\circ\text{C}$, $I_D = 1\text{ mA}$ | - | 0.12 | - | 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} | $V_{DS} = 100\text{ V}, V_{GS} = 0\text{ V}$ | - | - | 25 | μA |
| | | $V_{DS} = 80\text{ V}, V_{GS} = 0\text{ V}, T_J = 150\text{ }^\circ\text{C}$ | - | - | 250 | |
| Drain-Source On-State Resistance | $R_{DS(on)}$ | $V_{GS} = 10\text{ V}$ $I_D = 3.4\text{ A}^b$ | - | - | 0.54 | Ω |
| Forward Transconductance | g_{fs} | $V_{DS} = 50\text{ V}, I_D = 3.4\text{ A}^b$ | 1.3 | - | - | S |
| Dynamic | | | | | | |
| Input Capacitance | C_{iss} | $V_{GS} = 0\text{ V},$ $V_{DS} = 25\text{ V},$ $f = 1.0\text{ MHz},$ see fig. 5 | - | 180 | - | pF |
| Output Capacitance | C_{oss} | | - | 81 | - | |
| Reverse Transfer Capacitance | C_{rss} | | - | 15 | - | |
| Total Gate Charge | Q_g | $V_{GS} = 10\text{ V}$ $I_D = 5.6\text{ A}, V_{DS} = 80\text{ V}$ $V_{DS} = 10\text{ V},$ see fig. 6 and fig. 13 ^b | - | - | 8.3 | nC |
| Gate-Source Charge | Q_{gs} | | - | - | 2.3 | |
| Gate-Drain Charge | Q_{gd} | | - | - | 3.8 | |
| Turn-On Delay Time | $t_{d(on)}$ | $V_{DD} = 50\text{ V}, I_D = 5.6\text{ A}$ $R_g = 24\text{ }\Omega, R_D = 8.4\text{ }\Omega,$ see fig. 10 ^b | - | 6.9 | - | ns |
| Rise Time | t_r | | - | 16 | - | |
| Turn-Off Delay Time | $t_{d(off)}$ | | - | 15 | - | |
| Fall Time | t_f | | - | 9.4 | - | |
| 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  | - | - | 5.6 | A |
| Pulsed Diode Forward Current ^a | I_{SM} | | - | - | 20 | |
| Body Diode Voltage | V_{SD} | $T_J = 25\text{ }^\circ\text{C}, I_S = 5.6\text{ A}, V_{GS} = 0\text{ V}^b$ | - | - | 2.5 | V |
| Body Diode Reverse Recovery Time | t_{rr} | $T_J = 25\text{ }^\circ\text{C}, I_F = 5.6\text{ A}, di/dt = 100\text{ A}/\mu\text{s}^b$ | - | 100 | 200 | ns |
| Body Diode Reverse Recovery Charge | Q_{rr} | | - | 0.44 | 0.88 | 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 $\leq 2\text{ }\%$.

TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



Fig. 1 - Typical Output Characteristics, T_C = 25 °C



Fig. 4 - Normalized On-Resistance vs. Temperature



Fig. 2 - Typical Output Characteristics, T_C = 175 °C

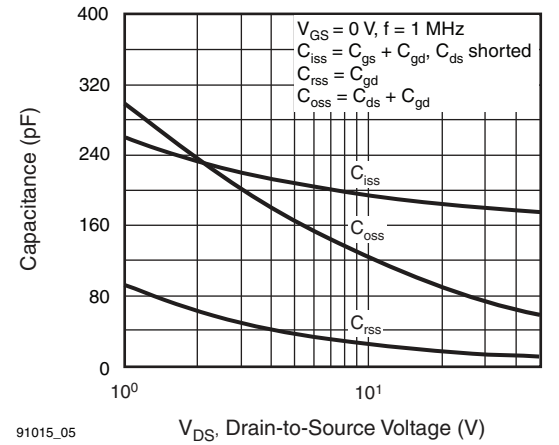


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage



Fig. 3 - Typical Transfer Characteristics

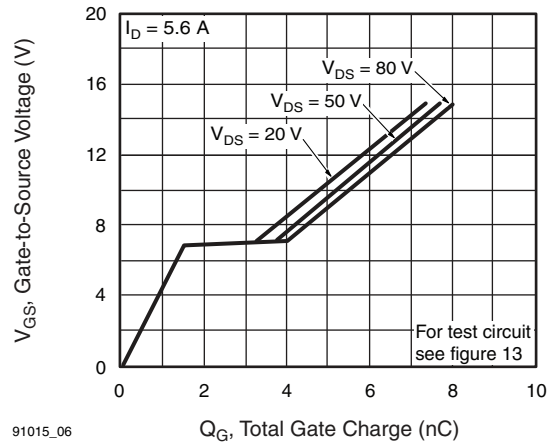
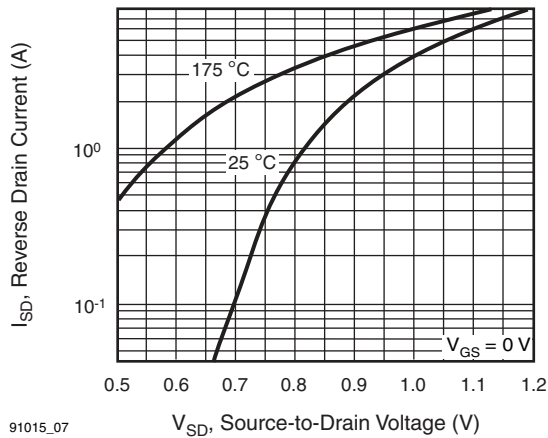
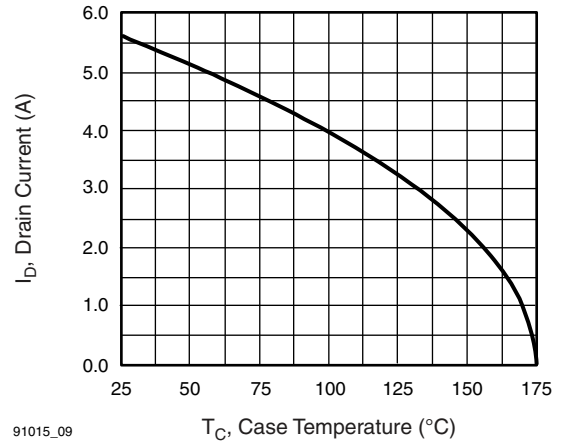


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage



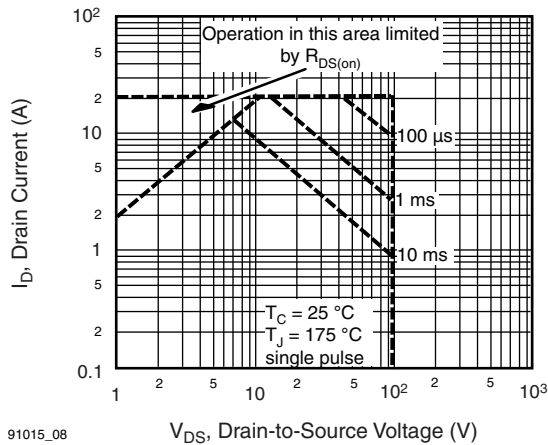
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Fig. 7 - Typical Source-Drain Diode Forward Voltage



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Fig. 9 - Maximum Drain Current vs. Case Temperature



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Fig. 8 - Maximum Safe Operating Area

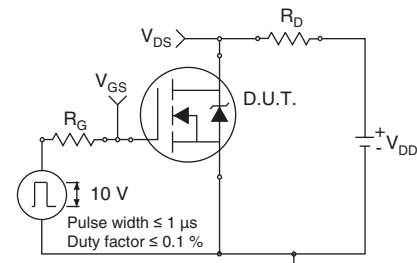


Fig. 10a - Switching Time Test Circuit

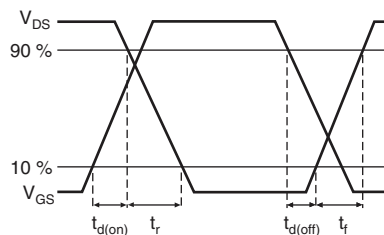
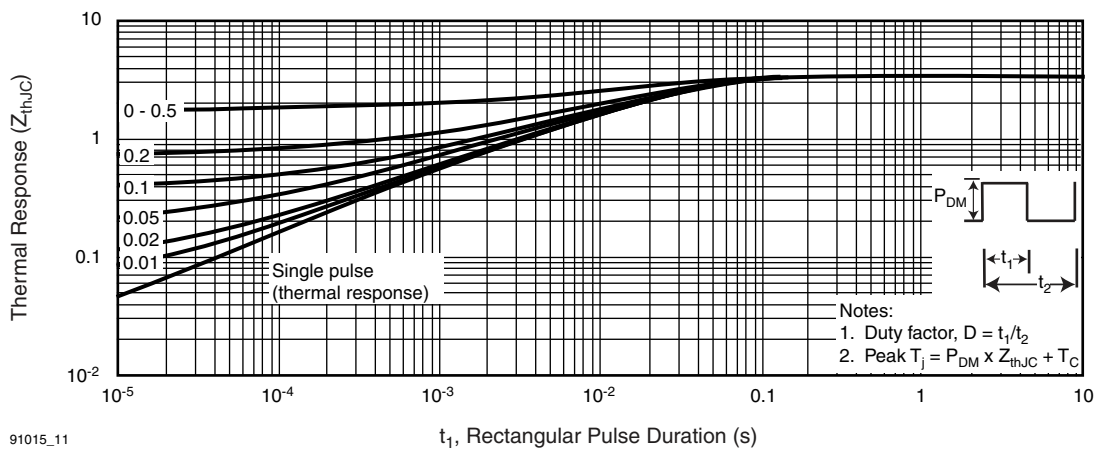


Fig. 10b - Switching Time Waveforms



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



Fig. 12a - Unclamped Inductive Test Circuit



Fig. 13a - Basic Gate Charge Waveform



Fig. 12b - Unclamped Inductive Waveforms

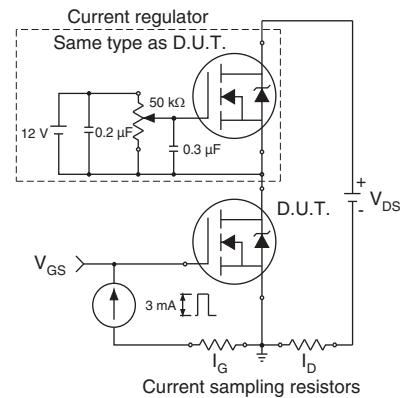


Fig. 13b - Gate Charge Test Circuit

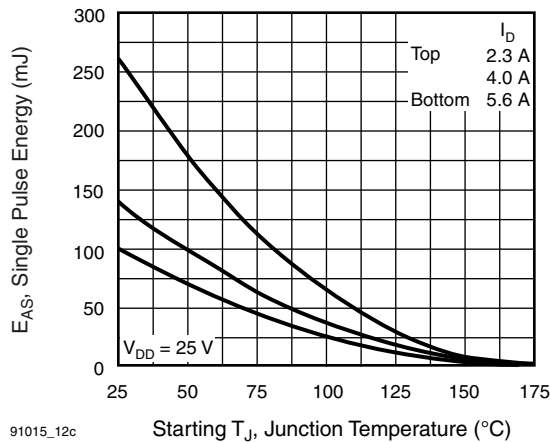
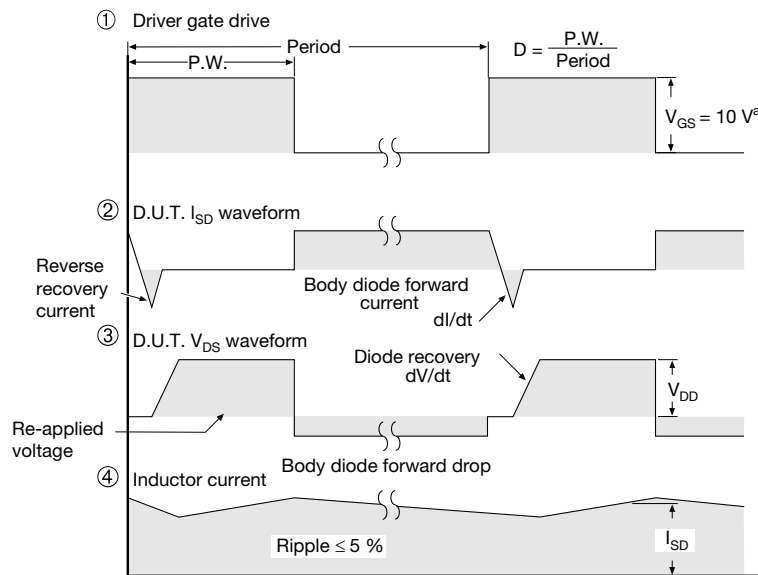
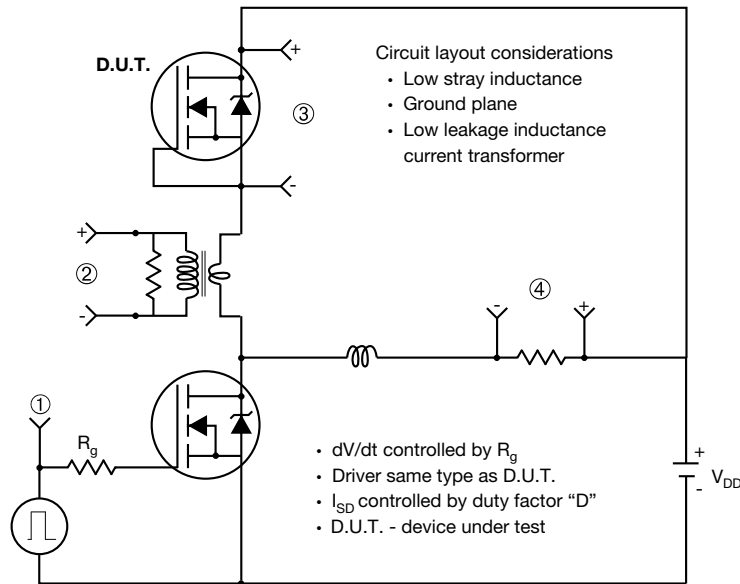


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

Peak Diode Recovery dV/dt Test Circuit



Note

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

Fig. 14 - For N-Channel

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TO-220-1



| DIM. | MILLIMETERS | | INCHES | |
|------|-------------|-------|--------|-------|
| | MIN. | MAX. | MIN. | MAX. |
| A | 4.24 | 4.65 | 0.167 | 0.183 |
| b | 0.69 | 1.02 | 0.027 | 0.040 |
| b(1) | 1.14 | 1.78 | 0.045 | 0.070 |
| c | 0.36 | 0.61 | 0.014 | 0.024 |
| D | 14.33 | 15.85 | 0.564 | 0.624 |
| E | 9.96 | 10.52 | 0.392 | 0.414 |
| e | 2.41 | 2.67 | 0.095 | 0.105 |
| e(1) | 4.88 | 5.28 | 0.192 | 0.208 |
| F | 1.14 | 1.40 | 0.045 | 0.055 |
| H(1) | 6.10 | 6.71 | 0.240 | 0.264 |
| J(1) | 2.41 | 2.92 | 0.095 | 0.115 |
| L | 13.36 | 14.40 | 0.526 | 0.567 |
| L(1) | 3.33 | 4.04 | 0.131 | 0.159 |
| Ø P | 3.53 | 3.94 | 0.139 | 0.155 |
| Q | 2.54 | 3.00 | 0.100 | 0.118 |

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DWG: 6031

Note

- M* = 0.052 inches to 0.064 inches (dimension including protrusion), heatsink hole for HVM





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