

Power MOSFET

TO-220AB


N-Channel MOSFET

FEATURES

- Low gate charge Q_g results in simple drive requirement
- Improved gate, avalanche, and dynamic dV/dt ruggedness
- Fully characterized capacitance and avalanche voltage and current
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912


RoHS*
Available

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

APPLICATIONS

- Switch mode power supply (SMPS)
- Uninterruptible power supply
- High speed power switching

APPLICABLE OFF LINE SMPS TOPOLOGIES

- Two transistor forward
- Half and full bridge
- Power factor correction boost

PRODUCT SUMMARY

| | | |
|---------------------------|------------------------|------|
| V_{DS} (V) | 500 | |
| $R_{DS(on)}$ (Ω) | $V_{GS} = 10\text{ V}$ | 0.52 |
| Q_g max. (nC) | 52 | |
| Q_{gs} (nC) | 13 | |
| Q_{gd} (nC) | 18 | |
| Configuration | Single | |

ORDERING INFORMATION

| | |
|---------------------------------|-------------------|
| Package | TO-220 |
| Lead (Pb)-free | IRFB11N50APbF |
| Lead (Pb)-free and halogen-free | IRFB11N50APbF-BE3 |

ABSOLUTE MAXIMUM RATINGS ($T_C = 25^\circ\text{C}$, unless otherwise noted)

| PARAMETER | SYMBOL | LIMIT | UNIT |
|---|------------------|---------------------------|---------------------|
| Drain-source voltage | V_{DS} | 500 | V |
| Gate-source voltage | V_{GS} | ± 30 | |
| Continuous drain current | V_{GS} at 10 V | $T_C = 25^\circ\text{C}$ | A |
| | | $T_C = 100^\circ\text{C}$ | |
| Pulsed drain current ^a | I_{DM} | 44 | |
| Linear derating factor | | 1.3 | W/ $^\circ\text{C}$ |
| Single pulse avalanche energy ^b | E_{AS} | 275 | mJ |
| Repetitive avalanche current ^a | I_{AR} | 11 | A |
| Repetitive avalanche energy ^a | E_{AR} | 17 | mJ |
| Maximum power dissipation | P_D | 170 | W |
| Peak diode recovery dV/dt ^c | dV/dt | 6.9 | 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 | |
| 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)
- Starting $T_J = 25^\circ\text{C}$, $L = 4.5\text{ mH}$, $R_G = 25\ \Omega$, $I_{AS} = 11\text{ A}$ (see fig. 12)
- $I_{SD} \leq 11\text{ A}$, $dI/dt \leq 140\text{ A}/\mu\text{s}$, $V_{DD} \leq V_{DS}$, $T_J \leq 150^\circ\text{C}$
- 1.6 mm from case

**THERMAL RESISTANCE**

| 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} | - | 0.75 | |

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

| PARAMETER | SYMBOL | TEST CONDITIONS | | MIN. | TYP. | MAX. | UNIT |
|---|-----------------------|--|---|------|------|-----------|---------------|
| Static | | | | | | | |
| Drain-source breakdown voltage | V_{DS} | $V_{GS} = 0\text{ V}$, $I_D = 250\text{ }\mu\text{A}$ | | 500 | - | - | V |
| 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} | $V_{GS} = \pm 30\text{ V}$ | | - | - | ± 100 | nA |
| Zero gate voltage drain current | I_{DSS} | $V_{DS} = 500\text{ V}$, $V_{GS} = 0\text{ V}$ | | - | - | 25 | μA |
| | | $V_{DS} = 400\text{ V}$, $V_{GS} = 0\text{ V}$, $T_J = 150\text{ }^\circ\text{C}$ | | - | - | 250 | |
| Drain-source on-state resistance | $R_{DS(on)}$ | $V_{GS} = 10\text{ V}$ | $I_D = 6.6\text{ A}^b$ | - | - | 0.52 | Ω |
| Forward transconductance | g_{fs} | $V_{DS} = 50\text{ V}$, $I_D = 6.6\text{ A}$ | | 6.1 | - | - | S |
| Dynamic | | | | | | | |
| Input capacitance | C_{iss} | $V_{GS} = 0\text{ V}$, $V_{DS} = 25\text{ V}$, $f = 1.0\text{ MHz}$, see fig. 5 | | - | 1423 | - | pF |
| Output capacitance | C_{oss} | | | - | 208 | - | |
| Reverse transfer capacitance | C_{rss} | | | - | 8.1 | - | |
| Output capacitance | C_{oss} | $V_{GS} = 0\text{ V}$ | $V_{DS} = 1.0\text{ V}$, $f = 1.0\text{ MHz}$ | - | 2000 | - | |
| Effective output capacitance | $C_{oss\text{ eff.}}$ | | $V_{DS} = 400\text{ V}$, $f = 1.0\text{ MHz}$ | - | 55 | - | |
| Total gate charge | Q_g | $V_{GS} = 10\text{ V}$ | $I_D = 11\text{ A}$, $V_{DS} = 400\text{ V}$ see fig. 6 and 13 ^b | - | - | 52 | nC |
| Gate-source charge | Q_{gs} | | | - | - | 13 | |
| Gate-drain charge | Q_{gd} | | | - | - | 18 | |
| Turn-on delay time | $t_{d(on)}$ | $V_{DD} = 250\text{ V}$, $I_D = 11\text{ A}$ $R_G = 9.1\text{ }\Omega$, $R_D = 22\text{ }\Omega$, see fig. 10 ^b | | - | 14 | - | ns |
| Rise time | t_r | | | - | 35 | - | |
| Turn-off delay time | $t_{d(off)}$ | | | - | 32 | - | |
| Fall time | t_f | | | - | 28 | - | |
| Gate input resistance | R_g | $f = 1\text{ MHz}$, open drain | | 0.5 | - | 3.2 | Ω |
| Drain-Source Body Diode Characteristics | | | | | | | |
| Continuous source-drain diode current | I_S | MOSFET symbol showing the integral reverse p - n junction diode |  | - | - | 11 | A |
| Pulsed diode forward current ^a | I_{SM} | | | - | - | 44 | |
| Body diode voltage | V_{SD} | $T_J = 25\text{ }^\circ\text{C}$, $I_S = 11\text{ A}$, $V_{GS} = 0\text{ V}^b$ | | - | - | 1.5 | V |
| Body diode reverse recovery time | t_{rr} | $T_J = 25\text{ }^\circ\text{C}$, $I_F = 11\text{ A}$, $dI/dt = 100\text{ A}/\mu\text{s}^b$ | | - | 510 | 770 | ns |
| Body diode reverse recovery charge | Q_{rr} | | | - | 3.4 | 5.1 | 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 $\leq 2\%$
c. $C_{oss\text{ eff.}}$ effective is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 % to 80 % V_{DS}



TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

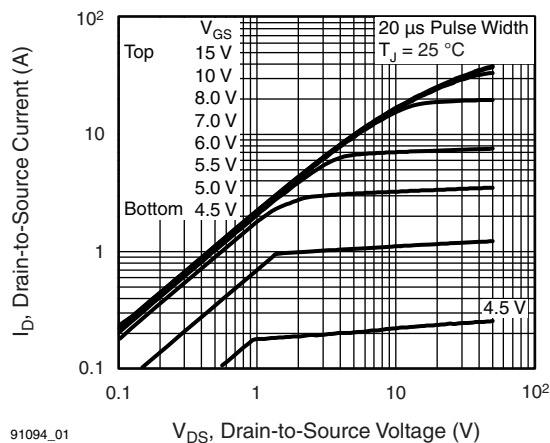


Fig. 1 - Typical Output Characteristics

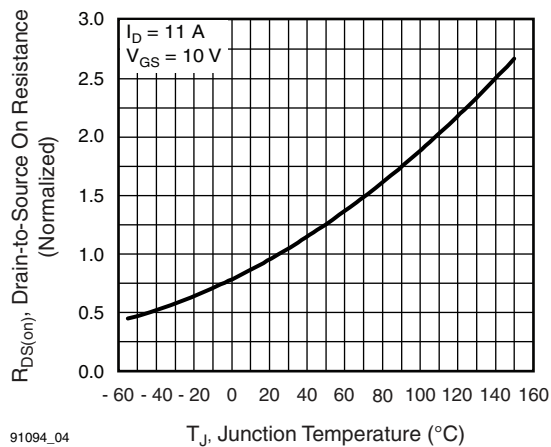


Fig. 4 - Normalized On-Resistance vs. Temperature

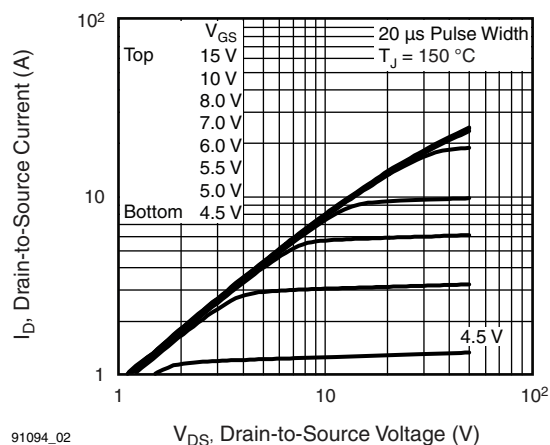


Fig. 2 - Typical Output Characteristics

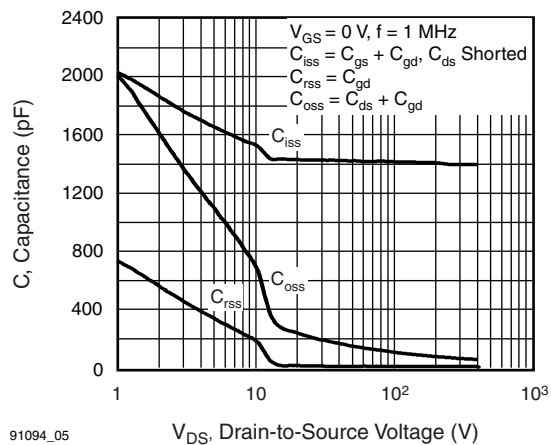


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

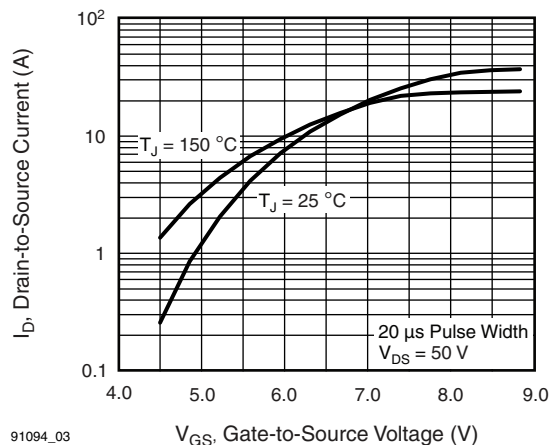


Fig. 3 - Typical Transfer Characteristics

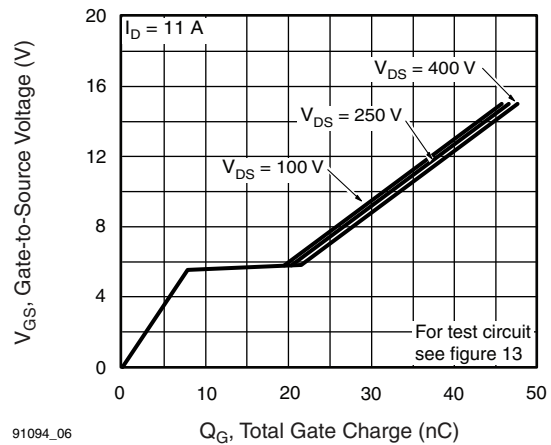
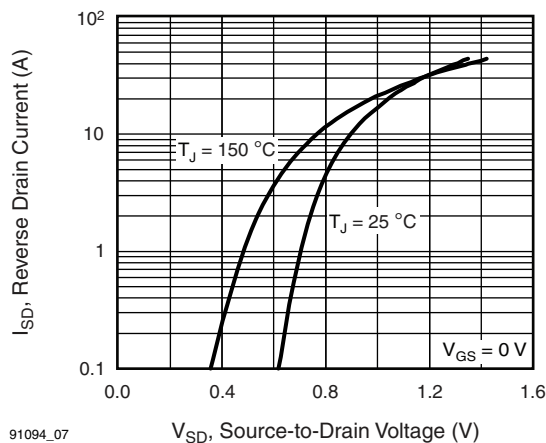
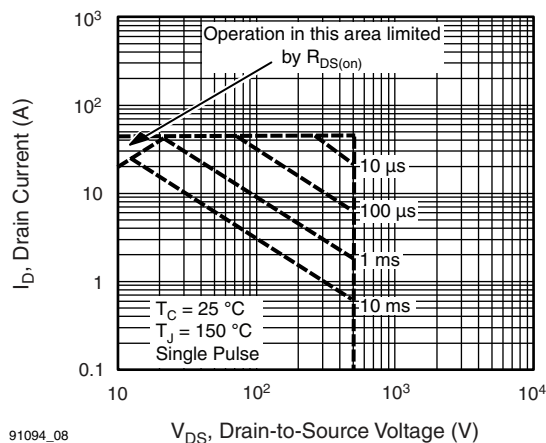
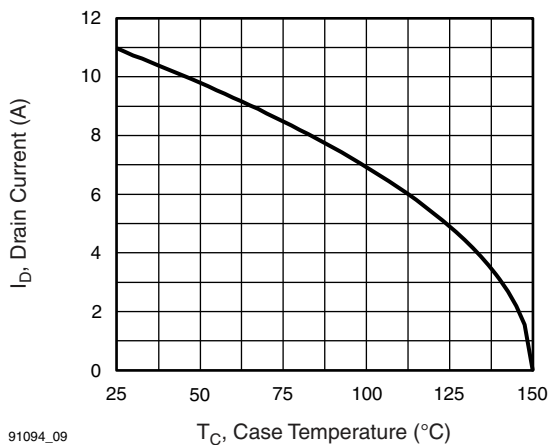
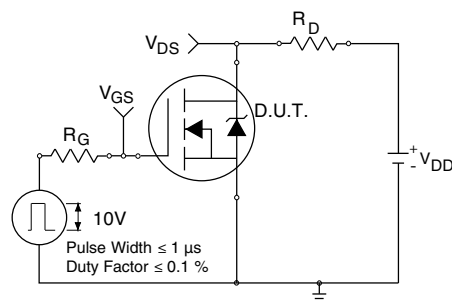
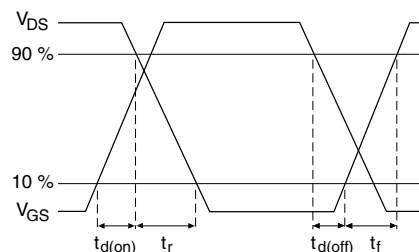
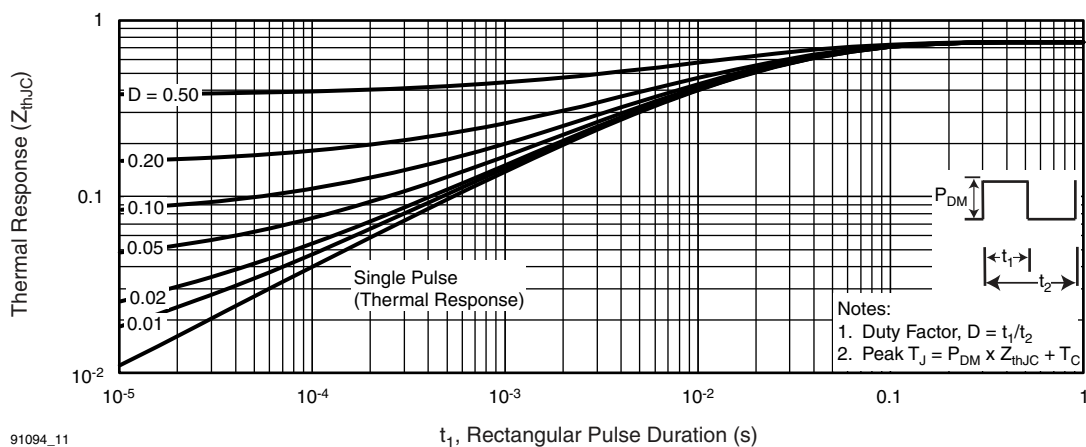
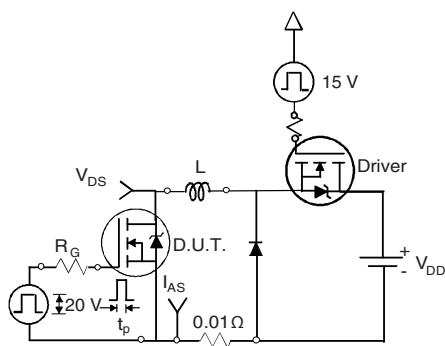
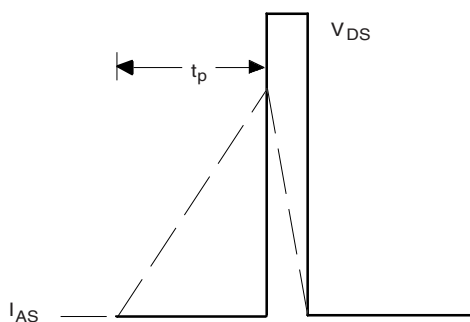
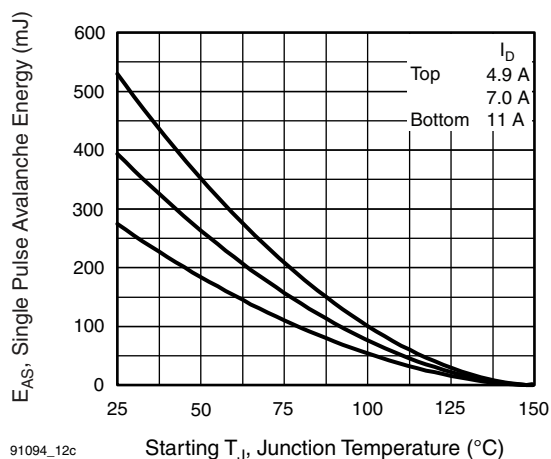
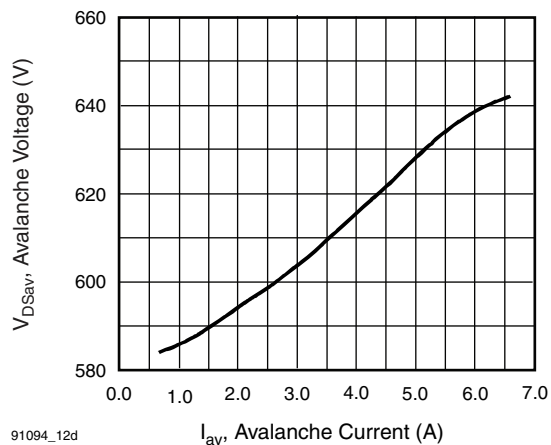
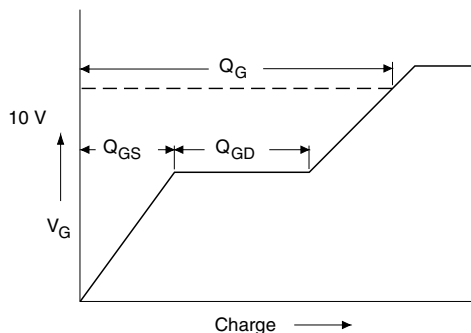
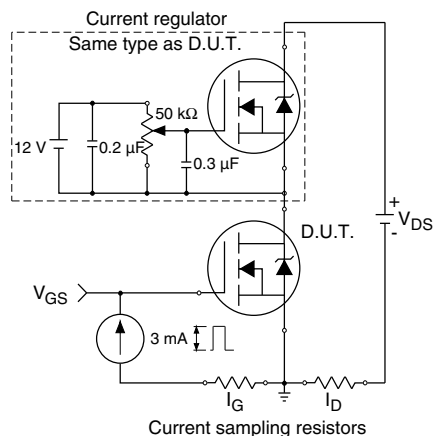
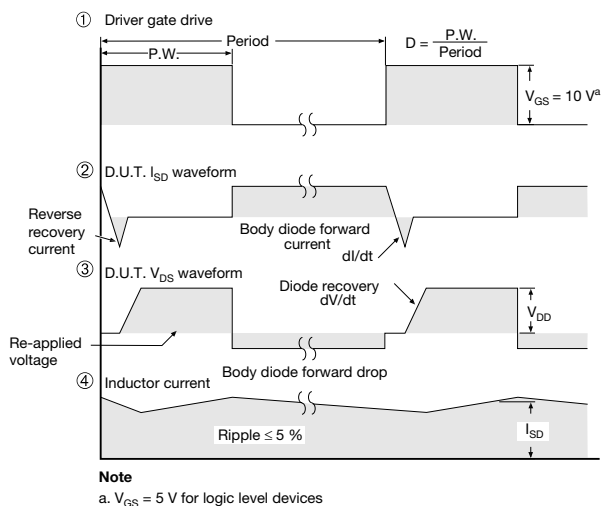
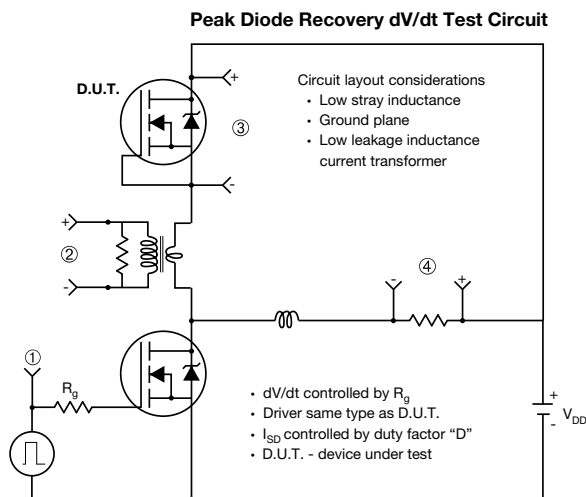


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage


Fig. 7 - Typical Source-Drain Diode Forward 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. 12d - Typical Drain-to-Source Voltage vs. Avalanche Current


Fig. 13a - Basic Gate Charge Waveform

Fig. 13b - Gate Charge Test Circuit

Fig. 14 - For N-Channel

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