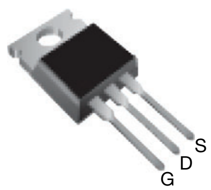
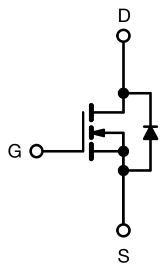
# Power MOSFET

TO-220AB




N-Channel MOSFET

| PRODUCT SUMMARY | | |
|---|---|---|
| $V_{DS}$ (V) | 500 | |
| $R_{DS(on)}$ (Ω) | $V_{GS}$ = 10 V | 0.85 |
| $Q_g$ max. (nC) | 39 | |
| $Q_{gs}$ (nC) | 10 | |
| $Q_{gd}$ (nC) | 19 | |
| Configuration | Single | |

## FEATURES

- Ultra low gate charge
- Reduced gate drive requirement
- Enhanced 30 V $V_{GS}$ rating
- Reduced $C_{iss}$, $C_{oss}$, $C_{rss}$
- Extremely high frequency operation
- Repetitive avalanche rated
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Available

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

## DESCRIPTION

This new series of low charge power MOSFETs achieve significantly lower gate charge over conventional MOSFETs. Utilizing the new LCDMOS technology, the device improvements are achieved without added product cost, allowing for reduced gate drive requirements and total system savings. In addition, reduced switching losses and improved efficiency are achievable in a variety of high frequency applications. Frequencies of a few MHz at high current are possible using the new low charge MOSFETs.

These device improvements combined with the proven ruggedness and reliability that are characteristic of Power MOSFETs offer the designer a new standard in power transistors for switching applications.

| ORDERING INFORMATION | |
|---|---|
| Package | TO-220AB |
| Lead (Pb)-free | IRF840LCPbF |
| Lead (Pb)-free and halogen-free | IRF840LCPbF-BE3 |

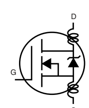
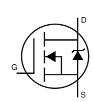
**ABSOLUTE MAXIMUM RATINGS** ($T_C$ = 25 °C, unless otherwise noted)

| 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 °C | $I_D$ | 8.0 | A |
| | | $T_C$ = 100 °C | | 5.1 | |
| Pulsed drain current [a] | | | $I_{DM}$ | 28 | |
| Linear derating factor | | | | 1.0 | W/°C |
| Single pulse avalanche energy [b] | | | $E_{AS}$ | 510 | mJ |
| Repetitive avalanche current [a] | | | $I_{AR}$ | 8.0 | A |
| Repetitive avalanche energy [a] | | | $E_{AR}$ | 13 | mJ |
| Maximum power dissipation | $T_C$ = 25 °C | | $P_D$ | 125 | W |
| Peak diode recovery dV/dt [c] | | | dV/dt | 3.5 | V/ns |
| Operating junction and storage temperature range | | | $T_J$, $T_{stg}$ | -55 to +150 | °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**

a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11)
b. $V_{DD}$ = 50 V, starting $T_J$ = 25 °C, L = 14 mH, $R_g$ = 25 Ω, $I_{AS}$ = 8.0 A (see fig. 12)
c. $I_{SD} \leq 8.0$ A, dI/dt ≤ 100 A/μs, $V_{DD} \leq V_{DS}$, $T_J \leq 150$ °C
d. 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) | $R_{thJC}$ | - | 1.0 | |

| **SPECIFICATIONS** ($T_J$ = 25 °C, unless otherwise noted) | | | | | | |
|---|---|---|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **TEST CONDITIONS** | **MIN.** | **TYP.** | **MAX.** | **UNIT** |
| **Static** | | | | | | |
| Drain-source breakdown voltage | $V_{DS}$ | $V_{GS}$ = 0 V, $I_D$ = 250 μA | 500 | - | - | V |
| $V_{DS}$ temperature coefficient | $\Delta V_{DS}/T_J$ | Reference to 25 °C, $I_D$ = 1 mA | - | 0.63 | - | V/°C |
| Gate-source threshold voltage | $V_{GS(th)}$ | $V_{DS} = V_{GS}$, $I_D$ = 250 μA | 2.0 | - | 4.0 | V |
| Gate-source leakage | $I_{GSS}$ | $V_{GS}$ = ± 20 V | - | - | ± 100 | nA |
| Zero gate voltage drain current | $I_{DSS}$ | $V_{DS}$ = 500 V, $V_{GS}$ = 0 V | - | - | 25 | μA |
| | | $V_{DS}$ = 400V, $V_{GS}$ = 0 V, $T_J$ = 125 °C | - | - | 250 | |
| Drain-source on-state resistance | $R_{DS(on)}$ | $V_{GS}$ = 10 V, $I_D$ = 4.8 A [b] | - | - | 0.85 | Ω |
| Forward transconductance | $g_{fs}$ | $V_{DS}$ = 50 V, $I_D$ = 4.8 A [b] | 4.0 | - | - | S |
| **Dynamic** | | | | | | |
| Drain-source breakdown voltage | $C_{iss}$ | $V_{GS}$ = 0 V, $V_{DS}$ = 25 V, f = 1.0 MHz, see fig. 5 | - | 1100 | - | pF |
| $V_{DS}$ temperature coefficient | $C_{oss}$ | | - | 170 | - | |
| Gate-source threshold voltage | $C_{rss}$ | | - | 18 | - | |
| Gate-source leakage | $Q_g$ | $V_{GS}$ = 10 V, $I_D$ = 8.0 A, $V_{DS}$ = 400 V see fig. 6 and 13 [b] | - | - | 39 | nC |
| Zero gate voltage drain current | $Q_{gs}$ | | - | - | 10 | |
| | $Q_{gd}$ | | - | - | 19 | |
| Drain-source on-state resistance | $t_{d(on)}$ | $V_{DD}$ = 250 V, $I_D$ = 8.0 A, $R_g$ = 9.1 Ω, $R_D$= 30 Ω see fig. 10 [b] | - | 12 | - | ns |
| Forward transconductance | $t_r$ | | - | 25 | - | |
| Drain-source breakdown voltage | $t_{d(off)}$ | | - | 27 | - | |
| $V_{DS}$ temperature coefficient | $t_f$ | | - | 19 | - | |
| Gate input resistance | $R_g$ | f = 1 MHz, open drain | 0.7 | - | 3.7 | Ω |
| 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  | - | - | 8.0 | A |
| Pulsed diode forward current [a] | $I_{SM}$ | | - | - | 28 | |
| Body diode voltage | $V_{SD}$ | $T_J$ = 25 °C, $I_S$ = 8.0 A, $V_{GS}$ = 0 V [b] | - | - | 2.0 | V |
| Body diode reverse recovery time | $t_{rr}$ | $T_J$ = 25 °C, $I_F$ = 8.0 A, dI/dt = 100 A/μs [b] | - | 490 | 740 | ns |
| Body diode reverse recovery charge | $Q_{rr}$ | | - | 3.0 | 4.5 | 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 ≤ 300 μs; duty cycle ≤ 2 %

**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)

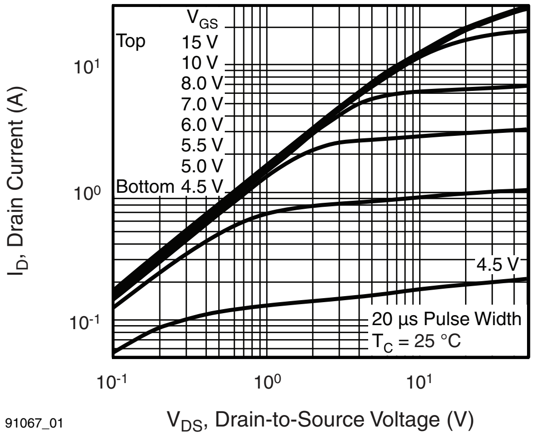



**Fig. 1 - Typical Output Characteristics, $T_C$ = 25 °C**

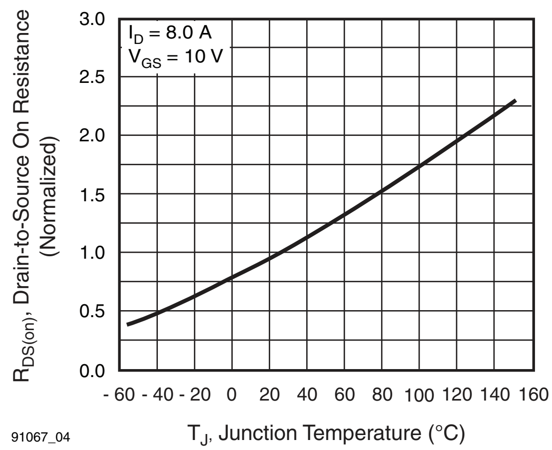



**Fig. 4 - Normalized On-Resistance vs. Temperature**

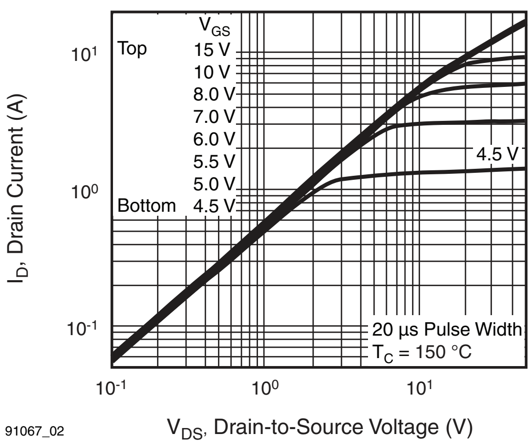



**Fig. 2 - Typical Output Characteristics, $T_C$ = 150 °C**

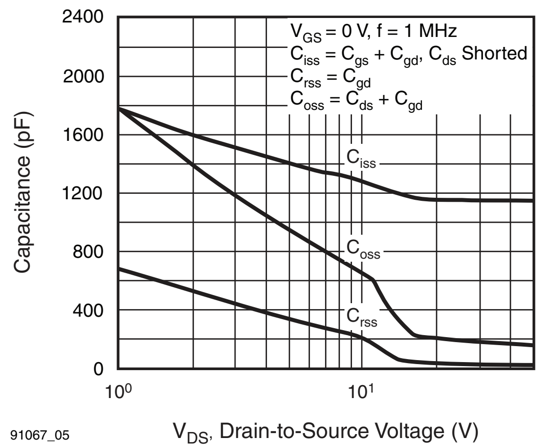



**Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage**

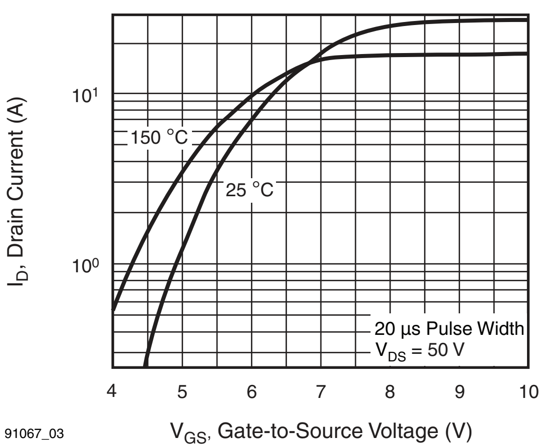



**Fig. 3 - Typical Transfer Characteristics**

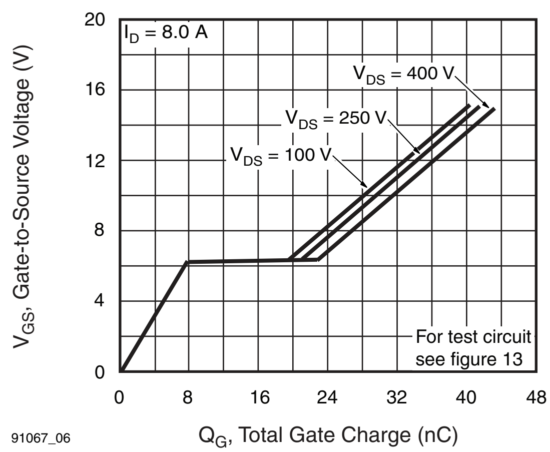



**Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage**

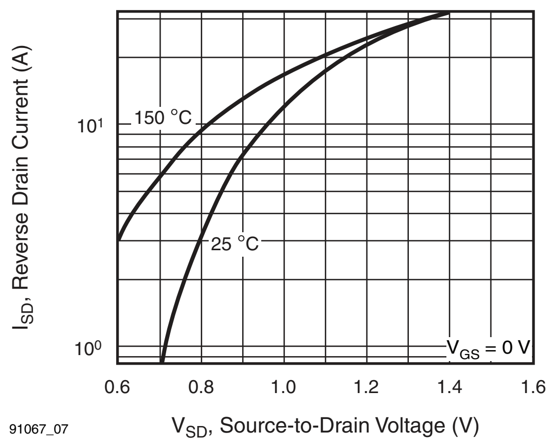



**Fig. 7 - Typical Source-Drain Diode Forward Voltage**

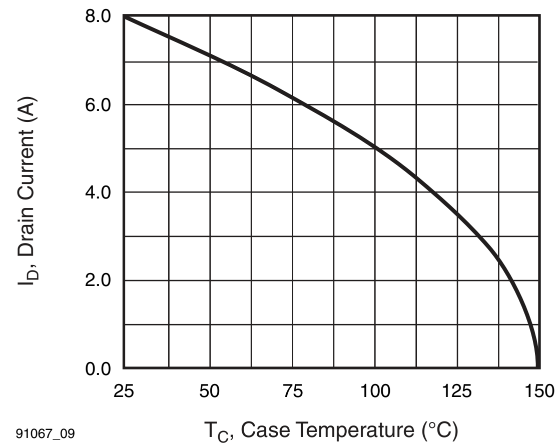



**Fig. 9 - Maximum Drain Current vs. Case Temperature**

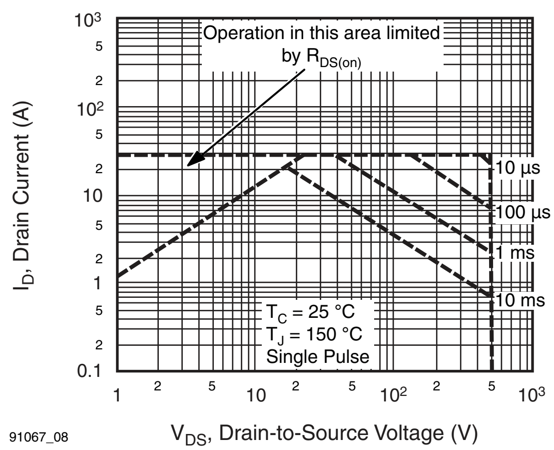



**Fig. 8 - Maximum Safe Operating Area**

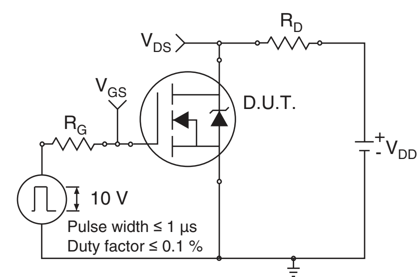



**Fig. 10a - Switching Time Test Circuit**

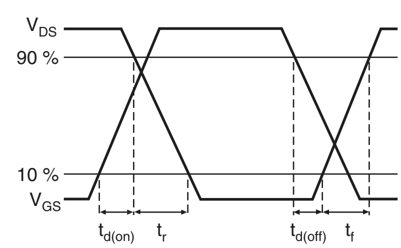



**Fig. 10b - Switching Time Waveforms**

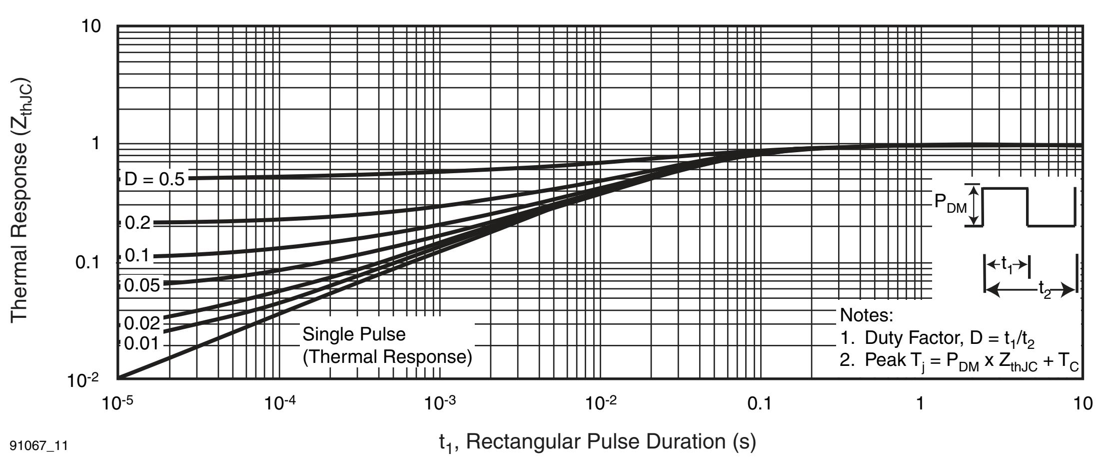



**Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case**

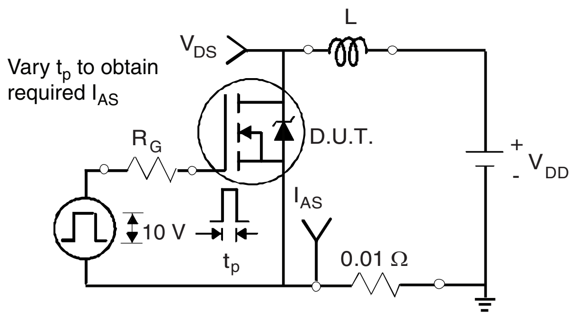



**Fig. 12a - Unclamped Inductive Test Circuit**

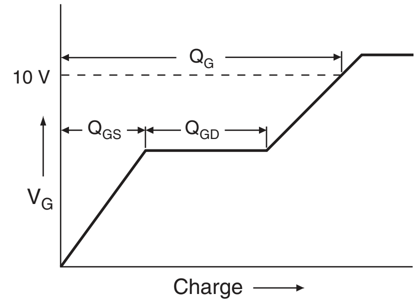



**Fig. 13a - Basic Gate Charge Waveform**

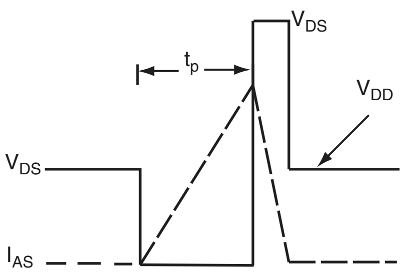



**Fig. 12b - Unclamped Inductive Waveforms**

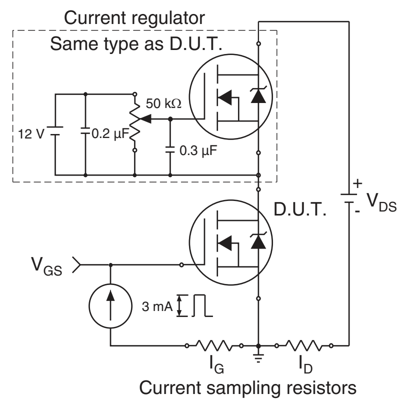



**Fig. 13b - Gate Charge Test Circuit**

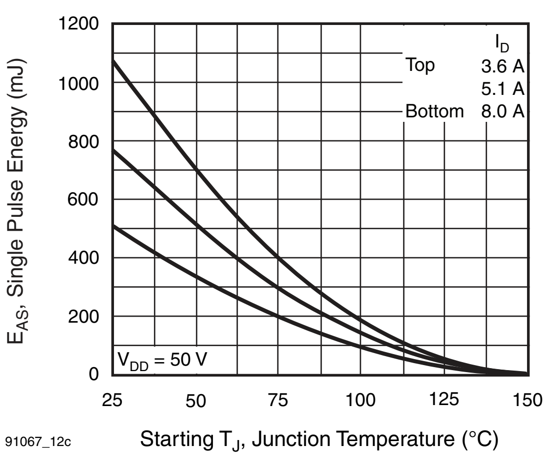
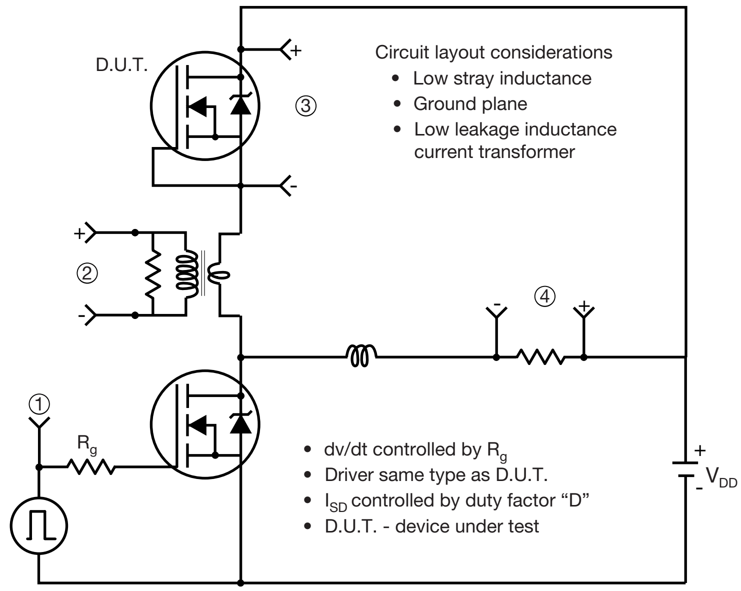
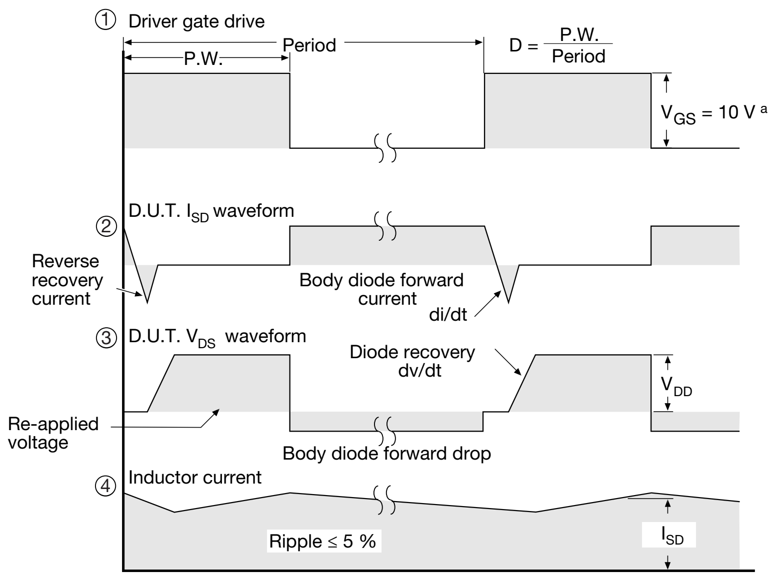



**Fig. 12c - Maximum Avalanche Energy vs. Drain Current**

**Peak Diode Recovery dv/dt Test Circuit**



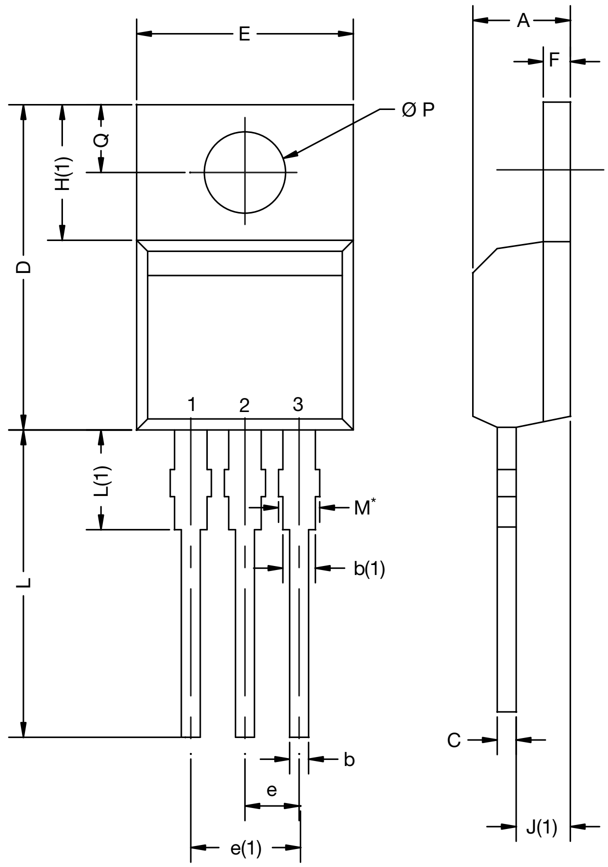

**Note**

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

**Fig. 14 - For N-Channel**

*Vishay Siliconix maintains worldwide manufacturing capability. Products may be manufactured at one of several qualified locations. Reliability data for Silicon Technology and Package Reliability represent a composite of all qualified locations. For related documents such as package/tape drawings, part marking, and reliability data, see www.vishay.com/ppg?91067.*

# 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 |
| ECN: E21-0621-Rev. D, 04-Nov-2021<br>DWG: 6031 | | | | |

**Note**

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

# Disclaimer

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, “Vishay”), disclaim any and all liability for any errors, inaccuracies or incompleteness contained in any datasheet or in any other disclosure relating to any product.

Vishay makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, Vishay disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.

Statements regarding the suitability of products for certain types of applications are based on Vishay's knowledge of typical requirements that are often placed on Vishay products in generic applications. Such statements are not binding statements about the suitability of products for a particular application. It is the customer's responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Parameters provided in datasheets and / or specifications may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated for each customer application by the customer's technical experts. Product specifications do not expand or otherwise modify Vishay's terms and conditions of purchase, including but not limited to the warranty expressed therein.

Hyperlinks included in this datasheet may direct users to third-party websites. These links are provided as a convenience and for informational purposes only. Inclusion of these hyperlinks does not constitute an endorsement or an approval by Vishay of any of the products, services or opinions of the corporation, organization or individual associated with the third-party website. Vishay disclaims any and all liability and bears no responsibility for the accuracy, legality or content of the third-party website or for that of subsequent links.

Except as expressly indicated in writing, Vishay products are not designed for use in medical, life-saving, or life-sustaining applications or for any other application in which the failure of the Vishay product could result in personal injury or death. Customers using or selling Vishay products not expressly indicated for use in such applications do so at their own risk. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay. Product names and markings noted herein may be trademarks of their respective owners.