

## Power MOSFET

| PRODUCT SUMMARY           |                        |     |
|---------------------------|------------------------|-----|
| $V_{DS}$ (V)              | 850                    |     |
| $R_{DS(on)}$ ( $\Omega$ ) | $V_{GS} = 10\text{ V}$ | 2.7 |
| $Q_g$ (Max.) (nC)         | 78                     |     |
| $Q_{gs}$ (nC)             | 9.6                    |     |
| $Q_{gd}$ (nC)             | 45                     |     |
| Configuration             | Single                 |     |

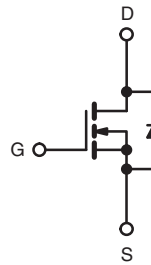
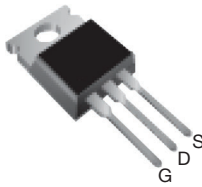
### FEATURES

- Halogen-free According to IEC 61249-2-21 Definition
- Dynamic  $dV/dt$  Rating
- Repetitive Avalanche Rated
- Fast Switching
- Ease of Paralleling
- Simple Drive Requirements
- Compliant to RoHS Directive 2002/95/EC



**RoHS\***  
 COMPLIANT  
 HALOGEN  
**FREE**  
 Available

TO-220AB



N-Channel MOSFET

| ABSOLUTE MAXIMUM RATINGS ( $T_C = 25\text{ }^\circ\text{C}$ , unless otherwise noted) |                                  |                                   |                           |          |
|---------------------------------------------------------------------------------------|----------------------------------|-----------------------------------|---------------------------|----------|
| PARAMETER                                                                             | SYMBOL                           | LIMIT                             | UNIT                      |          |
| Drain-Source Voltage                                                                  | $V_{DS}$                         | 850                               | V                         |          |
| Gate-Source Voltage                                                                   | $V_{GS}$                         | $\pm 20$                          |                           |          |
| Continuous Drain Current                                                              | $V_{GS}$ at 10 V                 | $T_C = 25\text{ }^\circ\text{C}$  | A                         |          |
|                                                                                       |                                  | $T_C = 100\text{ }^\circ\text{C}$ |                           |          |
| Pulsed Drain Current <sup>a</sup>                                                     | $I_{DM}$                         | 16                                |                           |          |
| Linear Derating Factor                                                                |                                  | 1.0                               | $\text{W}/^\circ\text{C}$ |          |
| Single Pulse Avalanche Energy <sup>b</sup>                                            | $E_{AS}$                         | 260                               | mJ                        |          |
| Avalanche Current <sup>a</sup>                                                        | $I_{AR}$                         | 4.1                               | A                         |          |
| Repetitive Avalanche Energy <sup>a</sup>                                              | $E_{AR}$                         | 13                                | mJ                        |          |
| Maximum Power Dissipation                                                             | $T_C = 25\text{ }^\circ\text{C}$ | $P_D$                             | 125                       | W        |
| Peak Diode Recovery $dV/dt$ <sup>c</sup>                                              | $dV/dt$                          | 2.0                               | V/ns                      |          |
| Operating Junction and Storage Temperature Range                                      | $T_J, T_{stg}$                   | - 55 to + 150                     | $^\circ\text{C}$          |          |
| Soldering Recommendations (Peak Temperature)                                          | for 10 s                         | 300 <sup>d</sup>                  |                           |          |
| 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).
- $V_{DD} = 50\text{ V}$ , starting  $T_J = 25\text{ }^\circ\text{C}$ ,  $L = 29\text{ mH}$ ,  $R_g = 25\text{ }\Omega$ ,  $I_{AS} = 4.1\text{ A}$  (see fig. 12).
- $I_{SD} \leq 4.1\text{ A}$ ,  $dI/dt \leq 100\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq 600\text{ V}$ ,  $T_J \leq 150\text{ }^\circ\text{C}$ .
- 1.6 mm from case.

| THERMAL RESISTANCE RATINGS          |            |      |      |      |      |
|-------------------------------------|------------|------|------|------|------|
| PARAMETER                           | SYMBOL     | MIN. | 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  |      |

**Note**

a. 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          |
| <b>Static</b>                                                               |                     |                                                                                                                             |                                                                                |      |      |           |               |
| Drain-Source Breakdown Voltage                                              | $V_{DS}$            | $V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$                                                                         |                                                                                | 850  | -    | -         | V             |
| $V_{DS}$ Temperature Coefficient                                            | $\Delta V_{DS}/T_J$ | Reference to $25\text{ }^\circ\text{C}$ , $I_D = 1\text{ mA}$                                                               |                                                                                | -    | 0.90 | -         | 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                                                         | $I_{GSS}$           | $V_{GS} = \pm 20\text{ V}$                                                                                                  |                                                                                | -    | -    | $\pm 100$ | nA            |
| Zero Gate Voltage Drain Current                                             | $I_{DSS}$           | $V_{DS} = 800\text{ V}, V_{GS} = 0\text{ V}$                                                                                |                                                                                | -    | -    | 100       | $\mu\text{A}$ |
|                                                                             |                     | $V_{DS} = 640\text{ V}, V_{GS} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$                                               |                                                                                | -    | -    | 500       |               |
| Drain-Source On-State Resistance                                            | $R_{DS(on)}$        | $V_{GS} = 10\text{ V}$                                                                                                      | $I_D = 2.5\text{ A}^b$                                                         | -    | 2.7  | -         | $\Omega$      |
| Forward Transconductance                                                    | $g_{fs}$            | $V_{DS} = 100\text{ V}, I_D = 2.5\text{ A}$                                                                                 |                                                                                | 2.5  | -    | -         | S             |
| <b>Dynamic</b>                                                              |                     |                                                                                                                             |                                                                                |      |      |           |               |
| Input Capacitance                                                           | $C_{iss}$           | $V_{GS} = 0\text{ V},$<br>$V_{DS} = 25\text{ V},$<br>$f = 1.0\text{ MHz}$ , see fig. 5                                      |                                                                                | -    | 1300 | -         | pF            |
| Output Capacitance                                                          | $C_{oss}$           |                                                                                                                             |                                                                                | -    | 310  | -         |               |
| Reverse Transfer Capacitance                                                | $C_{rss}$           |                                                                                                                             |                                                                                | -    | 190  | -         |               |
| Total Gate Charge                                                           | $Q_g$               | $V_{GS} = 10\text{ V}$                                                                                                      | $I_D = 4.1\text{ A}, V_{DS} = 400\text{ V},$<br>see fig. 6 and 13 <sup>b</sup> | -    | -    | 78        | nC            |
| Gate-Source Charge                                                          | $Q_{gs}$            |                                                                                                                             |                                                                                | -    | -    | 9.6       |               |
| Gate-Drain Charge                                                           | $Q_{gd}$            |                                                                                                                             |                                                                                | -    | -    | 45        |               |
| Turn-On Delay Time                                                          | $t_{d(on)}$         | $V_{DD} = 400\text{ V}, I_D = 4.1\text{ A},$<br>$R_g = 12\text{ }\Omega, R_D = 95\text{ }\Omega$ , see fig. 10 <sup>b</sup> |                                                                                | -    | 12   | -         | ns            |
| Rise Time                                                                   | $t_r$               |                                                                                                                             |                                                                                | -    | 33   | -         |               |
| Turn-Off Delay Time                                                         | $t_{d(off)}$        |                                                                                                                             |                                                                                | -    | 82   | -         |               |
| Fall Time                                                                   | $t_f$               |                                                                                                                             |                                                                                | -    | 30   | -         |               |
| Internal Drain Inductance                                                   | $L_D$               | Between lead,<br>6 mm (0.25") from<br>package and center of<br>die contact                                                  |                                                                                | -    | 4.5  | -         | nH            |
| Internal Source Inductance                                                  | $L_S$               |                                                                                                                             |                                                                                | -    | 7.5  | -         |               |
| <b>Drain-Source Body Diode Characteristics</b>                              |                     |                                                                                                                             |                                                                                |      |      |           |               |
| Continuous Source-Drain Diode Current                                       | $I_S$               | MOSFET symbol<br>showing the<br>integral reverse<br>p - n junction diode                                                    |                                                                                | -    | -    | 4.1       | A             |
| Pulsed Diode Forward Current <sup>a</sup>                                   | $I_{SM}$            |                                                                                                                             |                                                                                | -    | -    | 16        |               |
| Body Diode Voltage                                                          | $V_{SD}$            | $T_J = 25\text{ }^\circ\text{C}, I_S = 4.1\text{ A}, V_{GS} = 0\text{ V}^b$                                                 |                                                                                | -    | -    | 1.8       | V             |
| Body Diode Reverse Recovery Time                                            | $t_{rr}$            | $T_J = 25\text{ }^\circ\text{C}, I_F = 4.1\text{ A}, dI/dt = 100\text{ A}/\mu\text{s}^b$                                    |                                                                                | -    | 480  | 720       | ns            |
| Body Diode Reverse Recovery Charge                                          | $Q_{rr}$            |                                                                                                                             |                                                                                | -    | 1.8  | 2.7       | nC            |
| 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  $\leq 2\%$ .

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

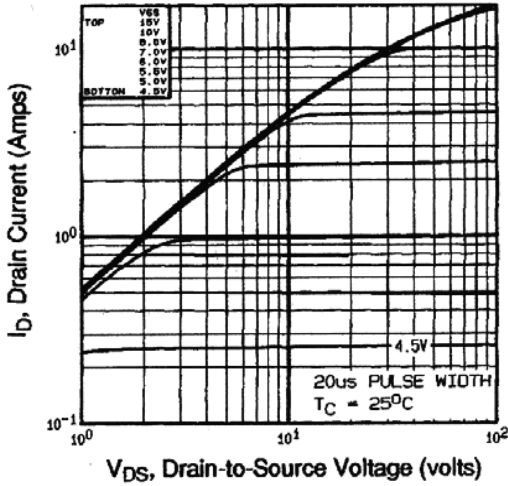


Fig. 1 - Typical Output Characteristics,  $T_C = 25\text{ }^\circ\text{C}$

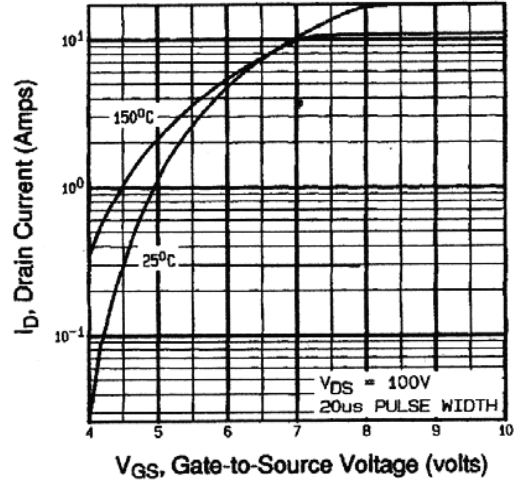


Fig. 3 - Typical Transfer Characteristics



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



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

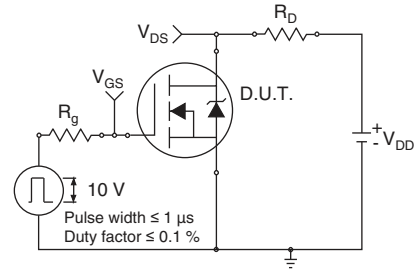


Fig. 10a - Switching Time Test Circuit

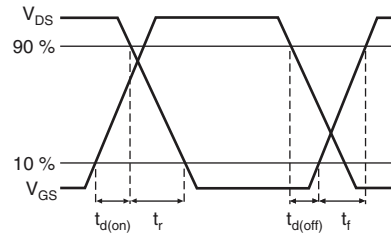


Fig. 10b - Switching Time Waveforms



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

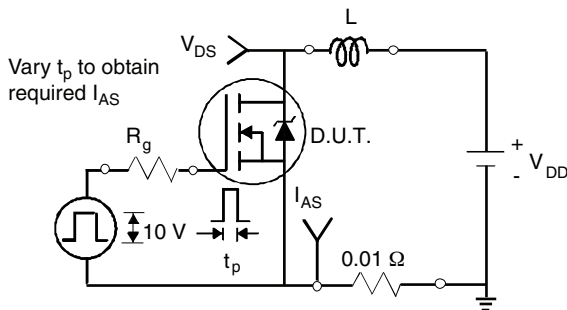


Fig. 12a - Unclamped Inductive Test Circuit



Fig. 12b - Unclamped Inductive Waveforms

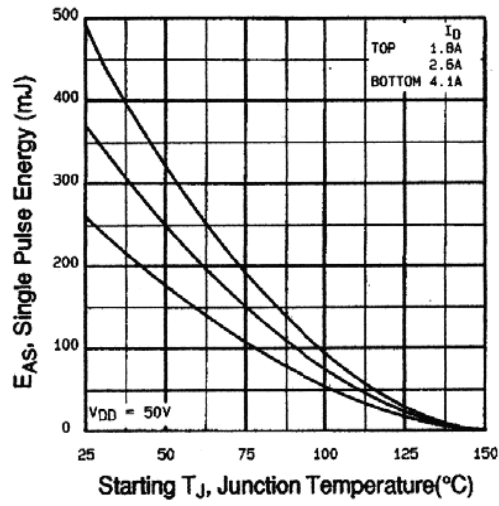


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

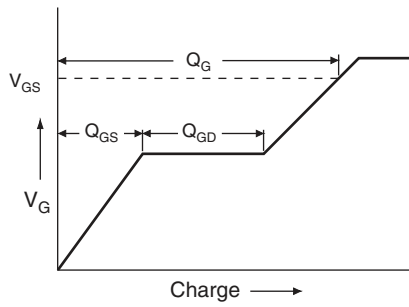


Fig. 13a - Maximum Avalanche Energy vs. Drain Current

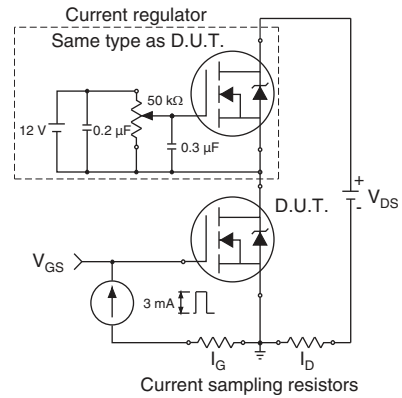
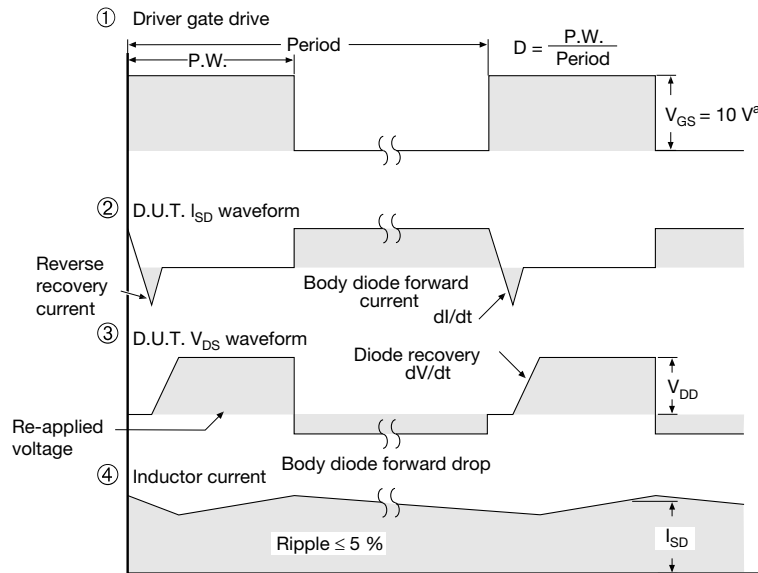
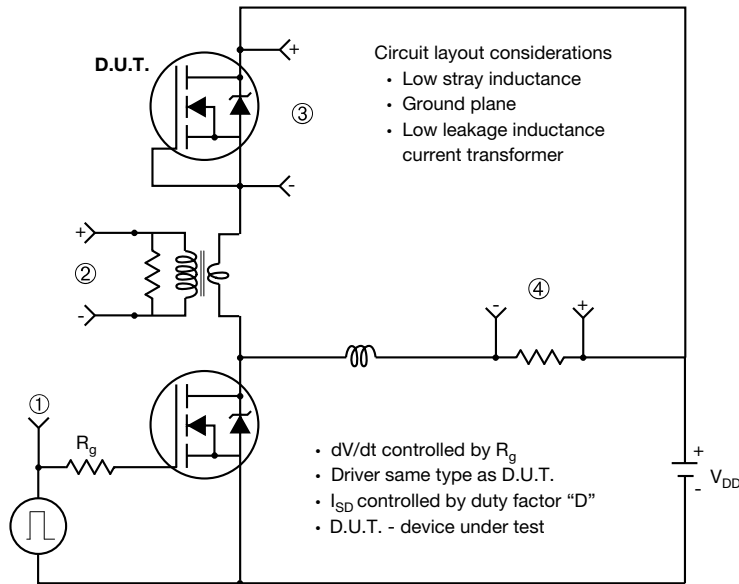


Fig. 13b - Gate Charge Test Circuit

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

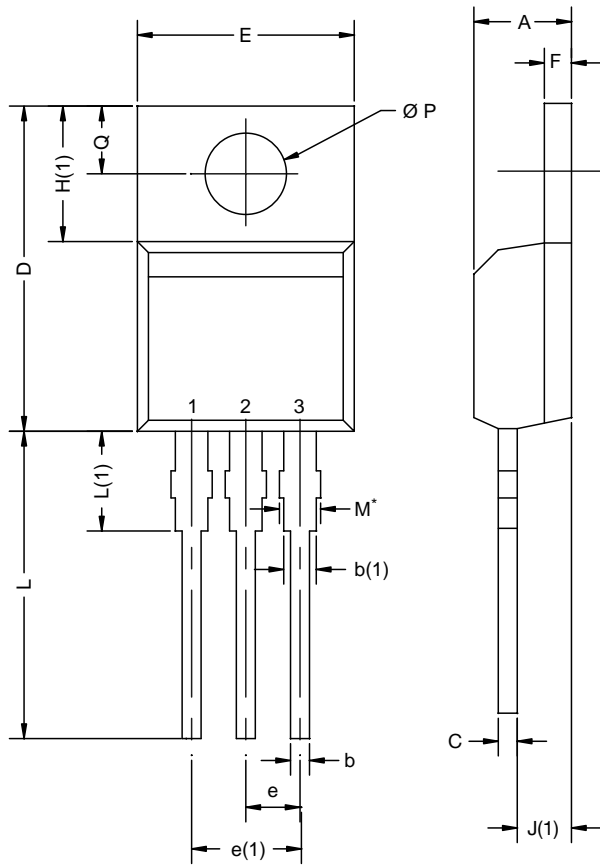


**Note**

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

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

### TO-220AB



| DIM. | MILLIMETERS |       | INCHES |       |
|------|-------------|-------|--------|-------|
|      | MIN.        | MAX.  | MIN.   | MAX.  |
| A    | 4.25        | 4.65  | 0.167  | 0.183 |
| b    | 0.69        | 1.01  | 0.027  | 0.040 |
| b(1) | 1.20        | 1.73  | 0.047  | 0.068 |
| c    | 0.36        | 0.61  | 0.014  | 0.024 |
| D    | 14.85       | 15.49 | 0.585  | 0.610 |
| E    | 10.04       | 10.51 | 0.395  | 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) | 6.09        | 6.48  | 0.240  | 0.255 |
| J(1) | 2.41        | 2.92  | 0.095  | 0.115 |
| L    | 13.35       | 14.02 | 0.526  | 0.552 |
| L(1) | 3.32        | 3.82  | 0.131  | 0.150 |
| Ø P  | 3.54        | 3.94  | 0.139  | 0.155 |
| Q    | 2.60        | 3.00  | 0.102  | 0.118 |

ECN: X12-0208-Rev. N, 08-Oct-12  
DWG: 5471

**Notes**

\* M = 1.32 mm to 1.62 mm (dimension including protrusion)  
Heatsink hole for HVM



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