

## 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                 |     |

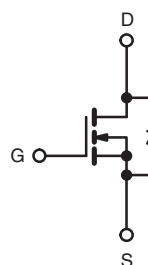
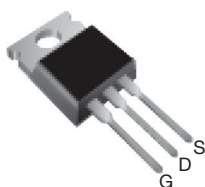
### FEATURES

- 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                   | $T_C = 25\text{ }^{\circ}\text{C}$  | $I_D$          | 4.1              | A                     |
|                                                  |                                    | $T_C = 100\text{ }^{\circ}\text{C}$ |                | 2.6              |                       |
| Pulsed Drain Current <sup>a</sup>                |                                    |                                     | $I_{DM}$       | 16               |                       |
| Linear Derating Factor                           |                                    |                                     |                | 1.0              | 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 $dV/dt^c$                    |                                    |                                     | $dV/dt$        | 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 |
|-------------------------------------------|----------------------------------|----------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|------|------|-------|------|
| Static                                    |                                  |                                                                                                                            |                                                                                    |      |      |       |      |
| Drain-Source Breakdown Voltage            | V <sub>DS</sub>                  | V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA                                                                             |                                                                                    | 850  | -    | -     | V    |
| V <sub>DS</sub> Temperature Coefficient   | ΔV <sub>DS</sub> /T <sub>J</sub> | Reference to 25 °C, I <sub>D</sub> = 1 mA                                                                                  |                                                                                    | -    | 0.90 | -     | V/°C |
| Gate-Source Threshold Voltage             | V <sub>GS(th)</sub>              | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA                                                                |                                                                                    | 2.0  | -    | 4.0   | V    |
| Gate-Source Leakage                       | I <sub>GSS</sub>                 | V <sub>GS</sub> = ± 20 V                                                                                                   |                                                                                    | -    | -    | ± 100 | nA   |
| Zero Gate Voltage Drain Current           | I <sub>DSS</sub>                 | V <sub>DS</sub> = 800 V, V <sub>GS</sub> = 0 V                                                                             |                                                                                    | -    | -    | 100   | μA   |
|                                           |                                  | V <sub>DS</sub> = 640 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 125 °C                                                    |                                                                                    | -    | -    | 500   |      |
| Drain-Source On-State Resistance          | R <sub>DS(on)</sub>              | V <sub>GS</sub> = 10 V                                                                                                     | I <sub>D</sub> = 2.5 A <sup>b</sup>                                                | -    | 2.7  | -     | Ω    |
| Forward Transconductance                  | g <sub>fs</sub>                  | V <sub>DS</sub> = 100 V, I <sub>D</sub> = 2.5 A                                                                            |                                                                                    | 2.5  | -    | -     | S    |
| Dynamic                                   |                                  |                                                                                                                            |                                                                                    |      |      |       |      |
| Input Capacitance                         | C <sub>iss</sub>                 | V <sub>GS</sub> = 0 V,<br>V <sub>DS</sub> = 25 V,<br>f = 1.0 MHz, see fig. 5                                               |                                                                                    | -    | 1300 | -     | pF   |
| Output Capacitance                        | C <sub>oss</sub>                 |                                                                                                                            |                                                                                    | -    | 310  | -     |      |
| Reverse Transfer Capacitance              | C <sub>rss</sub>                 |                                                                                                                            |                                                                                    | -    | 190  | -     |      |
| Total Gate Charge                         | Q <sub>g</sub>                   | V <sub>GS</sub> = 10 V                                                                                                     | I <sub>D</sub> = 4.1 A, V <sub>DS</sub> = 400 V,<br>see fig. 6 and 13 <sup>b</sup> | -    | -    | 78    | nC   |
| Gate-Source Charge                        | Q <sub>gs</sub>                  |                                                                                                                            |                                                                                    | -    | -    | 9.6   |      |
| Gate-Drain Charge                         | Q <sub>gd</sub>                  |                                                                                                                            |                                                                                    | -    | -    | 45    |      |
| Turn-On Delay Time                        | t <sub>d(on)</sub>               | V <sub>DD</sub> = 400 V, I <sub>D</sub> = 4.1 A,<br>R <sub>g</sub> = 12 Ω, R <sub>D</sub> = 95 Ω, see fig. 10 <sup>b</sup> |                                                                                    | -    | 12   | -     | ns   |
| Rise Time                                 | t <sub>r</sub>                   |                                                                                                                            |                                                                                    | -    | 33   | -     |      |
| Turn-Off Delay Time                       | t <sub>d(off)</sub>              |                                                                                                                            |                                                                                    | -    | 82   | -     |      |
| Fall Time                                 | t <sub>f</sub>                   |                                                                                                                            |                                                                                    | -    | 30   | -     |      |
| Internal Drain Inductance                 | L <sub>D</sub>                   | Between lead,<br>6 mm (0.25") from<br>package and center of<br>die contact                                                 |                                                                                    | -    | 4.5  | -     | nH   |
| Internal Source Inductance                | L <sub>S</sub>                   |                                                                                                                            |                                                                                    | -    | 7.5  | -     |      |
| Drain-Source Body Diode Characteristics   |                                  |                                                                                                                            |                                                                                    |      |      |       |      |
| Continuous Source-Drain Diode Current     | I <sub>S</sub>                   | MOSFET symbol<br>showing the<br>integral reverse<br>p - n junction diode                                                   |                                                                                    | -    | -    | 4.1   | A    |
| Pulsed Diode Forward Current <sup>a</sup> | I <sub>SM</sub>                  |                                                                                                                            |                                                                                    | -    | -    | 16    |      |
| Body Diode Voltage                        | V <sub>SD</sub>                  | T <sub>J</sub> = 25 °C, I <sub>S</sub> = 4.1 A, V <sub>GS</sub> = 0 V <sup>b</sup>                                         |                                                                                    | -    | -    | 1.8   | V    |
| Body Diode Reverse Recovery Time          | t <sub>rr</sub>                  | T <sub>J</sub> = 25 °C, I <sub>F</sub> = 4.1 A, dI/dt = 100 A/μs <sup>b</sup>                                              |                                                                                    | -    | 480  | 720   | ns   |
| Body Diode Reverse Recovery Charge        | Q <sub>rr</sub>                  |                                                                                                                            |                                                                                    | -    | 1.8  | 2.7   | nC   |
| Forward Turn-On Time                      | t <sub>on</sub>                  | Intrinsic turn-on time is negligible (turn-on is dominated by L <sub>S</sub> and L <sub>D</sub> )                          |                                                                                    |      |      |       |      |

**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  $\leq 2\%$ .

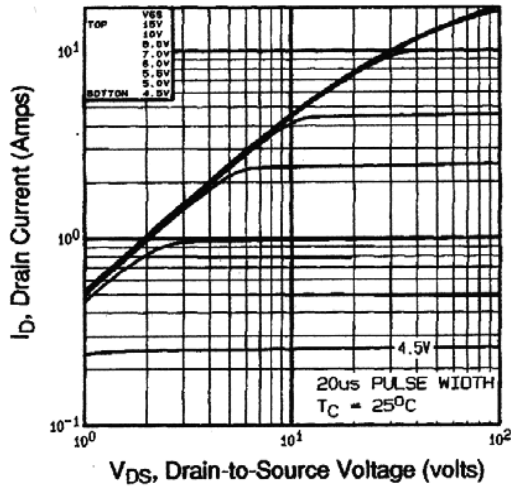
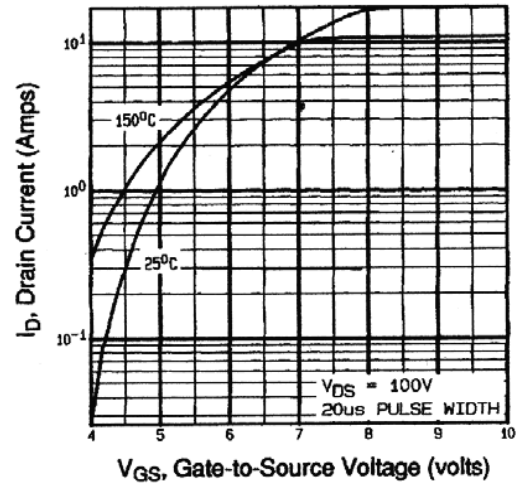
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)
Fig. 1 - Typical Output Characteristics,  $T_C = 25^\circ\text{C}$ 

Fig. 3 - Typical Transfer Characteristics

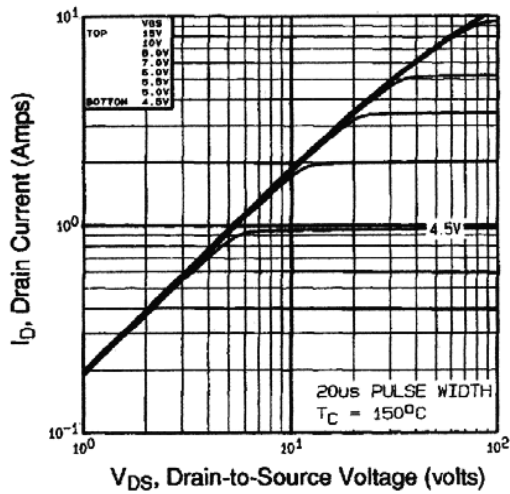
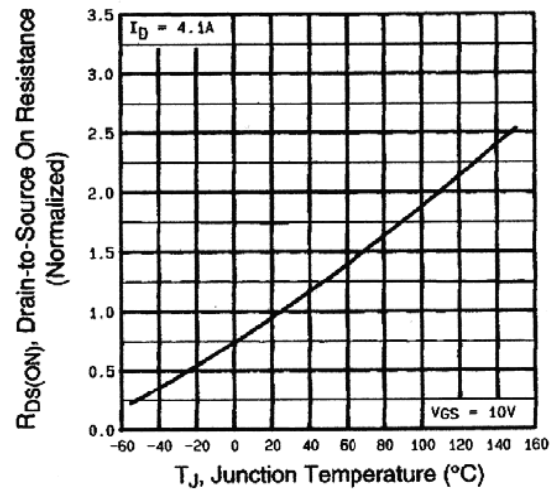
Fig. 2 - Typical Output Characteristics,  $T_C = 150^\circ\text{C}$ 

Fig. 4 - Normalized On-Resistance vs. Temperature

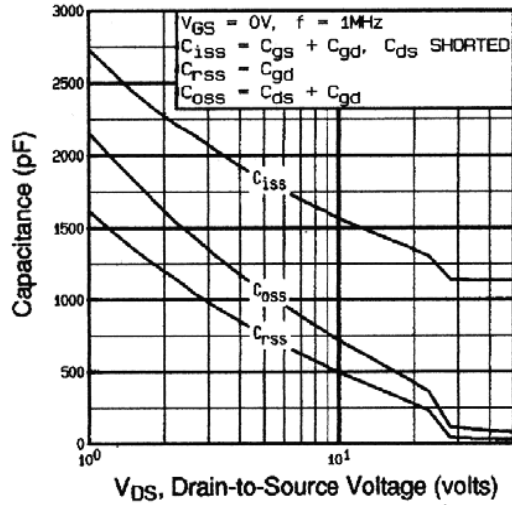


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

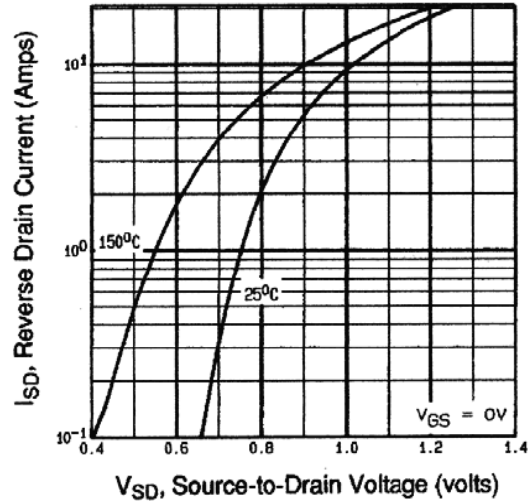


Fig. 7 - Typical Source-Drain Diode Forward Voltage

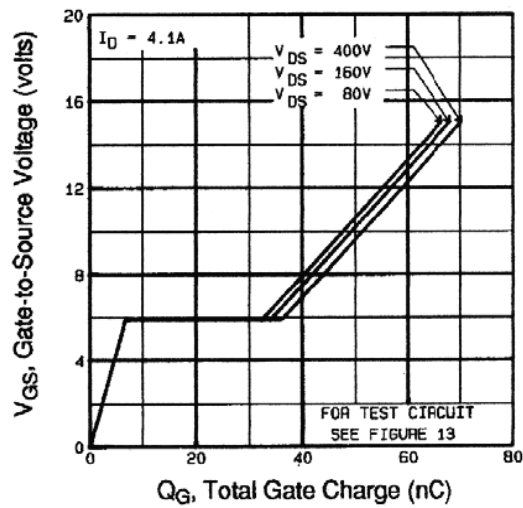


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

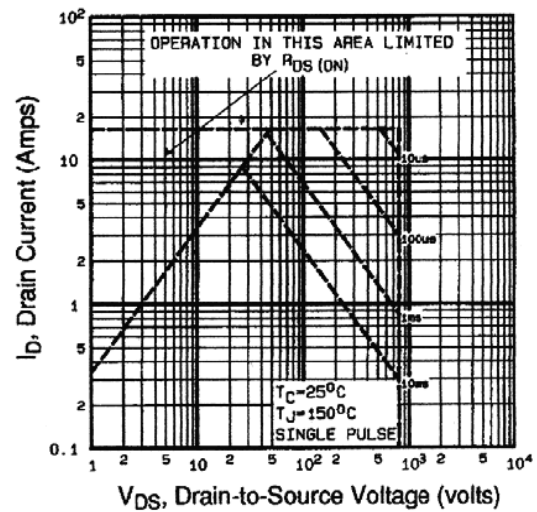


Fig. 8 - Maximum Safe Operating Area

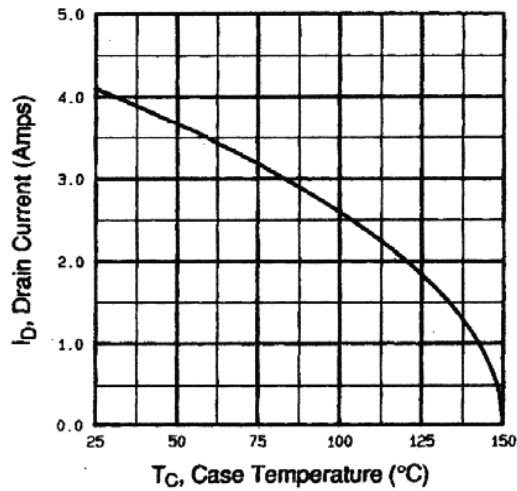


Fig. 9 - Maximum Drain Current vs. Case Temperature

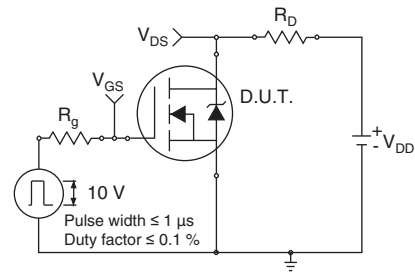


Fig. 10a - Switching Time Test Circuit

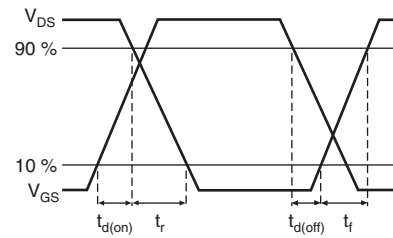


Fig. 10b - Switching Time Waveforms

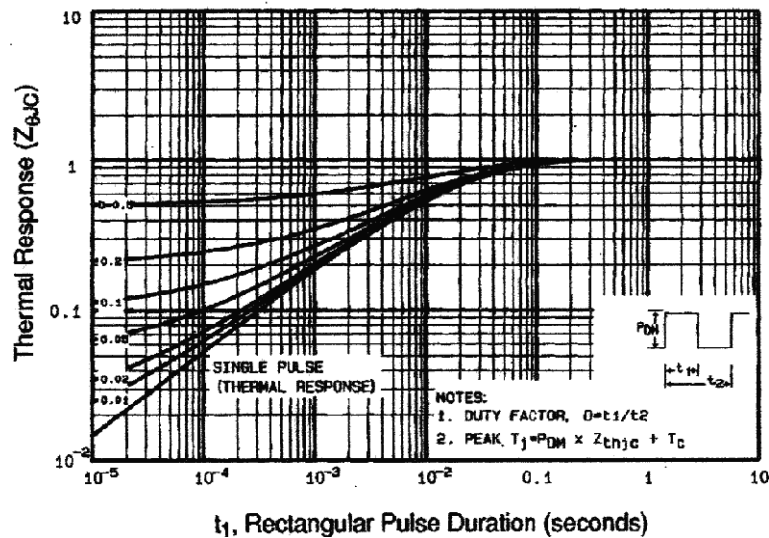


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

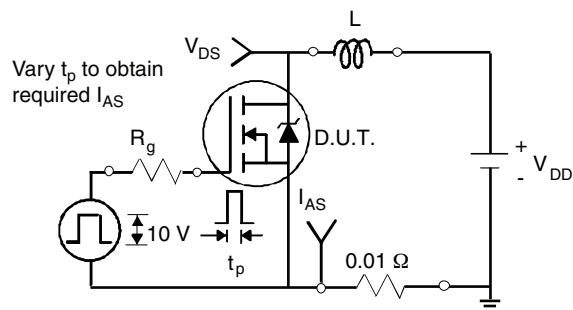


Fig. 12a - Unclamped Inductive Test Circuit

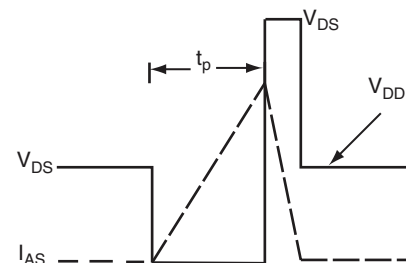


Fig. 12b - Unclamped Inductive Waveforms

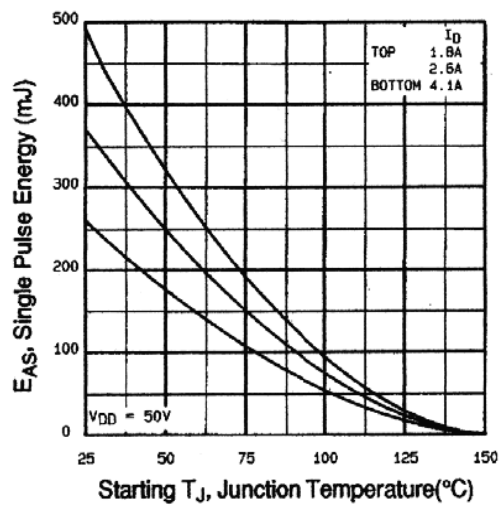


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

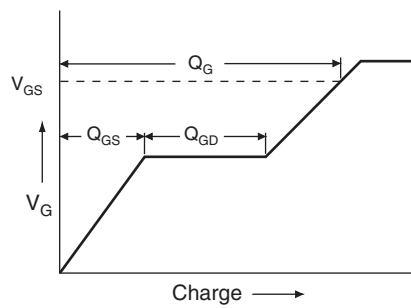


Fig. 13a - Maximum Avalanche Energy vs. Drain Current

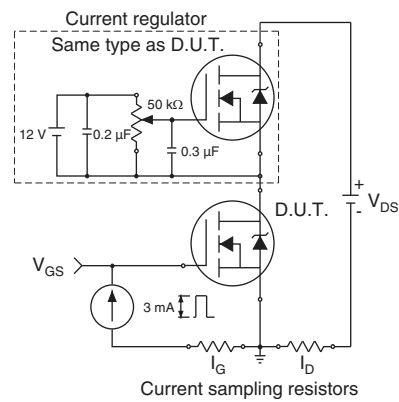
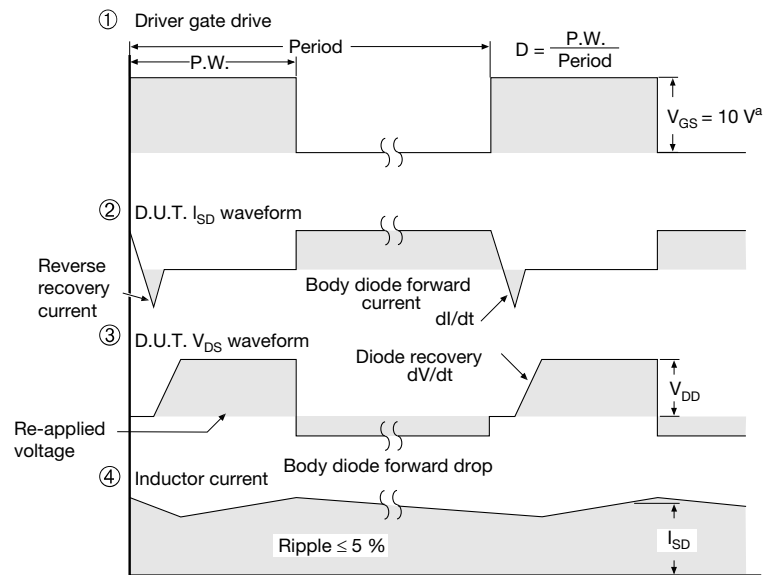
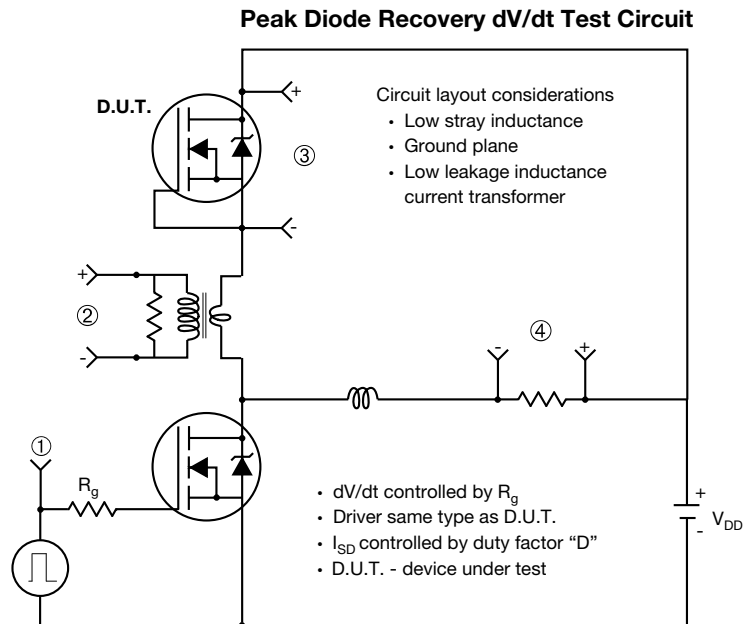


Fig. 13b - Gate Charge Test Circuit

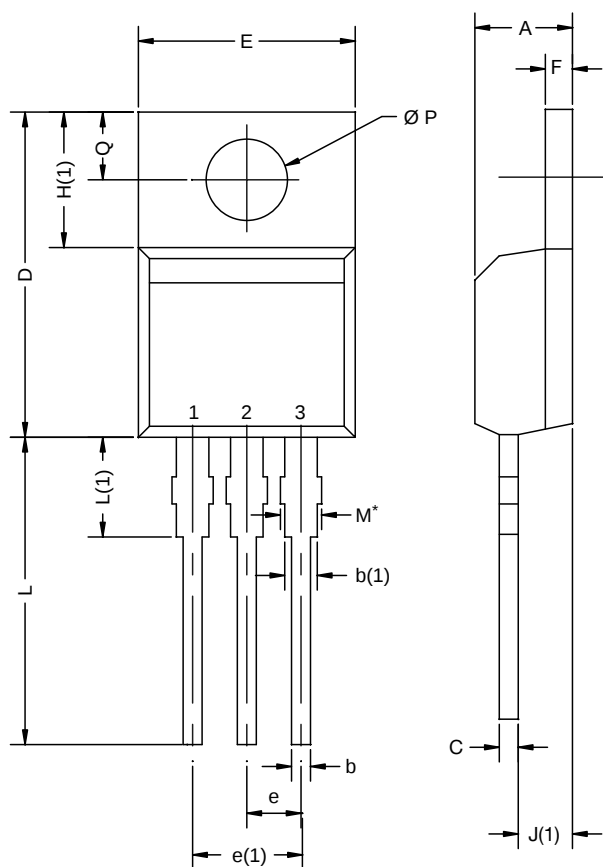


**Note**

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 |
| $\varnothing P$ | 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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