

## SWF8N65D-VB TO220 Datasheet

## N-Channel 650V (D-S) Super Junction Power MOSFET

| PRODUCT SUMMARY                    |                 |      |
|------------------------------------|-----------------|------|
| $V_{DS}$ (V) at $T_J$ max.         | 650             |      |
| $R_{DS(on)}$ at 25 °C ( $\Omega$ ) | $V_{GS} = 10$ V | 0.84 |
| $Q_g$ max. (nC)                    | 43              |      |
| $Q_{gs}$ (nC)                      | 5               |      |
| $Q_{gd}$ (nC)                      | 22              |      |
| Configuration                      | Single          |      |

## FEATURES

- Low figure-of-merit (FOM)  $R_{on} \times Q_g$
- Low input capacitance ( $C_{iss}$ )
- Reduced switching and conduction losses
- Ultra low gate charge ( $Q_g$ )
- Avalanche energy rated (UIS)

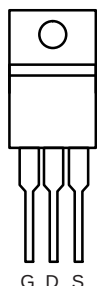


RoHS

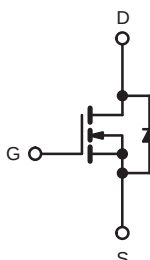
## APPLICATIONS

- Server and telecom power supplies
- Switch mode power supplies (SMPS)
- Power factor correction power supplies (PFC)
- Lighting
  - High-intensity discharge (HID)
  - Fluorescent ballast lighting
- Industrial

TO-220AB



Top View



N-Channel MOSFET

| ABSOLUTE MAXIMUM RATINGS (T <sub>C</sub> = 25 °C, unless otherwise noted) |                         |                         |                                   |             |      |
|---------------------------------------------------------------------------|-------------------------|-------------------------|-----------------------------------|-------------|------|
| PARAMETER                                                                 |                         |                         | SYMBOL                            | LIMIT       | UNIT |
| Drain-Source Voltage                                                      |                         |                         | V <sub>DS</sub>                   | 650         | V    |
| Gate-Source Voltage                                                       |                         |                         | V <sub>GS</sub>                   | ± 30        |      |
| Continuous Drain Current (T <sub>J</sub> = 150 °C)                        | V <sub>GS</sub> at 10 V | T <sub>C</sub> = 25 °C  | I <sub>D</sub>                    | 10          | A    |
|                                                                           |                         | T <sub>C</sub> = 100 °C |                                   | 8.0         |      |
| Pulsed Drain Current <sup>a</sup>                                         |                         |                         | I <sub>DM</sub>                   | 40          |      |
| Linear Derating Factor                                                    |                         |                         |                                   | 3.2         | W/°C |
| Single Pulse Avalanche Energy <sup>b</sup>                                |                         |                         | E <sub>AS</sub>                   | 280         | mJ   |
| Maximum Power Dissipation                                                 |                         |                         | P <sub>D</sub>                    | 106 /34     | W    |
| Operating Junction and Storage Temperature Range                          |                         |                         | T <sub>J</sub> , T <sub>stg</sub> | -55 to +150 | °C   |
| Drain-Source Voltage Slope                                                | T <sub>J</sub> = 125 °C |                         | dV/dt                             | 15          | V/ns |
| Reverse Diode dV/dt <sup>d</sup>                                          |                         |                         |                                   | 4.1         |      |
| Soldering Recommendations (Peak Temperature) <sup>c</sup>                 | for 10 s                |                         |                                   | 300         | °C   |

## Notes

- Repetitive rating; pulse width limited by maximum junction temperature.
- $V_{DD} = 50$  V, starting  $T_J = 25$  °C,  $L = 28.2$  mH,  $R_g = 25$   $\Omega$ ,  $I_{AS} = 4.5$  A.
- 1.6 mm from case.
- $I_{SD} \leq I_D$ ,  $dI/dt = 100$  A/ $\mu$ s, starting  $T_J = 25$  °C.

**THERMAL RESISTANCE RATINGS**

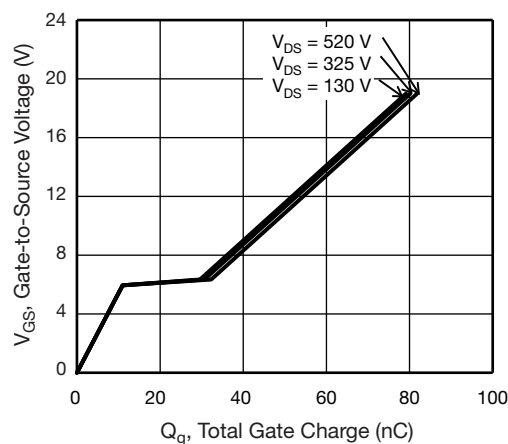
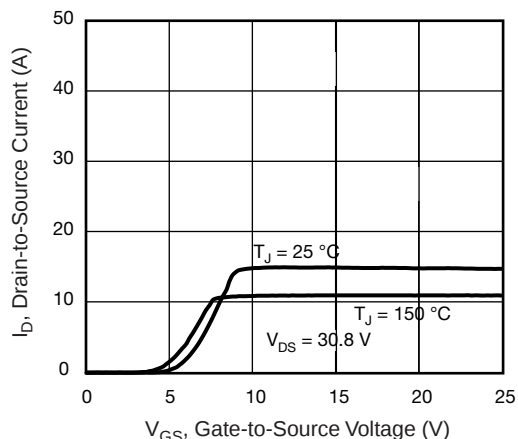
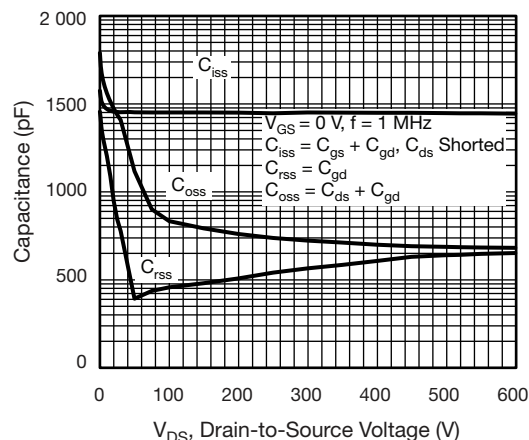
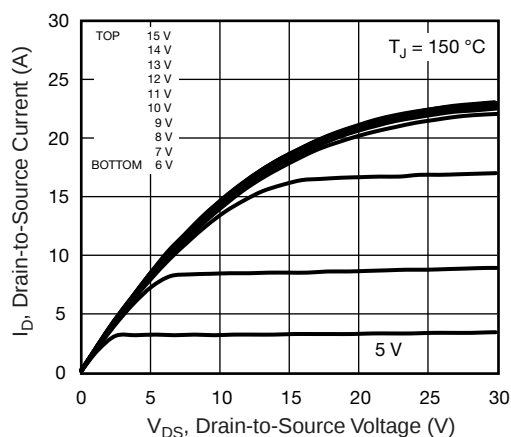
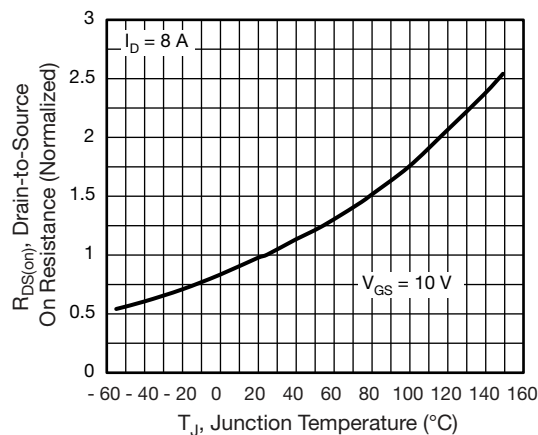
| PARAMETER                        | SYMBOL     | TYP. | MAX. | UNIT |
|----------------------------------|------------|------|------|------|
| Maximum Junction-to-Ambient      | $R_{thJA}$ | -    | 60   | °C/W |
| Maximum Junction-to-Case (Drain) | $R_{thJC}$ | -    | 0.8  |      |

**SPECIFICATIONS** ( $T_J = 25\text{ °C}$ , 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                                                                                                           |                                               | 650  | -    | -     | 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                                                                                                                |                                               | -    | 0.75 | -     | V/°C |
| Gate-Source Threshold Voltage (N)                         | V <sub>GS(th)</sub>              | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA                                                                                              |                                               | 2    | -    | 4     | V    |
| Gate-Source Leakage                                       | I <sub>GSS</sub>                 | V <sub>GS</sub> = ± 20 V                                                                                                                                 |                                               | -    | -    | ± 100 | nA   |
|                                                           |                                  | V <sub>GS</sub> = ± 30 V                                                                                                                                 |                                               | -    | -    | ± 1   | μA   |
| Zero Gate Voltage Drain Current                           | I <sub>DSS</sub>                 | V <sub>DS</sub> = 650 V, V <sub>GS</sub> = 0 V                                                                                                           |                                               | -    | -    | 1     | μA   |
|                                                           |                                  | V <sub>DS</sub> = 520 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 125 °C                                                                                  |                                               | -    | -    | 10    |      |
| Drain-Source On-State Resistance                          | R <sub>DS(on)</sub>              | V <sub>GS</sub> = 10 V                                                                                                                                   | I <sub>D</sub> = 8 A                          | -    | 0.84 | -     | Ω    |
| Forward Transconductance                                  | g <sub>fs</sub>                  | V <sub>DS</sub> = 30 V, I <sub>D</sub> = 8 A                                                                                                             |                                               | -    | 16   | -     | S    |
| Dynamic                                                   |                                  |                                                                                                                                                          |                                               |      |      |       |      |
| Input Capacitance                                         | C <sub>iss</sub>                 | V <sub>GS</sub> = 0 V,<br>V <sub>DS</sub> = 100 V,<br>f = 1 MHz                                                                                          |                                               | -    | 1200 | -     | pF   |
| Output Capacitance                                        | C <sub>oss</sub>                 |                                                                                                                                                          |                                               | -    | 230  | -     |      |
| Reverse Transfer Capacitance                              | C <sub>rss</sub>                 |                                                                                                                                                          |                                               | -    | 100  | -     |      |
| Effective Output Capacitance, Energy Related <sup>a</sup> | C <sub>o(er)</sub>               | V <sub>DS</sub> = 0 V to 520 V, V <sub>GS</sub> = 0 V                                                                                                    |                                               | -    | 63   | -     | pF   |
| Effective Output Capacitance, Time Related <sup>b</sup>   | C <sub>o(tr)</sub>               |                                                                                                                                                          |                                               | -    | 213  | -     |      |
| Total Gate Charge                                         | Q <sub>g</sub>                   | V <sub>GS</sub> = 10 V                                                                                                                                   | I <sub>D</sub> = 8 A, V <sub>DS</sub> = 520 V | -    | 43   | -     | nC   |
| Gate-Source Charge                                        | Q <sub>gs</sub>                  |                                                                                                                                                          |                                               | -    | 5    | -     |      |
| Gate-Drain Charge                                         | Q <sub>gd</sub>                  |                                                                                                                                                          |                                               | -    | 22   | -     |      |
| Turn-On Delay Time                                        | t <sub>d(on)</sub>               | V <sub>DD</sub> = 520 V, I <sub>D</sub> = 8 A,<br>V <sub>GS</sub> = 10 V, R <sub>g</sub> = 9.1 Ω                                                         |                                               | -    | 13   | -     | ns   |
| Rise Time                                                 | t <sub>r</sub>                   |                                                                                                                                                          |                                               | -    | 11   | -     |      |
| Turn-Off Delay Time                                       | t <sub>d(off)</sub>              |                                                                                                                                                          |                                               | -    | 81   | -     |      |
| Fall Time                                                 | t <sub>f</sub>                   |                                                                                                                                                          |                                               | -    | 25   | -     |      |
| Gate Input Resistance                                     | R <sub>g</sub>                   | f = 1 MHz, open drain                                                                                                                                    |                                               | -    | 3.5  | -     | Ω    |
| Drain-Source Body Diode Characteristics                   |                                  |                                                                                                                                                          |                                               |      |      |       |      |
| Continuous Source-Drain Diode Current                     | I <sub>S</sub>                   | MOSFET symbol showing the integral reverse p - n junction diode<br> |                                               | -    | -    | 15    | A    |
| Pulsed Diode Forward Current                              | I <sub>SM</sub>                  |                                                                                                                                                          |                                               | -    | -    | 40    |      |
| Diode Forward Voltage                                     | V <sub>SD</sub>                  | T <sub>J</sub> = 25 °C, I <sub>S</sub> = 8 A, V <sub>GS</sub> = 0 V                                                                                      |                                               | -    | -    | 1.5   | V    |
| Reverse Recovery Time                                     | t <sub>rr</sub>                  | T <sub>J</sub> = 25 °C, I <sub>F</sub> = I <sub>S</sub> = 8 A,<br>di/dt = 100 A/μs, V <sub>R</sub> = 400 V                                               |                                               | -    | 345  | -     | ns   |
| Reverse Recovery Charge                                   | Q <sub>rr</sub>                  |                                                                                                                                                          |                                               | -    | 4.5  | -     | μC   |
| Reverse Recovery Current                                  | I <sub>RRM</sub>                 |                                                                                                                                                          |                                               | -    | 35   | -     | A    |

**Notes**

- a.  $C_{oss(er)}$  is a fixed capacitance that gives the same energy as  $C_{oss}$  while  $V_{DS}$  is rising from 0 % to 80 %  $V_{DSS}$ .  
 b.  $C_{oss(tr)}$  is a fixed capacitance that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 % to 80 %  $V_{DSS}$ .

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


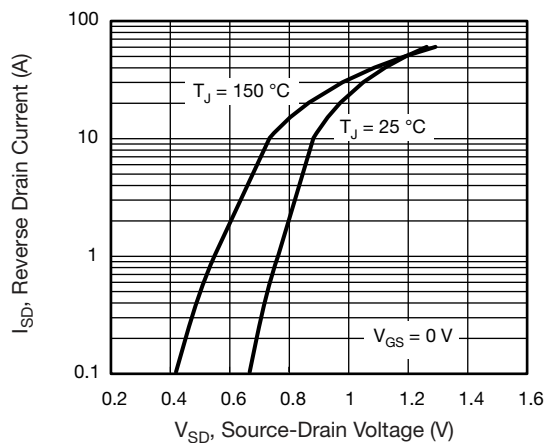


Fig. 7 - Typical Source-Drain Diode Forward Voltage

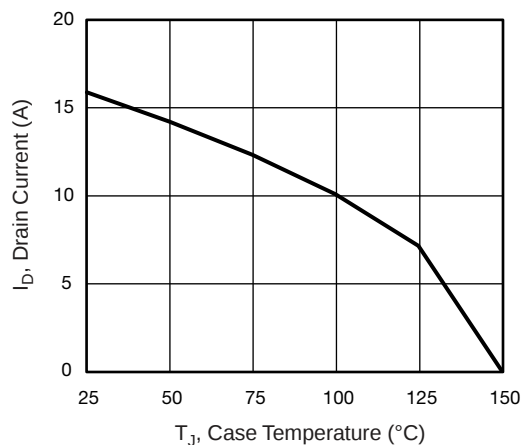


Fig. 9 - Maximum Drain Current vs. Case Temperature

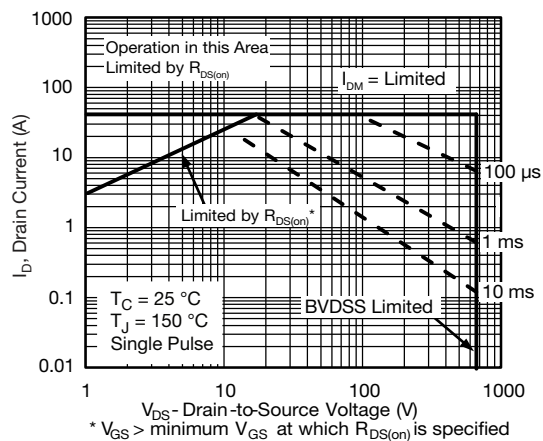


Fig. 8 - Maximum Safe Operating Area

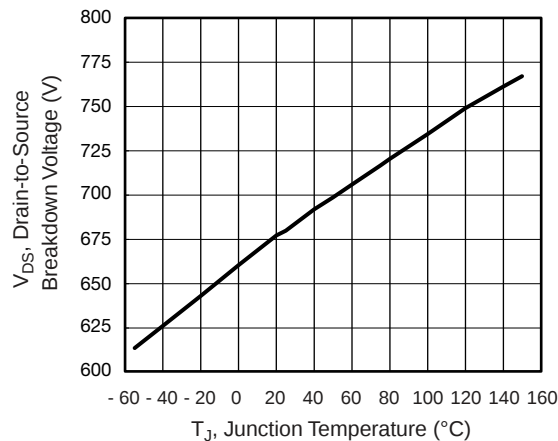


Fig. 10 - Temperature vs. Drain-to-Source Voltage

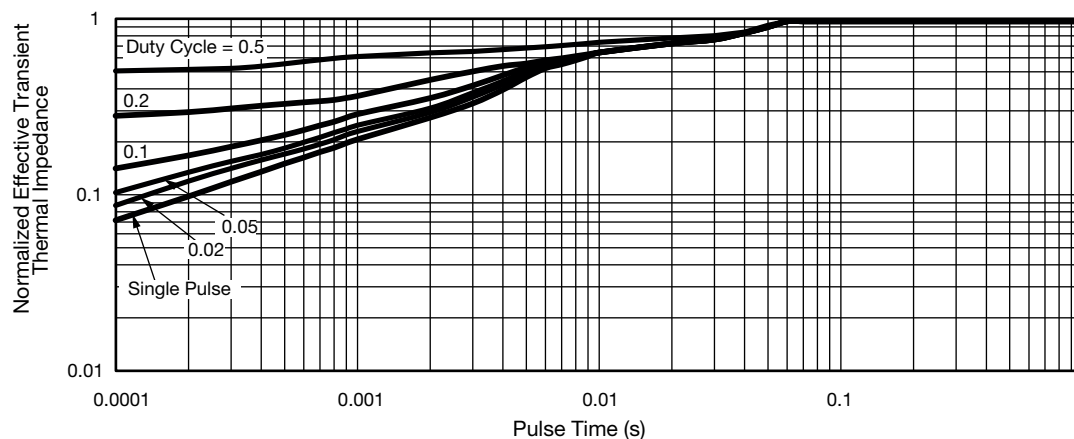


Fig. 11 - Normalized Thermal Transient Impedance, Junction-to-Case

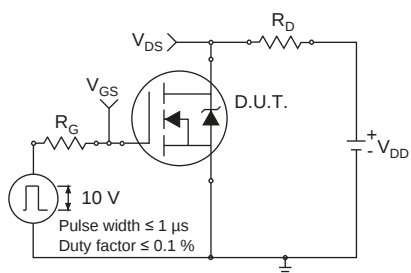


Fig. 12 - Switching Time Test Circuit

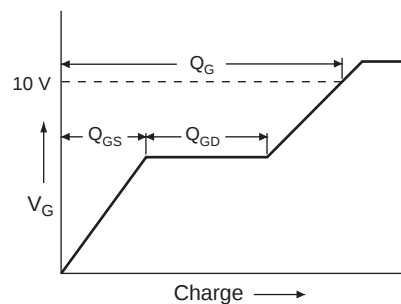


Fig. 16 - Basic Gate Charge Waveform

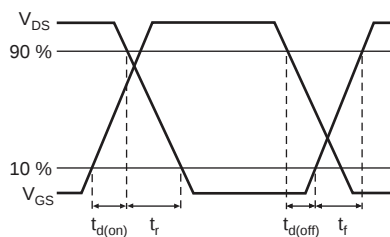


Fig. 13 - Switching Time Waveforms

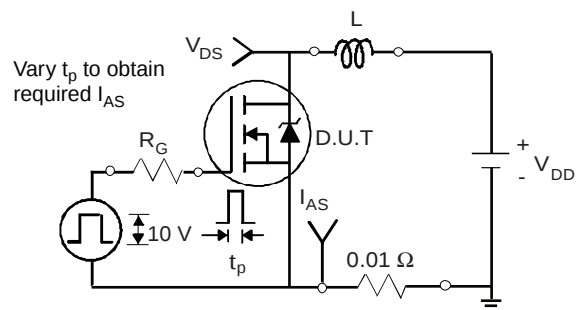


Fig. 14 - Unclamped Inductive Test Circuit

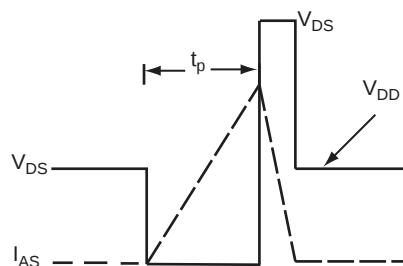


Fig. 15 - Unclamped Inductive Waveforms

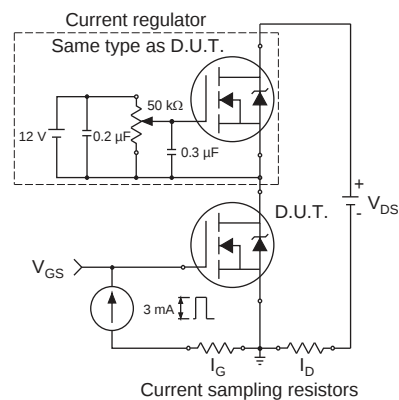
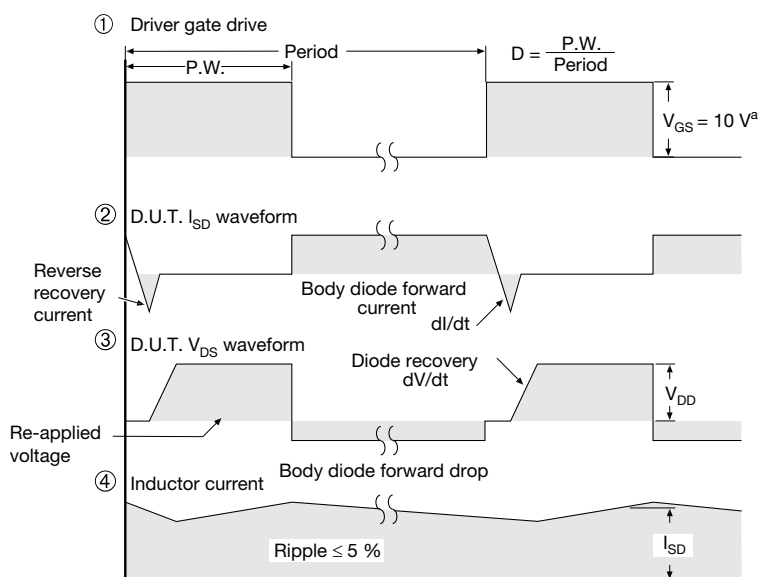
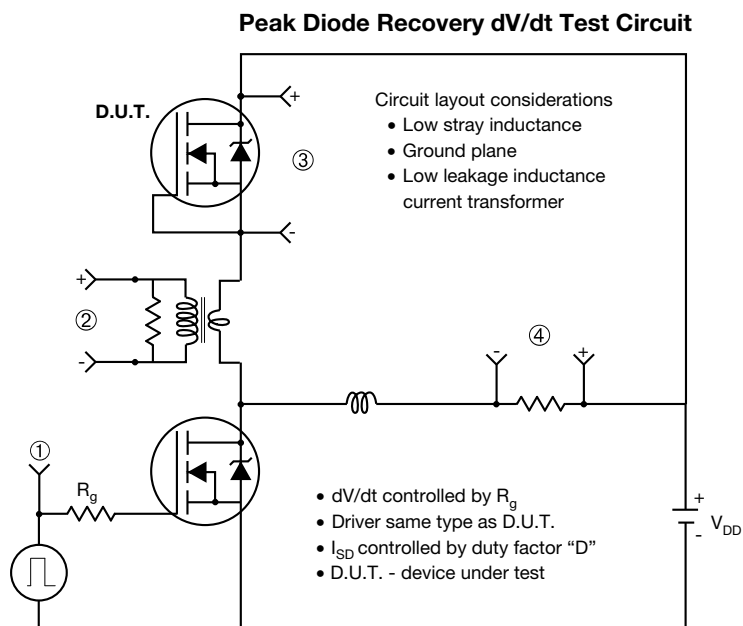


Fig. 17 - Gate Charge Test Circuit

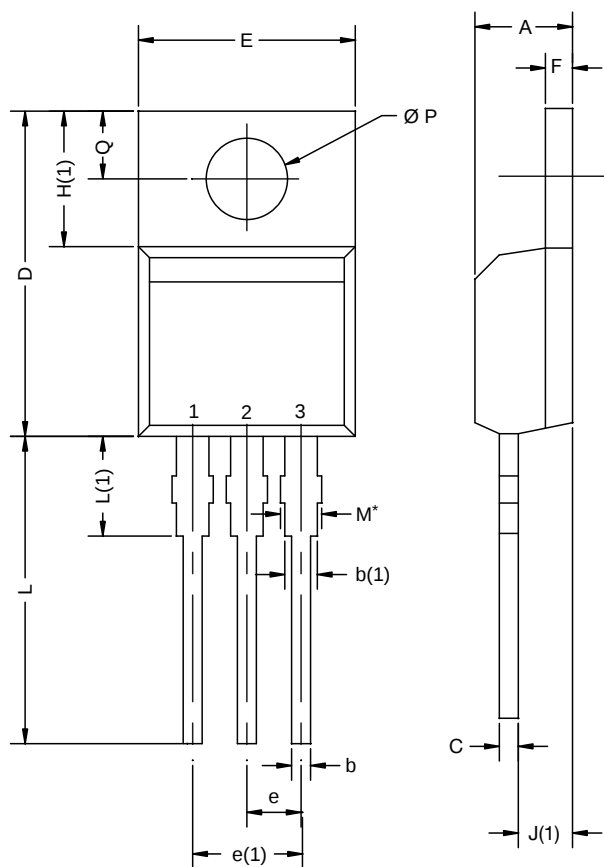


**Note**

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

**Fig. 18 - 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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