

7N52K3-VB TO252 Datasheet

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

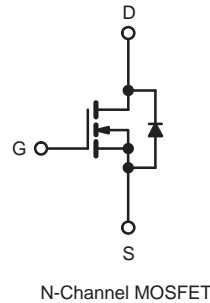
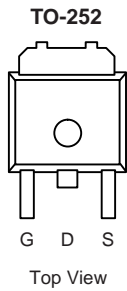
| PRODUCT SUMMARY            |                        |      |
|----------------------------|------------------------|------|
| V <sub>DS</sub> (V)        | 650                    |      |
| R <sub>DS(on)</sub> (Ω)    | V <sub>GS</sub> = 10 V | 0.95 |
| Q <sub>g</sub> (Max.) (nC) | 15                     |      |
| Q <sub>gs</sub> (nC)       | 3                      |      |
| Q <sub>gd</sub> (nC)       | 6                      |      |
| Configuration              | Single                 |      |

FEATURES

- Low Gate Charge Q<sub>g</sub> Results in Simple Drive Requirement
- Improved Gate, Avalanche and Dynamic dV/dt Ruggedness
- Fully Characterized Capacitance and Avalanche Voltage and Current
- Compliant to RoHS directive 2002/95/EC



RoHS\*  
COMPLIANT




| 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 <sup>e</sup>                                   | V <sub>GS</sub> at 10 V | I <sub>D</sub>                    | T <sub>C</sub> = 25 °C  | A        |
| Continuous Drain Current  |                         |                                   | T <sub>C</sub> = 100 °C |          |
| Pulsed Drain Current <sup>a</sup>                                       |                         | I <sub>DM</sub>                   | 16                      |          |
| Linear Derating Factor  |                         |                                   | 1.67/0.8/0.3            | W/°C     |
| Single Pulse Avalanche Energy <sup>b</sup>                              |                         | E <sub>AS</sub>                   | 120                     | mJ       |
| Repetitive Avalanche Current <sup>a</sup>                               |                         | I <sub>AR</sub>                   | 34                      | A        |
| Repetitive Avalanche Energy <sup>a</sup>                                |                         | E <sub>AR</sub>                   | 17                      | mJ       |
| Maximum Power Dissipation   | T <sub>C</sub> = 25 °C  | P <sub>D</sub>                    | 205/35/30               | W        |
| Peak Diode Recovery dV/dt <sup>c</sup>                                  |                         | dV/dt                             | 4.5                     | V/ns     |
| Operating Junction and Storage Temperature Range                        |                         | T <sub>J</sub> , T <sub>stg</sub> | - 55 to + 150           | °C       |
| Soldering Recommendations (Peak Temperature) <sup>d</sup>               | 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<sub>J</sub> = 25 °C, L = 24 mH, R<sub>G</sub> = 25 Ω, I<sub>AS</sub> = 3.2 A (see fig. 12).
- I<sub>SD</sub> ≤ 3.2 A, dI/dt ≤ 90 A/μs, V<sub>DD</sub> ≤ V<sub>DS</sub>, T<sub>J</sub> ≤ 150 °C.
- 1.6 mm from case.
- Drain current limited by maximum junction temperature.

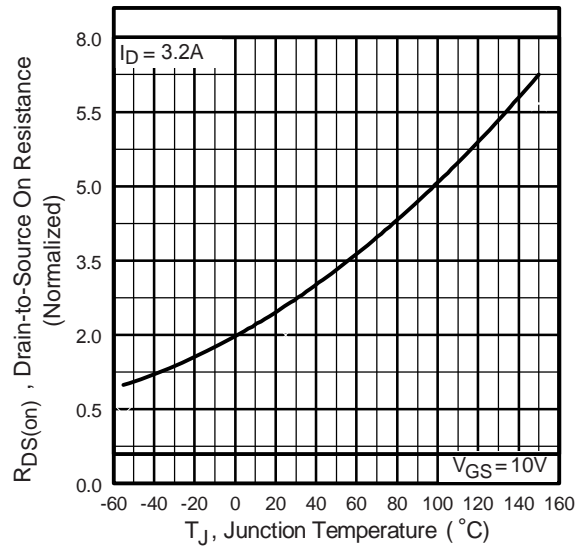
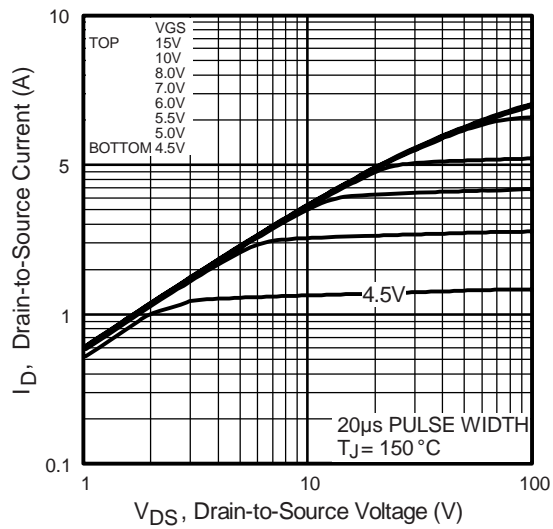
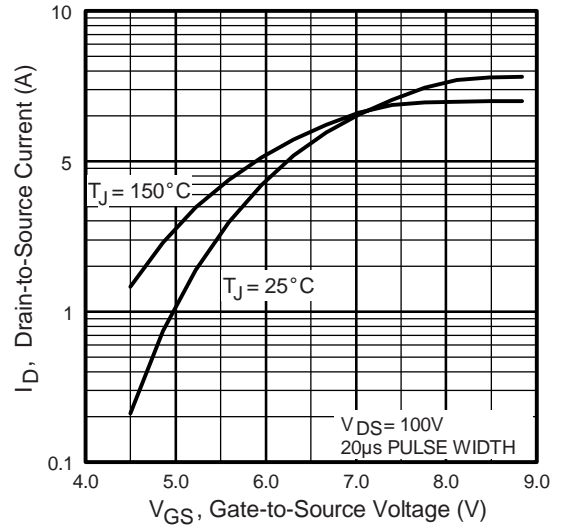
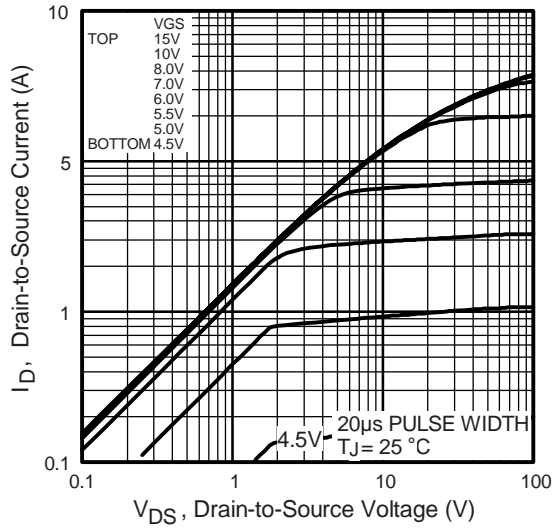
| THERMAL RESISTANCE RATINGS       |            |      |             |      |
|----------------------------------|------------|------|-------------|------|
| PARAMETER                        | SYMBOL     | TYP. | MAX.        | UNIT |
| Maximum Junction-to-Ambient      | $R_{thJA}$ | -    | 62          | °C/W |
| Maximum Junction-to-Case (Drain) | $R_{thJC}$ | -    | 3.6/1.2/0.6 |      |

| 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   | $V_{DS}$              | $V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$   |   | 650  | -    | -         | V             |
| $V_{DS}$ Temperature Coefficient   | $\Delta V_{DS}/T_J$   | Reference to $25\text{ }^\circ\text{C}$ , $I_D = 1\text{ mA}^d$   |   | -    | 0.6  | -         | mV/°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  | $I_{GSS}$             | $V_{GS} = \pm 30\text{ V}$  |   | -    | -    | $\pm 100$ | nA            |
| Zero Gate Voltage Drain Current  | $I_{DSS}$             | $V_{DS} = 650\text{ V}, V_{GS} = 0\text{ V}$  |   | -    | -    | 10        | $\mu\text{A}$ |
|  |                       | $V_{DS} = 520\text{ V}, V_{GS} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$   |   | -    | -    | 100       |               |
| Drain-Source On-State Resistance   | $R_{DS(on)}$          | $V_{GS} = 10\text{ V}$  | $I_D = 2.5\text{ A}^b$  | -    | 0.95 | -         | $\Omega$      |
| Forward Transconductance   | $g_{fs}$              | $V_{DS} = 50\text{ V}, I_D = 2.5\text{ A}$  |   | 8    | -    | -         | 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  |   | -    | 320  | -         | pF            |
| Output Capacitance   | $C_{oss}$             |   |   | -    | 75   | -         |               |
| Reverse Transfer Capacitance   | $C_{rss}$             |   |   | -    | 4    | -         |               |
| Output Capacitance   | $C_{oss}$             | $V_{GS} = 0\text{ V}$   | $V_{DS} = 1.0\text{ V}, f = 1.0\text{ MHz}$                                   | -    | 500  | -         | pF            |
|  |                       |   | $V_{DS} = 520\text{ V}, f = 1.0\text{ MHz}$                                   | -    | 83   | -         |               |
| Effective Output Capacitance   | $C_{oss\text{ eff.}}$ | $V_{DS} = 0\text{ V to } 520\text{ V}^c$  |   | -    | 14   | -         |               |
| Total Gate Charge  | $Q_g$                 | $V_{GS} = 10\text{ V}$  | $I_D = 2.5\text{ A}, V_{DS} = 400\text{ V}$<br>see fig. 6 and 13 <sup>b</sup> | -    | -    | 15        | nC            |
| Gate-Source Charge   | $Q_{gs}$              |   |   | -    | -    | 3         |               |
| Gate-Drain Charge  | $Q_{gd}$              |   |   | -    | -    | 6         |               |
| Turn-On Delay Time   | $t_{d(on)}$           | $V_{DD} = 325\text{ V}, I_D = 3.2\text{ A}$<br>$R_G = 9.1\text{ }\Omega, R_D = 62\text{ }\Omega,$<br>see fig. 10 <sup>b</sup>                           |   | -    | 18   | -         | ns            |
| Rise Time  | $t_r$                 |   |   | -    | 40   | -         |               |
| Turn-Off Delay Time  | $t_{d(off)}$          |   |   | -    | 50   | -         |               |
| Fall Time  | $t_f$                 |   |   | -    | 30   | -         |               |
| <b>Drain-Source Body Diode Characteristics</b>                           |                       |   |   |      |      |           |               |
| Continuous Source-Drain Diode Current                                    | $I_S$                 | MOSFET symbol showing the integral reverse p - n junction diode<br> | -   | -    | 5    | A         |               |
| Pulsed Diode Forward Current <sup>a</sup>                                | $I_{SM}$              |   | -   | -    | 16   |           |               |
| Body Diode Voltage   | $V_{SD}$              | $T_J = 25\text{ }^\circ\text{C}, I_S = 3.2\text{ A}, V_{GS} = 0\text{ V}^b$   |   | -    | -    | 1.5       | V             |
| Body Diode Reverse Recovery Time   | $t_{rr}$              | $T_J = 25\text{ }^\circ\text{C}, I_F = 3.2\text{ A}, di/dt = 100\text{ A}/\mu\text{s}^b$  |   | -    | 180  | -         | ns            |
| Body Diode Reverse Recovery Charge                                       | $Q_{rr}$              |   |   | -    | 2.1  | 3.2       | $\mu\text{C}$ |
| Forward Turn-On Time   | $t_{on}$              | Intrinsic turn-on time is negligible (turn-on is dominated by $L_S$ and $L_D$ )   |   |      |      |           |               |

**Notes**

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- Pulse width  $\leq 300\text{ }\mu\text{s}$ ; duty cycle  $\leq 2\%$ .
- $C_{oss\text{ eff.}}$  is a fixed capacitance that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 % to 80 %  $V_{DS}$ .
- $t = 60\text{ s}, f = 60\text{ Hz}$ .

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



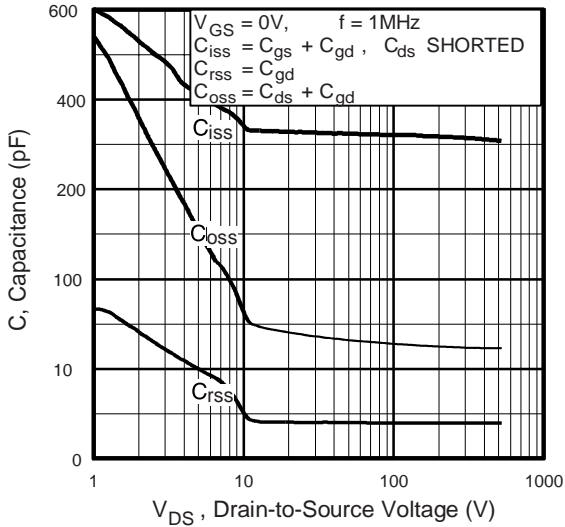


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

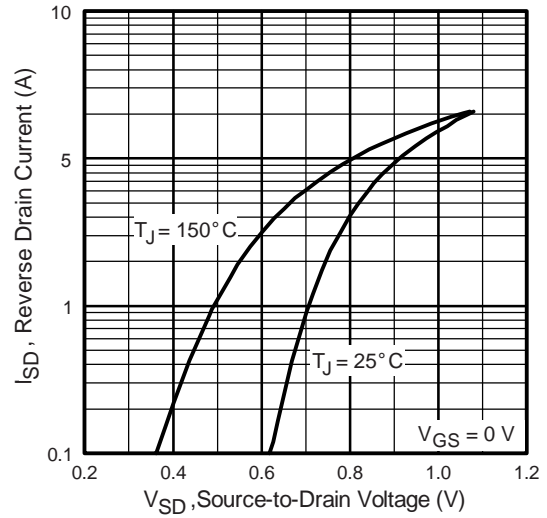


Fig. 7 - Typical Source-Drain Diode Forward Voltage

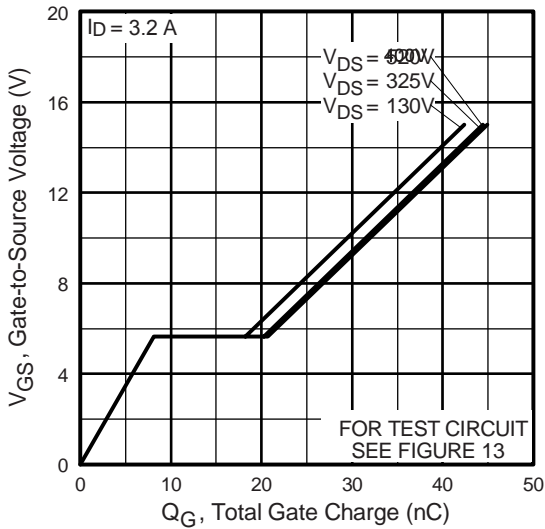


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

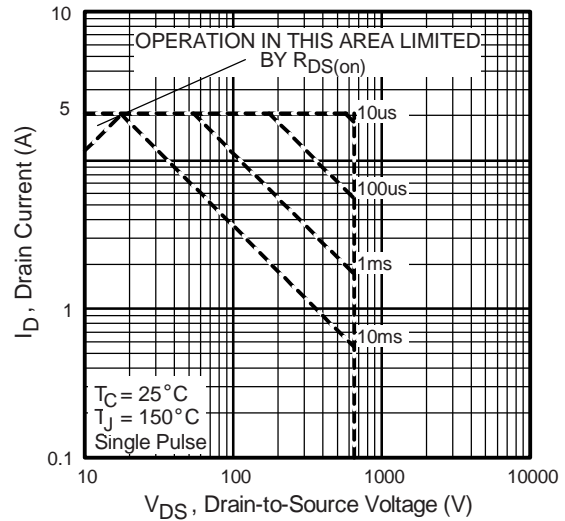


Fig. 8 - Maximum Safe Operating Area

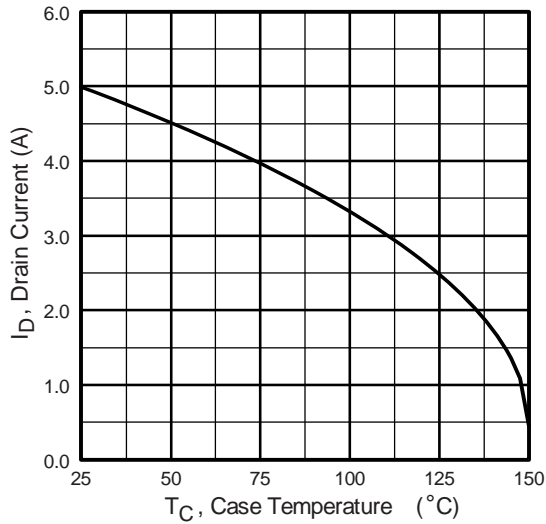


Fig. 9 - Maximum Drain Current vs. Case Temperature

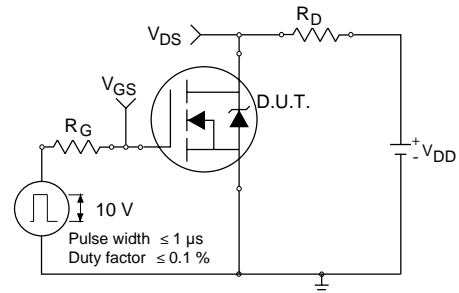


Fig. 10a - Switching Time Test Circuit

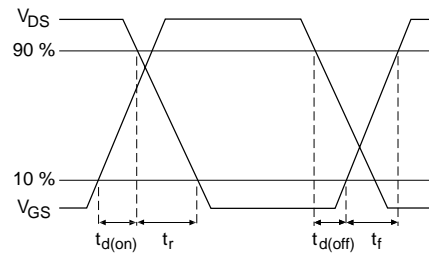


Fig. 10b - Switching Time Waveforms

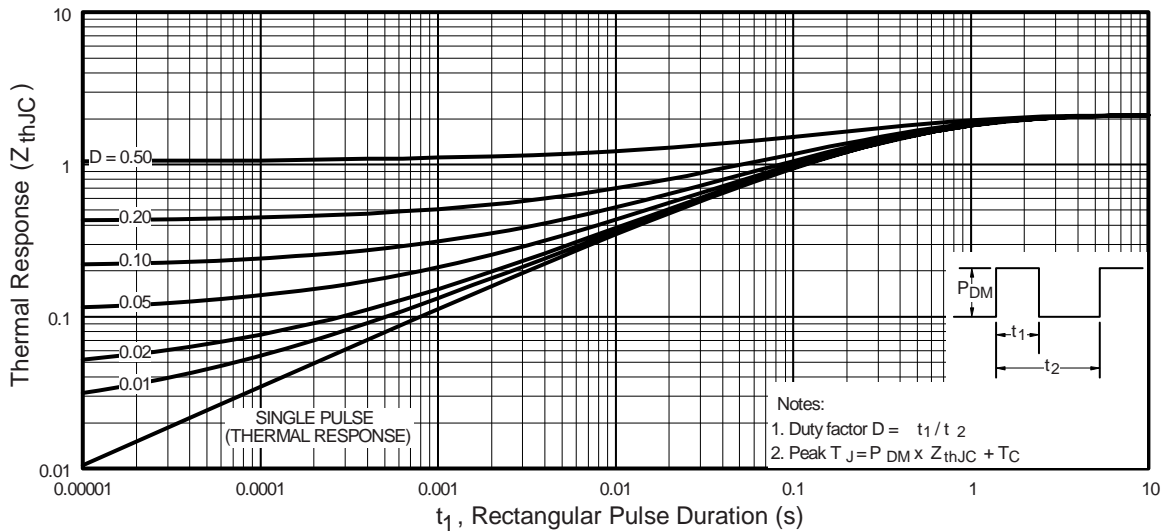


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

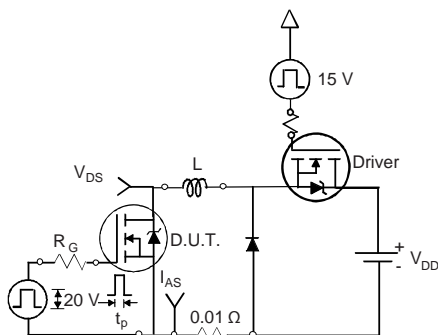


Fig. 12a - Unclamped Inductive Test Circuit

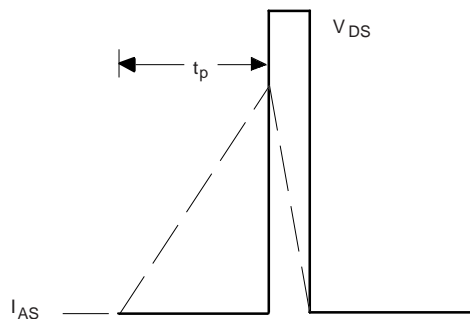


Fig. 12b - Unclamped Inductive Waveforms

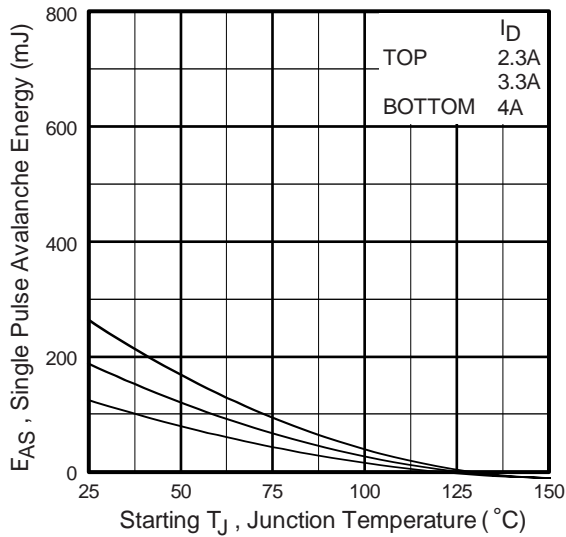


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

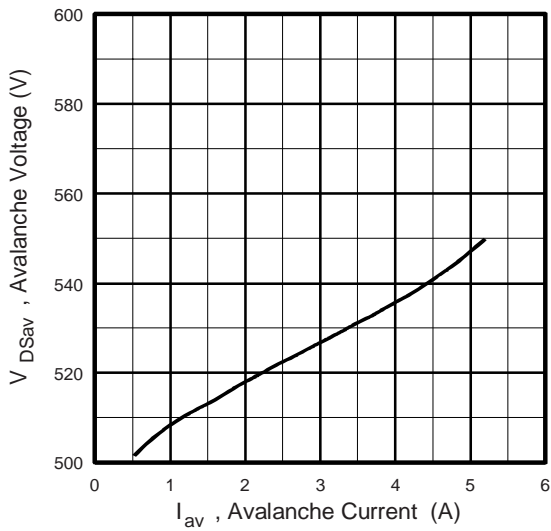


Fig. 12d - Typical Drain-to Source Voltage vs. Avalanche Current

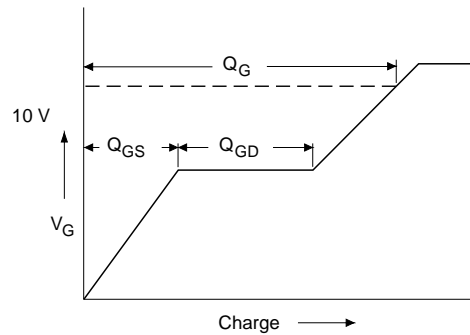


Fig. 13a - Basic Gate Charge Waveform

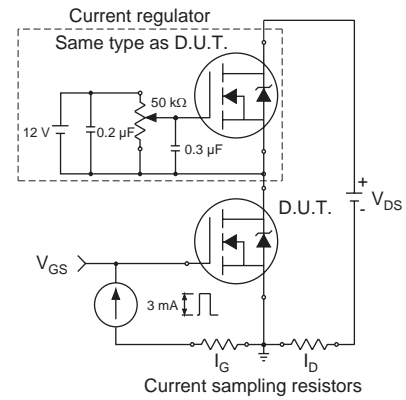
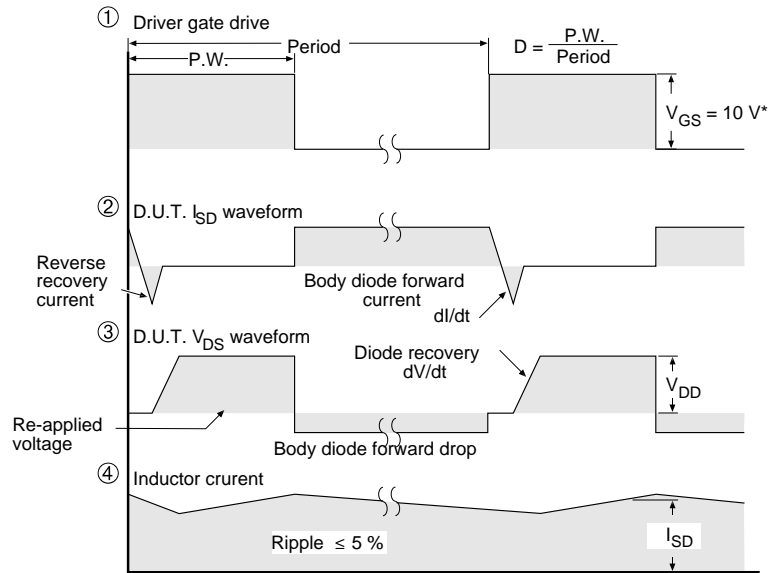
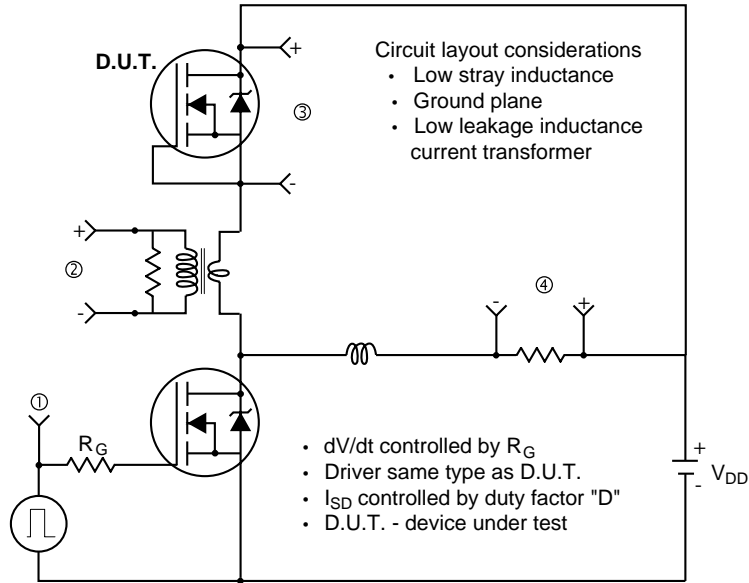


Fig. 13b - Gate Charge Test Circuit

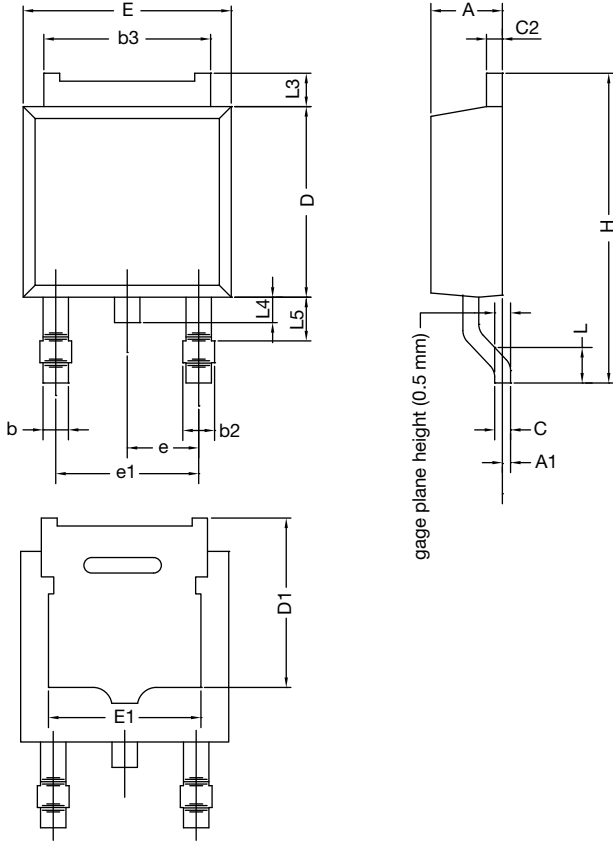
### Peak Diode Recovery dV/dt Test Circuit



\*  $V_{GS} = 5 V$  for logic level devices

Fig. 14 - For N-Channel

## TO-252AA CASE OUTLINE



| DIM.                            | MILLIMETERS |       | INCHES    |       |
|---------------------------------|-------------|-------|-----------|-------|
|                                 | MIN.        | MAX.  | MIN.      | MAX.  |
| A                               | 2.18        | 2.38  | 0.086     | 0.094 |
| A1                              | -           | 0.127 | -         | 0.005 |
| b                               | 0.64        | 0.88  | 0.025     | 0.035 |
| b2                              | 0.76        | 1.14  | 0.030     | 0.045 |
| b3                              | 4.95        | 5.46  | 0.195     | 0.215 |
| C                               | 0.46        | 0.61  | 0.018     | 0.024 |
| C2                              | 0.46        | 0.89  | 0.018     | 0.035 |
| D                               | 5.97        | 6.22  | 0.235     | 0.245 |
| D1                              | 5.21        | -     | 0.205     | -     |
| E                               | 6.35        | 6.73  | 0.250     | 0.265 |
| E1                              | 4.32        | -     | 0.170     | -     |
| H                               | 9.40        | 10.41 | 0.370     | 0.410 |
| e                               | 2.28 BSC    |       | 0.090 BSC |       |
| e1                              | 4.56 BSC    |       | 0.180 BSC |       |
| L                               | 1.40        | 1.78  | 0.055     | 0.070 |
| L3                              | 0.89        | 1.27  | 0.035     | 0.050 |
| L4                              | -           | 1.02  | -         | 0.040 |
| L5                              | 1.14        | 1.52  | 0.045     | 0.060 |
| ECN: X12-0247-Rev. M, 24-Dec-12 |             |       |           |       |
| DWG: 5347                       |             |       |           |       |

**Note**

- Dimension L3 is for reference only.



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