

## K3683-VB Datasheet

# N-Channel 550V (D-S) Power MOSFET

| PRODUCT SUMMARY                  |                        |      |
|----------------------------------|------------------------|------|
| V <sub>DS</sub> (V)              | 550                    |      |
| R <sub>DS(on)</sub> at 25 °C (Ω) | V <sub>GS</sub> = 10 V | 0.26 |
| Q <sub>g</sub> max. (nC)         | 150                    |      |
| Q <sub>gs</sub> (nC)             | 12                     |      |
| Q <sub>gd</sub> (nC)             | 25                     |      |
| Configuration                    | Single                 |      |

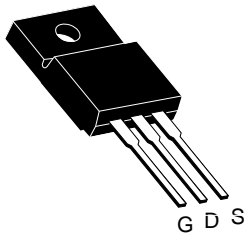
### FEATURES

- Optimal Design
  - Low Area Specific On-Resistance
  - Low Input Capacitance (C<sub>iss</sub>)
  - Reduced Capacitive Switching Losses
  - High Body Diode Ruggedness
  - Avalanche Energy Rated (UIS)
- Optimal Efficiency and Operation
  - Low Cost
  - Simple Gate Drive Circuitry
  - Low Figure-of-Merit (FOM): R<sub>on</sub> x Q<sub>g</sub>
  - Fast Switching

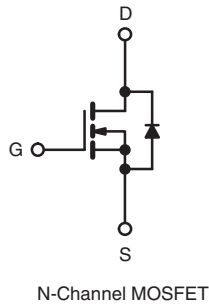


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TO-220 FULLPAK



Top View



N-Channel MOSFET

### APPLICATIONS


- Consumer Electronics
  - Displays (LCD or Plasma TV)
- Server and Telecom Power Supplies
  - SMPS
- Industrial
  - Welding
  - Induction Heating
  - Motor Drives
- Battery Chargers
- SMPS
  - Power Factor Correction (PFC)

| ABSOLUTE MAXIMUM RATINGS (T <sub>C</sub> = 25 °C, unless otherwise noted) |                                   |                         |      |
|---|-----------------------------------|-------------------------|------|
| PARAMETER   | SYMBOL                            | LIMIT                   | UNIT |
| Drain-Source Voltage  | V <sub>DS</sub>                   | 550                     | V    |
| Gate-Source Voltage   | V <sub>GS</sub>                   | ± 20                    |      |
| Gate-Source Voltage AC (f > 1 Hz)   |                                   | 30                      |      |
| Continuous Drain Current (T <sub>J</sub> = 150 °C)                        | V <sub>GS</sub> at 10 V           | T <sub>C</sub> = 25 °C  | A    |
|   |                                   | T <sub>C</sub> = 100 °C |      |
| Pulsed Drain Current <sup>a</sup>   | I <sub>DM</sub>                   | 56                      |      |
| Linear Derating Factor  |                                   | 2.2                     | W/°C |
| Single Pulse Avalanche Energy <sup>b</sup>                                | E <sub>AS</sub>                   | 281                     | mJ   |
| Maximum Power Dissipation   | P <sub>D</sub>                    | 60                      | W    |
| Operating Junction and Storage Temperature Range                          | T <sub>J</sub> , T <sub>stg</sub> | - 55 to + 150           | °C   |
| Drain-Source Voltage Slope  | dV/dt                             | T <sub>J</sub> = 125 °C | V/ns |
| Reverse Diode dV/dt <sup>d</sup>  |                                   | 0.36                    |      |
| Soldering Recommendations (Peak Temperature)                              | for 10 s                          | 300°                    | °C   |

#### Notes

- Repetitive rating; pulse width limited by maximum junction temperature.
- V<sub>DD</sub> = 50 V, starting T<sub>J</sub> = 25 °C, L = 10 mH, R<sub>g</sub> = 25 Ω, I<sub>AS</sub> = 7.5 A.
- 1.6 mm from case.
- I<sub>SD</sub> ≤ I<sub>D</sub>, starting T<sub>J</sub> = 25 °C.

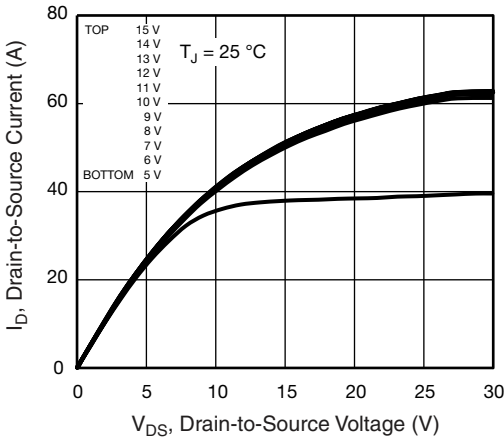
| THERMAL RESISTANCE RATINGS       |            |      |      |      |
|----------------------------------|------------|------|------|------|
| PARAMETER                        | SYMBOL     | TYP. | MAX. | UNIT |
| Maximum Junction-to-Ambient      | $R_{thJA}$ | -    | 40   | °C/W |
| Maximum Junction-to-Case (Drain) | $R_{thJC}$ | -    | 0.45 |      |

| 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  | $V_{DS}$            | $V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$  |  | 550  | -    | -         | V             |
| $V_{DS}$ Temperature Coefficient  | $\Delta V_{DS}/T_J$ | Reference to $25\text{ }^\circ\text{C}$ , $I_D = 250\text{ }\mu\text{A}$   |  | -    | 0.56 | -         | V/°C          |
| Gate-Source Threshold Voltage (N)   | $V_{GS(th)}$        | $V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$  |  | 2    | -    | 4         | V             |
| Gate-Source Leakage   | $I_{GSS}$           | $V_{GS} = \pm 20\text{ V}$   |  | -    | -    | $\pm 100$ | nA            |
| Zero Gate Voltage Drain Current   | $I_{DSS}$           | $V_{DS} = 500\text{ V}, V_{GS} = 0\text{ V}$   |  | -    | -    | 1         | $\mu\text{A}$ |
|   |                     | $V_{DS} = 400\text{ V}, V_{GS} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$  |  | -    | -    | 10        |               |
| Drain-Source On-State Resistance  | $R_{DS(on)}$        | $V_{GS} = 10\text{ V}$   | $I_D = 10\text{ A}$                        | -    | 0.26 | -         | $\Omega$      |
| Forward Transconductance  | $g_{fs}$            | $V_{DS} = 50\text{ V}, I_D = 10\text{ A}$  |  | -    | 12   | -         | S             |
| <b>Dynamic</b>  |                     |  |  |      |      |           |               |
| Input Capacitance   | $C_{iss}$           | $V_{GS} = 0\text{ V},$<br>$V_{DS} = 100\text{ V},$<br>$f = 1\text{ MHz}$   |  | -    | 3094 | -         | pF            |
| Output Capacitance  | $C_{oss}$           |  |  | -    | 152  | -         |               |
| Reverse Transfer Capacitance  | $C_{rss}$           |  |  | -    | 13   | -         |               |
| Effective output capacitance, energy related <sup>a</sup>                   | $C_{o(er)}$         | $V_{GS} = 0\text{ V},$<br>$V_{DS} = 0\text{ V to } 400\text{ V}$   |  | -    | 131  | -         | pF            |
| Effective output capacitance, time related <sup>b</sup>                     | $C_{o(tr)}$         |  |  | -    | 189  | -         |               |
| Total Gate Charge   | $Q_g$               | $V_{GS} = 10\text{ V}$   | $I_D = 10\text{ A}, V_{DS} = 400\text{ V}$ | -    | 80   | 150       | nC            |
| Gate-Source Charge  | $Q_{gs}$            |  |  | -    | 12   | -         |               |
| Gate-Drain Charge   | $Q_{gd}$            |  |  | -    | 25   | -         |               |
| Turn-On Delay Time  | $t_{d(on)}$         | $V_{DD} = 400\text{ V}, I_D = 10\text{ A},$<br>$V_{GS} = 10\text{ V}, R_g = 9.1\text{ }\Omega$   |  | -    | 24   | 50        | ns            |
| Rise Time   | $t_r$               |  |  | -    | 31   | 62        |               |
| Turn-Off Delay Time   | $t_{d(off)}$        |  |  | -    | 117  | 176       |               |
| Fall Time   | $t_f$               |  |  | -    | 56   | 112       |               |
| Gate Input Resistance   | $R_g$               | $f = 1\text{ MHz}, \text{ open drain}$   |  | -    | 1.8  | -         | $\Omega$      |
| <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> |  | -    | -    | 20        | A             |
| Pulsed Diode Forward Current  | $I_{SM}$            |  |  | -    | -    | 80        |               |
| Diode Forward Voltage   | $V_{SD}$            | $T_J = 25\text{ }^\circ\text{C}, I_S = 10\text{ A}, V_{GS} = 0\text{ V}$   |  | -    | -    | 1.2       | V             |
| Reverse Recovery Time   | $t_{rr}$            | $T_J = 25\text{ }^\circ\text{C}, I_F = I_S = 10\text{ A},$<br>$di/dt = 100\text{ A}/\mu\text{s}, V_R = 20\text{ V}$                                      |  | -    | 437  | -         | ns            |
| Reverse Recovery Charge   | $Q_{rr}$            |  |  | -    | 5.9  | -         | $\mu\text{C}$ |
| Reverse Recovery Current  | $I_{RRM}$           |  |  | -    | 25   | -         | A             |

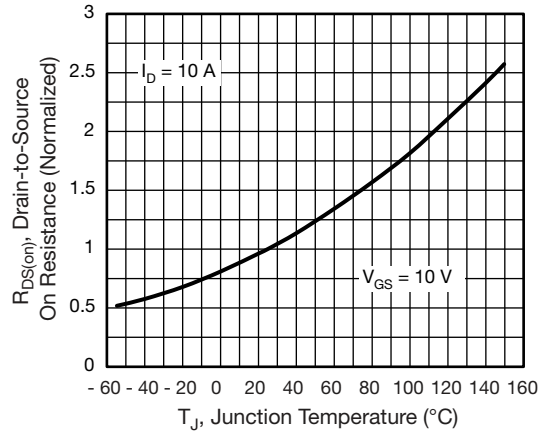
**Notes**

- 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 %  $V_{DS}$ .  
 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 %  $V_{DS}$ .

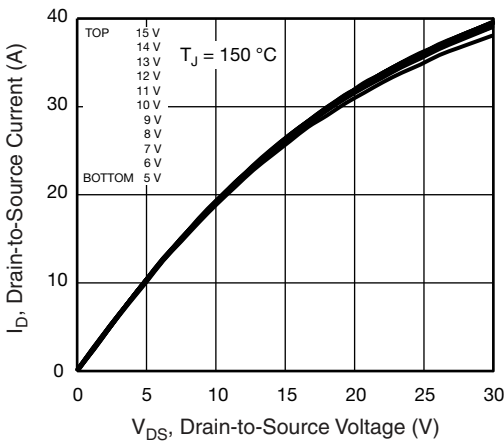
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



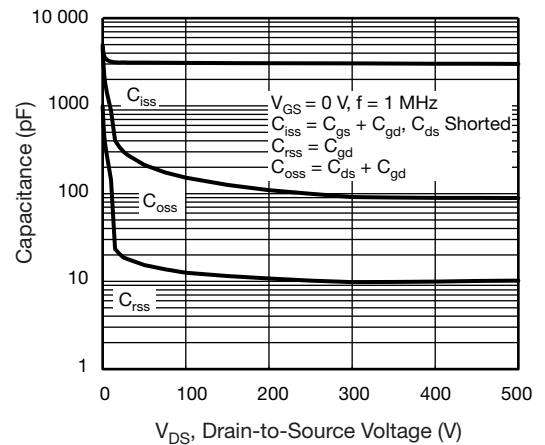
**Fig. 1 - Typical Output Characteristics**



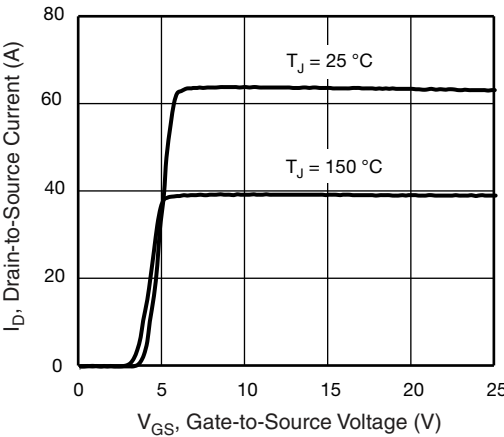
**Fig. 4 - Normalized On-Resistance vs. Temperature**



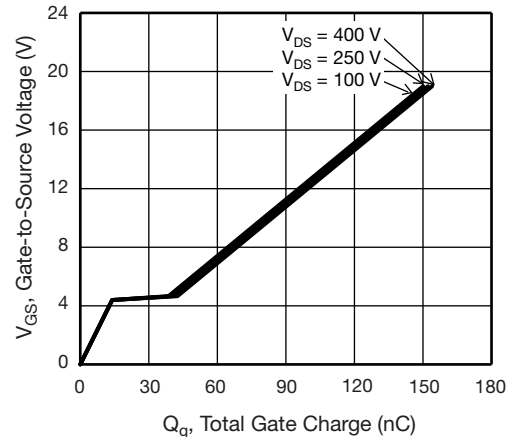
**Fig. 2 - Typical Output Characteristics**



**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

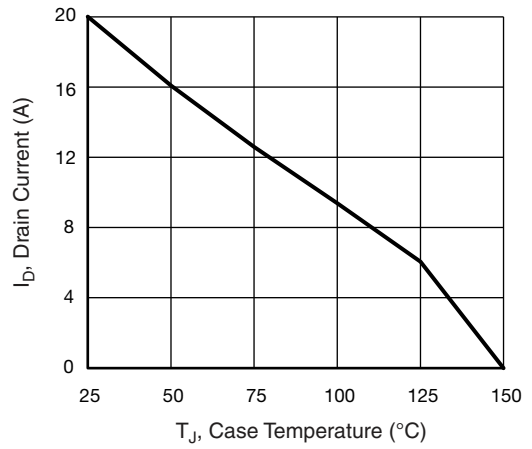


Fig. 9 - Maximum Drain Current vs. Case Temperature

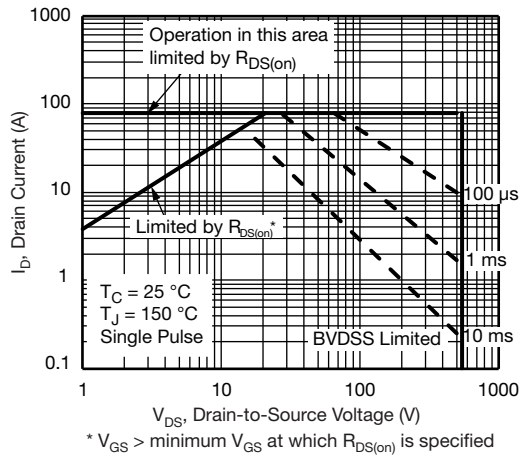


Fig. 8 - Maximum Safe Operating Area

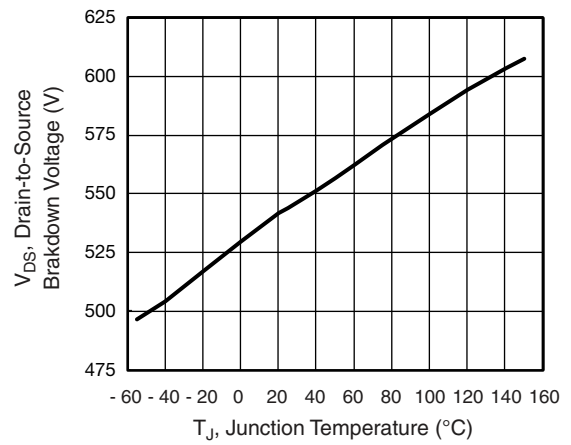


Fig. 10 - Temperature vs. Drain-to-Source Voltage

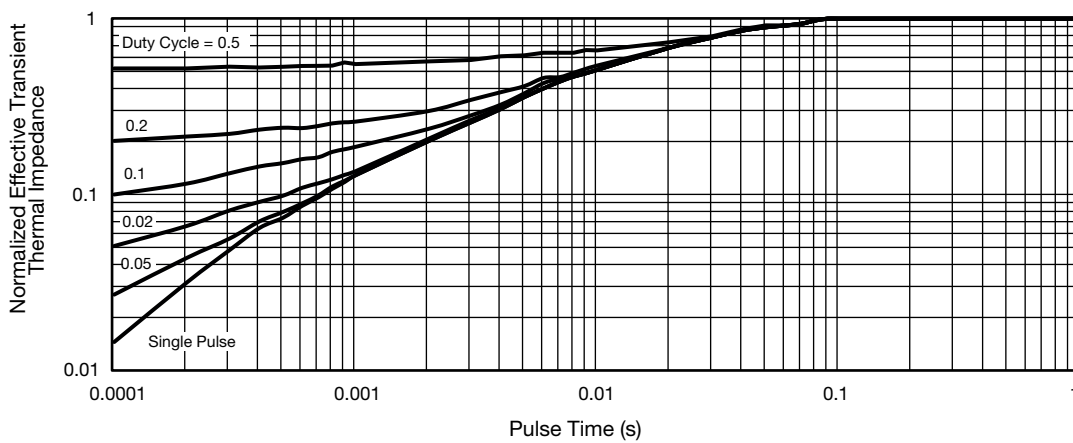
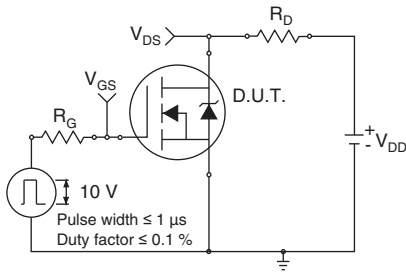
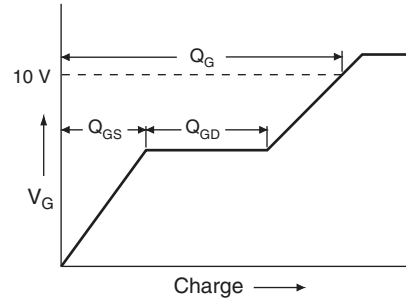


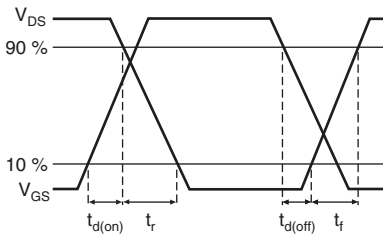
Fig. 11 - Normalized Thermal Transient Impedance, Junction-to-Case



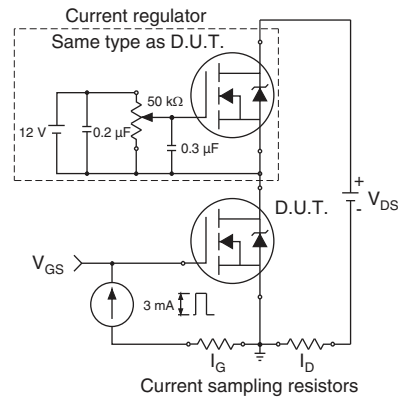
**Fig. 12 - Switching Time Test Circuit**



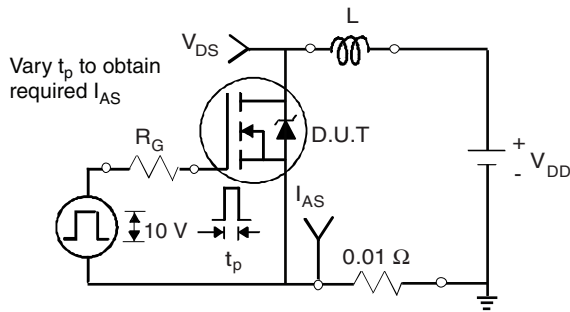
**Fig. 16 - Basic Gate Charge Waveform**



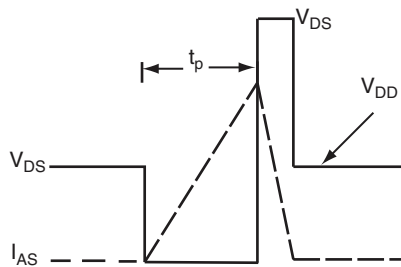
**Fig. 13 - Switching Time Waveforms**



**Fig. 17 - Gate Charge Test Circuit**

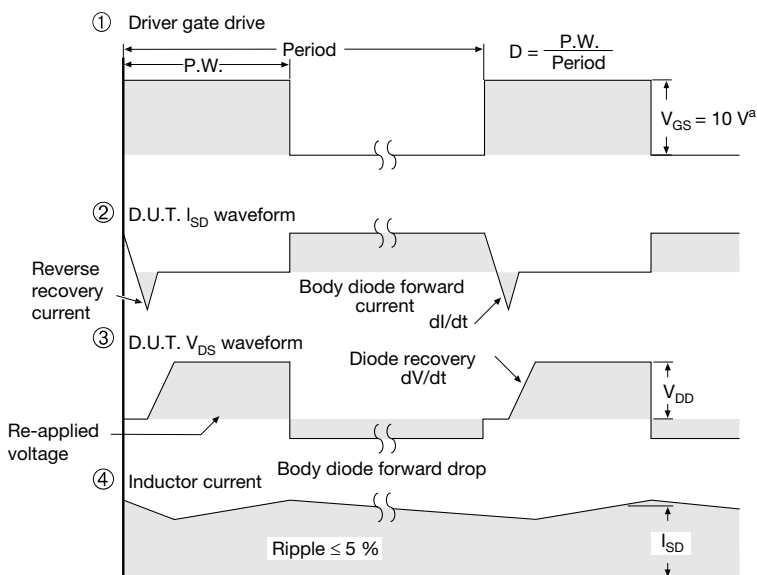
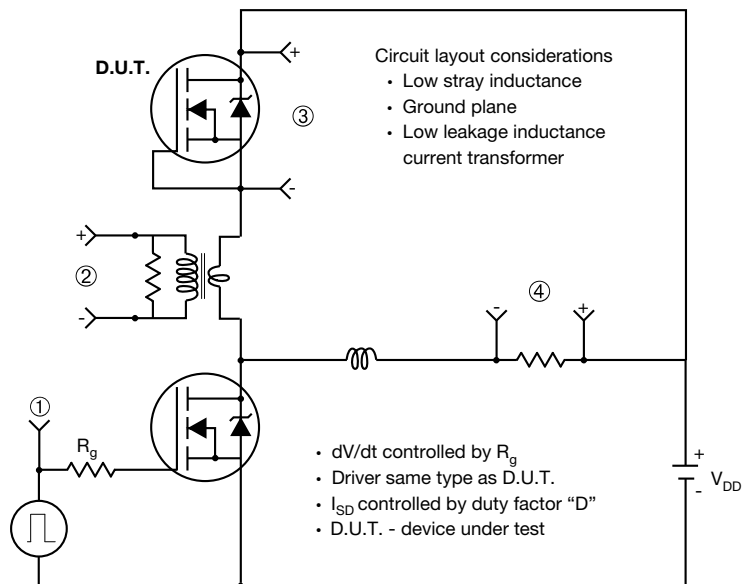


**Fig. 14 - Unclamped Inductive Test Circuit**



**Fig. 15 - Unclamped Inductive Waveforms**

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

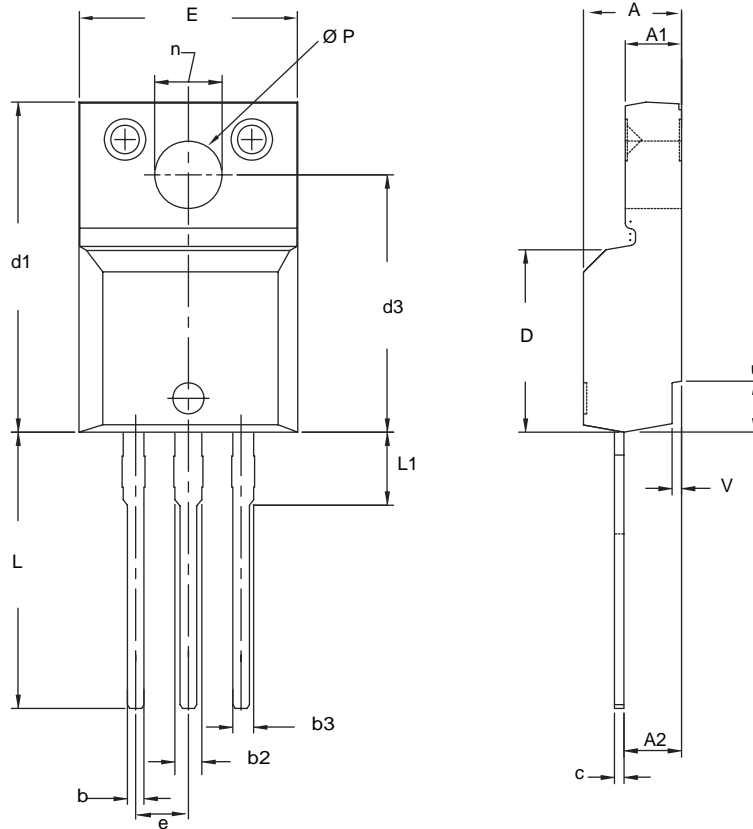


**Note**

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

**Fig. 18 - For N-Channel**

**TO-220 FULLPAK (HIGH VOLTAGE)**



| DIM. | MILLIMETERS |        | INCHES    |       |
|------|-------------|--------|-----------|-------|
|      | MIN.        | MAX.   | MIN.      | MAX.  |
| A    | 4.570       | 4.830  | 0.180     | 0.190 |
| A1   | 2.570       | 2.830  | 0.101     | 0.111 |
| A2   | 2.510       | 2.850  | 0.099     | 0.112 |
| b    | 0.622       | 0.890  | 0.024     | 0.035 |
| b2   | 1.229       | 1.400  | 0.048     | 0.055 |
| b3   | 1.229       | 1.400  | 0.048     | 0.055 |
| c    | 0.440       | 0.629  | 0.017     | 0.025 |
| D    | 8.650       | 9.800  | 0.341     | 0.386 |
| d1   | 15.88       | 16.120 | 0.622     | 0.635 |
| d3   | 12.300      | 12.920 | 0.484     | 0.509 |
| E    | 10.360      | 10.630 | 0.408     | 0.419 |
| e    | 2.54 BSC    |        | 0.100 BSC |       |
| L    | 13.200      | 13.730 | 0.520     | 0.541 |
| L1   | 3.100       | 3.500  | 0.122     | 0.138 |
| n    | 6.050       | 6.150  | 0.238     | 0.242 |
| Ø P  | 3.050       | 3.450  | 0.120     | 0.136 |
| u    | 2.400       | 2.500  | 0.094     | 0.098 |
| v    | 0.400       | 0.500  | 0.016     | 0.020 |

ECN: X09-0126-Rev. B, 26-Oct-09  
DWG: 5972

**Notes**

1. To be used only for process drawing.
2. These dimensions apply to all TO-220, FULLPAK leadframe versions 3 leads.
3. All critical dimensions should C meet  $C_{pk} > 1.33$ .
4. All dimensions include burrs and plating thickness.
5. No chipping or package damage.

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