



## STB6NB50

### N - CHANNEL 500V - 1.35Ω - 5.8A - D2PAK/I2PAK PowerMESH™ MOSFET

| TYPE     | V <sub>DSS</sub> | R <sub>DS(on)</sub> | I <sub>D</sub> |
|----------|------------------|---------------------|----------------|
| STB6NB50 | 500 V            | < 1.5 Ω             | 5.8 A          |

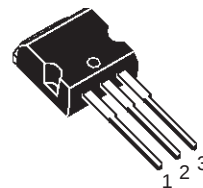
- TYPICAL R<sub>DS(on)</sub> = 1.35 Ω
- EXTREMELY HIGH dv/dt CAPABILITY
- 100% AVALANCHE TESTED
- VERY LOW INTRINSIC CAPACITANCES
- GATE CHARGE MINIMIZED

#### DESCRIPTION

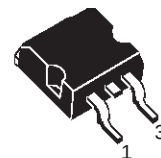
Using the latest high voltage MESH OVERLAY™ process, STMicroelectronics has designed an advanced family of power MOSFETs with outstanding performances. The new patent pending strip layout coupled with the Company's proprietary edge termination structure, gives the lowest R<sub>DS(on)</sub> per area, exceptional avalanche and dv/dt capabilities and unrivalled gate charge and switching characteristics.

#### APPLICATIONS

- HIGH CURRENT, HIGH SPEED SWITCHING
- SWITCH MODE POWER SUPPLIES (SMPS)
- DC-AC CONVERTERS FOR WELDING EQUIPMENT AND UNINTERRUPTIBLE POWER SUPPLIES AND MOTOR DRIVE

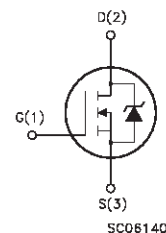


**I<sup>2</sup>PAK  
TO-262**  
(suffix "-1")



**D<sup>2</sup>PAK  
TO-263**  
(Suffix "T4")

#### INTERNAL SCHEMATIC DIAGRAM



#### ABSOLUTE MAXIMUM RATINGS

| Symbol              | Parameter                                             | Value      | Unit |
|---------------------|-------------------------------------------------------|------------|------|
| V <sub>DS</sub>     | Drain-source Voltage (V <sub>GS</sub> = 0)            | 500        | V    |
| V <sub>DGR</sub>    | Drain- gate Voltage (R <sub>GS</sub> = 20 kΩ)         | 500        | V    |
| V <sub>GS</sub>     | Gate-source Voltage                                   | ± 30       | V    |
| I <sub>D</sub>      | Drain Current (continuous) at T <sub>c</sub> = 25 °C  | 5.8        | A    |
| I <sub>D</sub>      | Drain Current (continuous) at T <sub>c</sub> = 100 °C | 3.7        | A    |
| I <sub>DM</sub> (●) | Drain Current (pulsed)                                | 23.2       | A    |
| P <sub>tot</sub>    | Total Dissipation at T <sub>c</sub> = 25 °C           | 100        | W    |
|                     | Derating Factor                                       | 0.8        | W/°C |
| dv/dt(1)            | Peak Diode Recovery voltage slope                     | 4.5        | V/ns |
| T <sub>stg</sub>    | Storage Temperature                                   | -65 to 150 | °C   |
| T <sub>j</sub>      | Max. Operating Junction Temperature                   | 150        | °C   |

(●) Pulse width limited by safe operating area

(1) I<sub>SD</sub> ≤ 6A, di/dt ≤ 200 A/μs, V<sub>DD</sub> ≤ V<sub>(BR)DSS</sub>, T<sub>j</sub> ≤ T<sub>JMAX</sub>

## THERMAL DATA

|                |                                                |     |      |               |
|----------------|------------------------------------------------|-----|------|---------------|
| $R_{thj-case}$ | Thermal Resistance Junction-case               | Max | 1.25 | $^{\circ}C/W$ |
| $R_{thj-amb}$  | Thermal Resistance Junction-ambient            | Max | 62.5 | $^{\circ}C/W$ |
| $R_{thc-sink}$ | Thermal Resistance Case-sink                   | Typ | 0.5  | $^{\circ}C/W$ |
| $T_I$          | Maximum Lead Temperature For Soldering Purpose |     | 300  | $^{\circ}C$   |

## AVALANCHE CHARACTERISTICS

| Symbol   | Parameter                                                                                       | Max Value | Unit |
|----------|-------------------------------------------------------------------------------------------------|-----------|------|
| $I_{AR}$ | Avalanche Current, Repetitive or Not-Repetitive (pulse width limited by $T_j$ max)              | 5.8       | A    |
| $E_{AS}$ | Single Pulse Avalanche Energy (starting $T_j = 25^{\circ}C$ , $I_D = I_{AR}$ , $V_{DD} = 50$ V) | 290       | mJ   |

ELECTRICAL CHARACTERISTICS ( $T_{case} = 25^{\circ}C$  unless otherwise specified)

OFF

| Symbol        | Parameter                                        | Test Conditions                                                                   | Min. | Typ. | Max.      | Unit               |
|---------------|--------------------------------------------------|-----------------------------------------------------------------------------------|------|------|-----------|--------------------|
| $V_{(BR)DSS}$ | Drain-source Breakdown Voltage                   | $I_D = 250 \mu A$ $V_{GS} = 0$                                                    | 500  |      |           | V                  |
| $I_{DSS}$     | Zero Gate Voltage Drain Current ( $V_{GS} = 0$ ) | $V_{DS} = \text{Max Rating}$<br>$V_{DS} = \text{Max Rating}$ $T_c = 125^{\circ}C$ |      |      | 1<br>50   | $\mu A$<br>$\mu A$ |
| $I_{GSS}$     | Gate-body Leakage Current ( $V_{DS} = 0$ )       | $V_{GS} = \pm 30$ V                                                               |      |      | $\pm 100$ | nA                 |

ON (\*)

| Symbol       | Parameter                         | Test Conditions                                              | Min. | Typ. | Max. | Unit     |
|--------------|-----------------------------------|--------------------------------------------------------------|------|------|------|----------|
| $V_{GS(th)}$ | Gate Threshold Voltage            | $V_{DS} = V_{GS}$ $I_D = 250 \mu A$                          | 3    | 4    | 5    | V        |
| $R_{DS(on)}$ | Static Drain-source On Resistance | $V_{GS} = 10$ V $I_D = 2.9$ A                                |      | 1.35 | 1.5  | $\Omega$ |
| $I_{D(on)}$  | On State Drain Current            | $V_{DS} > I_{D(on)} \times R_{DS(on)max}$<br>$V_{GS} = 10$ V | 5.8  |      |      | A        |

## DYNAMIC

| Symbol       | Parameter                    | Test Conditions                                         | Min. | Typ. | Max. | Unit |
|--------------|------------------------------|---------------------------------------------------------|------|------|------|------|
| $g_{fs}$ (*) | Forward Transconductance     | $V_{DS} > I_{D(on)} \times R_{DS(on)max}$ $I_D = 2.9$ A | 2.5  | 4    |      | S    |
| $C_{iss}$    | Input Capacitance            | $V_{DS} = 25$ V $f = 1$ MHz $V_{GS} = 0$                |      | 680  | 884  | pF   |
| $C_{oss}$    | Output Capacitance           |                                                         |      | 110  | 149  | pF   |
| $C_{rss}$    | Reverse Transfer Capacitance |                                                         |      | 12   | 16   | pF   |

**ELECTRICAL CHARACTERISTICS** (continued)**SWITCHING ON**

| Symbol      | Parameter          | Test Conditions                                                            | Min. | Typ. | Max. | Unit |
|-------------|--------------------|----------------------------------------------------------------------------|------|------|------|------|
| $t_{d(on)}$ | Turn-on Time       | $V_{DD} = 250\text{ V}$ $I_D = 2.9\text{ A}$                               |      | 11.5 | 16   | ns   |
| $t_r$       | Rise Time          | $R_G = 4.7\ \Omega$ $V_{GS} = 10\text{ V}$<br>(see test circuit, figure 3) |      | 8    | 12   | ns   |
| $Q_g$       | Total Gate Charge  | $V_{DD} = 400\text{ V}$ $I_D = 5.8\text{ A}$ $V_{GS} = 10\text{ V}$        |      | 21   | 30   | nC   |
| $Q_{gs}$    | Gate-Source Charge |                                                                            |      | 7.2  |      | nC   |
| $Q_{gd}$    | Gate-Drain Charge  |                                                                            |      | 8    |      | nC   |

**SWITCHING OFF**

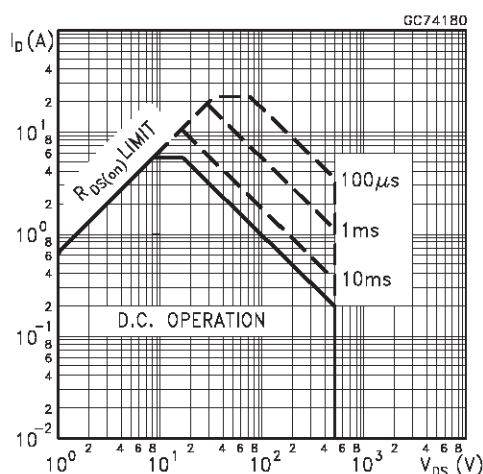
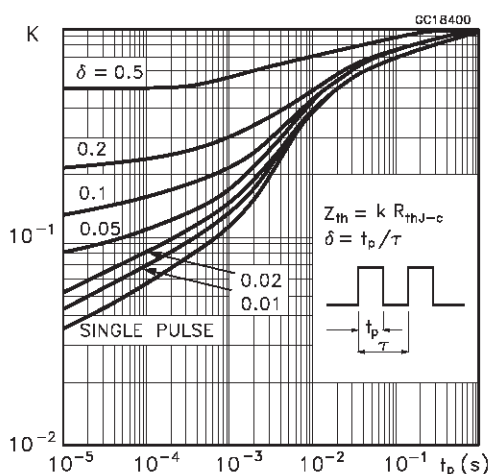
| Symbol         | Parameter             | Test Conditions                                                            | Min. | Typ. | Max. | Unit |
|----------------|-----------------------|----------------------------------------------------------------------------|------|------|------|------|
| $t_r(V_{off})$ | Off-voltage Rise Time | $V_{DD} = 400\text{ V}$ $I_D = 5.8\text{ A}$                               |      | 7    | 12   | ns   |
| $t_f$          | Fall Time             | $R_G = 4.7\ \Omega$ $V_{GS} = 10\text{ V}$<br>(see test circuit, figure 5) |      | 5    | 10   | ns   |
| $t_c$          | Cross-over Time       |                                                                            |      | 15   | 23   | ns   |

**SOURCE DRAIN DIODE**

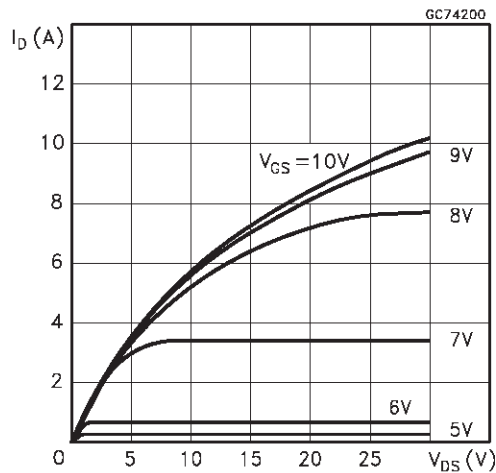
| Symbol             | Parameter                     | Test Conditions                                                                                                                                         | Min. | Typ. | Max. | Unit          |
|--------------------|-------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|---------------|
| $I_{SD}$           | Source-drain Current          |                                                                                                                                                         |      |      | 5.8  | A             |
| $I_{SDM}(\bullet)$ | Source-drain Current (pulsed) |                                                                                                                                                         |      |      | 23.2 | A             |
| $V_{SD} (*)$       | Forward On Voltage            | $I_{SD} = 5.8\text{ A}$ $V_{GS} = 0$                                                                                                                    |      |      | 1.6  | V             |
| $t_{rr}$           | Reverse Recovery Time         | $I_{SD} = 5.8\text{ A}$ $di/dt = 100\text{ A}/\mu\text{s}$<br>$V_{DD} = 100\text{ V}$ $T_j = 150\text{ }^\circ\text{C}$<br>(see test circuit, figure 5) |      | 435  |      | ns            |
| $Q_{rr}$           | Reverse Recovery Charge       |                                                                                                                                                         |      | 3.3  |      | $\mu\text{C}$ |
| $I_{RRM}$          | Reverse Recovery Current      |                                                                                                                                                         |      | 15   |      | A             |

(\*) Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5 %

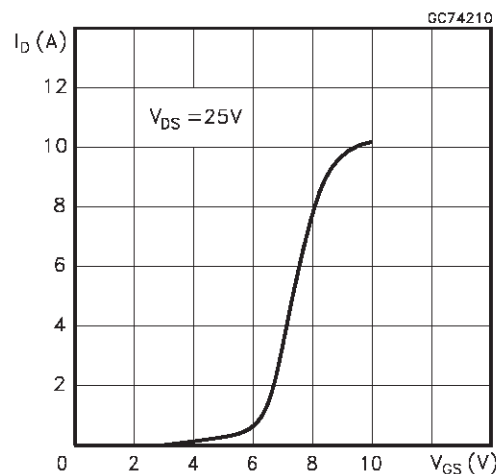
(•) Pulse width limited by safe operating area

**Safe Operating Area****Thermal Impedance**

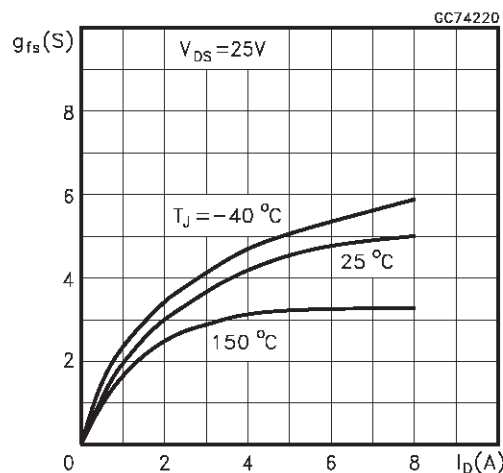
Output Characteristics



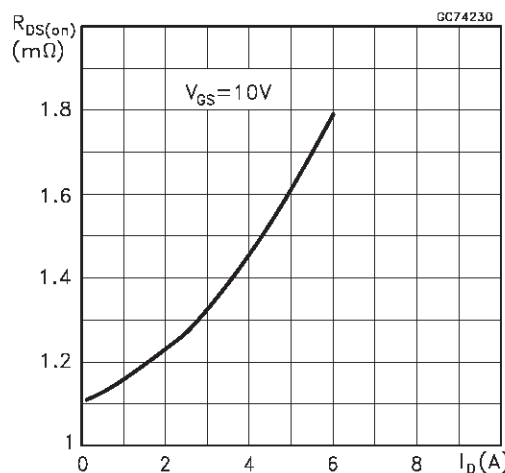
Transfer Characteristics



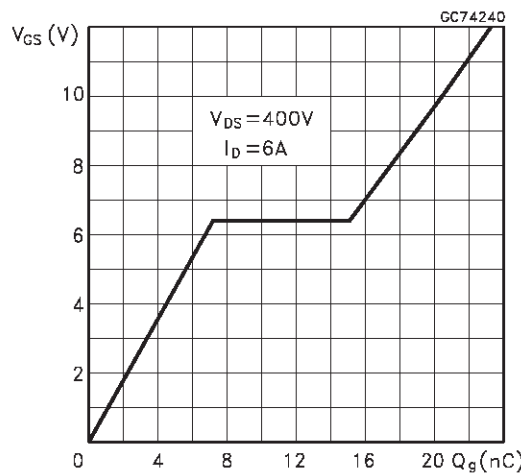
Transconductance



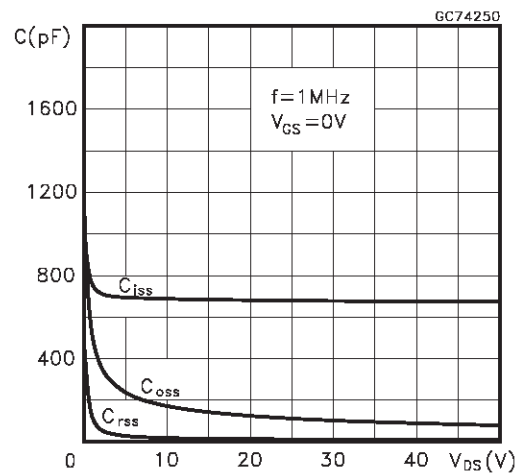
Static Drain-source On Resistance



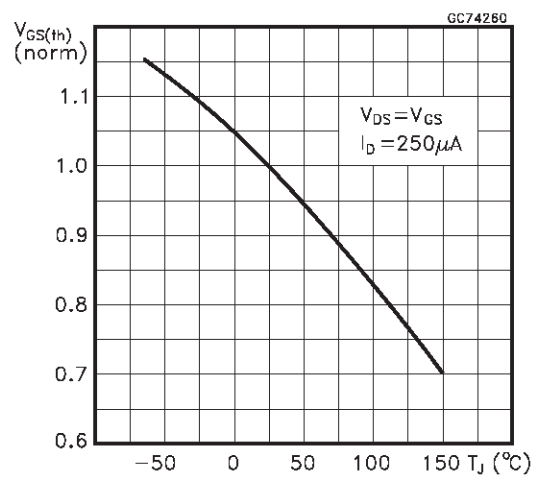
Gate Charge vs Gate-source Voltage



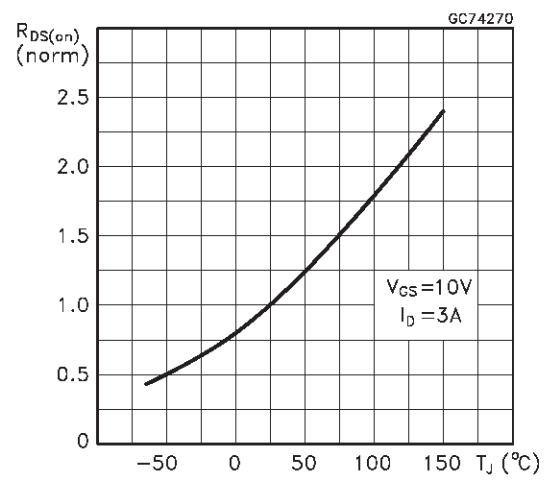
Capacitance Variations



Normalized Gate Threshold Voltage vs Temperature



Normalized On Resistance vs Temperature



Source-drain Diode Forward Characteristics

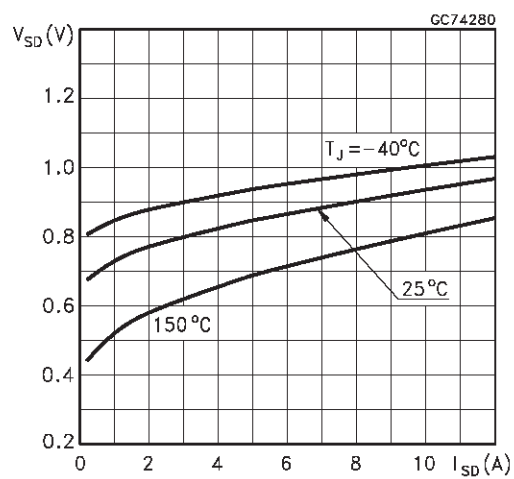


Fig. 1: Unclamped Inductive Load Test Circuit

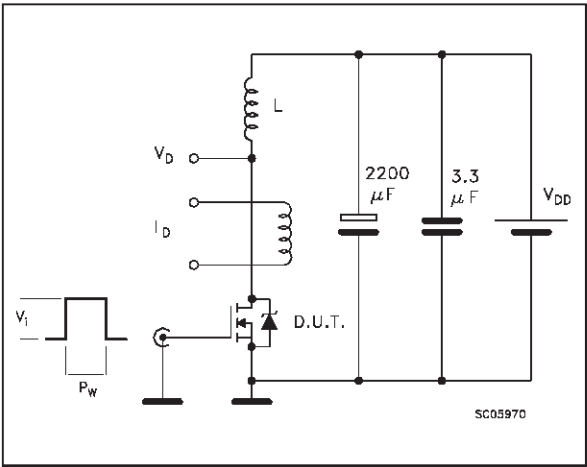


Fig. 2: Unclamped Inductive Waveform

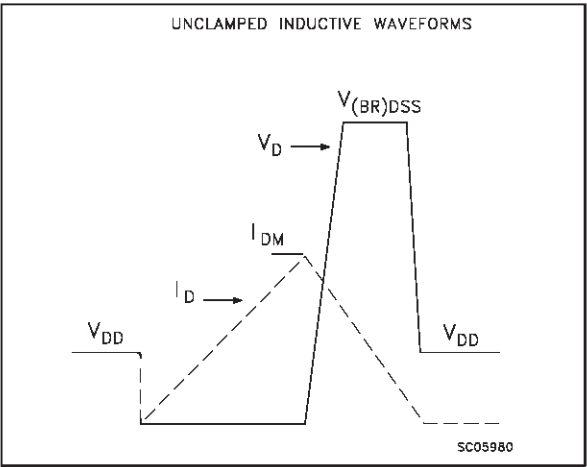


Fig. 3: Switching Times Test Circuits For Resistive Load

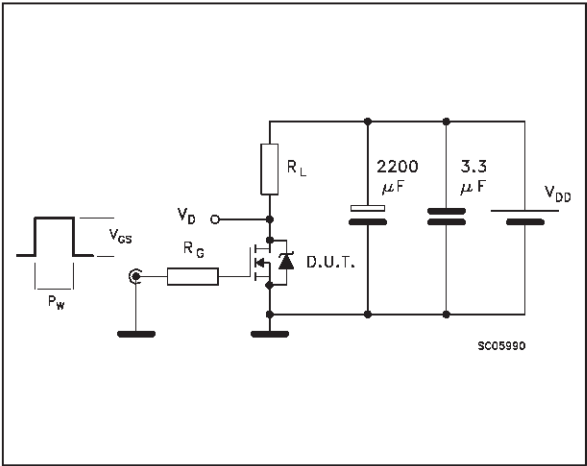


Fig. 4: Gate Charge test Circuit

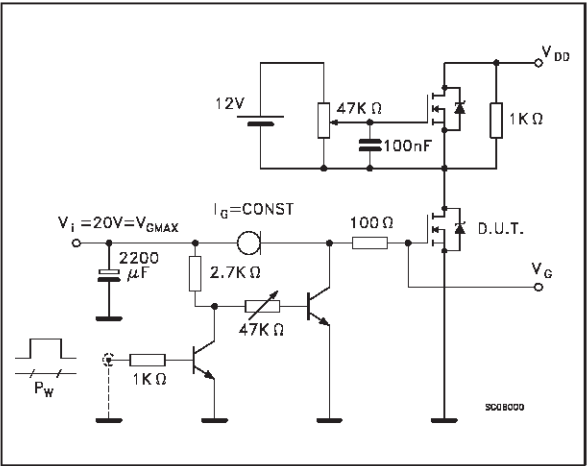
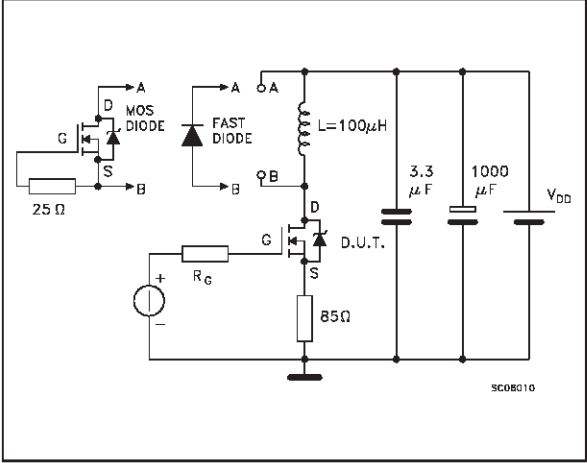
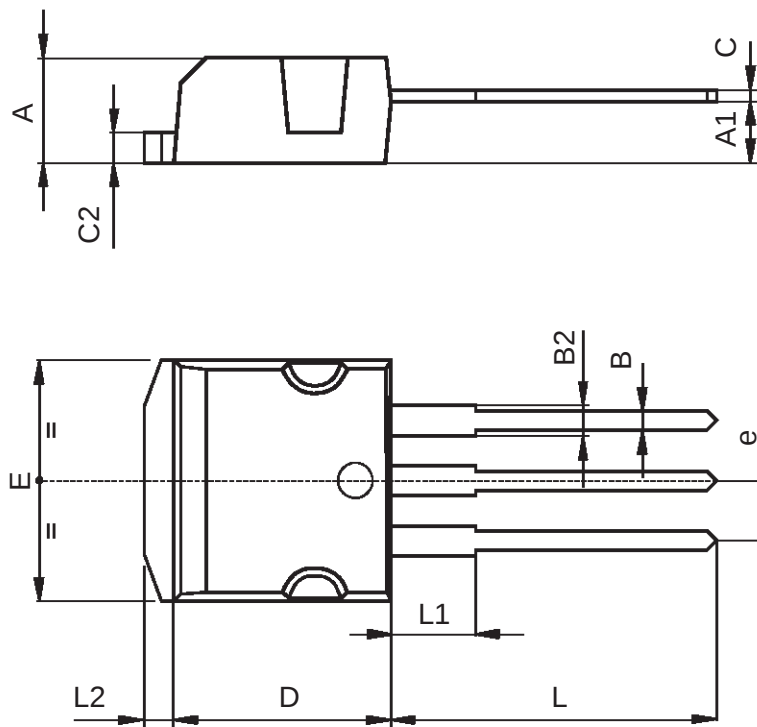


Fig. 5: Test Circuit For Inductive Load Switching And Diode Recovery Times



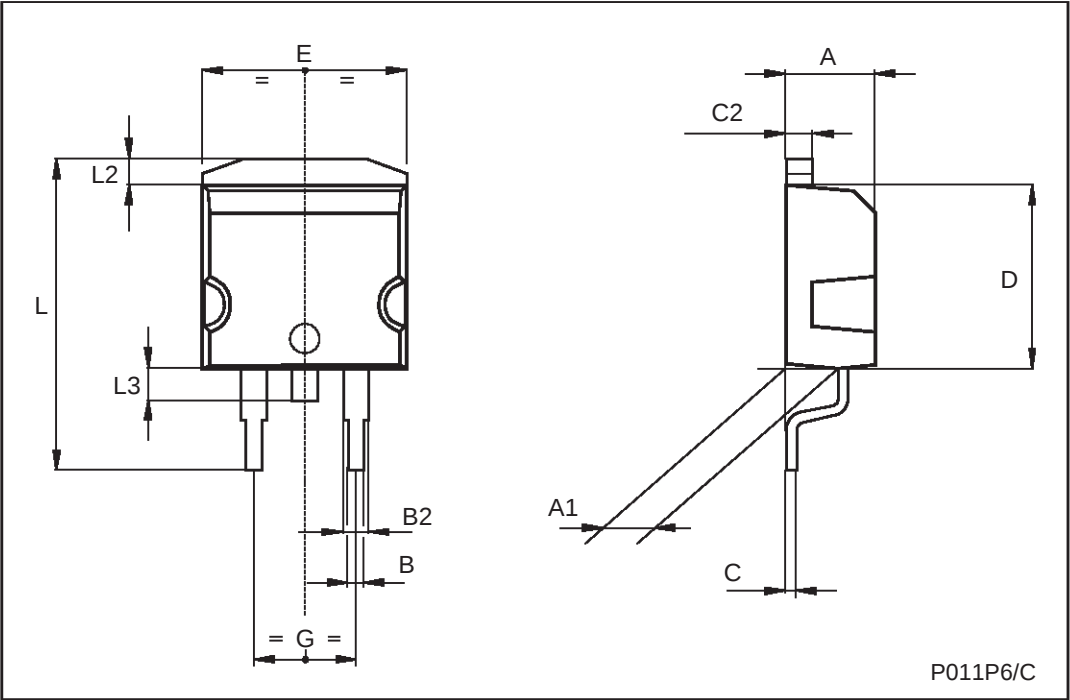
## TO-262 (I2PAK) MECHANICAL DATA

| DIM. | mm   |      |       | inch  |      |       |
|------|------|------|-------|-------|------|-------|
|      | MIN. | TYP. | MAX.  | MIN.  | TYP. | MAX.  |
| A    | 4.3  |      | 4.6   | 0.169 |      | 0.181 |
| A1   | 2.49 |      | 2.69  | 0.098 |      | 0.106 |
| B    | 0.7  |      | 0.93  | 0.027 |      | 0.036 |
| B1   | 1.2  |      | 1.38  | 0.047 |      | 0.054 |
| B2   | 1.25 |      | 1.4   | 0.049 |      | 0.055 |
| C    | 0.45 |      | 0.6   | 0.017 |      | 0.023 |
| C2   | 1.21 |      | 1.36  | 0.047 |      | 0.053 |
| D    | 8.95 |      | 9.35  | 0.352 |      | 0.368 |
| e    | 2.44 |      | 2.64  | 0.096 |      | 0.104 |
| E    | 10   |      | 10.28 | 0.393 |      | 0.404 |
| L    | 13.2 |      | 13.5  | 0.519 |      | 0.531 |
| L1   | 3.48 |      | 3.78  | 0.137 |      | 0.149 |
| L2   | 1.27 |      | 1.4   | 0.050 |      | 0.055 |



TO-263 (D<sup>2</sup>PAK) MECHANICAL DATA

| DIM. | mm   |      |       | inch  |      |       |
|------|------|------|-------|-------|------|-------|
|      | MIN. | TYP. | MAX.  | MIN.  | TYP. | MAX.  |
| A    | 4.3  |      | 4.6   | 0.169 |      | 0.181 |
| A1   | 2.49 |      | 2.69  | 0.098 |      | 0.106 |
| B    | 0.7  |      | 0.93  | 0.027 |      | 0.036 |
| B2   | 1.25 |      | 1.4   | 0.049 |      | 0.055 |
| C    | 0.45 |      | 0.6   | 0.017 |      | 0.023 |
| C2   | 1.21 |      | 1.36  | 0.047 |      | 0.053 |
| D    | 8.95 |      | 9.35  | 0.352 |      | 0.368 |
| E    | 10   |      | 10.28 | 0.393 |      | 0.404 |
| G    | 4.88 |      | 5.28  | 0.192 |      | 0.208 |
| L    | 15   |      | 15.85 | 0.590 |      | 0.624 |
| L2   | 1.27 |      | 1.4   | 0.050 |      | 0.055 |
| L3   | 1.4  |      | 1.75  | 0.055 |      | 0.068 |



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