

## N - CHANNEL ENHANCEMENT MODE PowerMESH™ MOSFET

| TYPE     | V <sub>DSS</sub> | R <sub>DS(on)</sub> | I <sub>D</sub> |
|----------|------------------|---------------------|----------------|
| STD2NB60 | 600 V            | < 3.6 Ω             | 2.6 A          |

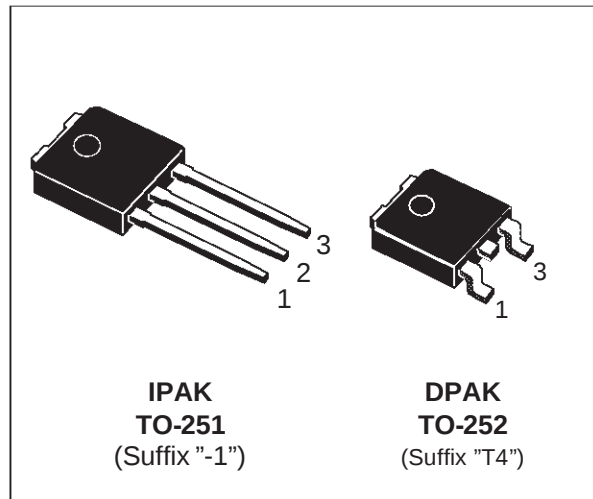
- TYPICAL R<sub>DS(on)</sub> = 3.3 Ω
- EXTREMELY HIGH dv/dt CAPABILITY
- 100% AVALANCHE TESTED
- VERY LOW INTRINSIC CAPACITANCES
- GATE CHARGE MINIMIZED

### DESCRIPTION

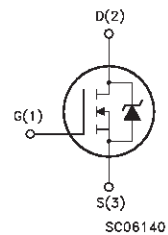
Using the latest high voltage MESH OVERLAY™ process, SGS-Thomson has designed an advanced family of power MOSFETs with outstanding performances. The new patent pending strip layout coupled with the Company's proprietary edge termination structure, gives the lowest R<sub>DS(on)</sub> per area, exceptional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

### APPLICATIONS

- SWITCH MODE POWER SUPPLIES (SMPS)
- DC-AC CONVERTERS FOR WELDING EQUIPMENT AND UNINTERRUPTIBLE POWER SUPPLIES AND MOTOR DRIVE



### INTERNAL SCHEMATIC DIAGRAM



### ABSOLUTE MAXIMUM RATINGS

| Symbol              | Parameter                                             | Value      | Unit |
|---------------------|-------------------------------------------------------|------------|------|
| V <sub>DS</sub>     | Drain-source Voltage (V <sub>GS</sub> = 0)            | 600        | V    |
| V <sub>DGR</sub>    | Drain- gate Voltage (R <sub>GS</sub> = 20 kΩ)         | 600        | V    |
| V <sub>GS</sub>     | Gate-source Voltage                                   | ± 30       | V    |
| I <sub>D</sub>      | Drain Current (continuous) at T <sub>c</sub> = 25 °C  | 2.6        | A    |
| I <sub>D</sub>      | Drain Current (continuous) at T <sub>c</sub> = 100 °C | 1.6        | A    |
| I <sub>DM</sub> (●) | Drain Current (pulsed)                                | 10.4       | A    |
| P <sub>tot</sub>    | Total Dissipation at T <sub>c</sub> = 25 °C           | 50         | W    |
|                     | Derating Factor                                       | 0.4        | 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> ≤ 2.6A, di/dt ≤ 200 A/μs, V<sub>DD</sub> ≤ V<sub>(BR)DSS</sub>, T<sub>j</sub> ≤ T<sub>JMAX</sub>

## STD2NB60

### THERMAL DATA

|                |                                                |     |     |               |
|----------------|------------------------------------------------|-----|-----|---------------|
| $R_{thj-case}$ | Thermal Resistance Junction-case               | Max | 2.5 | $^{\circ}C/W$ |
| $R_{thj-amb}$  | Thermal Resistance Junction-ambient            | Max | 100 | $^{\circ}C/W$ |
| $R_{thc-sink}$ | Thermal Resistance Case-sink                   | Typ | 1.5 | $^{\circ}C/W$ |
| $T_l$          | Maximum Lead Temperature For Soldering Purpose |     | 275 | $^{\circ}C$   |

### AVALANCHE CHARACTERISTICS

| Symbol   | Parameter                                                                                           | Max Value | Unit |
|----------|-----------------------------------------------------------------------------------------------------|-----------|------|
| $I_{AR}$ | Avalanche Current, Repetitive or Not-Repetitive (pulse width limited by $T_j$ max, $\delta < 1\%$ ) | 2.6       | A    |
| $E_{AS}$ | Single Pulse Avalanche Energy (starting $T_j = 25^{\circ}C$ , $I_D = I_{AR}$ , $V_{DD} = 50 V$ )    | 80        | 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                   | $I_D = 250 \mu A$ $V_{GS} = 0$                                                    | 600  |      |           | 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 | $V_{GS} = 10V$ $I_D = 1.6 A$                                 |      | 3.3  | 3.6  | $\Omega$ |
| $I_{D(on)}$  | On State Drain Current            | $V_{DS} > I_{D(on)} \times R_{DS(on)max}$<br>$V_{GS} = 10 V$ | 3.3  |      |      | A        |

### DYNAMIC

| Symbol                              | Parameter                                                               | Test Conditions                                         | Min. | Typ.           | Max.           | Unit           |
|-------------------------------------|-------------------------------------------------------------------------|---------------------------------------------------------|------|----------------|----------------|----------------|
| $g_{fs} (*)$                        | Forward Transconductance                                                | $V_{DS} > I_{D(on)} \times R_{DS(on)max}$ $I_D = 1.6 A$ | 1.2  | 2              |                | S              |
| $C_{iss}$<br>$C_{oss}$<br>$C_{rss}$ | Input Capacitance<br>Output Capacitance<br>Reverse Transfer Capacitance | $V_{DS} = 25 V$ $f = 1 MHz$ $V_{GS} = 0$                |      | 400<br>57<br>7 | 520<br>77<br>9 | pF<br>pF<br>pF |

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

| Symbol      | Parameter          | Test Conditions                                                            | Min. | Typ. | Max. | Unit |
|-------------|--------------------|----------------------------------------------------------------------------|------|------|------|------|
| $t_{d(on)}$ | Turn-on Time       | $V_{DD} = 300\text{ V}$ $I_D = 1.6\text{ A}$                               |      | 11   | 17   | ns   |
| $t_r$       | Rise Time          | $R_G = 4.7\ \Omega$ $V_{GS} = 10\text{ V}$<br>(see test circuit, figure 3) |      | 7    | 11   | ns   |
| $Q_g$       | Total Gate Charge  | $V_{DD} = 480\text{ V}$ $I_D = 3.3\text{ A}$ $V_{GS} = 10\text{ V}$        |      | 15   | 22   | nC   |
| $Q_{gs}$    | Gate-Source Charge |                                                                            |      | 6.2  |      | nC   |
| $Q_{gd}$    | Gate-Drain Charge  |                                                                            |      | 5.6  |      | nC   |

**SWITCHING OFF**

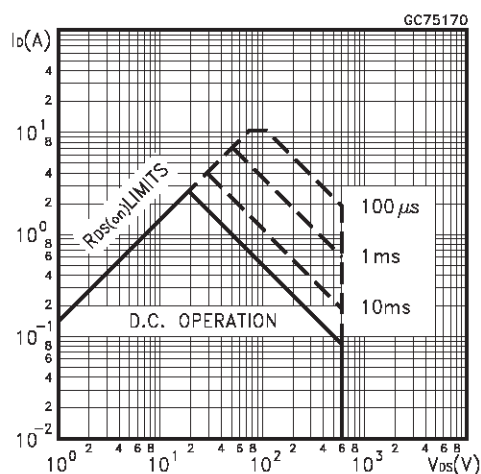
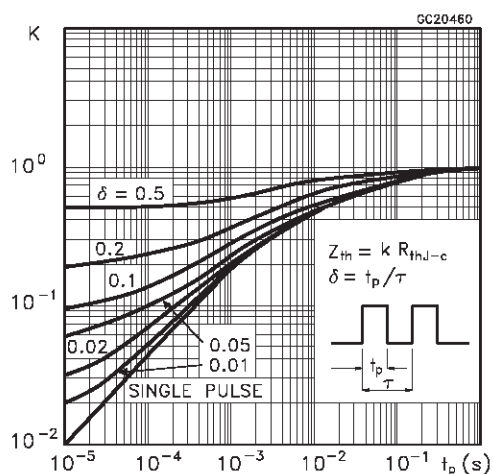
| Symbol         | Parameter             | Test Conditions                                                            | Min. | Typ. | Max. | Unit |
|----------------|-----------------------|----------------------------------------------------------------------------|------|------|------|------|
| $t_r(V_{off})$ | Off-voltage Rise Time | $V_{DD} = 480\text{ V}$ $I_D = 3.3\text{ A}$                               |      | 11   | 16   | ns   |
| $t_f$          | Fall Time             | $R_G = 4.7\ \Omega$ $V_{GS} = 10\text{ V}$<br>(see test circuit, figure 5) |      | 13   | 18   | ns   |
| $t_c$          | Cross-over Time       |                                                                            |      | 18   | 25   | ns   |

**SOURCE DRAIN DIODE**

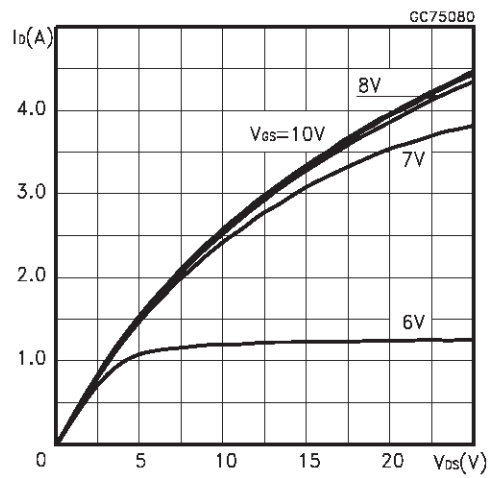
| Symbol             | Parameter                     | Test Conditions                                                                                                                                         | Min. | Typ. | Max. | Unit          |
|--------------------|-------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|---------------|
| $I_{SD}$           | Source-drain Current          |                                                                                                                                                         |      |      | 3.3  | A             |
| $I_{SDM}(\bullet)$ | Source-drain Current (pulsed) |                                                                                                                                                         |      |      | 13.2 | A             |
| $V_{SD} (*)$       | Forward On Voltage            | $I_{SD} = 3.3\text{ A}$ $V_{GS} = 0$                                                                                                                    |      |      | 1.6  | V             |
| $t_{rr}$           | Reverse Recovery Time         | $I_{SD} = 3.3\text{ A}$ $di/dt = 100\text{ A}/\mu\text{s}$<br>$V_{DD} = 100\text{ V}$ $T_j = 150\text{ }^\circ\text{C}$<br>(see test circuit, figure 5) |      | 500  |      | ns            |
| $Q_{rr}$           | Reverse Recovery Charge       |                                                                                                                                                         |      | 2.1  |      | $\mu\text{C}$ |
| $I_{RRM}$          | Reverse Recovery Current      |                                                                                                                                                         |      | 8.5  |      | A             |

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

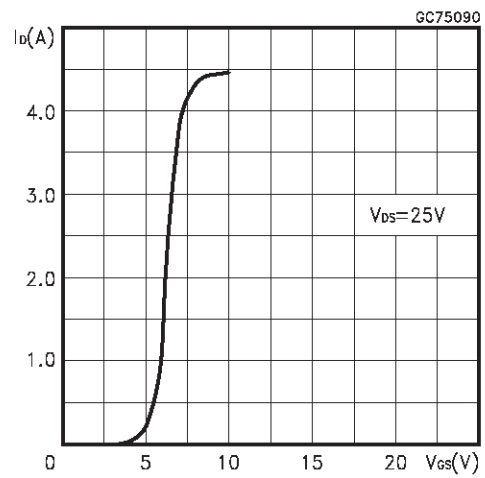
(•) Pulse width limited by safe operating area

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

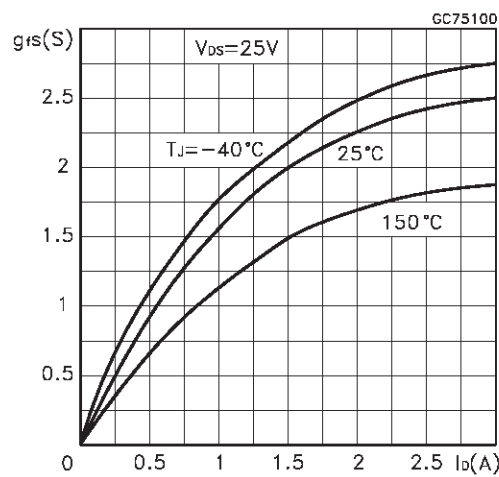
Output Characteristics



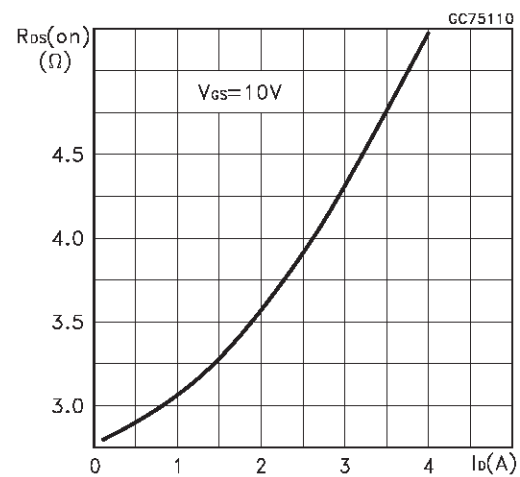
Transfer Characteristics



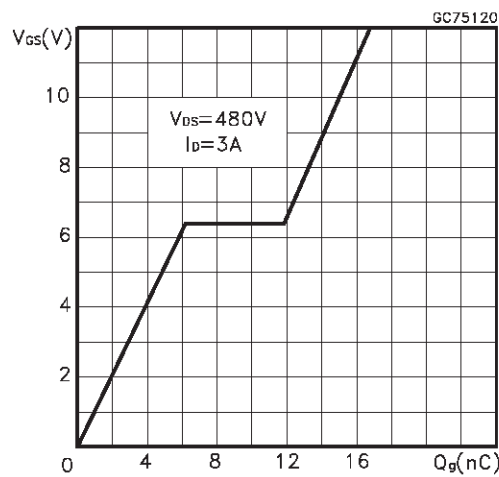
Transconductance



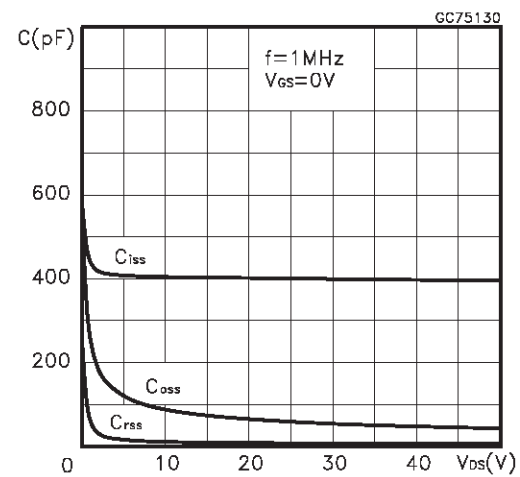
Static Drain-source On Resistance



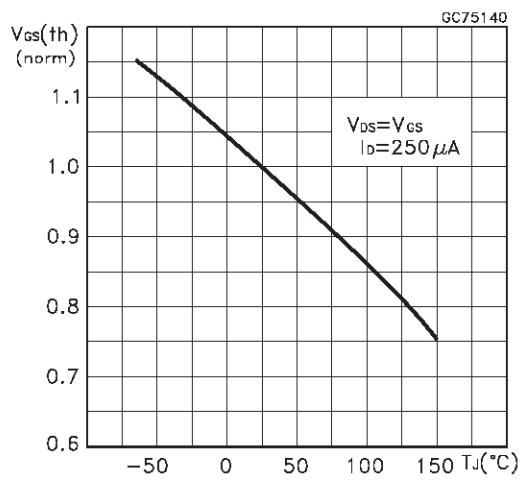
Gate Charge vs Gate-source Voltage



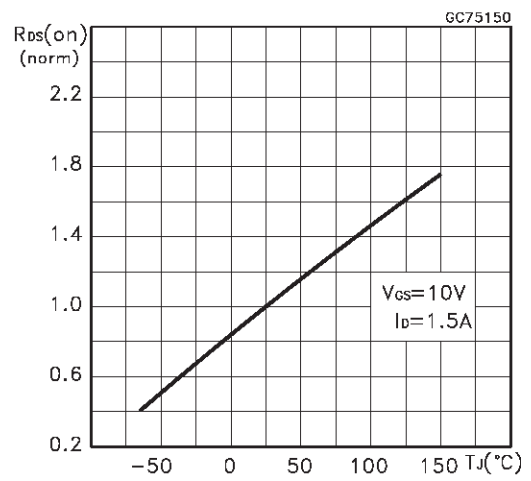
Capacitance Variations



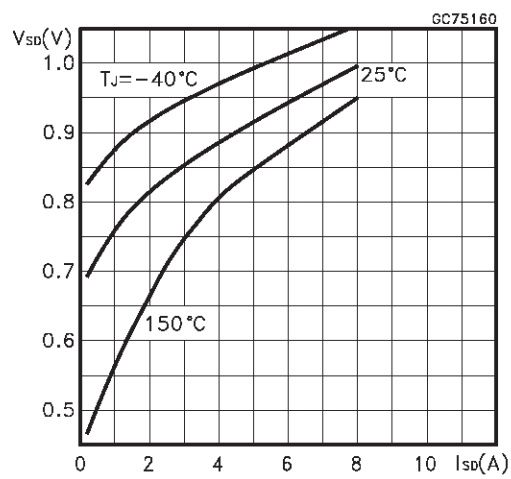
Normalized Gate Threshold Voltage vs Temperature



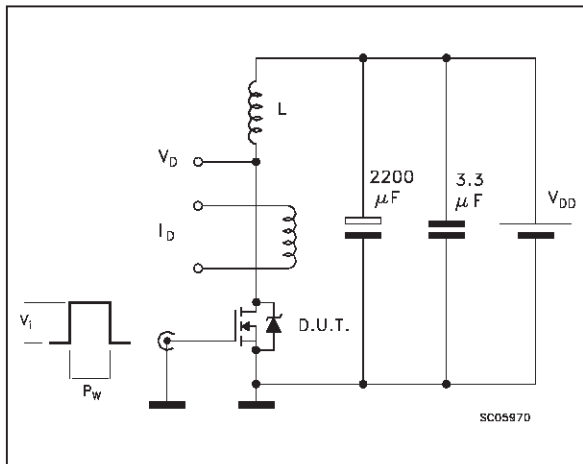
Normalized On Resistance vs Temperature



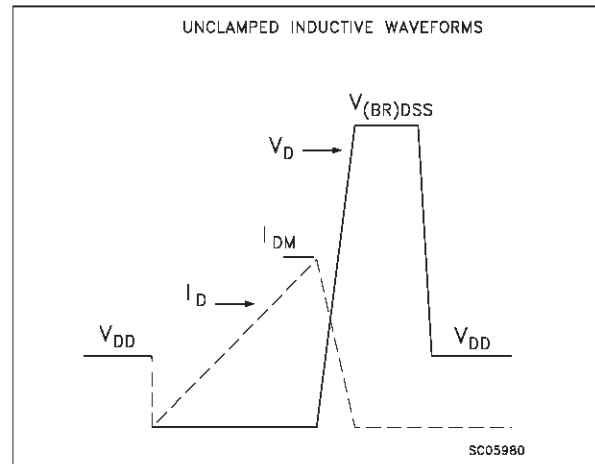
Source-drain Diode Forward Characteristics



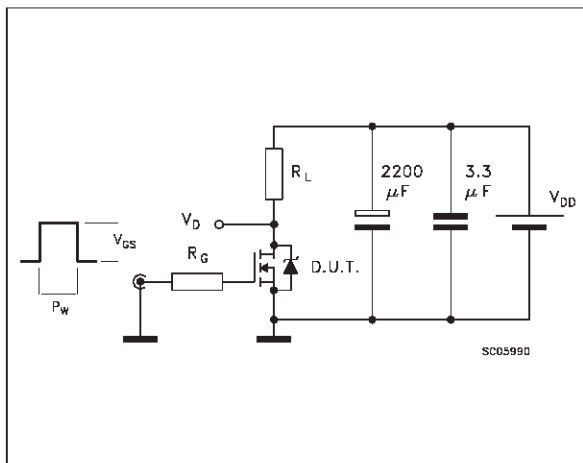
**Fig. 1: Unclamped Inductive Load Test Circuit**



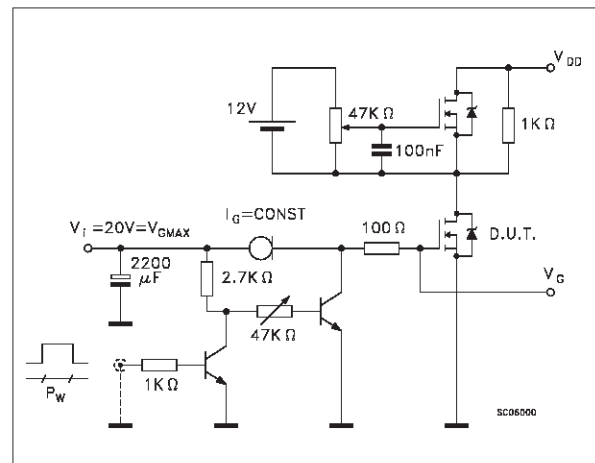
**Fig. 2: Unclamped Inductive Waveform**



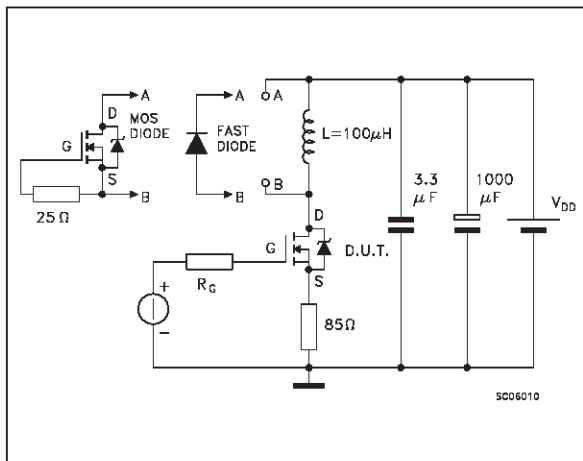
**Fig. 3: Switching Times Test Circuits For Resistive Load**



**Fig. 4: Gate Charge test Circuit**

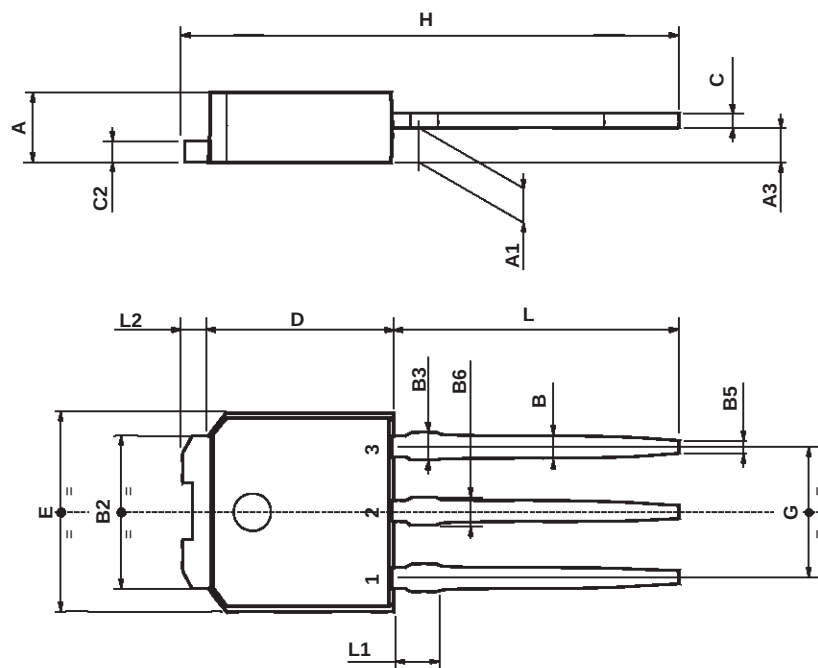


**Fig. 5: Test Circuit For Inductive Load Switching And Diode Recovery Times**



## TO-251 (IPAK) MECHANICAL DATA

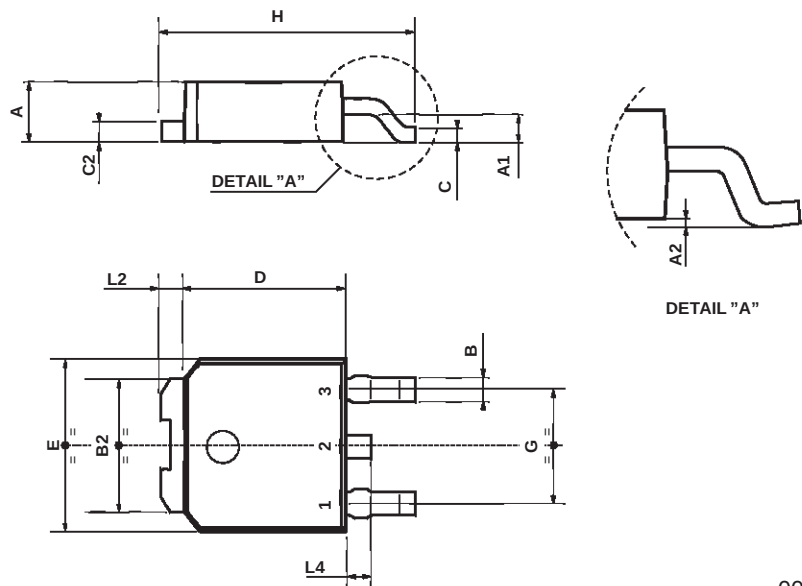
| DIM. | mm   |      |      | inch  |       |       |
|------|------|------|------|-------|-------|-------|
|      | MIN. | TYP. | MAX. | MIN.  | TYP.  | MAX.  |
| A    | 2.2  |      | 2.4  | 0.086 |       | 0.094 |
| A1   | 0.9  |      | 1.1  | 0.035 |       | 0.043 |
| A3   | 0.7  |      | 1.3  | 0.027 |       | 0.051 |
| B    | 0.64 |      | 0.9  | 0.025 |       | 0.031 |
| B2   | 5.2  |      | 5.4  | 0.204 |       | 0.212 |
| B3   |      |      | 0.85 |       |       | 0.033 |
| B5   |      | 0.3  |      |       | 0.012 |       |
| B6   |      |      | 0.95 |       |       | 0.037 |
| C    | 0.45 |      | 0.6  | 0.017 |       | 0.023 |
| C2   | 0.48 |      | 0.6  | 0.019 |       | 0.023 |
| D    | 6    |      | 6.2  | 0.236 |       | 0.244 |
| E    | 6.4  |      | 6.6  | 0.252 |       | 0.260 |
| G    | 4.4  |      | 4.6  | 0.173 |       | 0.181 |
| H    | 15.9 |      | 16.3 | 0.626 |       | 0.641 |
| L    | 9    |      | 9.4  | 0.354 |       | 0.370 |
| L1   | 0.8  |      | 1.2  | 0.031 |       | 0.047 |
| L2   |      | 0.8  | 1    |       | 0.031 | 0.039 |



0068771-E

TO-252 (DPAK) MECHANICAL DATA

| DIM. | mm   |      |      | inch  |       |       |
|------|------|------|------|-------|-------|-------|
|      | MIN. | TYP. | MAX. | MIN.  | TYP.  | MAX.  |
| A    | 2.2  |      | 2.4  | 0.086 |       | 0.094 |
| A1   | 0.9  |      | 1.1  | 0.035 |       | 0.043 |
| A2   | 0.03 |      | 0.23 | 0.001 |       | 0.009 |
| B    | 0.64 |      | 0.9  | 0.025 |       | 0.035 |
| B2   | 5.2  |      | 5.4  | 0.204 |       | 0.212 |
| C    | 0.45 |      | 0.6  | 0.017 |       | 0.023 |
| C2   | 0.48 |      | 0.6  | 0.019 |       | 0.023 |
| D    | 6    |      | 6.2  | 0.236 |       | 0.244 |
| E    | 6.4  |      | 6.6  | 0.252 |       | 0.260 |
| G    | 4.4  |      | 4.6  | 0.173 |       | 0.181 |
| H    | 9.35 |      | 10.1 | 0.368 |       | 0.397 |
| L2   |      | 0.8  |      |       | 0.031 |       |
| L4   | 0.6  |      | 1    | 0.023 |       | 0.039 |



0068772-B

Information furnished is believed to be accurate and reliable. However, SGS-THOMSON Microelectronics assumes no responsibility for the consequences of use of such information nor for any infringement of patents or other rights of third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of SGS-THOMSON Microelectronics. Specifications mentioned in this publication are subject to change without notice. This publication supersedes and replaces all information previously supplied. SGS-THOMSON Microelectronics products are not authorized for use as critical components in life support devices or systems without express written approval of SGS-THOMSON Microelectronics.

© 1998 SGS-THOMSON Microelectronics - Printed in Italy - All Rights Reserved

SGS-THOMSON Microelectronics GROUP OF COMPANIES

Australia - Brazil - Canada - China - France - Germany - Italy - Japan - Korea - Malaysia - Malta - Morocco - The Netherlands -  
Singapore - Spain - Sweden - Switzerland - Taiwan - Thailand - United Kingdom - U.S.A



...