

## N - CHANNEL ENHANCEMENT MODE PowerMESH™ MOSFET

| TYPE       | V <sub>DSS</sub> | R <sub>DS(on)</sub> | I <sub>D</sub> |
|------------|------------------|---------------------|----------------|
| STP6NB50   | 500 V            | < 1.5 Ω             | 5.8 A          |
| STP6NB50FP | 500 V            | < 1.5 Ω             | 3.4 A          |

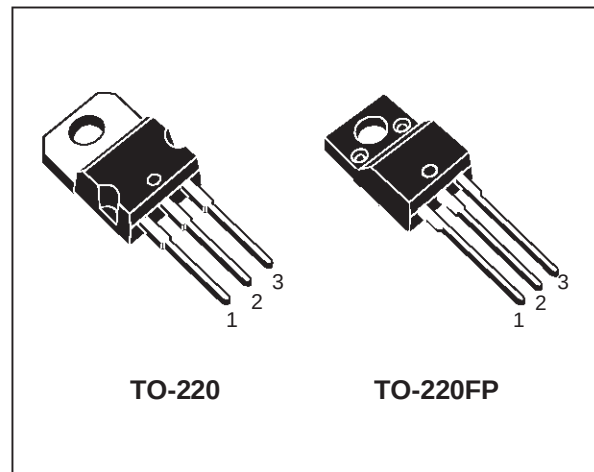
- TYPICAL R<sub>DS(on)</sub> = 1.35 Ω
- EXTREMELY HIGH dv/dt CAPABILITY
- 100% AVALANCHE TESTED
- VERY LOW INTRINSIC CAPACITANCES
- GATE CHARGE MINIMIZED

### DESCRIPTION

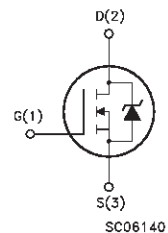
Using the latest high voltage MESH OVERLAY™ process, SGS-Thomson has designed an advanced family of power MOSFETs with outstanding performances. The new patent pending strip layout coupled with the Company's proprietary edge termination structure, gives the lowest R<sub>DS(on)</sub> per area, exceptional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

### APPLICATIONS

- HIGH CURRENT, HIGH SPEED SWITCHING
- 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 |
|---------------------|-------------------------------------------------------|------------|------------|------|
|                     |                                                       | STP6NB50   | STP6NB50FP |      |
| 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        | 3.4        | A    |
| I <sub>D</sub>      | Drain Current (continuous) at T <sub>c</sub> = 100 °C | 3.7        | 2.1        | A    |
| I <sub>DM</sub> (•) | Drain Current (pulsed)                                | 23.2       | 23.2       | A    |
| P <sub>tot</sub>    | Total Dissipation at T <sub>c</sub> = 25 °C           | 100        | 35         | W    |
|                     | Derating Factor                                       | 0.8        | 0.28       | W/°C |
| dv/dt(1)            | Peak Diode Recovery voltage slope                     | 4.5        | 4.5        | V/ns |
| V <sub>ISO</sub>    | Insulation Withstand Voltage (DC)                     | --         | 2000       | °C   |
| 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>

**STP6NB50/FP****THERMAL DATA**

|                       |                                                |     |      | TO-220 | TO-220FP |      |
|-----------------------|------------------------------------------------|-----|------|--------|----------|------|
| R <sub>thj-case</sub> | Thermal Resistance Junction-case               | Max |      | 1.25   | 3.57     | °C/W |
| R <sub>thj-amb</sub>  | Thermal Resistance Junction-ambient            | Max | 62.5 |        |          | °C/W |
| R <sub>thc-sink</sub> | Thermal Resistance Case-sink                   | Typ | 0.5  |        |          | °C/W |
| T <sub>l</sub>        | Maximum Lead Temperature For Soldering Purpose |     |      | 300    |          | °C   |

**AVALANCHE CHARACTERISTICS**

| Symbol          | Parameter                                                                                                                  | Max Value | Unit |
|-----------------|----------------------------------------------------------------------------------------------------------------------------|-----------|------|
| I <sub>AR</sub> | Avalanche Current, Repetitive or Not-Repetitive (pulse width limited by T <sub>j</sub> max, δ < 1%)                        | 5.8       | A    |
| E <sub>AS</sub> | Single Pulse Avalanche Energy (starting T <sub>j</sub> = 25 °C, I <sub>D</sub> = I <sub>AR</sub> , V <sub>DD</sub> = 50 V) | 290       | mJ   |

**ELECTRICAL CHARACTERISTICS** (T<sub>case</sub> = 25 °C unless otherwise specified)

OFF

| Symbol               | Parameter                                             | Test Conditions                                                                      | Min. | Typ. | Max.    | Unit     |
|----------------------|-------------------------------------------------------|--------------------------------------------------------------------------------------|------|------|---------|----------|
| V <sub>(BR)DSS</sub> | Drain-source Breakdown Voltage                        | I <sub>D</sub> = 250 μA V <sub>GS</sub> = 0                                          | 500  |      |         | V        |
| I <sub>DSS</sub>     | Zero Gate Voltage Drain Current (V <sub>GS</sub> = 0) | V <sub>DS</sub> = Max Rating<br>V <sub>DS</sub> = Max Rating T <sub>c</sub> = 125 °C |      |      | 1<br>50 | μA<br>μA |
| I <sub>GSS</sub>     | Gate-body Leakage Current (V <sub>DS</sub> = 0)       | V <sub>GS</sub> = ± 30 V                                                             |      |      | ± 100   | nA       |

ON (\*)

| Symbol              | Parameter                         | Test Conditions                                                                         | Min. | Typ. | Max. | Unit |
|---------------------|-----------------------------------|-----------------------------------------------------------------------------------------|------|------|------|------|
| V <sub>GS(th)</sub> | Gate Threshold Voltage            | V <sub>DS</sub> = V <sub>GS</sub> I <sub>D</sub> = 250 μA                               | 3    | 4    | 5    | V    |
| R <sub>DS(on)</sub> | Static Drain-source On Resistance | V <sub>GS</sub> = 10V I <sub>D</sub> = 2.9 A                                            |      | 1.35 | 1.5  | Ω    |
| I <sub>D(on)</sub>  | On State Drain Current            | V <sub>DS</sub> > I <sub>D(on)</sub> × R <sub>DS(on)max</sub><br>V <sub>GS</sub> = 10 V | 5.8  |      |      | A    |

**DYNAMIC**

| Symbol              | Parameter                    | Test Conditions                                                                      | Min. | Typ. | Max. | Unit |
|---------------------|------------------------------|--------------------------------------------------------------------------------------|------|------|------|------|
| g <sub>fs</sub> (*) | Forward Transconductance     | V <sub>DS</sub> > I <sub>D(on)</sub> × R <sub>DS(on)max</sub> I <sub>D</sub> = 2.9 A | 2.5  | 4    |      | S    |
| C <sub>iss</sub>    | Input Capacitance            | V <sub>DS</sub> = 25 V f = 1 MHz V <sub>GS</sub> = 0                                 |      | 680  | 884  | pF   |
| C <sub>oss</sub>    | Output Capacitance           |                                                                                      |      | 110  | 149  | pF   |
| C <sub>rss</sub>    | Reverse Transfer Capacitance |                                                                                      |      | 12   | 16   | pF   |

ELECTRICAL CHARACTERISTICS (continued)  
SWITCHING ON

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

SWITCHING OFF

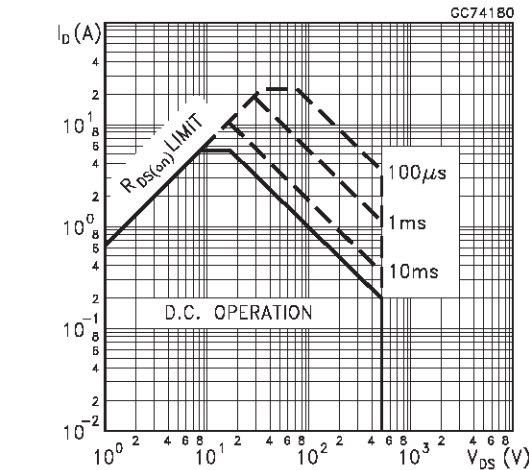
| Symbol                           | Parameter                                             | Test Conditions                                                                                                            | Min. | Typ.         | Max.           | Unit           |
|----------------------------------|------------------------------------------------------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

SOURCE DRAIN DIODE

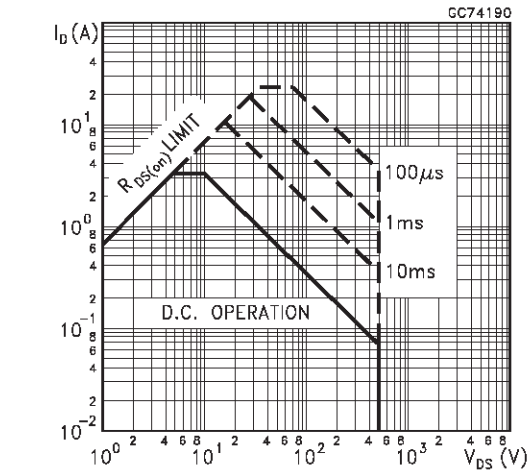
| Symbol                            | Parameter                                                                             | Test Conditions                                                                                                                                         | Min. | Typ.         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

(\*) Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5 %  
( $\bullet$ ) Pulse width limited by safe operating area

Safe Operating Area for TO-220

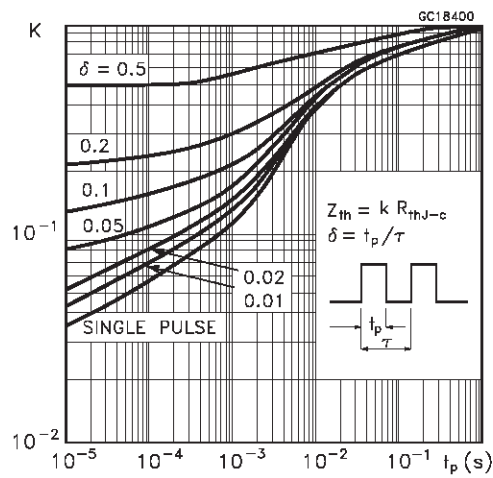


Safe Operating Area for TO-220FP

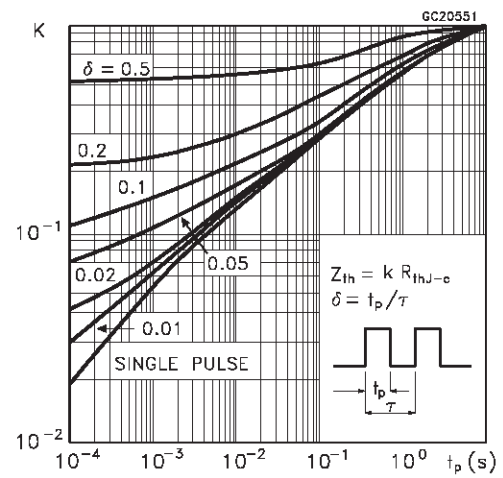


## STP6NB50/FP

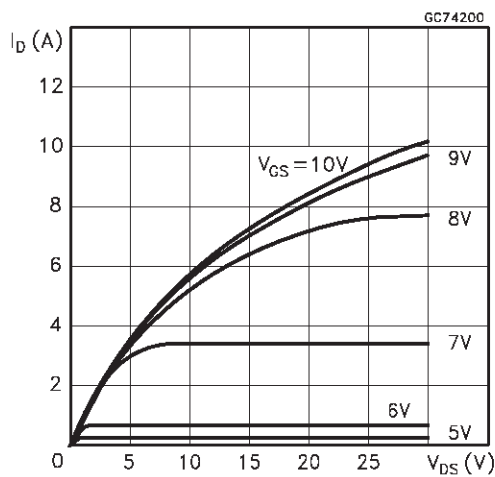
Thermal Impedance for TO-220



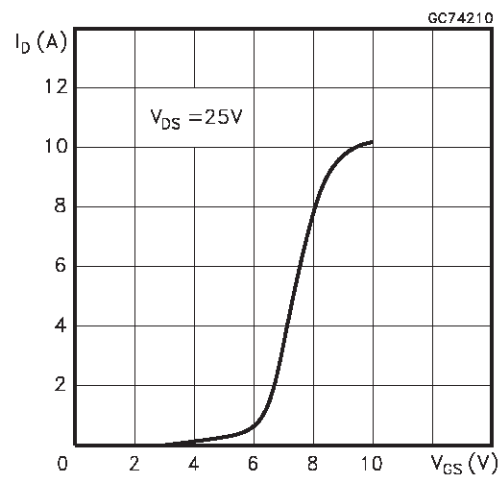
Thermal Impedance for TO-220FP



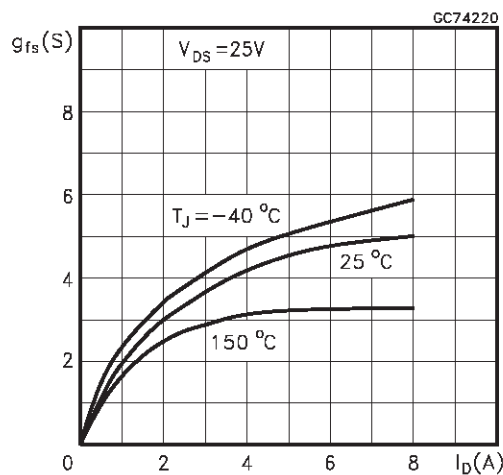
Output Characteristics



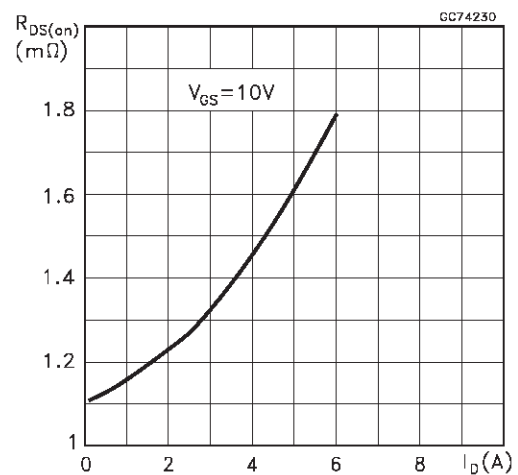
Transfer Characteristics



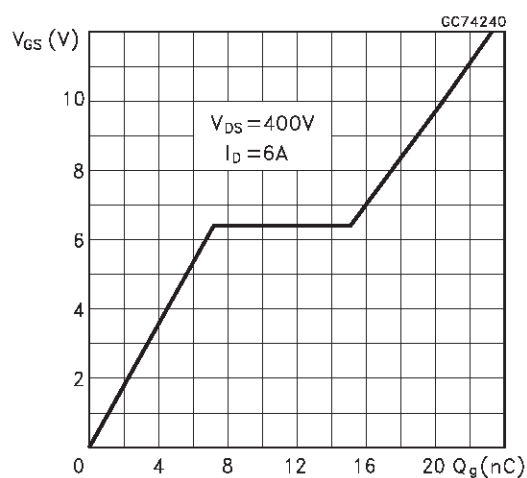
Transconductance



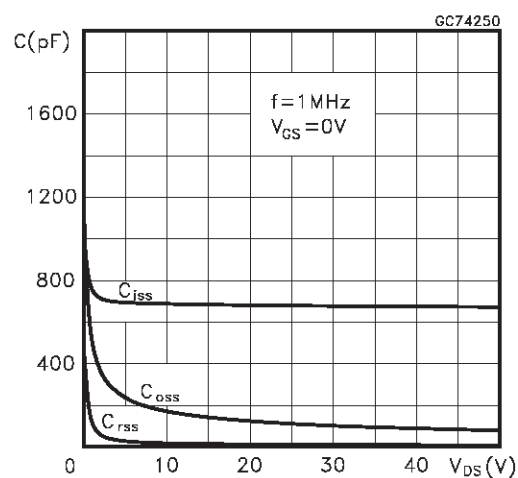
Static Drain-source On Resistance



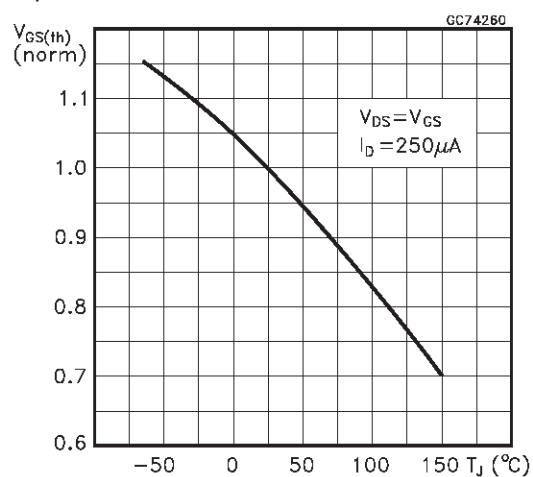
Gate Charge vs Gate-source Voltage



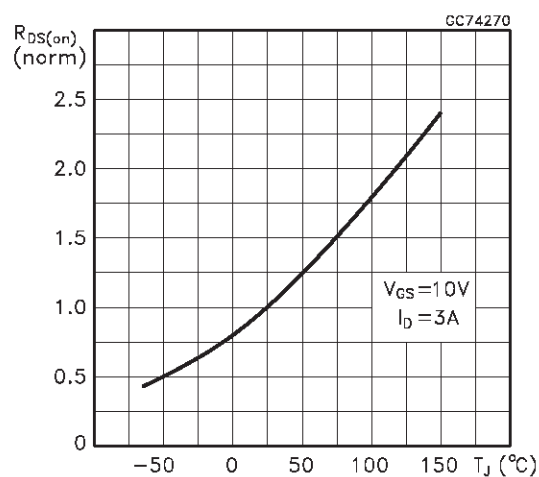
Capacitance Variations



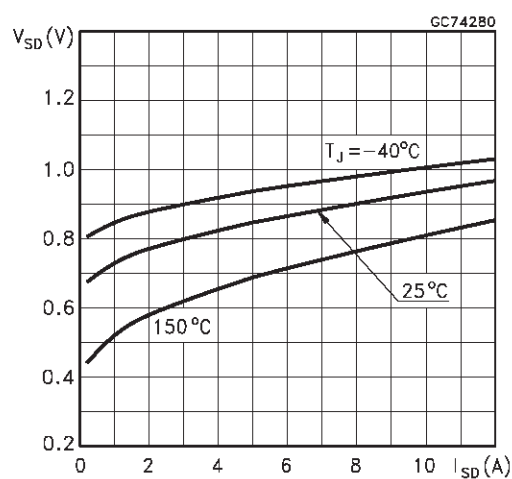
Normalized Gate Threshold Voltage vs Temperature



Normalized On Resistance vs Temperature

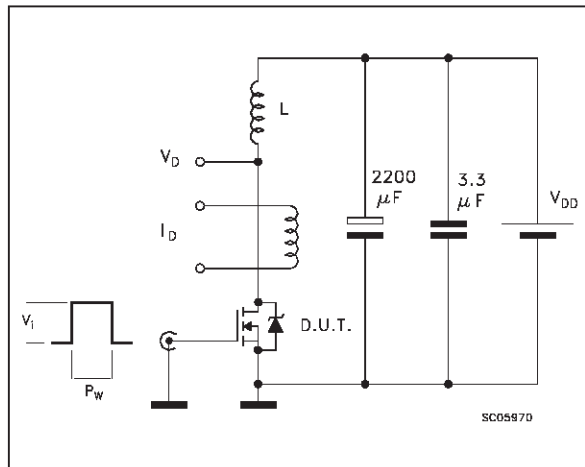


Source-drain Diode Forward Characteristics

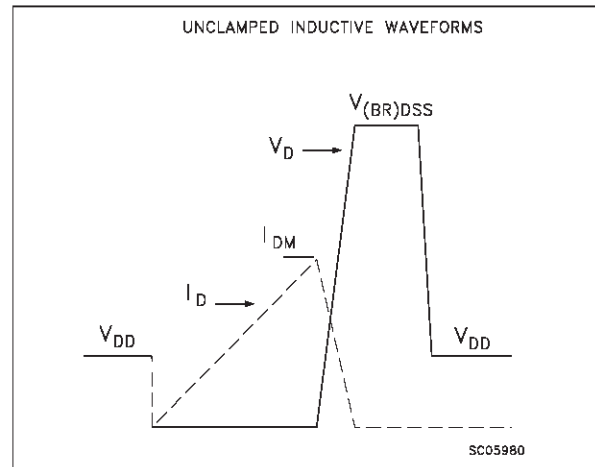


## STP6NB50/FP

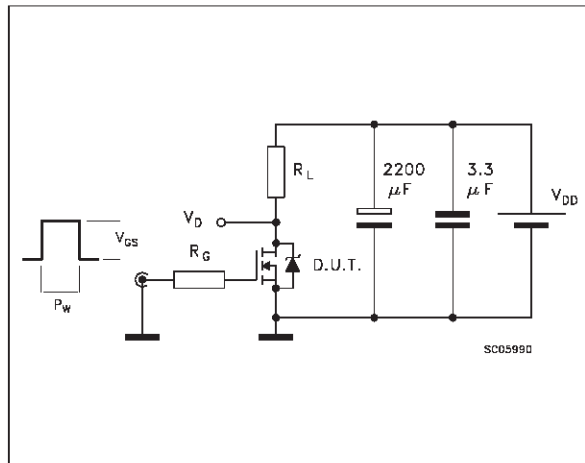
**Fig. 1: Unclamped Inductive Load Test Circuit**



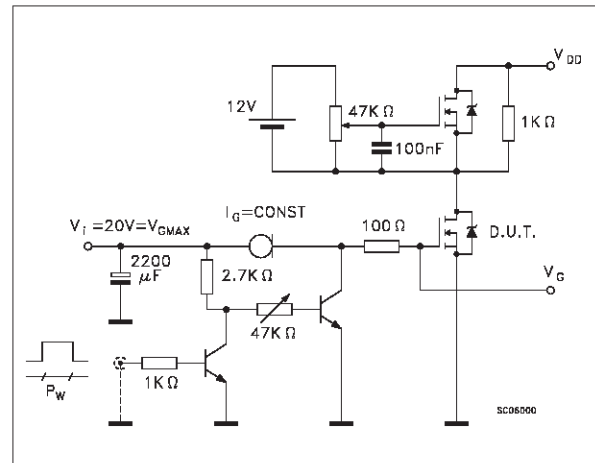
**Fig. 2: Unclamped Inductive Waveform**



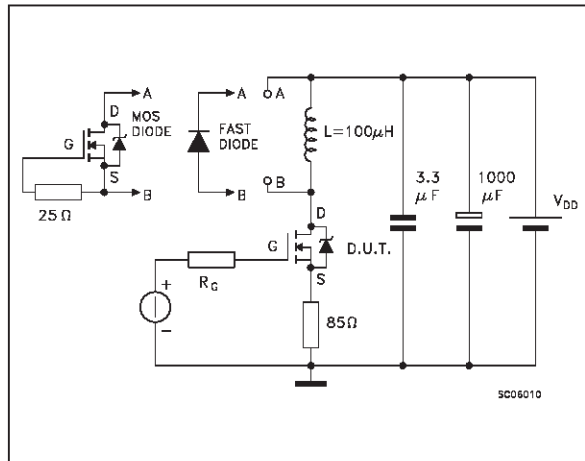
**Fig. 3: Switching Times Test Circuits For Resistive Load**



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

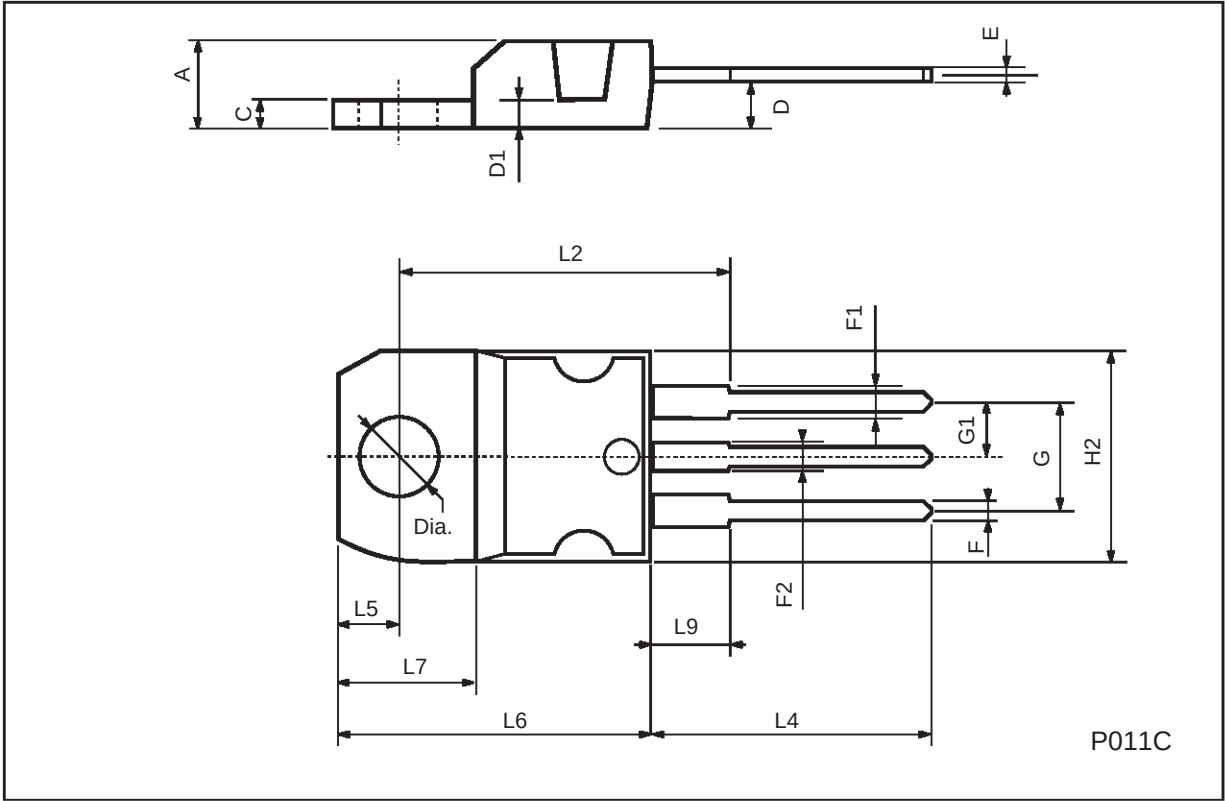


**Fig. 5: Test Circuit For Inductive Load Switching And Diode Recovery Times**



TO-220 MECHANICAL DATA

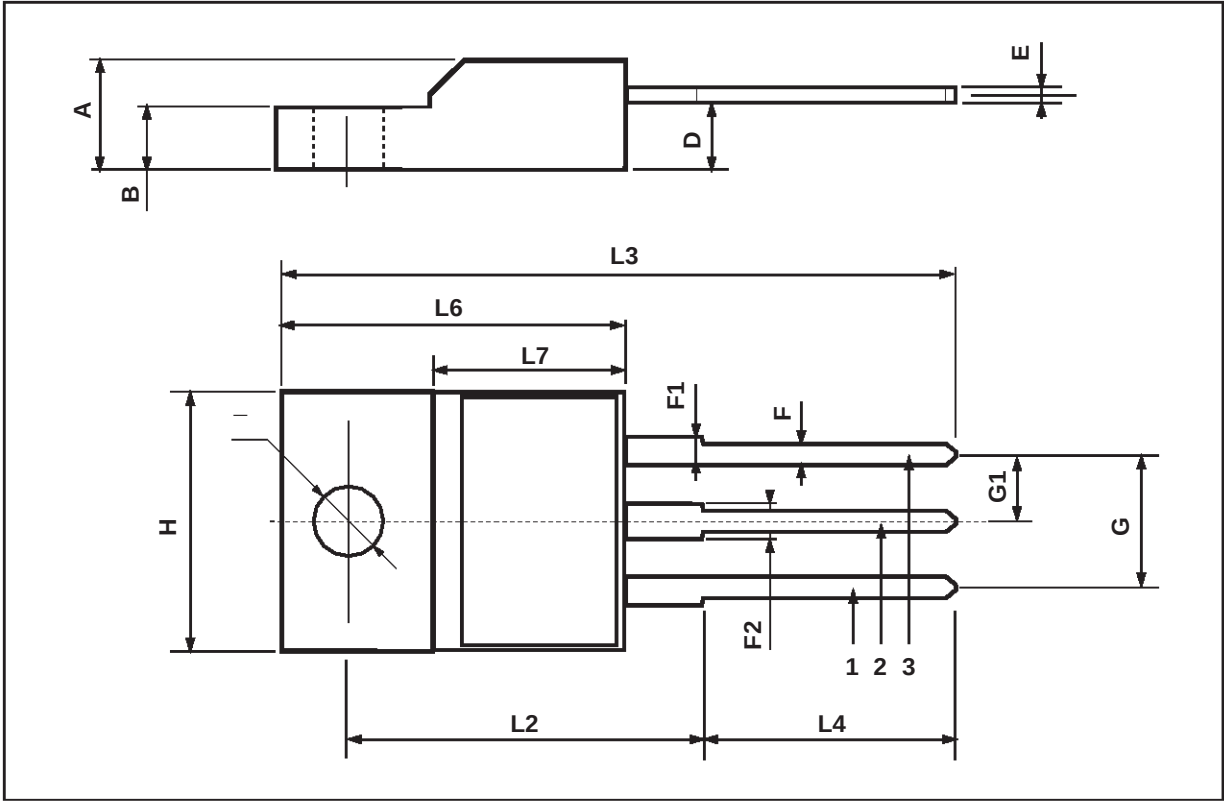
| DIM. | mm    |      |       | inch  |       |       |
|------|-------|------|-------|-------|-------|-------|
|      | MIN.  | TYP. | MAX.  | MIN.  | TYP.  | MAX.  |
| A    | 4.40  |      | 4.60  | 0.173 |       | 0.181 |
| C    | 1.23  |      | 1.32  | 0.048 |       | 0.051 |
| D    | 2.40  |      | 2.72  | 0.094 |       | 0.107 |
| D1   |       | 1.27 |       |       | 0.050 |       |
| E    | 0.49  |      | 0.70  | 0.019 |       | 0.027 |
| F    | 0.61  |      | 0.88  | 0.024 |       | 0.034 |
| F1   | 1.14  |      | 1.70  | 0.044 |       | 0.067 |
| F2   | 1.14  |      | 1.70  | 0.044 |       | 0.067 |
| G    | 4.95  |      | 5.15  | 0.194 |       | 0.203 |
| G1   | 2.4   |      | 2.7   | 0.094 |       | 0.106 |
| H2   | 10.0  |      | 10.40 | 0.393 |       | 0.409 |
| L2   |       | 16.4 |       |       | 0.645 |       |
| L4   | 13.0  |      | 14.0  | 0.511 |       | 0.551 |
| L5   | 2.65  |      | 2.95  | 0.104 |       | 0.116 |
| L6   | 15.25 |      | 15.75 | 0.600 |       | 0.620 |
| L7   | 6.2   |      | 6.6   | 0.244 |       | 0.260 |
| L9   | 3.5   |      | 3.93  | 0.137 |       | 0.154 |
| DIA. | 3.75  |      | 3.85  | 0.147 |       | 0.151 |



STP6NB50/FP

TO-220FP MECHANICAL DATA

| DIM. | mm   |      |      | inch  |       |       |
|------|------|------|------|-------|-------|-------|
|      | MIN. | TYP. | MAX. | MIN.  | TYP.  | MAX.  |
| A    | 4.4  |      | 4.6  | 0.173 |       | 0.181 |
| B    | 2.5  |      | 2.7  | 0.098 |       | 0.106 |
| D    | 2.5  |      | 2.75 | 0.098 |       | 0.108 |
| E    | 0.45 |      | 0.7  | 0.017 |       | 0.027 |
| F    | 0.75 |      | 1    | 0.030 |       | 0.039 |
| F1   | 1.15 |      | 1.7  | 0.045 |       | 0.067 |
| F2   | 1.15 |      | 1.7  | 0.045 |       | 0.067 |
| G    | 4.95 |      | 5.2  | 0.195 |       | 0.204 |
| G1   | 2.4  |      | 2.7  | 0.094 |       | 0.106 |
| H    | 10   |      | 10.4 | 0.393 |       | 0.409 |
| L2   |      | 16   |      |       | 0.630 |       |
| L3   | 28.6 |      | 30.6 | 1.126 |       | 1.204 |
| L4   | 9.8  |      | 10.6 | 0.385 |       | 0.417 |
| L6   | 15.9 |      | 16.4 | 0.626 |       | 0.645 |
| L7   | 9    |      | 9.3  | 0.354 |       | 0.366 |
| Ø    | 3    |      | 3.2  | 0.118 |       | 0.126 |





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