



# STP6NB25 STP6NB25FP

N-CHANNEL 250V - 0.9Ω - 5A TO-220/TO-220FP  
PowerMesh™ MOSFET

| TYPE       | V <sub>DSS</sub> | R <sub>DS(on)</sub> | I <sub>D</sub> |
|------------|------------------|---------------------|----------------|
| STP6NB25   | 250 V            | < 1.1 Ω             | 5 A            |
| STP6NB25FP | 250 V            | < 1.1 Ω             | 5 A            |

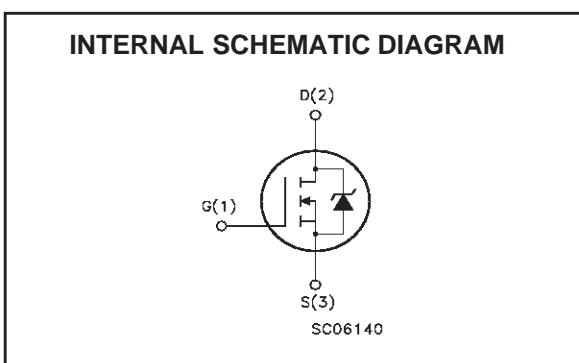
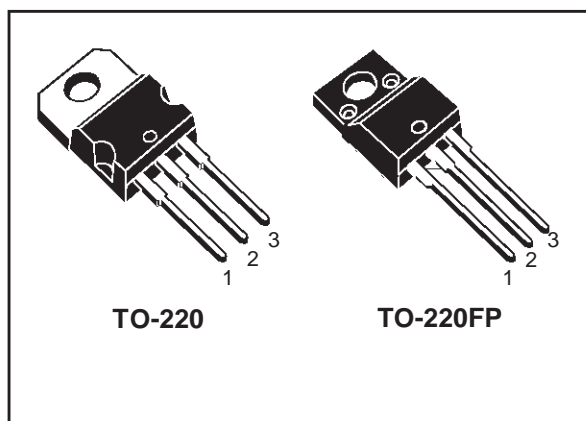
- TYPICAL R<sub>DS(on)</sub> = 0.9 Ω
- EXTREMELY HIGH dv/dt CAPABILITY
- 100% AVALANCHE TESTED
- VERY LOW INTRINSIC CAPACITANCES
- GATE CHARGE MINIMIZED

## 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
- UNINTERRUPTIBLE POWER SUPPLY (UPS)
- DC-DC & DC-AC CONVERTERS FOR TELECOM, INDUSTRIAL AND CONSUMER ENVIRONMENT



## ABSOLUTE MAXIMUM RATINGS

| Symbol              | Parameter  | Value      |            | Unit |
|---------------------|--|------------|------------|------|
|                     |  | STP6NB25   | STP6NB25FP |      |
| V <sub>DS</sub>     | Drain-source Voltage (V <sub>GS</sub> = 0)           | 250        |            | V    |
| V <sub>DGR</sub>    | Drain-gate Voltage (R <sub>GS</sub> = 20 kΩ)         | 250        |            | 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          | 5 (*)      | A    |
| I <sub>D</sub>      | Drain Current (continuous) at T <sub>C</sub> = 100°C | 3.15       | 3.15 (*)   | A    |
| I <sub>DM</sub> (●) | Drain Current (pulsed)                               | 20         | 20 (*)     | A    |
| P <sub>TOT</sub>    | Total Dissipation at T <sub>C</sub> = 25°C           | 65         | 30         | W    |
|                     | Derating Factor                                      | 0.52       | 0.24       | W/°C |
| dv/dt (1)           | Peak Diode Recovery voltage slope                    | 4          |            | V/ns |
| V <sub>ISO</sub>    | Insulation Withstand Voltage (DC)                    | -          | 2000       |      |
| T <sub>stg</sub>    | Storage Temperature                                  | -60 to 150 |            | °C   |
| T <sub>j</sub>      | Max. Operating Junction Temperature                  | 150        |            | °C   |

(●)Pulse width limited by safe operating area  
May 2001

(1)I<sub>SD</sub> ≤ 5A, di/dt ≤ 100A/μs, V<sub>DD</sub> ≤ V<sub>I(BR)DSS</sub>, T<sub>J</sub> ≤ T<sub>JMAX</sub>.

(\*)Limited only by maximum temperature allowed

## STP6NB25/FP

### THERMAL DATA

|                |  | TO-220 | TO-220FP |      |
|----------------|--|--------|----------|------|
| Rthj-case      | Thermal Resistance Junction-case Max           | 1.92   | 4.17     | °C/W |
| Rthj-amb       | Thermal Resistance Junction-ambient Max        | 62.5   |          | °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)                                | 5         | 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) | 120       | mJ   |

### ELECTRICAL CHARACTERISTICS (TCASE = 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  | 250  |      |         | 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> = ±30V  |      |      | ±100    | nA       |

#### ON (1)

| 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> = 250μA | 2    | 3    | 4    | V    |
| R <sub>DS(on)</sub> | Static Drain-source On Resistance | V <sub>GS</sub> = 10V, I <sub>D</sub> = 3 A                |      | 0.9  | 1.1  | Ω    |

### DYNAMIC

| Symbol              | Parameter                    | Test Conditions  | Min. | Typ. | Max. | Unit |
|---------------------|------------------------------|--|------|------|------|------|
| g <sub>fs</sub> (1) | Forward Transconductance     | V <sub>DS</sub> > I <sub>D(on)</sub> × R <sub>DS(on)</sub> max,<br>I <sub>D</sub> = 3A |      | 2.4  |      | S    |
| C <sub>iss</sub>    | Input Capacitance            | V <sub>DS</sub> = 25V, f = 1 MHz, V <sub>GS</sub> = 0                                  |      | 260  |      | pF   |
| C <sub>oss</sub>    | Output Capacitance           |  |      | 68   |      | pF   |
| C <sub>rss</sub>    | Reverse Transfer Capacitance |  |      | 9    |      | pF   |

**ELECTRICAL CHARACTERISTICS (CONTINUED)**

**SWITCHING ON**

| Symbol      | Parameter          | Test Conditions  | Min. | Typ. | Max. | Unit |
|-------------|--------------------|--|------|------|------|------|
| $t_{d(on)}$ | Turn-on Delay Time | $V_{DD} = 125\text{ V}, I_D = 3\text{ A}$<br>$R_G = 4.7\Omega, V_{GS} = 10\text{ V}$<br>(see test circuit, Figure 3) |      | 9    |      | ns   |
| $t_r$       | Rise Time          |  |      | 9    |      | ns   |
| $Q_g$       | Total Gate Charge  | $V_{DD} = 200\text{ V}, I_D = 6\text{ A},$<br>$V_{GS} = 10\text{ V}$   |      | 12   | 17   | nC   |
| $Q_{gs}$    | Gate-Source Charge |  |      | 7.5  |      | nC   |
| $Q_{gd}$    | Gate-Drain Charge  |  |      | 3    |      | nC   |

**SWITCHING OFF**

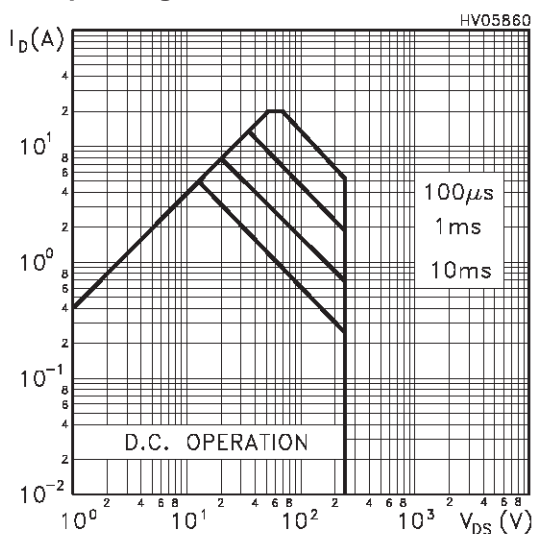
| Symbol        | Parameter             | Test Conditions   | Min. | Typ. | Max. | Unit |
|---------------|-----------------------|---|------|------|------|------|
| $t_{r(Voff)}$ | Off-voltage Rise Time | $V_{DD} = 200\text{ V}, I_D = 6\text{ A},$<br>$R_G = 4.7\Omega, V_{GS} = 10\text{ V}$<br>(see test circuit, Figure 5) |      | 8    |      | ns   |
| $t_f$         | Fall Time             |   |      | 7    |      | ns   |
| $t_c$         | Cross-over Time       |   |      | 15   |      | ns   |

**SOURCE DRAIN DIODE**

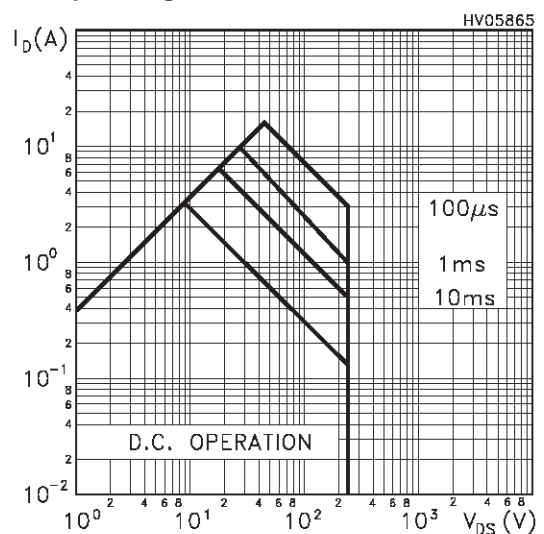
| Symbol       | Parameter                     | Test Conditions  | Min. | Typ. | Max. | Unit          |
|--------------|-------------------------------|--|------|------|------|---------------|
| $I_{SD}$     | Source-drain Current          |  |      |      | 5    | A             |
| $I_{SDM(2)}$ | Source-drain Current (pulsed) |  |      |      | 20   | A             |
| $V_{SD(1)}$  | Forward On Voltage            | $I_{SD} = 5\text{ A}, V_{GS} = 0$  |      |      | 1.6  | V             |
| $t_{rr}$     | Reverse Recovery Time         | $I_{SD} = 6\text{ A}, di/dt = 100\text{ A}/\mu\text{s},$<br>$V_{DD} = 100\text{ V}, T_J = 150^\circ\text{C}$<br>(see test circuit, Figure 5) |      | 160  |      | ns            |
| $Q_{rr}$     | Reverse Recovery Charge       |  |      | 720  |      | $\mu\text{C}$ |
| $I_{RRM}$    | Reverse Recovery Current      |  |      | 9    |      | A             |

Note: 1. Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%.  
2. Pulse width limited by safe operating area.

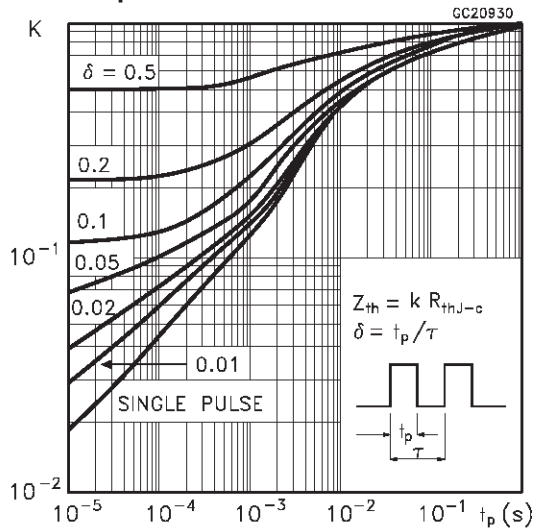
**Safe Operating Area for TO-220**



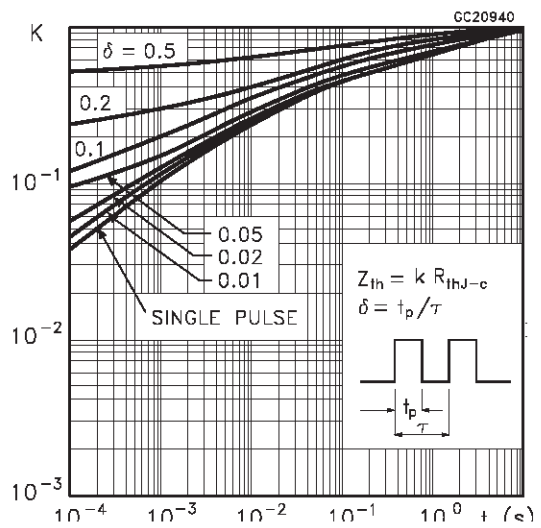
**Safe Operating Area for TO-220FP**



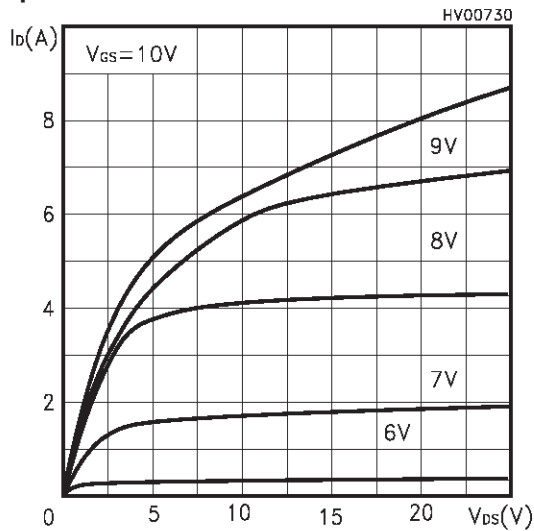
Thermal Impedance for TO-220



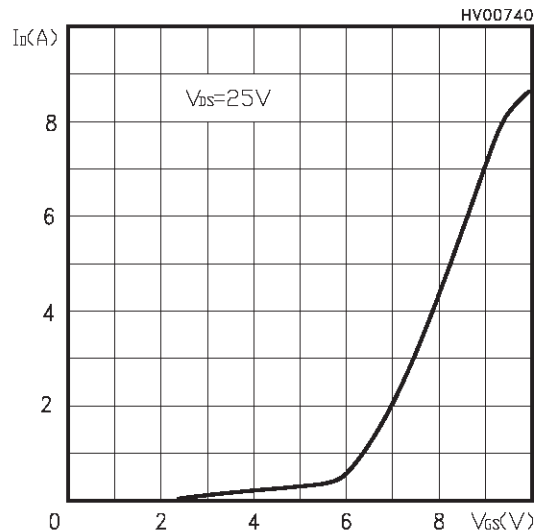
Thermal Impedance for TO-220FP



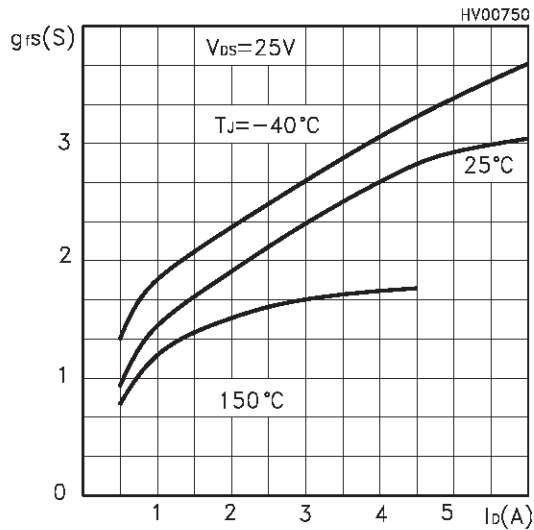
Output Characteristics



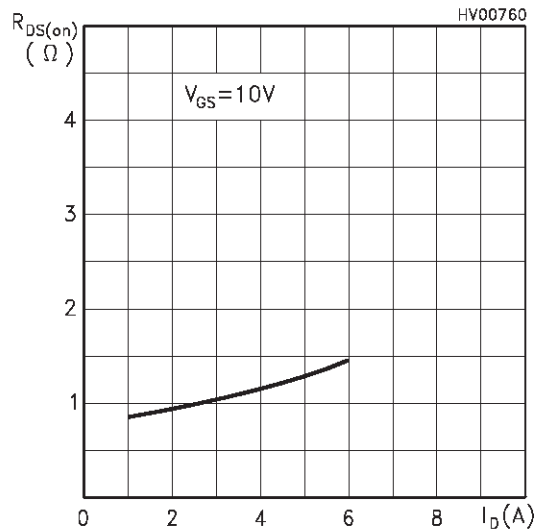
Transfer Characteristics



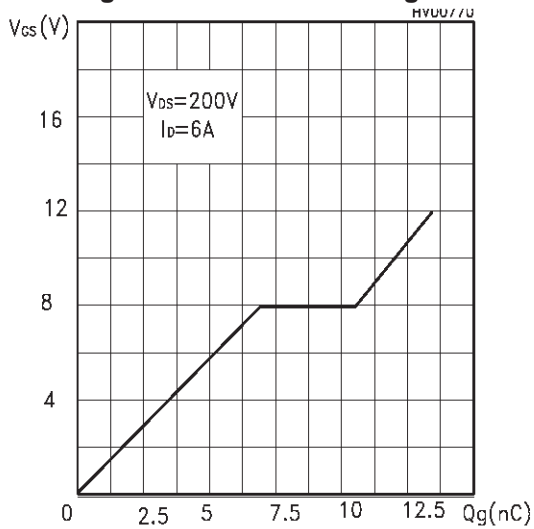
Transconductance



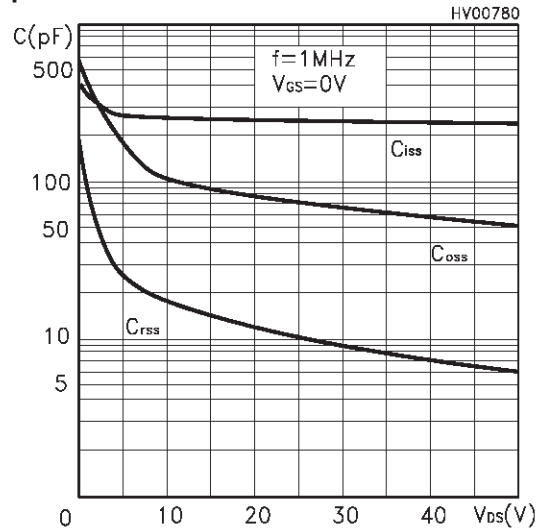
Static Drain-source On Resistance



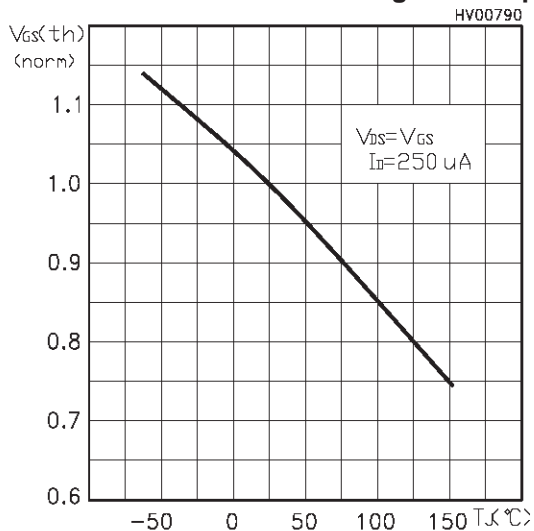
**Gate Charge vs Gate-source Voltage**



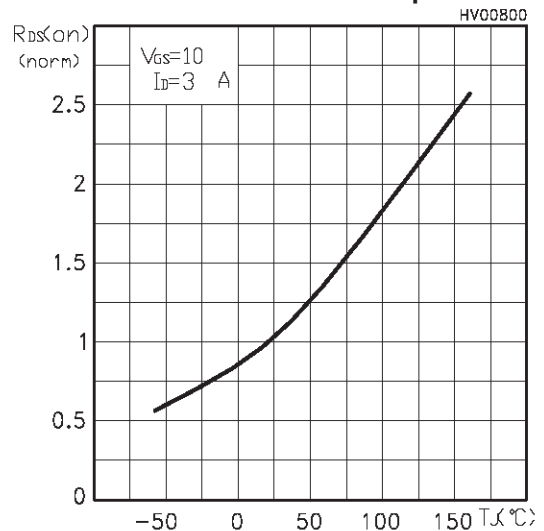
**Capacitance Variations**



**Normalized Gate Threshold Voltage vs Temp.**



**Normalized On Resistance vs Temperature**



**Source-drain Diode Forward Characteristics**

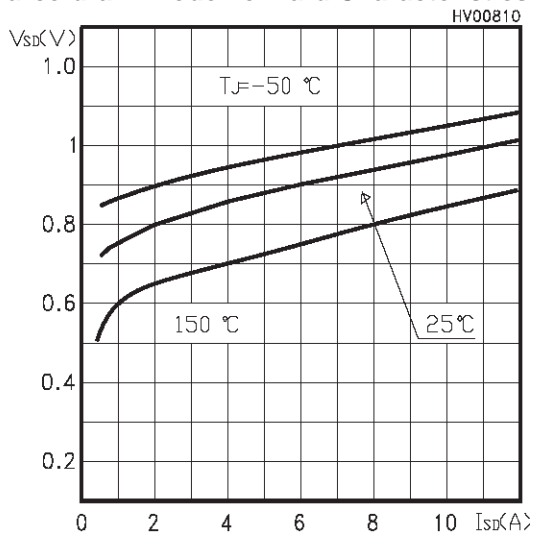


Fig. 1: Unclamped Inductive Load Test Circuit

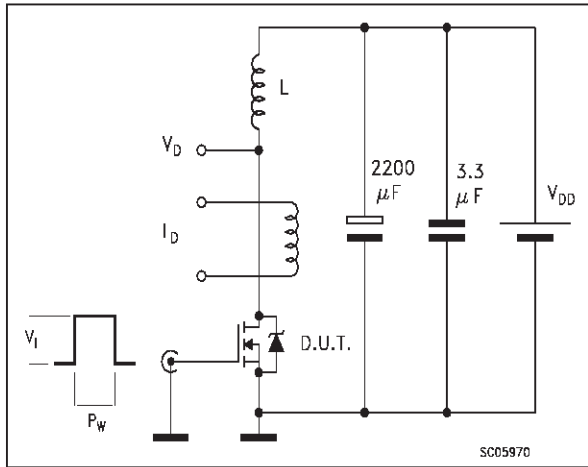


Fig. 2: Unclamped Inductive Waveform

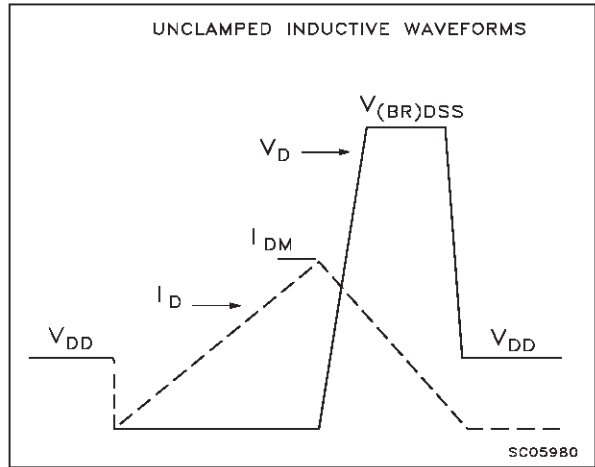


Fig. 3: Switching Times Test Circuit For Resistive Load

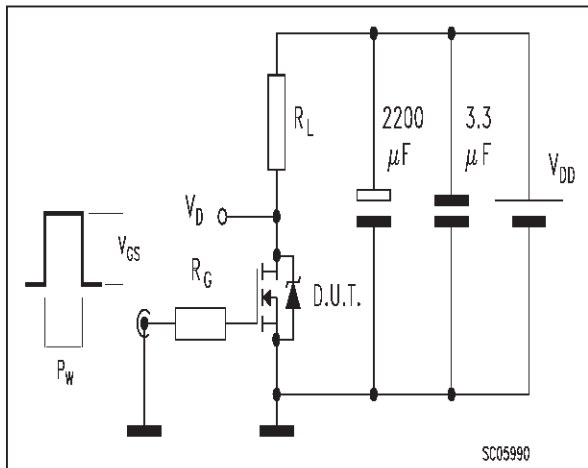


Fig. 4: Gate Charge test Circuit

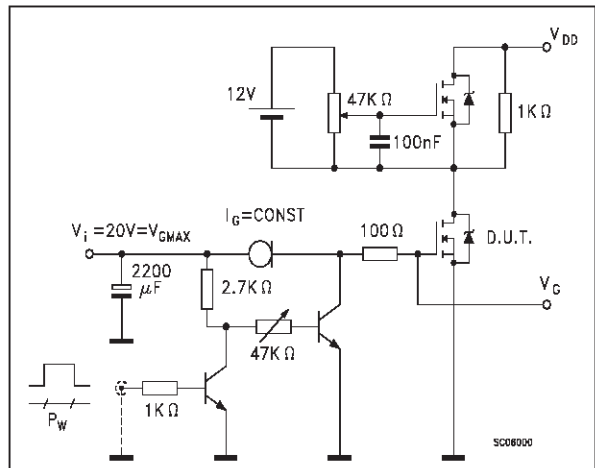
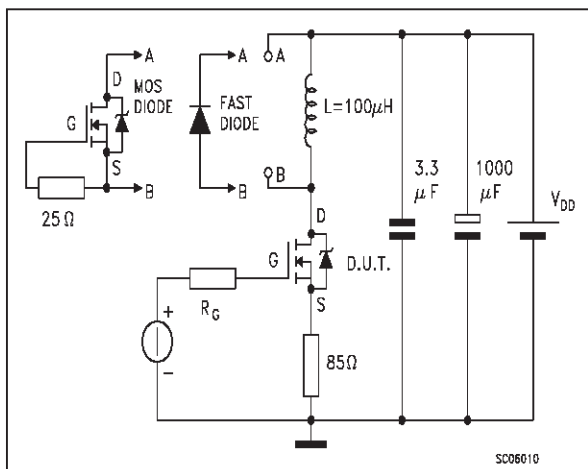
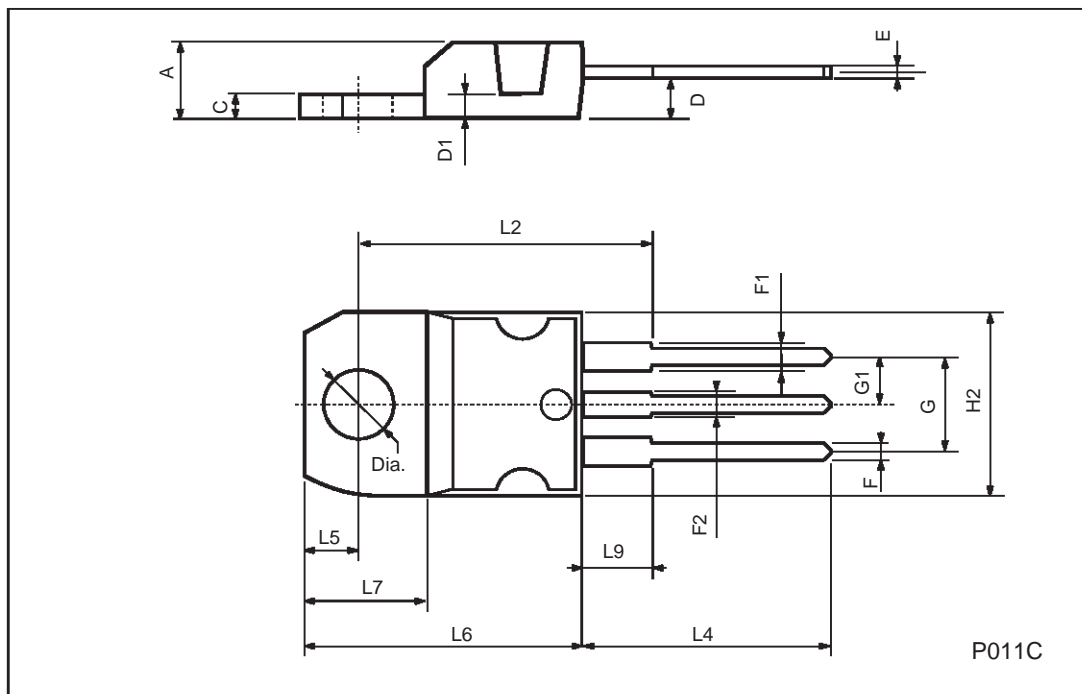


Fig. 5: Test Circuit For Inductive Load Switching And Diode Recovery Times



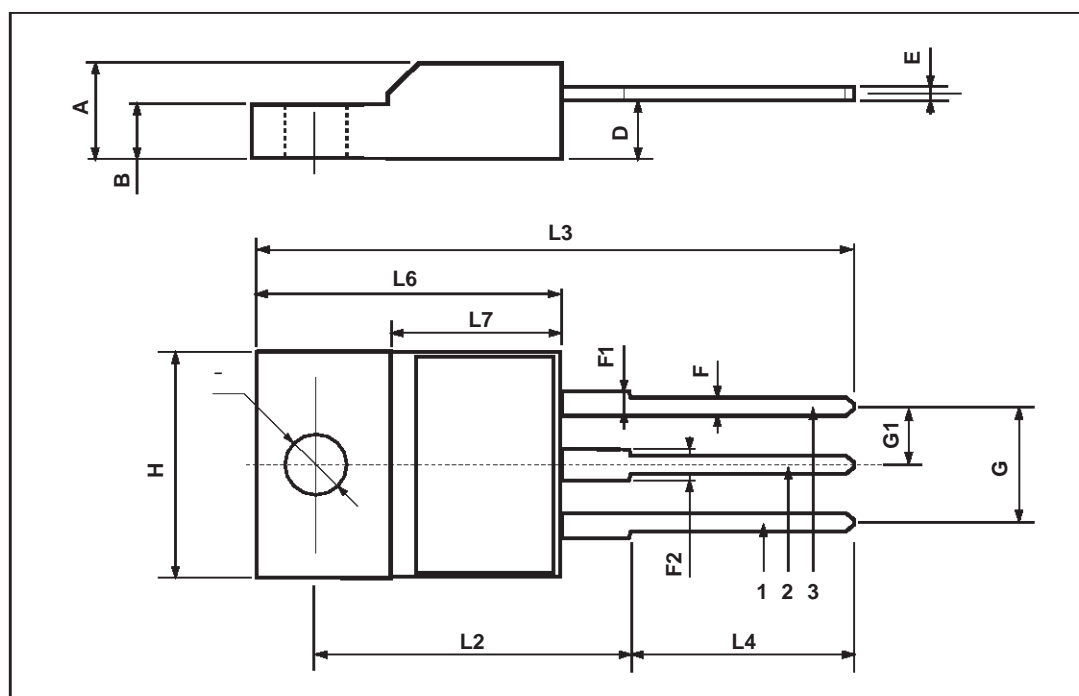
## TO-220 MECHANICAL DATA

| 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 |



## 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 |
| ∅    | 3    |      | 3.2  | 0.118 |       | 0.126 |



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