



# STP16NF06 STP16NF06FP

N-CHANNEL 60V - 0.08  $\Omega$  - 16A TO-220/TO-220FP  
STripFET™ II POWER MOSFET

| TYPE        | V <sub>DSS</sub> | R <sub>DS(on)</sub> | I <sub>D</sub> |
|-------------|------------------|---------------------|----------------|
| STP16NF06   | 60 V             | <0.1 $\Omega$       | 16 A           |
| STP60NF06FP | 60 V             | <0.1 $\Omega$       | 11 A           |

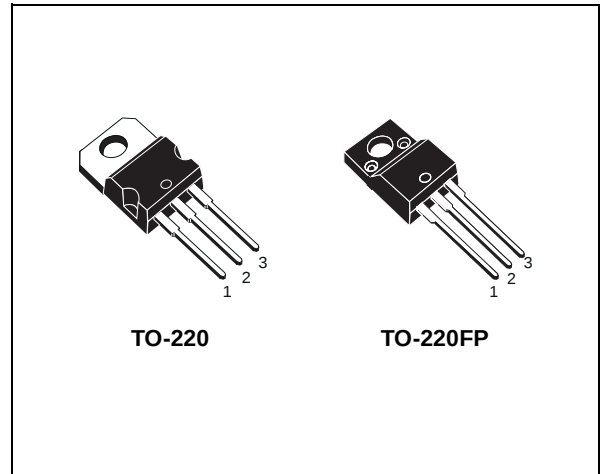
- TYPICAL R<sub>DS(on)</sub> = 0.08 $\Omega$
- EXCEPTIONAL dv/dt CAPABILITY
- LOW GATE CHARGE AT 100 °C
- APPLICATION ORIENTED CHARACTERIZATION

## DESCRIPTION

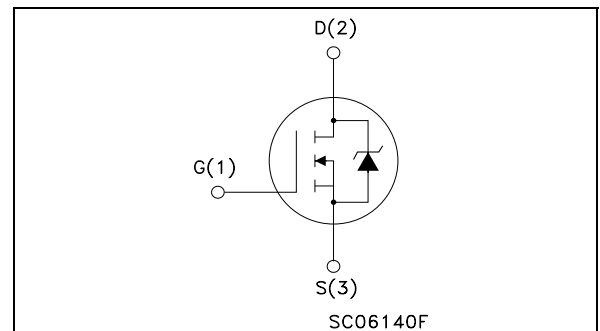
This Power MOSFET is the latest development of STMicroelectronics unique "Single Feature Size™" strip-based process. The resulting transistor shows extremely high packing density for low on-resistance, rugged avalanche characteristics and less critical alignment steps therefore a remarkable manufacturing reproducibility.

## APPLICATIONS

- MOTOR CONTROL, AUDIO AMPLIFIERS
- HIGH CURRENT, HIGH SWITCHING SPEED
- SOLENOID AND RELAY DRIVERS
- DC-DC & DC-AC CONVERTERS
- AUTOMOTIVE ENVIRONMENT



## INTERNAL SCHEMATIC DIAGRAM



## ABSOLUTE MAXIMUM RATINGS

| Symbol              | Parameter                                             | Value      |             | Unit |
|---------------------|-------------------------------------------------------|------------|-------------|------|
|                     |                                                       | STP16NF06  | STP16NF06FP |      |
| V <sub>DS</sub>     | Drain-source Voltage (V <sub>GS</sub> = 0)            | 60         |             | V    |
| V <sub>DGR</sub>    | Drain-gate Voltage (R <sub>GS</sub> = 20 k $\Omega$ ) | 60         |             | V    |
| V <sub>GS</sub>     | Gate- source Voltage                                  | $\pm 20$   |             | V    |
| I <sub>D</sub>      | Drain Current (continuous) at T <sub>C</sub> = 25°C   | 16         | 11(*)       | A    |
| I <sub>D</sub>      | Drain Current (continuous) at T <sub>C</sub> = 100°C  | 11         | 7.5(*)      | A    |
| I <sub>DM</sub> (•) | Drain Current (pulsed)                                | 64         | 44(*)       | A    |
| P <sub>tot</sub>    | Total Dissipation at T <sub>C</sub> = 25°C            | 45         | 25          | W    |
|                     | Derating Factor                                       | 0.3        | 0.17        | W/°C |
| dv/dt (1)           | Peak Diode Recovery voltage slope                     | 20         |             | V/ns |
| E <sub>AS</sub> (2) | Single Pulse Avalanche Energy                         | 130        |             | mJ   |
| V <sub>ISO</sub>    | Insulation Withstand Voltage (DC)                     | -----      | 2500        | V    |
| T <sub>stg</sub>    | Storage Temperature                                   | -55 to 175 |             | °C   |
| T <sub>j</sub>      | Operating Junction Temperature                        |            |             |      |

(•) Pulse width limited by safe operating area.

(\*) Current Limited by package's thermal resistance

(1) I<sub>SD</sub>  $\leq$  16A, di/dt  $\leq$  200A/ $\mu$ s, V<sub>DD</sub>  $\leq$  V<sub>(BR)DSS</sub>, T<sub>j</sub>  $\leq$  T<sub>JMAX</sub>.

(2) Starting T<sub>j</sub> = 25 °C, I<sub>D</sub> = 8A, V<sub>DD</sub> = 30V

## STP16NF06/FP

### THERMAL DATA

|                            |                                                                                           | TO-220      | TO-220FP |            |
|----------------------------|-------------------------------------------------------------------------------------------|-------------|----------|------------|
| Rthj-case                  | Thermal Resistance Junction-case Max                                                      | 3.33        | 6        | °C/W       |
| Rthj-amb<br>T <sub>I</sub> | Thermal Resistance Junction-ambient Max<br>Maximum Lead Temperature For Soldering Purpose | 62.5<br>300 |          | °C/W<br>°C |

### 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                                        | 60   |      |         | 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>10 | µA<br>µA |
| I <sub>GSS</sub>     | Gate-body Leakage Current (V <sub>DS</sub> = 0)       | V <sub>GS</sub> = ± 20 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 | 2    |      | 4    | V    |
| R <sub>DS(on)</sub> | Static Drain-source On Resistance | V <sub>GS</sub> = 10 V I <sub>D</sub> = 8 A               |      | 0.08 | 0.1  | Ω    |

#### DYNAMIC

| Symbol                                                   | Parameter                                                               | Test Conditions                                       | Min. | Typ.            | Max. | Unit           |
|----------------------------------------------------------|-------------------------------------------------------------------------|-------------------------------------------------------|------|-----------------|------|----------------|
| g <sub>fs</sub> (*)                                      | Forward Transconductance                                                | V <sub>DS</sub> = 15 V I <sub>D</sub> = 8 A           |      | 6.5             |      | S              |
| C <sub>iss</sub><br>C <sub>oss</sub><br>C <sub>rss</sub> | Input Capacitance<br>Output Capacitance<br>Reverse Transfer Capacitance | V <sub>DS</sub> = 25V, f = 1 MHz, V <sub>GS</sub> = 0 |      | 315<br>70<br>30 |      | pF<br>pF<br>pF |

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

| Symbol                        | Parameter                                                    | Test Conditions                                                                                                       | Min. | Typ.             | Max. | Unit           |
|-------------------------------|--------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|------|------------------|------|----------------|
| $t_{d(on)}$<br>$t_r$          | Turn-on Delay Time<br>Rise Time                              | $V_{DD} = 30\text{ V}$ $I_D = 8\text{ A}$<br>$R_G = 4.7\ \Omega$ $V_{GS} = 10\text{ V}$<br>(Resistive Load, Figure 3) |      | 7<br>18          |      | ns<br>ns       |
| $Q_g$<br>$Q_{gs}$<br>$Q_{gd}$ | Total Gate Charge<br>Gate-Source Charge<br>Gate-Drain Charge | $V_{DD} = 48\text{ V}$ $I_D = 16\text{ A}$ $V_{GS} = 10\text{ V}$                                                     |      | 10<br>3.5<br>3.5 | 13   | nC<br>nC<br>nC |

**SWITCHING OFF**

| Symbol                | Parameter                        | Test Conditions                                                                                                         | Min. | Typ.    | Max. | Unit     |
|-----------------------|----------------------------------|-------------------------------------------------------------------------------------------------------------------------|------|---------|------|----------|
| $t_{d(off)}$<br>$t_f$ | Turn-off Delay Time<br>Fall Time | $V_{DD} = 30\text{ V}$ $I_D = 8\text{ A}$<br>$R_G = 4.7\ \Omega$ , $V_{GS} = 10\text{ V}$<br>(Resistive Load, Figure 3) |      | 17<br>6 |      | ns<br>ns |

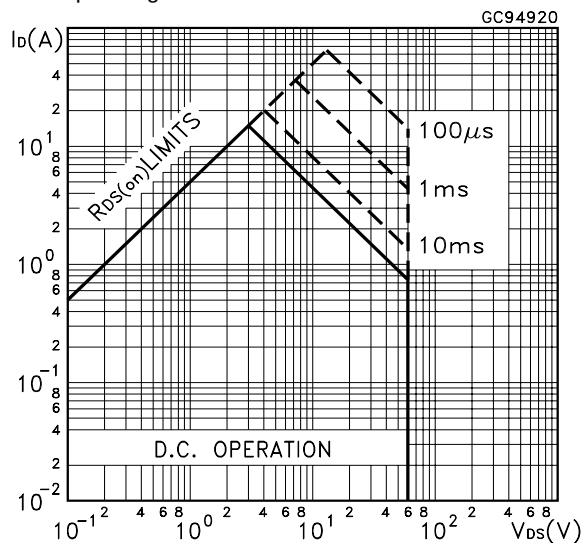
**SOURCE DRAIN DIODE**

| Symbol                            | Parameter                                                                    | Test Conditions                                                                                                                               | Min. | Typ.            | Max.     | Unit          |
|-----------------------------------|------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|------|-----------------|----------|---------------|
| $I_{SD}$<br>$I_{SDM} (\bullet)$   | Source-drain Current<br>Source-drain Current (pulsed)                        |                                                                                                                                               |      |                 | 16<br>64 | A<br>A        |
| $V_{SD} (*)$                      | Forward On Voltage                                                           | $I_{SD} = 16\text{ A}$ $V_{GS} = 0$                                                                                                           |      |                 | 1.3      | V             |
| $t_{rr}$<br>$Q_{rr}$<br>$I_{RRM}$ | Reverse Recovery Time<br>Reverse Recovery Charge<br>Reverse Recovery Current | $I_{SD} = 16\text{ A}$ $di/dt = 100\text{ A}/\mu\text{s}$<br>$V_{DD} = 30\text{ V}$ $T_j = 150^\circ\text{C}$<br>(see test circuit, Figure 5) |      | 50<br>88<br>3.5 |          | ns<br>nC<br>A |

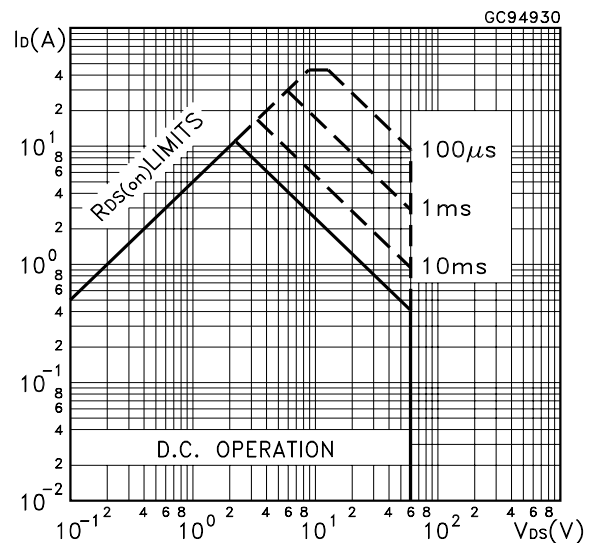
(\*) Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5 %.

(\bullet) Pulse width limited by safe operating area.

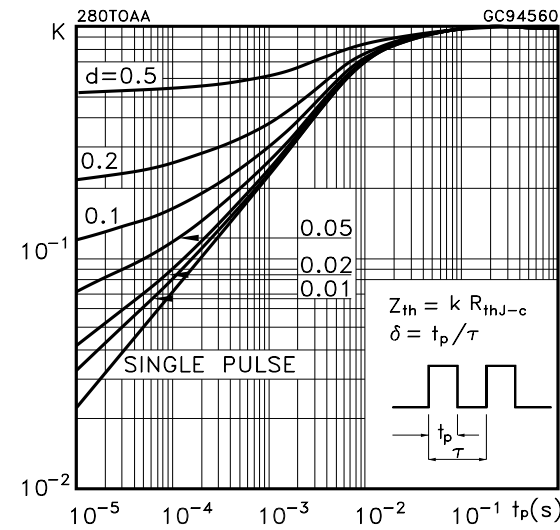
Safe Operating Area for TO-220



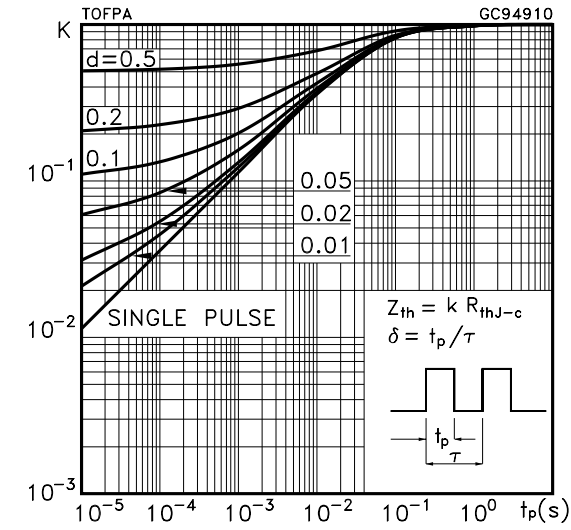
Safe Operating Area for TO-220FP



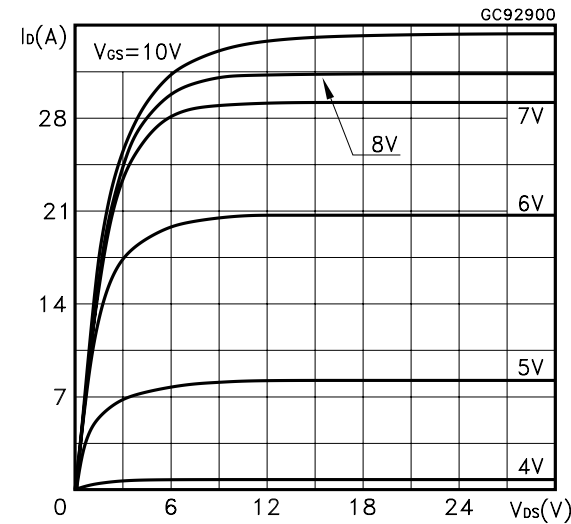
Thermal Impedance



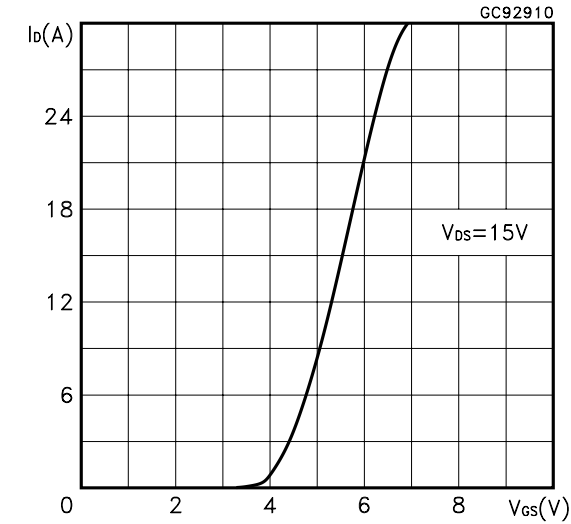
Thermal Impedance for TO-220FP



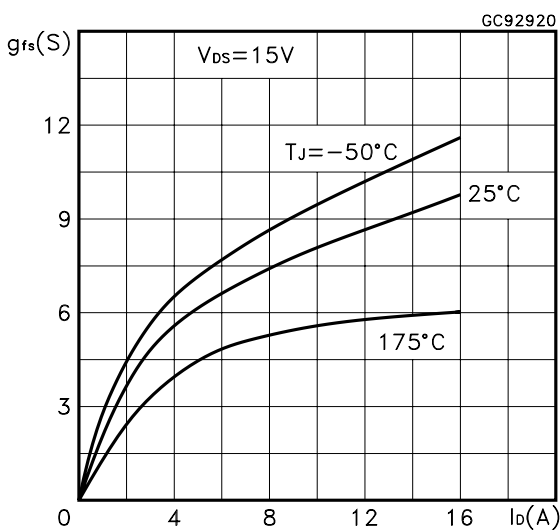
Output Characteristics



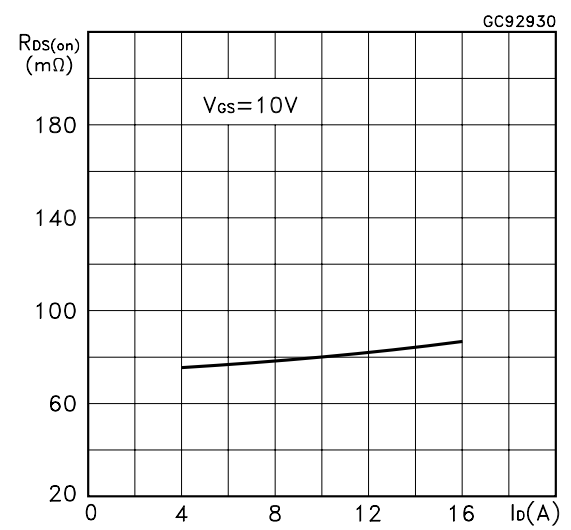
Transfer Characteristics



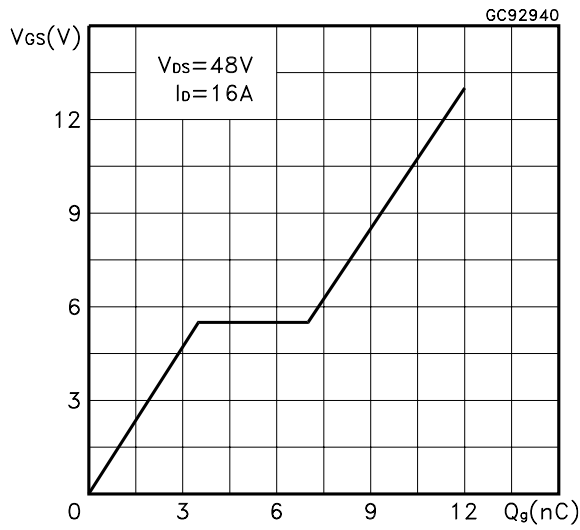
Transconductance



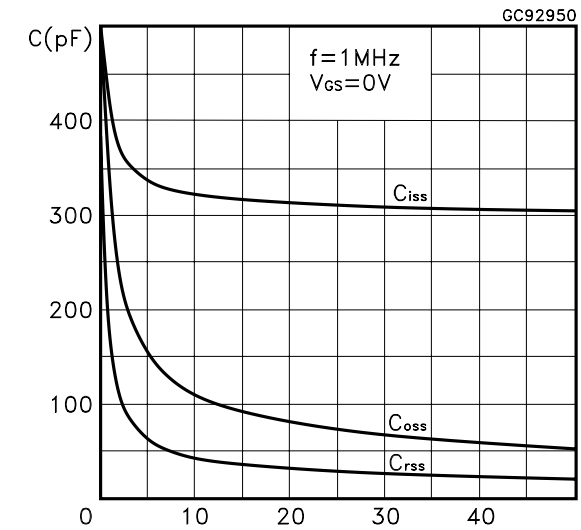
Static Drain-source On Resistance



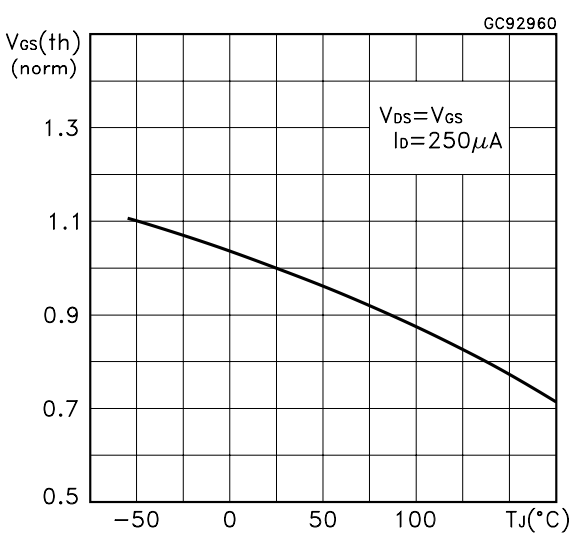
Gate Charge vs Gate-source Voltage



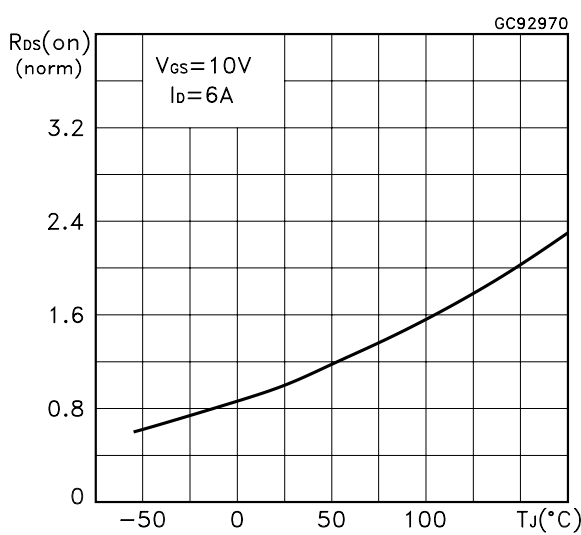
Capacitance Variations



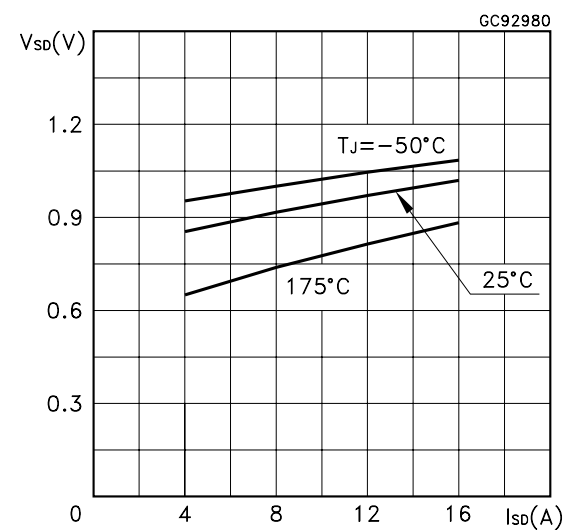
Normalized Gate Threshold Voltage vs Temperature



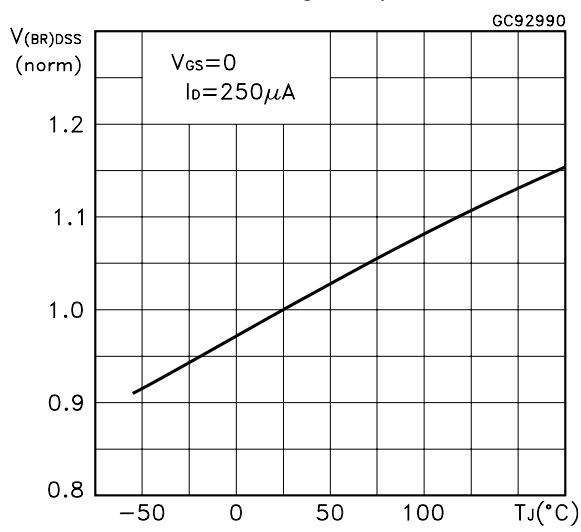
Normalized on Resistance vs Temperature



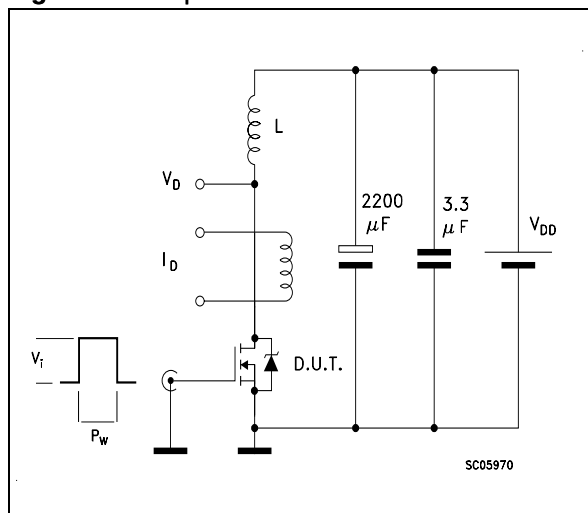
Source-drain Diode Forward Characteristics



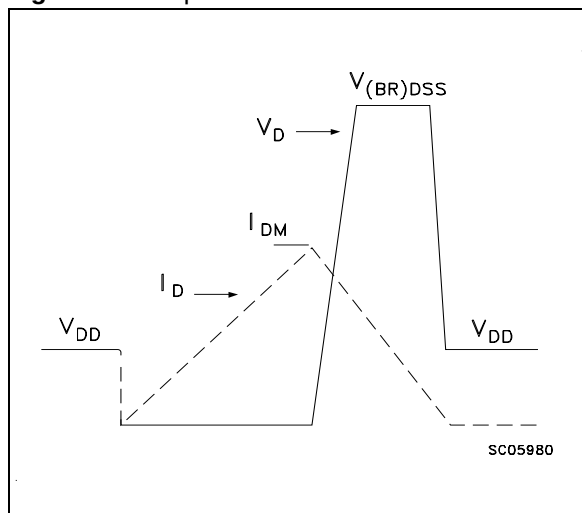
Normalized Breakdown Voltage Temperature



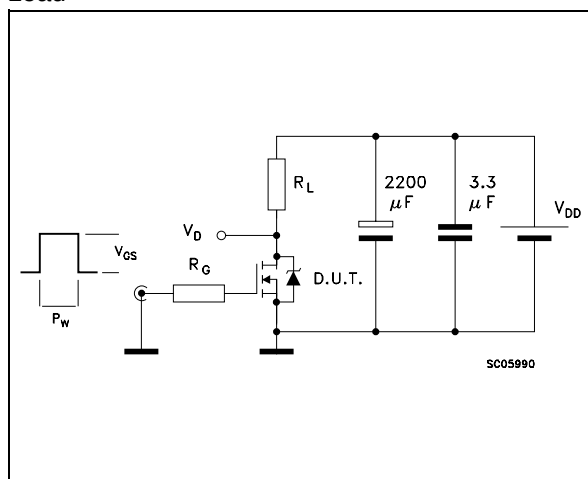
**Fig. 1: Unclamped Inductive Load Test Circuit**



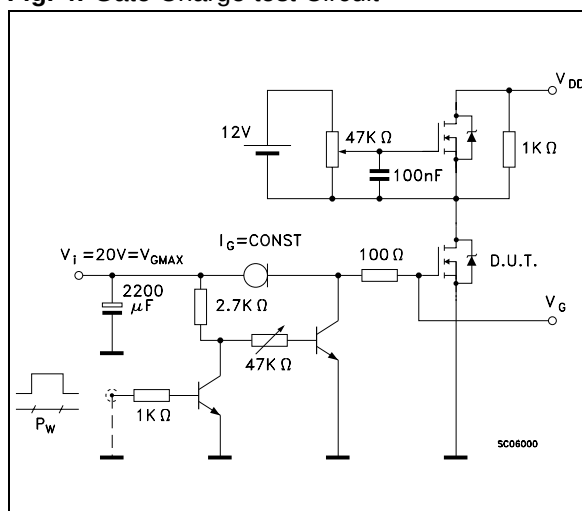
**Fig. 2: Unclamped Inductive Waveform**



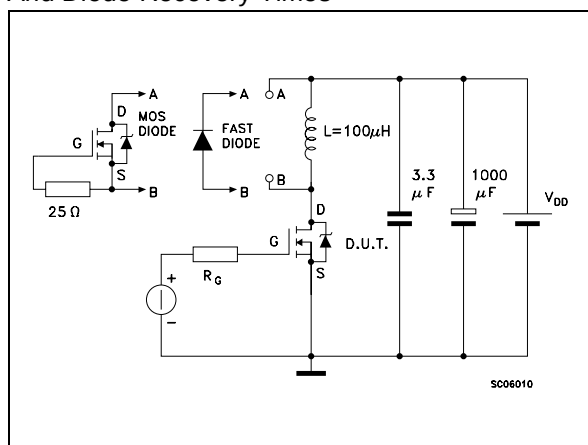
**Fig. 3: Switching Times Test Circuits For Resistive Load**



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

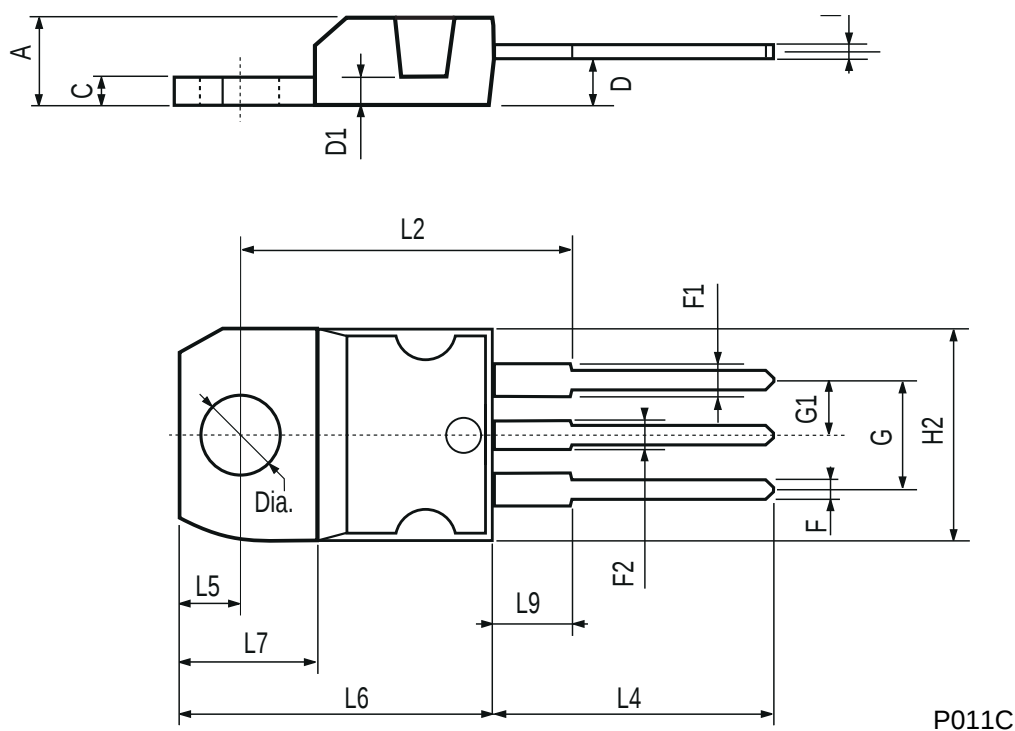


**Fig. 5: Test Circuit For Inductive Load Switching And Diode Recovery Times**



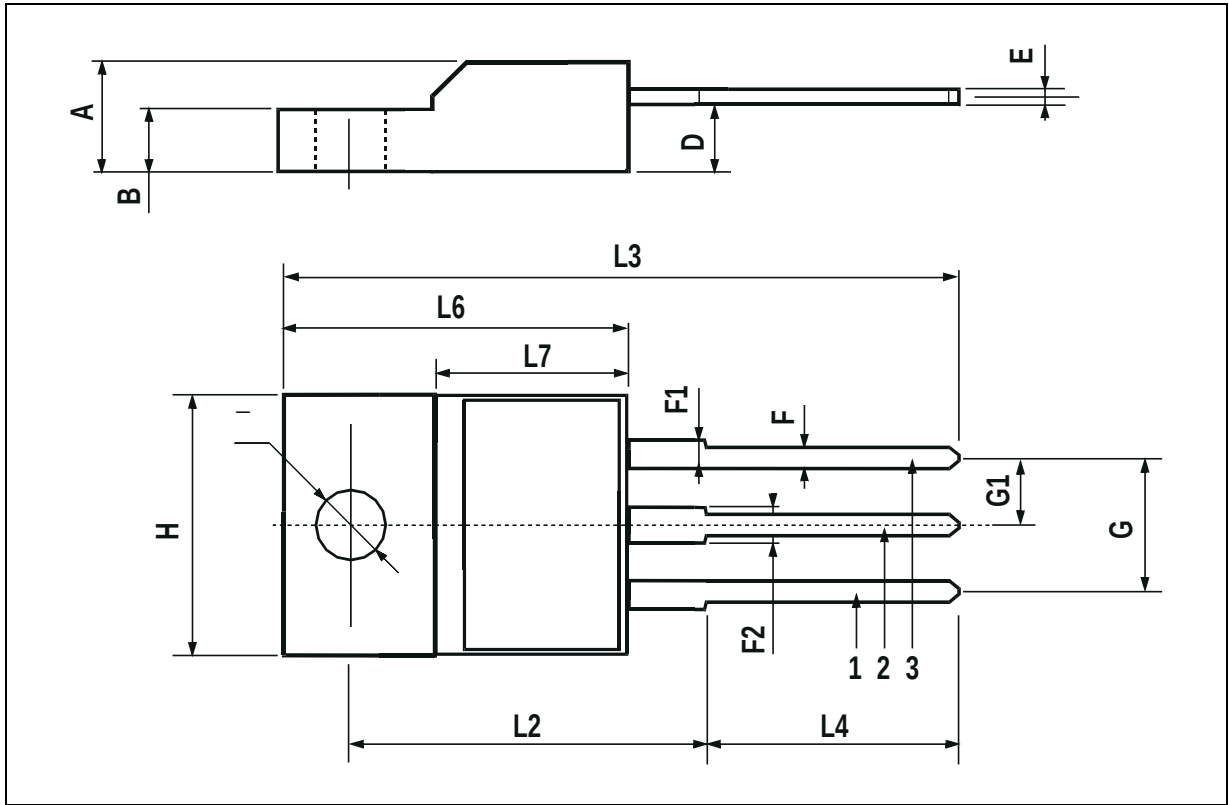
## TO-220 MECHANICAL DATA

| 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 |



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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