



# STP60NF06 STP60NF06FP

N-CHANNEL 60V - 0.014Ω - 60A TO-220/TO-220FP  
STripFET™ POWER MOSFET

| TYPE        | V <sub>DSS</sub> | R <sub>DS(on)</sub> | I <sub>D</sub> |
|-------------|------------------|---------------------|----------------|
| STP60NF06   | 60 V             | < 0.016 Ω           | 60A            |
| STP60NF06FP | 60 V             | < 0.016 Ω           | 60A            |

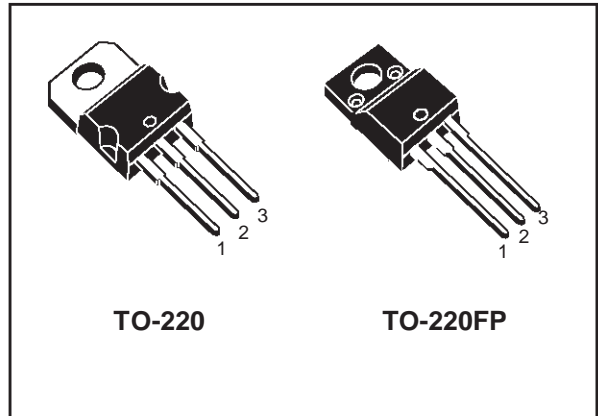
- TYPICAL R<sub>DS(on)</sub> = 0.014Ω
- EXCEPTIONAL dv/dt CAPABILITY
- 100% AVALANCHE TESTED
- APPLICATION ORIENTED CHARACTERIZATION

## DESCRIPTION

This Power Mosfet series realized with STMicroelectronics unique STripFET process has specifically been designed to minimize input capacitance and gate charge. It is therefore suitable as primary switch in advanced high-efficiency isolated DC-DC converters for Telecom and Computer application. It is also intended for any application with low gate charge drive requirements.

## APPLICATIONS

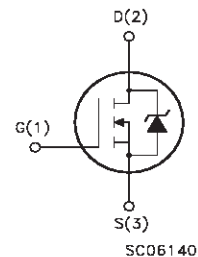
- HIGH-EFFICIENCY DC-DC CONVERTERS
- UPS AND MOTOR CONTROL
- AUTOMOTIVE



TO-220

TO-220FP

## INTERNAL SCHEMATIC DIAGRAM



## ABSOLUTE MAXIMUM RATINGS

| Symbol              | Parameter  | Value      |             | Unit |
|---------------------|--|------------|-------------|------|
|                     |  | STP60NF06  | STP60NF06FP |      |
| 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 kΩ)         | 60         |             | V    |
| V <sub>GS</sub>     | Gate- source Voltage                                 | ± 20       |             | V    |
| I <sub>D</sub>      | Drain Current (continuous) at T <sub>C</sub> = 25°C  | 60         | 37          | A    |
| I <sub>D</sub>      | Drain Current (continuous) at T <sub>C</sub> = 100°C | 42         | 26          | A    |
| I <sub>DM</sub> (1) | Drain Current (pulsed)                               | 240        | 148         | A    |
| P <sub>TOT</sub>    | Total Dissipation at T <sub>C</sub> = 25°C           | 110        | 42          | W    |
|                     | Derating Factor                                      | 0.73       | 0.28        | W/°C |
| dv/dt (1)           | Peak Diode Recovery voltage slope                    | 4          |             | V/ns |
| V <sub>ISO</sub>    | Insulation Withstand Voltage (DC)                    | --         | 2500        | V    |
| T <sub>stg</sub>    | Storage Temperature                                  | -65 to 175 |             | °C   |
| T <sub>j</sub>      | Max. Operating Junction Temperature                  |            |             |      |

(●) Pulse width limited by safe operating area

(1) I<sub>SD</sub> ≤ 60A, di/dt ≤ 400 A/μs, V<sub>DD</sub> ≤ 24V, T<sub>j</sub> ≤ T<sub>jMAX</sub>

## STP60NF06 - STP60NF06FP

### THERMAL DATA

|                |  | TO-220 | TO-220FP |      |
|----------------|--|--------|----------|------|
| Rthj-case      | Thermal Resistance Junction-case Max           | 1.36   | 3.57     | °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)                                | 30        | 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> = 30 V) | 360       | 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  | 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> = ± 20V   |      |      | ±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    |       | 4     | V    |
| R <sub>DS(on)</sub> | Static Drain-source On Resistance | V <sub>GS</sub> = 10V, I <sub>D</sub> = 30 A               |      | 0.014 | 0.016 | Ω    |

### DYNAMIC

| Symbol              | Parameter                    | Test Conditions                                       | Min. | Typ. | Max. | Unit |
|---------------------|------------------------------|---|------|------|------|------|
| g <sub>fs</sub> (1) | Forward Transconductance     | V <sub>DS</sub> = 15V, I <sub>D</sub> = 30 A          |      | 20   |      | S    |
| C <sub>iss</sub>    | Input Capacitance            | V <sub>DS</sub> = 25V, f = 1 MHz, V <sub>GS</sub> = 0 |      | 1810 |      | pF   |
| C <sub>oss</sub>    | Output Capacitance           |   |      | 360  |      | pF   |
| C <sub>rss</sub>    | Reverse Transfer Capacitance |   |      | 125  |      | pF   |

**ELECTRICAL CHARACTERISTICS (CONTINUED)**

**SWITCHING ON**

| Symbol      | Parameter          | Test Conditions   | Min. | Typ. | Max. | Unit |
|-------------|--------------------|---|------|------|------|------|
| $t_{d(on)}$ | Turn-on Delay Time | $V_{DD} = 30\text{ V}, I_D = 30\text{ A}$                               |      | 16   |      | ns   |
| $t_r$       | Rise Time          | $R_G = 4.7\Omega, V_{GS} = 10\text{ V}$<br>(see test circuit, Figure 3) |      | 108  |      | ns   |
| $Q_g$       | Total Gate Charge  | $V_{DD} = 48\text{ V}, I_D = 60\text{ A}, V_{GS} = 10\text{ V}$         |      | 49   | 66   | nC   |
| $Q_{gs}$    | Gate-Source Charge |   |      | 18   |      | nC   |
| $Q_{gd}$    | Gate-Drain Charge  |   |      | 14   |      | nC   |

**SWITCHING OFF**

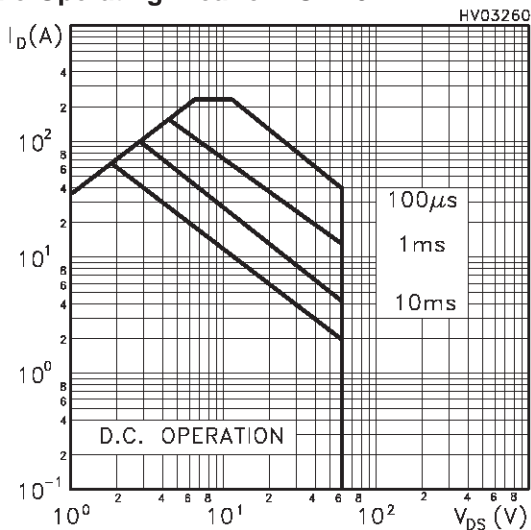
| Symbol       | Parameter             | Test Conditions   | Min. | Typ. | Max. | Unit |
|--------------|-----------------------|---|------|------|------|------|
| $t_{d(off)}$ | Turn-off-Delay Time   | $V_{DD} = 30\text{ V}, I_D = 30\text{ A},$                              |      | 43   |      | ns   |
| $t_f$        | Fall Time             | $R_G = 4.7\Omega, V_{GS} = 10\text{ V}$<br>(see test circuit, Figure 3) |      | 20   |      | ns   |
| $t_{d(off)}$ | Off-voltage Rise Time | $V_{clamp} = 48\text{ V}, I_D = 60\text{ A}$                            |      | 40   |      | ns   |
| $t_f$        | Fall Time             | $R_G = 4.7\Omega, V_{GS} = 10\text{ V}$                                 |      | 12   |      | ns   |
| $t_c$        | Cross-over Time       | (see test circuit, Figure 3)  |      | 21   |      | ns   |

**SOURCE DRAIN DIODE**

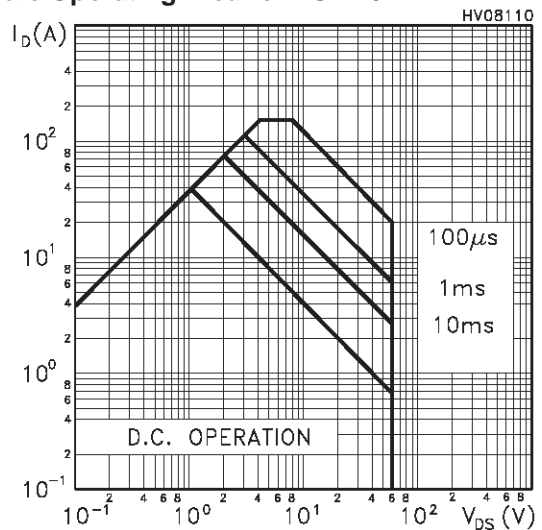
| Symbol       | Parameter                     | Test Conditions   | Min. | Typ. | Max. | Unit |
|--------------|-------------------------------|---|------|------|------|------|
| $I_{SD}$     | Source-drain Current          |   |      |      | 60   | A    |
| $I_{SDM(2)}$ | Source-drain Current (pulsed) |   |      |      | 240  | A    |
| $V_{SD(1)}$  | Forward On Voltage            | $I_{SD} = 60\text{ A}, V_{GS} = 0$                        |      |      | 1.3  | V    |
| $t_{rr}$     | Reverse Recovery Time         | $I_{SD} = 60\text{ A}, di/dt = 100\text{ A}/\mu\text{s},$ |      | 73   |      | ns   |
| $Q_{rr}$     | Reverse Recovery Charge       | $V_{DD} = 25\text{ V}, T_j = 150^\circ\text{C}$           |      | 182  |      | nC   |
| $I_{RRM}$    | Reverse Recovery Current      | (see test circuit, Figure 5)                              |      | 5    |      | A    |

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

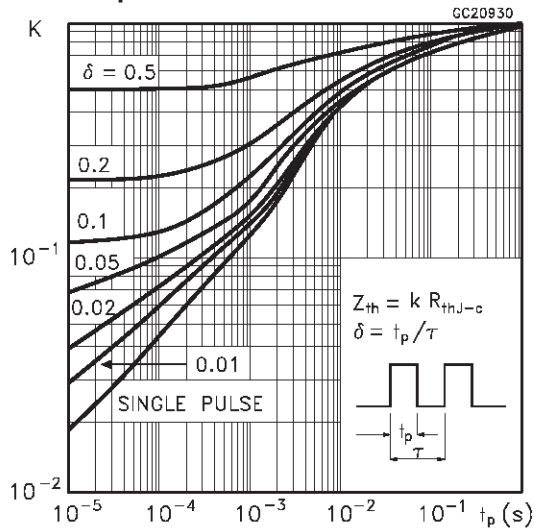
**Safe Operating Area for TO-220**



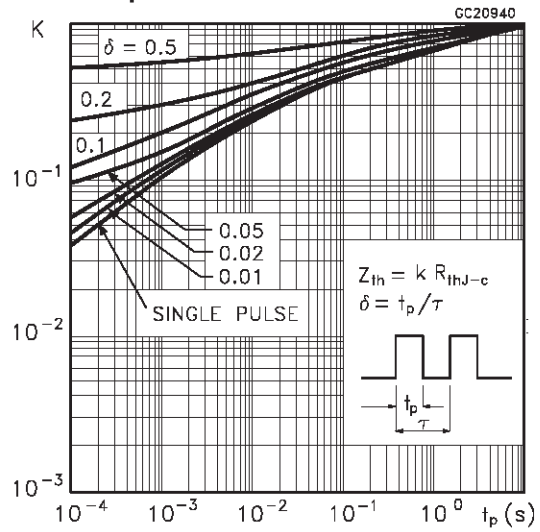
**Safe Operating Area for TO-220FP**



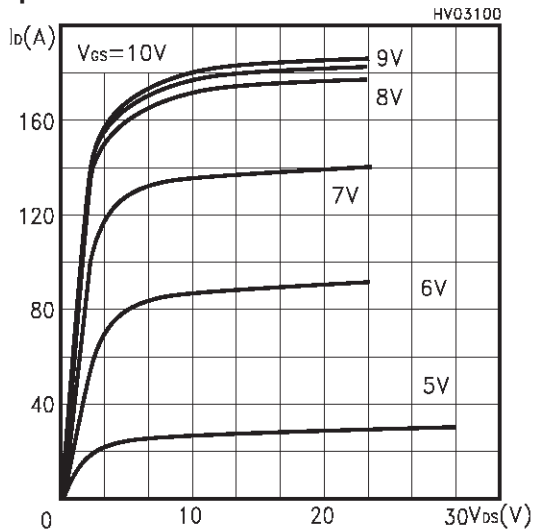
Thermal Impedance for TO-220



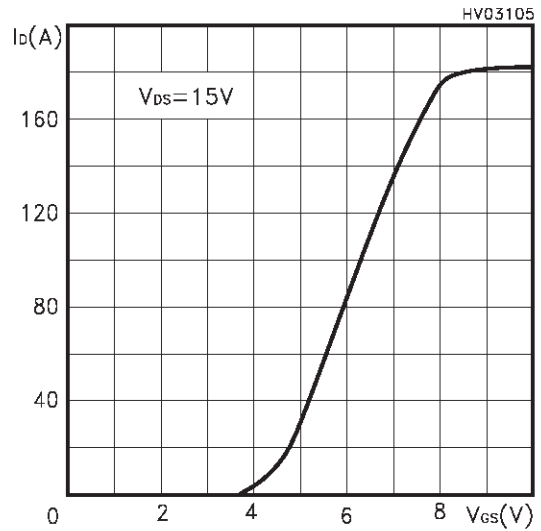
Thermal Impedance for TO-220FP



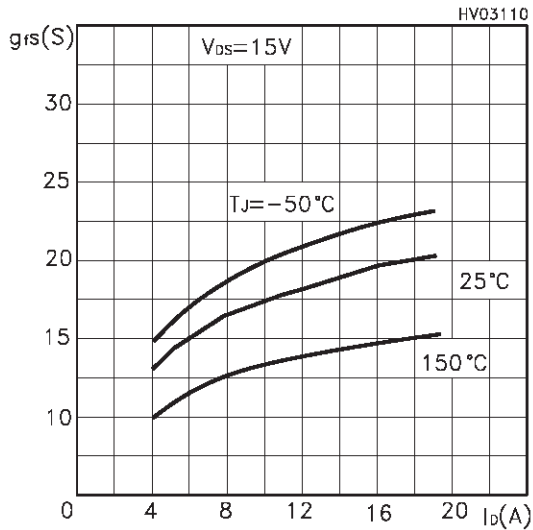
Output Characteristics



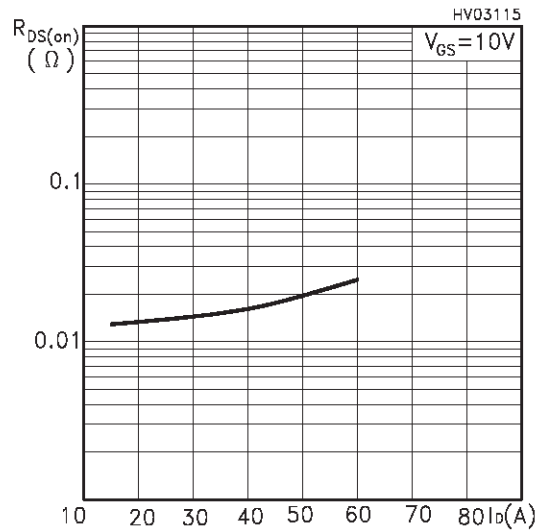
Transfer Characteristics



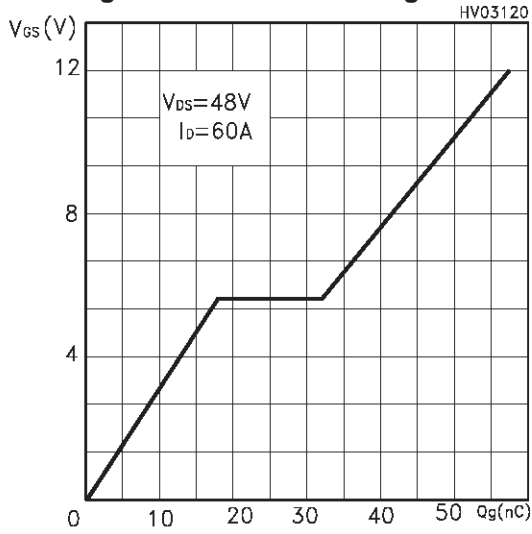
Transconductance



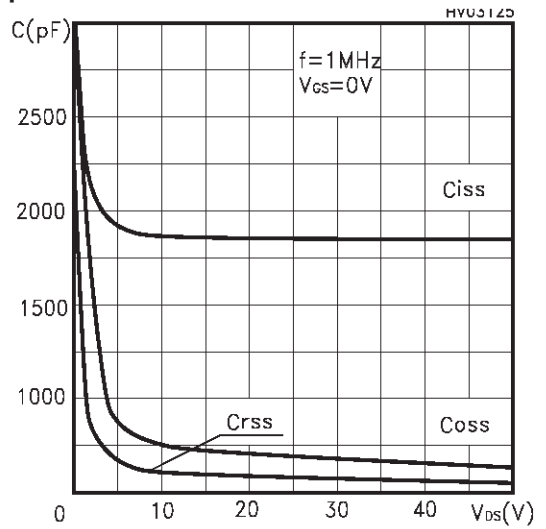
Static Drain-source On Resistance



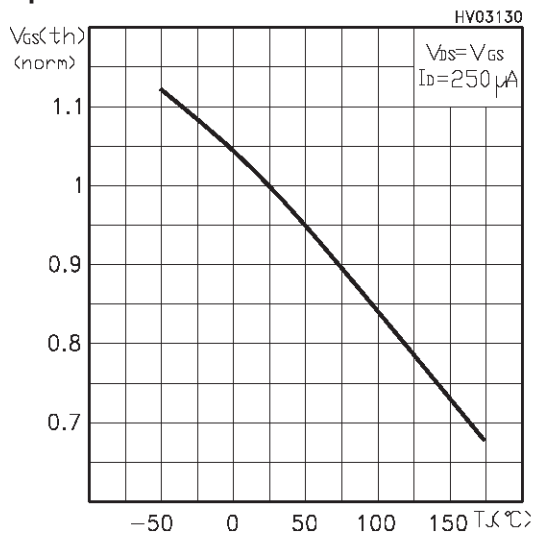
Gate Charge vs Gate-source Voltage



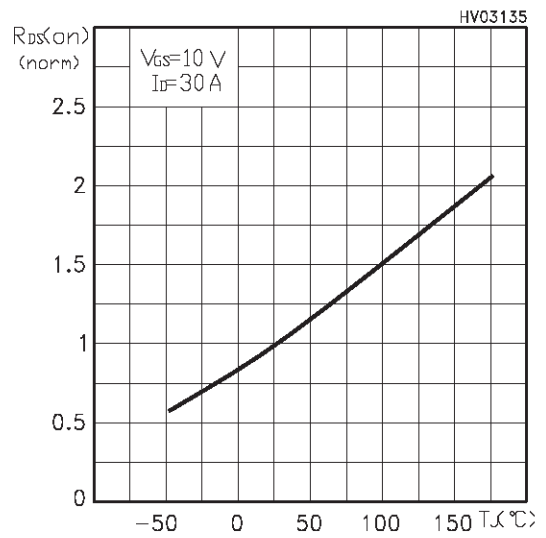
Capacitance Variations



Normalized Gate Threshold Voltage vs Temperature



Normalized On Resistance vs Temperature



Source-drain Diode Forward Characteristics

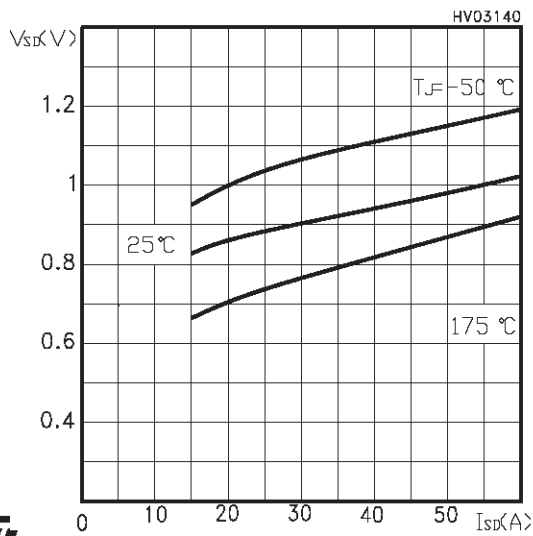


Fig. 1: Unclamped Inductive Load Test Circuit

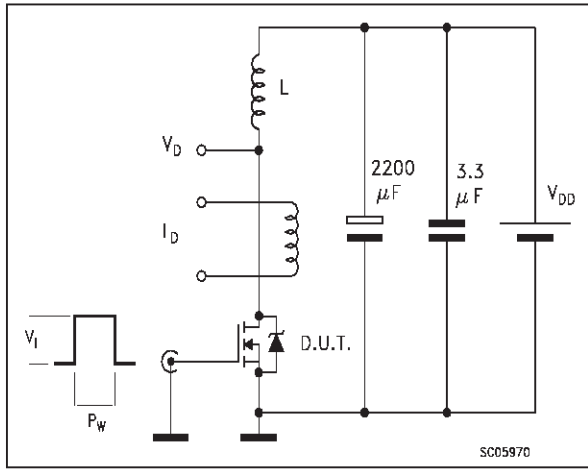


Fig. 2: Unclamped Inductive Waveform

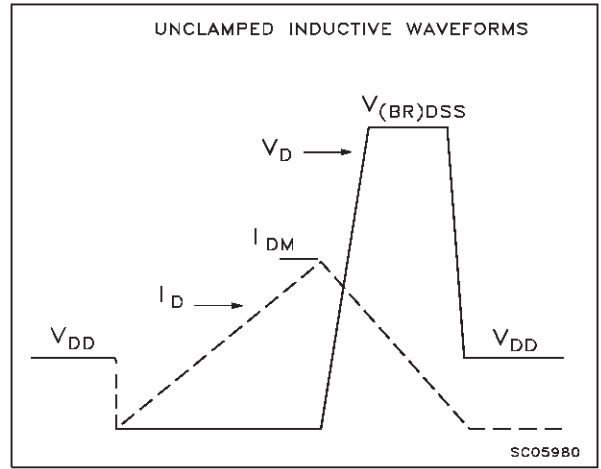


Fig. 3: Switching Times Test Circuit For Resistive Load

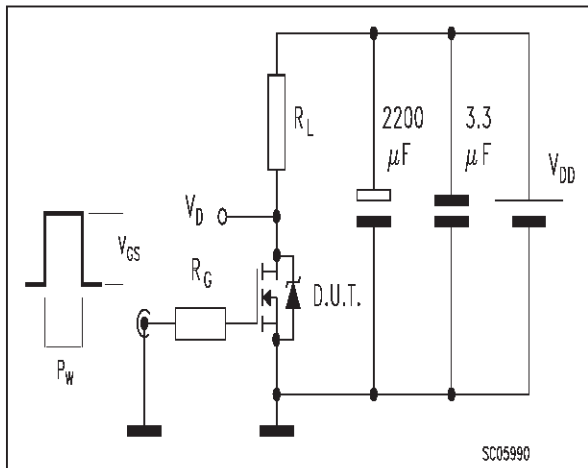


Fig. 4: Gate Charge test Circuit

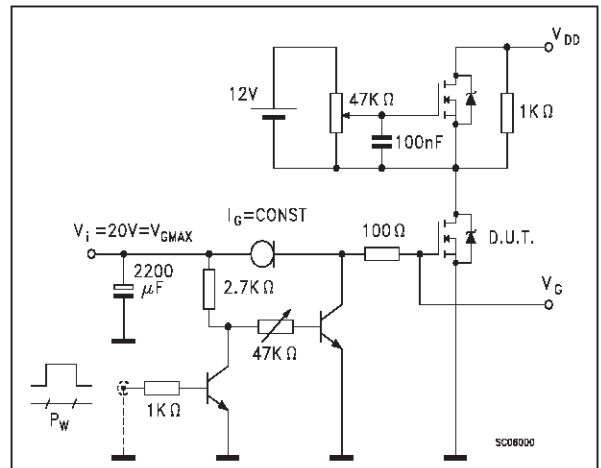
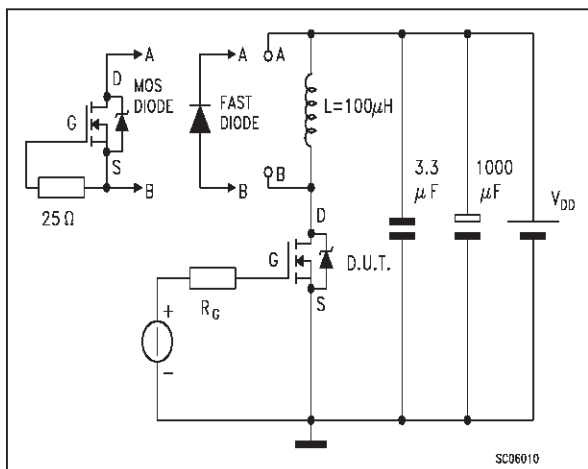


Fig. 5: Test Circuit For Inductive Load Switching And Diode Recovery Times



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 |

