



## IRF520

### N-CHANNEL 100V - 0.115 $\Omega$ - 10A TO-220 LOW GATE CHARGE STripFET™ II POWER MOSFET

| TYPE   | V <sub>DSS</sub> | R <sub>DS(on)</sub> | I <sub>D</sub> |
|--------|------------------|---------------------|----------------|
| IRF520 | 100 V            | <0.27 $\Omega$      | 10 A           |

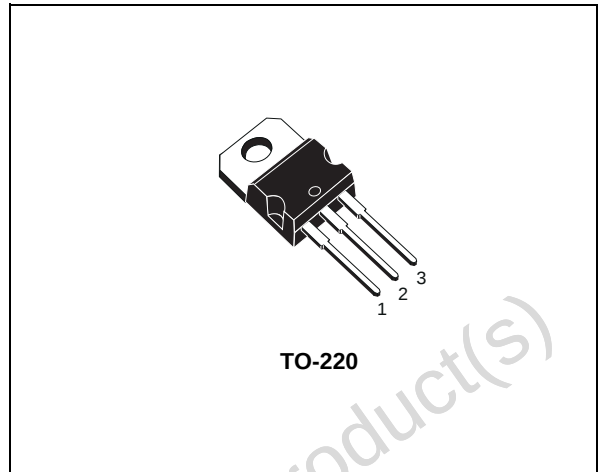
- TYPICAL R<sub>DS(on)</sub> = 0.115 $\Omega$
- AVALANCHE RUGGED TECHNOLOGY
- 100% AVALANCHE TESTED
- LOW GATE CHARGE
- HIGH CURRENT CAPABILITY
- 175 °C OPERATING TEMPERATURE

#### DESCRIPTION

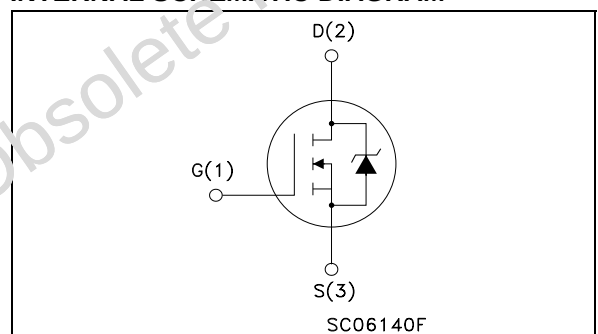
This MOSFET series realized with STMicroelectronics unique STripFET™ process has specifically been designed to minimize input capacitance and gate charge. It is therefore suitable as primary switch in advanced high-efficiency, high-frequency isolated DC-DC converters for Telecom and Computer applications.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

#### APPLICATIONS

- HIGH CURRENT, HIGH SWITCHING SPEED
- SOLENOID AND RELAY DRIVERS
- REGULATOR
- DC-DC & DC-AC CONVERTERS
- MOTOR CONTROL, AUDIO AMPLIFIERS
- AUTOMOTIVE ENVIRONMENT (INJECTION, ABS, AIR-BAG, LAMPDRIVERS, etc.)



#### INTERNAL SCHEMATIC DIAGRAM



#### ABSOLUTE MAXIMUM RATINGS

| Symbol                         | Parameter                                             | Value      | Unit |
|--------------------------------|-------------------------------------------------------|------------|------|
| V <sub>DS</sub>                | Drain-source Voltage (V <sub>GS</sub> = 0)            | 100        | V    |
| V <sub>DGR</sub>               | Drain-gate Voltage (R <sub>GS</sub> = 20 k $\Omega$ ) | 100        | V    |
| V <sub>GS</sub>                | Gate-source Voltage                                   | $\pm 20$   | V    |
| i <sub>ID</sub>                | Drain Current (continuous) at T <sub>C</sub> = 25°C   | 10         | A    |
| I <sub>D</sub>                 | Drain Current (continuous) at T <sub>C</sub> = 100°C  | 7          | A    |
| I <sub>DM</sub> (●)            | Drain Current (pulsed)                                | 40         | A    |
| P <sub>tot</sub>               | Total Dissipation at T <sub>C</sub> = 25°C            | 60         | W    |
|                                | Derating Factor                                       | 0.4        | W/°C |
| dv/dt <sup>(1)</sup>           | Peak Diode Recovery voltage slope                     | 20         | V/ns |
| E <sub>AS</sub> <sup>(2)</sup> | Single Pulse Avalanche Energy                         | 100        | mJ   |
| T <sub>stg</sub>               | Storage Temperature                                   | -55 to 175 | °C   |
| T <sub>J</sub>                 | Operating Junction Temperature                        |            |      |

(●) Pulse width limited by safe operating area.

(1) I<sub>SD</sub>  $\leq$  10A, di/dt  $\leq$  300A/ $\mu$ 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> = 10A, V<sub>DD</sub> = 50V

**THERMAL DATA**

|                       |                                                |     |      |      |
|-----------------------|------------------------------------------------|-----|------|------|
| R <sub>thj-case</sub> | Thermal Resistance Junction-case               | Max | 2.5  | °C/W |
| R <sub>thj-amb</sub>  | Thermal Resistance Junction-ambient            | Max | 62.5 | °C/W |
| T <sub>l</sub>        | Maximum Lead Temperature For Soldering Purpose |     | 300  | °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> = 100°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    | 3     | 4    | V    |
| R <sub>DS(on)</sub> | Static Drain-source On Resistance | V <sub>GS</sub> = 10 V I <sub>D</sub> = 7 A               |      | 0.115 | 0.27 | 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> = 7 A           |      | 20   |      | S    |
| C <sub>iss</sub>    | Input Capacitance            | V <sub>DS</sub> = 25V, f = 1 MHz, V <sub>GS</sub> = 0 |      | 460  |      | pF   |
| C <sub>oss</sub>    | Output Capacitance           |                                                       |      | 70   |      | pF   |
| C <sub>rss</sub>    | Reverse Transfer Capacitance |                                                       |      | 30   |      | 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                              | $V_{DD} = 50\text{ V}$ $I_D = 7\text{ A}$<br>$R_G = 4.7\ \Omega$ $V_{GS} = 10\text{ V}$<br>(Resistive Load, Figure 3) |      | 16<br>25     |      | ns<br>ns       |
| $Q_g$<br>$Q_{gs}$<br>$Q_{gd}$ | Total Gate Charge<br>Gate-Source Charge<br>Gate-Drain Charge | $V_{DD} = 80\text{ V}$ $I_D = 10\text{ A}$ $V_{GS} = 10\text{ V}$                                                     |      | 16<br>4<br>5 | 22   | 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 | $V_{DD} = 50\text{ V}$ $I_D = 7\text{ A}$<br>$R_G = 4.7\ \Omega$ , $V_{GS} = 10\text{ V}$<br>(Resistive Load, Figure 3) |      | 32<br>8 |      | ns<br>ns |

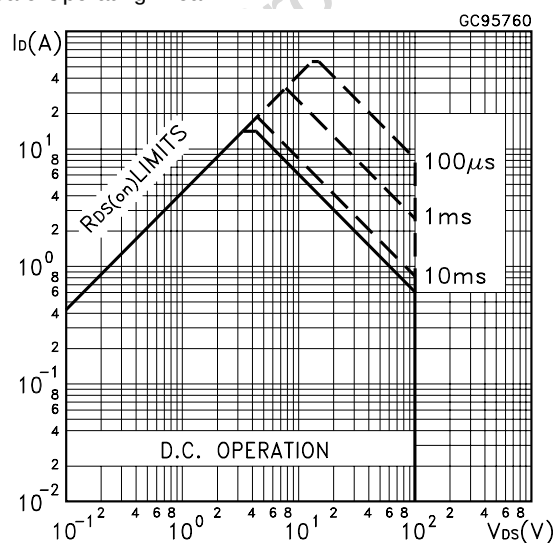
## SOURCE DRAIN DIODE

| Symbol                            | Parameter                                                                    | Test Conditions                                                                                                                               | Min. | Typ.           | Max.     | Unit          |
|-----------------------------------|------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|------|----------------|----------|---------------|
| $I_{SD}$<br>$I_{SDM}^{(*)}$       | Source-drain Current<br>Source-drain Current (pulsed)                        |                                                                                                                                               |      |                | 10<br>40 | A<br>A        |
| $V_{SD}^{(*)}$                    | Forward On Voltage                                                           | $I_{SD} = 10\text{ A}$ $V_{GS} = 0$                                                                                                           |      |                | 1.5      | V             |
| $t_{rr}$<br>$Q_{rr}$<br>$I_{RRM}$ | Reverse Recovery Time<br>Reverse Recovery Charge<br>Reverse Recovery Current | $I_{SD} = 10\text{ A}$ $di/dt = 100\text{ A}/\mu\text{s}$<br>$V_{DD} = 40\text{ V}$ $T_j = 150^\circ\text{C}$<br>(see test circuit, Figure 5) |      | 95<br>230<br>5 |          | ns<br>nC<br>A |

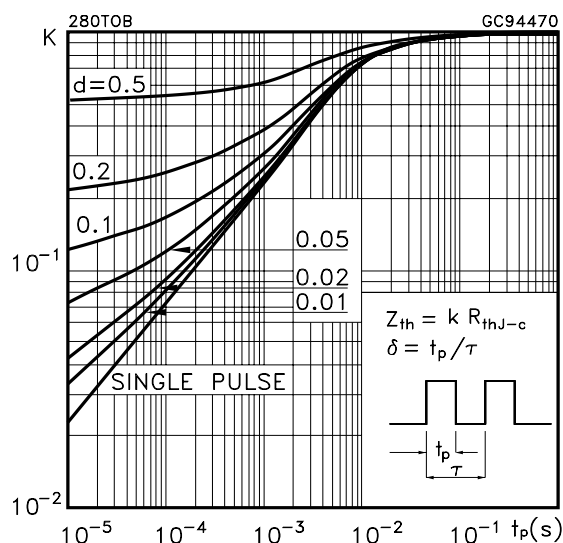
(\*) Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5 %.

(●) Pulse width limited by safe operating area.

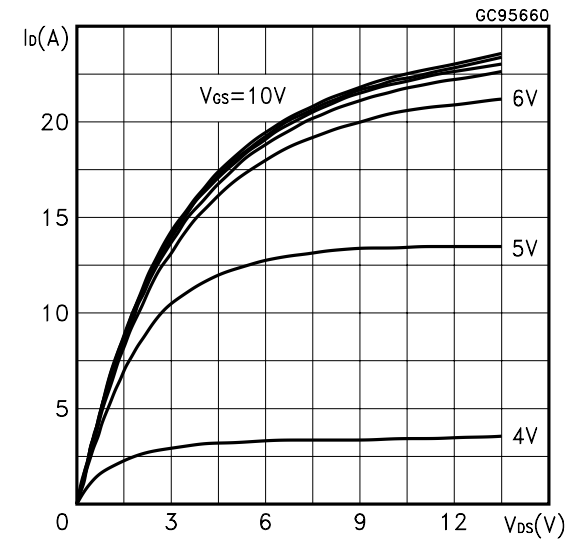
## Safe Operating Area



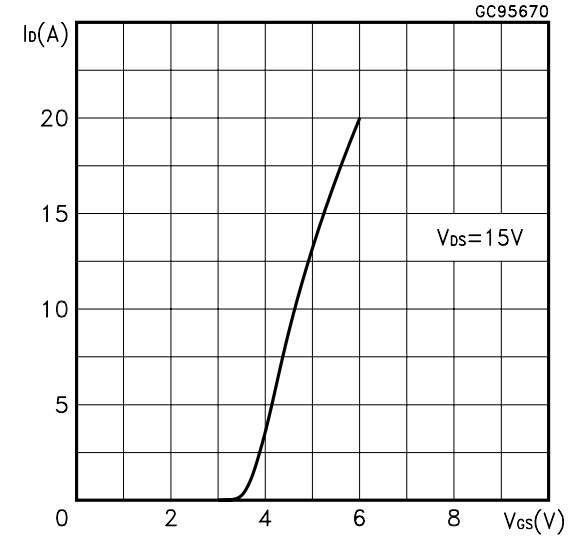
## Thermal Impedance



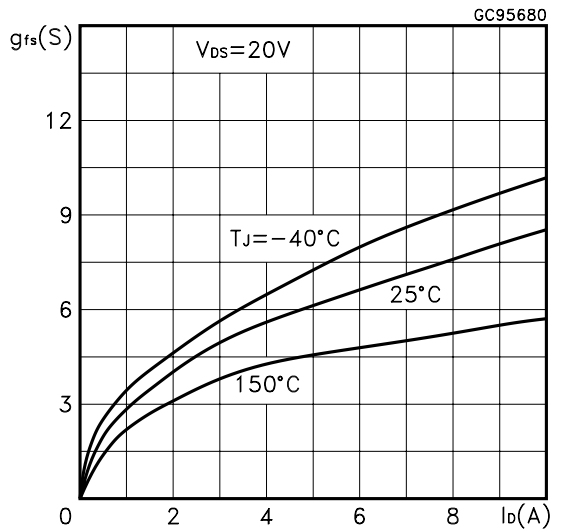
Output Characteristics



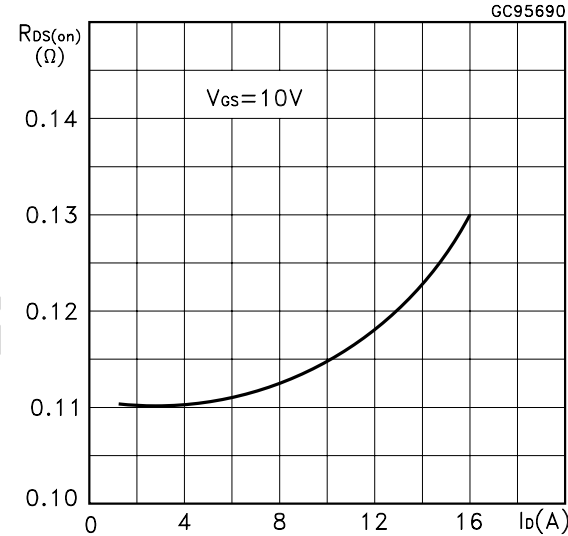
Transfer Characteristics



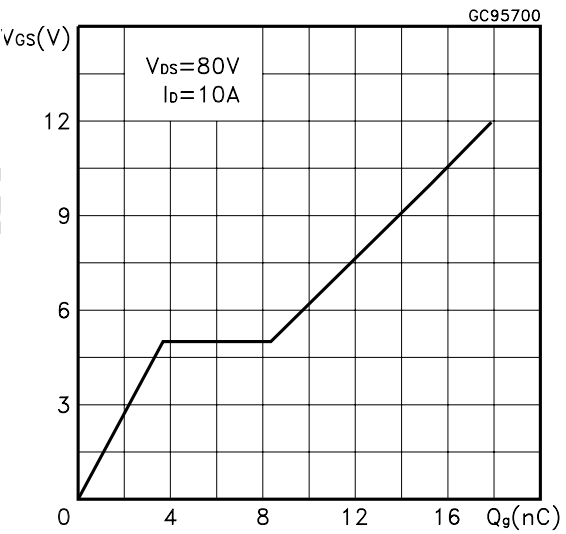
Transconductance



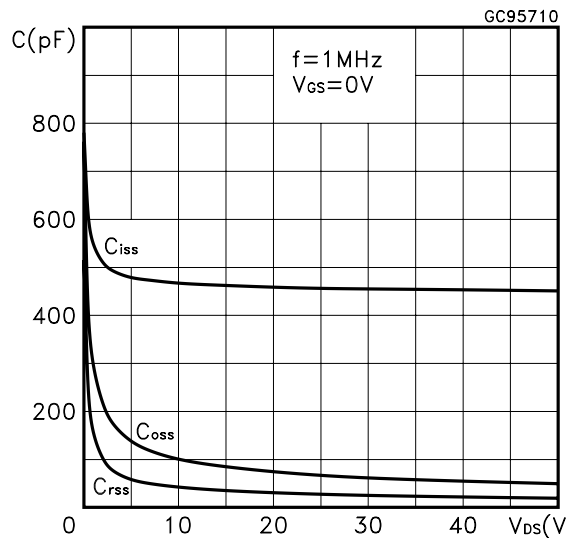
Static Drain-source On Resistance



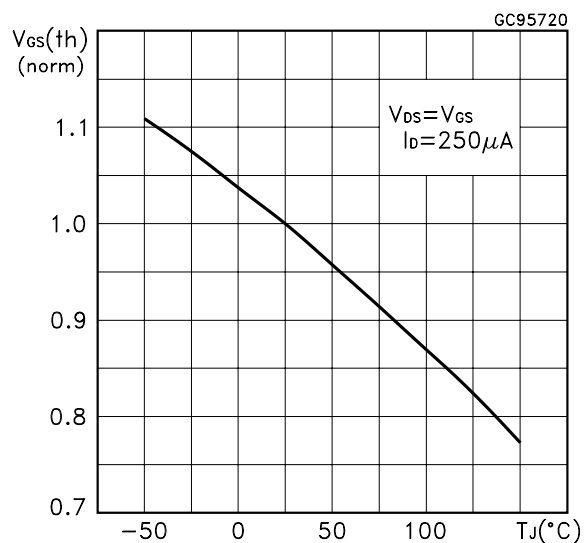
Gate Charge vs Gate-source Voltage



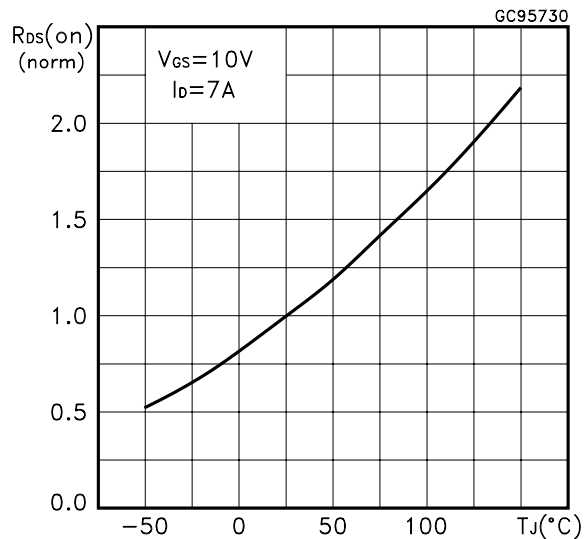
Capacitance Variations



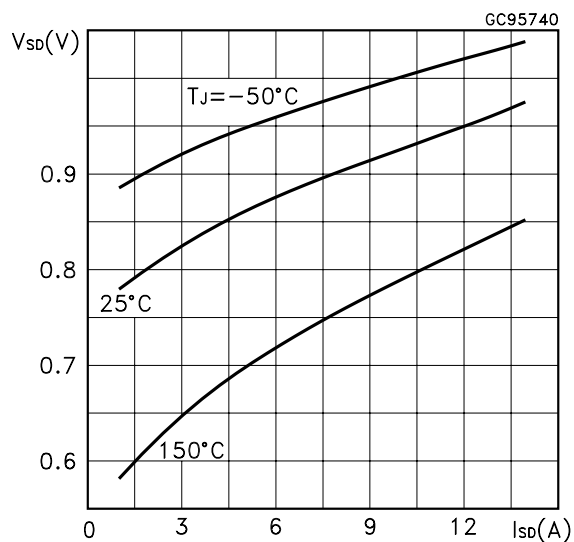
Normalized Gate Threshold Voltage vs Temperature



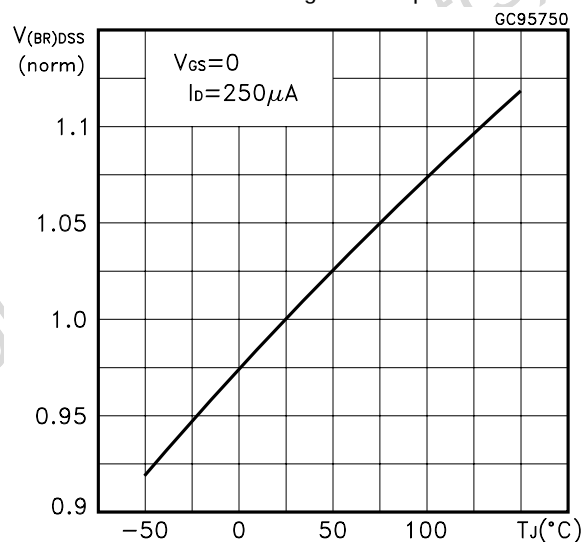
Normalized on Resistance vs Temperature



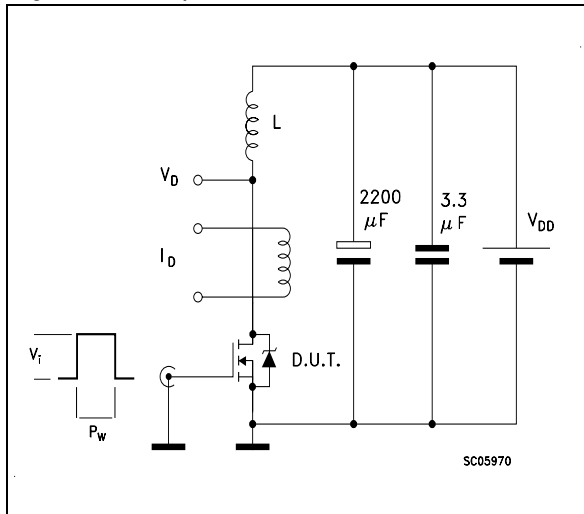
Source-drain Diode Forward Characteristics



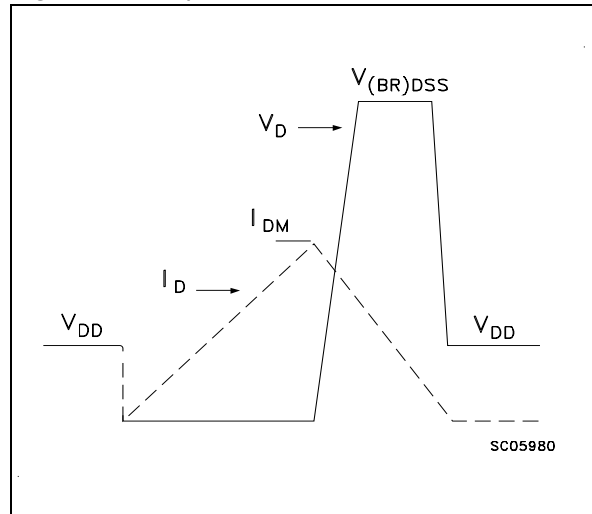
Normalized Breakdown Voltage vs Temperature



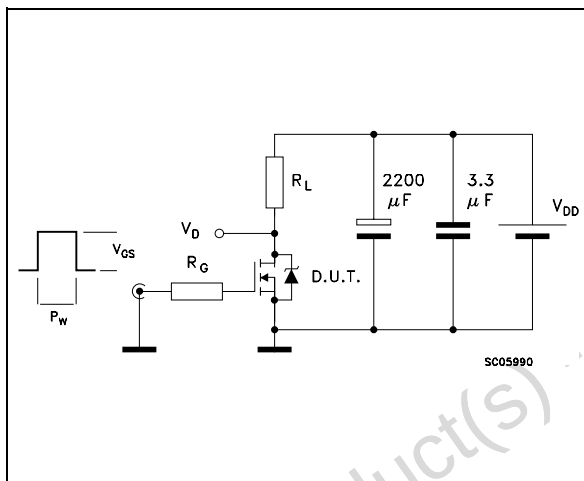
**Fig. 1: Unclamped Inductive Load Test Circuit**



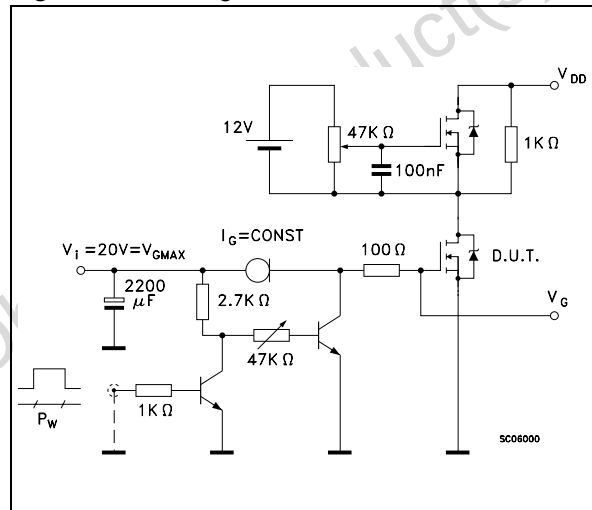
**Fig. 2: Unclamped Inductive Waveform**



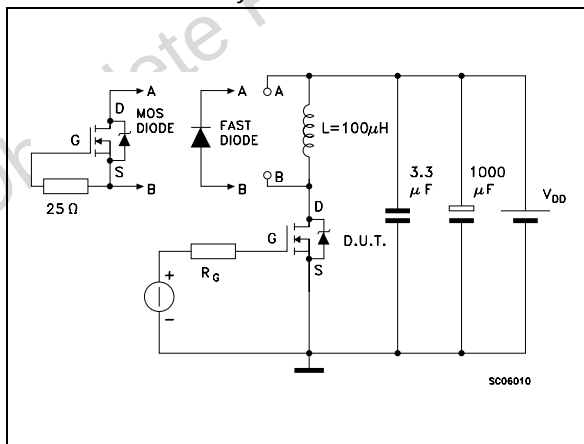
**Fig. 3: Switching Times Test Circuits For Resistive Load**



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

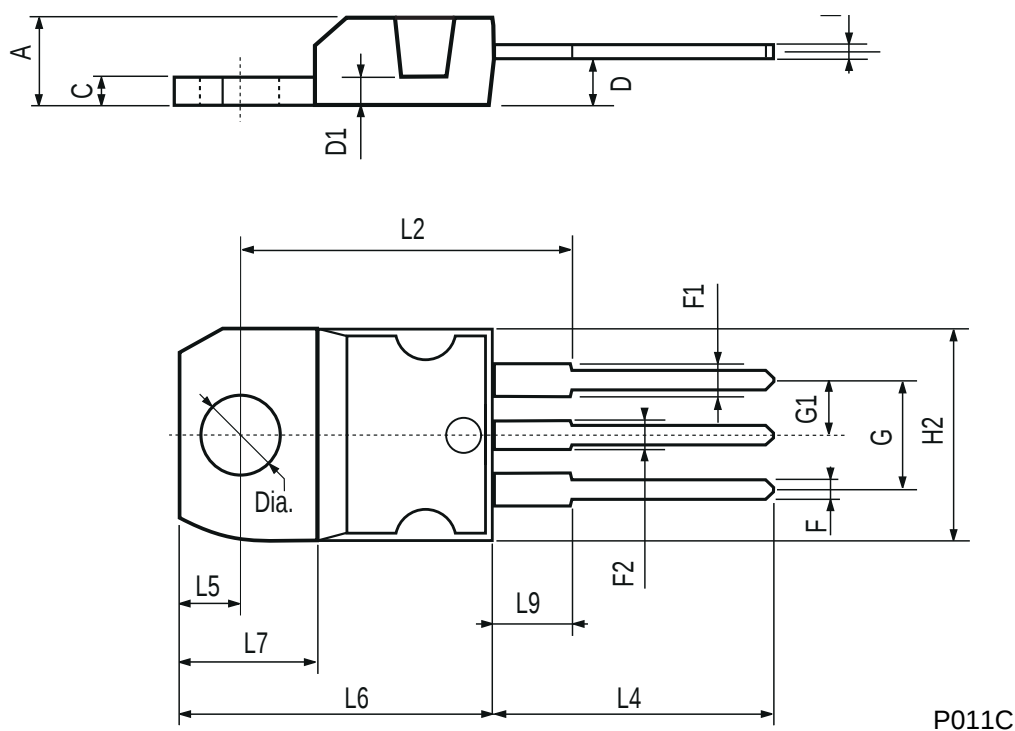


**Fig. 5: Test Circuit For Inductive Load Switching And Diode Recovery Times**



## 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 |



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