



# STU13NC50

N-CHANNEL 500V - 0.31Ω - 13A Max220

PowerMesh™ II MOSFET

| TYPE      | V <sub>DSS</sub> | R <sub>DS(on)</sub> | I <sub>D</sub> |
|-----------|------------------|---------------------|----------------|
| STU13NC50 | 500V             | < 0.4 Ω             | 13 A           |

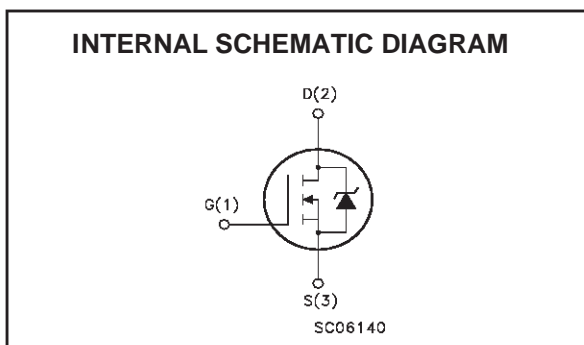
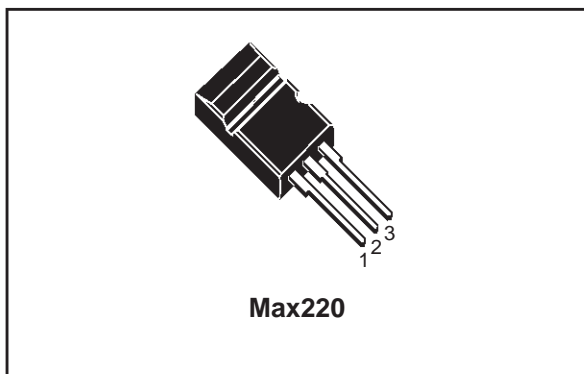
- TYPICAL R<sub>DS(on)</sub> = 0.31Ω
- EXTREMELY HIGH dv/dt CAPABILITY
- 100% AVALANCHE TESTED
- NEW HIGH VOLTAGE BENCHMARK
- GATE CHARGE MINIMIZED

### DESCRIPTION

The PowerMESH™ II is the evolution of the first generation of MESH OVERLAY™. The layout refinements introduced greatly improve the Ron\*area figure of merit while keeping the device at the leading edge for what concerns switching speed, gate charge and ruggedness.

### APPLICATIONS

- HIGH CURRENT, HIGH SPEED SWITCHING
- UNINTERRUPTIBLE POWER SUPPLIES (UPS)
- DC-AC CONVERTERS FOR TELECOM, INDUSTRIAL, AND LIGHTING EQUIPMENT



### ABSOLUTE MAXIMUM RATINGS

| Symbol              | Parameter  | Value      | Unit |
|---------------------|--|------------|------|
| 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  | 13         | A    |
| I <sub>D</sub>      | Drain Current (continuous) at T <sub>C</sub> = 100°C | 8          | A    |
| I <sub>DM</sub> (●) | Drain Current (pulsed)                               | 52         | A    |
| P <sub>TOT</sub>    | Total Dissipation at T <sub>C</sub> = 25°C           | 160        | W    |
|                     | Derating Factor                                      | 1.28       | W/°C |
| dv/dt(1)            | Peak Diode Recovery voltage slope                    | 3.5        | V/ns |
| 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> ≤ 13A, di/dt ≤ 130A/μs, V<sub>DD</sub> ≤ V<sub>(BR)DSS</sub>, T<sub>j</sub> ≤ T<sub>JMAX</sub>.

## STU13NC50

### THERMAL DATA

|                |  |      |      |
|----------------|--|------|------|
| Rthj-case      | Thermal Resistance Junction-case Max           | 0.78 | °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)                                | 13        | 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) | 800       | 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  | 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> = ±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> = 250 μA | 2    | 3    | 4    | V    |
| R <sub>DS(on)</sub> | Static Drain-source On Resistance | V <sub>GS</sub> = 10V, I <sub>D</sub> = 7 A                 |      | 0.31 | 0.4  | Ω    |

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> ,<br>I <sub>D</sub> = 7A |      | 13   |      | S    |
| C <sub>iss</sub> | Input Capacitance            | V <sub>DS</sub> = 25V, f = 1 MHz, V <sub>GS</sub> = 0                                  |      | 1970 |      | pF   |
| C <sub>oss</sub> | Output Capacitance           |  |      | 300  |      | pF   |
| C <sub>rss</sub> | Reverse Transfer Capacitance |  |      | 48   |      | pF   |

**ELECTRICAL CHARACTERISTICS (CONTINUED)**

**SWITCHING ON**

| Symbol      | Parameter          | Test Conditions   | Min. | Typ. | Max. | Unit |
|-------------|--------------------|---|------|------|------|------|
| $t_{d(on)}$ | Turn-on Delay Time | $V_{DD} = 250V, I_D = 7 A$                                      |      | 20   |      | ns   |
| $t_r$       | Rise Time          | $R_G = 4.7\Omega, V_{GS} = 10V$<br>(see test circuit, Figure 3) |      | 23   |      | ns   |
| $Q_g$       | Total Gate Charge  | $V_{DD} = 400V, I_D = 14 A,$                                    |      | 75   | 105  | nC   |
| $Q_{gs}$    | Gate-Source Charge | $V_{GS} = 10V$  |      | 10   |      | nC   |
| $Q_{gd}$    | Gate-Drain Charge  |   |      | 38   |      | nC   |

**SWITCHING OFF**

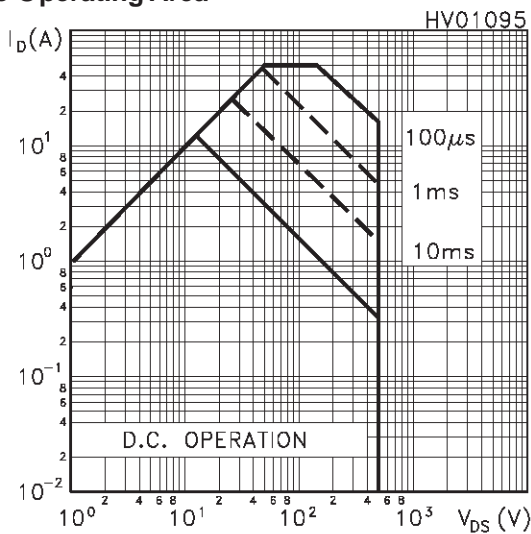
| Symbol         | Parameter             | Test Conditions   | Min. | Typ. | Max. | Unit |
|----------------|-----------------------|---|------|------|------|------|
| $t_r(V_{off})$ | Off-voltage Rise Time | $V_{DD} = 400V, I_D = 14 A,$                                    |      | 25   |      | ns   |
| $t_f$          | Fall Time             | $R_G = 4.7\Omega, V_{GS} = 10V$<br>(see test circuit, Figure 5) |      | 30   |      | ns   |
| $t_c$          | Cross-over Time       |   |      | 62   |      | ns   |

**SOURCE DRAIN DIODE**

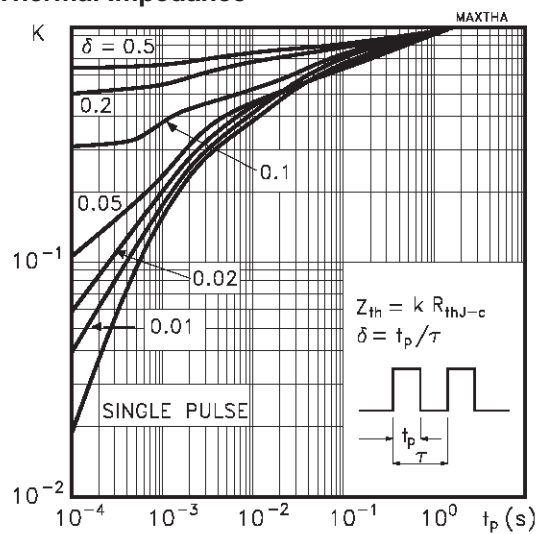
| Symbol        | Parameter                     | Test Conditions  | Min. | Typ. | Max. | Unit    |
|---------------|-------------------------------|--|------|------|------|---------|
| $I_{SD}$      | Source-drain Current          |  |      |      | 13   | A       |
| $I_{SDM} (2)$ | Source-drain Current (pulsed) |  |      |      | 52   | A       |
| $V_{SD} (1)$  | Forward On Voltage            | $I_{SD} = 14 A, V_{GS} = 0$  |      |      | 1.4  | V       |
| $t_{rr}$      | Reverse Recovery Time         | $I_{SD} = 14 A, di/dt = 100A/\mu s,$                               |      | 670  |      | ns      |
| $Q_{rr}$      | Reverse Recovery Charge       | $V_{DD} = 100V, T_j = 150^\circ C$<br>(see test circuit, Figure 5) |      | 6.7  |      | $\mu C$ |
| $I_{RRM}$     | Reverse Recovery Current      |  |      | 20   |      | A       |

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

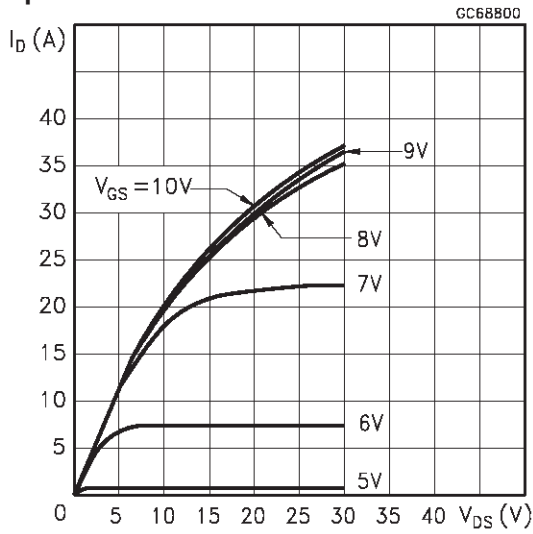
**Safe Operating Area**



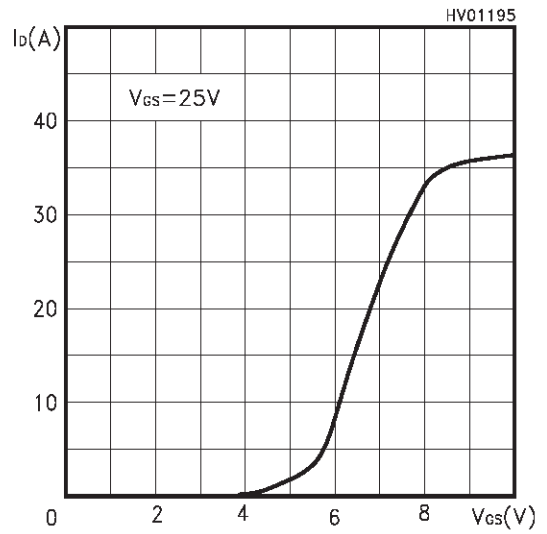
**Thermal Impedance**



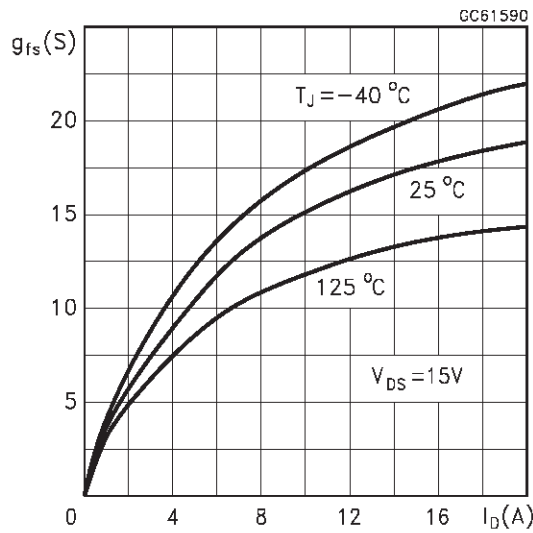
Output Characteristics



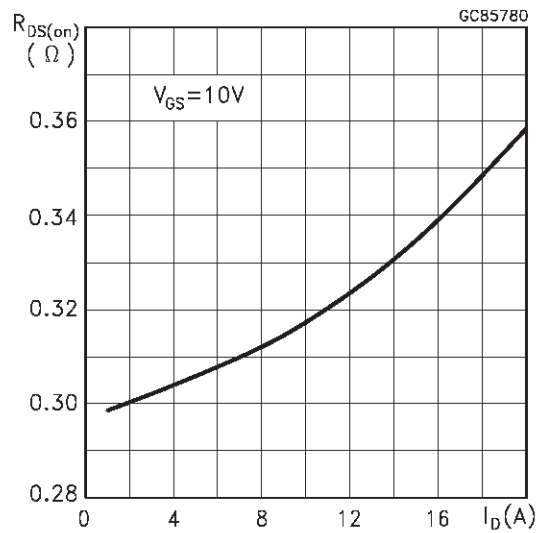
Transfer Characteristics



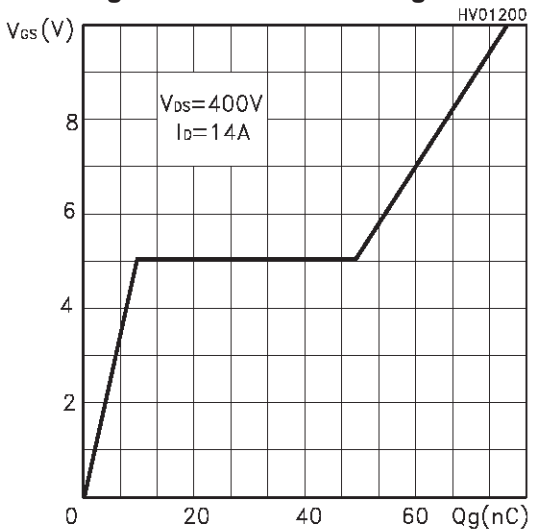
Transconductance



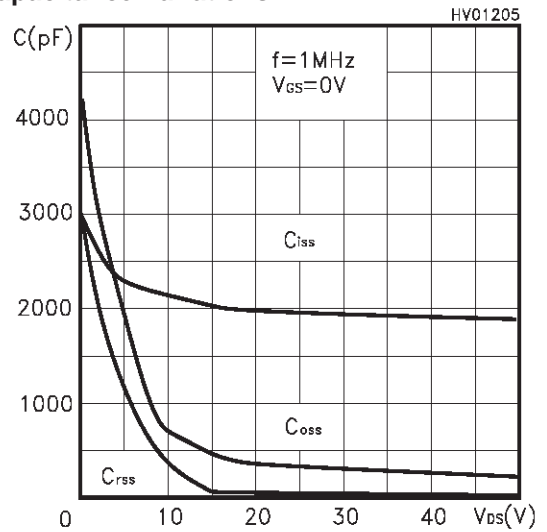
Static Drain-source On Resistance



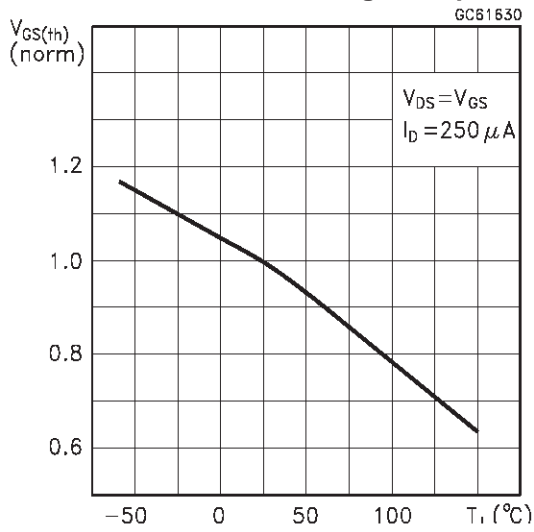
Gate Charge vs Gate-source Voltage



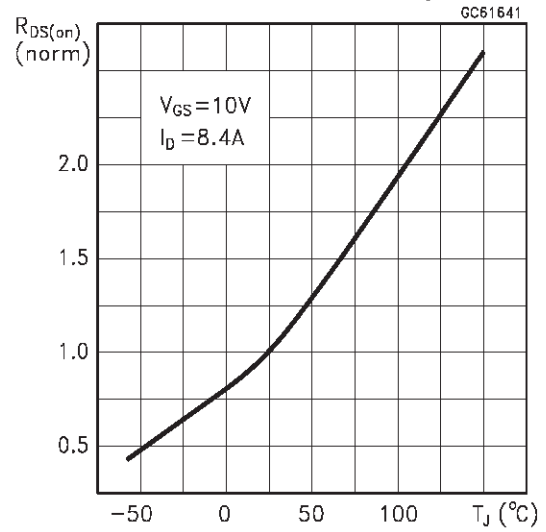
Capacitance Variations



Normalized Gate Threshold Voltage vs Temperature



Normalized On Resistance vs Temperature



Source-drain Diode Forward Characteristics

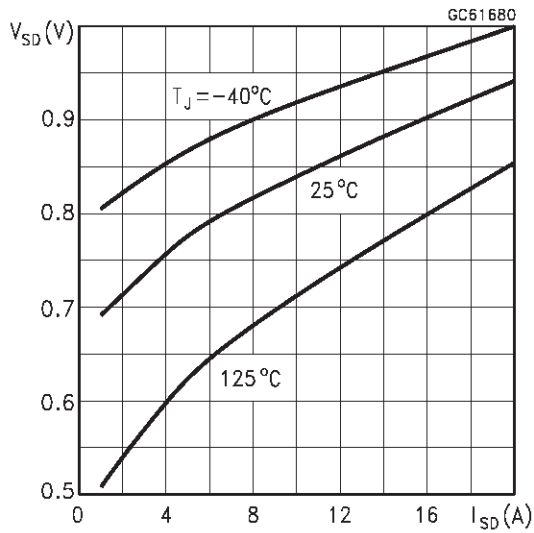


Fig. 1: Unclamped Inductive Load Test Circuit

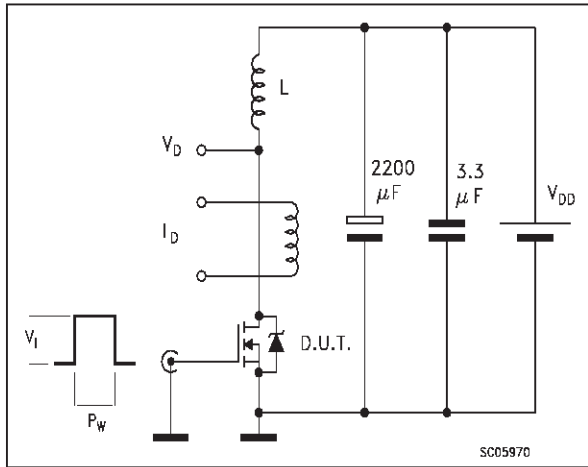


Fig. 2: Unclamped Inductive Waveform

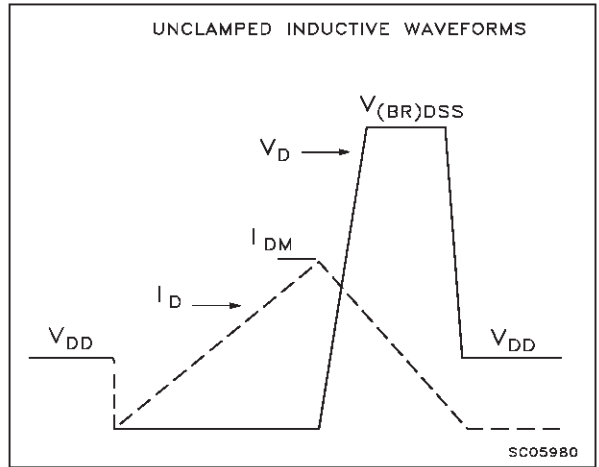


Fig. 3: Switching Times Test Circuit For Resistive Load

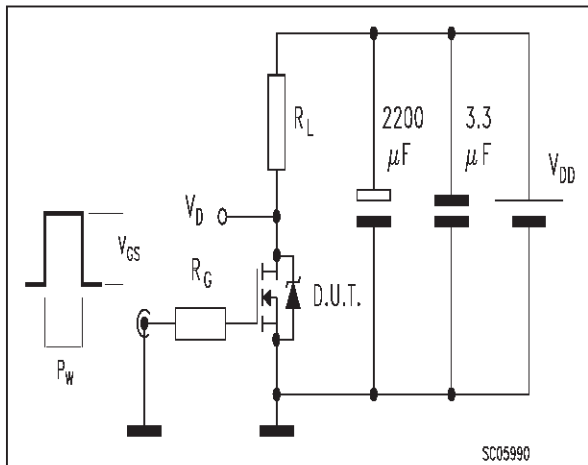


Fig. 4: Gate Charge test Circuit

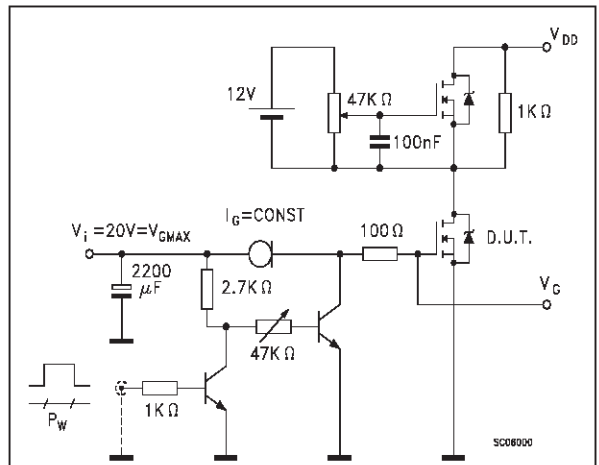
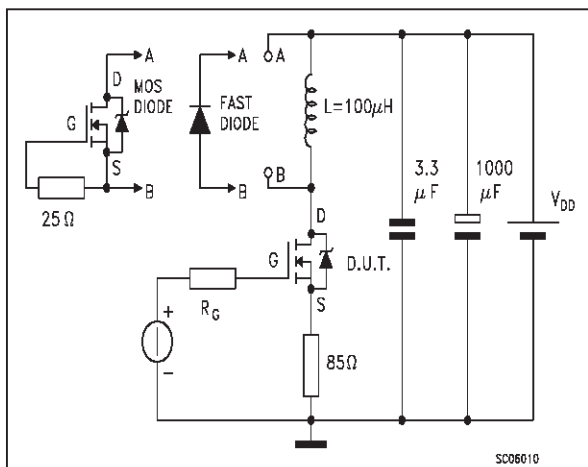
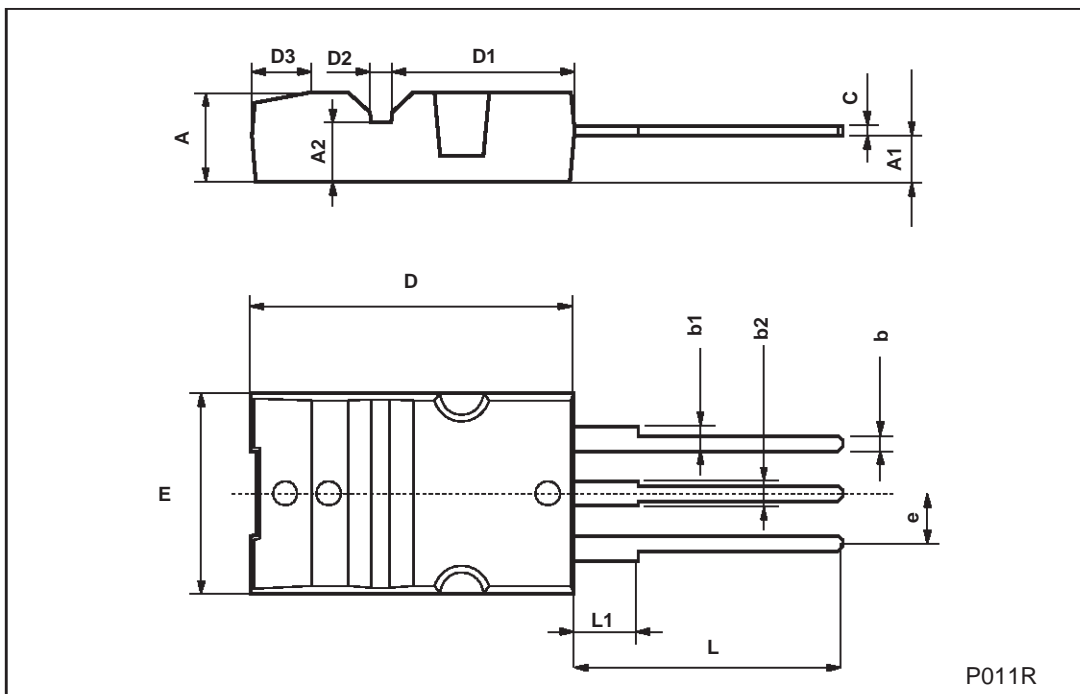


Fig. 5: Test Circuit For Inductive Load Switching And Diode Recovery Times



**Max220 MECHANICAL DATA**

| DIM. | mm    |      |       | inch  |       |       |
|------|-------|------|-------|-------|-------|-------|
|      | MIN.  | TYP. | MAX.  | MIN.  | TYP.  | MAX.  |
| A    | 4.3   |      | 4.6   | 0.169 |       | 0.181 |
| A1   | 2.2   |      | 2.4   | 0.087 |       | 0.094 |
| A2   | 2.9   |      | 3.1   | 0.114 |       | 0.122 |
| b    | 0.7   |      | 0.93  | 0.027 |       | 0.036 |
| b1   | 1.25  |      | 1.4   | 0.049 |       | 0.055 |
| b2   | 1.2   |      | 1.38  | 0.047 |       | 0.054 |
| c    | 0.45  |      | 0.6   |       | 0.18  | 0.023 |
| D    | 15.9  |      | 16.3  |       | 0.626 | 0.641 |
| D1   | 9     |      | 9.35  | 0.354 |       | 0.368 |
| D2   | 0.8   |      | 1.2   | 0.031 |       | 0.047 |
| D3   | 2.8   |      | 3.2   | 0.110 |       | 0.126 |
| e    | 2.44  |      | 2.64  | 0.096 |       | 0.104 |
| E    | 10.05 |      | 10.35 | 0.396 |       | 0.407 |
| L    | 13.2  |      | 13.6  | 0.520 |       | 0.535 |
| L1   | 3     |      | 3.4   | 0.118 |       | 0.133 |



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