



# IRFBC40

## N - CHANNEL 600V - 1.0 $\Omega$ - 6.2 A - TO-220 PowerMESH™ MOSFET

| TYPE    | V <sub>DSS</sub> | R <sub>DS(on)</sub> | I <sub>D</sub> |
|---------|------------------|---------------------|----------------|
| IRFBC40 | 600 V            | < 1.2 $\Omega$      | 6.2 A          |

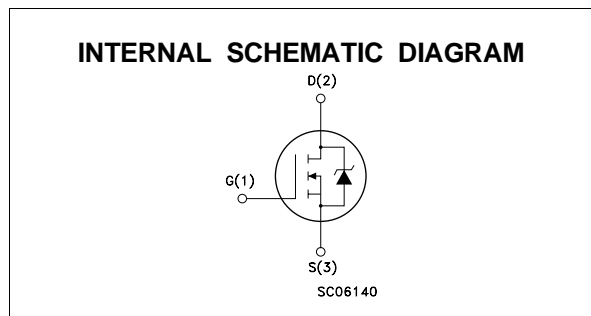
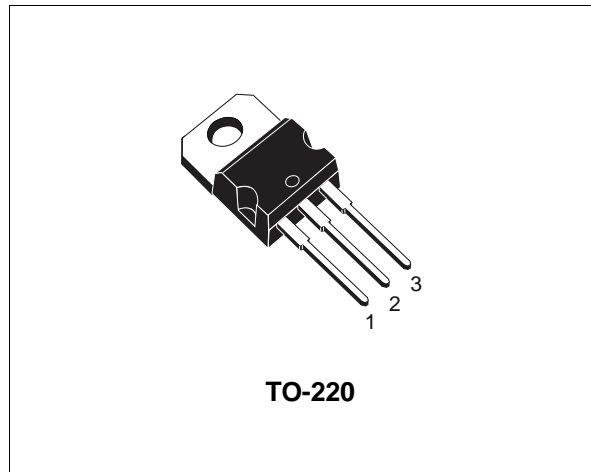
- TYPICAL R<sub>DS(on)</sub> = 1.0  $\Omega$
- EXTREMELY HIGH dv/dt CAPABILITY
- 100% AVALANCHE TESTED
- VERY LOW INTRINSIC CAPACITANCES
- GATE CHARGE MINIMIZED

### DESCRIPTION

This power MOSFET is designed using the company's consolidated strip layout-based MESH OVERLAY™ process. This technology matches and improves the performances compared with standard parts from various sources.

### APPLICATIONS

- HIGH CURRENT, HIGH SPEED SWITCHING
- SWITCH MODE POWER SUPPLIES (SMPS)
- DC-AC CONVERTERS FOR WELDING EQUIPMENT AND UNINTERRUPTIBLE POWER SUPPLIES AND MOTOR DRIVER



### ABSOLUTE MAXIMUM RATINGS

| Symbol              | Parameter  | Value      | Unit |
|---------------------|--|------------|------|
| V <sub>DS</sub>     | Drain-source Voltage (V <sub>GS</sub> = 0)             | 600        | V    |
| V <sub>DGR</sub>    | Drain- gate Voltage (R <sub>GS</sub> = 20 k $\Omega$ ) | 600        | 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   | 2          | A    |
| I <sub>D</sub>      | Drain Current (continuous) at T <sub>c</sub> = 100 °C  | 3.9        | A    |
| I <sub>DM</sub> (●) | Drain Current (pulsed)                                 | 25         | A    |
| P <sub>tot</sub>    | Total Dissipation at T <sub>c</sub> = 25 °C            | 125        | W    |
|                     | Derating Factor  | 1.0        | W/°C |
| dv/dt(1)            | Peak Diode Recovery voltage slope                      | 3          | 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>  $\leq$  6.2 A, di/dt  $\leq$  80 A/ $\mu$ s, V<sub>DD</sub>  $\leq$  V<sub>(BR)DSS</sub>, T<sub>j</sub>  $\leq$  T<sub>JMAX</sub>

# IRFBC40

## THERMAL DATA

|                       |  |     |      |      |
|-----------------------|--|-----|------|------|
| R <sub>thj-case</sub> | Thermal Resistance Junction-case               | Max | 1.0  | °C/W |
| R <sub>thj-amb</sub>  | Thermal Resistance Junction-ambient            | Max | 62.5 | °C/W |
| R <sub>thc-sink</sub> | Thermal Resistance Case-sink                   | Typ | 0.5  | °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)                                | 6.2       | 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) | 580       | mJ   |

## 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  | 600  |      |         | 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> = ± 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> = 10V I <sub>D</sub> = 3.7 A  |      | 1.0  | 1.2  | Ω    |
| I <sub>D(on)</sub>  | On State Drain Current            | V <sub>DS</sub> > I <sub>D(on)</sub> × R <sub>DS(on)max</sub><br>V <sub>GS</sub> = 10 V | 6.2  |      |      | A    |

## 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> I <sub>D</sub> = 3.7 A | 4.7  |      |      | S    |
| C <sub>iss</sub>    | Input Capacitance            | V <sub>DS</sub> = 25 V f = 1 MHz V <sub>GS</sub> = 0                                 |      | 1300 |      | pF   |
| C <sub>oss</sub>    | Output Capacitance           |  |      | 180  |      | pF   |
| C <sub>rss</sub>    | Reverse Transfer Capacitance |  |      | 15   |      | pF   |

**ELECTRICAL CHARACTERISTICS** (continued)

**SWITCHING ON**

| Symbol      | Parameter          | Test Conditions  | Min. | Typ. | Max. | Unit |
|-------------|--------------------|--|------|------|------|------|
| $t_{d(on)}$ | Turn-on Time       | $V_{DD} = 300\text{ V}$ $I_D = 3.6\text{ A}$<br>$R_G = 4.7\ \Omega$ $V_{GS} = 10\text{ V}$<br>(see test circuit, figure 3) |      | 18   |      | ns   |
| $t_r$       | Rise Time          |  |      | 8    |      | ns   |
| $Q_g$       | Total Gate Charge  | $V_{DD} = 480\text{ V}$ $I_D = 6.2\text{ A}$ $V_{GS} = 10\text{ V}$  |      | 38   | 50   | nC   |
| $Q_{gs}$    | Gate-Source Charge |  |      | 9.9  |      | nC   |
| $Q_{gd}$    | Gate-Drain Charge  |  |      | 13.3 |      | nC   |

**SWITCHING OFF**

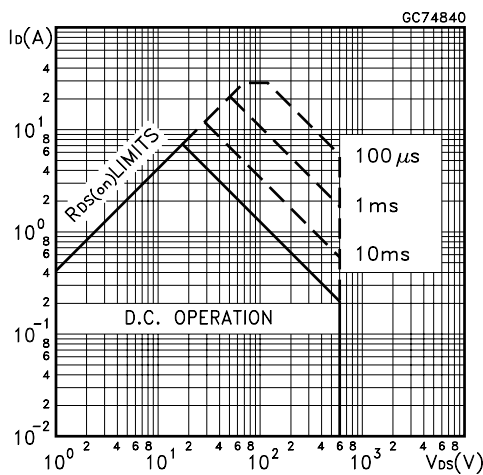
| Symbol        | Parameter             | Test Conditions  | Min. | Typ. | Max. | Unit |
|---------------|-----------------------|--|------|------|------|------|
| $t_{r(Voff)}$ | Off-voltage Rise Time | $V_{DD} = 480\text{ V}$ $I_D = 6.2\text{ A}$<br>$R_G = 4.7\ \Omega$ $V_{GS} = 10\text{ V}$<br>(see test circuit, figure 5) |      | 8    |      | ns   |
| $t_f$         | Fall Time             |  |      | 5    |      | ns   |
| $t_c$         | Cross-over Time       |  |      | 15   |      | ns   |

**SOURCE DRAIN DIODE**

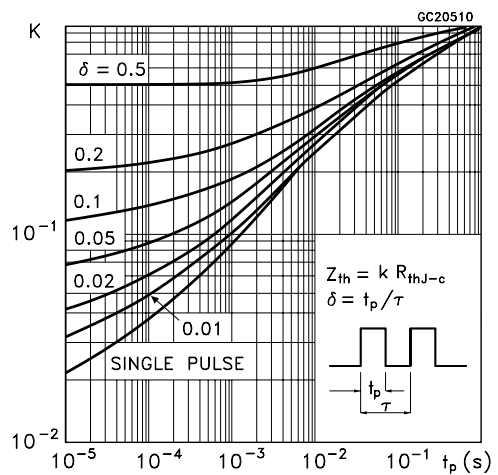
| Symbol             | Parameter                     | Test Conditions   | Min. | Typ. | Max. | Unit          |
|--------------------|-------------------------------|---|------|------|------|---------------|
| $I_{SD}$           | Source-drain Current          |   |      |      | 6.2  | A             |
| $I_{SDM}(\bullet)$ | Source-drain Current (pulsed) |   |      |      | 25   | A             |
| $V_{SD} (*)$       | Forward On Voltage            | $I_{SD} = 6.2\text{ A}$ $V_{GS} = 0$  |      |      | 1.6  | V             |
| $t_{rr}$           | Reverse Recovery Time         | $I_{SD} = 6.2\text{ A}$ $di/dt = 100\text{ A}/\mu\text{s}$<br>$V_{DD} = 100\text{ V}$ $T_j = 150\text{ }^\circ\text{C}$<br>(see test circuit, figure 5) |      | 530  |      | ns            |
| $Q_{rr}$           | Reverse Recovery Charge       |   |      | 4.5  |      | $\mu\text{C}$ |
| $I_{RRM}$          | Reverse Recovery Current      |   |      | 17   |      | A             |

(\*) Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5 %  
 (•) Pulse width limited by safe operating area

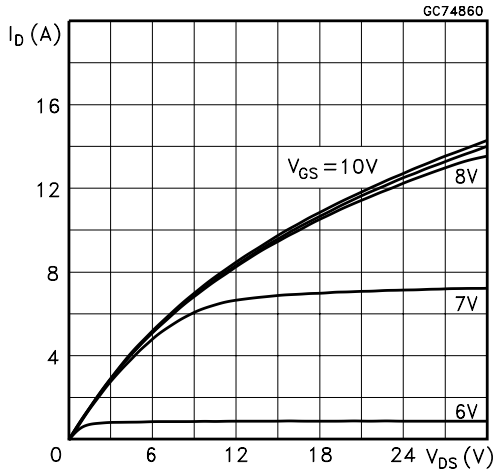
**Safe Operating Area**



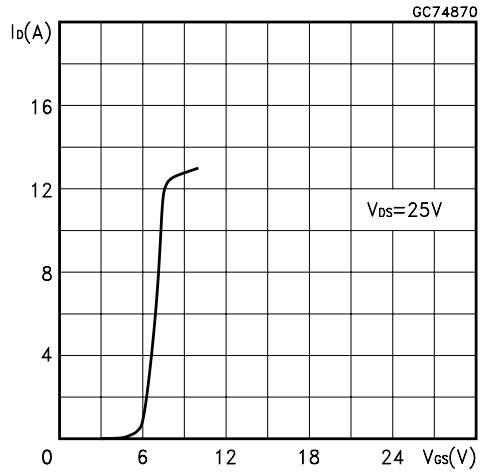
**Thermal Impedance**



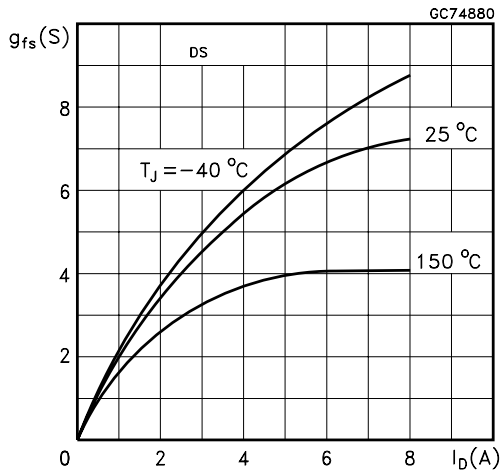
Output Characteristics



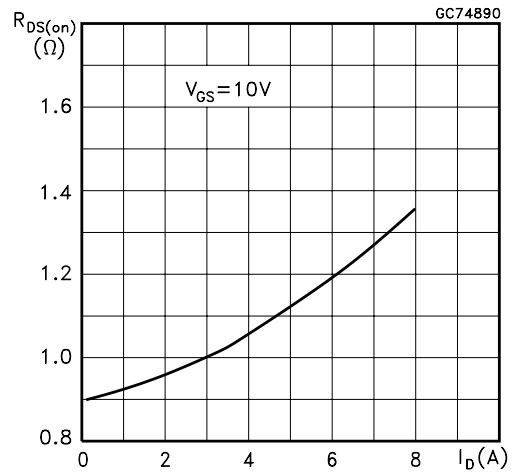
Transfer Characteristics



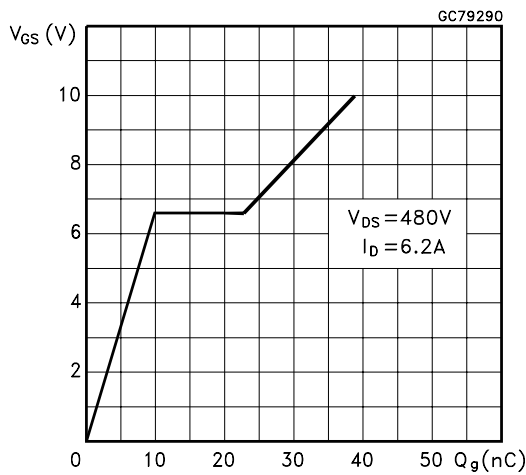
Transconductance



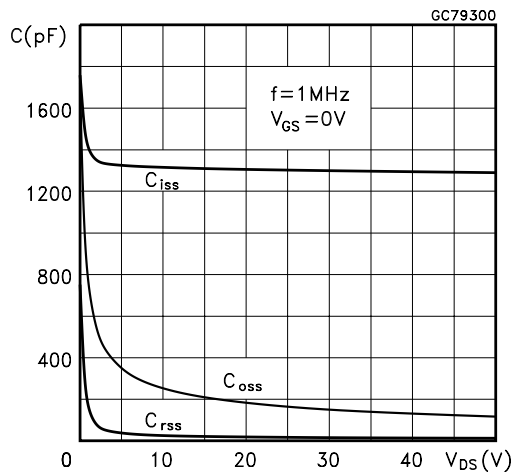
Static Drain-source On Resistance



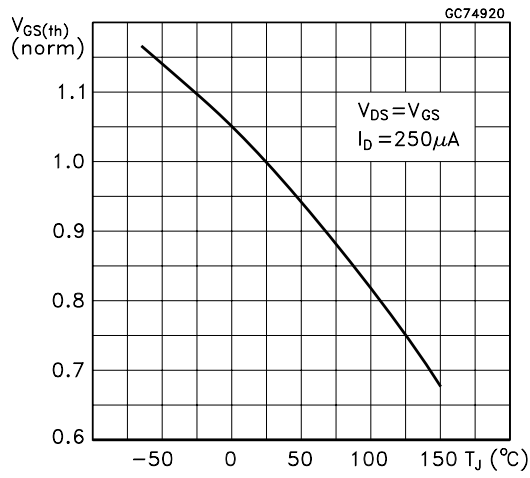
Gate Charge vs Gate-source Voltage



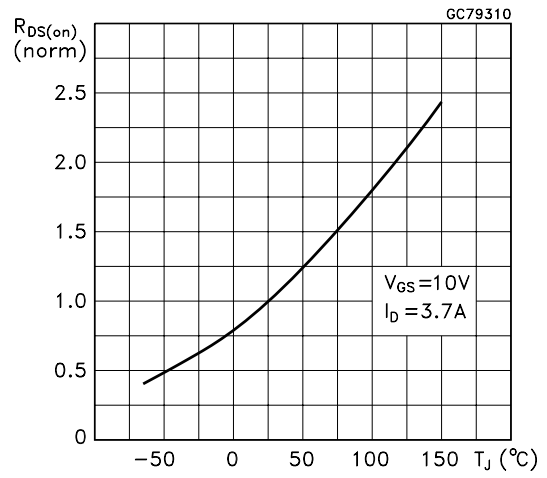
Capacitance Variations



Normalized Gate Threshold Voltage vs Temperature



Normalized On Resistance vs Temperature



Source-drain Diode Forward Characteristics

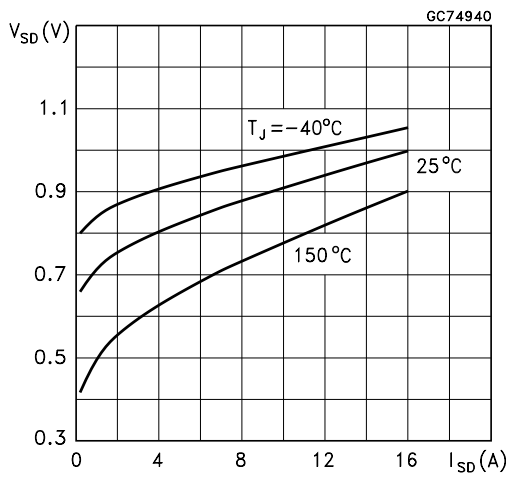


Fig. 1: Unclamped Inductive Load Test Circuit

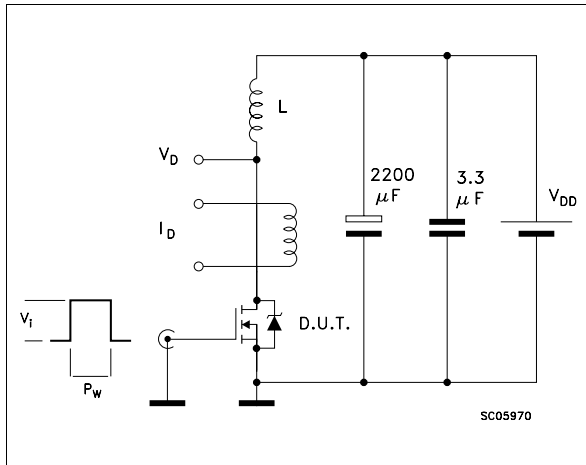


Fig. 1: Unclamped Inductive Waveform

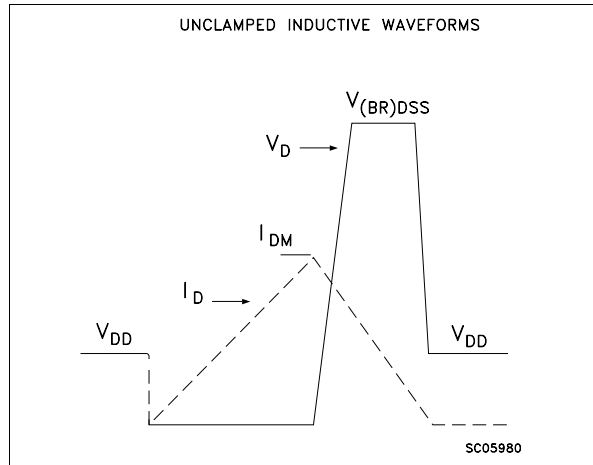


Fig. 3: Switching Times Test Circuits For Resistive Load

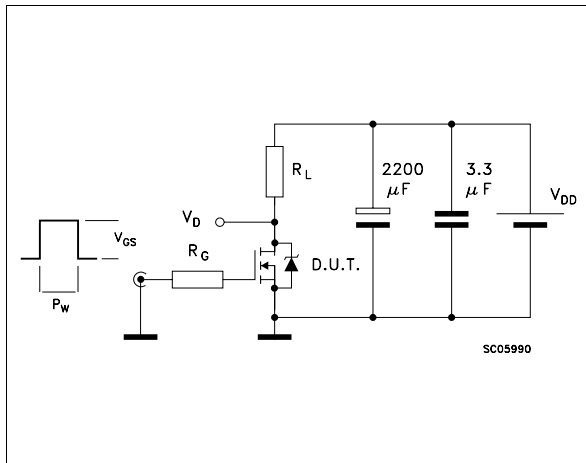


Fig. 4: Gate Charge test Circuit

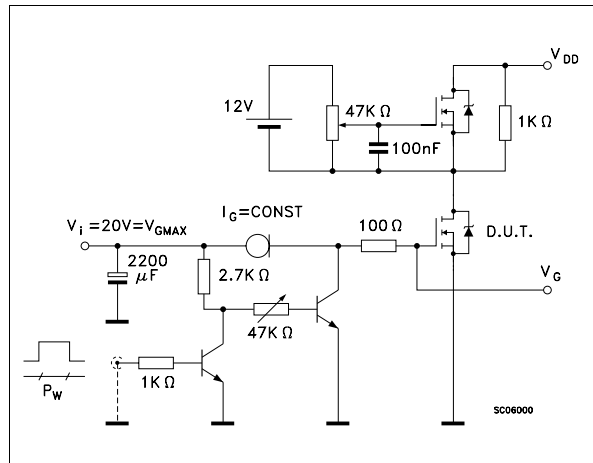
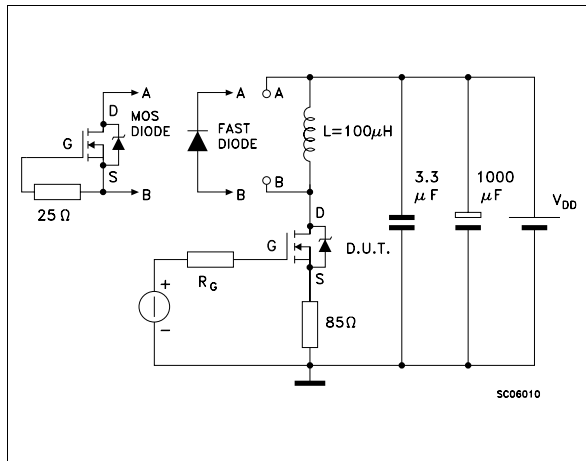
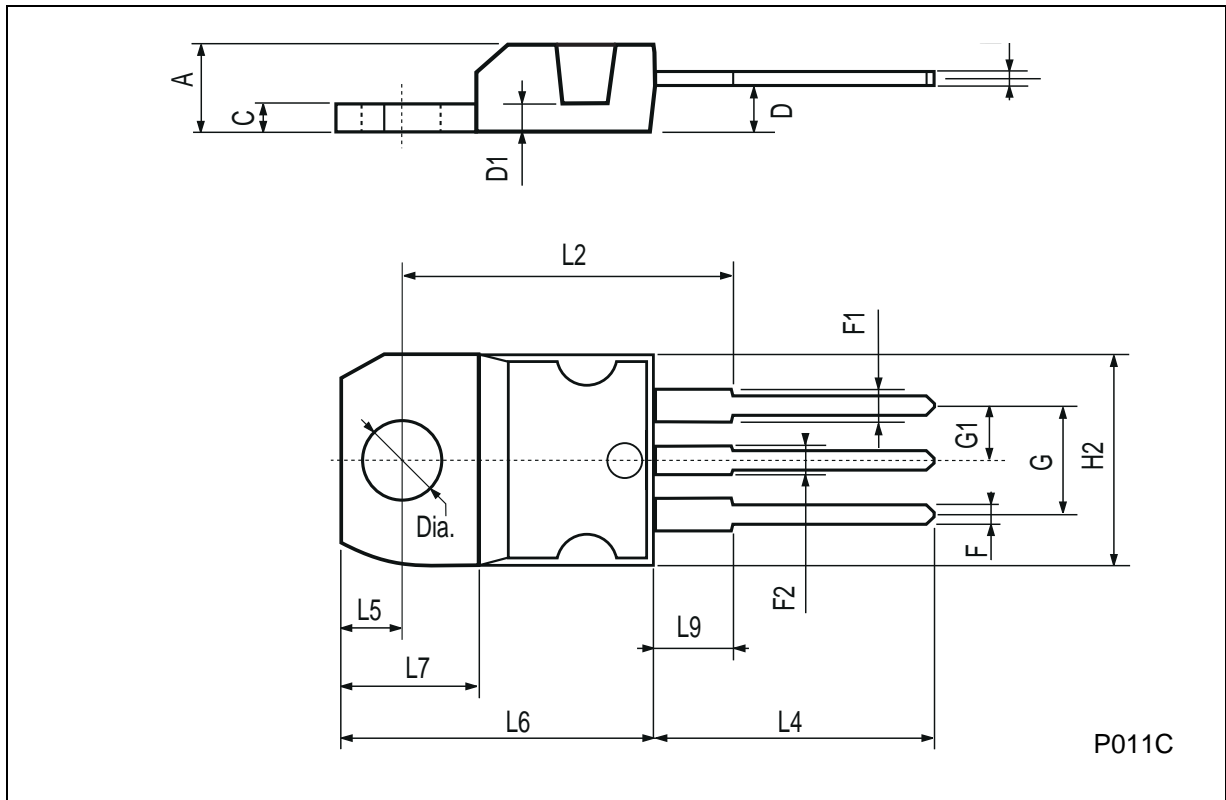


Fig. 5: Test Circuit For Inductive Load Switching And Diode Recovery Times



**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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