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## IRF830

# N - CHANNEL 500V - 1.35Ω - 4.5A - TO-220

## PowerMESH™ MOSFET

| TYPE   | V <sub>DSS</sub> | R <sub>DS(on)</sub> | I <sub>D</sub> |
|--------|------------------|---------------------|----------------|
| IRF830 | 500 V            | < 1.5 Ω             | 4.5 A          |

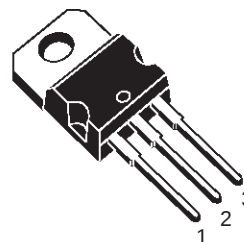
- TYPICAL R<sub>DS(on)</sub> = 1.35 Ω
- EXTREMELY HIGH dv/dt CAPABILITY
- 100% AVALANCHE TESTED
- VERY LOW INTRINSIC CAPACITANCES
- GATE CHARGE MINIMIZED

**DESCRIPTION**

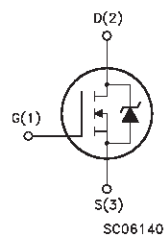
This power MOSFET is designed using the company's consolidated strip layout-based MESH OVERLAY™ process. This technology matches and improves the performances compared with standard parts from various sources.

**APPLICATIONS**

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



TO-220

**INTERNAL SCHEMATIC DIAGRAM****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                                   | ± 20       | V    |
| I <sub>D</sub>      | Drain Current (continuous) at T <sub>c</sub> = 25 °C  | 4.5        | A    |
| I <sub>D</sub>      | Drain Current (continuous) at T <sub>c</sub> = 100 °C | 2.9        | A    |
| I <sub>DM</sub> (•) | Drain Current (pulsed)                                | 18         | A    |
| P <sub>tot</sub>    | Total Dissipation at T <sub>c</sub> = 25 °C           | 100        | W    |
|                     | Derating Factor                                       | 0.8        | 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> ≤ 4.5A, di/dt ≤ 75 A/μs, V<sub>DD</sub> ≤ V<sub>(BR)DSS</sub>, T<sub>j</sub> ≤ T<sub>JMAX</sub>

First Digit of the Datecode Being Z or K Identifies Silicon Characterized in this Datasheet

## THERMAL DATA

|                |                                                |     |      |               |
|----------------|------------------------------------------------|-----|------|---------------|
| $R_{thj-case}$ | Thermal Resistance Junction-case               | Max | 1.25 | $^{\circ}C/W$ |
| $R_{thj-amb}$  | Thermal Resistance Junction-ambient            | Max | 62.5 | $^{\circ}C/W$ |
| $R_{thc-sink}$ | Thermal Resistance Case-sink                   | Typ | 0.5  | $^{\circ}C/W$ |
| $T_l$          | Maximum Lead Temperature For Soldering Purpose |     | 300  | $^{\circ}C$   |

## AVALANCHE CHARACTERISTICS

| Symbol   | Parameter                                                                                        | Max Value | Unit |
|----------|--------------------------------------------------------------------------------------------------|-----------|------|
| $I_{AR}$ | Avalanche Current, Repetitive or Not-Repetitive (pulse width limited by $T_j$ max)               | 4.5       | A    |
| $E_{AS}$ | Single Pulse Avalanche Energy (starting $T_j = 25^{\circ}C$ , $I_D = I_{AR}$ , $V_{DD} = 50 V$ ) | 290       | mJ   |

## ELECTRICAL CHARACTERISTICS ( $T_{case} = 25^{\circ}C$ unless otherwise specified)

### OFF

| Symbol        | Parameter                                        | Test Conditions                                                                   | Min. | Typ. | Max.      | Unit               |
|---------------|--------------------------------------------------|-----------------------------------------------------------------------------------|------|------|-----------|--------------------|
| $V_{(BR)DSS}$ | Drain-source Breakdown Voltage                   | $I_D = 250 \mu A$ $V_{GS} = 0$                                                    | 500  |      |           | V                  |
| $I_{DSS}$     | Zero Gate Voltage Drain Current ( $V_{GS} = 0$ ) | $V_{DS} = \text{Max Rating}$<br>$V_{DS} = \text{Max Rating}$ $T_c = 125^{\circ}C$ |      |      | 1<br>50   | $\mu A$<br>$\mu A$ |
| $I_{GSS}$     | Gate-body Leakage Current ( $V_{DS} = 0$ )       | $V_{GS} = \pm 20 V$                                                               |      |      | $\pm 100$ | nA                 |

### ON (\*)

| Symbol       | Parameter                         | Test Conditions                                              | Min. | Typ. | Max. | Unit     |
|--------------|-----------------------------------|--------------------------------------------------------------|------|------|------|----------|
| $V_{GS(th)}$ | Gate Threshold Voltage            | $V_{DS} = V_{GS}$ $I_D = 250 \mu A$                          | 2    | 3    | 4    | V        |
| $R_{DS(on)}$ | Static Drain-source On Resistance | $V_{GS} = 10V$ $I_D = 2.7 A$                                 |      | 1.35 | 1.5  | $\Omega$ |
| $I_{D(on)}$  | On State Drain Current            | $V_{DS} > I_{D(on)} \times R_{DS(on)max}$<br>$V_{GS} = 10 V$ | 4.5  |      |      | A        |

## DYNAMIC

| Symbol                              | Parameter                                                               | Test Conditions                                         | Min. | Typ.             | Max. | Unit           |
|-------------------------------------|-------------------------------------------------------------------------|---------------------------------------------------------|------|------------------|------|----------------|
| $g_{fs} (*)$                        | Forward Transconductance                                                | $V_{DS} > I_{D(on)} \times R_{DS(on)max}$ $I_D = 2.7 A$ | 2.5  |                  |      | S              |
| $C_{iss}$<br>$C_{oss}$<br>$C_{rss}$ | Input Capacitance<br>Output Capacitance<br>Reverse Transfer Capacitance | $V_{DS} = 25 V$ $f = 1 MHz$ $V_{GS} = 0$                |      | 610<br>120<br>10 |      | pF<br>pF<br>pF |

# ELECTRICAL CHARACTERISTICS (continued)

## SWITCHING ON

| Symbol      | Parameter          | Test Conditions                                                            | Min. | Typ. | Max. | Unit |
|-------------|--------------------|----------------------------------------------------------------------------|------|------|------|------|
| $t_{d(on)}$ | Turn-on Time       | $V_{DD} = 250\text{ V}$ $I_D = 2.9\text{ A}$                               |      | 11.5 |      | ns   |
| $t_r$       | Rise Time          | $R_G = 4.7\ \Omega$ $V_{GS} = 10\text{ V}$<br>(see test circuit, figure 3) |      | 8    |      | ns   |
| $Q_g$       | Total Gate Charge  | $V_{DD} = 400\text{ V}$ $I_D = 3\text{ A}$ $V_{GS} = 10\text{ V}$          |      | 22   | 30   | nC   |
| $Q_{gs}$    | Gate-Source Charge |                                                                            |      | 7.2  |      | nC   |
| $Q_{gd}$    | Gate-Drain Charge  |                                                                            |      | 8    |      | nC   |

## SWITCHING OFF

| Symbol         | Parameter             | Test Conditions                                                            | Min. | Typ. | Max. | Unit |
|----------------|-----------------------|----------------------------------------------------------------------------|------|------|------|------|
| $t_r(V_{off})$ | Off-voltage Rise Time | $V_{DD} = 400\text{ V}$ $I_D = 4.5\text{ A}$                               |      | 7    |      | ns   |
| $t_f$          | Fall Time             | $R_G = 4.7\ \Omega$ $V_{GS} = 10\text{ V}$<br>(see test circuit, figure 5) |      | 5    |      | ns   |
| $t_c$          | Cross-over Time       |                                                                            |      | 15   |      | ns   |

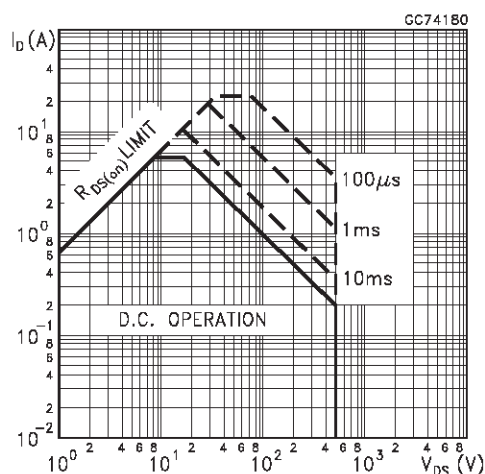
## SOURCE DRAIN DIODE

| Symbol             | Parameter                     | Test Conditions                                                                                                                                         | Min. | Typ. | Max. | Unit          |
|--------------------|-------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|---------------|
| $I_{SD}$           | Source-drain Current          |                                                                                                                                                         |      |      | 4.5  | A             |
| $I_{SDM}(\bullet)$ | Source-drain Current (pulsed) |                                                                                                                                                         |      |      | 18   | A             |
| $V_{SD} (*)$       | Forward On Voltage            | $I_{SD} = 4.5\text{ A}$ $V_{GS} = 0$                                                                                                                    |      |      | 1.6  | V             |
| $t_{rr}$           | Reverse Recovery Time         | $I_{SD} = 4.5\text{ A}$ $di/dt = 100\text{ A}/\mu\text{s}$<br>$V_{DD} = 100\text{ V}$ $T_j = 150\text{ }^\circ\text{C}$<br>(see test circuit, figure 5) |      | 435  |      | ns            |
| $Q_{rr}$           | Reverse Recovery Charge       |                                                                                                                                                         |      | 3.3  |      | $\mu\text{C}$ |
| $I_{RRM}$          | Reverse Recovery Current      |                                                                                                                                                         |      | 15   |      | A             |

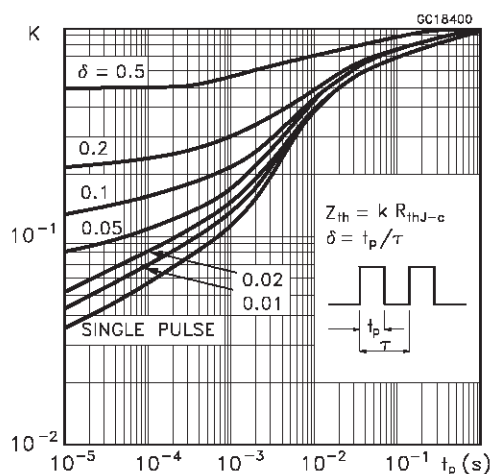
(\*) Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5 %

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

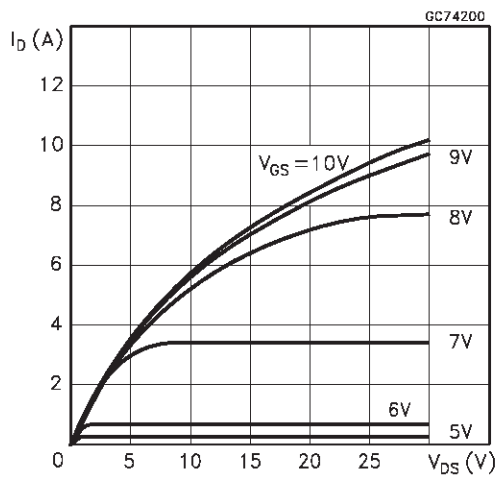
## Safe Operating Area



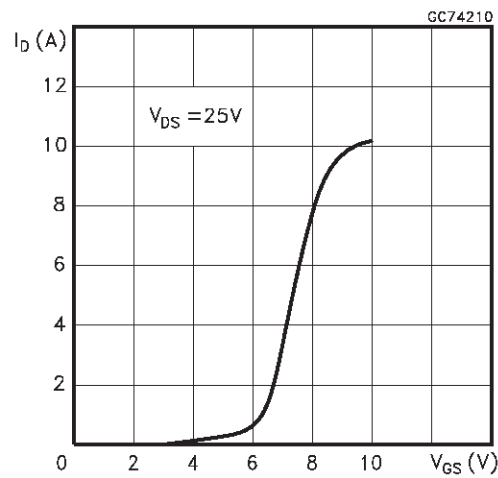
## Thermal Impedance



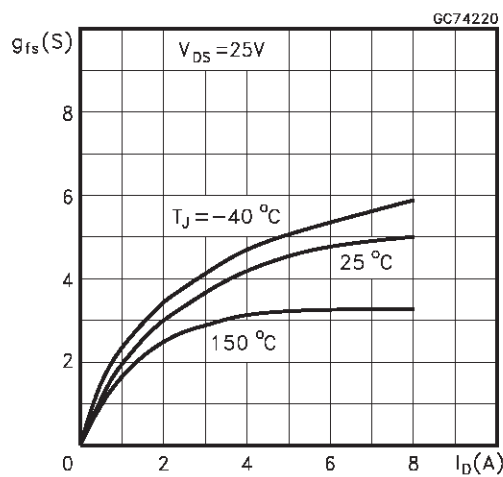
Output Characteristics



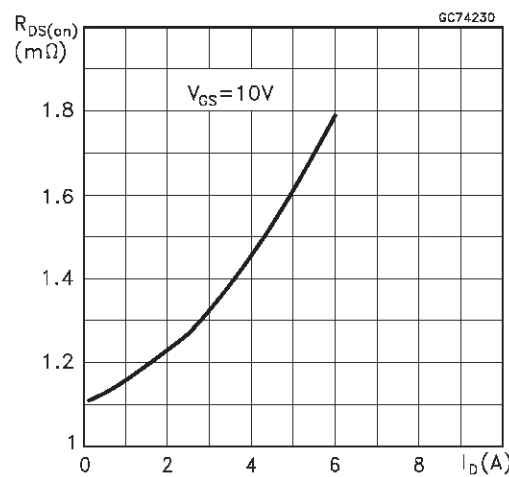
Transfer Characteristics



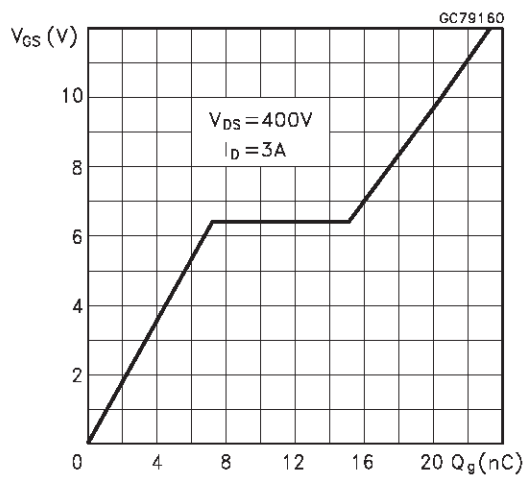
Transconductance



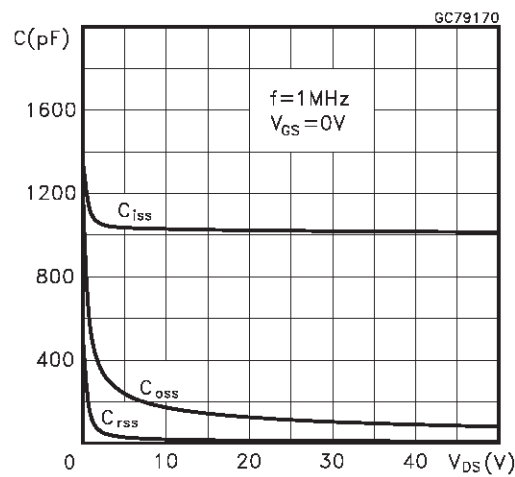
Static Drain-source On Resistance



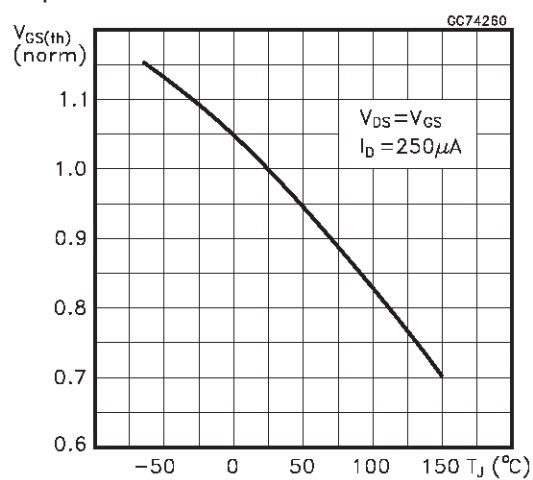
Gate Charge vs Gate-source Voltage



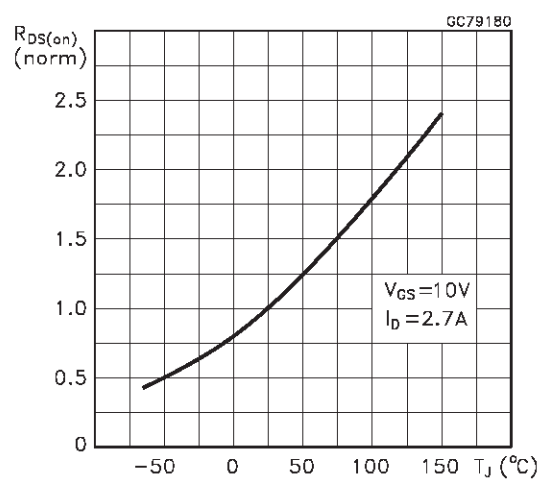
Capacitance Variations



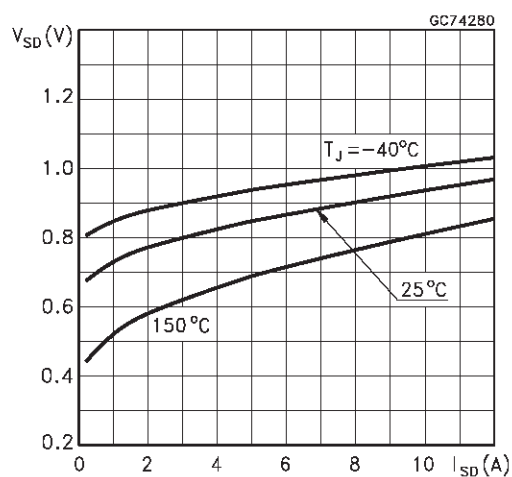
Normalized Gate Threshold Voltage vs Temperature



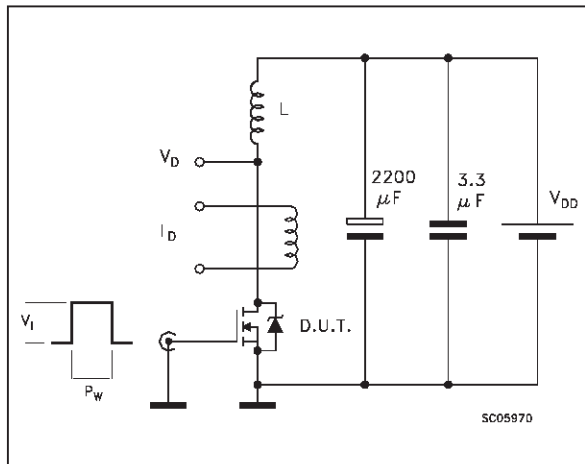
Normalized On Resistance vs Temperature



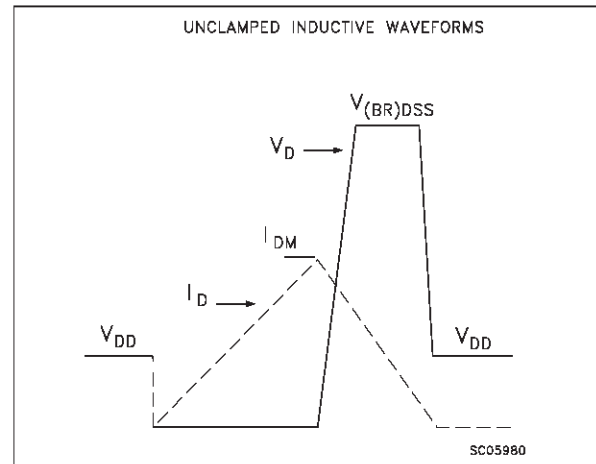
Source-drain Diode Forward Characteristics



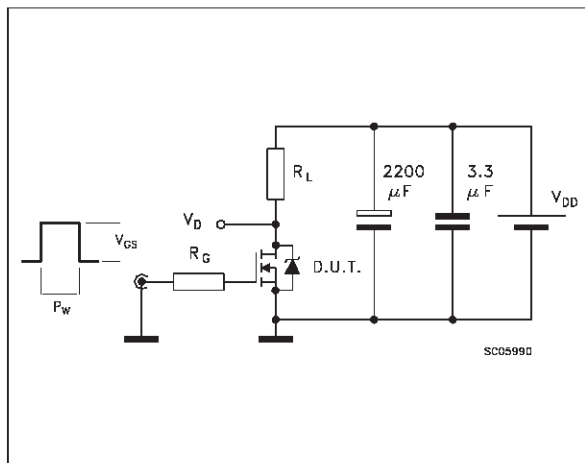
**Fig. 1: Unclamped Inductive Load Test Circuit**



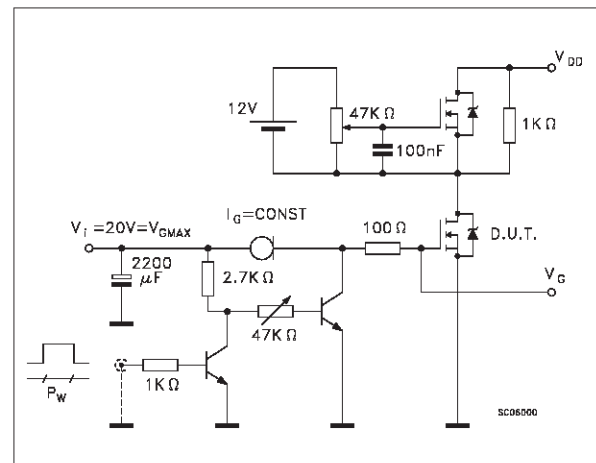
**Fig. 1: Unclamped Inductive Waveform**



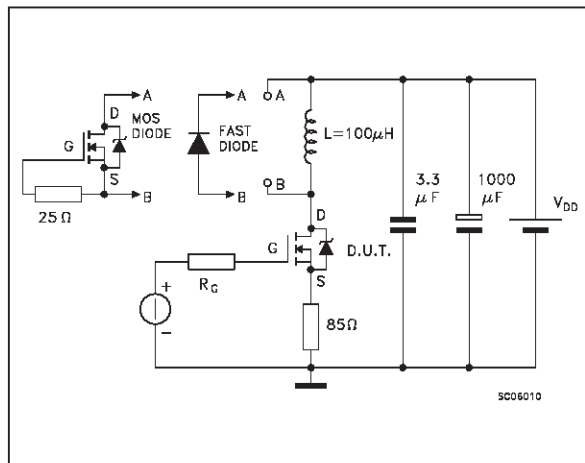
**Fig. 3: Switching Times Test Circuits For Resistive Load**



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

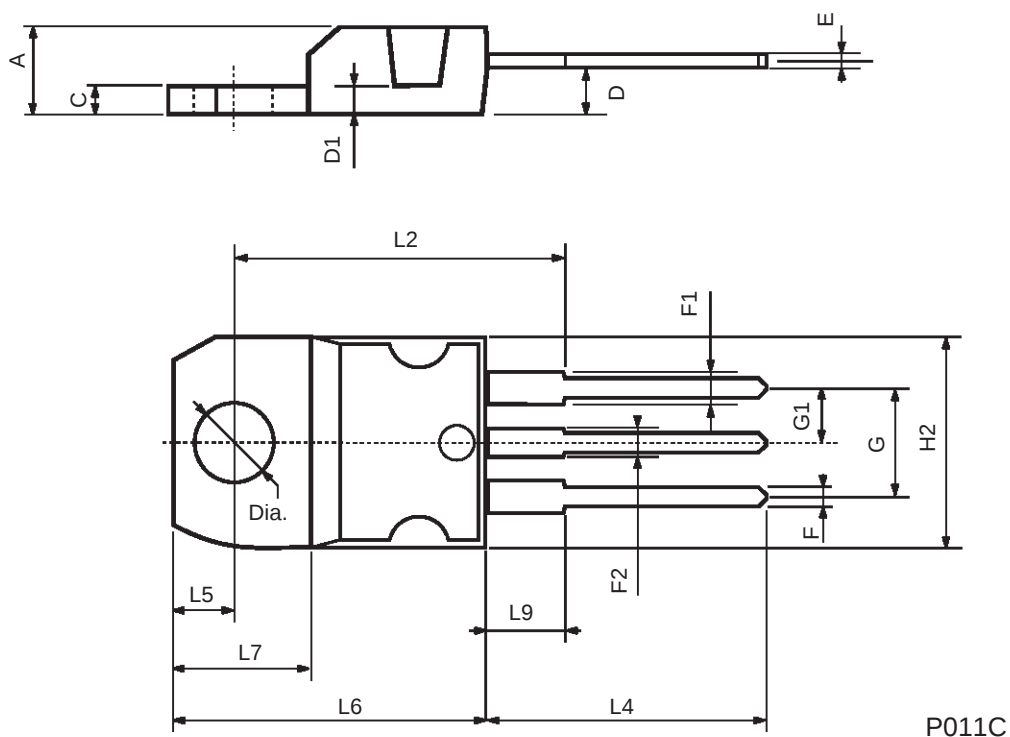


**Fig. 5: Test Circuit For Inductive Load Switching And Diode Recovery Times**



## 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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