



STP5NB60 STP5NB60FP

N - CHANNEL 600V - 1.8Ω - 5A - TO-220/TO-220FP
PowerMESH™ MOSFET

| TYPE | V _{DSS} | R _{DS(on)} | I _D |
|------------|------------------|---------------------|----------------|
| STP5NB60 | 600 V | < 2.0 Ω | 5 A |
| STP5NB60FP | 600 V | < 2.0 Ω | 3 A |

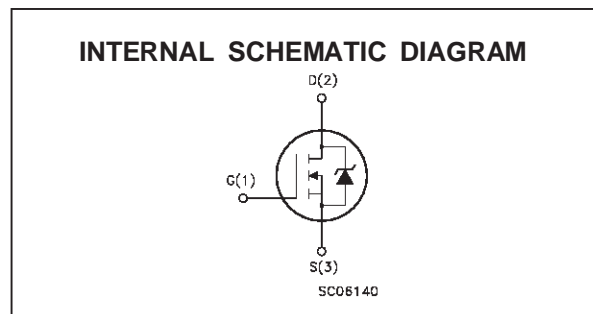
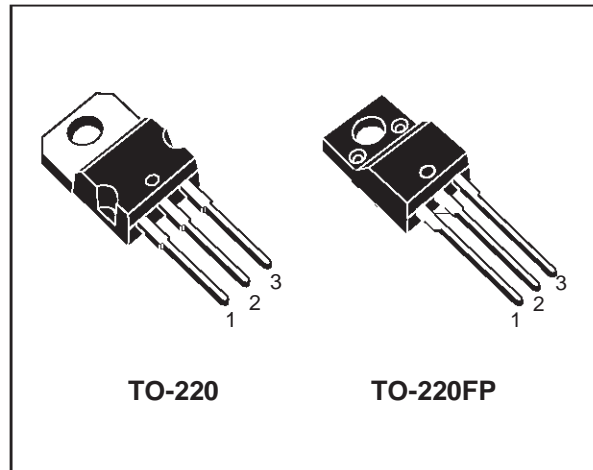
- TYPICAL R_{DS(on)} = 1.8 Ω
- EXTREMELY HIGH dv/dt CAPABILITY
- 100% AVALANCHE TESTED
- VERY LOW INTRINSIC CAPACITANCES
- GATE CHARGE MINIMIZED

DESCRIPTION

Using the latest high voltage MESH OVERLAY™ process, STMicroelectronics has designed an advanced family of power MOSFETs with outstanding performances. The new patent pending strip layout coupled with the Company's proprietary edge termination structure, gives the lowest RDS(on) per area, exceptional avalanche and dv/dt capabilities and unrivalled gate charge and switching characteristics.

APPLICATIONS

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



ABSOLUTE MAXIMUM RATINGS

| Symbol | Parameter | Value | | Unit |
|---------------------|---|------------|------------|------|
| | | STP5NB60 | STP5NB60FP | |
| V _{DS} | Drain-source Voltage (V _{GS} = 0) | 600 | | V |
| V _{DGR} | Drain- gate Voltage (R _{GS} = 20 kΩ) | 600 | | V |
| V _{GS} | Gate-source Voltage | ± 30 | | V |
| I _D | Drain Current (continuous) at T _c = 25 °C | 5 | 3 | A |
| I _D | Drain Current (continuous) at T _c = 100 °C | 3.1 | 1.9 | A |
| I _{DM} (•) | Drain Current (pulsed) | 20 | 20 | A |
| P _{tot} | Total Dissipation at T _c = 25 °C | 100 | 35 | W |
| | Derating Factor | 0.8 | 0.28 | W/°C |
| dv/dt(1) | Peak Diode Recovery voltage slope | 4.5 | 4.5 | V/ns |
| V _{ISO} | Insulation Withstand Voltage (DC) | — | 2000 | V |
| T _{stg} | Storage Temperature | -65 to 150 | | °C |
| T _j | Max. Operating Junction Temperature | 150 | | °C |

(•) Pulse width limited by safe operating area

(1) I_{SD} ≤ 5A, di/dt ≤ 200 A/μs, V_{DD} ≤ V_{(BR)DSS}, T_j ≤ T_{JMAX}

STP5NB60/FP

THERMAL DATA

| | | | | TO-220 | TO220-FP | |
|-----------------------|--|-----|------|--------|----------|------|
| R _{thj-case} | Thermal Resistance Junction-case | Max | | 1.25 | 3.57 | °C/W |
| R _{thj-amb} | Thermal Resistance Junction-ambient | Max | 62.5 | | | °C/W |
| R _{thc-sink} | Thermal Resistance Case-sink | Typ | 0.5 | | | °C/W |
| T _l | Maximum Lead Temperature For Soldering Purpose | | | 300 | | °C |

AVALANCHE CHARACTERISTICS

| Symbol | Parameter | Min. Value | Max. Value | Unit |
|----------|--|------------|------------|------|
| I_{AR} | Avalanche Current, Repetitive or Not-Repetitive (pulse width limited by T_j max) | | 5 | A |
| E_{AS} | Single Pulse Avalanche Energy (starting $T_j = 25^{\circ}\text{C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$) | | 300 | mJ |

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

OFF

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---------------|--|--|------|------|-----------|--------------------------------|
| $V_{(BR)DSS}$ | Drain-source Breakdown Voltage | $I_D = 250\text{ }\mu\text{A}$ $V_{GS} = 0$ | 600 | | | V |
| I_{DSS} | Zero Gate Voltage Drain Current ($V_{GS} = 0$) | $V_{DS} = \text{Max Rating}$ $V_{DS} = \text{Max Rating}$ $T_c = 125^{\circ}\text{C}$ | | | 1 50 | μA μA |
| I_{GSS} | Gate-body Leakage Current ($V_{DS} = 0$) | $V_{GS} = \pm 30\text{ V}$ | | | ± 100 | nA |

ON (*)

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|--------------|-----------------------------------|---|------|------|------|----------|
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS} = V_{GS}$ $I_D = 250\text{ }\mu\text{A}$ | 3 | 4 | 5 | V |
| $R_{DS(on)}$ | Static Drain-source On Resistance | $V_{GS} = 10\text{ V}$ $I_D = 2.5\text{ A}$ | | 1.8 | 2.0 | Ω |
| $I_{D(on)}$ | On State Drain Current | $V_{DS} > I_{D(on)} \times R_{DS(on)max}$ $V_{GS} = 10\text{ V}$ | 5.0 | | | A |

DYNAMIC

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|--------------|------------------------------|--|------|------|------|------|
| $g_{fs} (*)$ | Forward Transconductance | $V_{DS} > I_{D(on)} \times R_{DS(on)max}$ $I_D = 2.5\text{ A}$ | 2.5 | 4.5 | | S |
| C_{iss} | Input Capacitance | $V_{DS} = 25\text{ V}$ $f = 1\text{ MHz}$ $V_{GS} = 0$ | | 680 | 884 | pF |
| C_{oss} | Output Capacitance | | | 103 | 139 | pF |
| C_{rss} | Reverse Transfer Capacitance | | | 10.5 | 14 | pF |

ELECTRICAL CHARACTERISTICS (continued)**SWITCHING ON**

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|-------------|--------------------|--|------|------|------|------|
| $t_{d(on)}$ | Turn-on Time | $V_{DD} = 300\text{ V}$ $I_D = 2.5\text{ A}$ | | 12 | 17 | ns |
| t_r | Rise Time | $R_G = 4.7\ \Omega$ $V_{GS} = 10\text{ V}$ (see test circuit, figure 3) | | 10 | 14 | ns |
| Q_g | Total Gate Charge | $V_{DD} = 480\text{ V}$ $I_D = 5\text{ A}$ $V_{GS} = 10\text{ V}$ | | 21 | 30 | nC |
| Q_{gs} | Gate-Source Charge | | | 7.6 | | nC |
| Q_{gd} | Gate-Drain Charge | | | 7.5 | | nC |

SWITCHING OFF

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---------------|-----------------------|--|------|------|------|------|
| $t_{r(Voff)}$ | Off-voltage Rise Time | $V_{DD} = 480\text{ V}$ $I_D = 5\text{ A}$ | | 8 | 13 | ns |
| t_f | Fall Time | $R_G = 4.7\ \Omega$ $V_{GS} = 10\text{ V}$ (see test circuit, figure 5) | | 7 | 12 | ns |
| t_c | Cross-over Time | | | 15 | 23 | ns |

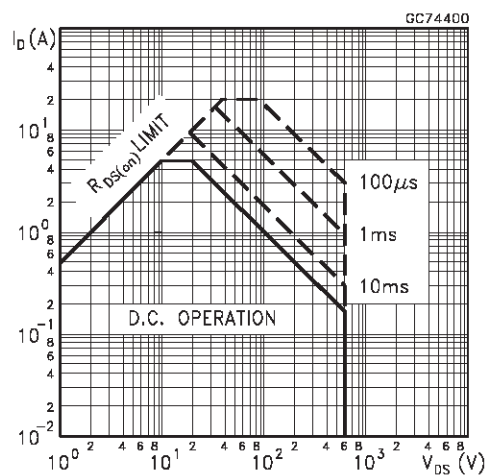
SOURCE DRAIN DIODE

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|--------------------|----------------------------------|---|------|------|------|---------------|
| I_{SD} | Source-drain Current | | | | 5 | A |
| $I_{SDM}(\bullet)$ | Source-drain Current (pulsed) | | | | 20 | A |
| $V_{SD} (*)$ | Forward On Voltage | $I_{SD} = 5\text{ A}$ $V_{GS} = 0$ | | | 1.6 | V |
| t_{rr} | Reverse Recovery Time | $I_{SD} = 5\text{ A}$ $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 100\text{ V}$ $T_j = 150\text{ }^\circ\text{C}$ (see test circuit, figure 5) | | 610 | | ns |
| Q_{rr} | Reverse Recovery Charge | | | 3.6 | | μC |
| I_{RRM} | Reverse Recovery Current | | | 11.7 | | A |

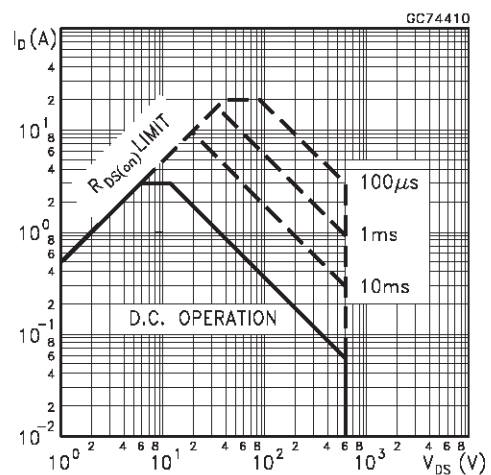
(*) Pulsed: Pulse duration = 300 μs , duty cycle 1.5 %

(•) Pulse width limited by safe operating area

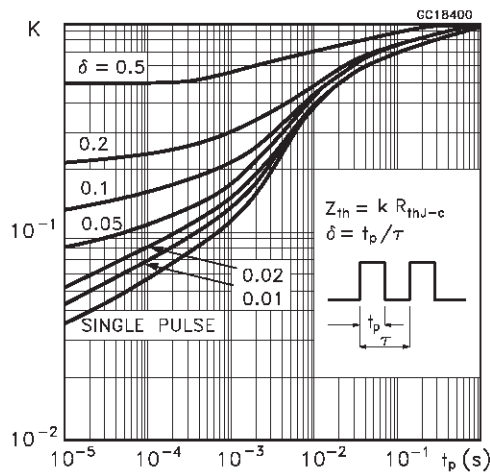
Safe Operating Area for TO-220



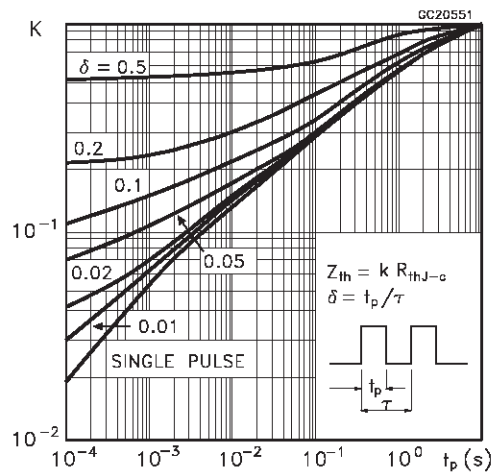
Safe Operating Area for TO-220FP



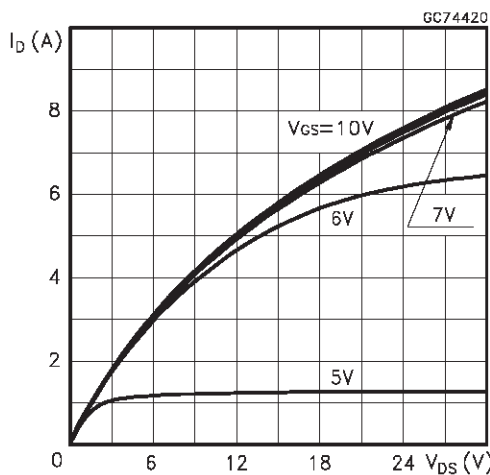
Thermal Impedance for TO-220



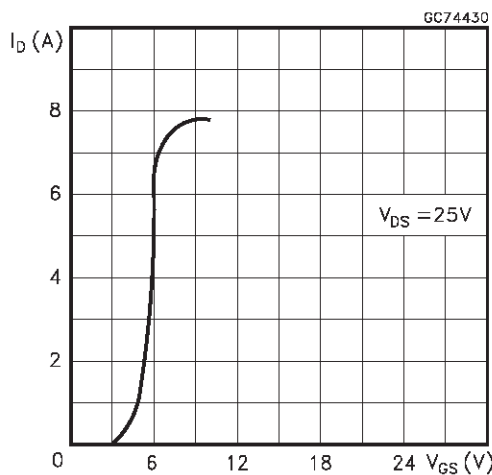
Thermal Impedance for TO-220FP



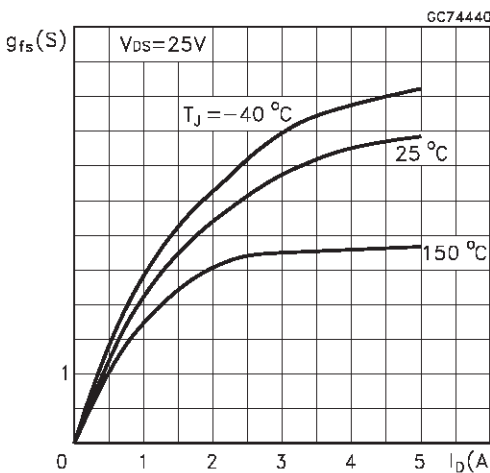
Output Characteristics



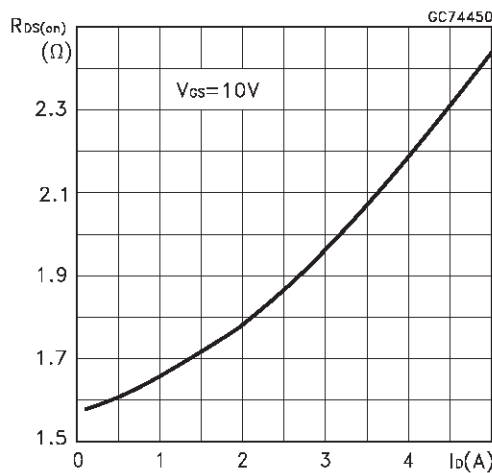
Transfer Characteristics



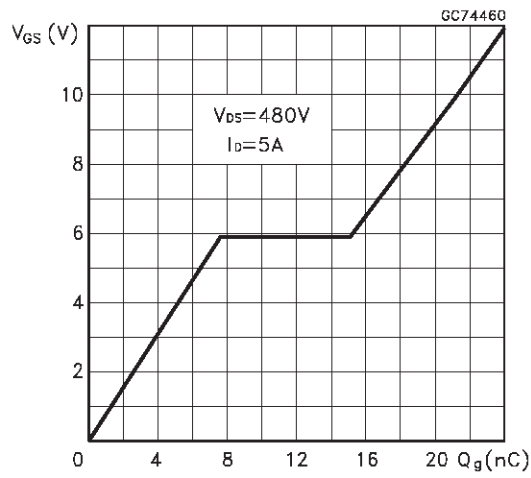
Transconductance



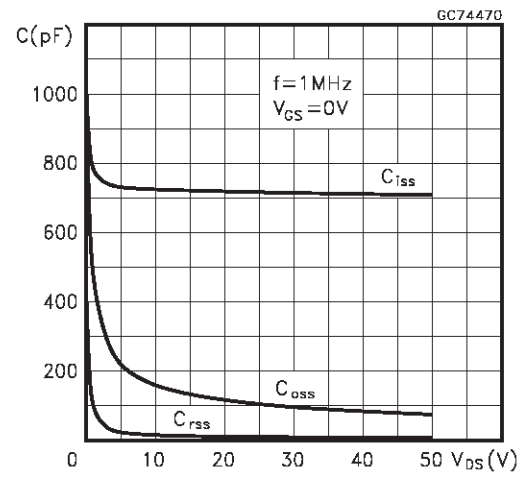
Static Drain-source On Resistance



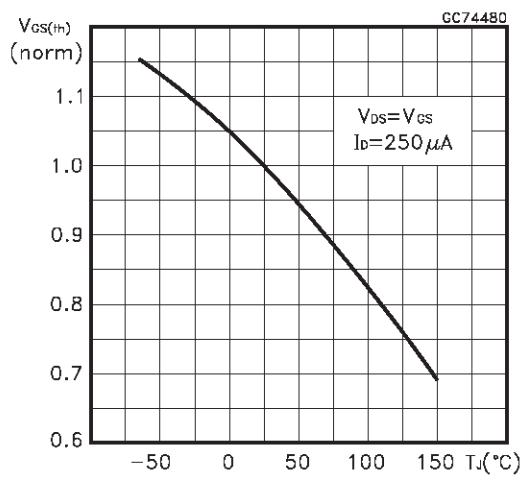
Gate Charge vs Gate-source Voltage



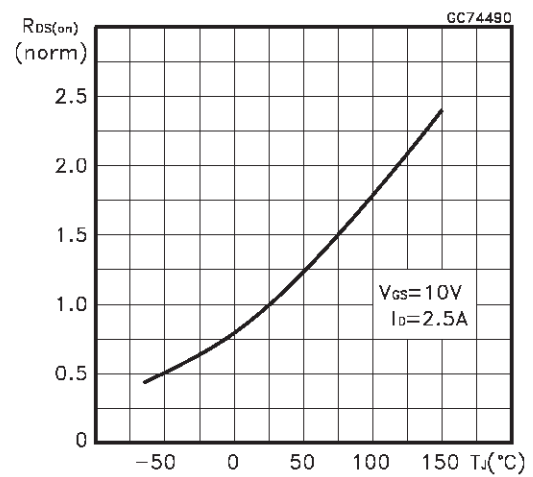
Capacitance Variations



Normalized Gate Threshold Voltage vs Temperature



Normalized On Resistance vs Temperature



Source-drain Diode Forward Characteristics

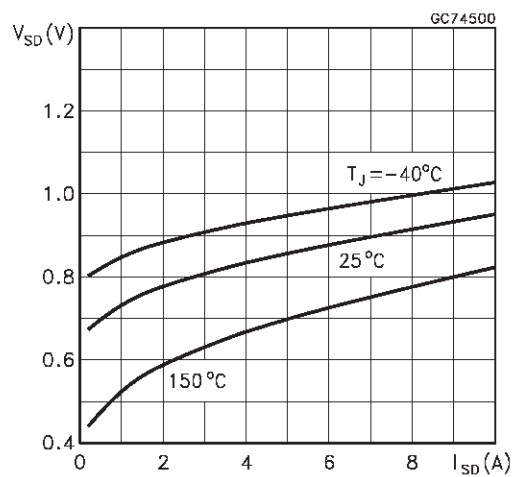


Fig. 1: Unclamped Inductive Load Test Circuit

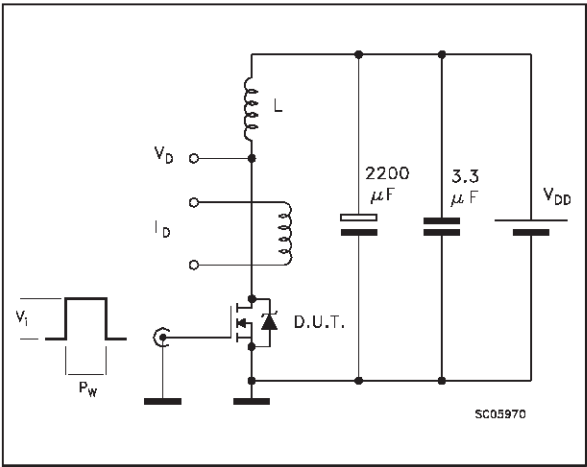


Fig. 2: Unclamped Inductive Waveform



Fig. 3: Switching Times Test Circuits For Resistive Load

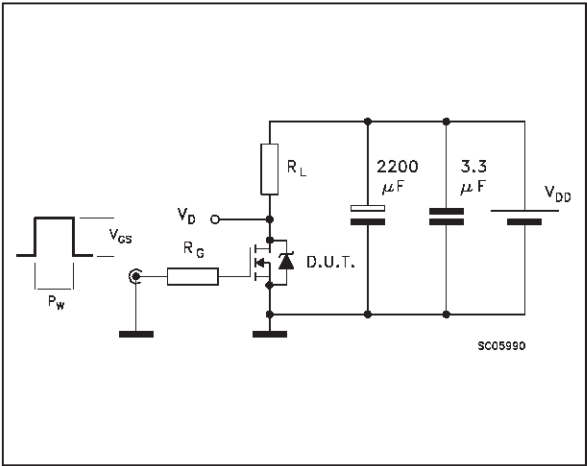


Fig. 4: Gate Charge test Circuit

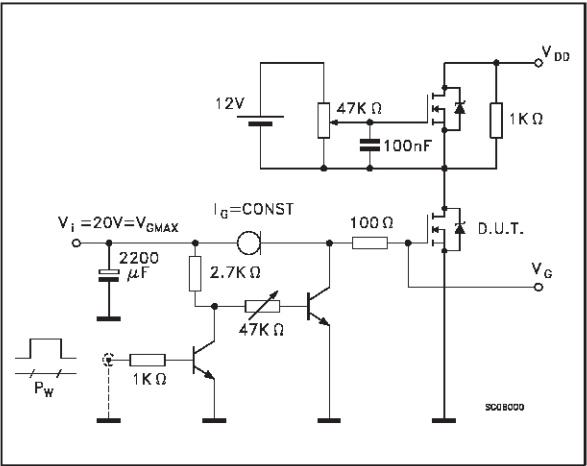
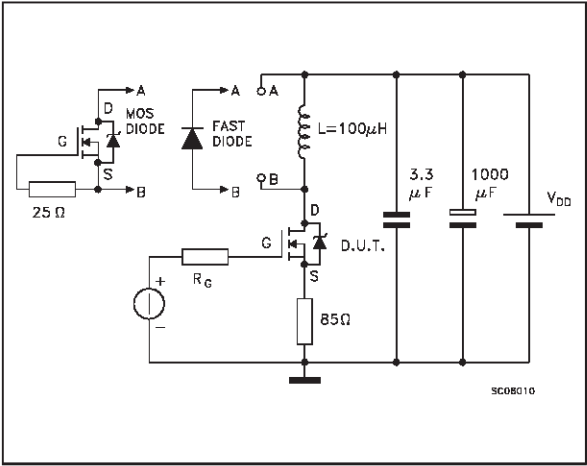
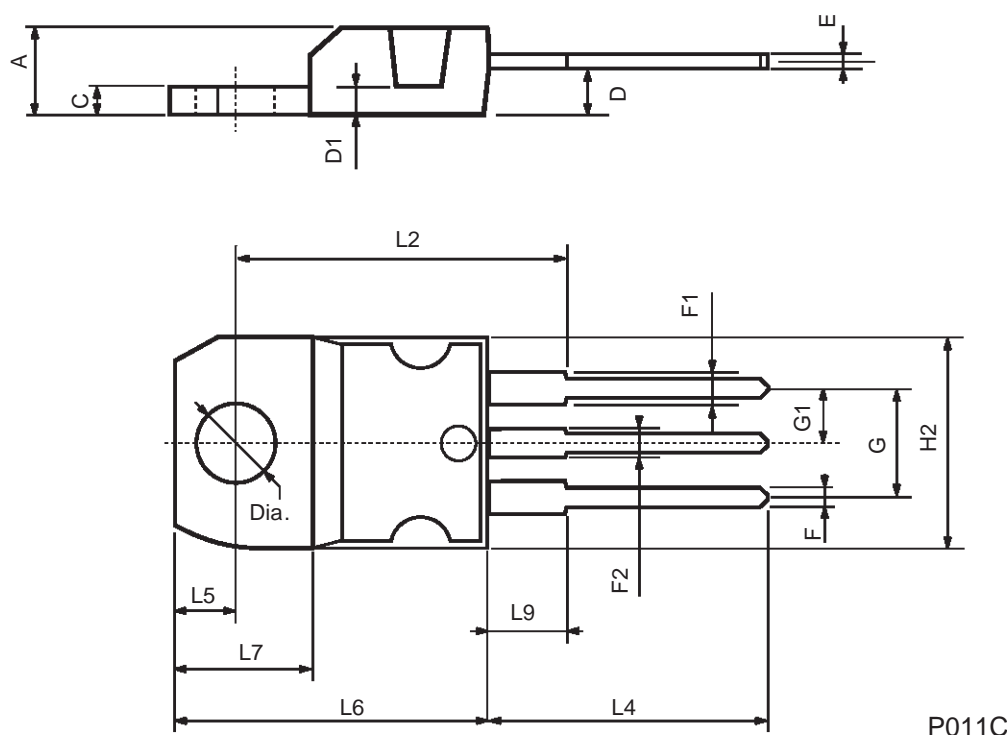


Fig. 5: Test Circuit For Inductive Load Switching And Diode Recovery Times



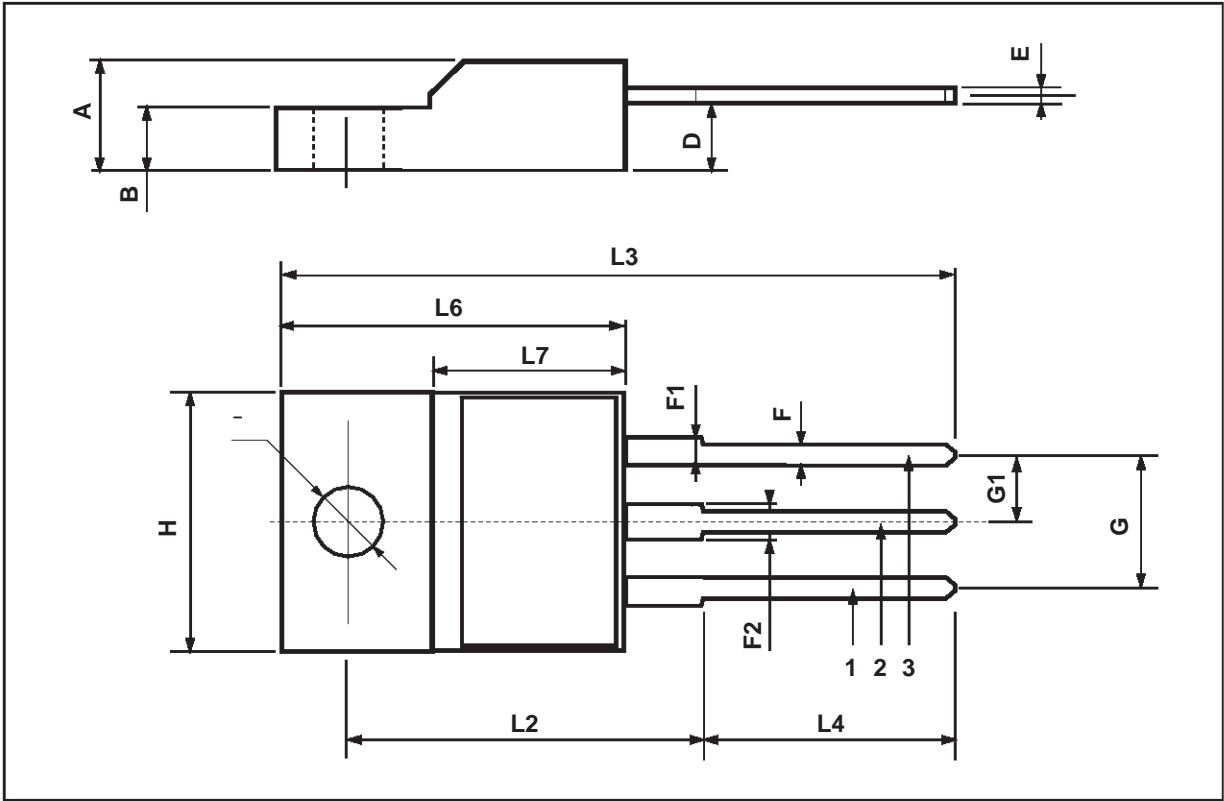
TO-220 MECHANICAL DATA

| 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 |



TO-220FP MECHANICAL DATA

| DIM. | mm | | | inch | | |
|------|------|------|------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | 4.4 | | 4.6 | 0.173 | | 0.181 |
| B | 2.5 | | 2.7 | 0.098 | | 0.106 |
| D | 2.5 | | 2.75 | 0.098 | | 0.108 |
| E | 0.45 | | 0.7 | 0.017 | | 0.027 |
| F | 0.75 | | 1 | 0.030 | | 0.039 |
| F1 | 1.15 | | 1.7 | 0.045 | | 0.067 |
| F2 | 1.15 | | 1.7 | 0.045 | | 0.067 |
| G | 4.95 | | 5.2 | 0.195 | | 0.204 |
| G1 | 2.4 | | 2.7 | 0.094 | | 0.106 |
| H | 10 | | 10.4 | 0.393 | | 0.409 |
| L2 | | 16 | | | 0.630 | |
| L3 | 28.6 | | 30.6 | 1.126 | | 1.204 |
| L4 | 9.8 | | 10.6 | 0.385 | | 0.417 |
| L6 | 15.9 | | 16.4 | 0.626 | | 0.645 |
| L7 | 9 | | 9.3 | 0.354 | | 0.366 |
| Ø | 3 | | 3.2 | 0.118 | | 0.126 |



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