



STP60NE06L-16 STP60NE06L-16FP

N - CHANNEL 60V - 0.014Ω - 60A TO-220/TO-220FP
STripFET™ POWER MOSFET

| TYPE | V _{DSS} | R _{DS(on)} | I _D |
|-----------------|------------------|---------------------|----------------|
| STP60NE06L-16 | 60 V | < 0.016 Ω | 60 A |
| STP60NE06L-16FP | 60 V | < 0.016 Ω | 35 A |

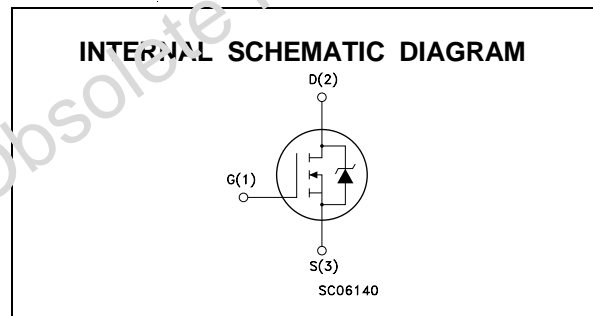
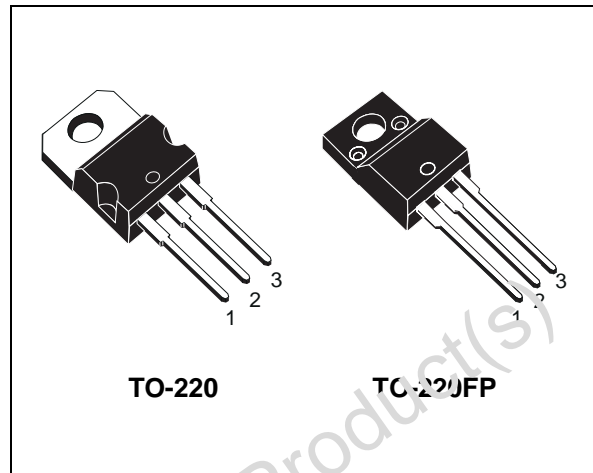
- TYPICAL R_{DS(on)} = 0.014 Ω
- AVALANCHE RUGGED TECHNOLOGY
- LOW GATE CHARGE
- HIGH CURRENT CAPABILITY
- 175 °C OPERATING TEMPERATURE
- LOW THRESHOLD DRIVE

DESCRIPTION

This Power Mosfet is the latest development of STMicroelectronics unique "Single Feature Size™" strip-based process. The resulting transistor shows extremely high packing density for low on-resistance, rugged avalanche characteristics and less critical alignment steps therefore a remarkable manufacturing reproducibility.

APPLICATIONS

- HIGH CURRENT, HIGH SPEED SWITCHING
- SOLENOID AND RELAY DRIVERS
- DC-DC & DC-AC CONVERTERS
- AUTOMOTIVE ENVIRONMENT



ABSOLUTE MAXIMUM RATINGS

| Symbol | Parameter | Value | | Unit |
|---------------------|---|---------------|-----------------|------|
| | | STP60NE06L-16 | STP60NE06L-16FP | |
| V _{DS} | Drain-source Voltage (V _{GS} = 0) | 60 | | V |
| V _{DGK} | Drain- gate Voltage (R _{GS} = 20 kΩ) | 60 | | V |
| V _{GS} | Gate-source Voltage | ± 15 | | V |
| I _D | Drain Current (continuous) at T _c = 25 °C | 60 | 35 | A |
| I _D | Drain Current (continuous) at T _c = 100 °C | 42 | 24 | A |
| I _{DM} (•) | Drain Current (pulsed) | 240 | 140 | A |
| P _{tot} | Total Dissipation at T _c = 25 °C | 150 | 45 | W |
| | Derating Factor | 1 | 0.3 | W/°C |
| V _{ISO} | Insulation Withstand Voltage (DC) | — | 2000 | V |
| dv/dt | Peak Diode Recovery voltage slope | 6 | | V/ns |
| T _{stg} | Storage Temperature | -65 to 175 | | °C |
| T _j | Max. Operating Junction Temperature | 175 | | °C |

(•) Pulse width limited by safe operating area

(1) I_{SD} ≤ 60 A, di/dt ≤ 300 A/μs, V_{DD} ≤ V_{(BR)DSS}, T_j ≤ T_{JMAX}

STP60NE06L-16/FP

THERMAL DATA

| | | | TO-220 | TO-220FP | |
|-----------------------|--|-----|--------|----------|------|
| R _{thj-case} | Thermal Resistance Junction-case | Max | 0.94 | 2.7 | °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 | Max Value | Unit |
|-----------------|---|-----------|------|
| I _{AR} | Avalanche Current, Repetitive or Not-Repetitive (pulse width limited by T _j max) | 60 | A |
| E _{AS} | Single Pulse Avalanche Energy (starting T _j = 25 °C, I _D = I _{AR} , V _{DD} = 25V) | 400 | mJ |

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

OFF

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|----------------------|---|--|------|------|---------|----------|
| V _{(BR)DSS} | Drain-source Breakdown Voltage | I _D = 250 μA V _{GS} = 0 | 60 | | | V |
| I _{DSS} | Zero Gate Voltage Drain Current (V _{GS} = 0) | V _{DS} = Max Rating V _{DS} = Max Rating T _c = 125 °C | | | 1 10 | μA μA |
| I _{GSS} | Gate-body Leakage Current (V _{DS} = 0) | V _{GS} = ± 15 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 μA | 1 | 1.6 | 2.5 | V |
| R _{DS(on)} | Static Drain-source On Resistance | V _{GS} = 5V I _D = 30 A V _{GS} = 10V I _D = 30 A | | 0.014 0.012 | 0.016 0.014 | Ω Ω |
| I _{D(on)} | On State Drain Current | V _{DS} > I _{D(on)} × R _{DS(on)max} V _{GS} = 10 V | 60 | | | A |

DYNAMIC

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---------------------|------------------------------|---|------|------|------|------|
| g _{fs} (*) | Forward Transconductance | V _{DS} > I _{D(on)} × R _{DS(on)max} I _D = 30 A | | 30 | | S |
| C _{iss} | Input Capacitance | V _{DS} = 25 V f = 1 MHz V _{GS} = 0 | | 4150 | | pF |
| C _{oss} | Output Capacitance | | | 590 | | pF |
| C _{rss} | Reverse Transfer Capacitance | | | 150 | | pF |

ELECTRICAL CHARACTERISTICS (continued)

SWITCHING ON

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|-------------|--------------------|---|------|------|------|------|
| $t_{d(on)}$ | Turn-on Delay Time | $V_{DD} = 30\text{ V}$ $I_D = 30\text{ A}$ $R_G = 4.7\ \Omega$ $V_{GS} = 5\text{ V}$ (Resistive Load, see fig. 3) | | 50 | | ns |
| t_r | Rise Time | | | 155 | | ns |
| Q_g | Total Gate Charge | $V_{DD} = 40\text{ V}$ $I_D = 60\text{ A}$ $V_{GS} = 5\text{ V}$ | | 55 | 70 | nC |
| Q_{gs} | Gate-Source Charge | | | 15 | | nC |
| Q_{gd} | Gate-Drain Charge | | | 30 | | nC |

SWITCHING OFF

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---------------|-----------------------|---|------|------|------|------|
| $t_{d(off)}$ | Turn-off Delay Time | $V_{DD} = 30\text{ V}$ $I_D = 30\text{ A}$ $R_G = 4.7\ \Omega$ $V_{GS} = 5\text{ V}$ (Resistive Load, see fig. 3) | | 125 | | ns |
| t_f | Fall Time | | | 25 | | ns |
| $t_{r(Voff)}$ | Off-voltage Rise Time | $V_{DD} = 48\text{ V}$ $I_D = 20\text{ A}$ $R_G = 4.7\ \Omega$ $V_{GS} = 5\text{ V}$ (Inductive Load, see fig. 5) | | 45 | | ns |
| t_f | Fall Time | | | 220 | | ns |
| t_c | Cross-over Time | | | 280 | | ns |

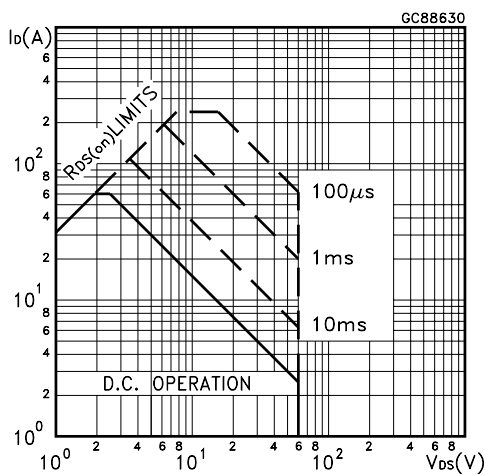
SOURCE DRAIN DIODE

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|--------------------|-------------------------------|---|------|------|------|---------------|
| I_{SD} | Source-drain Current | | | | 60 | A |
| $I_{SDM}(\bullet)$ | Source-drain Current (pulsed) | | | | 240 | A |
| $V_{SD}(\ast)$ | Forward On Voltage | $I_{SD} = 60\text{ A}$ $V_{GS} = 0$ | | | 1.5 | V |
| t_{rr} | Reverse Recovery Time | $I_{SD} = 60\text{ A}$ $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 30\text{ V}$ $T_J = 150\text{ }^\circ\text{C}$ (see test circuit, fig. 5) | | 85 | | ns |
| Q_{rr} | Reverse Recovery Charge | | | 300 | | μC |
| I_{RRM} | Reverse Recovery Current | | | 7 | | A |

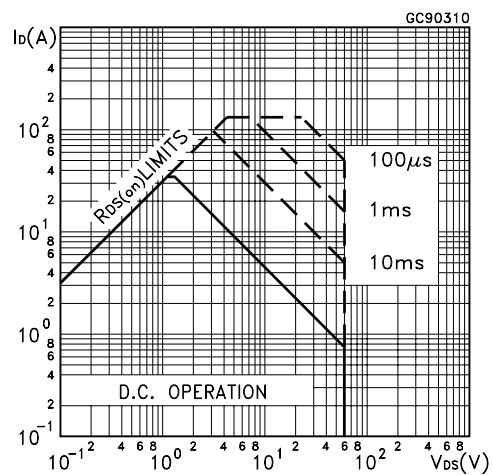
(*) Pulsed: Pulse duration = 300 μs , duty cycle 1.5 %

(•) Pulse width limited by safe operating area

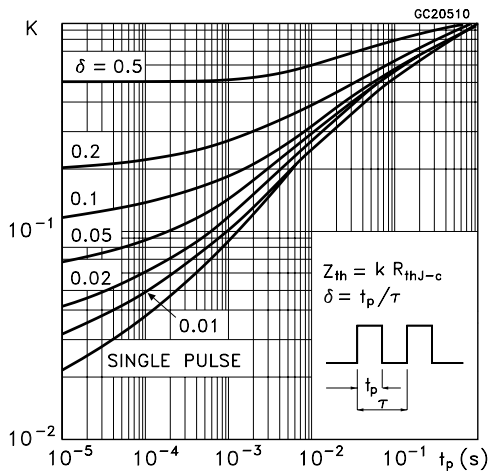
Safe Operating Area for TO-220



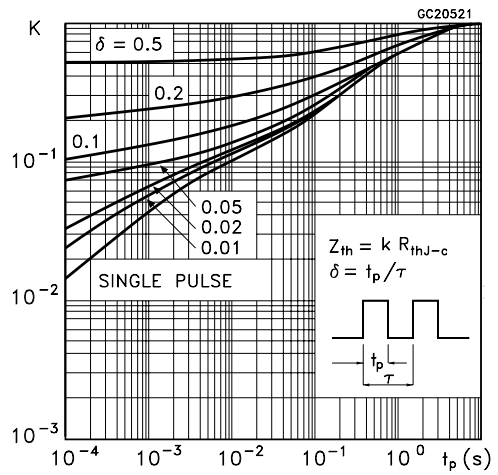
Safe Operating Area for TO-220FP



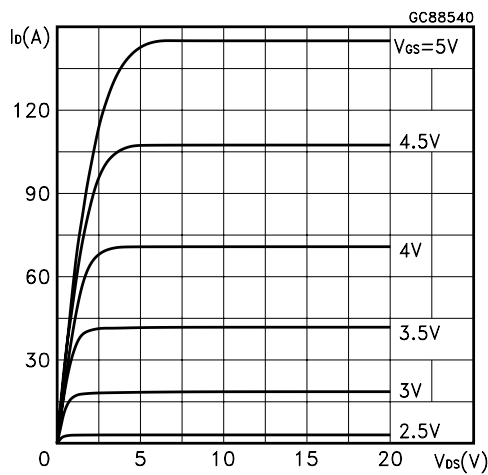
Thermal Impedance for TO-220



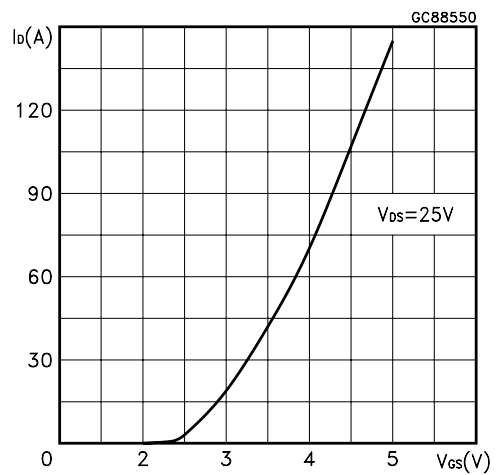
Thermal Impedance for TO-220FP



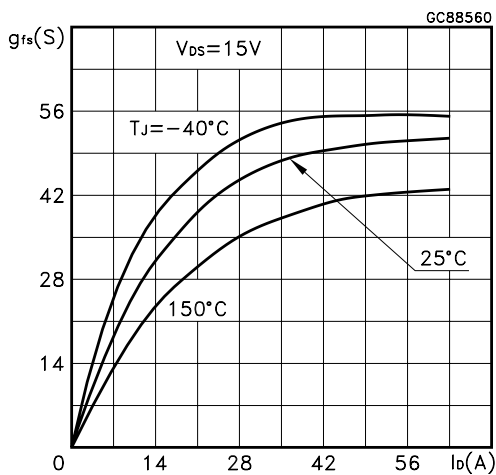
Output Characteristics



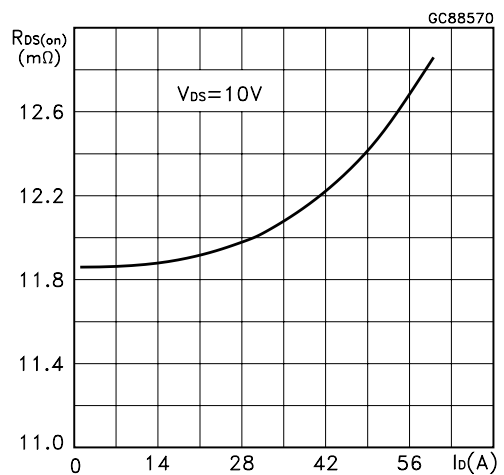
Transfer Characteristics



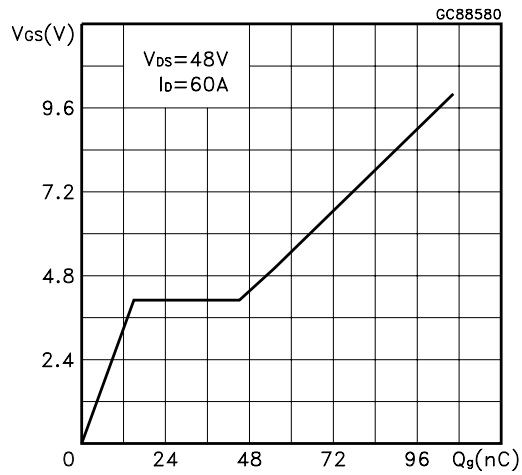
Transconductance



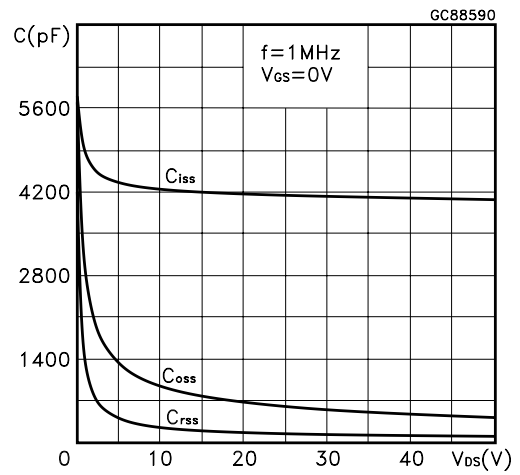
Static Drain-source On Resistance



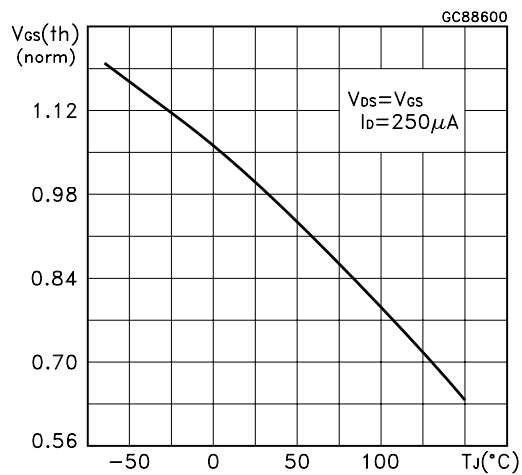
Gate Charge vs Gate-source Voltage



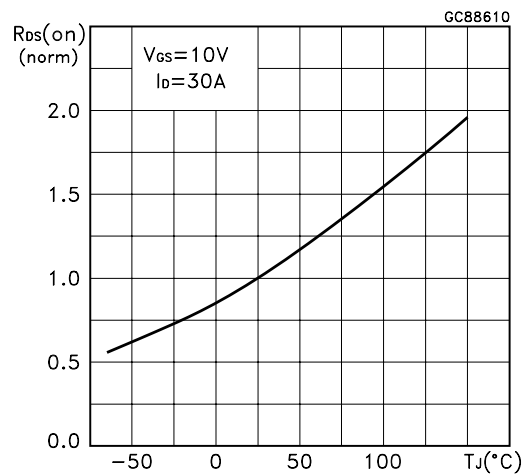
Capacitance Variations



Normalized Gate Threshold Voltage vs Temperature



Normalized On Resistance vs Temperature



Source-drain Diode Forward Characteristics

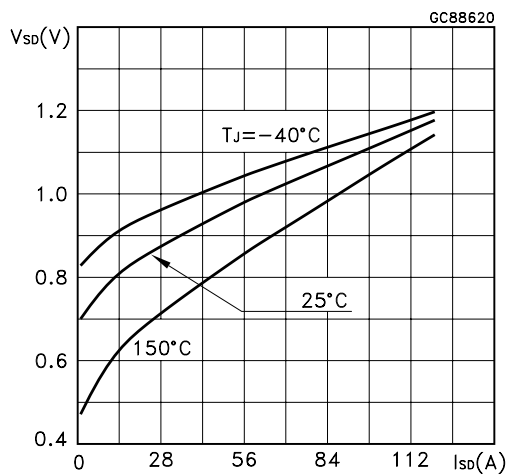


Fig. 1: Unclamped Inductive Load Test Circuit



Fig. 2: Unclamped Inductive Waveform

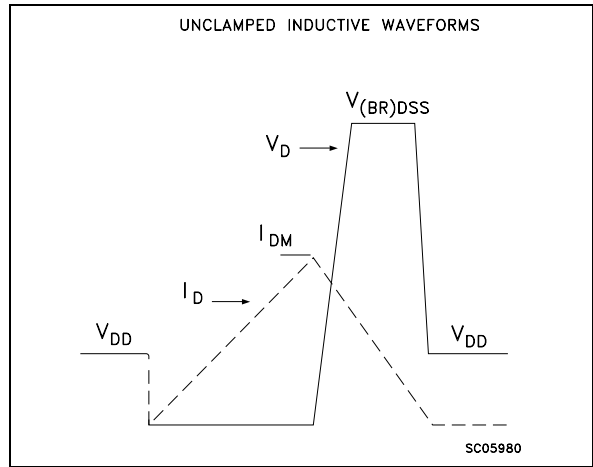


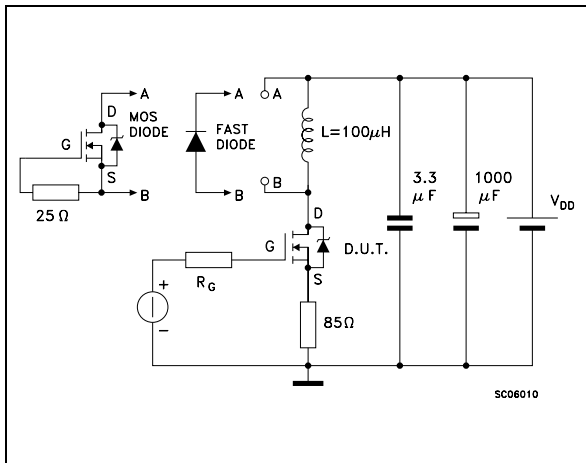
Fig. 3: Switching Times Test Circuits For Resistive Load



Fig. 4: Gate Charge test Circuit

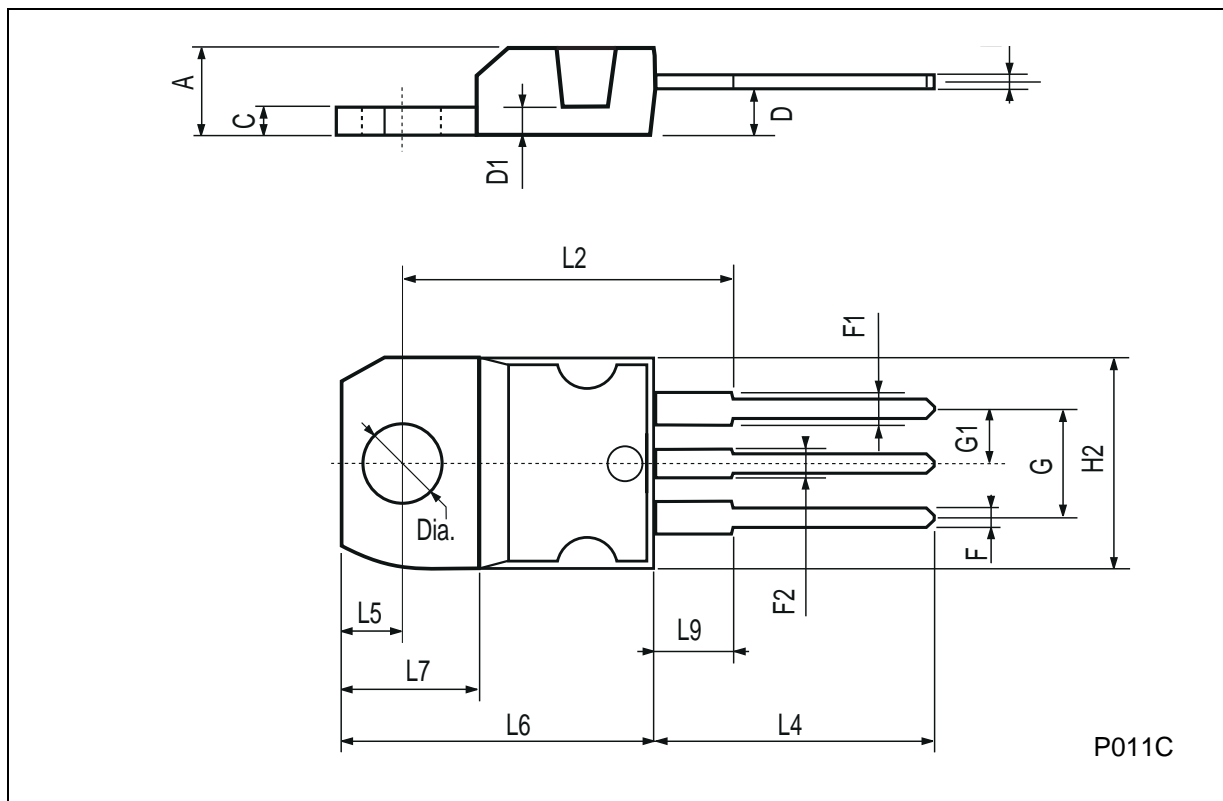


Fig. 5: Test Circuit For Inductive Load Switching And Diode Recovery Times



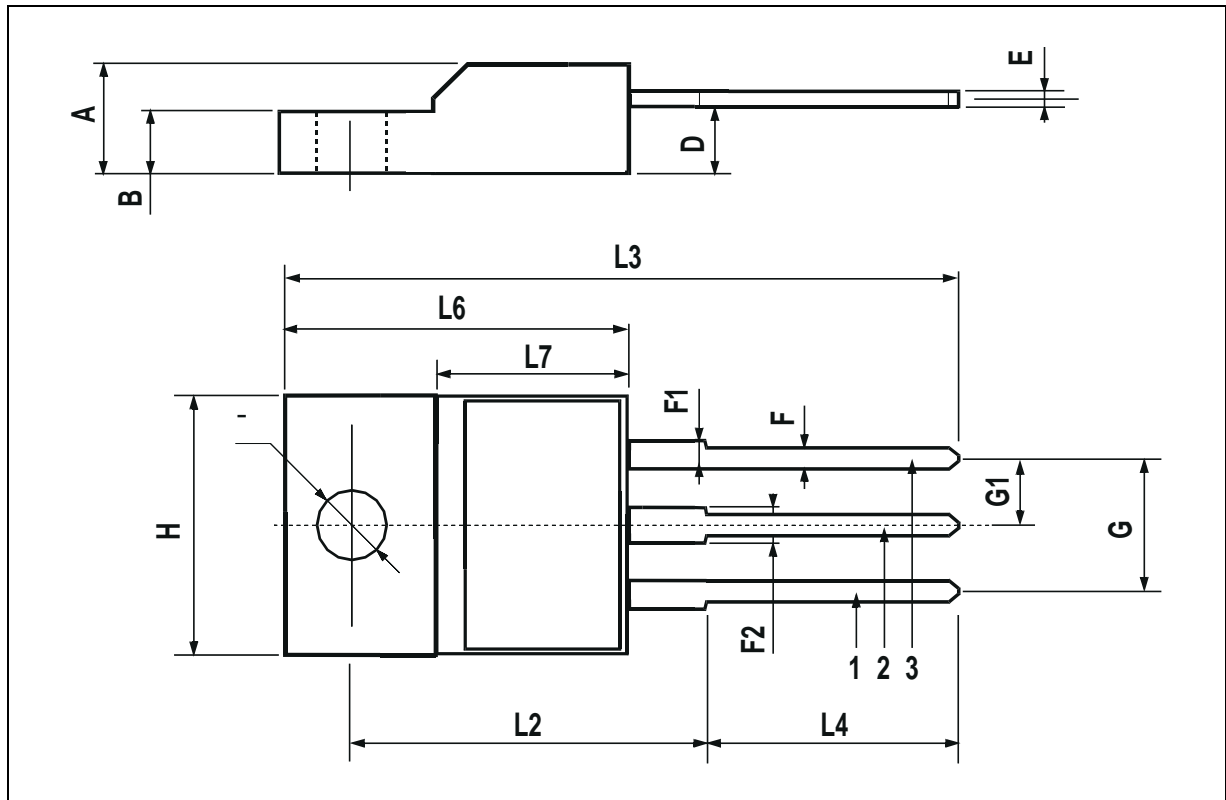
TO-220 MECHANICAL DATA

| 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 |



Information furnished is believed to be accurate and reliable. However, STMicroelectronics assumes no responsibility for the consequences of use of such information nor for any infringement of patents or other rights of third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of STMicroelectronics. Specification mentioned in this publication are subject to change without notice. This publication supersedes and replaces all information previously supplied. STMicroelectronics products are not authorized for use as critical components in life support devices or systems without express written approval of STMicroelectronics.

The ST logo is a trademark of STMicroelectronics

© 2000 STMicroelectronics – Printed in Italy – All Rights Reserved

STMicroelectronics GROUP OF COMPANIES

Australia - Brazil - China - Finland - France - Germany - Hong Kong - India - Italy - Japan - Malaysia - Malta - Morocco -
Singapore - Spain - Sweden - Switzerland - United Kingdom - U.S.A.

<http://www.st.com>