



STP12PF06 STF12PF06

P-CHANNEL 60V - 0.18 Ω - 12A TO-220/TO-220FP STripFET™ II POWER MOSFET

Table 1: General Features

| TYPE | V _{DSS} | R _{DS(on)} | I _D |
|-----------|------------------|---------------------|----------------|
| STP12PF06 | 60 V | < 0.20 Ω | 12 A |
| STF12PF06 | 60 V | < 0.20 Ω | 12 A |

- TYPICAL R_{DS(on)} = 0.18 Ω
- EXCEPTIONAL dv/dt CAPABILITY
- 100% AVALANCHE TESTED
- LOW GATE CHARGE
- APPLICATION ORIENTED CHARACTERIZATION

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

- MOTOR CONTROL
- DC-DC & DC-AC CONVERTERS

Figure 1: Package

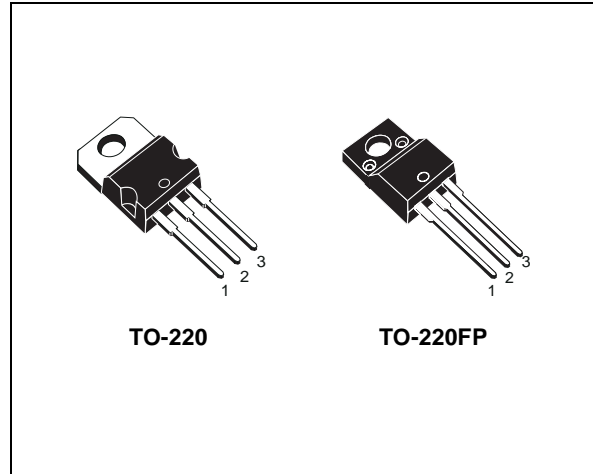


Figure 2: Internal Schematic Diagram

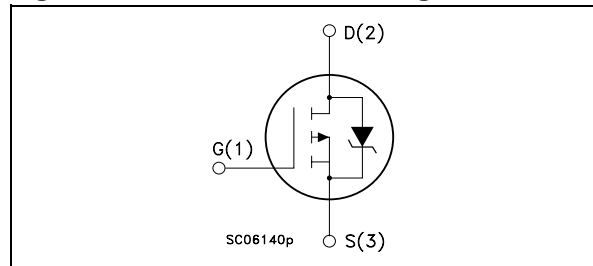


Table 2: Order Codes

| PART NUMBER | MARKING | PACKAGE | PACKAGING |
|-------------|---------|----------|-----------|
| STP12PF06 | P12PF06 | TO-220 | TUBE |
| STF12PF06 | F12PF06 | TO-220FP | TUBE |

Table 3: ABSOLUTE MAXIMUM RATINGS

| Symbol | Parameter | Value | | Unit |
|---------------------|---|------------|-----------|------|
| | | STP20PF06 | STF20PF06 | |
| V _{DS} | Drain-source Voltage (V _{GS} = 0) | 60 | | V |
| V _{DGR} | Drain-gate Voltage (R _{GS} = 20 k Ω) | 60 | | V |
| V _{GS} | Gate- source Voltage | ± 20 | | V |
| I _D | Drain Current (continuous) at T _C = 25°C | 12 | 8 | A |
| I _D | Drain Current (continuous) at T _C = 100°C | 8.4 | 5.6 | A |
| I _{DM} (*) | Drain Current (pulsed) | 48 | 32 | A |
| P _{tot} | Total Dissipation at T _C = 25°C | 60 | 225 | W |
| | Derating Factor | 0.4 | 0.17 | W/°C |
| dv/dt (1) | Peak Diode Recovery voltage slope | 6 | | V/ns |
| E _{AS} (2) | Single Pulse Avalanche Energy | 200 | | mJ |
| T _{stg} | Storage Temperature | -55 to 175 | | °C |
| T _j | Operating Junction Temperature | | | |

(*) Pulse width limited by safe operating area.

NOTE: For the P-CHANNEL MOSFET actual polarity of voltages and current has to be reversed.

(1) I_{SD} \leq 12A, di/dt \leq 200A/ μ s, V_{DD} \leq V_{(BR)DSS}, T_j \leq T_{JMAX}

(2) Starting T_j = 25 °C, I_D = 12A, V_{DD} = 25V

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Table 4: THERMAL DATA

| | | | TO-220 | TO-220FP | |
|----------------------------|---|-----|-------------|----------|------------|
| Rthj-case | Thermal Resistance Junction-case | Max | 2.5 | 5.35 | °C/W |
| Rthj-amb T _I | Thermal Resistance Junction-ambient Maximum Lead Temperature For Soldering Purpose | Max | 62.5 300 | | °C/W °C |

ELECTRICAL CHARACTERISTICS (T_{CASE} = 25 °C UNLESS OTHERWISE SPECIFIED)

Table 5: 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} = ± 20V | | | ±100 | nA |

Table 6: ON (*)

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---------------------|-----------------------------------|---|------|------|------|------|
| V _{GS(th)} | Gate Threshold Voltage | V _{DS} = V _{GS} I _D = 250 μA | 2 | 3.4 | 4 | V |
| R _{DS(on)} | Static Drain-source On Resistance | V _{GS} = 10 V I _D = 10 A | | 0.18 | 0.20 | Ω |

Table 7: DYNAMIC

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|--|---|---|------|------------------|------|----------------|
| g _{fs} (2) | Forward Transconductance | V _{DS} = 15 V I _D = 6 A | 2.5 | 6 | | S |
| C _{iss} C _{oss} C _{rss} | Input Capacitance Output Capacitance Reverse Transfer Capacitance | V _{DS} = 25V f = 1 MHz V _{GS} = 0 | | 850 230 75 | | pF pF pF |

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ELECTRICAL CHARACTERISTICS (continued)

Table 8: SWITCHING ON

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|-------------------------------|--|--|------|--------------|------|----------------|
| $t_{d(on)}$ t_r | Turn-on Delay Time Rise Time | $V_{DD} = 30\text{ V}$ $I_D = 6\text{ A}$ $R_G = 4.7\ \Omega$ $V_{GS} = 10\text{ V}$ (Resistive Load, Figure 19) | | 20 40 | | ns ns |
| Q_g Q_{gs} Q_{gd} | Total Gate Charge Gate-Source Charge Gate-Drain Charge | $V_{DD} = 48\text{ V}$ $I_D = 12\text{ A}$ $V_{GS} = 10\text{ V}$ | | 16 4 6 | 21 | nC nC nC |

Table 9: SWITCHING OFF

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|-----------------------|----------------------------------|--|------|----------|------|----------|
| $t_{d(off)}$ t_f | Turn-off Delay Time Fall Time | $V_{DD} = 30\text{ V}$ $I_D = 6\text{ A}$ $R_G = 4.7\ \Omega$, $V_{GS} = 10\text{ V}$ (Resistive Load, Figure 19) | | 40 10 | | ns ns |

Table 10: SOURCE DRAIN DIODE

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|-----------------------------------|--|--|------|-------------------|----------|---------------|
| I_{SD} $I_{SDM}^{(1)}$ | Source-drain Current Source-drain Current (pulsed) | | | | 10 40 | A A |
| $V_{SD}^{(2)}$ | Forward On Voltage | $I_{SD} = 12\text{ A}$ $V_{GS} = 0$ | | | 2.5 | V |
| t_{rr} Q_{rr} I_{RRM} | Reverse Recovery Time Reverse Recovery Charge Reverse Recovery Current | $I_{SD} = 12\text{ A}$ $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 30\text{ V}$ $T_j = 150^\circ\text{C}$ (see test circuit, Figure 21) | | 100 260 5.2 | | ns nC A |

(1) Pulse width limited by safe operating area.
(2) Pulsed: Pulse duration = 300 μs , duty cycle 1.5 %.

Figure 3: Safe Operating Area for TO-220

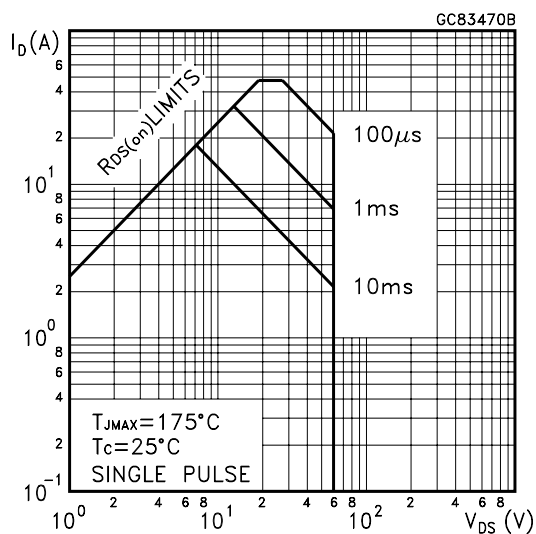


Figure 4: Safe Operating Area for TO-220FP

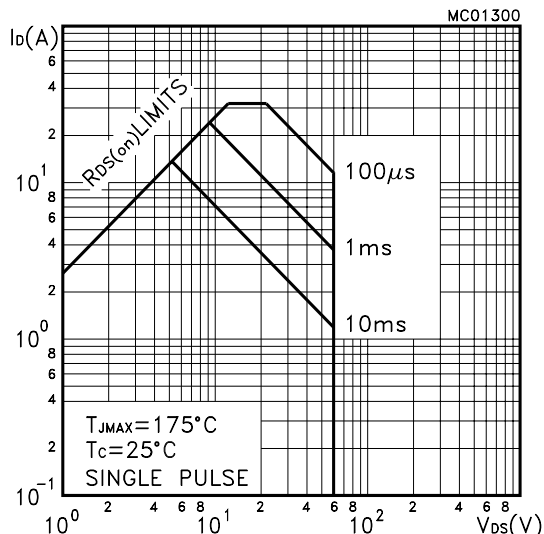


Figure 5: Thermal Impedance

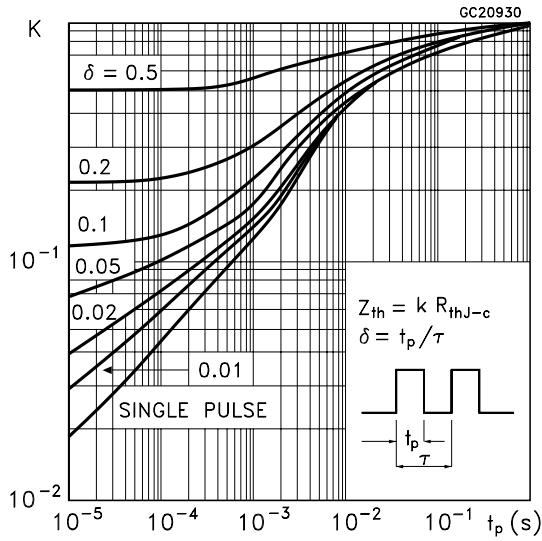


Figure 6: Thermal Impedance for TO-220FP

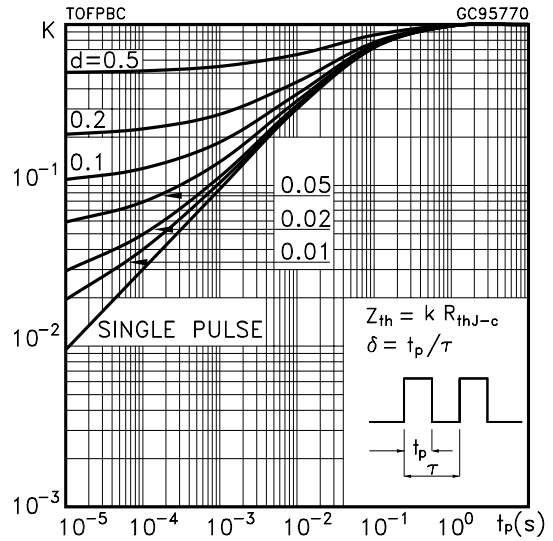


Figure 7: Output Characteristics

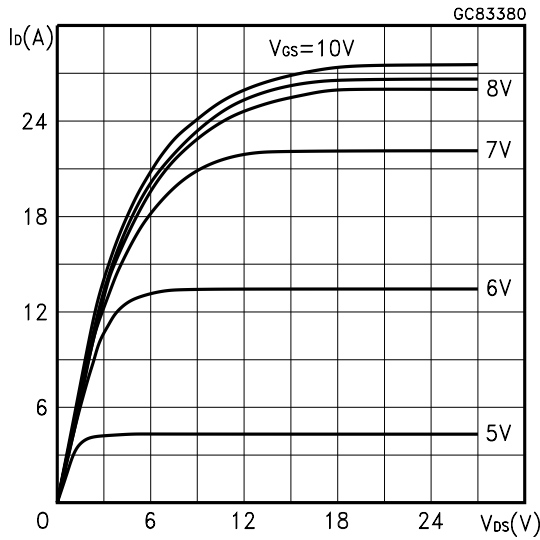


Figure 8: Transfer Characteristics

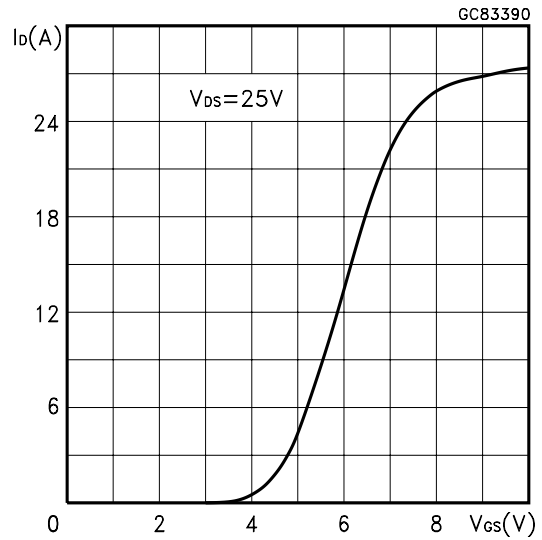


Figure 9: Transconductance

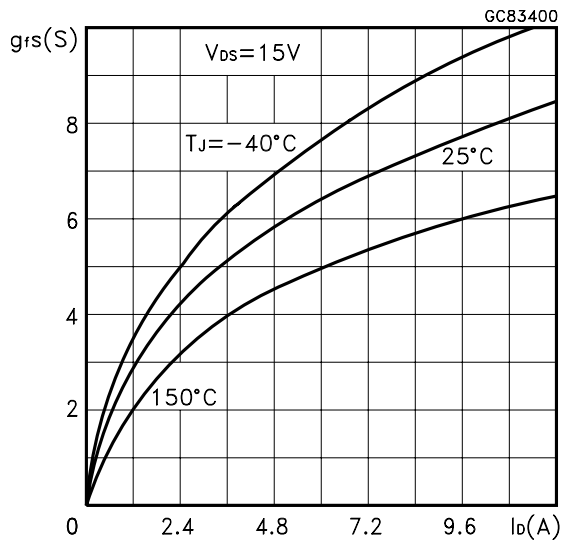


Figure 10: Static Drain-source On Resistance

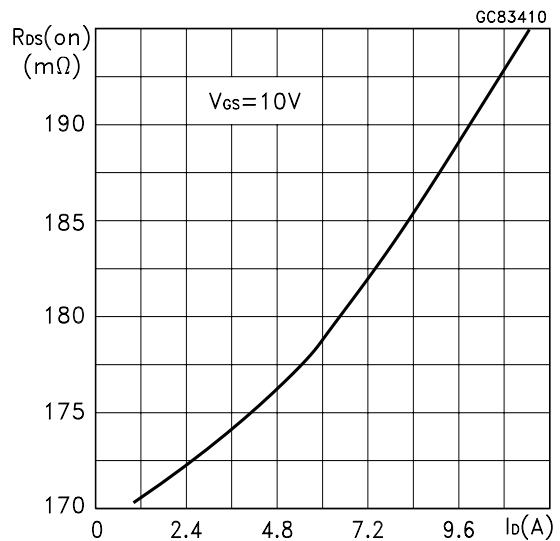


Figure 11: Gate Charge vs Gate-source Voltage

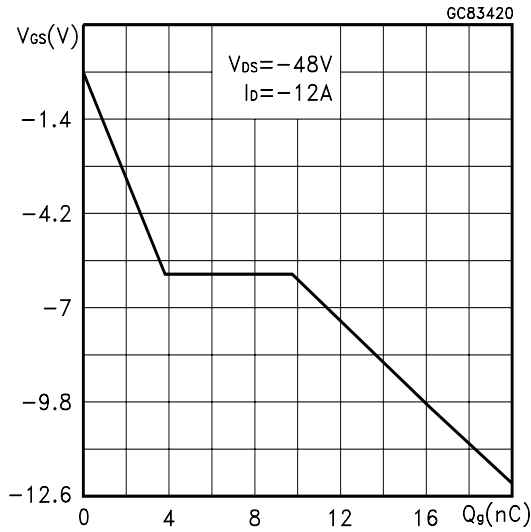


Figure 13: Normalized Gate Threshold Voltage vs Temperature

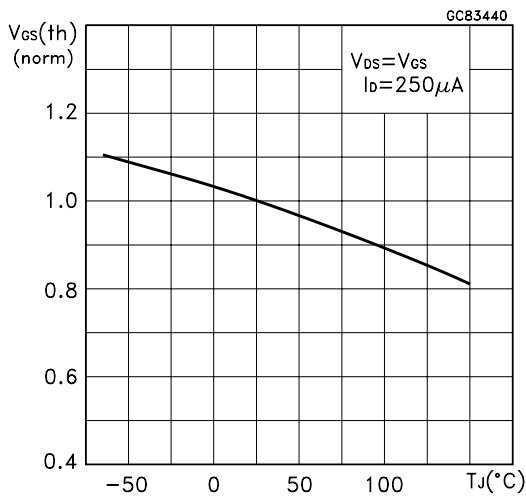


Figure 15: Source-drain Diode Forward Characteristics

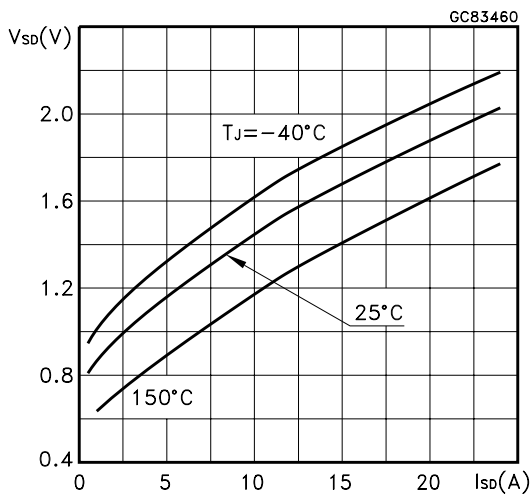


Figure 12: Capacitance Variations

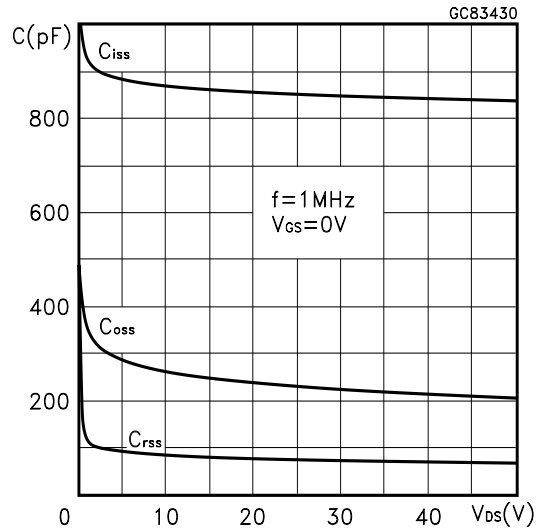


Figure 14: Normalized on Resistance vs Temperature

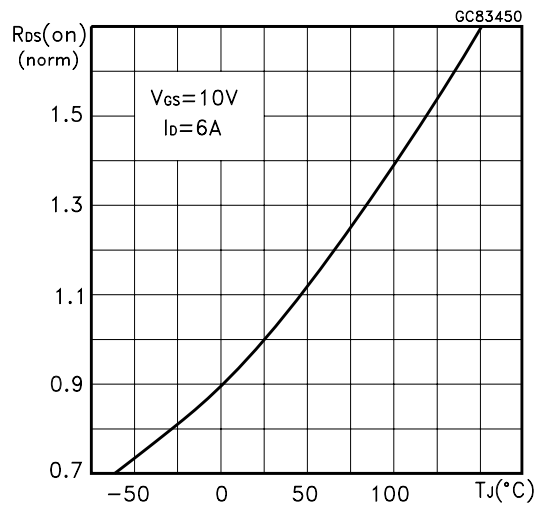


Figure 16: Normalized Breakdown Voltage Temperature

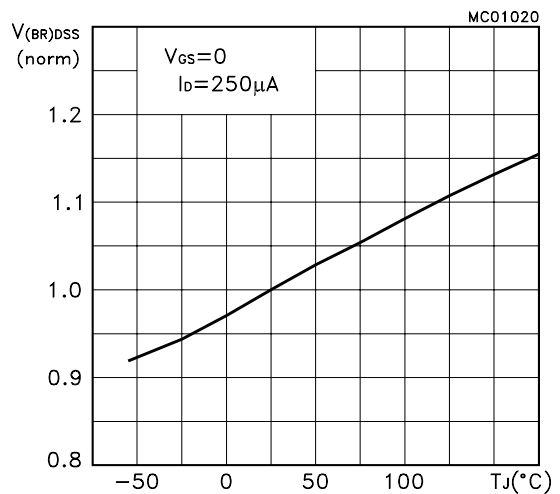


Figure 17: Unclamped Inductive Load Test Circuit

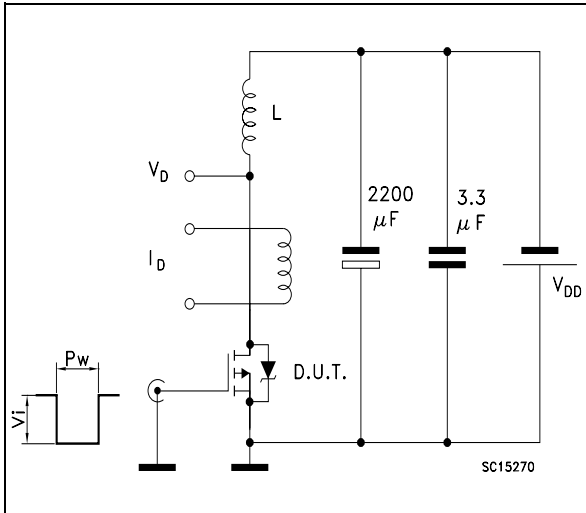


Figure 18: Unclamped Inductive Waveform

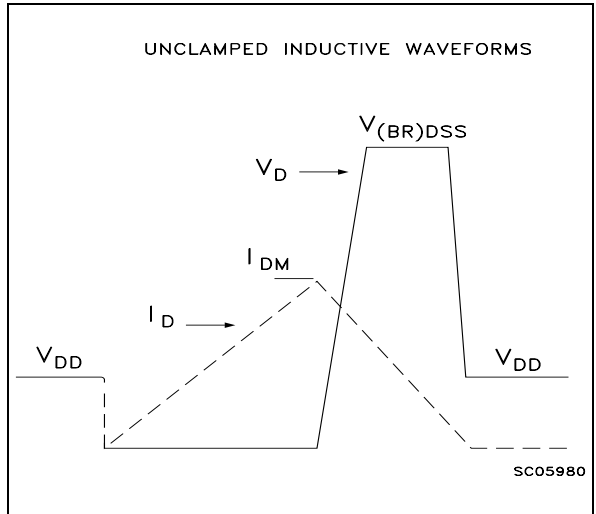


Figure 19: Switching Times Test Circuits For Resistive Load

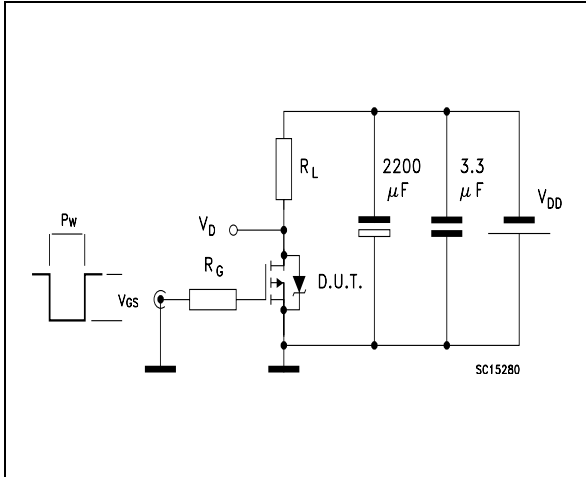


Figure 20: Gate Charge test Circuit

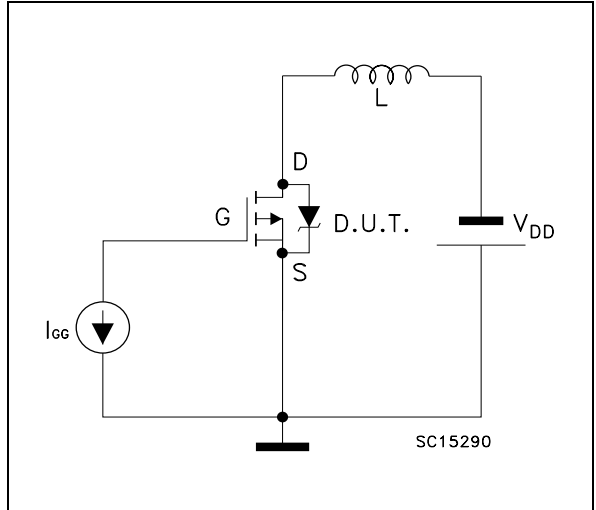
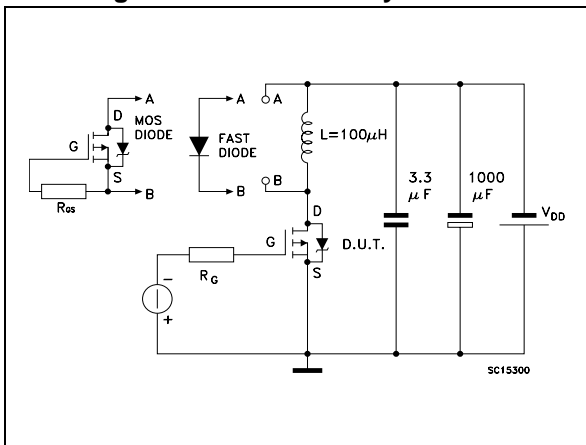
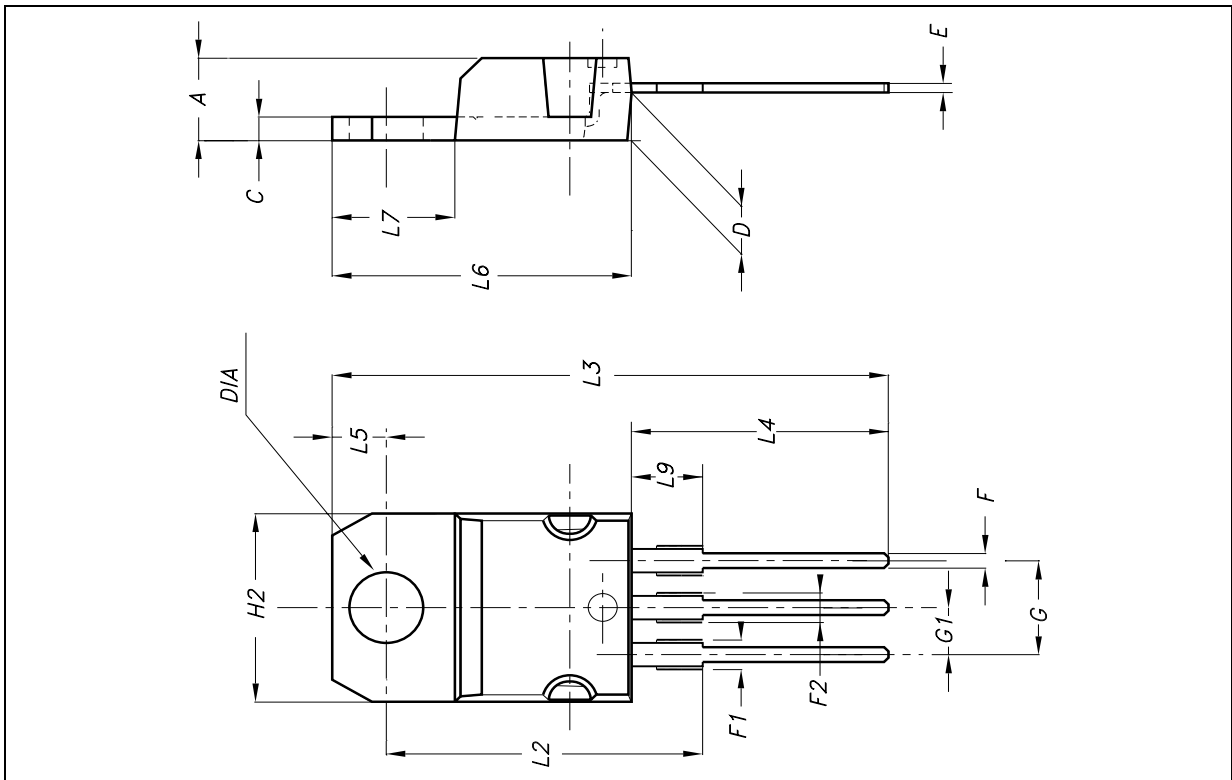


Figure 21: Test Circuit For Inductive Load Switching And Diode Recovery Times



TO-220 MECHANICAL DATA

| DIM. | mm. | | | inch. | | |
|------|-------|-------|-------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | TYP. |
| A | 4.4 | | 4.6 | 0.173 | | 0.181 |
| C | 1.23 | | 1.32 | 0.048 | | 0.051 |
| D | 2.40 | | 2.72 | 0.094 | | 0.107 |
| 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 | 2.40 | | 2.70 | 0.094 | | 0.106 |
| H2 | 10 | | 10.40 | 0.393 | | 0.409 |
| L2 | | 16.40 | | | 0.645 | |
| L3 | | 28.90 | | | 1.137 | |
| L4 | 13 | | 14 | 0.511 | | 0.551 |
| L5 | 2.65 | | 2.95 | 0.104 | | 0.116 |
| L6 | 15.25 | | 15.75 | 0.600 | | 0.620 |
| L7 | 6.20 | | 6.60 | 0.244 | | 0.260 |
| L9 | 3.50 | | 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 |

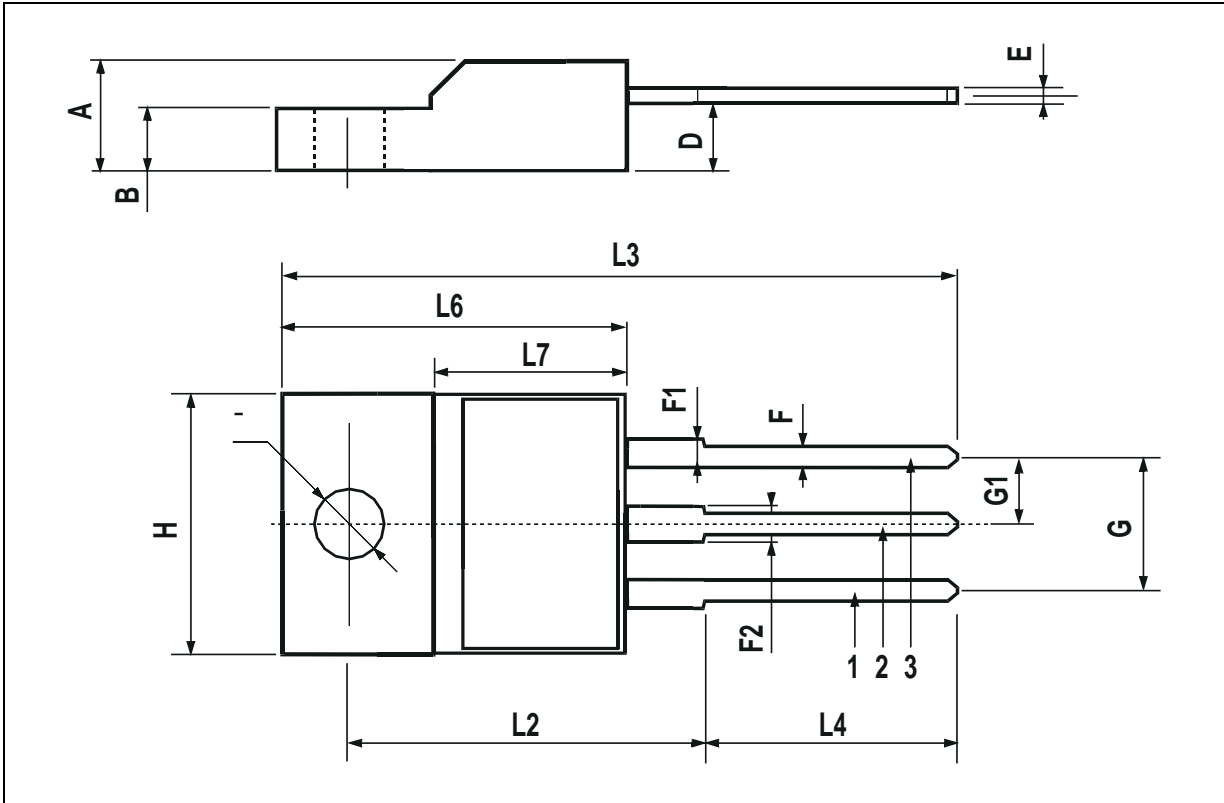


Table 11:Revision History

| Date | Revision | Description of Changes |
|-------------|-----------------|-------------------------------|
| March 2005 | 1.0 | FIRST ISSUE |
| March 2005 | 2.0 | MINOR REVISION |

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