



STP5NC50 - STP5NC50FP STB5NC50 - STB5NC50-1

N-CHANNEL 500V - 1.3Ω - 5.5A TO-220/FP/D²PAK/I²PAK

PowerMesh™ II MOSFET

| TYPE | V _{DSS} | R _{DS(on)} | I _D |
|------------|------------------|---------------------|----------------|
| STP5NC50 | 500 V | < 1.5Ω | 5.5A |
| STP5NC50FP | 500 V | < 1.5Ω | 5.5A |
| STB5NC50 | 500 V | < 1.5Ω | 5.5A |
| STB5NC50-1 | 500 V | < 1.5Ω | 5.5A |

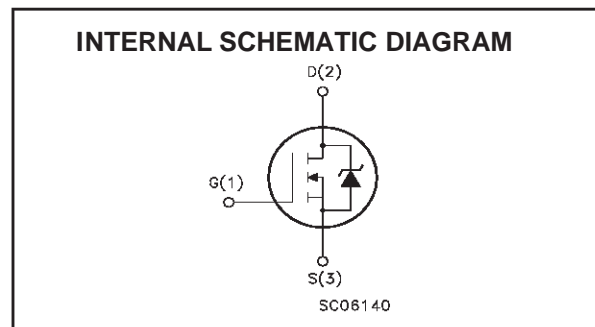
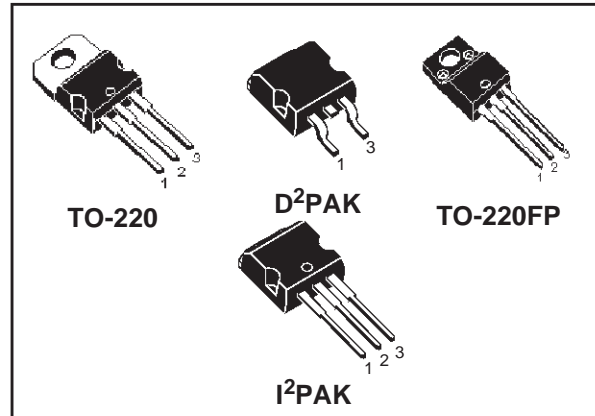
- TYPICAL R_{DS(on)} = 1.3Ω
- EXTREMELY HIGH dv/dt CAPABILITY
- 100% AVALANCHE TESTED
- NEW HIGH VOLTAGE BENCHMARK
- GATE CHARGE MINIMIZED

DESCRIPTION

The PowerMESH™ II is the evolution of the first generation of MESH OVERLAY™. The layout refinements introduced greatly improve the Ron*area figure of merit while keeping the device at the leading edge for what concerns switching speed, gate charge and ruggedness.

APPLICATIONS

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



ABSOLUTE MAXIMUM RATINGS

| Symbol | Parameter | Value | | Unit |
|---------------------|--|-------------------------|------------|------|
| | | STP5NC50 STB5NC50/-1 | STP5NC50FP | |
| V _{DS} | Drain-source Voltage (V _{GS} = 0) | 500 | | V |
| V _{DGR} | Drain-gate Voltage (R _{GS} = 20 kΩ) | 500 | | V |
| V _{GS} | Gate- source Voltage | ±30 | | V |
| I _D | Drain Current (continuous) at T _C = 25°C | 5.5 | 5.5(*) | A |
| I _D | Drain Current (continuous) at T _C = 100°C | 3.5 | 3.5(*) | A |
| I _{DM} (●) | Drain Current (pulsed) | 22 | 22 | 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 | 3.5 | | V/ns |
| V _{ISO} | Insulation Withstand Voltage (DC) | - | 2500 | V |
| T _j | Operating Junction Temperature | -55 to 175 | | °C |
| T _{stg} | Storage Temperature | -65 to 175 | | °C |

(●)Pulse width limited by safe operating area

(1)I_{SD} ≤ 5.5A, di/dt ≤ 100A/μs, V_{DD} ≤ V_{(BR)DSS}, T_j ≤ T_{JMAX}.

(*) Limited only by maximum temperature allowed

STP5NC50 - STP5NC50FP - STB5NC50 - STB5NC50-1

THERMAL DATA

| | | TO-220 D ² PAK I ² PAK | TO-220FP | |
|----------------|--|--|----------|------|
| Rthj-case | Thermal Resistance Junction-case Max | 1.25 | 3.57 | °C/W |
| Rthj-amb | Thermal Resistance Junction-ambient Max | 62.5 | | °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) | 5.5 | A |
| E _{AS} | Single Pulse Avalanche Energy (starting T _j = 25 °C, I _D = I _{AR} , V _{DD} = 50 V) | 280 | mJ |

ELECTRICAL CHARACTERISTICS (TCASE = 25 °C UNLESS OTHERWISE SPECIFIED) OFF

| Symbol | Parameter | Test Condition s | Min. | Typ. | Max. | Unit |
|----------------------|---|---|------|------|---------|----------|
| V _{(BR)DSS} | Drain-source Breakdown Voltage | I _D = 250μA, V _{GS} = 0 | 500 | | | V |
| I _{DSS} | Zero Gate Voltage Drain Current (V _{GS} = 0) | V _{DS} = Max Rating V _{DS} = Max Rating, T _C = 125 °C | | | 1 50 | μA μA |
| I _{GSS} | Gate-body Leakage Current (V _{DS} = 0) | V _{GS} = ±30V | | | ±100 | nA |

ON ⁽¹⁾

| Symbol | Parameter | Test Condition s | Min. | Typ. | Max. | Unit |
|---------------------|-----------------------------------|--|------|------|------|------|
| V _{GS(th)} | Gate Threshold Voltage | V _{DS} = V _{GS} , I _D = 250μA | 2 | 3 | 4 | V |
| R _{DS(on)} | Static Drain-source On Resistance | V _{GS} = 10V, I _D = 2 A | | 1.3 | 1.5 | Ω |

DYNAMIC

| Symbol | Parameter | Test Condition s | Min. | Typ. | Max. | Unit |
|--------------------------------|------------------------------|--|------|------|------|------|
| g _{fs} ⁽¹⁾ | Forward Transconductance | V _{DS} > I _{D(on)} × R _{DS(on)max} , I _D = 2.5A | | 4 | | S |
| C _{iss} | Input Capacitance | V _{DS} = 25V, f = 1 MHz, V _{GS} = 0 | | 480 | | pF |
| C _{oss} | Output Capacitance | | | 80 | | pF |
| C _{rss} | Reverse Transfer Capacitance | | | 11.5 | | pF |

ELECTRICAL CHARACTERISTICS
(CONTINUED)

SWITCHING ON

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|-------------|--------------------|--|------|------|------|------|
| $t_{d(on)}$ | Turn-on Delay Time | $V_{DD} = 250V, I_D = 2.5A$ $R_G = 4.7\Omega, V_{GS} = 10V$ (see test circuit, Figure 3) | | 14 | | ns |
| t_r | Rise Time | | | 15 | | ns |
| Q_g | Total Gate Charge | $V_{DD} = 400V, I_D = 5.5A,$ $V_{GS} = 10V$ | | 17.5 | 24.5 | nC |
| Q_{gs} | Gate-Source Charge | | | 3 | | nC |
| Q_{gd} | Gate-Drain Charge | | | 9 | | nC |

SWITCHING OFF

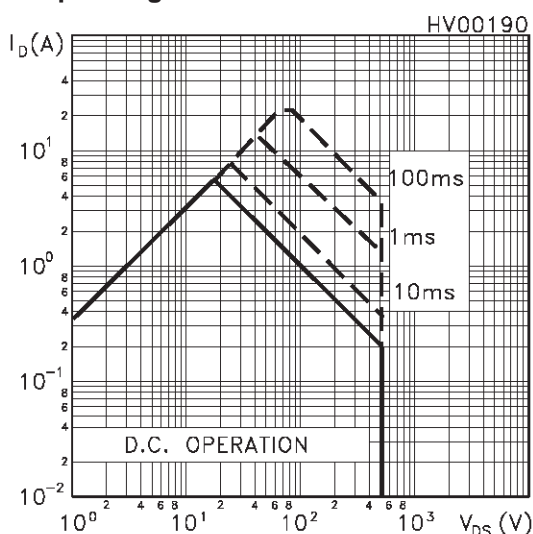
| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---------------|-----------------------|---|------|------|------|------|
| $t_{r(Voff)}$ | Off-voltage Rise Time | $V_{DD} = 400V, I_D = 5.5A,$ $R_G = 4.7\Omega, V_{GS} = 10V$ (see test circuit, Figure 5) | | 12 | | ns |
| t_f | Fall Time | | | 14 | | ns |
| t_c | Cross-over Time | | | 20 | | ns |

SOURCE DRAIN DIODE

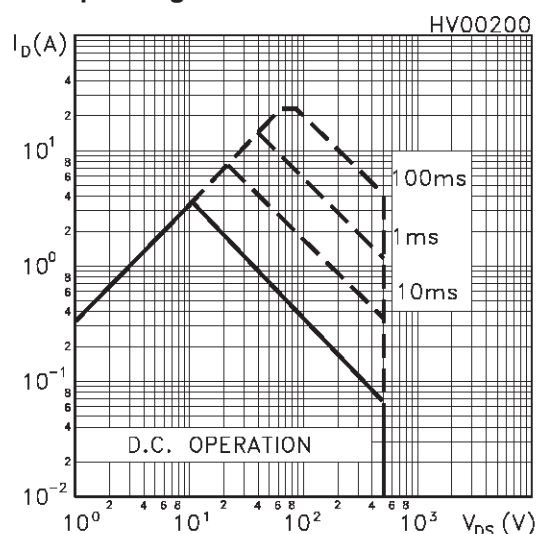
| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|--------------|-------------------------------|--|------|------|------|---------|
| I_{SD} | Source-drain Current | | | | 5.5 | A |
| $I_{SDM(2)}$ | Source-drain Current (pulsed) | | | | 22 | A |
| $V_{SD(1)}$ | Forward On Voltage | $I_{SD} = 5.5A, V_{GS} = 0$ | | | 1.6 | V |
| t_{rr} | Reverse Recovery Time | $I_{SD} = 5.5A, di/dt = 100A/\mu s,$ $V_{DD} = 100V, T_j = 150^\circ C$ (see test circuit, Figure 5) | | 360 | | ns |
| Q_{rr} | Reverse Recovery Charge | | | 1.6 | | μC |
| I_{RRM} | Reverse Recovery Current | | | 9 | | A |

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

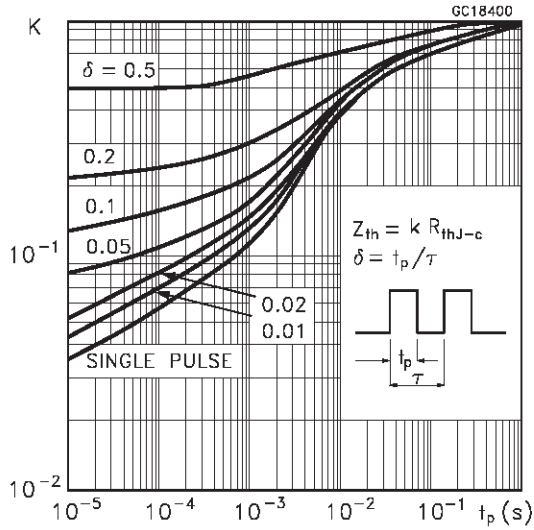
Safe Operating Area for TO-220/D2PAK/I2PAK



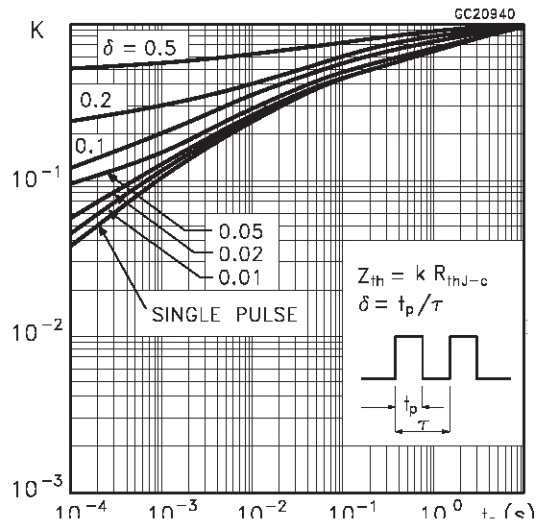
Safe Operating Area for TO-220FP



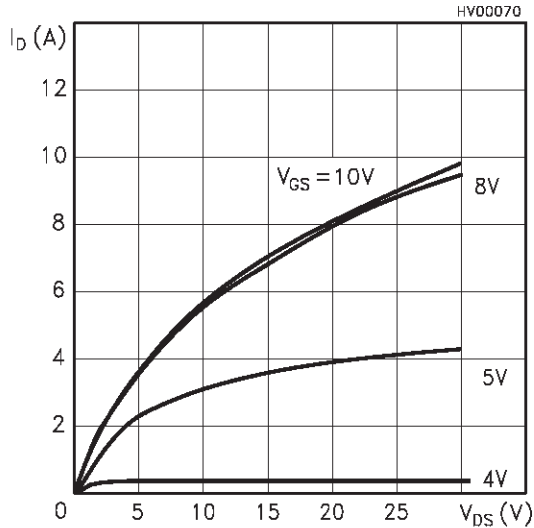
Thermal Impedance for TO-220/D2PAK/I2PAK



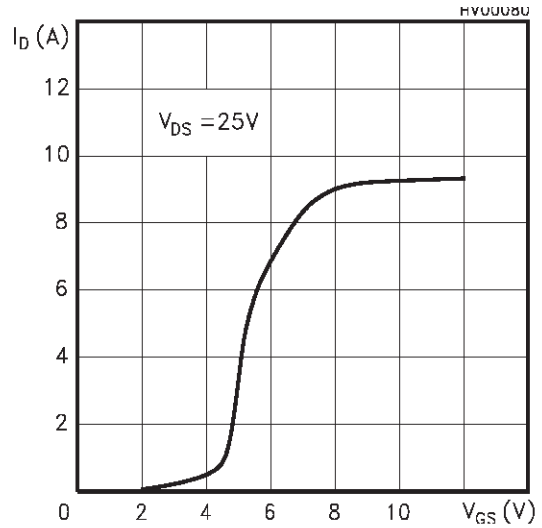
Thermal Impedance for TO-220FP



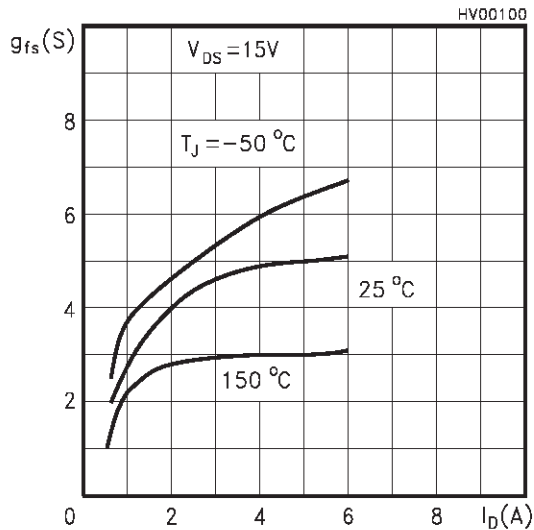
Output Characteristics



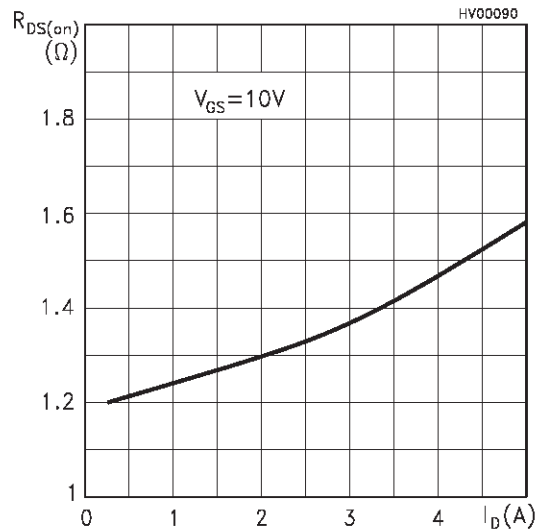
Transfer Characteristics



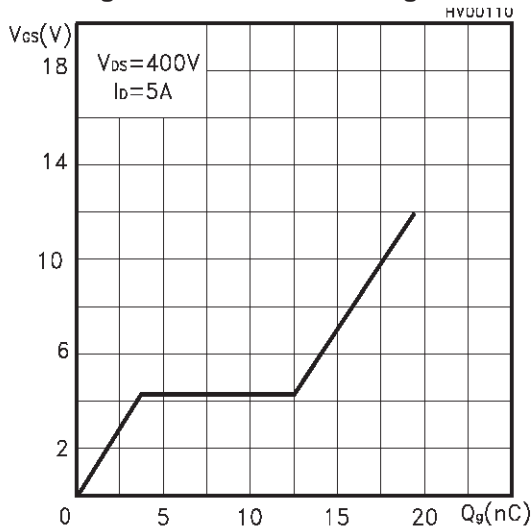
Transconductance



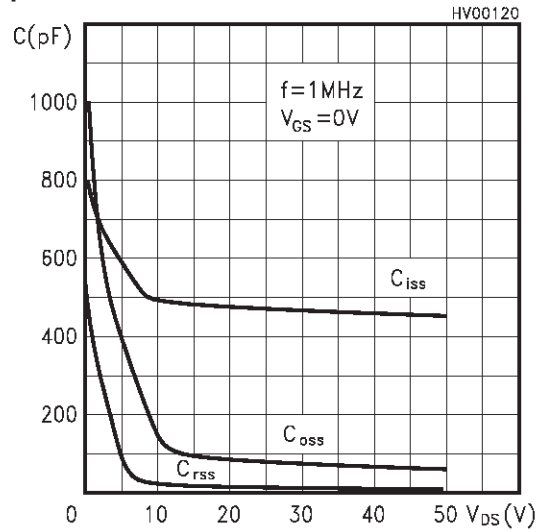
Static Drain-source On Resistance



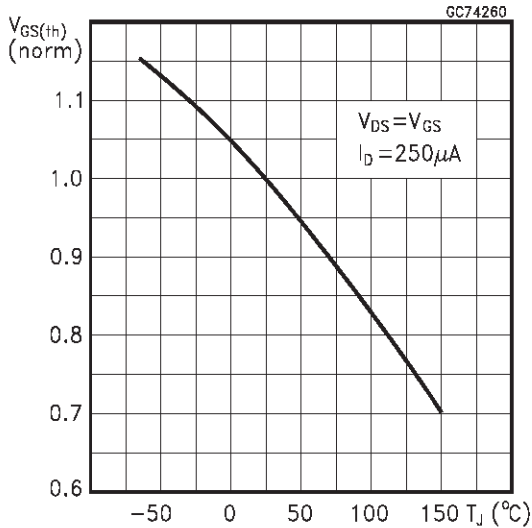
Gate Charge vs Gate-source Voltage



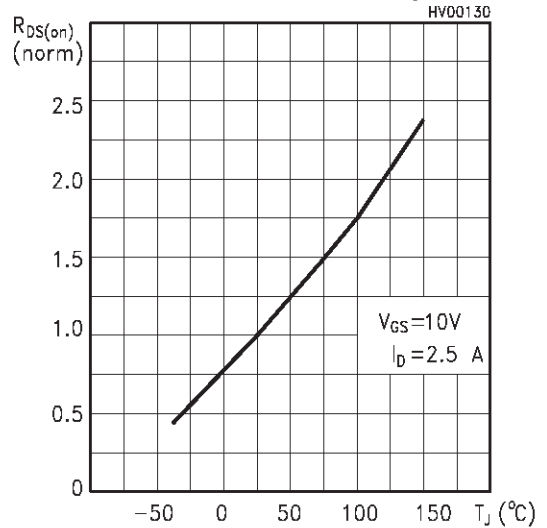
Capacitance Variations



Normalized Gate Threshold Voltage vs Temp.



Normalized On Resistance vs Temperature



Source-drain Diode Forward Characteristics

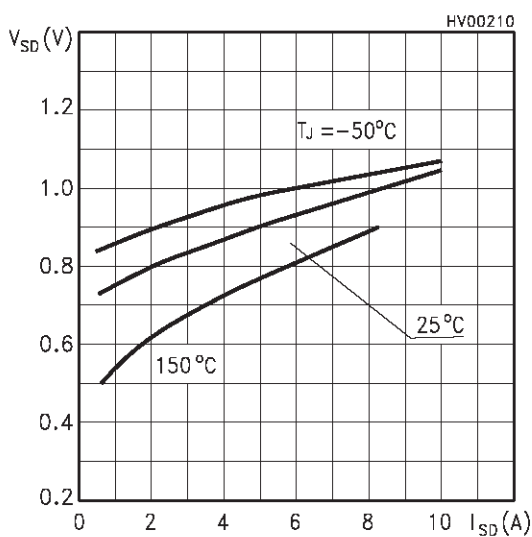


Fig. 1: Unclamped Inductive Load Test Circuit

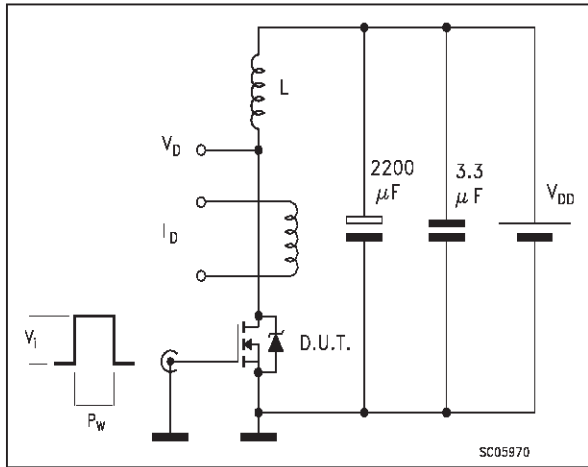


Fig. 2: Unclamped Inductive Waveform

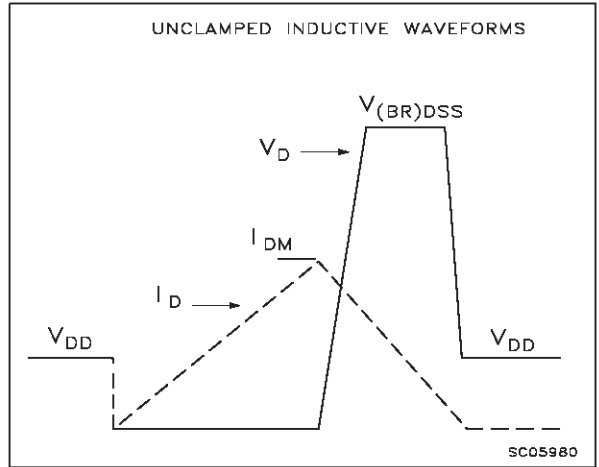


Fig. 3: Switching Times Test Circuit For Resistive Load

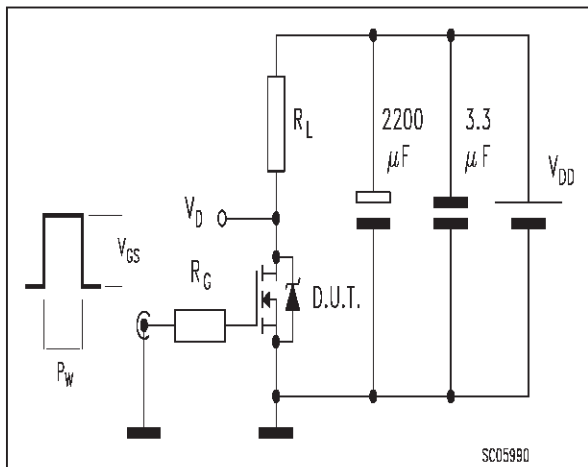


Fig. 4: Gate Charge test Circuit

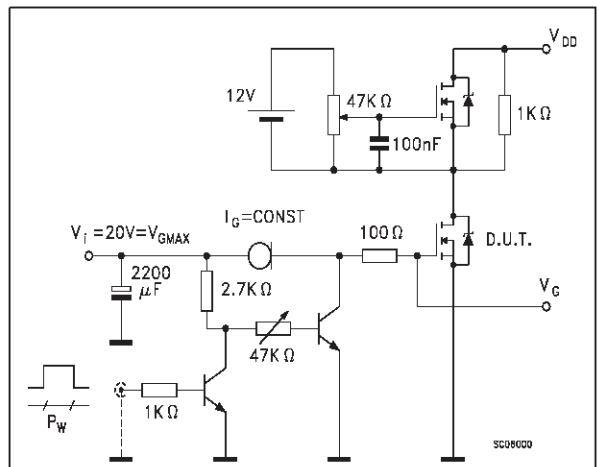
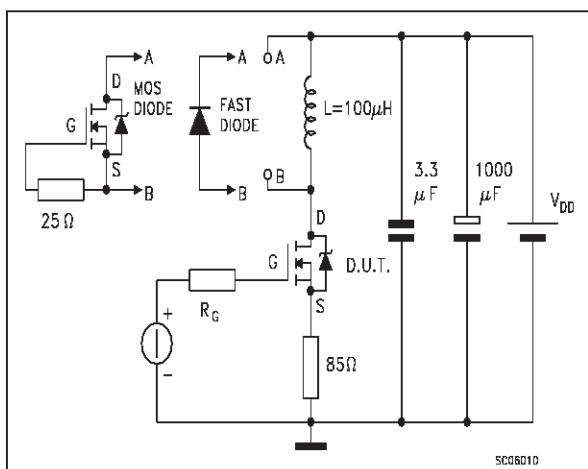
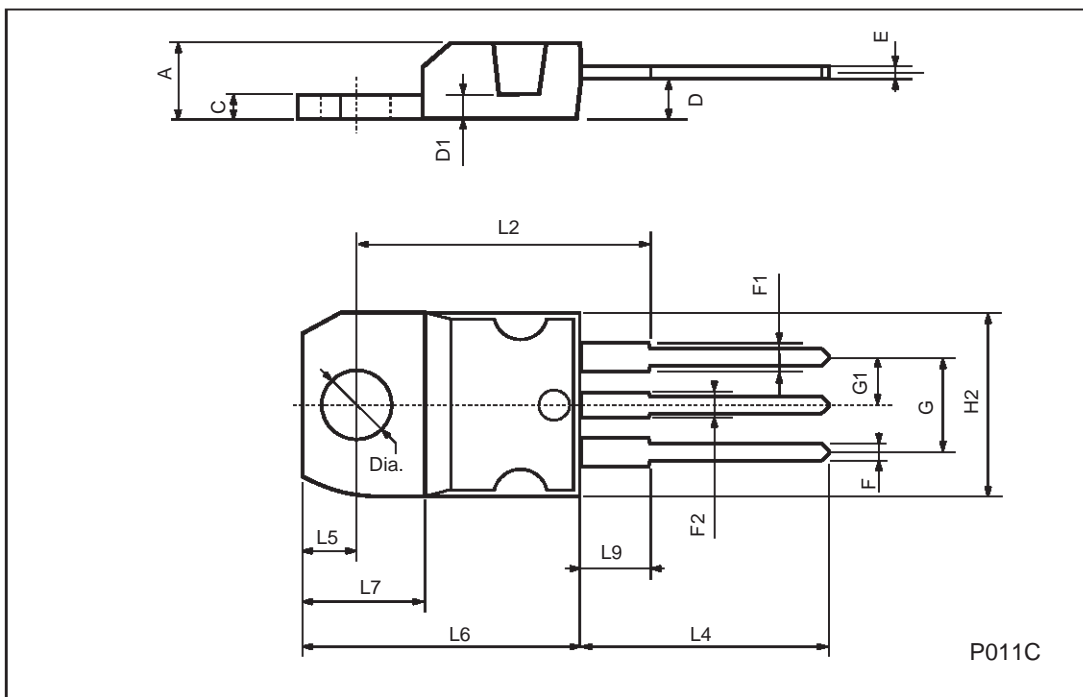


Fig. 5: Test Circuit For Inductive Load Switching And Diode Recovery Times



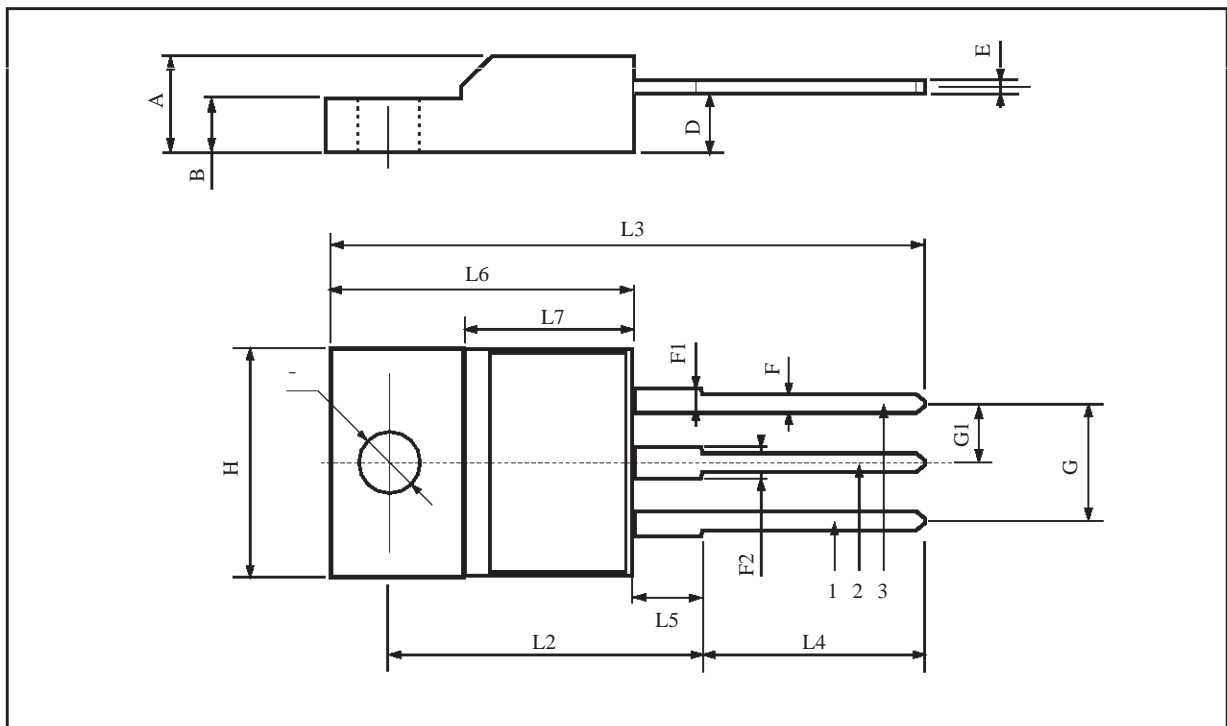
TO-220 MECHANICAL DATA

| 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 |



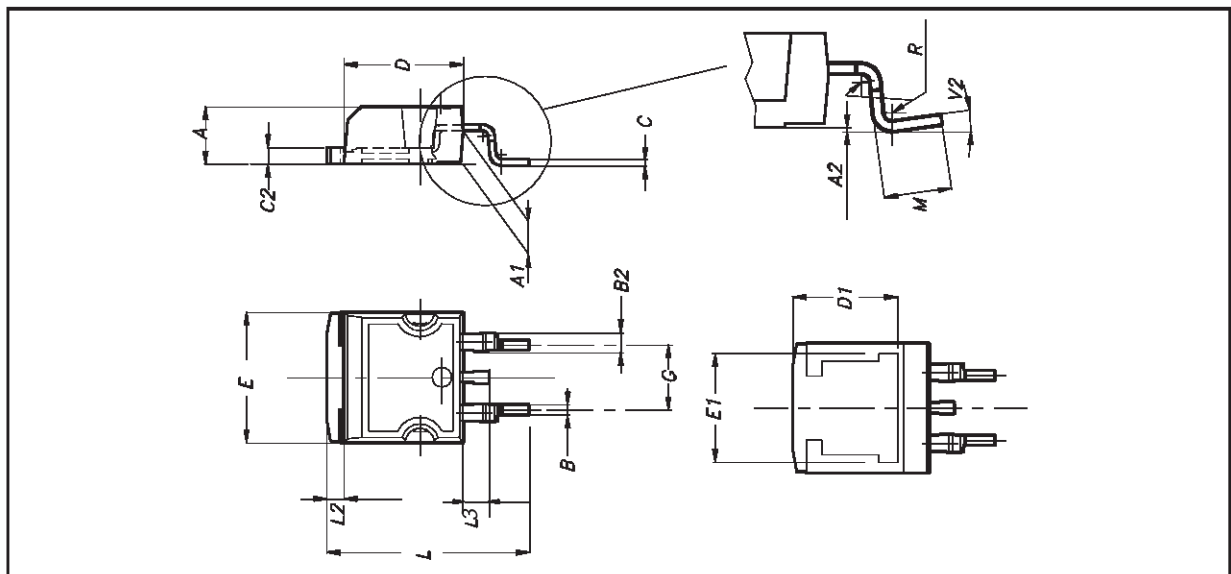
TO-220FP MECHANICAL DATA

| 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 | | 1.5 | 0.045 | | 0.067 |
| F2 | 1.15 | | 1.5 | 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 |
| L5 | 2.9 | | 3.6 | 0.114 | | 0.141 |
| 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 |



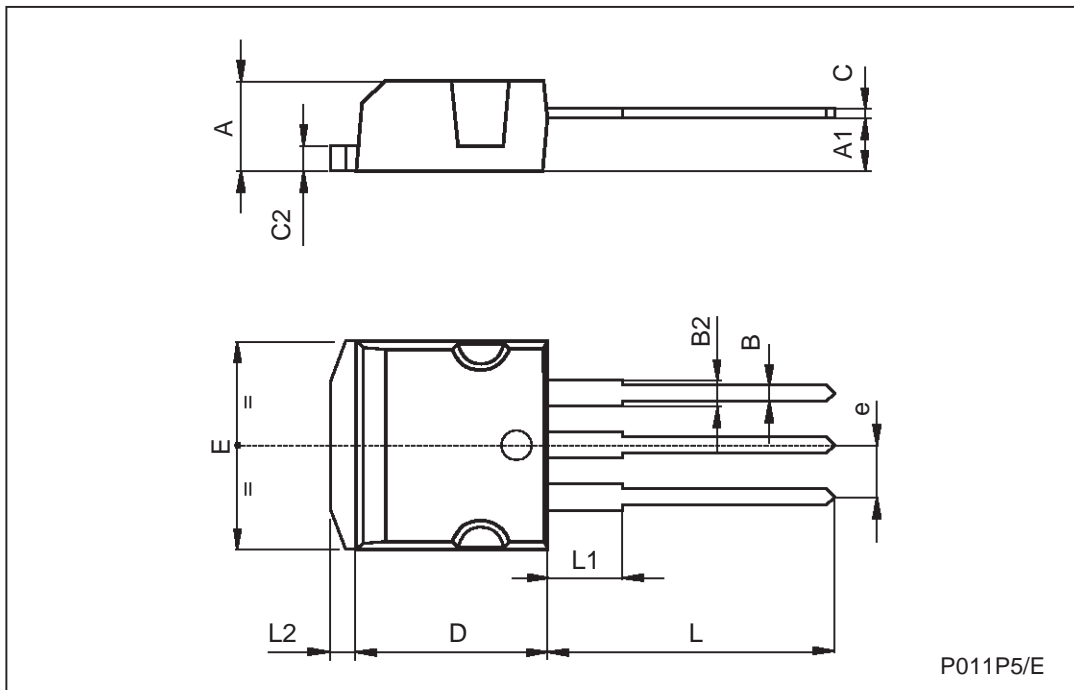
D²PAK MECHANICAL DATA

| DIM. | mm. | | | inch | | |
|------|------|-----|-------|-------|-------|-------|
| | MIN. | TYP | MAX. | MIN. | TYP. | MAX. |
| A | 4.4 | | 4.6 | 0.173 | | 0.181 |
| A1 | 2.49 | | 2.69 | 0.098 | | 0.106 |
| A2 | 0.03 | | 0.23 | 0.001 | | 0.009 |
| B | 0.7 | | 0.93 | 0.027 | | 0.036 |
| B2 | 1.14 | | 1.7 | 0.044 | | 0.067 |
| C | 0.45 | | 0.6 | 0.017 | | 0.023 |
| C2 | 1.23 | | 1.36 | 0.048 | | 0.053 |
| D | 8.95 | | 9.35 | 0.352 | | 0.368 |
| D1 | | 8 | | | 0.315 | |
| E | 10 | | 10.4 | 0.393 | | |
| E1 | | 8.5 | | | 0.334 | |
| G | 4.88 | | 5.28 | 0.192 | | 0.208 |
| L | 15 | | 15.85 | 0.590 | | 0.625 |
| L2 | 1.27 | | 1.4 | 0.050 | | 0.055 |
| L3 | 1.4 | | 1.75 | 0.055 | | 0.068 |
| M | 2.4 | | 3.2 | 0.094 | | 0.126 |
| R | | 0.4 | | | 0.015 | |
| V2 | 0° | | 8° | | | |

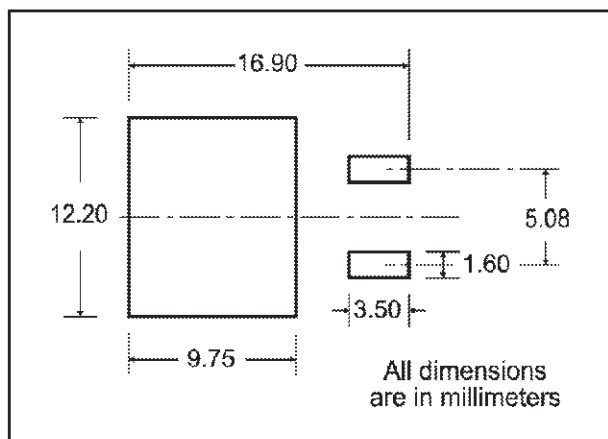


TO-262 (I²PAK) MECHANICAL DATA

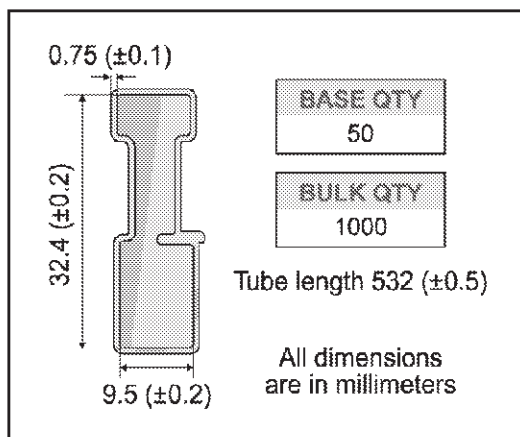
| DIM. | mm | | | inch | | |
|------|------|------|------|-------|------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | 4.4 | | 4.6 | 0.173 | | 0.181 |
| A1 | 2.49 | | 2.69 | 0.098 | | 0.106 |
| B | 0.7 | | 0.93 | 0.027 | | 0.036 |
| B2 | 1.14 | | 1.7 | 0.044 | | 0.067 |
| C | 0.45 | | 0.6 | 0.017 | | 0.023 |
| C2 | 1.23 | | 1.36 | 0.048 | | 0.053 |
| D | 8.95 | | 9.35 | 0.352 | | 0.368 |
| e | 2.4 | | 2.7 | 0.094 | | 0.106 |
| E | 10 | | 10.4 | 0.393 | | 0.409 |
| L | 13.1 | | 13.6 | 0.515 | | 0.531 |
| L1 | 3.48 | | 3.78 | 0.137 | | 0.149 |
| L2 | 1.27 | | 1.4 | 0.050 | | 0.055 |



D²PAK FOOTPRINT



TUBE SHIPMENT (no suffix)*



TAPE AND REEL SHIPMENT (suffix "T4")*

Diagram showing the tape mechanical data. It includes a circular reel view with dimensions A, B, C, D, and G. A note indicates "40 mm min. Access hole at slot location". Another note says "Tape slot in core for tape start 2.5mm min. width". A third note says "Full radius". A side view shows dimensions T, N, and G (measured at hub).

TAPE MECHANICAL DATA

| DIM. | mm | | inch | |
|------|------|------|--------|--------|
| | MIN. | MAX. | MIN. | MAX. |
| A0 | 10.5 | 10.7 | 0.413 | 0.421 |
| B0 | 15.7 | 15.9 | 0.618 | 0.626 |
| D | 1.5 | 1.6 | 0.059 | 0.063 |
| D1 | 1.59 | 1.61 | 0.062 | 0.063 |
| E | 1.65 | 1.85 | 0.065 | 0.073 |
| F | 11.4 | 11.6 | 0.449 | 0.456 |
| K0 | 4.8 | 5.0 | 0.189 | 0.197 |
| P0 | 3.9 | 4.1 | 0.153 | 0.161 |
| P1 | 11.9 | 12.1 | 0.468 | 0.476 |
| P2 | 1.9 | 2.1 | 0.075 | 0.082 |
| R | 50 | | 1.574 | |
| T | 0.25 | 0.35 | 0.0098 | 0.0137 |
| W | 23.7 | 24.3 | 0.933 | 0.956 |

REEL MECHANICAL DATA

| DIM. | mm | | inch | |
|------|------|------|-------|--------|
| | MIN. | MAX. | MIN. | MAX. |
| A | | 330 | | 12.992 |
| B | 1.5 | | 0.059 | |
| C | 12.8 | 13.2 | 0.504 | 0.520 |
| D | 20.2 | | 0.795 | |
| G | 24.4 | 26.4 | 0.960 | 1.039 |
| N | 100 | | 3.937 | |
| T | | 30.4 | | 1.197 |

| BASE QTY | BULK QTY |
|----------|----------|
| 1000 | 1000 |

Diagram showing the reel mechanical data. It includes a side view of the reel with dimensions F₀, f, B₀, D₁, A₀, P₁, P₂, P₀, E, F, W, and Center line of cavity. A note indicates "10 pitches cumulative tolerance on tape + / - 0.2 mm". A top view shows the "TOP COVER TAPE" and "FEED DIRECTION". A bending radius diagram shows "R min.".

* on sales type



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