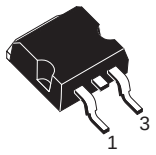
# STB9NC60
# STB9NC60-1

## N-CHANNEL 600V - 0.6Ω - 9A - D²PAK/I²PAK
## PowerMesh™II MOSFET

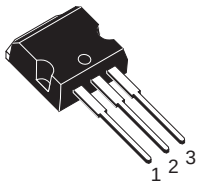
| TYPE | $V_{DSS}$ | $R_{DS(on)}$ | $I_D$ |
|---|---|---|---|
| STB9NC60 | 600 V | < 0.75 Ω | 9.0 A |
| STB9NC60-1 | 600 V | < 0.75 Ω | 9.0 A |



- TYPICAL $R_{DS}$(on) = 0.6 Ω
- EXTREMELY HIGH dv/dt CAPABILITY
- 100% AVALANCHE TESTED
- NEW HIGH VOLTAGE BENCHMARK
- GATE CHARGE MINIMIZED




D²PAK




I²PAK

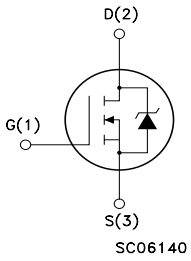
### DESCRIPTION

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 swithing speed, gate charge and ruggedness.

### APPLICATIONS

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

### INTERNAL SCHEMATIC DIAGRAM




### ABSOLUTE MAXIMUM RATINGS

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_{DS}$ | 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 (continuos) at $T_C$ = 25°C | 9 | A |
| $I_D$ | Drain Current (continuos) at $T_C$ = 100°C | 5.7 | A |
| $I_{DM}$ (1) | Drain Current (pulsed) | 36 | A |
| $P_{TOT}$ | Total Dissipation at $T_C$ = 25°C | 125 | W |
| | Derating Factor | 1.0 | W/°C |
| dv/dt | Peak Diode Recovery voltage slope | 3.5 | V/ns |
| $T_{stg}$ | Storage Temperature | – 55 to 150 | °C |
| $T_j$ | Max. Operating Junction Temperature | | |

(•)Pulse width limited by safe operating area

(1)$I_{SD}$ ≤9A, di/dt ≤100A/µs, $V_{DD}$ ≤ $V_{(BR)DSS}$, $T_j$ ≤ $T_{JMAX}$

## THERMAL DATA

| | | | |
|---|---|---|---|
| Rthj-case | Thermal Resistance Junction-case Max | 1.0 | °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) | 9 | A |
| $E_{AS}$ | Single Pulse Avalanche Energy (starting $T_j$ = 25 °C, $I_D$ = $I_{AR}$, $V_{DD}$ = 50 V) | 850 | mJ |



## ELECTRICAL CHARACTERISTICS (TCASE = 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 | 600 | | | V |
| $I_{DSS}$ | Zero Gate Voltage Drain Current ($V_{GS}$ = 0) | $V_{DS}$ = Max Rating | | | 1 | µA |
| | | $V_{DS}$ = Max Rating, $T_C$ = 125 °C | | | 50 | µA |
| $I_{GSS}$ | Gate-body Leakage Current ($V_{DS}$ = 0) | $V_{GS}$ = ±30V | | | ±100 | nA |

ON (1)

| Symbol | Parameter | Test Conditions | 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, $I_D$ = 4.5 A | | 0.6 | 0.75 | Ω |

DYNAMIC

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $g_{fs}$ (1) | Forward Transconductance | $V_{DS}$ =20 V , $I_D$ = 4.5A | | 9 | | S |
| $C_{iss}$ | Input Capacitance | $V_{DS}$ = 25V, f = 1 MHz, $V_{GS}$ = 0 | | 1420 | | pF |
| $C_{oss}$ | Output Capacitance | | | 205 | | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | | 35 | | pF |

**ELECTRICAL CHARACTERISTICS** (CONTINUED)

SWITCHING ON

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $t_{d(on)}$ | Turn-on Delay Time | $V_{DD}$ = 300V, $I_D$ = 4.5 A<br>$R_G$ = 4.7Ω $V_{GS}$ = 10V<br>(see test circuit, Figure 3) | | 20 | | ns |
| $t_r$ | Rise Time | | | 16 | | ns |
| $Q_g$ | Total Gate Charge | $V_{DD}$ = 480V, $I_D$ = 9.0 A,<br>$V_{GS}$ = 10V | | 55 | 77 | nC |
| $Q_{gs}$ | Gate-Source Charge | | | 4.5 | | nC |
| $Q_{gd}$ | Gate-Drain Charge | | | 31 | | nC |



SWITCHING OFF

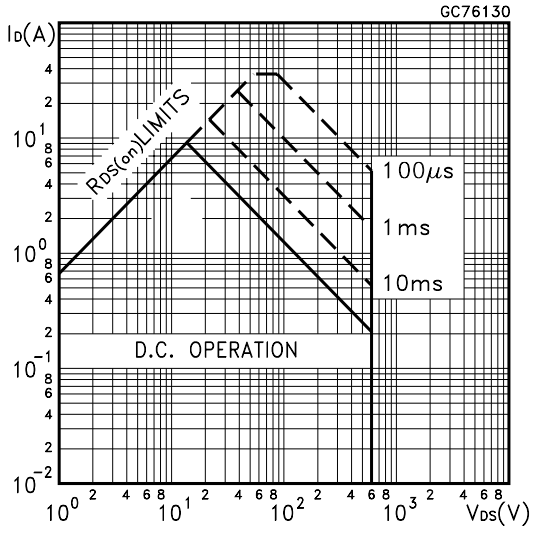
| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $t_{d(off)}$<br>$t_f$ | Turn-off Delay Time<br>Fall Time | $V_{DD}$ = 300 V, $I_D$ = 4.5 A<br>$R_G$ = 4.7Ω $V_{GS}$ = 10 V<br>(Resistive Load see, Figure 3) | | 64<br>32 | | ns<br>ns |
| $t_{r(Voff)}$<br>$t_f$<br>$t_c$ | Off-voltage Rise Time<br>Fall Time<br>Cross-over Time | $V_{DD}$ = 480V, $I_D$ = 9.0 A,<br>$R_G$ = 4.7Ω, $V_{GS}$ = 10V<br>(Inductive Load see, Figure 5) | | 19<br>13<br>32 | | ns<br>ns<br>ns |

SOURCE DRAIN DIODE

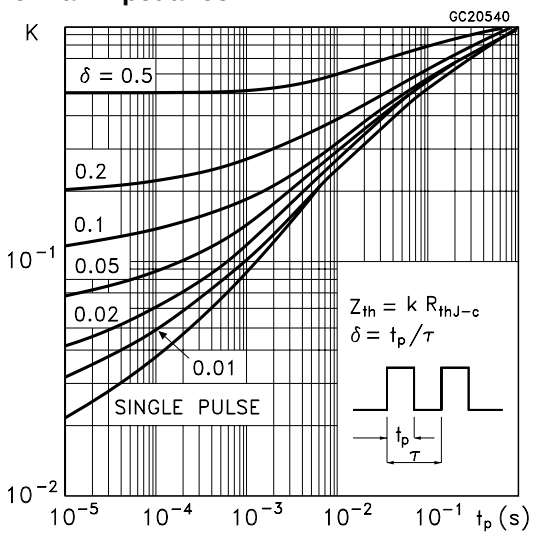
| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $I_{SD}$ | Source-drain Current | | | | 9.0 | A |
| $I_{SDM}$ (2) | Source-drain Current (pulsed) | | | | 36 | A |
| $V_{SD}$ (1) | Forward On Voltage | $I_{SD}$ = 9 A, $V_{GS}$ = 0 | | | 1.6 | V |
| $t_{rr}$ | Reverse Recovery Time | $I_{SD}$ = 9 A, di/dt = 100A/µs,<br>$V_{DD}$ = 100V, Tj = 150°C<br>(see test circuit, Figure 5) | | 600 | | ns |
| $Q_{rr}$ | Reverse Recovery Charge | | | 4.7 | | µC |
| $I_{RRM}$ | Reverse Recovery Current | | | 15.5 | | A |

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

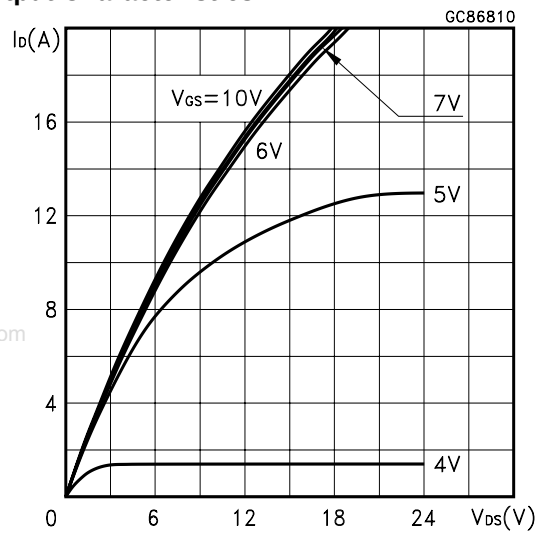
**Safe Operating Area**




**Thermal Impedance**

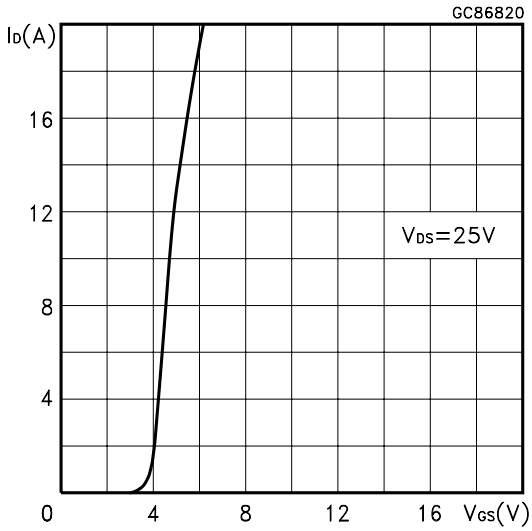


### Output Characteristics

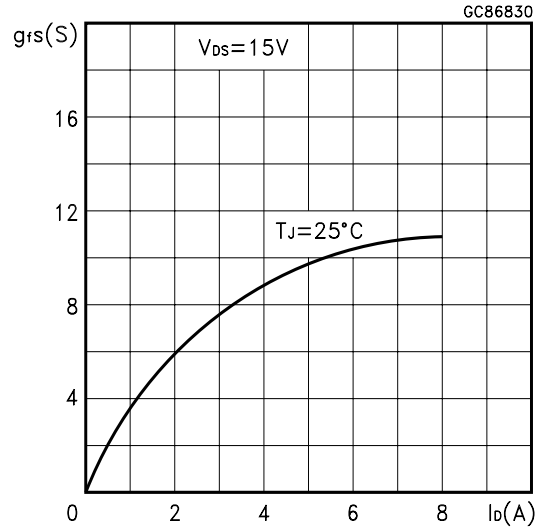




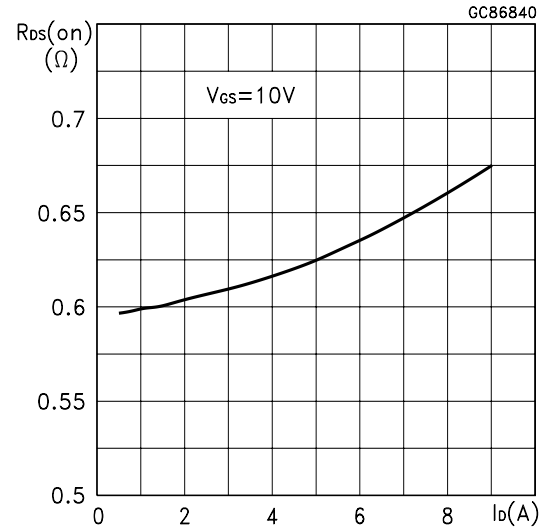

### Transfer Characteristics



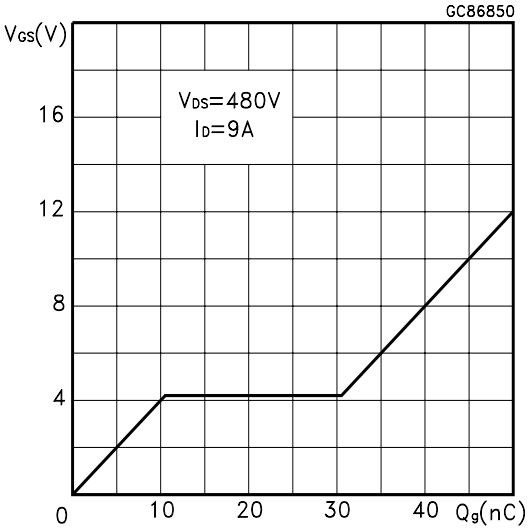

### Transconductance



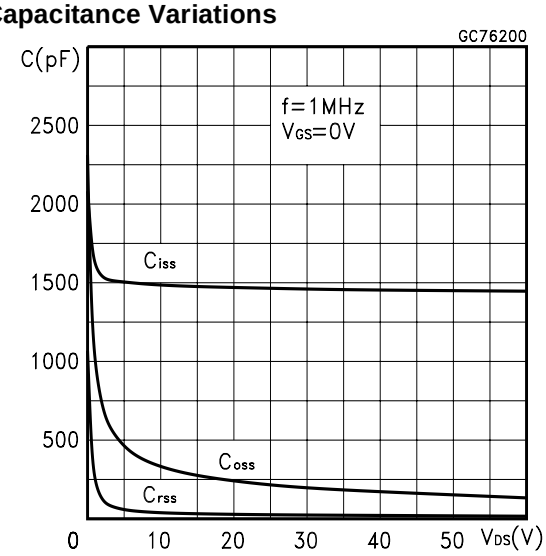

### Transconductance



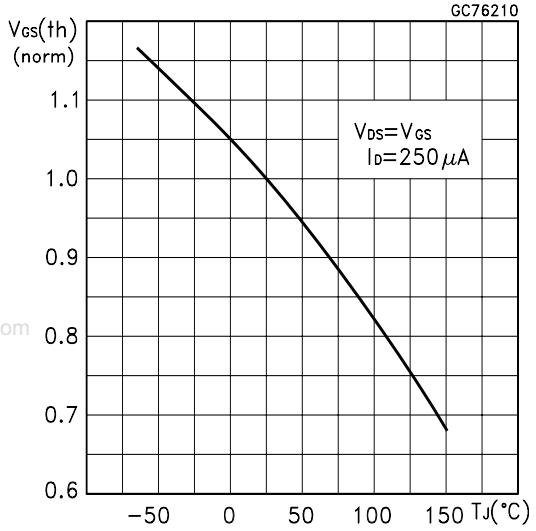

### Gate Charge vs Gate-source Voltage



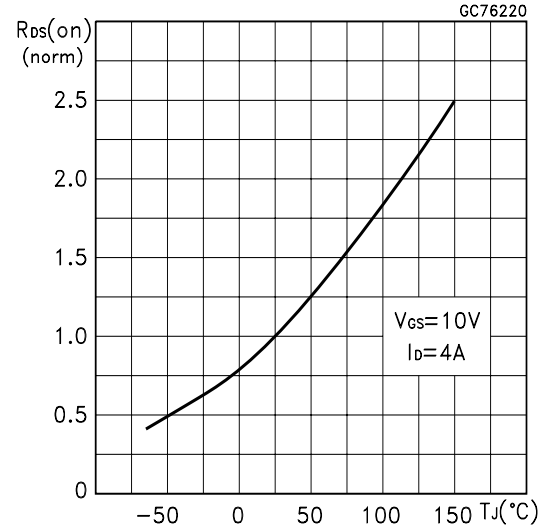

### Capacitance Variations



**Normalized Gate Thereshold Voltage vs Temp.**




**Normalized On Resistance vs Temperature**




**Source-drain Diode Forward Characteristics**

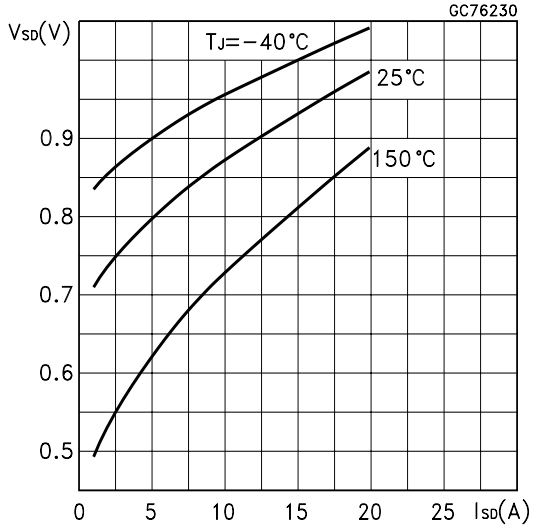


**Fig. 1:** Unclamped Inductive Load Test Circuit

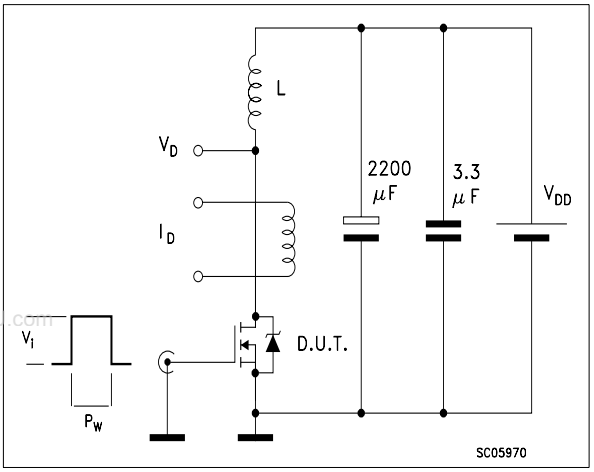



**Fig. 2:** Unclamped Inductive Waveform

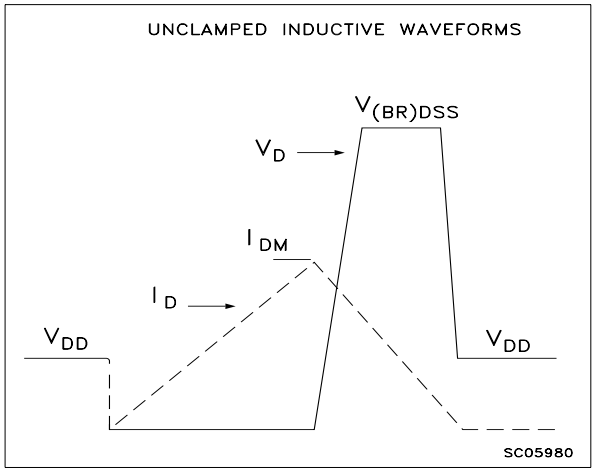



**Fig. 3:** Switching Times Test Circuit For Resistive Load

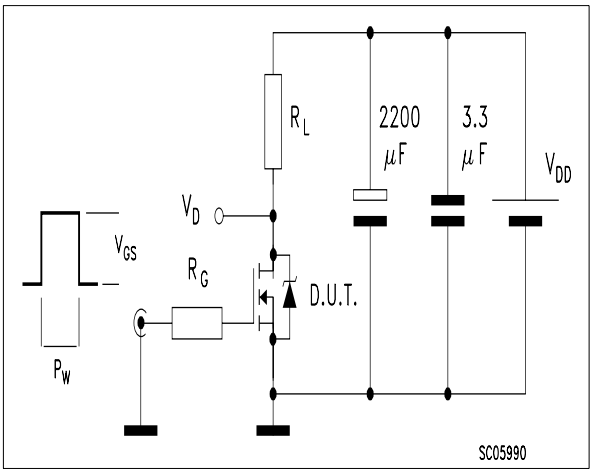



**Fig. 4:** Gate Charge test Circuit

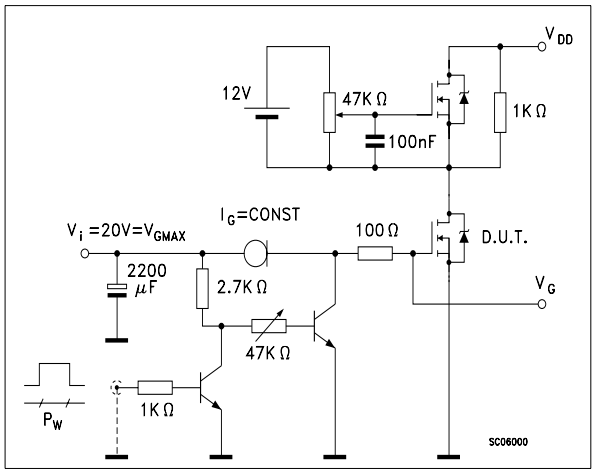
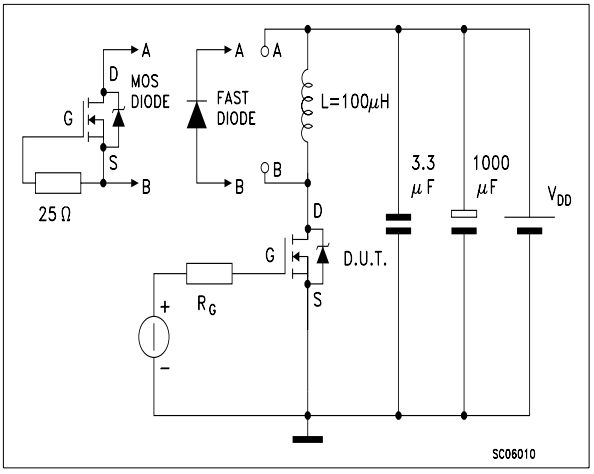
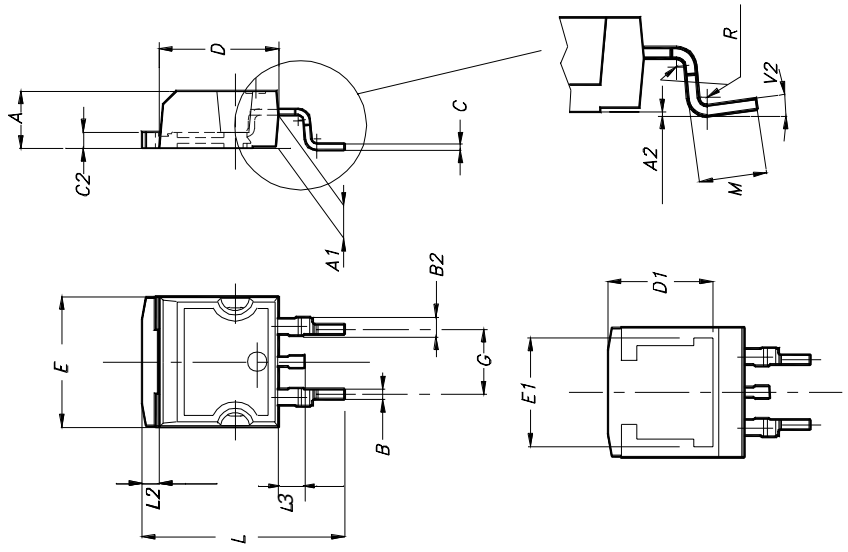



**Fig. 5:** Test Circuit For Inductive Load Switching And Diode Recovery Times



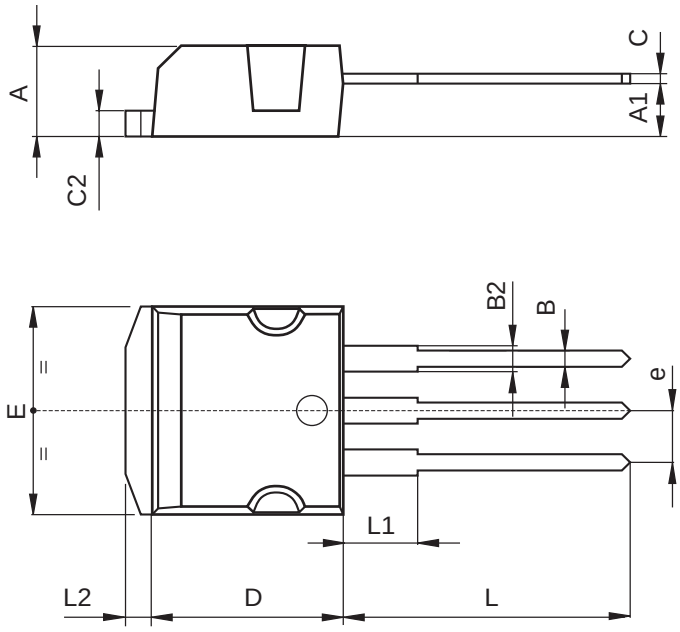
# D²PAK MECHANICAL DATA

| 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 | 0º | | 8º | | | |



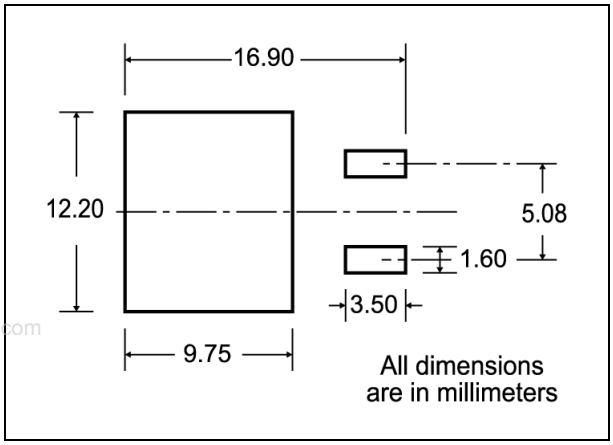
## TO-262 ($I^2$PAK) MECHANICAL DATA

| 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 |



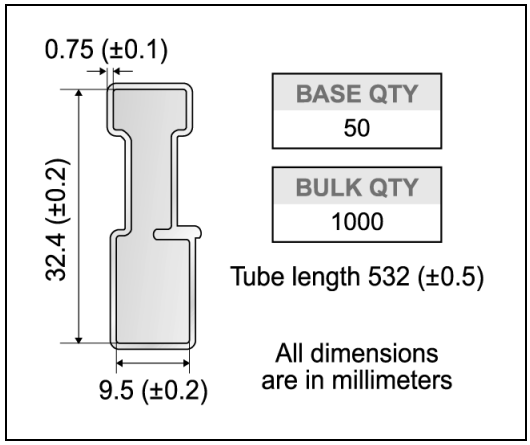

P011P5/E

## D²PAK FOOTPRINT

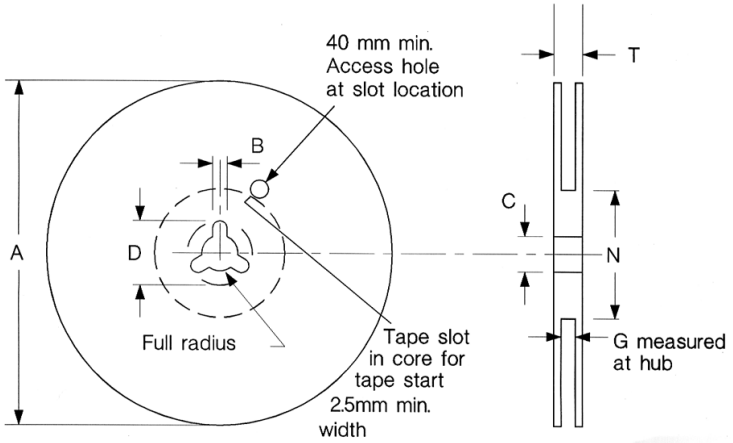





## TUBE SHIPMENT (no suffix)*




## TAPE AND REEL SHIPMENT (suffix "T4")*



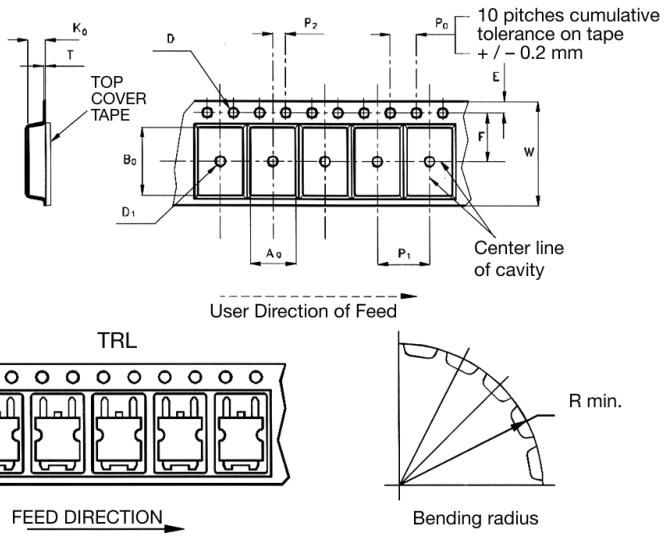

REEL MECHANICAL DATA

| 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 | | 0795 | |
| G | 24.4 | 26.4 | 0.960 | 1.039 |
| N | 100 | | 3.937 | |
| T | | 30.4 | | 1.197 |

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

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 |




* on sales type