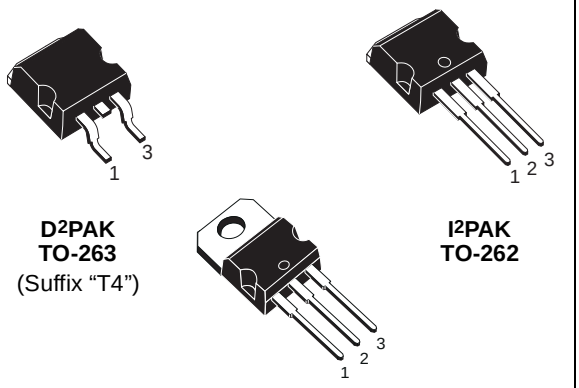
# STB140NF75 STP140NF75 STB140NF75-1

## N-CHANNEL 75V - 0.0065 Ω -120A D²PAK/I²PAK/TO-220 STripFET™ II POWER MOSFET

**AUTOMOTIVE SPECIFIC**

| TYPE | $V_{DSS}$ | $R_{DS(on)}$ | $I_D$ |
|---|---|---|---|
| STB140NF75 | 75 V | <0.0075 Ω | 120 A(**) |
| STP140NF75 | 75 V | <0.0075 Ω | 120 A(**) |
| STB140NF75-1 | 75 V | <0.0075 Ω | 120 A(**) |

- TYPICAL $R_{DS}$(on) = 0.0065 Ω
- SURFACE-MOUNTING D²PAK (TO-263) POWER PACKAGE



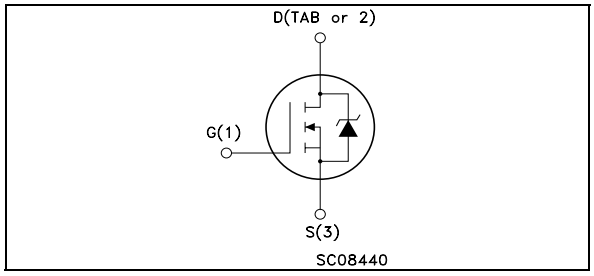

### DESCRIPTION

This Power MOSFET is the latest development of STMicroelectronis 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 SWITCHING SPEED
- SOLENOID AND RELAY DRIVERS
- AUTOMOTIVE 42V BATTERY DRIVERS

### INTERNAL SCHEMATIC DIAGRAM




### Ordering Information

| SALES TYPE | MARKING | PACKAGE | PACKAGING |
|---|---|---|---|
| STB140NF75T4 | B140NF75 | D²PAK | TAPE & REEL |
| STP140NF75 | P140NF75 | TO-220 | TUBE |
| STB140NF75-1 | B140NF75 | I²PAK | TUBE |

### ABSOLUTE MAXIMUM RATINGS

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_{DS}$ | Drain-source Voltage ($V_{GS}$ = 0) | 75 | V |
| $V_{DGR}$ | Drain-gate Voltage ($R_{GS}$ = 20 kΩ) | 75 | V |
| $V_{GS}$ | Gate- source Voltage | ± 20 | V |
| $I_D$(**) | Drain Current (continuous) at $T_C$ = 25°C | 120 | A |
| $I_D$ | Drain Current (continuous) at $T_C$ = 100°C | 100 | A |
| $I_{DM}$(•) | Drain Current (pulsed) | 480 | A |
| $P_{tot}$ | Total Dissipation at $T_C$ = 25°C | 310 | W |
| | Derating Factor | 2.08 | W/°C |
| dv/dt (1) | Peak Diode Recovery voltage slope | 10 | V/ns |
| $E_{AS}$ (2) | Single Pulse Avalanche Energy | 750 | mJ |
| $T_{stg}$ | Storage Temperature | -55 to 175 | °C |
| $T_j$ | Operating Junction Temperature | | |

(•) Pulse width limited by safe operating area.
(**) Current Limited by Package

(1) $I_{SD}$ ≤120A, di/dt ≤400A/µs, $V_{DD}$ ≤ $V_{(BR)DSS}$, $T_j$ ≤ $T_{JMAX}$
(2) Starting $T_j$ = 25 °C, $I_D$ = 60 A, $V_{DD}$ = 30V

## THERMAL DATA

| | | | | |
|---|---|---|---|---|
| Rthj-case | Thermal Resistance Junction-case | Max | 0.48 | °C/W |
| Rthj-amb | Thermal Resistance Junction-ambient | Max | 62.5 | °C/W |
| Rthj-pcb | Thermal Resistance Junction-pcb | Max | see curve on page 6 | °C/W |
| $T_l$ | Maximum Lead Temperature For Soldering Purpose (for 10 sec. 1.6 mm from case) | | 300 | °C |

## 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 | 75 | | | V |
| $I_{DSS}$ | Zero Gate Voltage Drain Current ($V_{GS}$ = 0) | $V_{DS}$ = Max Rating<br>$V_{DS}$ = Max Rating $T_C$ = 125°C | | | 1<br>10 | µA<br>µA |
| $I_{GSS}$ | Gate-body Leakage Current ($V_{DS}$ = 0) | $V_{GS}$ = ± 20 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 | 2 | | 4 | V |
| $R_{DS(on)}$ | Static Drain-source On Resistance | $V_{GS}$ = 10 V $I_D$ = 70 A | | 0.0065 | 0.0075 | Ω |

DYNAMIC

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $g_{fs}$ (*) | Forward Transconductance | $V_{DS}$ = 15 V $I_D$ = 70 A | | 160 | | S |
| $C_{iss}$<br>$C_{oss}$<br>$C_{rss}$ | Input Capacitance<br>Output Capacitance<br>Reverse Transfer Capacitance | $V_{DS}$ = 25V, f = 1 MHz, $V_{GS}$ = 0 | | 5000<br>960<br>310 | | pF<br>pF<br>pF |

**ELECTRICAL CHARACTERISTICS** (continued)

SWITCHING ON

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $t_{d(on)}$<br>$t_r$ | Turn-on Delay Time<br>Rise Time | $V_{DD}$ = 38 V $I_D$ = 70 A<br>$R_G$ = 4.7 Ω $V_{GS}$ = 10 V<br>(Resistive Load, Figure 3) | | 30<br>140 | | ns<br>ns |
| $Q_g$<br>$Q_{gs}$<br>$Q_{gd}$ | Total Gate Charge<br>Gate-Source Charge<br>Gate-Drain Charge | $V_{DD}$=60 V $I_D$=120A $V_{GS}$= 10V<br><br>(see test circuit, Figure 4) | | 160<br>28<br>70 | 218 | nC<br>nC<br>nC |

SWITCHING OFF

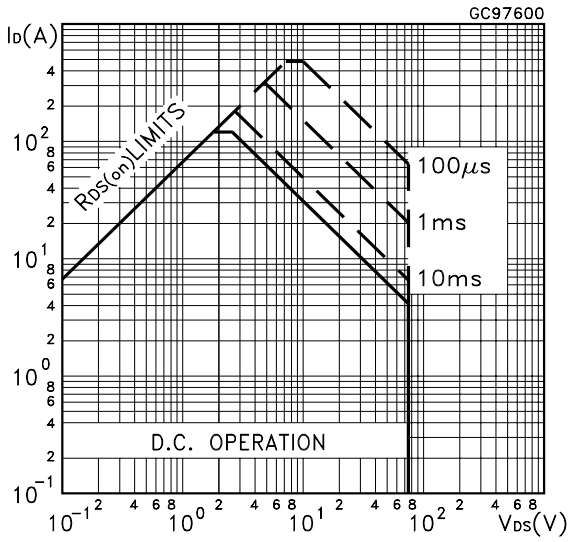
| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $t_{d(off)}$<br>$t_f$ | Turn-off Delay Time<br>Fall Time | $V_{DD}$ = 38 V $I_D$ = 70 A<br>$R_G$ = 4.7Ω, $V_{GS}$ = 10 V<br>(Resistive Load, Figure 3) | | 130<br>90 | | ns<br>ns |

SOURCE DRAIN DIODE

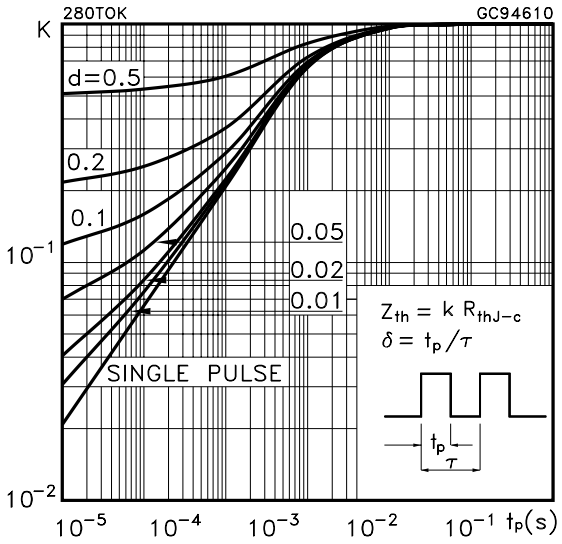
| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $I_{SD}$<br>$I_{SDM}$ (•) | Source-drain Current<br>Source-drain Current (pulsed) | | | | 120<br>480 | A<br>A |
| $V_{SD}$ (*) | Forward On Voltage | $I_{SD}$ = 120 A $V_{GS}$ = 0 | | | 1.5 | V |
| $t_{rr}$<br>$Q_{rr}$<br>$I_{RRM}$ | Reverse Recovery Time<br>Reverse Recovery Charge<br>Reverse Recovery Current | $I_{SD}$ = 120 A di/dt = 100A/µs<br>$V_{DD}$ = 35 V $T_j$ = 150°C<br>(see test circuit, Figure 5) | | 115<br>450<br>8 | | ns<br>nC<br>A |

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

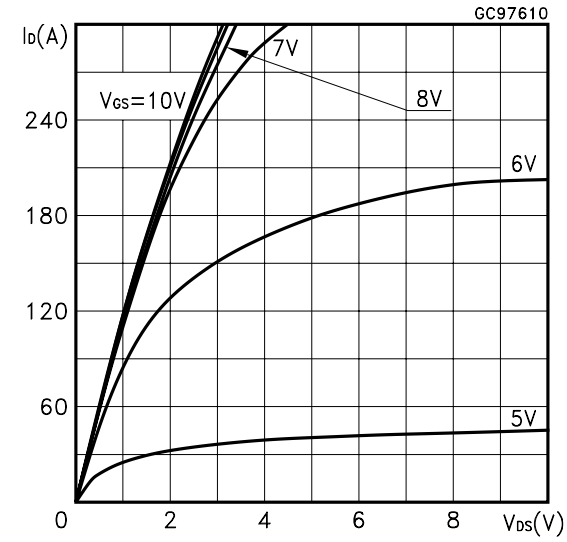
Safe Operating Area



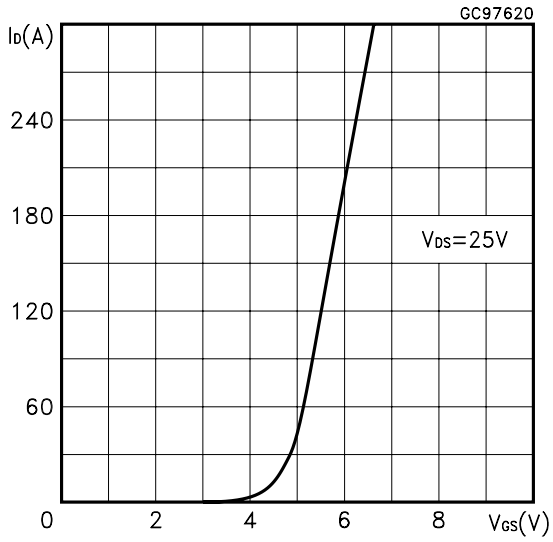

Thermal Impedance



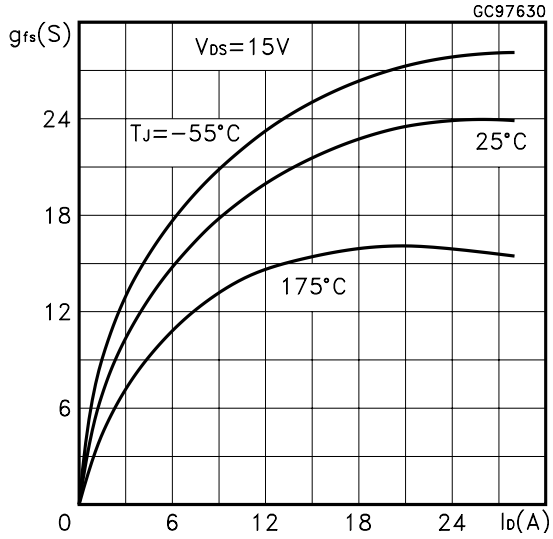
Output Characteristics



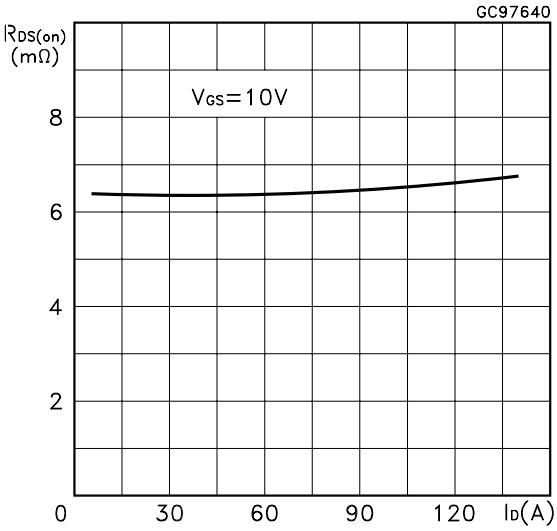

Transfer Characteristics



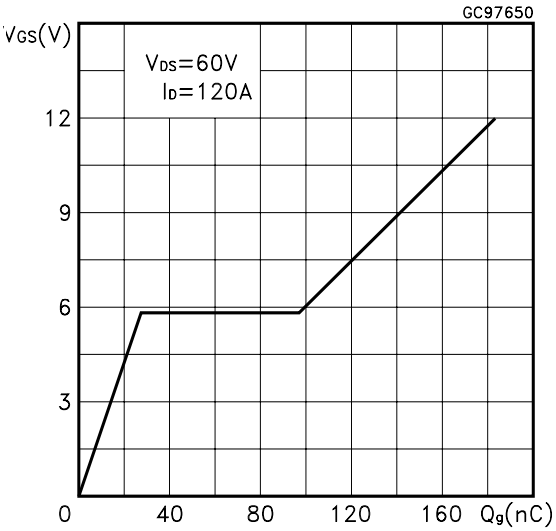

Transconductance



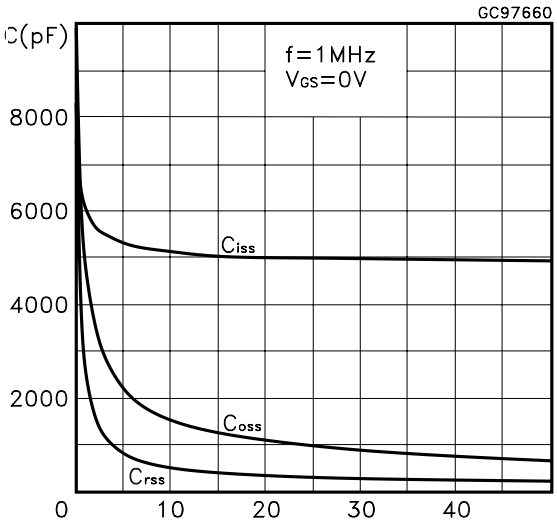

Static Drain-source On Resistance



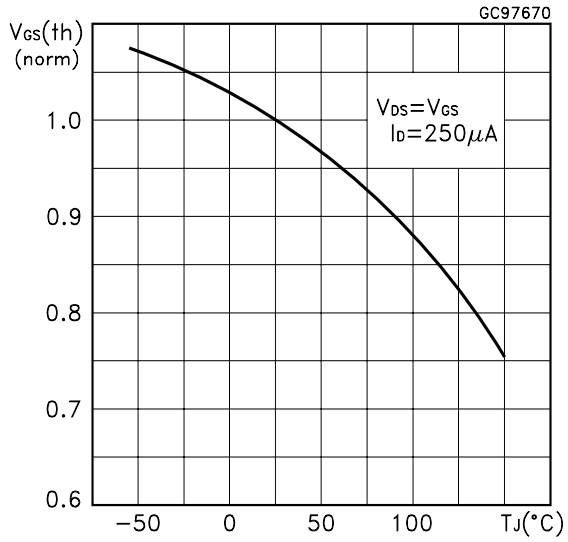

Gate Charge vs Gate-source Voltage



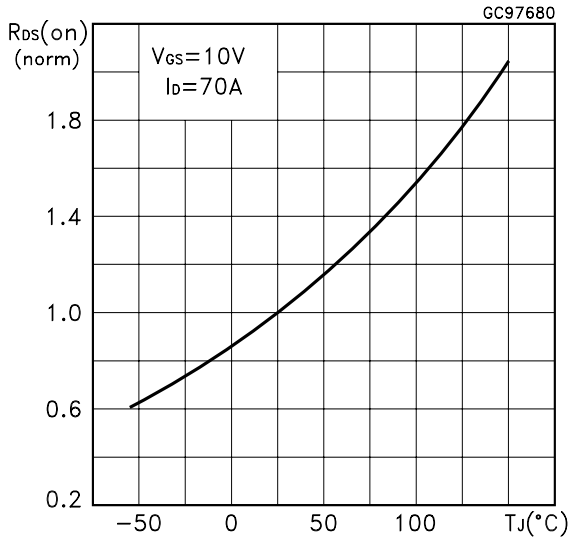

Capacitance Variations



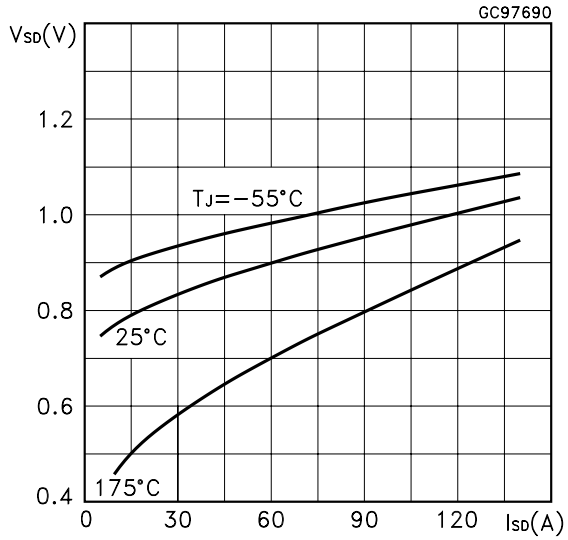
Normalized Gate Threshold Voltage vs Temperature



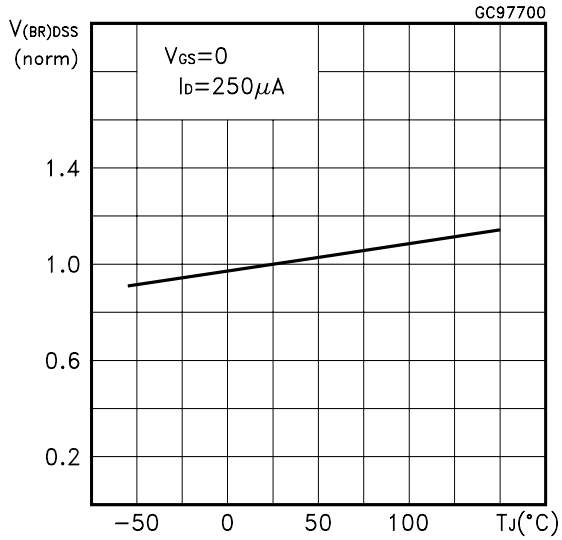

Normalized on Resistance vs Temperature



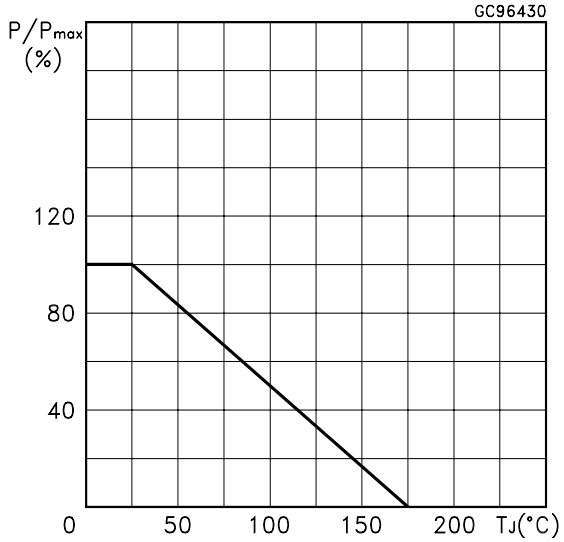

Source-drain Diode Forward Characteristics



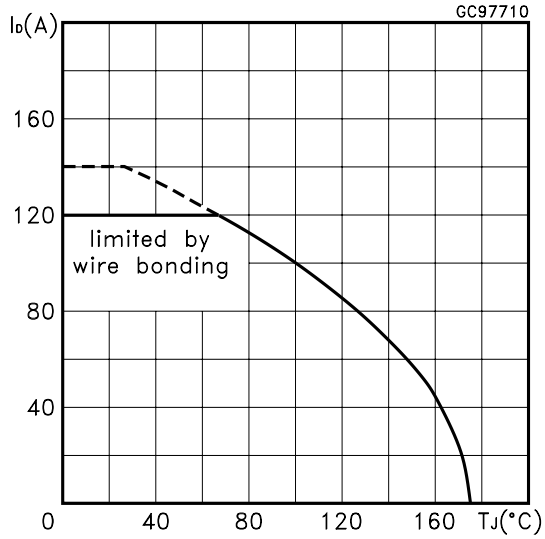

Normalized Breakdown Voltage vs Temperature.



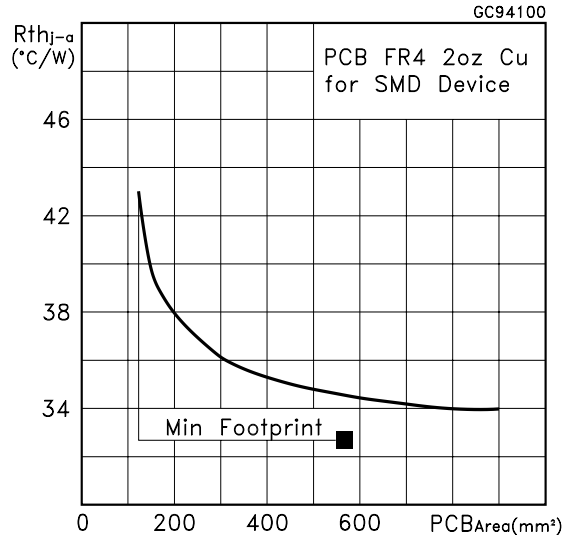

Power Derating vs Tc



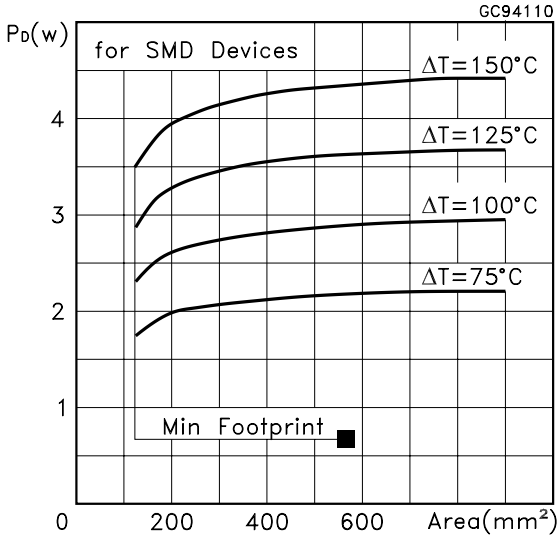

Max Id Current vs Tc.



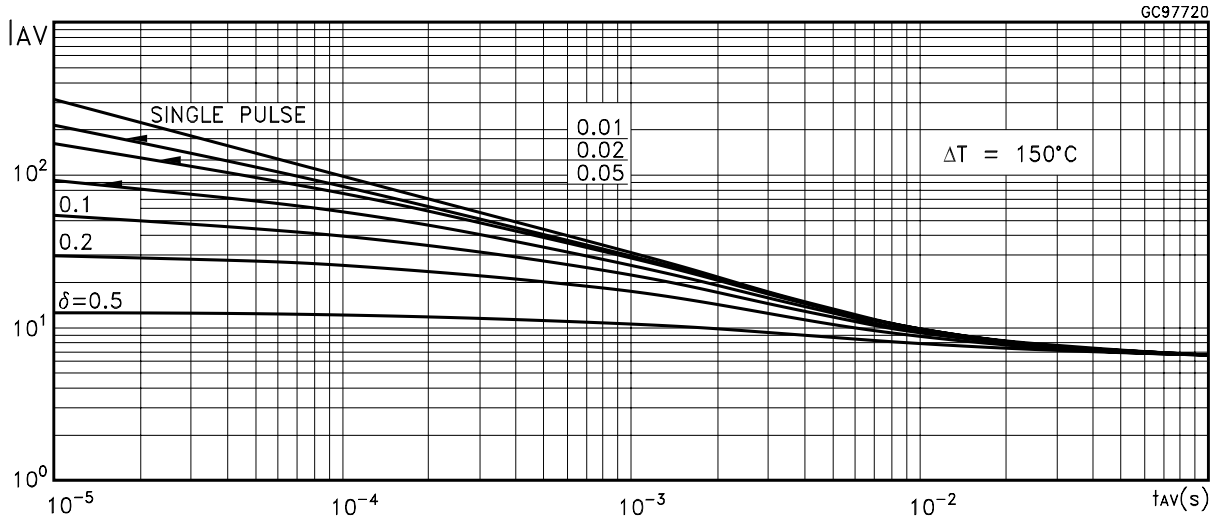
Thermal Resistance Rthj-a vs PCB Copper Area




Max Power Dissipation vs PCB Copper Area




**Allowable Iav vs. Time in Avalanche**




The previous curve gives the safe operating area for unclamped inductive loads, single pulse or repetitive, under the following conditions:

$P_{D(AVE)} = 0.5 * (1.3 * BV_{DSS} * I_{AV})$
$E_{AS(AR)} = P_{D(AVE)} * t_{AV}$

Where:
$I_{AV}$ is the Allowable Current in Avalanche
$P_{D(AVE)}$ is the Average Power Dissipation in Avalanche (Single Pulse)
$t_{AV}$ is the Time in Avalanche

To derate above 25 °C, at fixed $I_{AV}$, the following equation must be applied:

$$I_{AV} = 2 * (T_{jmax} - T_{CASE}) / (1.3 * BV_{DSS} * Z_{th})$$

Where:
$Z_{th} = K * R_{th}$ is the value coming from Normalized Thermal Response at fixed pulse width equal to $T_{AV}$ .

## SPICE THERMAL MODEL

| Parameter | Node | Value |
|---|---|---|
| CTHERM1 | 7 - 6 | $1.49 * 10^{-3}$ |
| CTHERM2 | 6 - 5 | $3.50 * 10^{-2}$ |
| CTHERM3 | 5 - 4 | $5.94 * 10^{-2}$ |
| CTHERM4 | 4 - 3 | $9.74 * 10^{-2}$ |
| CTHERM5 | 3 - 2 | $8.86 * 10^{-2}$ |
| CTHERM6 | 2 - 1 | $8.27 * 10^{-1}$ |
| | | |
| RTHERM1 | 7 - 6 | 0.0384 |
| RTHERM2 | 6 - 5 | 0.0624 |
| RTHERM3 | 5 - 4 | 0.072 |
| RTHERM4 | 4 - 3 | 0.0912 |
| RTHERM5 | 3 - 2 | 0.1008 |
| RTHERM6 | 2 - 1 | 0.1152 |

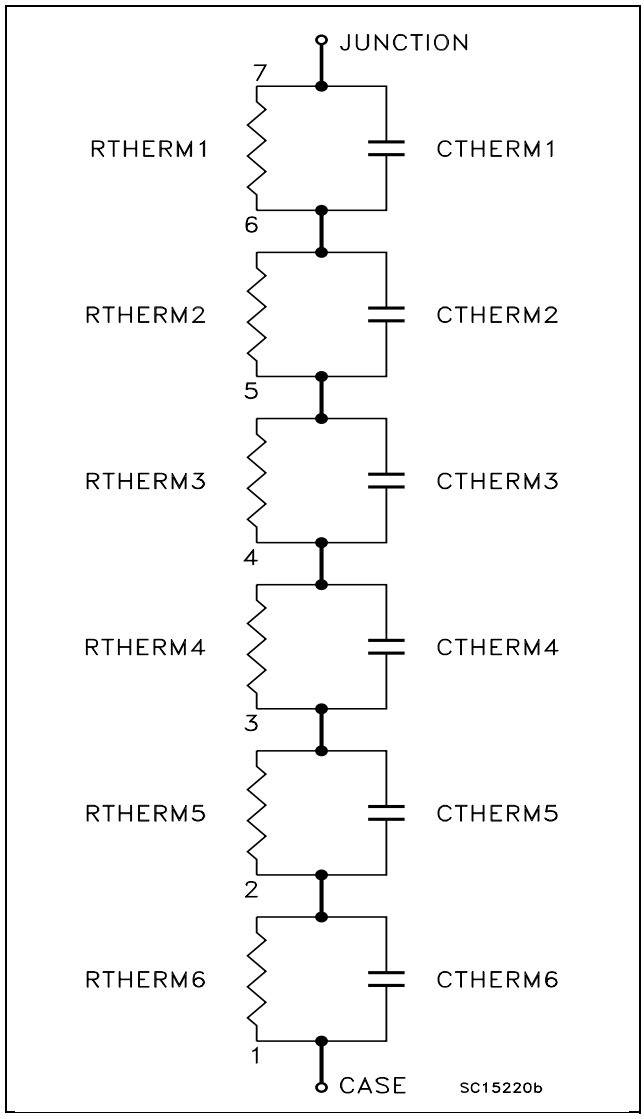


**Fig. 1:** Unclamped Inductive Load Test Circuit

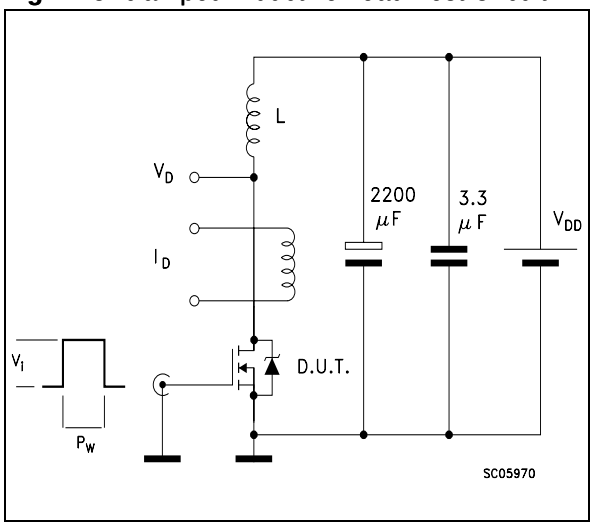



**Fig. 2:** Unclamped Inductive Waveform

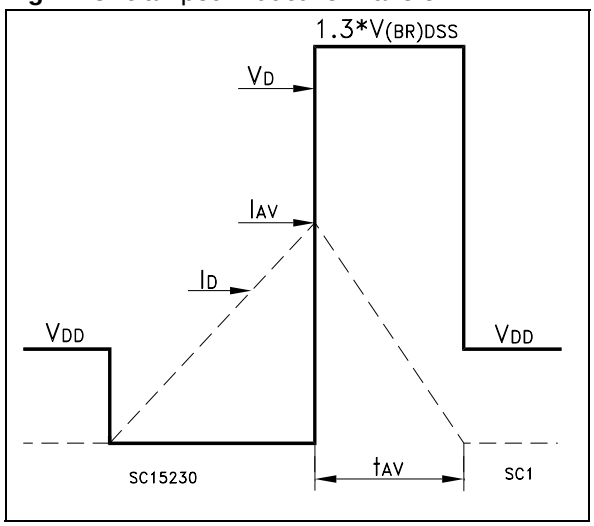



**Fig. 3:** Switching Times Test Circuits For Resistive Load

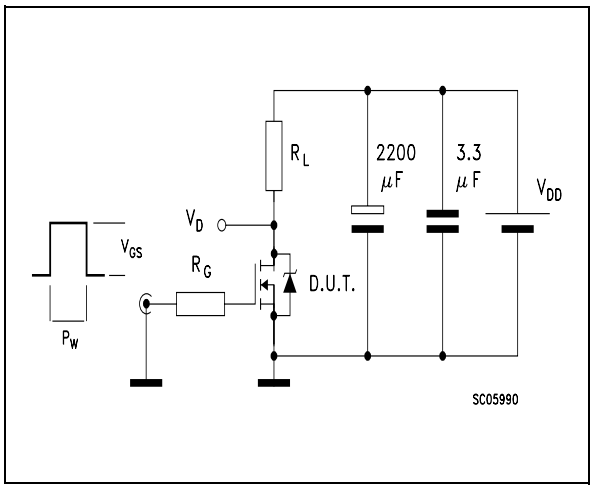



**Fig. 3.1:** Switching Time Waveform

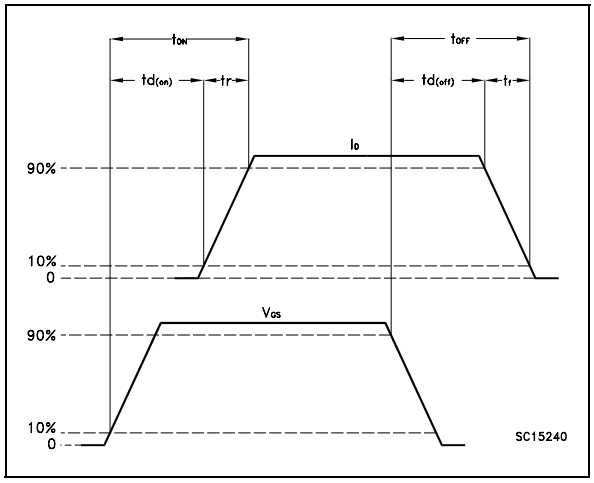



**Fig. 4:** Gate Charge Test Circuit

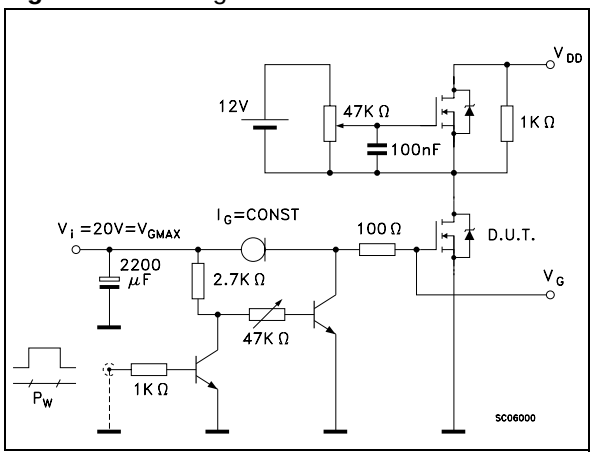



**Fig. 4.1:** Gate Charge Test Waveform

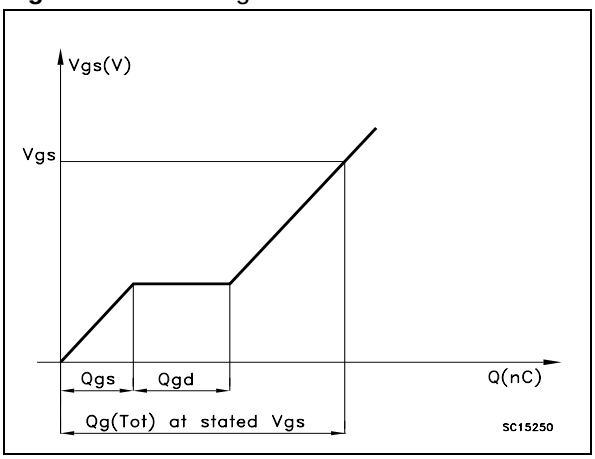


**Fig. 5:** Diode Switching Test Circuit

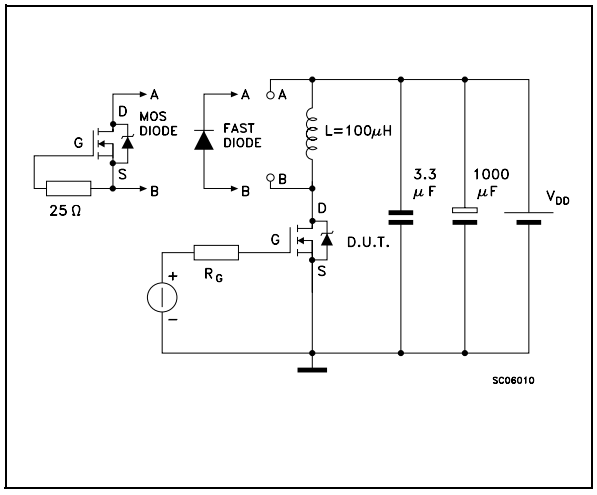
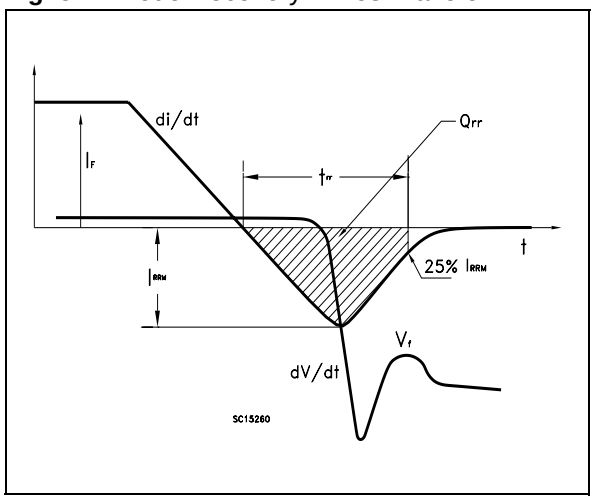
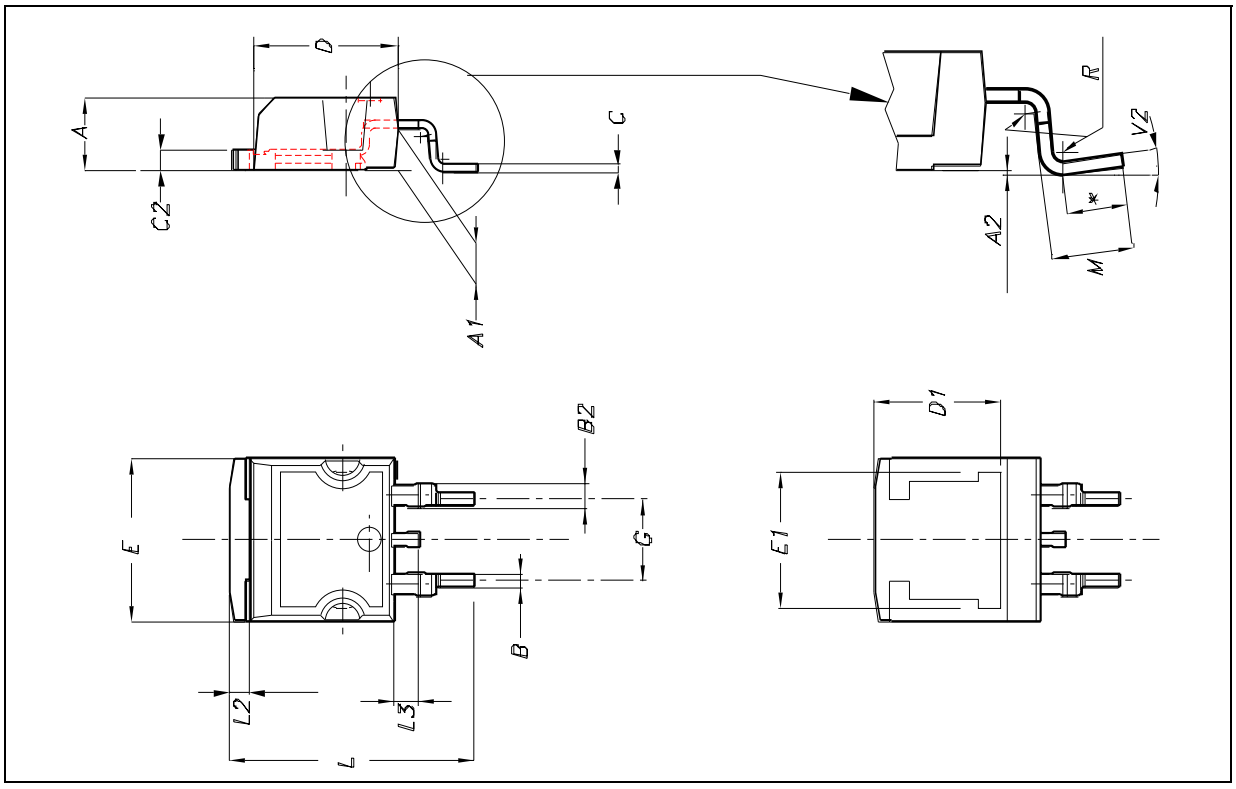



**Fig. 5.1:** Diode Recovery Times Waveform



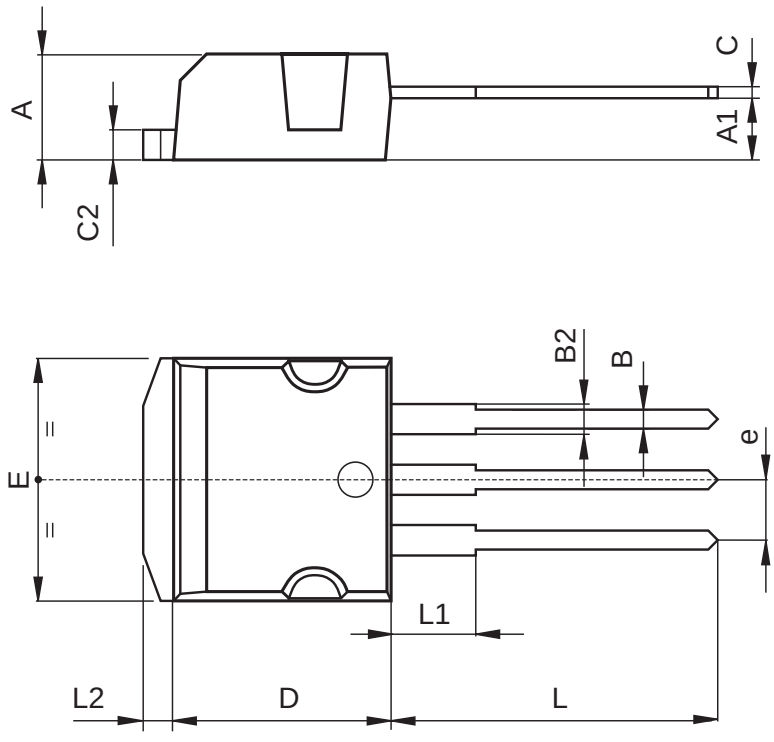
## D²PAK MECHANICAL DATA

| DIM. | mm. | | | inch. | | |
|---|---|---|---|---|---|---|
| | MIN. | TYP. | MAX. | MIN. | TYP. | TYP. |
| 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 | 0.028 | | 0.037 |
| B2 | 1.14 | | 1.7 | 0.045 | | 0.067 |
| C | 0.45 | | 0.6 | 0.018 | | 0.024 |
| C2 | 1.21 | | 1.36 | 0.048 | | 0.054 |
| D | 8.95 | | 9.35 | 0.352 | | 0.368 |
| D1 | | 8 | | | 0.315 | |
| E | 10 | | 10.4 | 0.394 | | 0.409 |
| E1 | | 8.5 | | | 0.334 | |
| G | 4.88 | | 5.28 | 0.192 | | 0.208 |
| L | 15 | | 15.85 | 0.591 | | 0.624 |
| L2 | 1.27 | | 1.4 | 0.050 | | 0.055 |
| L3 | 1.4 | | 1.75 | 0.055 | | 0.069 |
| M | 2.4 | | 3.2 | 0.094 | | 0.126 |
| R | | 0.4 | | | 0.015 | |
| V2 | 0° | | 8° | 0° | | 8° |



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

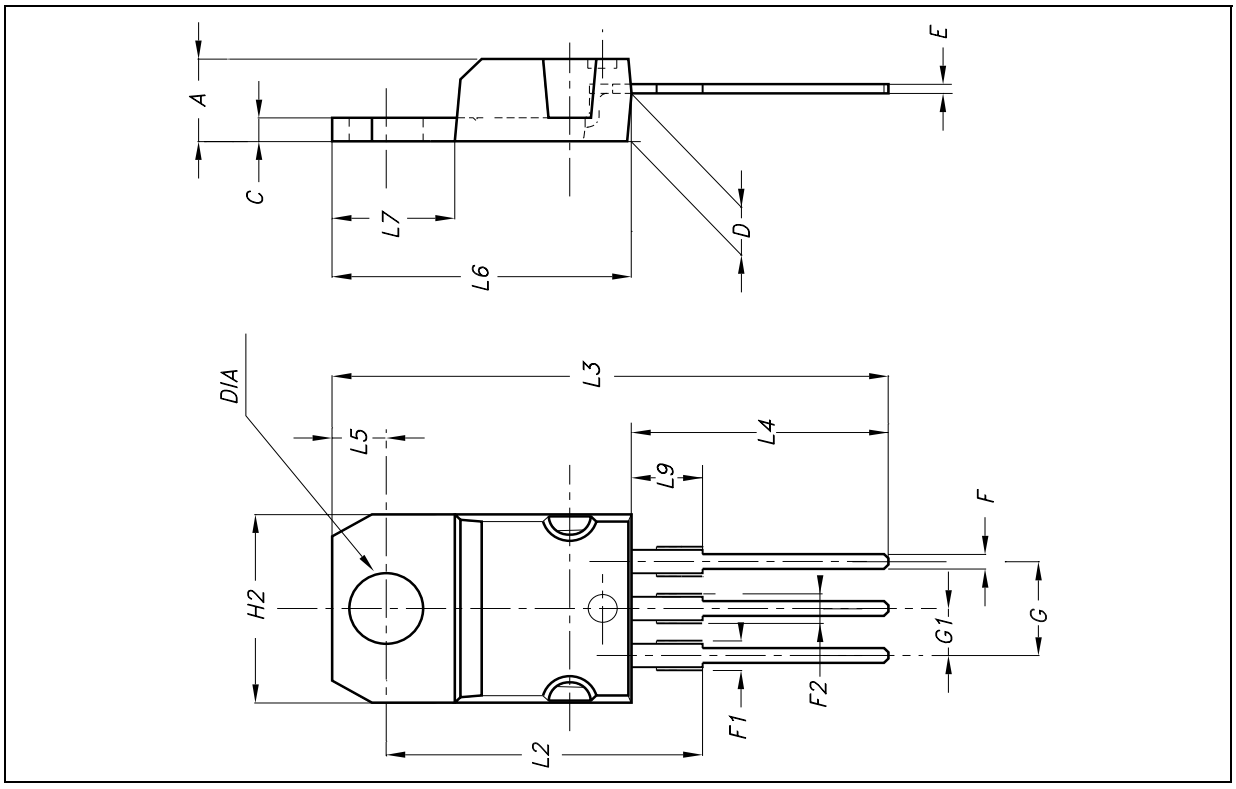
| DIM. | mm | | | inch | | |
|---|---|---|---|---|---|---|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | 4.4 | | 4.6 | 0.173 | | 0.181 |
| A1 | 2.49 | | 2.69 | 0.098 | | 0.106 |
| B | 0.7 | | 0.93 | 0.027 | | 0.036 |
| B2 | 1.14 | | 1.7 | 0.044 | | 0.067 |
| C | 0.45 | | 0.6 | 0.017 | | 0.023 |
| 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 |



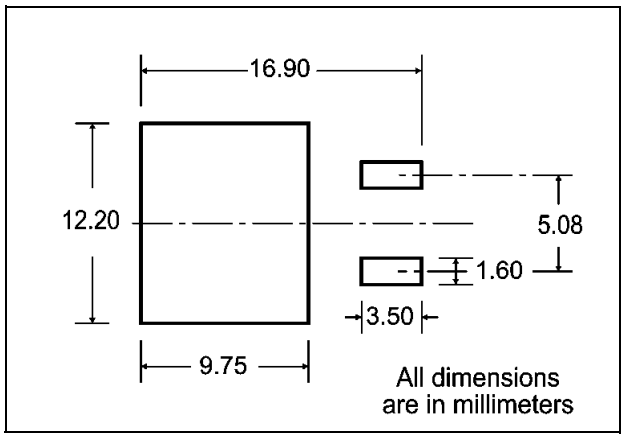

P011P5/E

## TO-220 MECHANICAL DATA

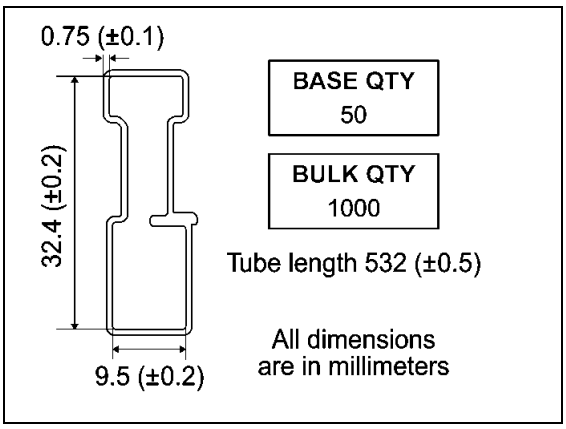
| DIM. | mm. | | | inch. | | |
|---|---|---|---|---|---|---|
| | MIN. | TYP. | MAX. | MIN. | TYP. | TYP. |
| A | 4.4 | | 4.6 | 0.173 | | 0.181 |
| C | 1.23 | | 1.32 | 0.048 | | 0.051 |
| D | 2.40 | | 2.72 | 0.094 | | 0.107 |
| E | 0.49 | | 0.70 | 0.019 | | 0.027 |
| F | 0.61 | | 0.88 | 0.024 | | 0.034 |
| 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 |



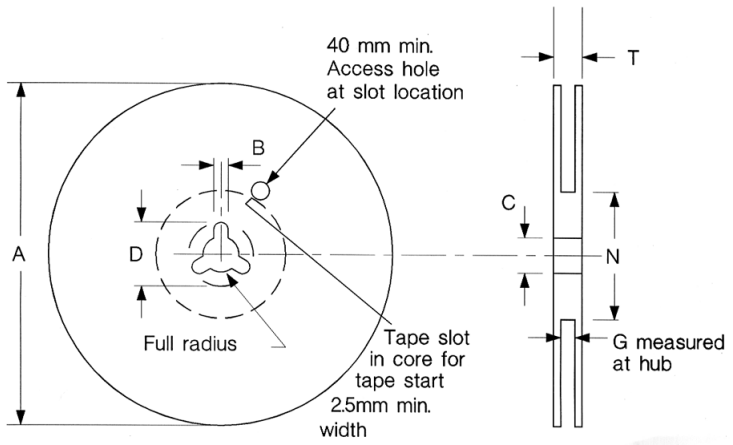
## D²PAK FOOTPRINT




## TUBE SHIPMENT (no suffix)*




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



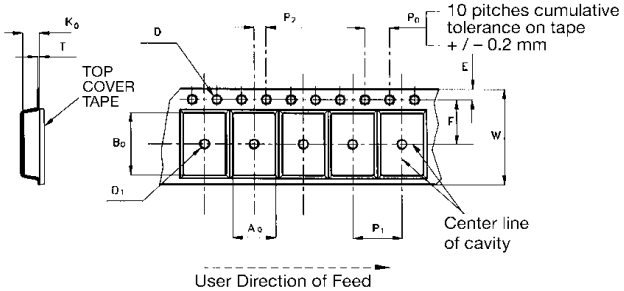

REEL MECHANICAL DATA

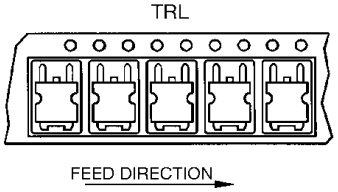
| DIM. | mm | | inch | |
|---|---|---|---|---|
| | MIN. | MAX. | MIN. | MAX. |
| A | | 330 | | 12.992 |
| B | 1.5 | | 0.059 | |
| C | 12.8 | 13.2 | 0.504 | 0.520 |
| D | 20.2 | | 0.795 | |
| G | 24.4 | 26.4 | 0.960 | 1.039 |
| N | 100 | | 3.937 | |
| T | | 30.4 | | 1.197 |

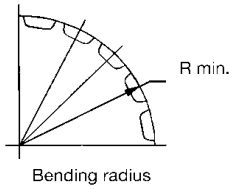
| BASE QTY | BULK QTY |
|---|---|
| 1000 | 1000 |

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 | 0075 | 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