



STP100NF04 STB100NF04, STB100NF04-1

N-CHANNEL 40V - 0.0043Ω - 120A TO-220/D²PAK/I²PAK
STripFET™ II POWER MOSFET

AUTOMOTIVE SPECIFIC

| TYPE | V _{DSS} | R _{DS(on)} | I _D | P _w |
|--------------|------------------|---------------------|----------------|----------------|
| STP100NF04 | 40 V | < 0.0046 Ω | 120 A | 300 W |
| STB100NF04 | 40 V | < 0.0046 Ω | 120 A | 300 W |
| STB100NF04-1 | 40 V | < 0.0046 Ω | 120 A | 300 W |

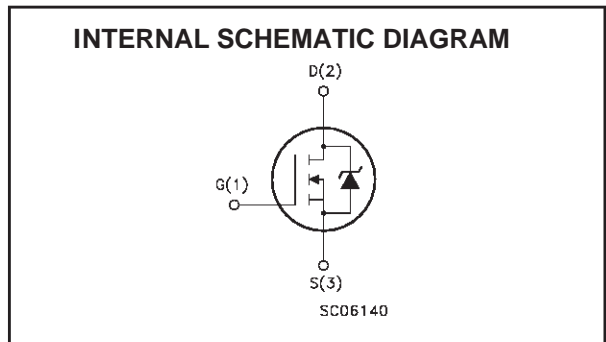
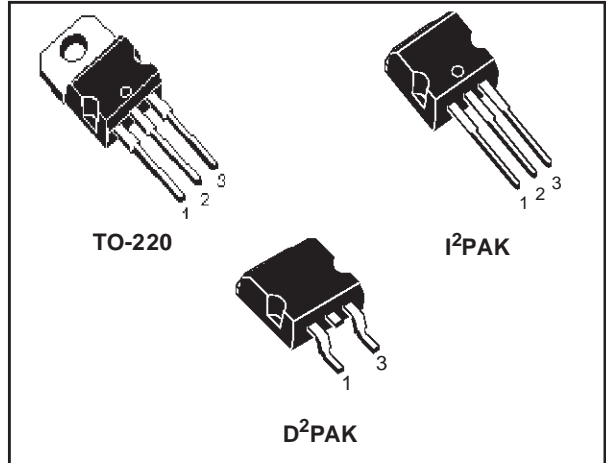
- TYPICAL R_{DS(on)} = 0.0043 Ω
- STANDARD THRESHOLD DRIVE
- 100% AVALANCHE TESTED

DESCRIPTION

This Power Mosfet is the latest development of ST-Microelectronics 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
- MOTOR CONTROL, AUDIO AMPLIFIERS
- DC-DC & DC-AC CONVERTERS
- SOLENOID AND RELAY DRIVERS



ORDERING INFORMATION

| SALES TYPE | MARKING | PACKAGE | PACKAGING |
|--------------|----------|--------------------|-------------|
| STP100NF04 | P100NF04 | TO-220 | TUBE |
| STB100NF04T4 | B100NF04 | D ² PAK | TAPE & REEL |
| STB100NF04-1 | B100NF04 | I ² PAK | TUBE |

STP100NF04, STB100NF04, STB100NF04-1

ABSOLUTE MAXIMUM RATINGS

| Symbol | Parameter | Value | Unit |
|------------------------------------|---|------------|------|
| V _{DS} | Drain-source Voltage (V _{GS} = 0) | 40 | V |
| V _{DGR} | Drain-gate Voltage (R _{GS} = 20 kΩ) | 40 | 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 | 120 | A |
| I _{DM} (i) | Drain Current (pulsed) | 480 | A |
| P _{TOT} | Total Dissipation at T _C = 25°C | 300 | W |
| | Derating Factor | 2 | W/°C |
| dv/dt (1) | Peak Diode Recovery voltage slope | 6 | V/ns |
| E _{AS} (2) | Single Pulse Avalanche Energy | 1.2 | J |
| T _j T _{stg} | Operating Junction Temperature Storage Temperature | -55 to 175 | °C |

(1) Pulse width limited by safe operating area

(1) I_{SD} ≤ 120A, di/dt ≤ 300A/μs, V_{DD} ≤ V_{(BR)DSS}, T_j ≤ T_{JMAX}.

(2) Starting T_j = 25°C, I_d = 60A, V_{DD} = 30 V

(#) Current Limited by Package

THERMAL DATA

| | | TO-220 / I ² PAK / D ² PAK | |
|-----------------------|--|--|------|
| R _{thj-case} | Thermal Resistance Junction-case Max | 0.5 | °C/W |
| R _{thj-pcb} | Thermal Resistance Junction-pcb Max | See Curve on page 6 | °C/W |
| R _{thj-amb} | Thermal Resistance Junction-ambient (Free air) Max | 62.5 | °C/W |
| T _l | Maximum Lead Temperature For Soldering Purpose | 300 | °C |

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

ON/OFF

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|----------------------|---|---|------|--------|---------|----------|
| V _{(BR)DSS} | Drain-source Breakdown Voltage | I _D = 250 μA, V _{GS} = 0 | 40 | | | 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 |
| V _{GS(th)} | Gate Threshold Voltage | V _{DS} = V _{GS} , I _D = 250μA | 2 | | 4 | V |
| R _{DS(on)} | Static Drain-source On Resistance | V _{GS} = 10V, I _D = 50 A | | 0.0043 | 0.0046 | Ω |

ELECTRICAL CHARACTERISTICS (CONTINUED)

DYNAMIC

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|-------------------------------------|---|--|------|---------------------|------|----------------|
| g_{fs} (1) | Forward Transconductance | $V_{DS} = 15\text{ V}, I_D = 50\text{ A}$ | | 150 | | S |
| C_{iss} C_{oss} C_{rss} | Input Capacitance Output Capacitance Reverse Transfer Capacitance | $V_{DS} = 25\text{ V}, f = 1\text{ MHz}, V_{GS} = 0$ | | 5100 1300 160 | | pF pF pF |

SWITCHING ON

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|-------------------------------|--|--|------|-----------------|------|----------------|
| $t_{d(on)}$ t_r | Turn-on Delay Time Rise Time | $V_{DD} = 20\text{ V}, I_D = 60\text{ A}$ $R_G = 4.7\Omega, V_{GS} = 10\text{ V}$ (Resistive Load see, Figure 3) | | 35 220 | | ns ns |
| Q_g Q_{gs} Q_{gd} | Total Gate Charge Gate-Source Charge Gate-Drain Charge | $V_{DD} = 32\text{ V}, I_D = 120\text{ A},$ $V_{GS} = 10\text{ V}$ (see, Figure 4) | | 110 35 35 | 150 | nC nC nC |

SWITCHING OFF

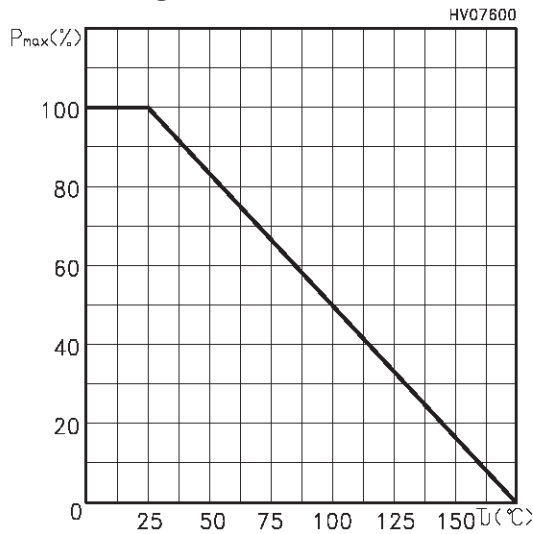
| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|-----------------------|----------------------------------|--|------|----------|------|----------|
| $t_{d(off)}$ t_f | Turn-off Delay Time Fall Time | $V_{DD} = 20\text{ V}, I_D = 60\text{ A}$ $R_G = 4.7\Omega, V_{GS} = 10\text{ V}$ (Resistive Load see, Figure 3) | | 80 50 | | ns ns |

SOURCE DRAIN DIODE

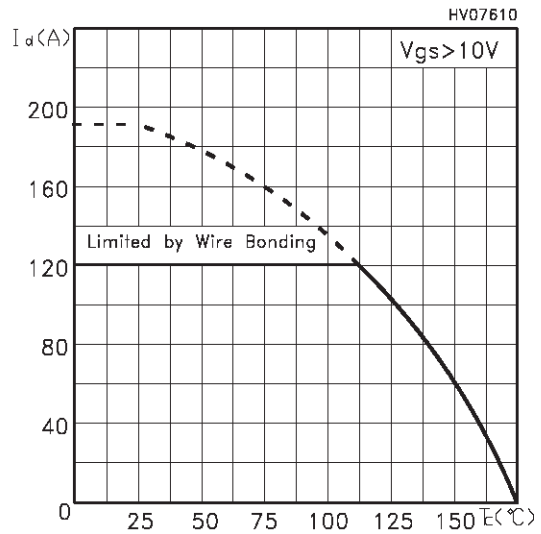
| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|-----------------------------------|--|--|------|----------------|------------|---------------|
| I_{SD} I_{SDM} (2) | Source-drain Current Source-drain Current (pulsed) | | | | 120 480 | A A |
| V_{SD} (1) | Forward On Voltage | $I_{SD} = 120\text{ A}, V_{GS} = 0$ | | | 1.3 | V |
| t_{rr} Q_{rr} I_{RRM} | Reverse Recovery Time Reverse Recovery Charge Reverse Recovery Current | $I_{SD} = 120\text{ A}, di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 20\text{ V}, T_j = 150^\circ\text{C}$ (see test circuit, Figure 5) | | 75 185 5 | | ns nC A |

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

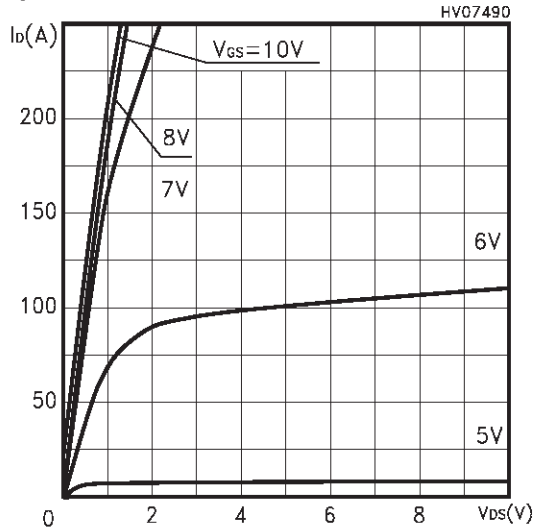
Power Derating vs Tc



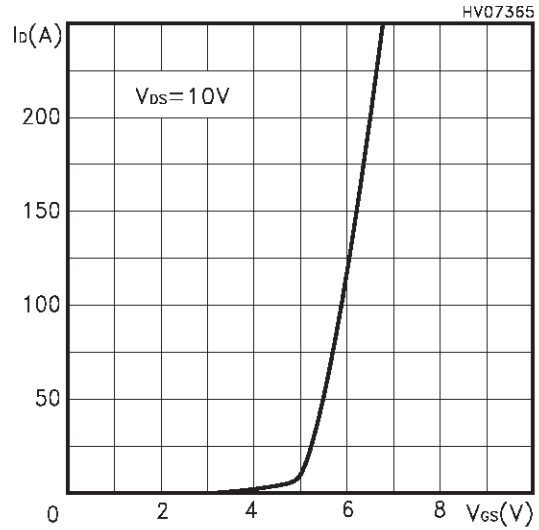
Max Id Current vs Tc



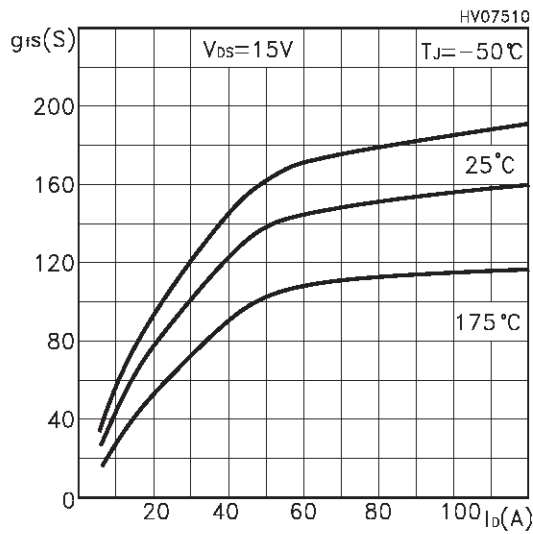
Output Characteristics



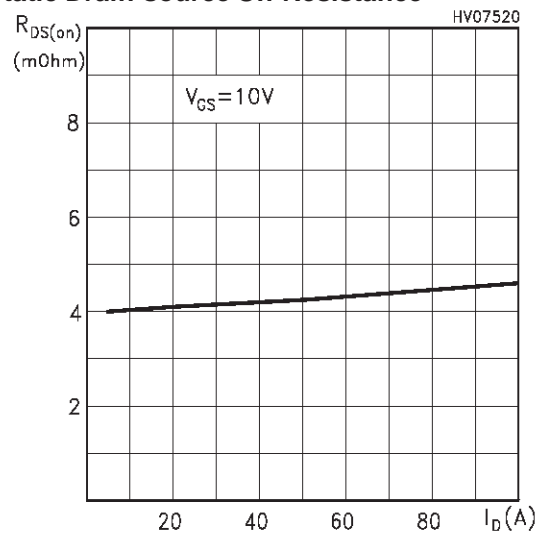
Transfer Characteristics



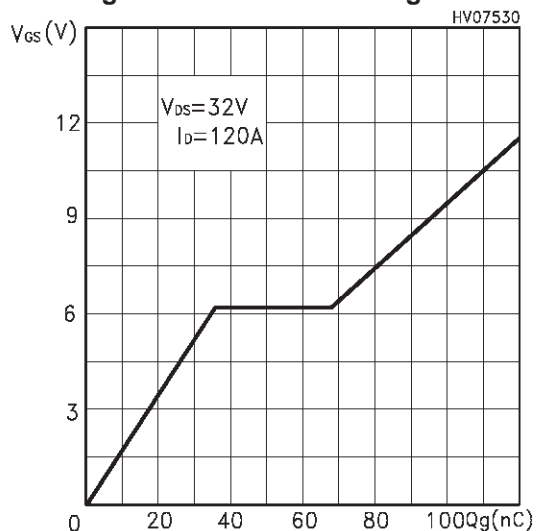
Transconductance



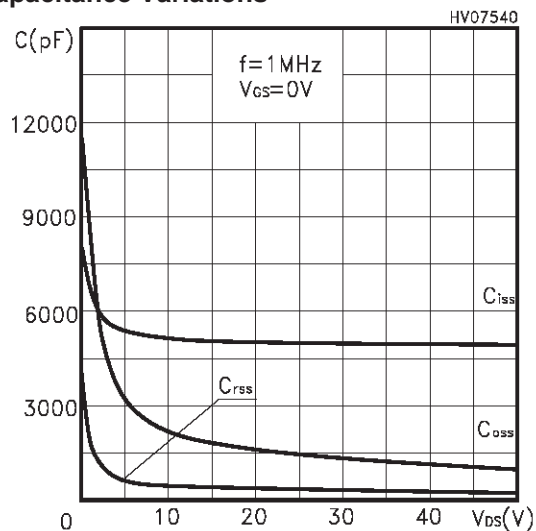
Static Drain-source On Resistance



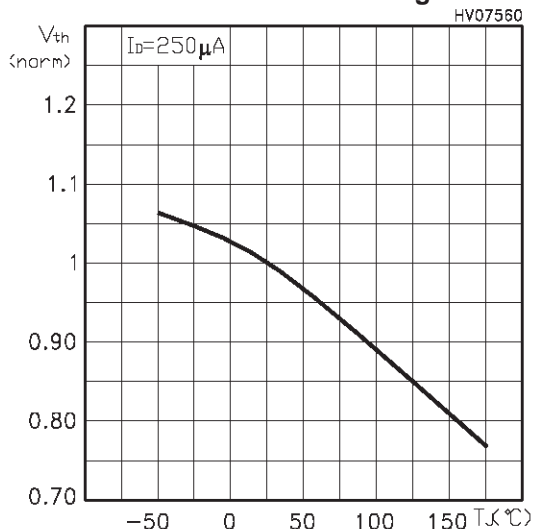
Gate Charge vs Gate-source Voltage



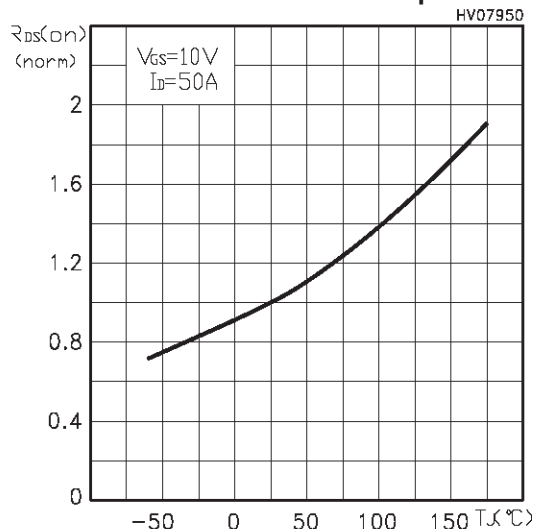
Capacitance Variations



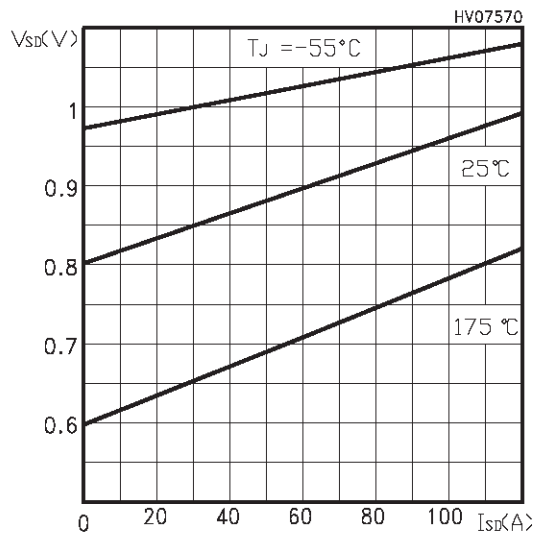
Normalized Gate Threshold Voltage vs Temp.



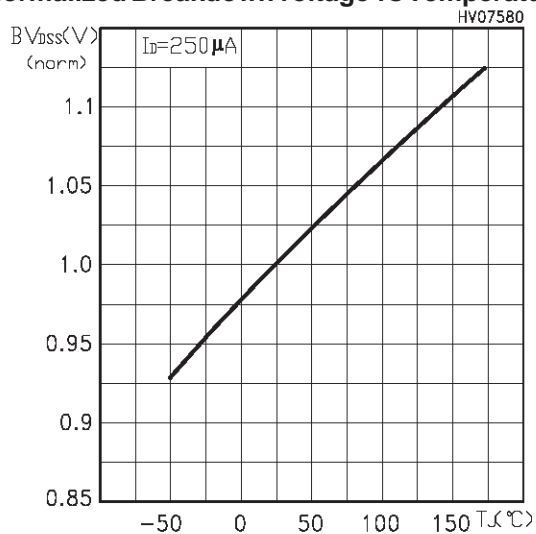
Normalized On Resistance vs Temperature



Source-drain Diode Forward Characteristics

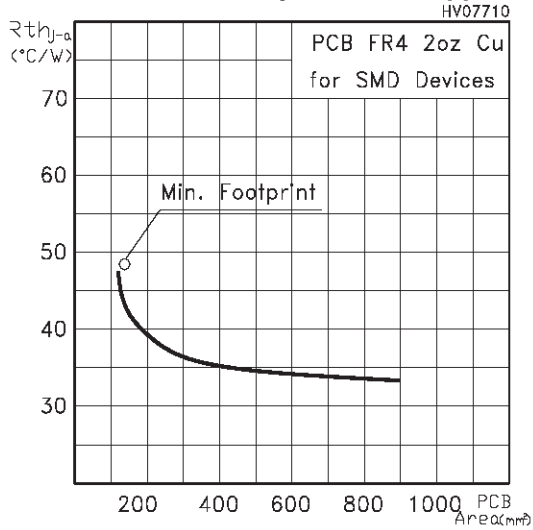


Normalized Breakdown voltage vs Temperature

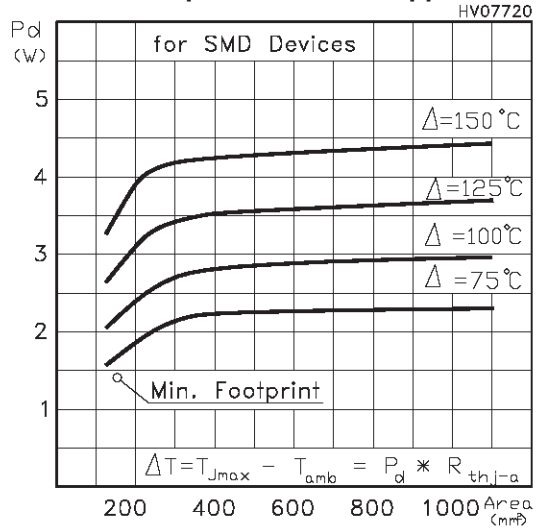


STP100NF04, STB100NF04, STB100NF04-1

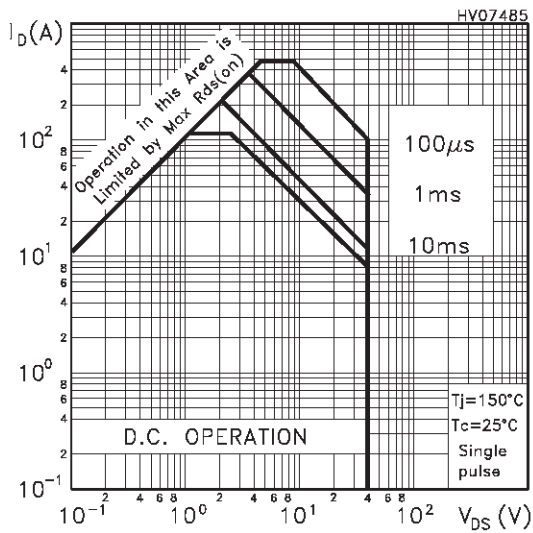
Thermal Resistance R_{thj-a} vs PCB Copper Area



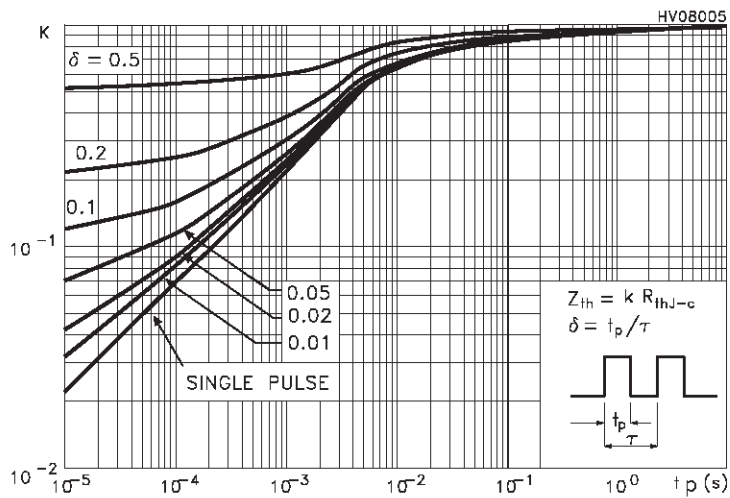
Max Power Dissipation vs PCB Copper Area



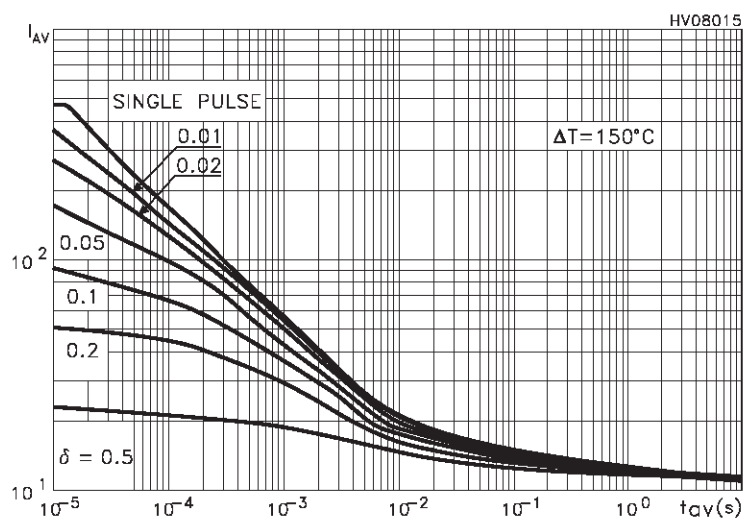
Safe Operating Area



Thermal Impedance



Allowable I_{AV} 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 | 5 - 4 | 0.011 |
| CTHERM2 | 4 - 3 | 0.0012 |
| CTHERM3 | 3 - 2 | 0.05 |
| CTHERM4 | 2 - 1 | 0.1 |
| | | |
| R THERM1 | 5 - 4 | 0.09 |
| R THERM2 | 4 - 3 | 0.02 |
| R THERM3 | 3 - 2 | 0.11 |
| R THERM4 | 2 - 1 | 0.17 |

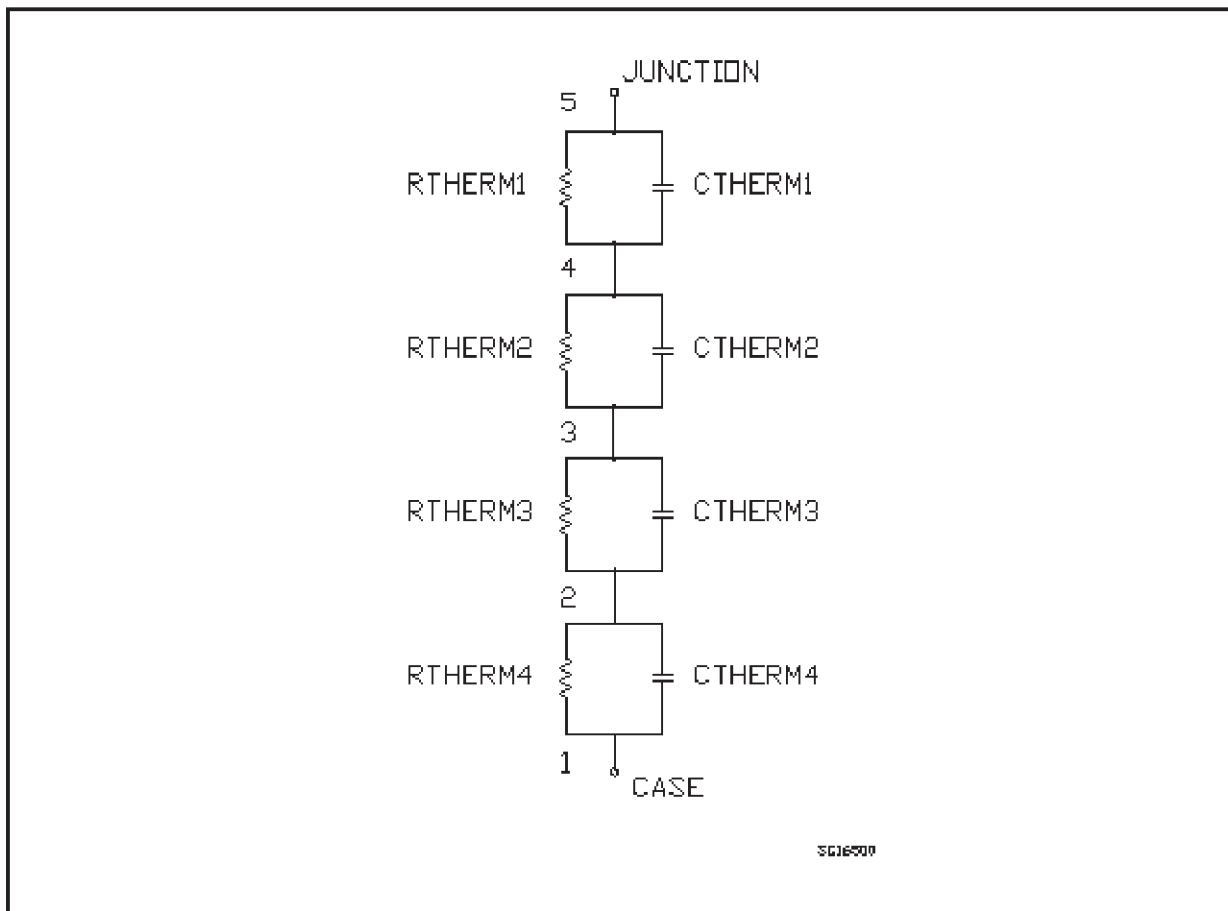


Fig. 1: Unclamped Inductive Load Test Circuit

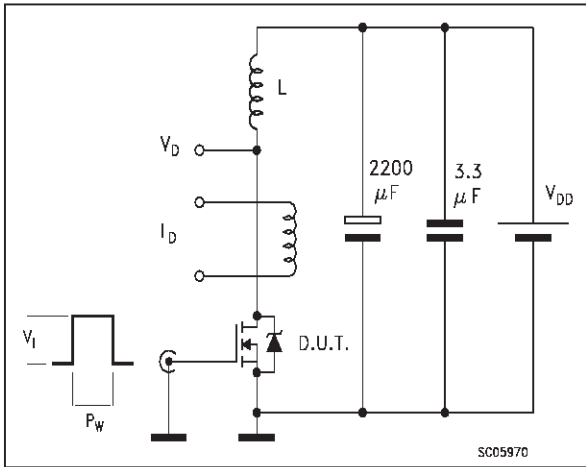


Fig. 2: Unclamped Inductive Waveform

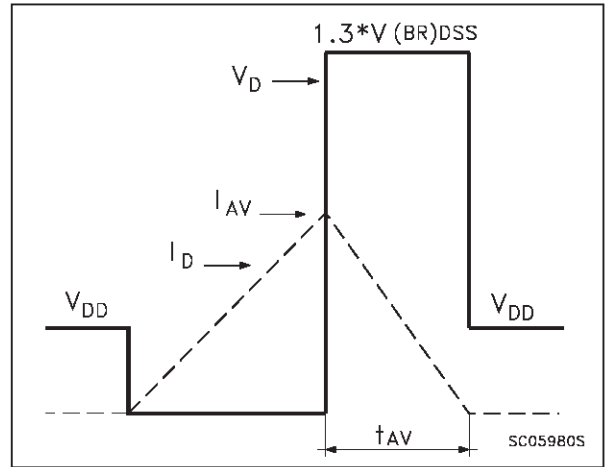


Fig. 3: Switching Times Test Circuit For Resistive Load

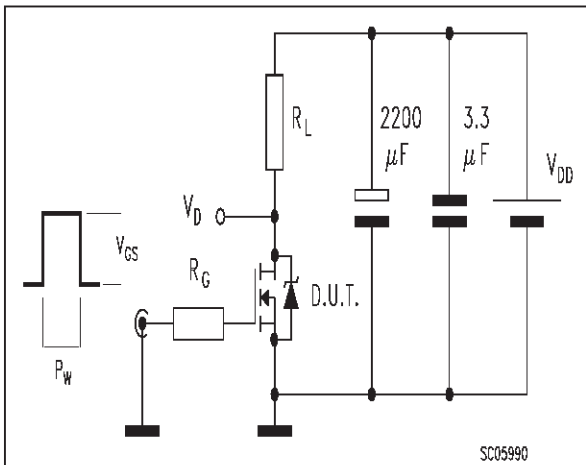


Fig. 3.1: Inductive Load Switching And Diode Recovery Times Waveform

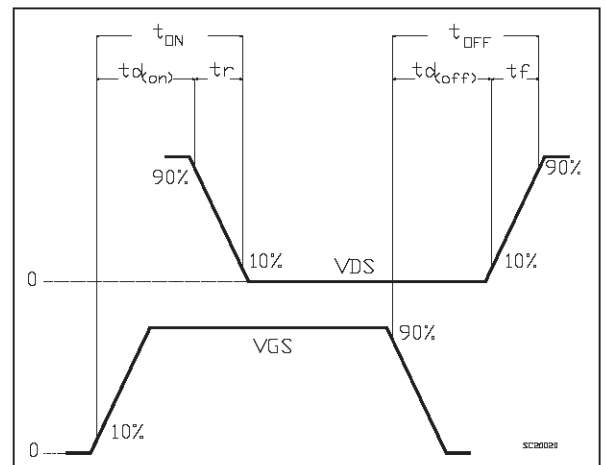


Fig. 4: Gate Charge test Circuit

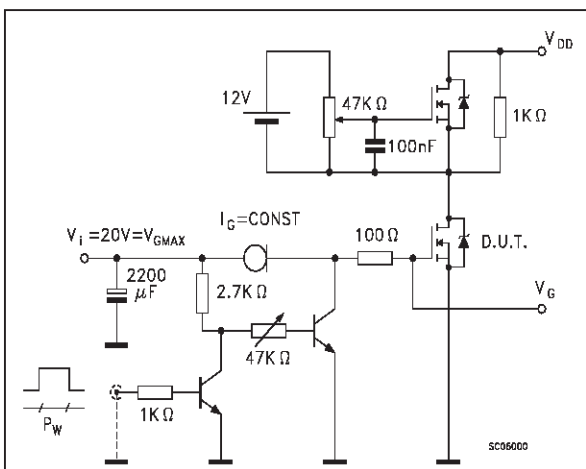


Fig. 4.1: Gate Charge test Waveform

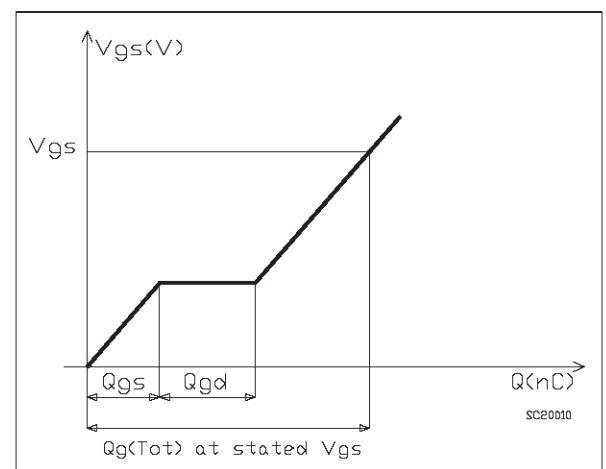


Fig. 5: Test Circuit For Diode Recovery Times

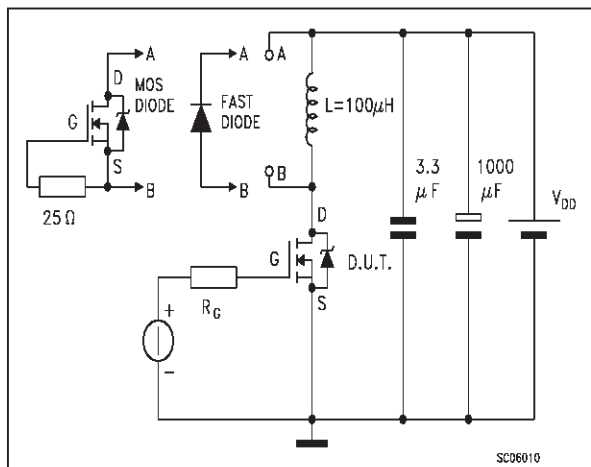
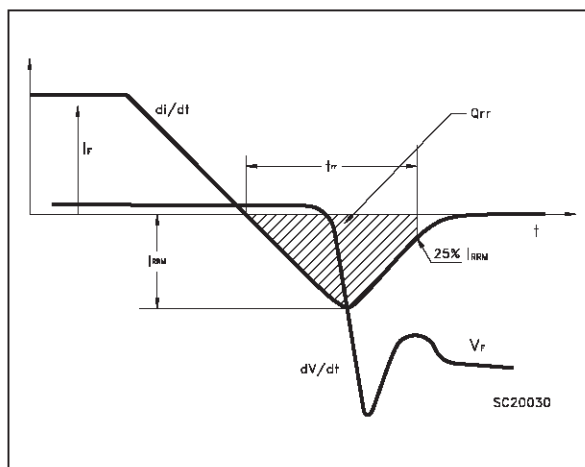
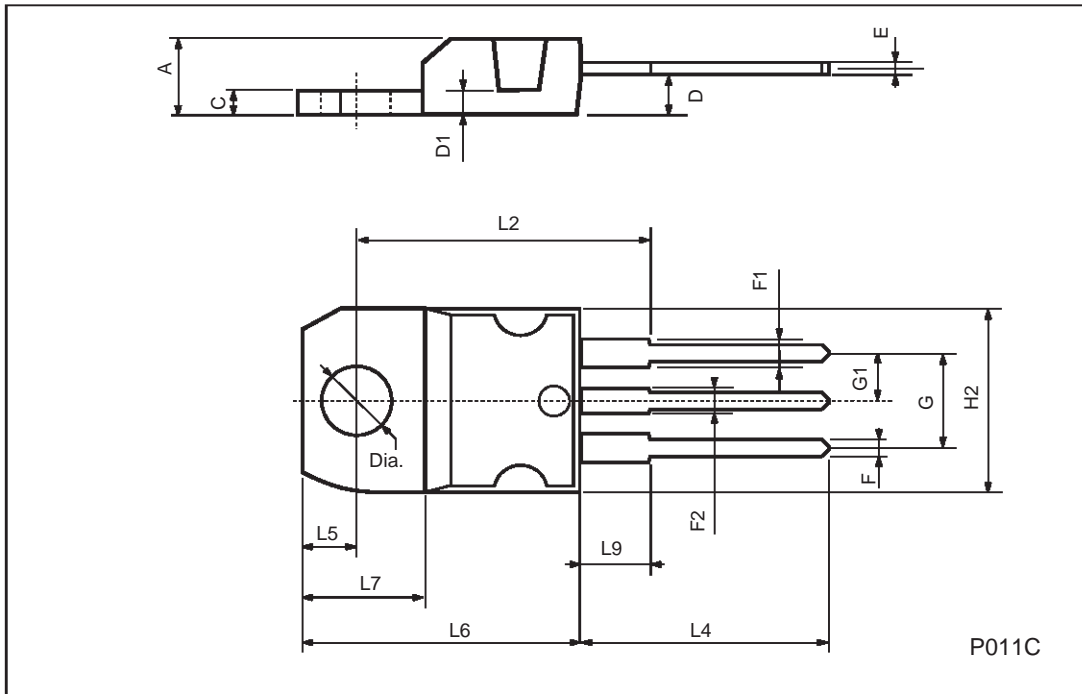


Fig. 5.1: Diode Recovery Times Waveform



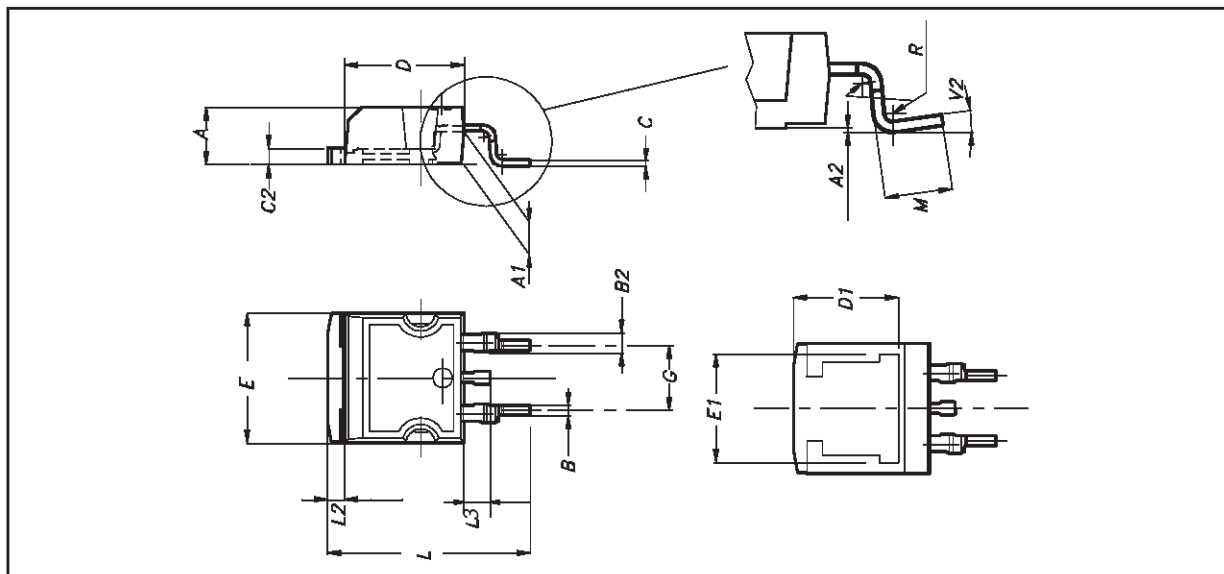
TO-220 MECHANICAL DATA

| 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 |



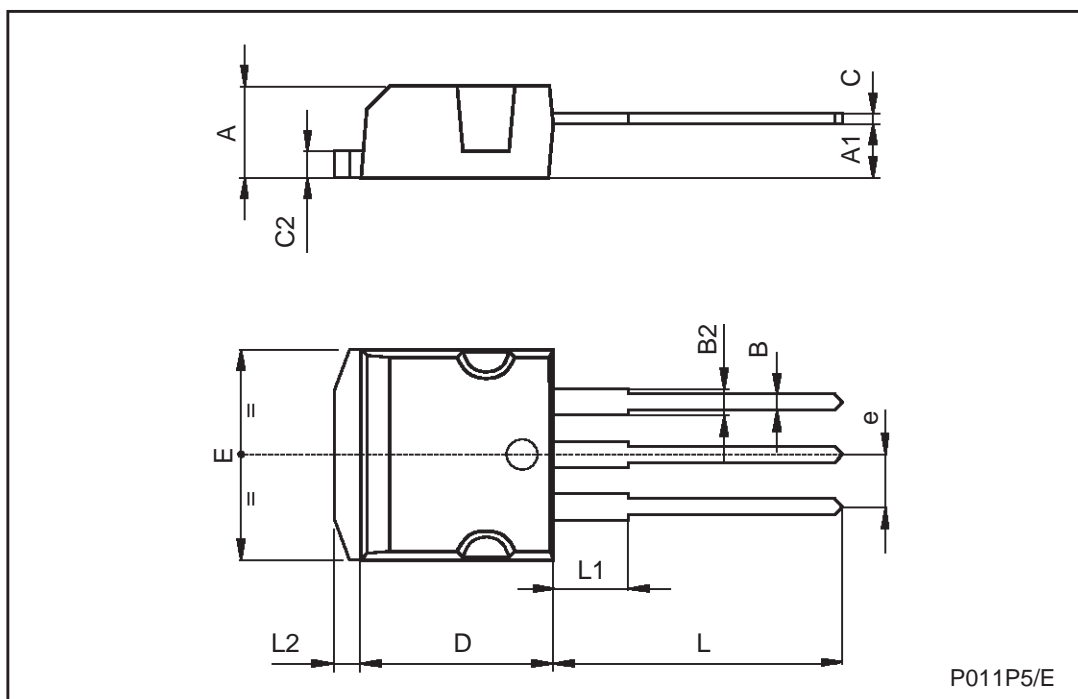
D²PAK MECHANICAL DATA

| 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° | | | |

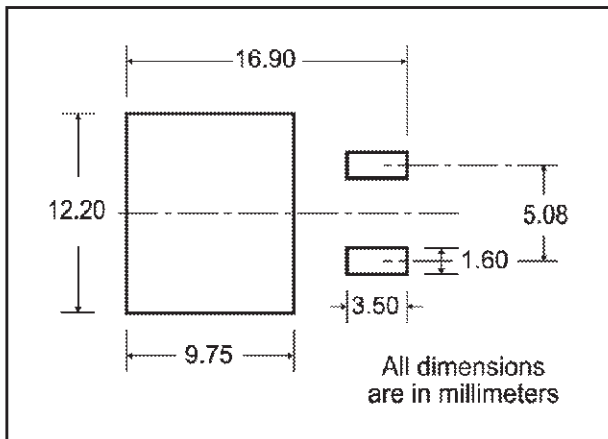


TO-262 (I²PAK) MECHANICAL DATA

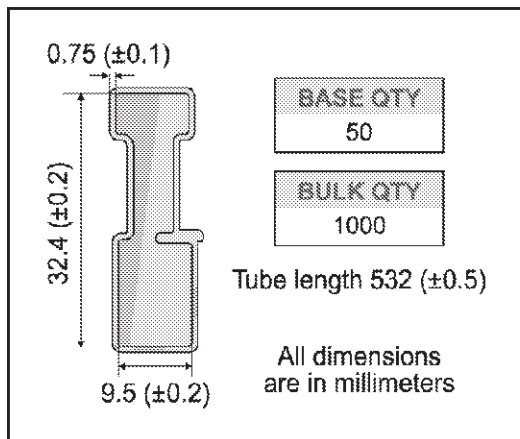
| DIM. | mm | | | inch | | |
|------|------|------|------|-------|------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | 4.4 | | 4.6 | 0.173 | | 0.181 |
| A1 | 2.49 | | 2.69 | 0.098 | | 0.106 |
| B | 0.7 | | 0.93 | 0.027 | | 0.036 |
| B2 | 1.14 | | 1.7 | 0.044 | | 0.067 |
| C | 0.45 | |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

40 mm min. Access hole at slot location

Full radius

Tape slot in core for tape start 2.5mm min. width

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 |

User Direction of Feed

10 pitches cumulative tolerance on tape + / - 0.2 mm

Center line of cavity

FEED DIRECTION

Bending radius

R min.

* on sales type
14/15



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