



STP25NM60N - STF25NM60N STB25NM60N/-1 - STW25NM60N

N-CHANNEL 600V 0.140Ω-20A TO-220/FP/D²/I²PAK/TO-247
SECOND GENERATION MDmesh™ MOSFET

PRODUCT PREVIEW

Table 1: General Features

| TYPE | V _{DS} (@T _{jmax}) | R _{DS(on)} | I _D |
|--------------|--|---------------------|----------------|
| STB25NM60N-1 | 650 V | < 0.170 Ω | 20 A |
| STF25NM60N | 650 V | < 0.170 Ω | 20(*) A |
| STP25NM60N | 650 V | < 0.170 Ω | 20 A |
| STW25NM60N | 650 V | < 0.170 Ω | 20 A |
| STB25NM60N | 650 V | < 0.170 Ω | 20 A |

- WORLD'S LOWEST ON RESISTANCE
- TYPICAL R_{DS(on)} = 0.140 Ω
- HIGH dv/dt AND AVALANCHE CAPABILITIES
- 100% AVALANCHE TESTED
- LOW INPUT CAPACITANCE AND GATE CHARGE
- LOW GATE INPUT RESISTANCE

DESCRIPTION

The **STP25NM60N** is realized with the second generation of MDmesh Technology. This revolutionary MOSFET associates a new vertical structure to the Company's strip layout to yield the world's lowest on-resistance and gate charge. It is therefore suitable for the most demanding high efficiency converters

APPLICATIONS

The MDmesh™ II family is very suitable for increase the power density of high voltage converters allowing system miniaturization and higher efficiencies.

Table 2: Order Code

| SALES TYPE | MARKING | PACKAGE | PACKAGING |
|--------------|----------|--------------------|-------------|
| STB25NM60N-1 | B25NM60N | I ² PAK | TUBE |
| STF25NM60N | F25NM60N | TO-220FP | TUBE |
| STP25NM60N | P25NM60N | TO-220 | TUBE |
| STW25NM60N | W25NM60N | TO-247 | TUBE |
| STB25NM60N | B25NM60N | D ² PAK | TAPE & REEL |

Figure 1: Package

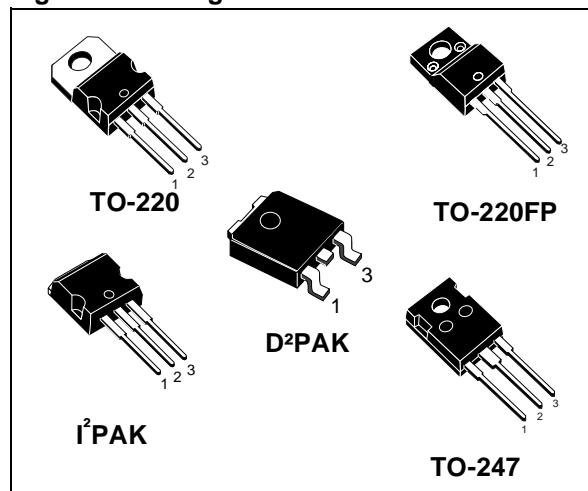
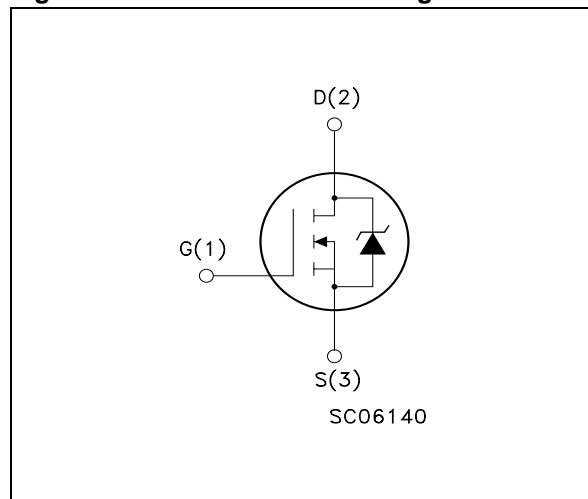


Figure 2: Internal Schematic Diagram



Rev. 4

Table 3: Absolute Maximum ratings

| Symbol | Parameter | Value | | Unit |
|---------------------|--|--|----------|------|
| | | TO-220/I ² PAK TO-247/D ² PAK | TO-220FP | |
| 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 | ± 25 | | V |
| I _D | Drain Current (continuous) at T _C = 25°C | 20 | 20 (*) | A |
| I _D | Drain Current (continuous) at T _C = 100°C | 12.8 | 12.8 (*) | A |
| I _{DM} (1) | Drain Current (pulsed) | 80 | 80 (*) | A |
| P _{TOT} | Total Dissipation at T _C = 25°C | 160 | 40 | W |
| | Derating Factor | 1.28 | 0.32 | W/°C |
| dv/dt (2) | Peak Diode Recovery voltage slope | TBD | | V/ns |
| T _{stg} | Storage Temperature | - 55 to 150 | | °C |
| T _j | Max. Operating Junction Temperature | 150 | | °C |

(*) Limited only by maximum temperature allowed

(1) Pulse width limited by safe operating area

(2) I_{SD} ≤ 20 A, di/dt ≤ 400 A/μs, V_{DD} = 80%V_{(BR)DSS}.

Table 4: Thermal Data

| | | TO-220/I ² PAK TO-247/D ² PAK | TO-220FP | |
|-----------------------|--|--|----------|------|
| R _{thj-case} | Thermal Resistance Junction-case Max | 0.78 | 3.1 | °C/W |
| R _{thj-amb} | Thermal Resistance Junction-ambient Max | 62.5 | | °C/W |
| T _l | Maximum Lead Temperature For Soldering Purpose | 300 | | °C |

Table 5: Avalanche Characteristics

| Symbol | Parameter | Max Value | Unit |
|-----------------|--|-----------|------|
| I _{AS} | Avalanche Current, Repetitive or Not-Repetitive (pulse width limited by T _j max) | TBD | A |
| E _{AS} | Single Pulse Avalanche Energy (starting T _j = 25 °C, I _D = I _{AS} , V _{DD} = 50 V) | TBD | mJ |

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

Table 6: On /Off

| Symbol | Parameter | Test Conditions | Value | | | Unit |
|----------------------|---|--|-------|-------|---------|----------|
| | | | Min. | Typ. | Max. | |
| V _{(BR)DSS} | Drain-source Breakdown Voltage | I _D = 1 mA, V _{GS} = 0 | 600 | | | V |
| dv/dt(2) | Drain Source Voltage Slope | V _{dd} =TBD, I _d =TBD, V _{gs} =TBD | TBD | | | V/ns |
| 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} = ± 20 V | | | 100 | nA |
| V _{GS(th)} | Gate Threshold Voltage | V _{DS} = V _{GS} , I _D = 250 μA | 2 | 3 | 4 | V |
| R _{DS(on)} | Static Drain-source On Resistance | V _{GS} = 10 V, I _D = 10 A | | 0.140 | 0.170 | Ω |

(2) Characteristic value at turn off on inductive load

ELECTRICAL CHARACTERISTICS (CONTINUED)

Table 7: Dynamic

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|--|------|--------------------------|------|----------------------|
| g_{fs} (1) | Forward Transconductance | $V_{DS} = 15V, I_D = 10A$ | | 17 | | S |
| C_{iss} C_{oss} C_{rss} | Input Capacitance Output Capacitance Reverse Transfer Capacitance | $V_{DS} = 25V, f = 1MHz,$ $V_{GS} = 0$ | | 2565 511 77 | | pF pF pF |
| $C_{OSS\ eq}$ (3). | Equivalent Output Capacitance | $V_{GS} = 0V, V_{DS} = 0\ to\ 480V$ | | TBD | | pF |
| R_G | Gate Input Resistance | $f=1MHz$ Gate DC Bias = 0 Test Signal Level = 20mV Open Drain | | 2 | | Ω |
| $t_{d(on)}$ t_r $t_{d(off)}$ t_f | Turn-on Delay Time Rise Time Turn-off-Delay Time Fall Time | $V_{DD} = 300V, I_D = 10A,$ $R_G = 4.7\ \Omega, V_{GS} = 10V$ (see Figure 4) | | TBD TBD TBD TBD | | ns ns ns ns |
| Q_g Q_{gs} Q_{gd} | Total Gate Charge Gate-Source Charge Gate-Drain Charge | $V_{DD} = 480V, I_D = 20A,$ $V_{GS} = 10V$ (see Figure 7) | | 93 TBD TBD | | nC nC nC |

Table 8: Source Drain Diode

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|-----------------------------------|--|--|------|-------------------|----------|--------------------|
| I_{SD} I_{SDM} (2) | Source-drain Current Source-drain Current (pulsed) | | | | 20 80 | A A |
| V_{SD} (1) | Forward On Voltage | $I_{SD} = 20A, V_{GS} = 0$ | | | 1.3 | V |
| t_{rr} Q_{rr} I_{RRM} | Reverse Recovery Time Reverse Recovery Charge Reverse Recovery Current | $I_{SD} = 25A, di/dt = 100A/\mu s$ $V_{DD} = 100V$ (see Figure 5) | | TBD TBD TBD | | ns μC A |
| t_{rr} Q_{rr} I_{RRM} | Reverse Recovery Time Reverse Recovery Charge Reverse Recovery Current | $I_{SD} = 25A, di/dt = 100A/\mu s$ $V_{DD} = 100V, T_j = 150^\circ C$ (see Figure 5) | | TBD TBD TBD | | ns μC A |

(1) Pulsed: Pulse duration = 300 μs , duty cycle 1.5 %.

(2) Pulse width limited by safe operating area.

(3) $C_{OSS\ eq}$ is defined as a constant equivalent capacitance giving the same charging time as C_{OSS} when V_{DS} increases from 0 to 80% V_{DSS} .

Figure 3: Unclamped Inductive Load Test Circuit

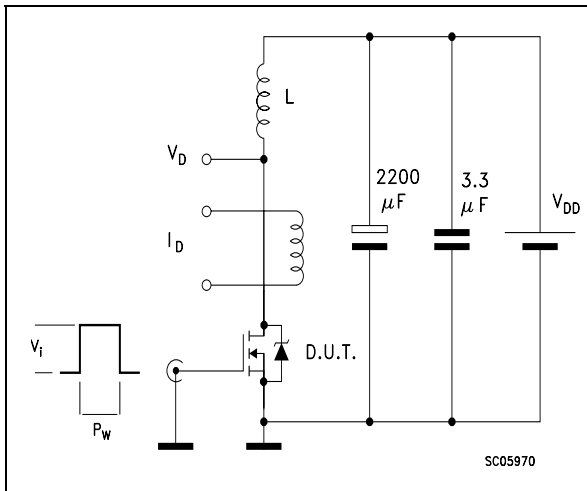


Figure 4: Switching Times Test Circuit For Resistive Load

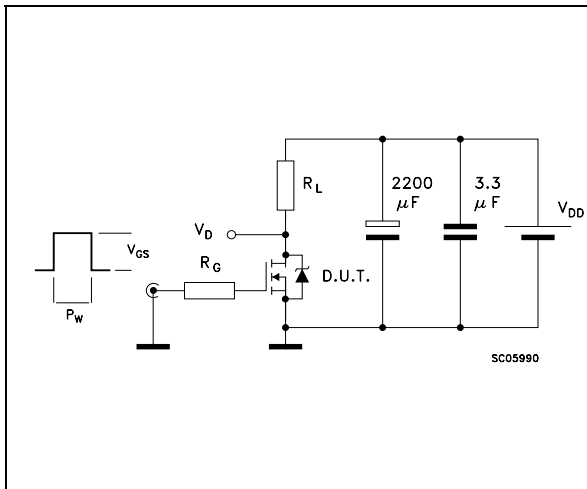


Figure 5: Test Circuit For Inductive Load Switching and Diode Recovery Times

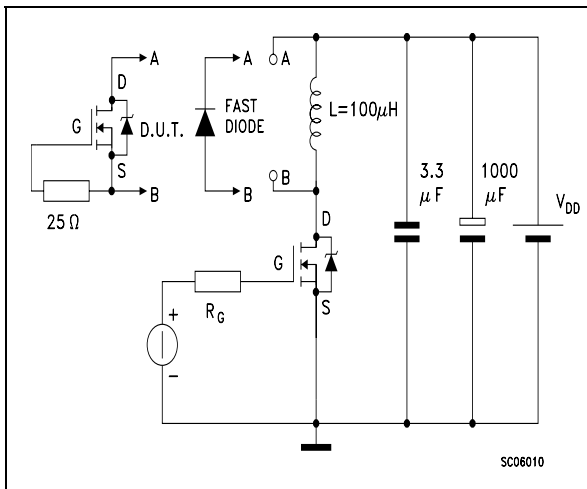


Figure 6: Unclamped Inductive Wafeform

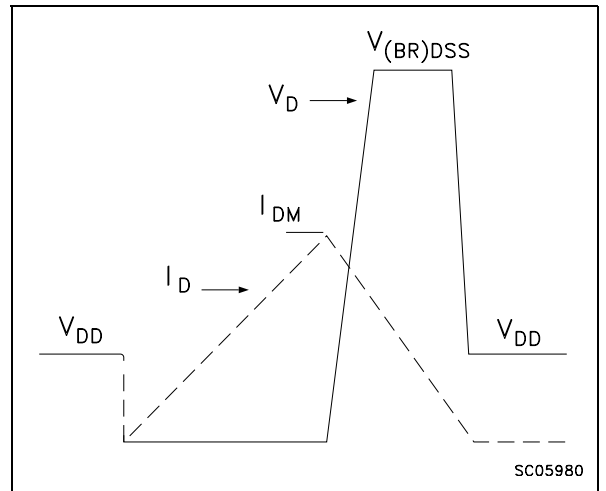
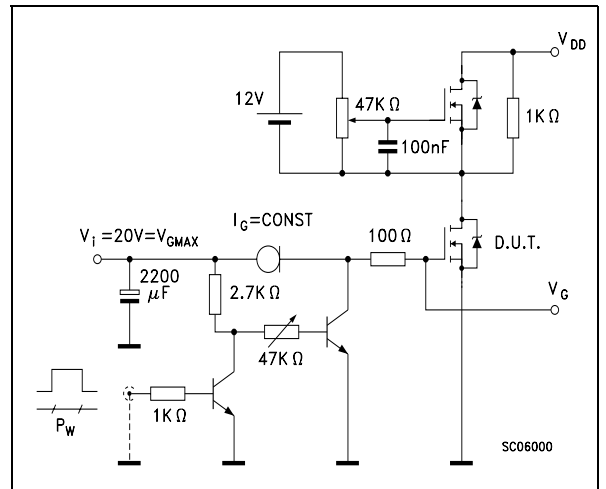
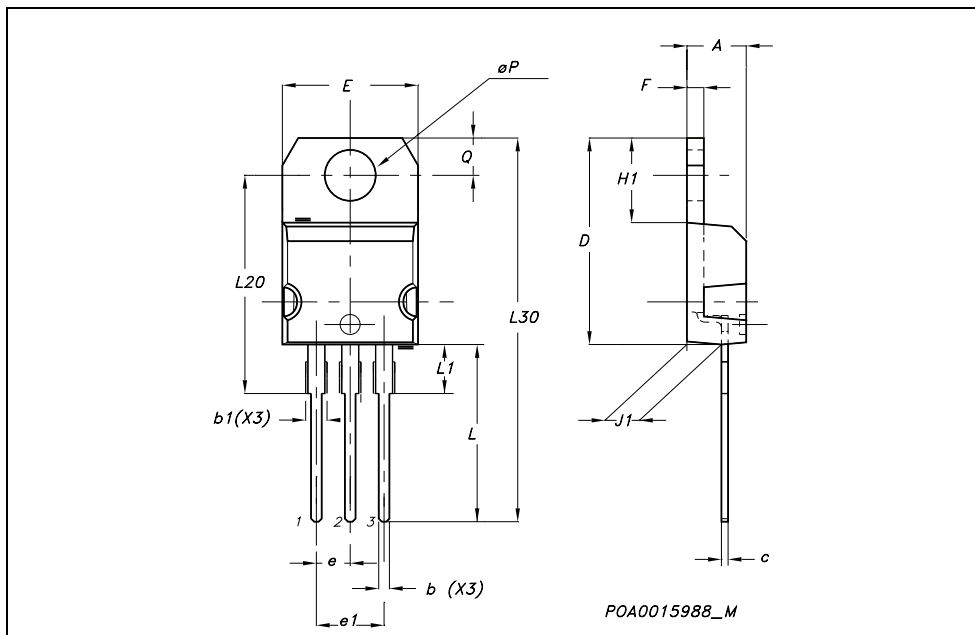


Figure 7: Gate Charge Test Circuit



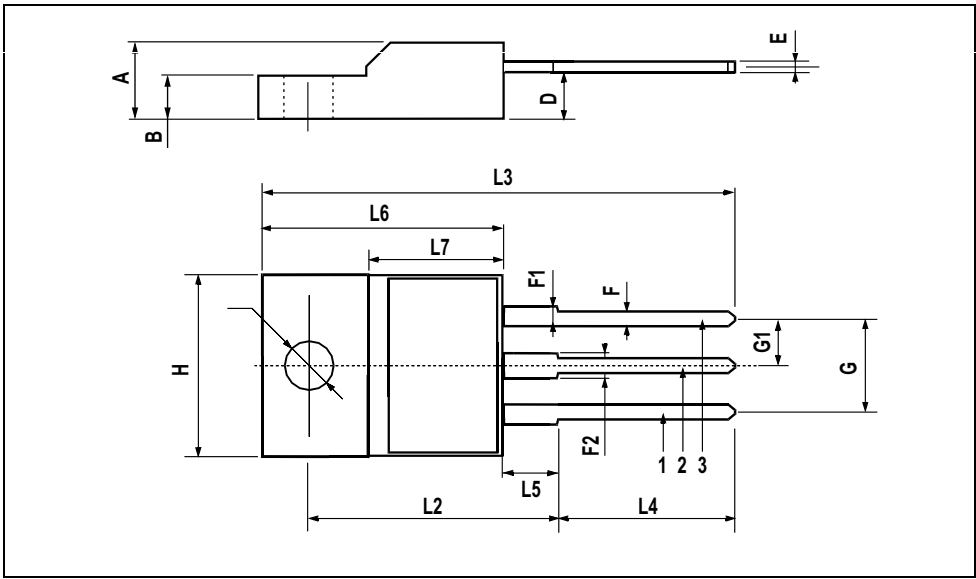
TO-220 MECHANICAL DATA

| DIM. | mm. | | | inch | | |
|------|-------|-------|-------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | 4.40 | | 4.60 | 0.173 | | 0.181 |
| b | 0.61 | | 0.88 | 0.024 | | 0.034 |
| b1 | 1.15 | | 1.70 | 0.045 | | 0.066 |
| c | 0.49 | | 0.70 | 0.019 | | 0.027 |
| D | 15.25 | | 15.75 | 0.60 | | 0.620 |
| E | 10 | | 10.40 | 0.393 | | 0.409 |
| e | 2.40 | | 2.70 | 0.094 | | 0.106 |
| e1 | 4.95 | | 5.15 | 0.194 | | 0.202 |
| F | 1.23 | | 1.32 | 0.048 | | 0.052 |
| H1 | 6.20 | | 6.60 | 0.244 | | 0.256 |
| J1 | 2.40 | | 2.72 | 0.094 | | 0.107 |
| L | 13 | | 14 | 0.511 | | 0.551 |
| L1 | 3.50 | | 3.93 | 0.137 | | 0.154 |
| L20 | | 16.40 | | | 0.645 | |
| L30 | | 28.90 | | | 1.137 | |
| øP | 3.75 | | 3.85 | 0.147 | | 0.151 |
| Q | 2.65 | | 2.95 | 0.104 | | 0.116 |



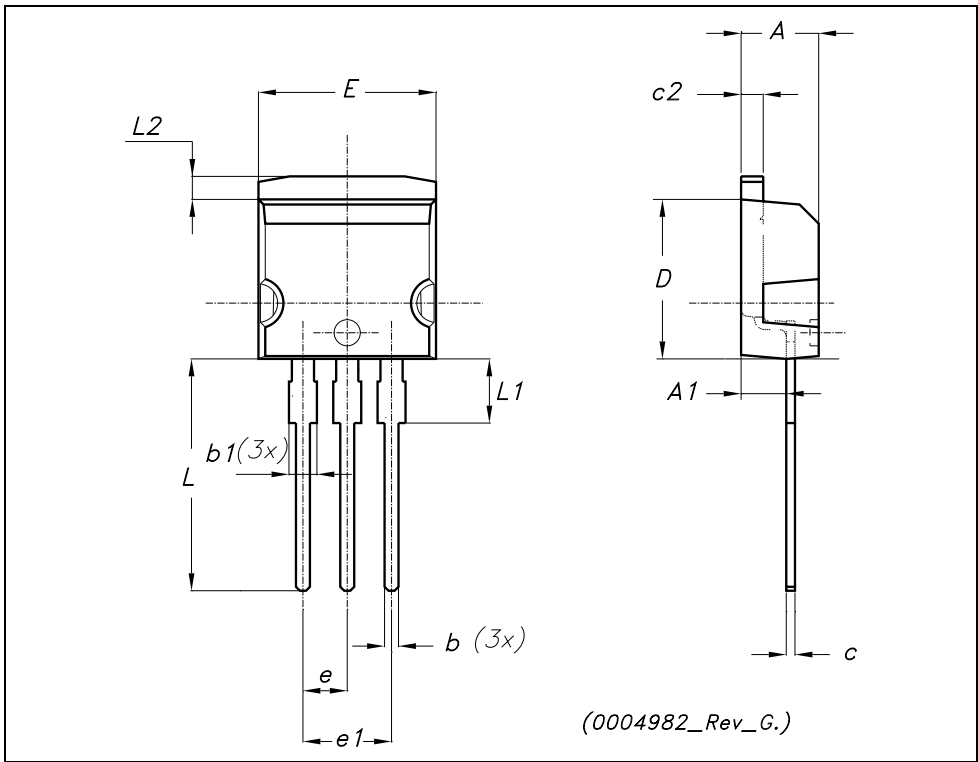
TO-220FP MECHANICAL DATA

| 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 | .0385 | | 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 |



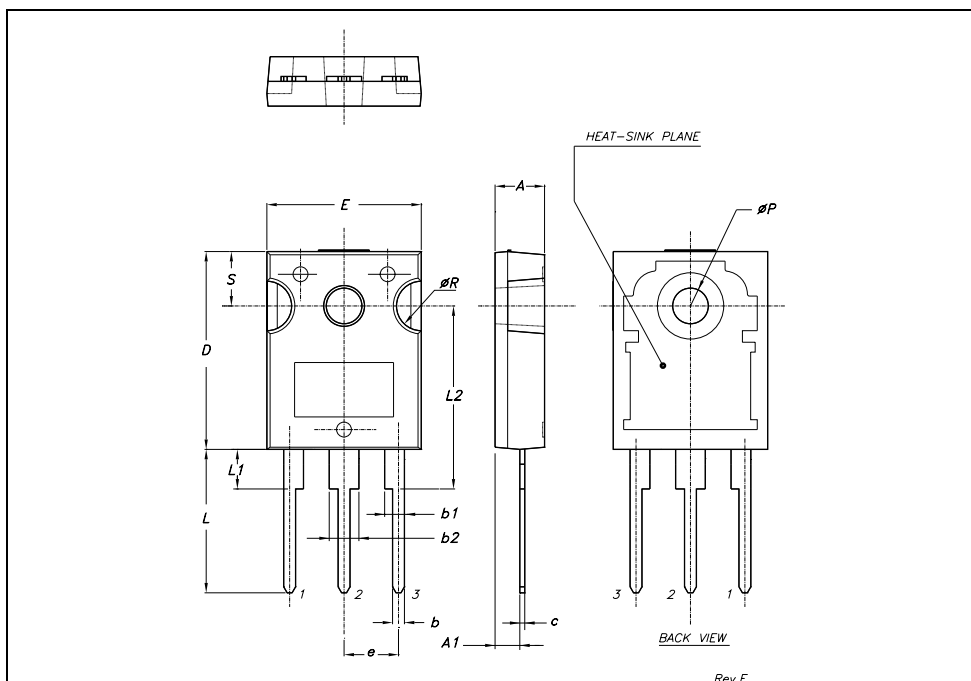
TO-262 (I²PAK) MECHANICAL DATA

| DIM. | mm. | | | inch | | |
|------|------|------|-------|-------|------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | 4.40 | | 4.60 | 0.173 | | 0.181 |
| A1 | 2.40 | | 2.72 | 0.094 | | 0.107 |
| b | 0.61 | | 0.88 | 0.024 | | 0.034 |
| b1 | 1.14 | | 1.70 | 0.044 | | 0.066 |
| c | 0.49 | | 0.70 | 0.019 | | 0.027 |
| c2 | 1.23 | | 1.32 | 0.048 | | 0.052 |
| D | 8.95 | | 9.35 | 0.352 | | 0.368 |
| e | 2.40 | | 2.70 | 0.094 | | 0.106 |
| e1 | 4.95 | | 5.15 | 0.194 | | 0.202 |
| E | 10 | | 10.40 | 0.393 | | 0.410 |
| L | 13 | | 14 | 0.511 | | 0.551 |
| L1 | 3.50 | | 3.93 | 0.137 | | 0.154 |
| L2 | 1.27 | | 1.40 | 0.050 | | 0.055 |



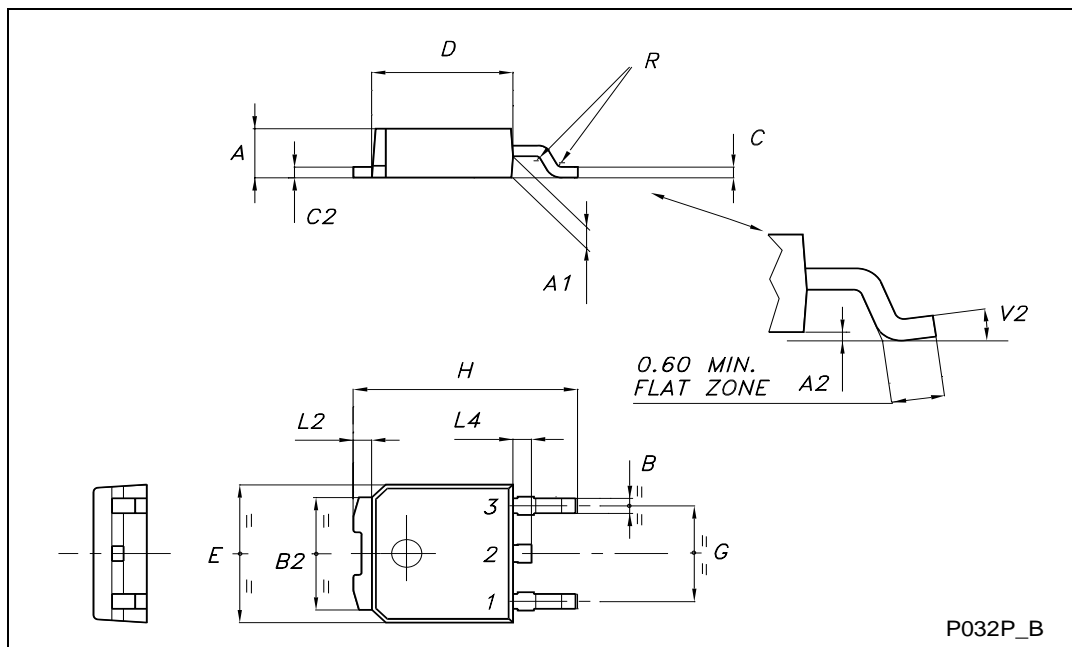
TO-247 MECHANICAL DATA

| DIM. | mm. | | | inch | | |
|------|-------|-------|-------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | 4.85 | | 5.15 | 0.19 | | 0.20 |
| A1 | 2.20 | | 2.60 | 0.086 | | 0.102 |
| b | 1.0 | | 1.40 | 0.039 | | 0.055 |
| b1 | 2.0 | | 2.40 | 0.079 | | 0.094 |
| b2 | 3.0 | | 3.40 | 0.118 | | 0.134 |
| c | 0.40 | | 0.80 | 0.015 | | 0.03 |
| D | 19.85 | | 20.15 | 0.781 | | 0.793 |
| E | 15.45 | | 15.75 | 0.608 | | 0.620 |
| e | | 5.45 | | | 0.214 | |
| L | 14.20 | | 14.80 | 0.560 | | 0.582 |
| L1 | 3.70 | | 4.30 | 0.14 | | 0.17 |
| L2 | | 18.50 | | | 0.728 | |
| øP | 3.55 | | 3.65 | 0.140 | | 0.143 |
| øR | 4.50 | | 5.50 | 0.177 | | 0.216 |
| S | | 5.50 | | | 0.216 | |

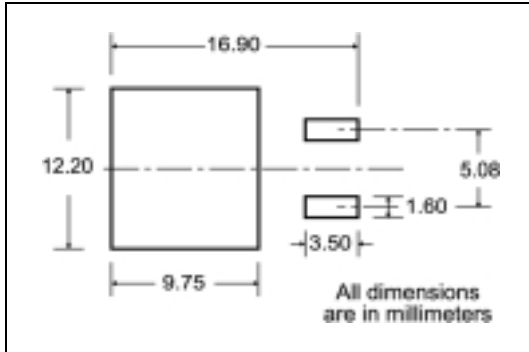


TO-252 (DPAK) MECHANICAL DATA

| DIM. | mm | | | inch | | |
|------|------|------|-------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | 2.20 | | 2.40 | 0.087 | | 0.094 |
| A1 | 0.90 | | 1.10 | 0.035 | | 0.043 |
| A2 | 0.03 | | 0.23 | 0.001 | | 0.009 |
| B | 0.64 | | 0.90 | 0.025 | | 0.035 |
| B2 | 5.20 | | 5.40 | 0.204 | | 0.213 |
| C | 0.45 | | 0.60 | 0.018 | | 0.024 |
| C2 | 0.48 | | 0.60 | 0.019 | | 0.024 |
| D | 6.00 | | 6.20 | 0.236 | | 0.244 |
| E | 6.40 | | 6.60 | 0.252 | | 0.260 |
| G | 4.40 | | 4.60 | 0.173 | | 0.181 |
| H | 9.35 | | 10.10 | 0.368 | | 0.398 |
| L2 | | 0.8 | | | 0.031 | |
| L4 | 0.60 | | 1.00 | 0.024 | | 0.039 |
| V2 | 0° | | 8° | 0° | | 0° |



D²PAK FOOTPRINT



TAPE AND REEL SHIPMENT

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 |

* on sales type

Table 9: Revision History

| Date | Revision | Description of Changes |
|-------------|-----------------|-------------------------------|
| 30-Nov-2004 | 1 | First Release. |
| 22-Mar-2005 | 2 | Modified title |
| 23-May-2005 | 3 | Inserted some values in Tab7 |
| 08-Jun-2005 | 4 | Inserted new row in table 6 |

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