



STB7N52K3 - STD7N52K3 STF7N52K3 - STP7N52K3

N-channel 525 V, 0.84 Ω , 6.3 A, D²PAK, DPAK, TO-220FP, TO-220
SuperMESH3™ Power MOSFET

Preliminary Data

Features

| Type | V _{DSS} | R _{DS(on) max} | I _D | P _w |
|-----------|------------------|-------------------------|----------------------|----------------|
| STB7N52K3 | 525 V | < 0.98 Ω | 6.3 A | 90 W |
| STD7N52K3 | 525 V | < 0.98 Ω | 6.3 A | 90 W |
| STF7N52K3 | 525 V | < 0.98 Ω | 6.3 A ⁽¹⁾ | 25 W |
| STP7N52K3 | 525 V | < 0.98 Ω | 6.3 A | 90 W |

1. Limited by package

- 100% avalanche tested
- Extremely high dv/dt capability
- Gate charge minimized
- Very low intrinsic capacitances
- Improved diode reverse recovery characteristics
- Zener-protected

Application

- Switching applications

Description

The new SuperMESH3™ series is obtained through the combination of a further fine tuning of ST's well established strip-based PowerMESH™ layout with a new optimization of the vertical structure. In addition to reducing on-resistance significantly versus previous generation, special attention has been taken to ensure a very good dv/dt capability and higher margin in breakdown voltage for the most demanding application.

Table 1. Device summary

| Order codes | Marking | Package | Packaging |
|-------------|---------|--------------------|---------------|
| STB7N52K3 | 7N52K3 | D ² PAK | Tape and reel |
| STD7N52K3 | 7N52K3 | DPAK | Tape and reel |
| STF7N52K3 | 7N52K3 | TO-220FP | Tube |
| STP7N52K3 | 7N52K3 | TO-220 | Tube |

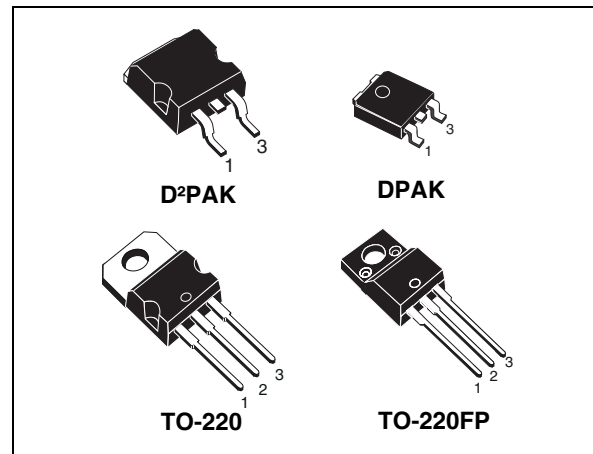
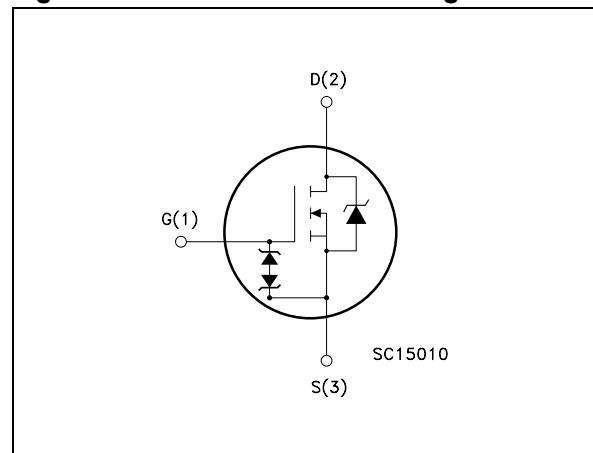


Figure 1. Internal schematic diagram



Contents

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1 Electrical ratings

Table 2. Absolute maximum ratings

| Symbol | Parameter | Value | | | | Unit |
|----------------|--|------------|------|--------------------|----------|------|
| | | TO-220 | DPAK | D ² PAK | TO-220FP | |
| V_{DS} | Drain-source voltage ($V_{GS} = 0$) | 525 | | | | V |
| V_{GS} | Gate- source voltage | ± 30 | | | | V |
| I_D | Drain current (continuous) at $T_C = 25\text{ °C}$ | 6.3 | | 6.3 ⁽¹⁾ | | A |
| I_D | Drain current (continuous) at $T_C = 100\text{ °C}$ | 4 | | 4 ⁽¹⁾ | | A |
| $I_{DM}^{(2)}$ | Drain current (pulsed) | 25 | | 25 ⁽¹⁾ | | A |
| P_{TOT} | Total dissipation at $T_C = 25\text{ °C}$ | 90 | | 25 | | W |
| | Derating factor | 0.72 | | 0.2 | | W/°C |
| $V_{ESD(G-S)}$ | Gate source ESD(HBM-C = 100 pF, R = 1.5 kΩ) | 2500 | | | | V |
| $dv/dt^{(3)}$ | Peak diode recovery voltage slope | TBD | | | | V/ns |
| V_{ISO} | Insulation withstand voltage (RMS) from all three leads to external heat sink (t = 1 s; $T_C = 25\text{ °C}$) | -- | | 2500 | | V |
| T_{stg} | Storage temperature | -55 to 150 | | | | °C |
| T_j | Max. operating junction temperature | 150 | | | | °C |

- Limited by package
- Pulse width limited by safe operating area
- $I_{SD} \leq 6.3\text{ A}$, $di/dt = \text{TBD}$, $V_{DD} = 80\% V_{(BR)DSS}$.

Table 3. Thermal data

| Symbol | Parameter | TO-220 | DPAK | D ² PAK | TO-220FP | Unit |
|----------------|--|--------|------|--------------------|----------|------|
| $R_{thj-case}$ | Thermal resistance junction-case max | 1.39 | | | 5 | °C/W |
| $R_{thj-pcb}$ | Thermal resistance junction-pcb max | -- | 50 | 30 | -- | °C/W |
| $R_{thj-amb}$ | Thermal resistance junction-ambient max | 62.5 | -- | -- | 62.5 | °C/W |
| T_l | Maximum lead temperature for soldering purpose | 300 | | | | °C |

Table 4. Avalanche characteristics

| Symbol | Parameter | Max value | Unit |
|----------|--|-----------|------|
| I_{AR} | Avalanche current, repetitive or not-repetitive (pulse width limited by T_j max) | 6.3 | A |
| E_{AS} | Single pulse avalanche energy (starting $T_j = 25\text{ °C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$) | TBD | mJ |

2 Electrical characteristics

($T_C = 25\text{ °C}$ unless otherwise specified)

Table 5. On /off states

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---------------|--|--|------|------|----------|--------------------------------|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage | $I_D = 1\text{ mA}$, $V_{GS} = 0$ | 525 | | | V |
| I_{DSS} | Zero gate voltage drain current ($V_{GS} = 0$) | $V_{DS} = \text{Max rating}$ $V_{DS} = \text{Max rating}$, $T_C = 125\text{ °C}$ | | | 1 50 | μA μA |
| I_{GSS} | Gate-body leakage current ($V_{DS} = 0$) | $V_{GS} = \pm 20\text{ V}$ | | | ± 10 | μA |
| $V_{GS(th)}$ | Gate threshold voltage | $V_{DS} = V_{GS}$, $I_D = 50\text{ }\mu\text{A}$ | 3 | 3.75 | 4.5 | V |
| $R_{DS(on)}$ | Static drain-source on resistance | $V_{GS} = 10\text{ V}$, $I_D = 3.1\text{ A}$ | | 0.84 | 0.98 | Ω |

Table 6. Dynamic

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-------------------------------------|---|---|------|-------------------|------|----------------|
| $g_{fs} (1)$ | Forward transconductance | $V_{DS} = 15\text{ V}$, $I_D = 3.1\text{ A}$ | | TBD | | S |
| C_{iss} C_{oss} C_{rss} | Input capacitance Output capacitance Reverse transfer capacitance | $V_{DS} = 50\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0$ | | TBD TBD TBD | | pF pF pF |
| $C_{OSS\ eq}^{(1)}$ | Equivalent output capacitance | $V_{GS} = 0$, $V_{DS} = 0\text{ to }420\text{ V}$ | | TBD | | pF |
| R_G | Intrinsic gate resistance | $f = 1\text{ MHz}$ open drain | | TBD | | Ω |
| Q_g Q_{gs} Q_{gd} | Total gate charge Gate-source charge Gate-drain charge | $V_{DD} = 420\text{ V}$, $I_D = 6.3\text{ A}$, $V_{GS} = 10\text{ V}$ (see Figure 3) | | TBD TBD TBD | | nC nC nC |

1. $C_{OSS\ eq}$ 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}

Table 7. Switching times

| Symbol | Parameter | Test conditions | Min. | Typ. | Max | Unit |
|---|---|---|------|--------------------------|-----|----------------------|
| $t_{d(on)}$ t_r $t_{d(off)}$ t_f | Turn-on delay time Rise time Turn-off-delay time Fall time | $V_{DD} = 262\text{ V}$, $I_D = 3.1\text{ A}$, $R_G = 4.7\text{ }\Omega$, $V_{GS} = 10\text{ V}$ (see Figure 2) | | TBD TBD TBD TBD | | ns ns ns ns |

Table 8. Source drain diode

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------------|-------------------------------|---|------|------|------|------|
| I_{SD} | Source-drain current | | | | 6.3 | A |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) | | | | 25 | A |
| $V_{SD}^{(2)}$ | Forward on voltage | $I_{SD} = 6.3 \text{ A}, V_{GS} = 0$ | | | 1.6 | V |
| t_{rr} | Reverse recovery time | $I_{SD} = 6.3 \text{ A}, di/dt = 100 \text{ A}/\mu\text{s}$ $V_{DD} = 30 \text{ V}$ (see Figure 7) | | TBD | | ns |
| Q_{rr} | Reverse recovery charge | | | TBD | | nC |
| I_{RRM} | Reverse recovery current | | | TBD | | A |
| t_{rr} | Reverse recovery time | $I_{SD} = 6.3 \text{ A}, di/dt = 100 \text{ A}/\mu\text{s}$ $V_{DD} = 30 \text{ V}, T_j = 150 \text{ }^\circ\text{C}$ (see Figure 7) | | TBD | | ns |
| Q_{rr} | Reverse recovery charge | | | TBD | | nC |
| I_{RRM} | Reverse recovery current | | | TBD | | A |

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

Table 9. Gate-source Zener diode

| Symbol | Parameter | Test conditions | Min | Typ | Max | Unit |
|------------------|-------------------------------|--|-----|-----|-----|------|
| $BV_{GSO}^{(1)}$ | Gate-source breakdown voltage | $I_{GS} = \pm 1 \text{ mA}$ (open drain) | 30 | | | V |

1. The built-in back-to-back Zener diodes have specifically been designed to enhance not only the device's ESD capability, but also to make them safely absorb possible voltage transients that may occasionally be applied from gate to source. In this respect the Zener voltage is appropriate to achieve an efficient and cost-effective intervention to protect the device's integrity. These integrated Zener diodes thus avoid the usage of external components

3 Test circuits

Figure 2. Switching times test circuit for resistive load

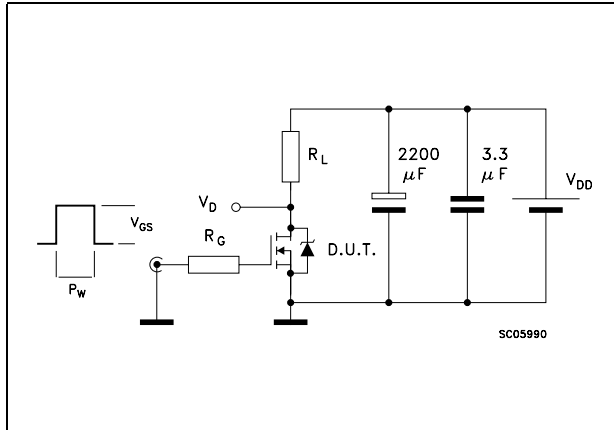


Figure 3. Gate charge test circuit

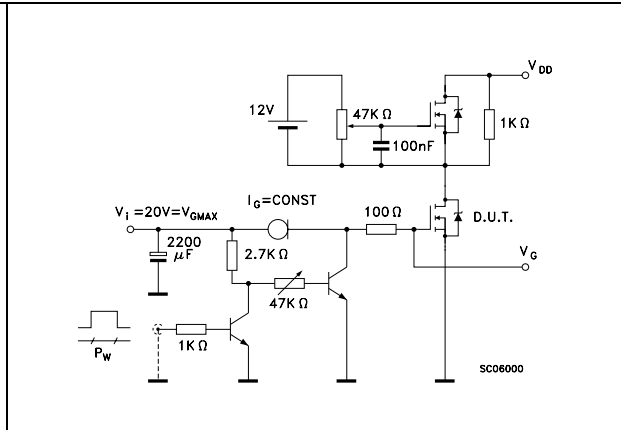


Figure 4. Test circuit for inductive load switching and diode recovery times

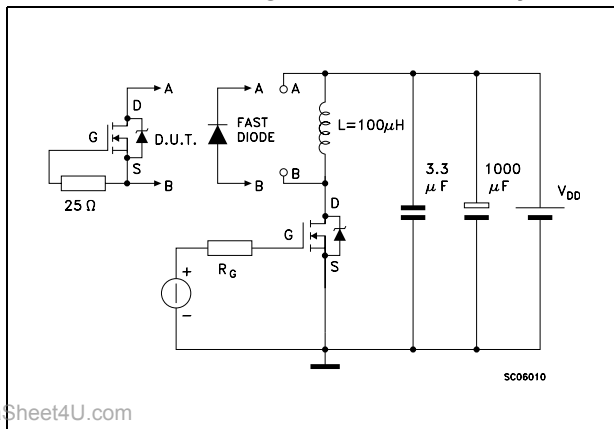


Figure 5. Unclamped Inductive load test circuit

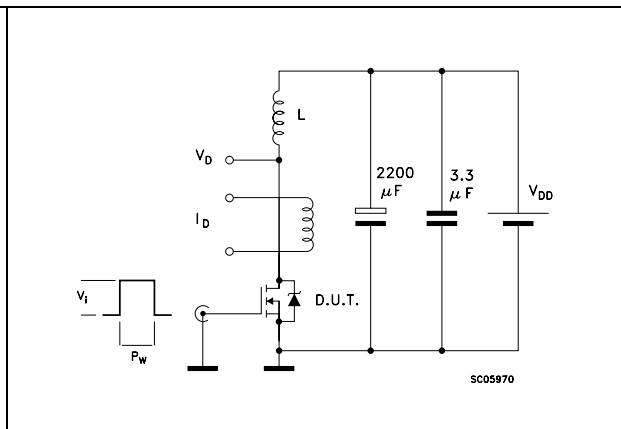


Figure 6. Unclamped inductive waveform

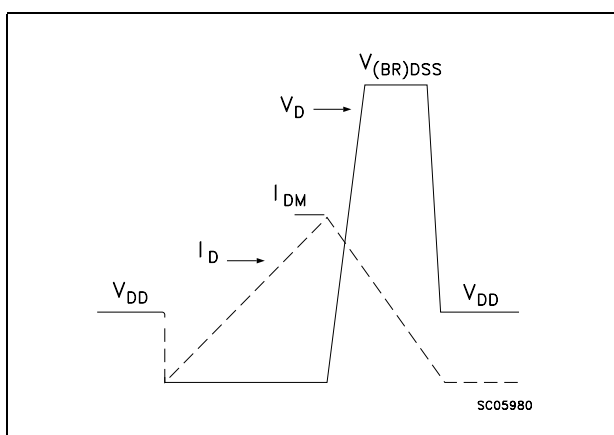
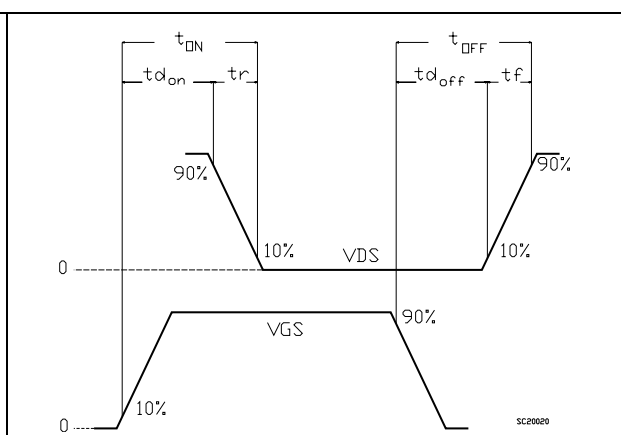


Figure 7. Switching time waveform



4 Package mechanical data

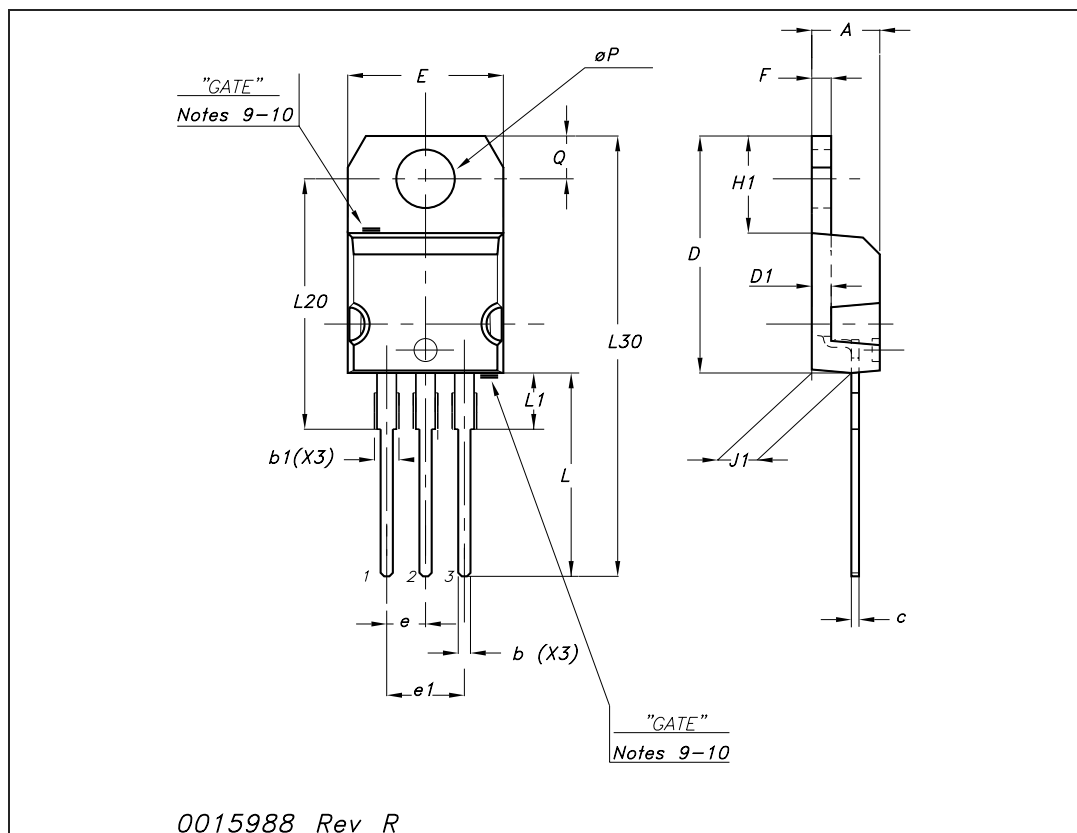
In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a Lead-free second level interconnect. The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: www.st.com

Package mechanical data

STB7N52K3 - STD7N52K3 - STF7N52K3 - STP7N52K3

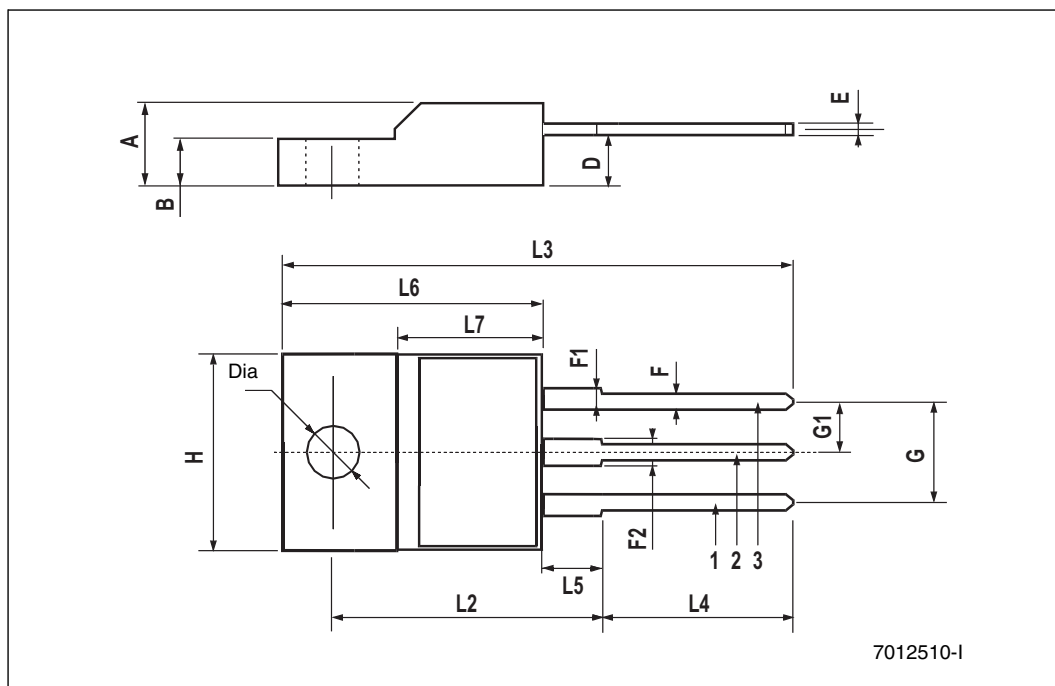
TO-220 mechanical data

| 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 | 1.14 | | 1.70 | 0.044 | | 0.066 |
| c | 0.48 | | 0.70 | 0.019 | | 0.027 |
| D | 15.25 | | 15.75 | 0.6 | | 0.62 |
| D1 | | 1.27 | | | 0.050 | |
| 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 | | 0.051 |
| 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 | |
| ∅P | 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 | 4.40 | | 4.60 | 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 | | 0.70 | 0.017 | | 0.027 |
| F | 0.75 | | 1.00 | 0.030 | | 0.039 |
| F1 | 1.15 | | 1.50 | 0.045 | | 0.067 |
| F2 | 1.15 | | 1.50 | 0.045 | | 0.067 |
| G | 4.95 | | 5.20 | 0.195 | | 0.204 |
| G1 | 2.40 | | 2.70 | 0.094 | | 0.106 |
| H | 10 | | 10.40 | 0.393 | | 0.409 |
| L2 | | 16 | | | 0.630 | |
| L3 | 28.6 | | 30.6 | 1.126 | | 1.204 |
| L4 | 9.80 | | 10.60 | 0.385 | | 0.417 |
| L5 | 2.9 | | 3.6 | 0.114 | | 0.141 |
| L6 | 15.90 | | 16.40 | 0.626 | | 0.645 |
| L7 | 9 | | 9.30 | 0.354 | | 0.366 |
| Dia | 3 | | 3.2 | 0.118 | | 0.126 |

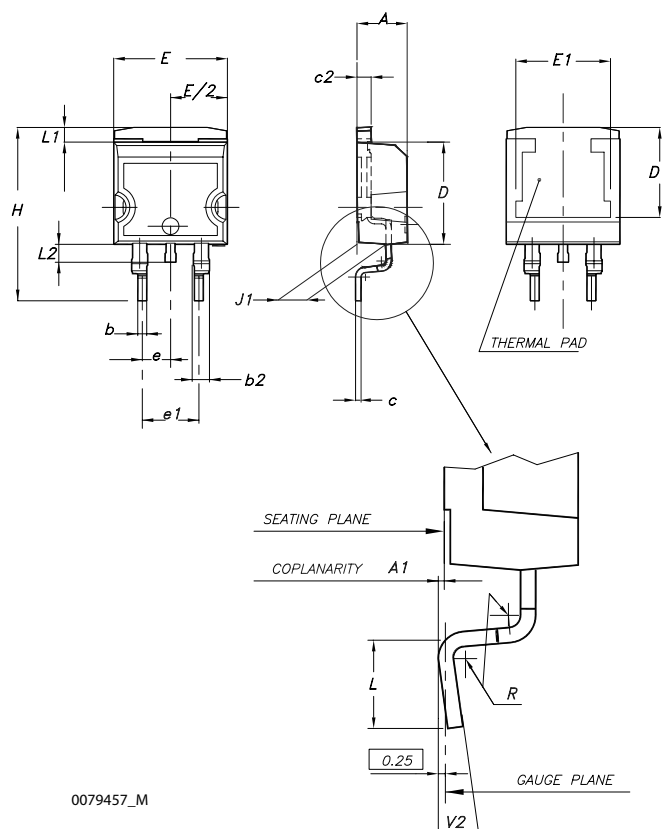


Package mechanical data

STB7N52K3 - STD7N52K3 - STF7N52K3 - STP7N52K3

D²PAK (TO-263) mechanical data

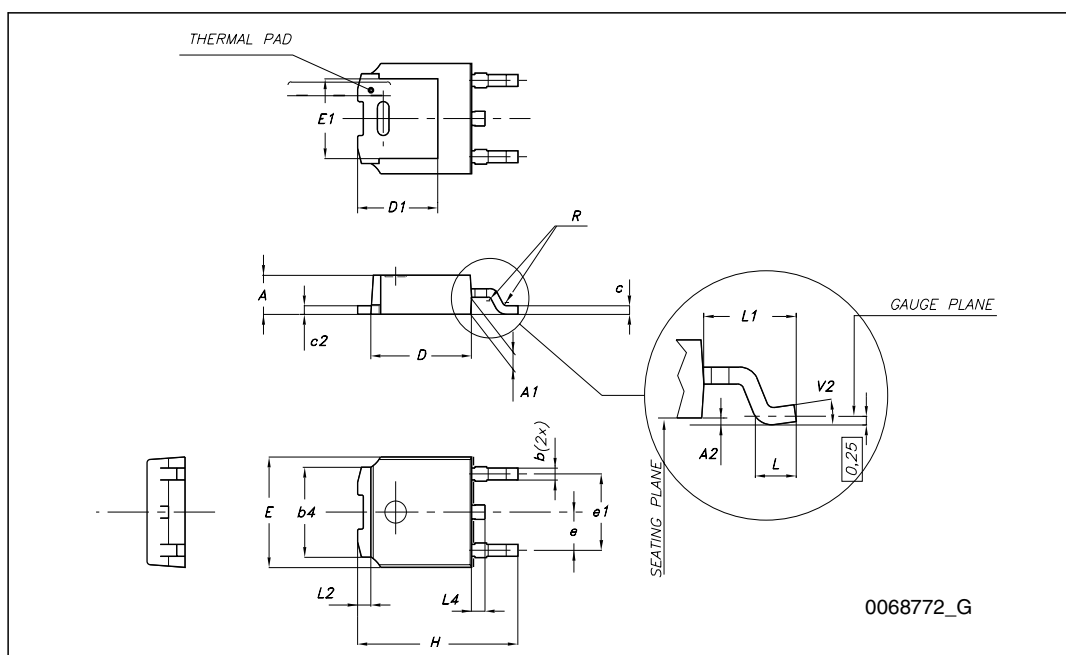
| Dim | mm | | | inch | | |
|-----|------|------|-------|-------|-------|-------|
| | Min | Typ | Max | Min | Typ | Max |
| A | 4.40 | | 4.60 | 0.173 | | 0.181 |
| A1 | 0.03 | | 0.23 | 0.001 | | 0.009 |
| b | 0.70 | | 0.93 | 0.027 | | 0.037 |
| b2 | 1.14 | | 1.70 | 0.045 | | 0.067 |
| c | 0.45 | | 0.60 | 0.017 | | 0.024 |
| c2 | 1.23 | | 1.36 | 0.048 | | 0.053 |
| D | 8.95 | | 9.35 | 0.352 | | 0.368 |
| D1 | 7.50 | | | 0.295 | | |
| E | 10 | | 10.40 | 0.394 | | 0.409 |
| E1 | 8.50 | | | 0.334 | | |
| e | | 2.54 | | | 0.1 | |
| e1 | 4.88 | | 5.28 | 0.192 | | 0.208 |
| H | 15 | | 15.85 | 0.590 | | 0.624 |
| J1 | 2.49 | | 2.69 | 0.099 | | 0.106 |
| L | 2.29 | | 2.79 | 0.090 | | 0.110 |
| L1 | 1.27 | | 1.40 | 0.05 | | 0.055 |
| L2 | 1.30 | | 1.75 | 0.051 | | 0.069 |
| R | | 0.4 | | | 0.016 | |
| V2 | 0° | | 8° | 0° | | 8° |



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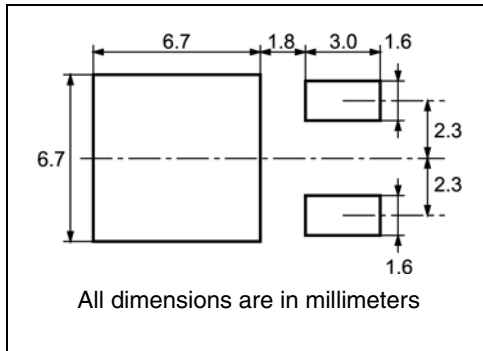
TO-252 (DPAK) mechanical data

| DIM. | mm. | | |
|------|------|------|-------|
| | min. | typ | max. |
| A | 2.20 | | 2.40 |
| A1 | 0.90 | | 1.10 |
| A2 | 0.03 | | 0.23 |
| b | 0.64 | | 0.90 |
| b4 | 5.20 | | 5.40 |
| c | 0.45 | | 0.60 |
| c2 | 0.48 | | 0.60 |
| D | 6.00 | | 6.20 |
| D1 | | 5.10 | |
| E | 6.40 | | 6.60 |
| E1 | | 4.70 | |
| e | | 2.28 | |
| e1 | 4.40 | | 4.60 |
| H | 9.35 | | 10.10 |
| L | 1 | | |
| L1 | | 2.80 | |
| L2 | | 0.80 | |
| L4 | 0.60 | | 1 |
| R | | 0.20 | |
| V2 | 0° | | 8° |



5 Package mechanical data

DPAK FOOTPRINT



TAPE AND REEL SHIPMENT

40 mm min. Access hole at slot location

Full radius

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

G measured at hub

| 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 | 16.4 | 18.4 | 0.645 | 0.724 |
| N | 50 | | 1.968 | |
| T | | 22.4 | | 0.881 |

| BASE QTY | BULK QTY |
|----------|----------|
| 2500 | 2500 |

TAPE MECHANICAL DATA

| DIM. | mm | | inch | |
|------|------|------|-------|-------|
| | MIN. | MAX. | MIN. | MAX. |
| A0 | 6.8 | 7 | 0.267 | 0.275 |
| B0 | 10.4 | 10.6 | 0.409 | 0.417 |
| B1 | | 12.1 | | 0.476 |
| D | 1.5 | 1.6 | 0.059 | 0.063 |
| D1 | 1.5 | | 0.059 | |
| E | 1.65 | 1.85 | 0.065 | 0.073 |
| F | 7.4 | 7.6 | 0.291 | 0.299 |
| K0 | 2.55 | 2.75 | 0.100 | 0.108 |
| P0 | 3.9 | 4.1 | 0.153 | 0.161 |
| P1 | 7.9 | 8.1 | 0.311 | 0.319 |
| P2 | 1.9 | 2.1 | 0.075 | 0.082 |
| R | 40 | | 1.574 | |
| W | 15.7 | 16.3 | 0.618 | 0.641 |

10 pitches cumulative tolerance on tape +/- 0.2 mm

TOP COVER TAPE

Center line of cavity

User Direction of Feed

TRL

FEED DIRECTION

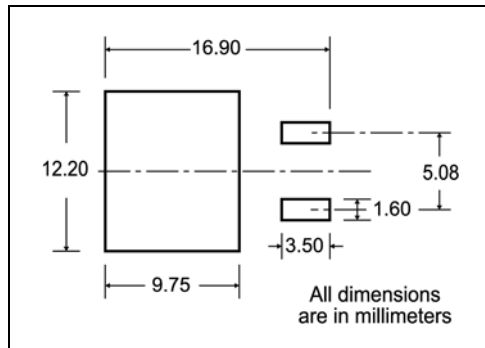
Bending radius

R min.

For machine ref. only including draft and radii concentric around B0

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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

6 Revision history

Table 10. Document revision history

| Date | Revision | Changes |
|-------------|----------|---------------|
| 07-Jul-2008 | 1 | First release |

STB7N52K3 - STD7N52K3 - STF7N52K3 - STP7N52K3

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