



# STD6N62K3 - STF6N62K3 STP6N62K3 - STU6N62K3

N-channel 620 V, 1.1  $\Omega$ , 5.5 A, IPAK, DPAK, TO-220, TO-220FP  
SuperMESH3™ Power MOSFET

## Features

| Type      | V <sub>DSS</sub> | R <sub>DS(on) max</sub> | I <sub>D</sub>       | P <sub>w</sub> |
|-----------|------------------|-------------------------|----------------------|----------------|
| STD6N62K3 | 620 V            | < 1.28 $\Omega$         | 5.5 A                | 90 W           |
| STF6N62K3 | 620 V            | < 1.28 $\Omega$         | 5.5 A <sup>(1)</sup> | 25 W           |
| STP6N62K3 | 620 V            | < 1.28 $\Omega$         | 5.5 A                | 90 W           |
| STU6N62K3 | 620 V            | < 1.28 $\Omega$         | 5.5 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

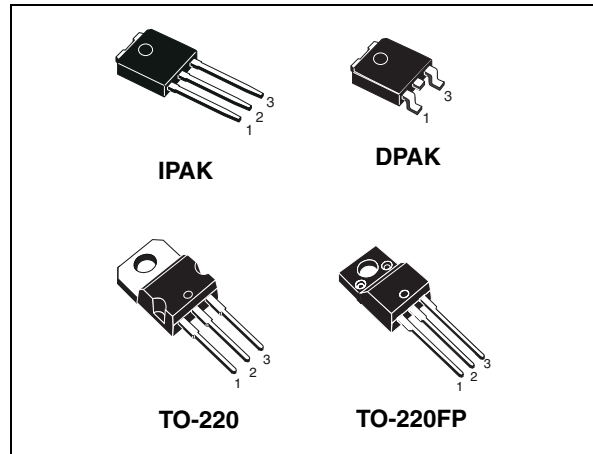
- Switching applications

## Description

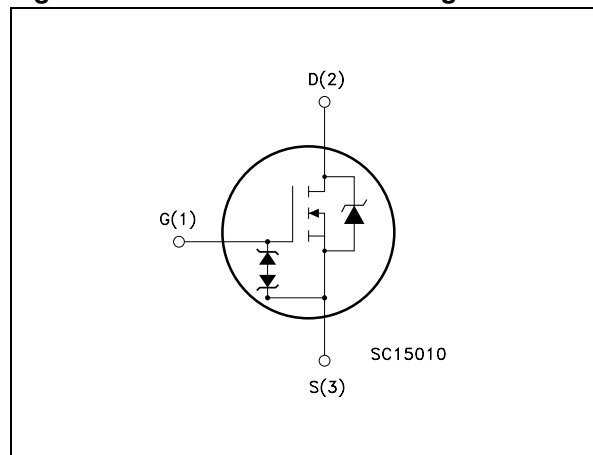
The new SuperMESH3™ series is obtained through the combination of a further fine tuning of ST's well established strip-based PowerMESH™ layout with a new optimization of the vertical structure. In addition to reducing on-resistance significantly versus previous generation, special attention has been 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     |
|-------------|---------|----------|---------------|
| STD6N62K3   | 6N62K3  | DPAK     | Tape and reel |
| STF6N62K3   | 6N62K3  | TO-220FP | Tube          |
| STP6N62K3   | 6N62K3  | TO-220   | Tube          |
| STU6N62K3   | 6N62K3  | IPAK     | 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 | IPAK                 | TO-220FP |                     |
| $V_{DS}$       | Drain-source voltage ( $V_{GS} = 0$ )  | 620        |      |                      |          | V                   |
| $V_{GS}$       | Gate- source voltage   | $\pm 30$   |      |                      |          | V                   |
| $I_D$          | Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$   | 5.5        |      | 5.5 <sup>(1)</sup>   |          | A                   |
| $I_D$          | Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$  | 3.465      |      | 3.465 <sup>(1)</sup> |          | A                   |
| $I_{DM}^{(2)}$ | Drain current (pulsed)   | 22         |      | 22 <sup>(1)</sup>    |          | A                   |
| $P_{TOT}$      | Total dissipation at $T_C = 25\text{ }^\circ\text{C}$  | 90         |      | 25                   |          | W                   |
|                | Derating factor  | 0.72       |      | 0.2                  |          | W/ $^\circ\text{C}$ |
| $V_{ESD(G-S)}$ | Gate source ESD(HBM-C = 100 pF, R = 1.5 k $\Omega$ )   | 2500       |      |                      |          | V                   |
| $dv/dt^{(3)}$  | Peak diode recovery voltage slope  | 9          |      |                      |          | V/ns                |
| $V_{ISO}$      | Insulation withstand voltage (RMS) from all three leads to external heat sink (t = 1 s; $T_C = 25\text{ }^\circ\text{C}$ ) | --         |      | 2500                 |          | V                   |
| $T_{stg}$      | Storage temperature  | -55 to 150 |      |                      |          | $^\circ\text{C}$    |
| $T_j$          | Max. operating junction temperature  | 150        |      |                      |          | $^\circ\text{C}$    |

1. Limited by package
2. Pulse width limited by safe operating area
3.  $I_{SD} \leq 5.5\text{ A}$ ,  $di/dt \leq 200\text{ A}/\mu\text{s}$ ,  $V_{DD} = 80\% V_{(BR)DSS}$

**Table 3. Thermal data**

| Symbol         | Parameter                                      | TO-220 | DPAK | IPAK | TO-220FP | Unit                      |
|----------------|--|--------|------|------|----------|---------------------------|
| $R_{thj-case}$ | Thermal resistance junction-case max           | 1.39   |      |      | 5        | $^\circ\text{C}/\text{W}$ |
| $R_{thj-pcb}$  | Thermal resistance junction-pcb max            | --     | 50   | --   | --       | $^\circ\text{C}/\text{W}$ |
| $R_{thj-amb}$  | Thermal resistance junction-ambient max        | 62.5   | 100  |      | 62.5     | $^\circ\text{C}/\text{W}$ |
| $T_l$          | Maximum lead temperature for soldering purpose | 300    |      |      |          | $^\circ\text{C}$          |

**Table 4. Avalanche characteristics**

| Symbol   | Parameter   | Max value | Unit |
|----------|---|-----------|------|
| $I_{AR}$ | Avalanche current, repetitive or not-repetitive (pulse width limited by $T_j$ max)                                  | 5.5       | A    |
| $E_{AS}$ | Single pulse avalanche energy (starting $T_j = 25\text{ }^\circ\text{C}$ , $I_D = I_{AR}$ , $V_{DD} = 50\text{V}$ ) | 140       | 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                   | $I_D = 1\text{ mA}$ , $V_{GS} = 0$   | 620  |      |          | V                              |
| $I_{DSS}$     | Zero gate voltage drain current ( $V_{GS} = 0$ ) | $V_{DS} = \text{Max rating}$<br>$V_{DS} = \text{Max rating}$ , $T_C = 125\text{ °C}$ |      |      | 1<br>50  | $\mu\text{A}$<br>$\mu\text{A}$ |
| $I_{GSS}$     | Gate-body leakage current ( $V_{DS} = 0$ )       | $V_{GS} = \pm 20\text{ V}$   |      |      | $\pm 10$ | $\mu\text{A}$                  |
| $V_{GS(th)}$  | 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                | $V_{GS} = 10\text{ V}$ , $I_D = 2.8\text{ A}$  |      | 1.1  | 1.28     | $\Omega$                       |

**Table 6. Dynamic**

| Symbol                              | Parameter   | Test conditions  | Min. | Typ.                | Max. | Unit           |
|-------------------------------------|---|--|------|---------------------|------|----------------|
| $g_{fs} (1)$                        | Forward transconductance  | $V_{DS} = 15\text{ V}$ , $I_D = 2.8\text{ A}$  |      | 4.1                 |      | S              |
| $C_{iss}$<br>$C_{oss}$<br>$C_{rss}$ | Input capacitance<br>Output capacitance<br>Reverse transfer capacitance | $V_{DS} = 50\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0$   |      | 706<br>66<br>8.4    |      | pF<br>pF<br>pF |
| $C_{OSS\ eq}^{(1)}$                 | Equivalent output capacitance   | $V_{GS} = 0$ , $V_{DS} = 0\text{ to }496\text{ V}$   |      | 60                  |      | pF             |
| $R_G$                               | Intrinsic gate resistance   | $f = 1\text{ MHz}$ open drain  |      | 7                   |      | $\Omega$       |
| $Q_g$<br>$Q_{gs}$<br>$Q_{gd}$       | Total gate charge<br>Gate-source charge<br>Gate-drain charge            | $V_{DD} = 496\text{ V}$ , $I_D = 5.5\text{ A}$ ,<br>$V_{GS} = 10\text{ V}$<br>(see <a href="#">Figure 17</a> ) |      | 25.7<br>4.6<br>14.4 |      | nC<br>nC<br>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                 |
|---|---|---|------|------------------------|-----|----------------------|
| $t_{d(on)}$<br>$t_r$<br>$t_{d(off)}$<br>$t_f$ | Turn-on delay time<br>Rise time<br>Turn-off-delay time<br>Fall time | $V_{DD} = 310\text{ V}$ , $I_D = 2.75\text{ A}$ ,<br>$R_G = 4.7\text{ }\Omega$ , $V_{GS} = 10\text{ V}$<br>(see <a href="#">Figure 16</a> ) |      | 13<br>12.5<br>27<br>19 |     | ns<br>ns<br>ns<br>ns |

**Table 8. Source drain diode**

| Symbol          | Parameter                     | Test conditions  | Min. | Typ. | Max. | Unit |
|-----------------|-------------------------------|--|------|------|------|------|
| $I_{SD}$        | Source-drain current          |  |      |      | 5.5  | A    |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) |  |      |      | 22   | A    |
| $V_{SD}^{(2)}$  | Forward on voltage            | $I_{SD} = 5.5 \text{ A}, V_{GS} = 0$   |      |      | 1.6  | V    |
| $t_{rr}$        | Reverse recovery time         | $I_{SD} = 5.5 \text{ A}, di/dt = 100 \text{ A}/\mu\text{s}$<br>$V_{DD} = 30 \text{ V}$ (see <a href="#">Figure 21</a> )                                      |      | 190  |      | ns   |
| $Q_{rr}$        | Reverse recovery charge       |  |      | 970  |      | nC   |
| $I_{RRM}$       | Reverse recovery current      |  |      | 10.5 |      | A    |
| $t_{rr}$        | Reverse recovery time         | $I_{SD} = 5.5 \text{ A}, di/dt = 100 \text{ A}/\mu\text{s}$<br>$V_{DD} = 30 \text{ V}, T_j = 150 \text{ }^\circ\text{C}$<br>(see <a href="#">Figure 21</a> ) |      | 255  |      | ns   |
| $Q_{rr}$        | Reverse recovery charge       |  |      | 1520 |      | nC   |
| $I_{RRM}$       | Reverse recovery current      |  |      | 12   |      | A    |

1. Pulse width limited by safe operating area
2. Pulsed: Pulse duration = 300  $\mu\text{s}$ , 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

## 2.1 Electrical characteristics (curves)

Figure 2. Safe operating area for TO-220, IPAK, DPAK

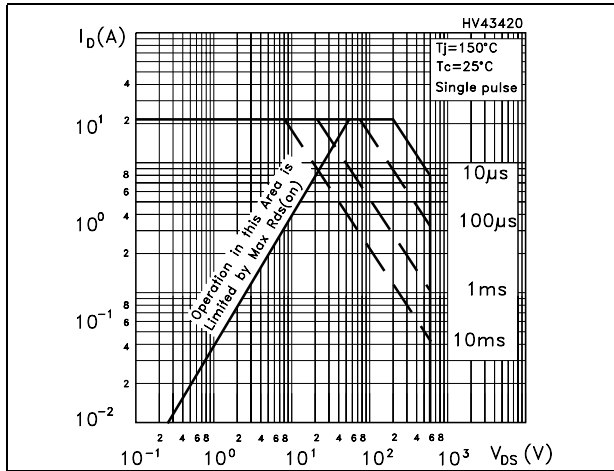


Figure 3. Thermal impedance for TO-220, IPAK, DPAK

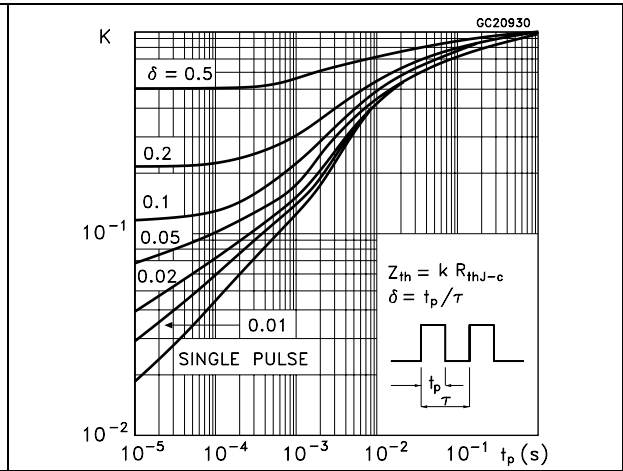


Figure 4. Safe operating area for TO-220FP

Figure 5. Thermal impedance for TO-220FP

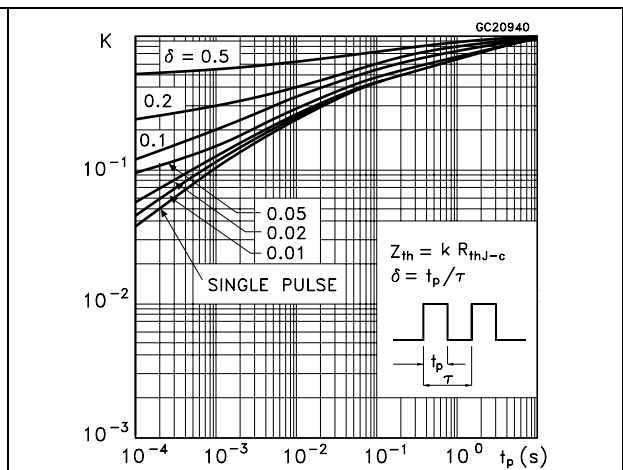
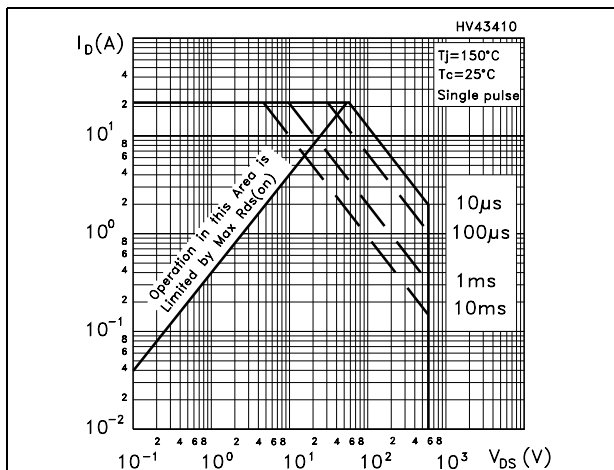


Figure 6. Output characteristics

Figure 7. Transfer characteristics

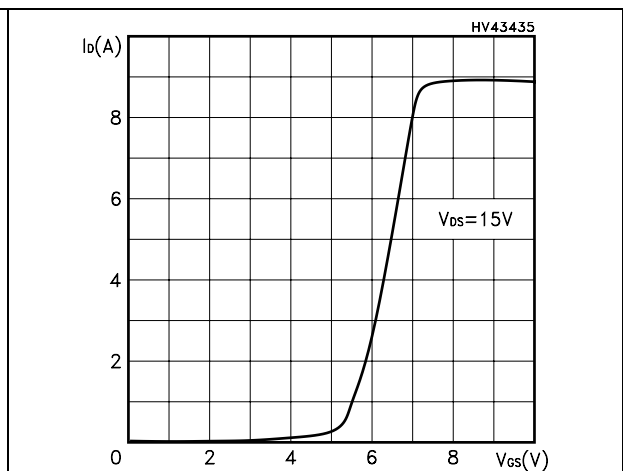
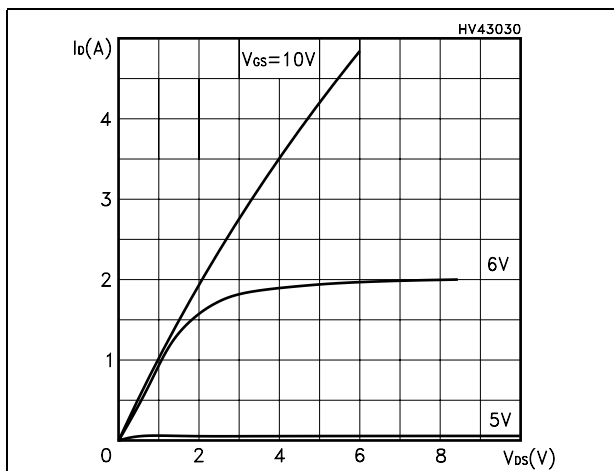


Figure 8. Normalized  $BV_{DSS}$  vs temperature      Figure 9. Static drain-source on resistance

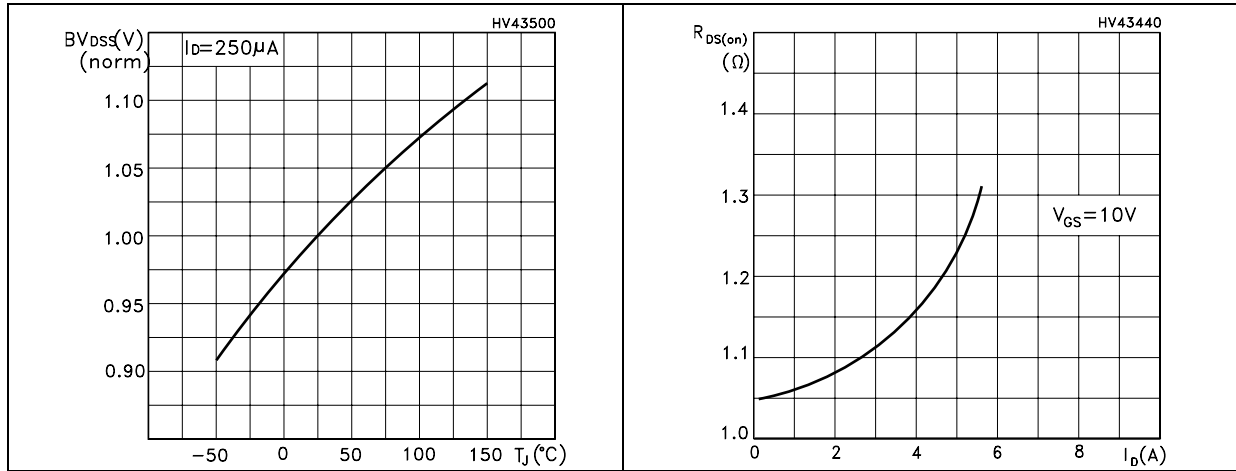


Figure 10. Gate charge vs gate-source voltage      Figure 11. Capacitance variations

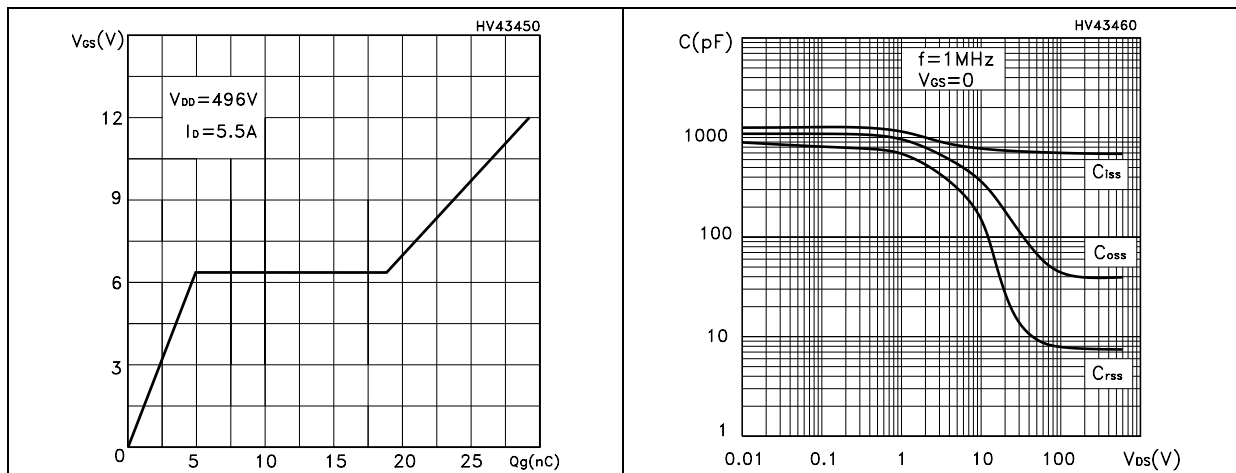


Figure 12. Normalized gate threshold voltage vs temperature      Figure 13. Normalized on resistance vs temperature

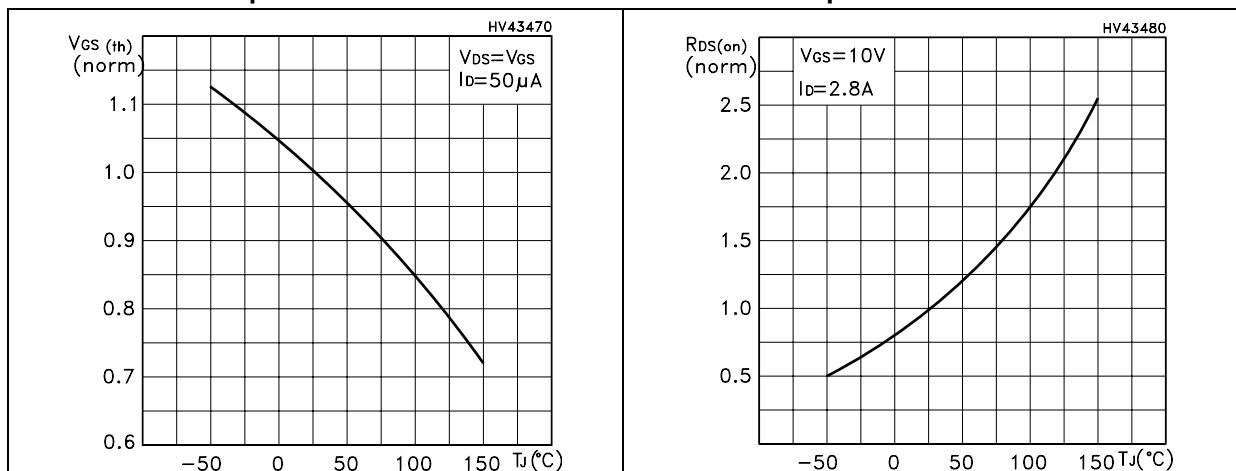


Figure 14. Source-drain diode forward characteristics

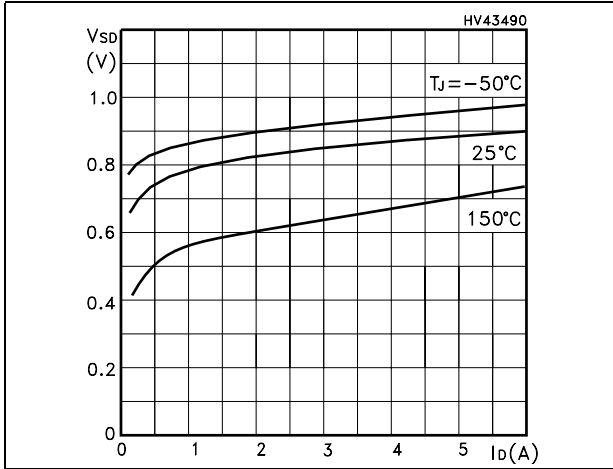
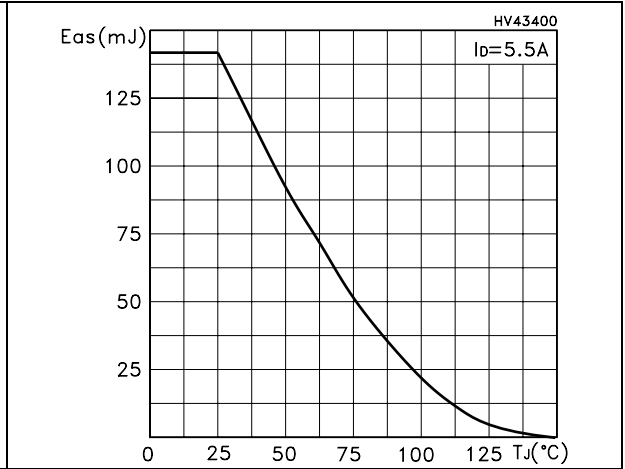


Figure 15. Maximum avalanche energy vs temperature





### 3 Test circuits

Figure 16. Switching times test circuit for resistive load



Figure 17. Gate charge test circuit



Figure 18. Test circuit for inductive load switching and diode recovery times



Figure 19. Unclamped Inductive load test circuit



Figure 20. Unclamped inductive waveform



Figure 21. Switching time waveform

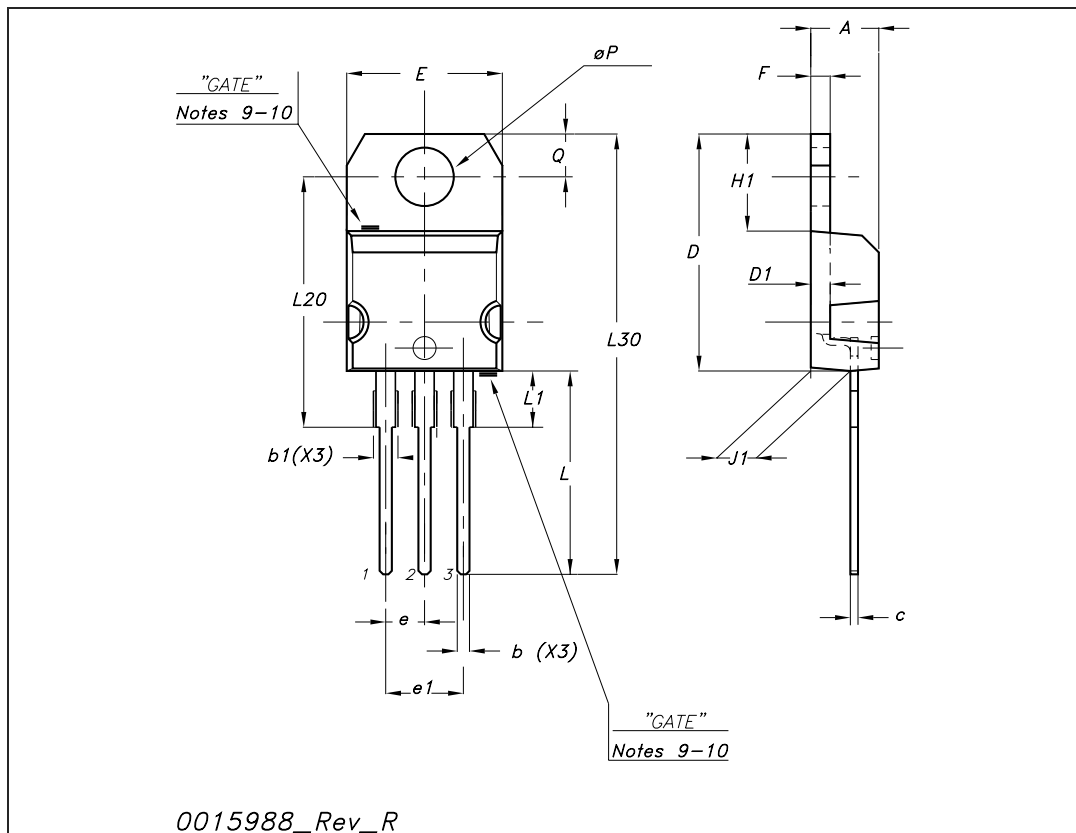


## 4 Package mechanical data

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](http://www.st.com)

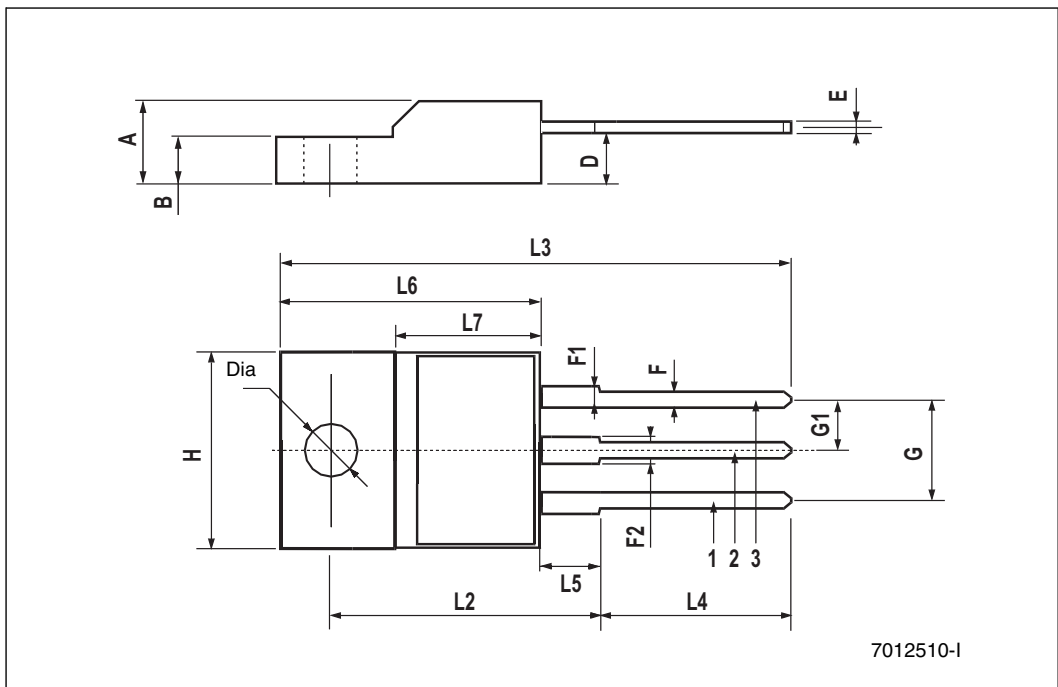
TO-220 mechanical data

| 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 |



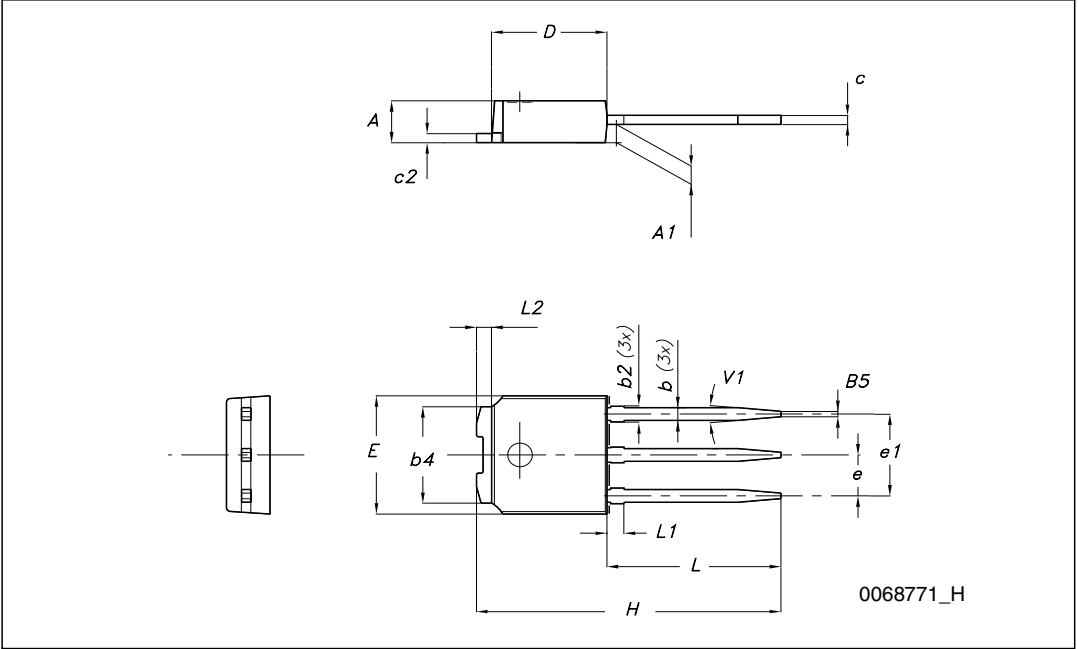
**TO-220FP mechanical data**

| 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 |



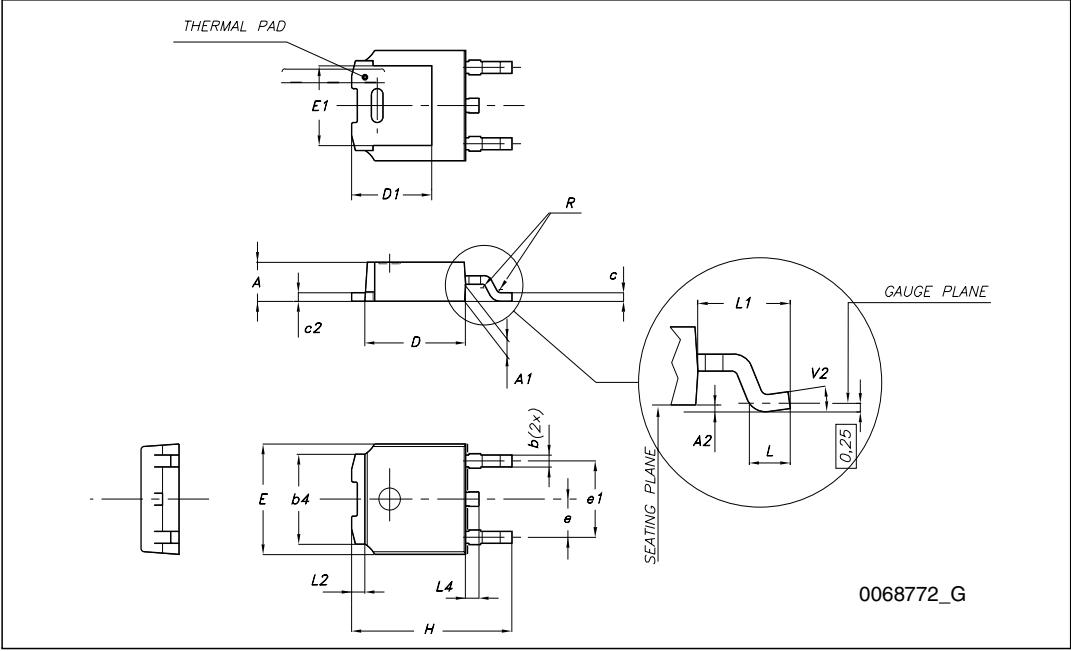
**TO-251 (IPAK) mechanical data**

| DIM. | mm.  |       |      |
|------|------|-------|------|
|      | min. | typ   | max. |
| A    | 2.20 |       | 2.40 |
| A1   | 0.90 |       | 1.10 |
| b    | 0.64 |       | 0.90 |
| b2   |      |       | 0.95 |
| b4   | 5.20 |       | 5.40 |
| c    | 0.45 |       | 0.60 |
| c2   | 0.48 |       | 0.60 |
| D    | 6.00 |       | 6.20 |
| E    | 6.40 |       | 6.60 |
| e    |      | 2.28  |      |
| e1   | 4.40 |       | 4.60 |
| H    |      | 16.10 |      |
| L    | 9.00 |       | 9.40 |
| (L1) | 0.80 |       | 1.20 |
| L2   |      | 0.80  |      |
| V1   |      | 10°   |      |



**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

| 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     |

| 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 |

TOP COVER TAPE

10 pitches cumulative tolerance on tape +/- 0.2 mm

Center line of cavity

User Direction of Feed

FEED DIRECTION

Bending radius R min.

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

## 6 Revision history

Table 10. Document revision history

| Date        | Revision | Changes       |
|-------------|----------|---------------|
| 19-May-2006 | 1        | First release |



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