



# STF4N62K3, STFI4N62K3, STI4N62K3, STP4N62K3, STU4N62K3

N-channel 620 V, 1.7  $\Omega$  typ., 3.8 A SuperMESH3™ Power MOSFET  
in TO-220FP, I<sup>2</sup>PAKFP, I<sup>2</sup>PAK, TO-220 and IPAK packages

Datasheet — production data

## Features

| Order codes | V <sub>DSS</sub> | R <sub>DS(on)</sub> max | I <sub>D</sub> | P <sub>TOT</sub> |
|-------------|------------------|-------------------------|----------------|------------------|
| STF4N62K3   | 620 V            | < 2 $\Omega$            | 3.8 A          | 25 W             |
| STFI4N62K3  |                  |                         |                | 25 W             |
| STI4N62K3   |                  |                         |                | 70 W             |
| STP4N62K3   |                  |                         |                | 70 W             |
| STU4N62K3   |                  |                         |                | 70 W             |

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

## Applications

- Switching applications

## Description

These SuperMESH3™ Power MOSFETs are the result of improvements applied to STMicroelectronics' SuperMESH™ technology, combined with a new optimized vertical structure. These devices boast an extremely low on-resistance, superior dynamic performance and high avalanche capability, rendering them suitable for the most demanding applications.

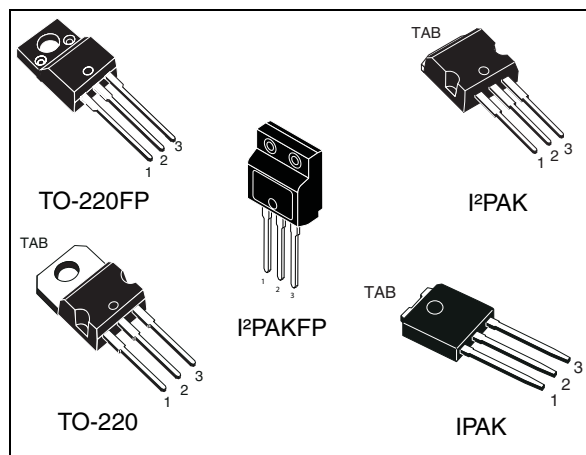
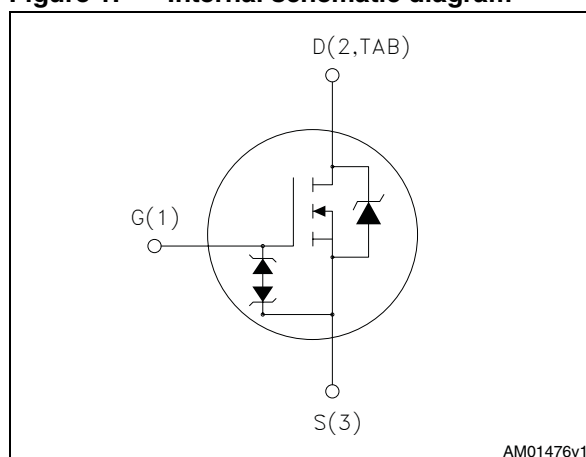


Figure 1. Internal schematic diagram



AM01476v1

Table 1. Device summary

| Order codes                                                    | Marking | Package                                                                  | Packaging |
|----------------------------------------------------------------|---------|--------------------------------------------------------------------------|-----------|
| STF4N62K3<br>STFI4N62K3<br>STI4N62K3<br>STP4N62K3<br>STU4N62K3 | 4N62K3  | TO-220FP<br>I <sup>2</sup> PAKFP<br>I <sup>2</sup> PAK<br>TO-220<br>IPAK | Tube      |

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol                         | Parameter                                                                                                                | Value                            |                              |      | Unit |
|--------------------------------|--------------------------------------------------------------------------------------------------------------------------|----------------------------------|------------------------------|------|------|
|                                |                                                                                                                          | TO-220FP<br>I <sup>2</sup> PAKFP | I <sup>2</sup> PAK<br>TO-220 | IPAK |      |
| V <sub>DS</sub>                | Drain-source voltage                                                                                                     | 620                              |                              |      | V    |
| V <sub>GS</sub>                | Gate- source voltage                                                                                                     | ± 30                             |                              |      | V    |
| I <sub>D</sub>                 | Drain current (continuous) at T <sub>C</sub> = 25 °C                                                                     | 3.8 <sup>(1)</sup>               | 3.8                          |      | A    |
| I <sub>D</sub>                 | Drain current (continuous) at T <sub>C</sub> = 100 °C                                                                    | 2 <sup>(1)</sup>                 | 2                            |      | A    |
| I <sub>DM</sub> <sup>(2)</sup> | Drain current (pulsed)                                                                                                   | 15.2 <sup>(1)</sup>              | 15.2                         |      | A    |
| P <sub>TOT</sub>               | Total dissipation at T <sub>C</sub> = 25 °C                                                                              | 25                               | 70                           |      | W    |
| I <sub>AR</sub>                | Avalanche current, repetitive or not-repetitive (pulse width limited by T <sub>j</sub> max)                              | 3.8                              |                              |      | A    |
| E <sub>AS</sub>                | Single pulse avalanche energy (starting T <sub>j</sub> = 25°C, I <sub>D</sub> = I <sub>AR</sub> , V <sub>DD</sub> = 50V) | 115                              |                              |      | mJ   |
| ESD                            | Gate-source human body model (R = 1.5 kΩ, C = 100 pF)                                                                    | 2.5                              |                              |      | kV   |
| dv/dt <sup>(3)</sup>           | Peak diode recovery voltage slope                                                                                        | 12                               |                              |      | V/ns |
| V <sub>ISO</sub>               | Insulation withstand voltage (RMS) from all three leads to external heat sink (t = 1 s; T <sub>C</sub> = 25 °C)          | 2500                             |                              |      | V    |
| T <sub>stg</sub>               | Storage temperature                                                                                                      | - 55 to 150                      |                              |      | °C   |
| T <sub>j</sub>                 | Max. operating junction temperature                                                                                      | 150                              |                              |      | °C   |

1. Limited by maximum junction temperature.

2. Pulse width limited by safe operating area.

3. I<sub>SD</sub> ≤ 3.8 A, di/dt = 400 A/μs, V<sub>DD</sub> = 80% V<sub>(BR)DSS</sub>, V<sub>DS peak</sub> ≤ V<sub>(BR)DSS</sub>.

**Table 3. Thermal data**

| Symbol                | Parameter                               | Value                            |                              |      | Unit |
|-----------------------|-----------------------------------------|----------------------------------|------------------------------|------|------|
|                       |                                         | TO-220FP<br>I <sup>2</sup> PAKFP | I <sup>2</sup> PAK<br>TO-220 | IPAK |      |
| R <sub>thj-case</sub> | Thermal resistance junction-case max    | 5                                | 1.79                         |      | °C/W |
| R <sub>thj-amb</sub>  | Thermal resistance junction-ambient max | 62.5                             |                              |      | °C/W |

## 2 Electrical characteristics

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

**Table 4. 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 ( $V_{GS} = 0$ ) | $V_{DS} = 620\text{ V}$<br>$V_{DS} = 620\text{ V}$ , $T_C = 125\text{ }^{\circ}\text{C}$ |      |      | 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                | $V_{GS} = 10\text{ V}$ , $I_D = 1.9\text{ A}$                                            |      | 1.7  | 2        | $\Omega$                       |

**Table 5. Dynamic**

| Symbol                              | Parameter                                                               | Test conditions                                                                                                | Min. | Typ.           | Max. | Unit           |
|-------------------------------------|-------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|------|----------------|------|----------------|
| $C_{iss}$<br>$C_{oss}$<br>$C_{rss}$ | Input capacitance<br>Output capacitance<br>Reverse transfer capacitance | $V_{DS} = 50\text{ V}$ , $f = 1\text{ MHz}$ ,<br>$V_{GS} = 0$                                                  |      | 550<br>42<br>7 |      | pF<br>pF<br>pF |
| $C_{oss\text{ eq.}}^{(1)}$          | Equivalent output capacitance                                           | $V_{DS} = 0\text{ to }496\text{ V}$ , $V_{GS} = 0$                                                             |      | 27             |      | pF             |
| $R_G$                               | Intrinsic gate resistance                                               | $f = 1\text{ MHz}$ open drain                                                                                  | 2    | 5              | 10   | $\Omega$       |
| $Q_g$<br>$Q_{gs}$<br>$Q_{gd}$       | Total gate charge<br>Gate-source charge<br>Gate-drain charge            | $V_{DD} = 496\text{ V}$ , $I_D = 3.8\text{ A}$ ,<br>$V_{GS} = 10\text{ V}$<br>(see <a href="#">Figure 20</a> ) |      | 22<br>4<br>13  |      | nC<br>nC<br>nC |

1.  $C_{oss\text{ eq.}}$  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 6. Switching times**

| Symbol       | Parameter           | Test conditions                                                                                                                      | Min. | Typ. | Max. | Unit |
|--------------|---------------------|--------------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| $t_{d(on)}$  | Turn-on delay time  | $V_{DD} = 300\text{ V}$ , $I_D = 1.9\text{ A}$ ,<br>$R_G = 4.7\ \Omega$ , $V_{GS} = 10\text{ V}$<br>(see <a href="#">Figure 19</a> ) | -    | 10   | -    | ns   |
| $t_r$        | Rise time           |                                                                                                                                      |      | 9    |      | ns   |
| $t_{d(off)}$ | Turn-off-delay time |                                                                                                                                      |      | 29   |      | ns   |
| $t_f$        | Fall time           |                                                                                                                                      |      | 19   |      | ns   |

**Table 7. Source drain diode**

| Symbol          | Parameter                     | Test conditions                                                                                                                                                | Min. | Typ. | Max. | Unit          |
|-----------------|-------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|---------------|
| $I_{SD}$        | Source-drain current          |                                                                                                                                                                | -    |      | 3.8  | A             |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) |                                                                                                                                                                |      |      | 15.2 | A             |
| $V_{SD}^{(2)}$  | Forward on voltage            | $I_{SD} = 3.8\text{ A}$ , $V_{GS} = 0$                                                                                                                         | -    |      | 1.6  | V             |
| $t_{rr}$        | Reverse recovery time         | $I_{SD} = 3.8\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$<br>$V_{DD} = 60\text{ V}$ (see <a href="#">Figure 24</a> )                                        | -    | 220  |      | ns            |
| $Q_{rr}$        | Reverse recovery charge       |                                                                                                                                                                |      | 1.4  |      | $\mu\text{C}$ |
| $I_{RRM}$       | Reverse recovery current      |                                                                                                                                                                |      | 13   |      | A             |
| $t_{rr}$        | Reverse recovery time         | $I_{SD} = 3.8\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$<br>$V_{DD} = 60\text{ V}$ , $T_j = 150\text{ }^\circ\text{C}$<br>(see <a href="#">Figure 24</a> ) | -    | 270  |      | ns            |
| $Q_{rr}$        | Reverse recovery charge       |                                                                                                                                                                |      | 1.9  |      | $\mu\text{C}$ |
| $I_{RRM}$       | Reverse recovery current      |                                                                                                                                                                |      | 14   |      | A             |

1. Pulse width limited by safe operating area

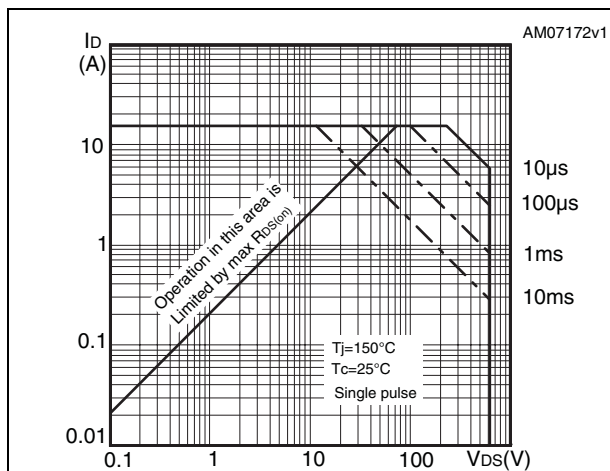
2. Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%**Table 8. Gate-source Zener diode**

| Symbol        | Parameter                                   | Test conditions            | Min. | Typ. | Max. | Unit |
|---------------|---------------------------------------------|----------------------------|------|------|------|------|
| $V_{(BR)GSO}$ | Gate-source breakdown voltage ( $I_D = 0$ ) | $I_{gs} = \pm 1\text{ mA}$ | 30   | -    |      | V    |

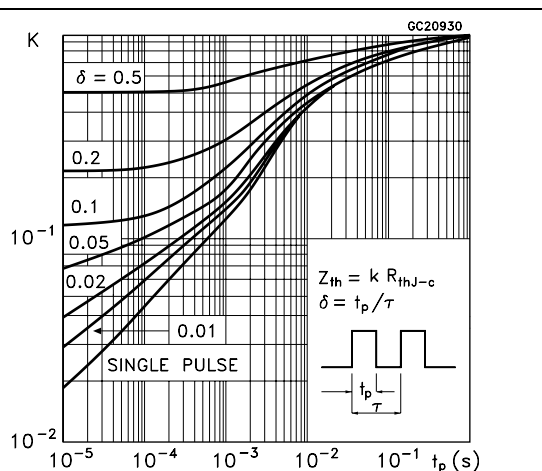
The built-in back-to-back Zener diodes have specifically been designed to enhance not only the device's ESD capability, but also to make them safely absorb possible voltage transients that may occasionally be applied from gate to source. In this respect the Zener voltage is appropriate to achieve an 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)

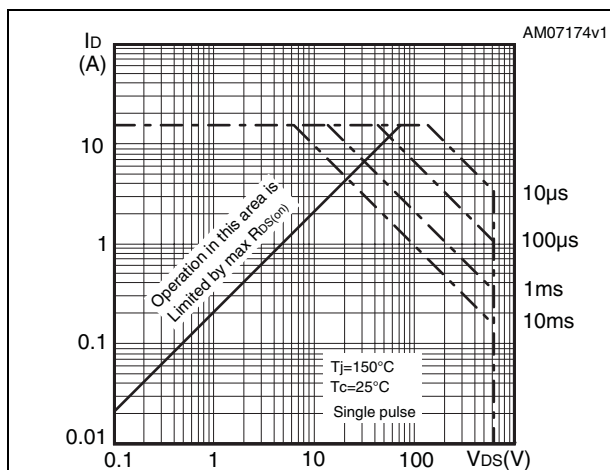
**Figure 2. Safe operating area for TO-220, I<sup>2</sup>PAK**



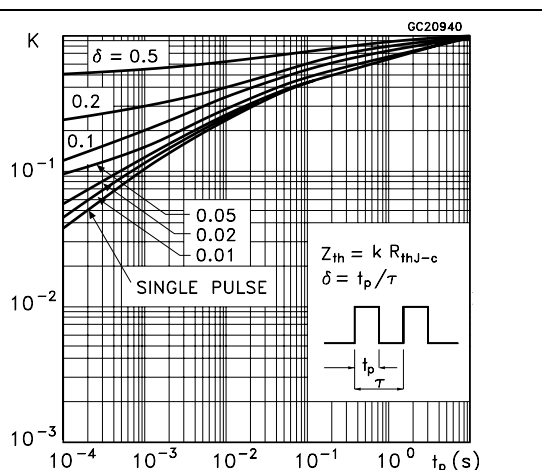
**Figure 3. Thermal impedance for TO-220, I<sup>2</sup>PAK**



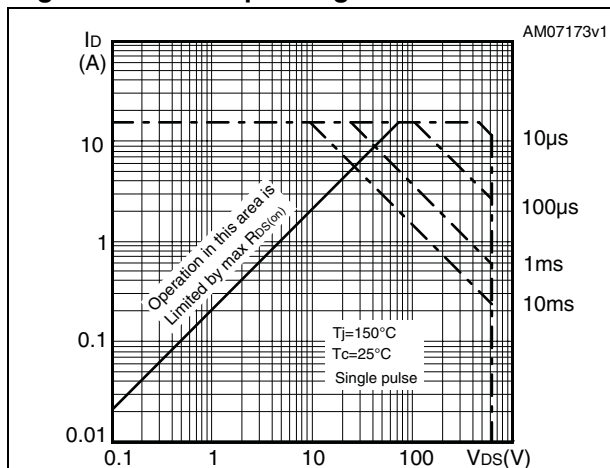
**Figure 4. Safe operating area for TO-220FP, I<sup>2</sup>PAKFP**



**Figure 5. Thermal impedance for TO-220FP, I<sup>2</sup>PAKFP**



**Figure 6. Safe operating area for IPAK**



**Figure 7. Thermal impedance for IPAK**

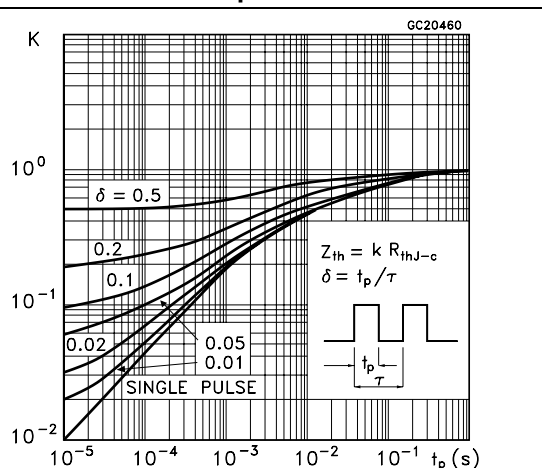


Figure 8. Output characteristics

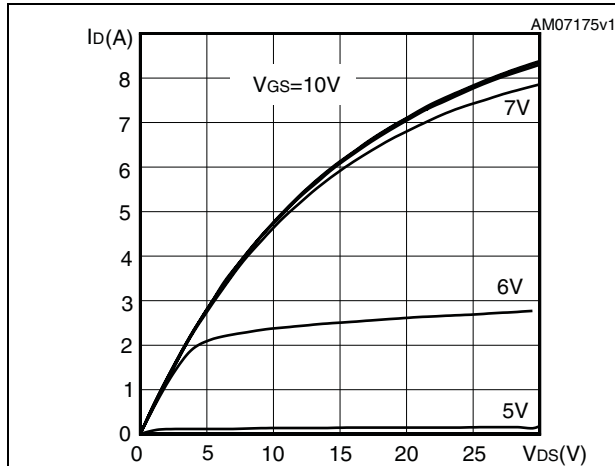


Figure 9. Transfer characteristics

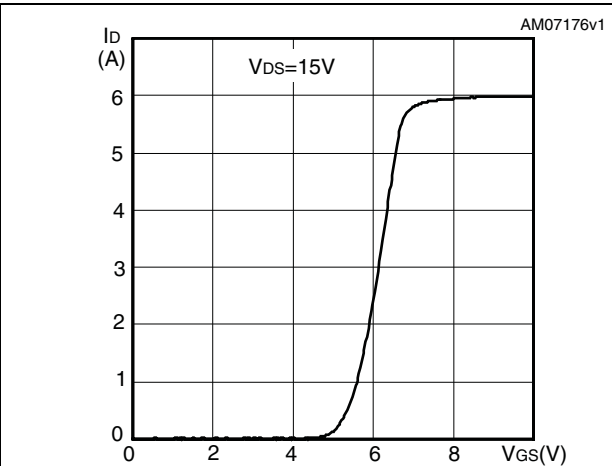


Figure 10. Gate charge vs gate-source voltage

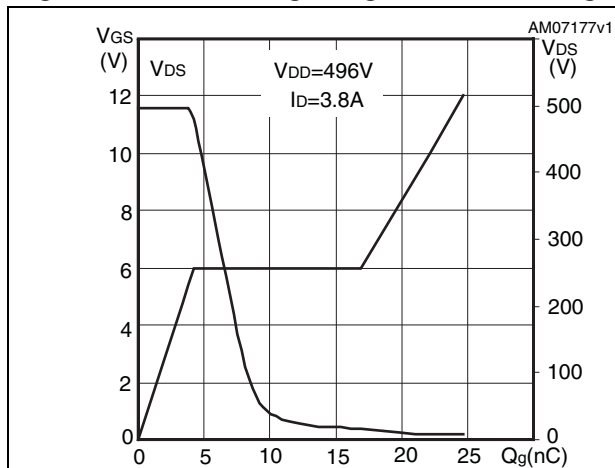


Figure 11. Static drain-source on resistance

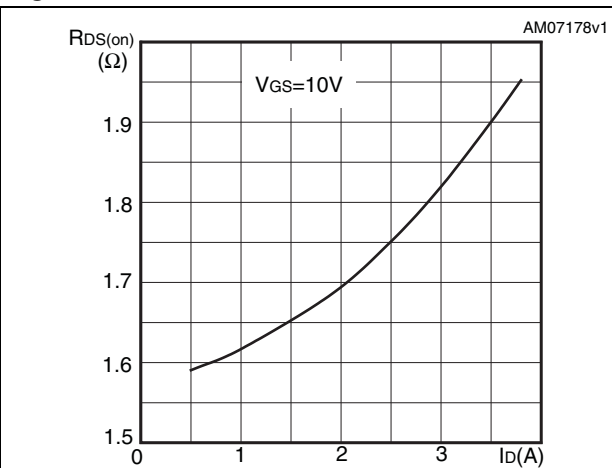


Figure 12. Capacitance variations

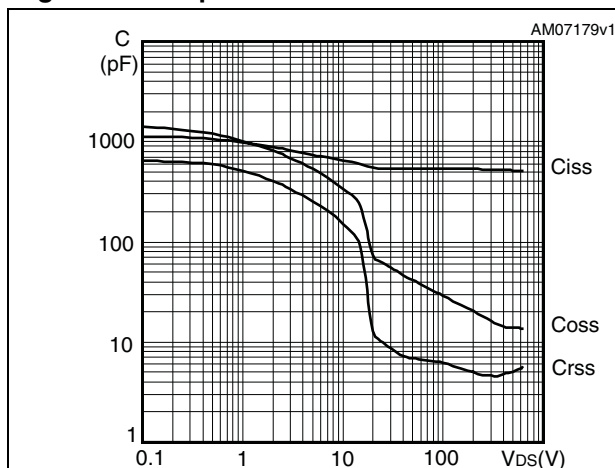


Figure 13. Output capacitance stored energy

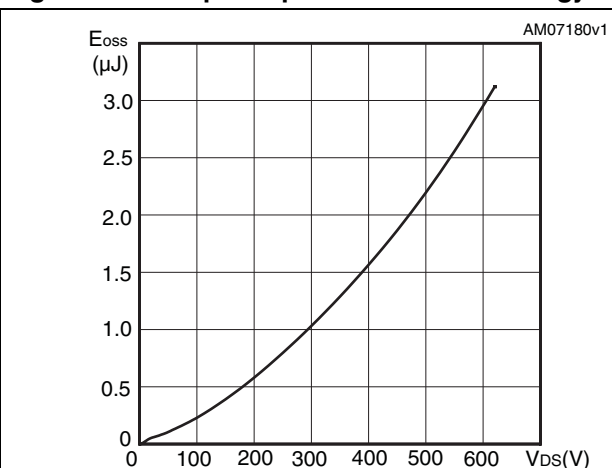


Figure 14. Normalized gate threshold voltage vs temperature

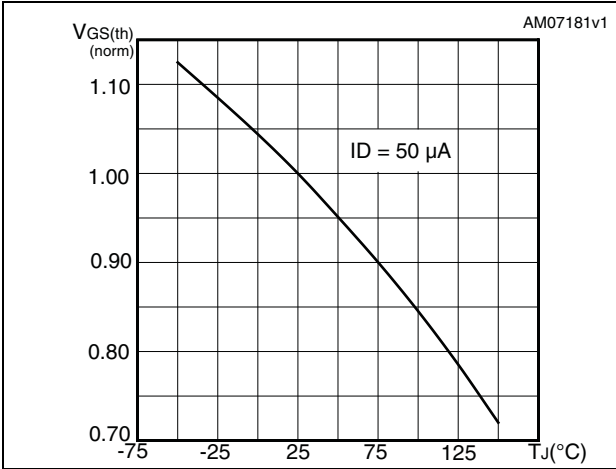


Figure 15. Normalized on resistance vs temperature

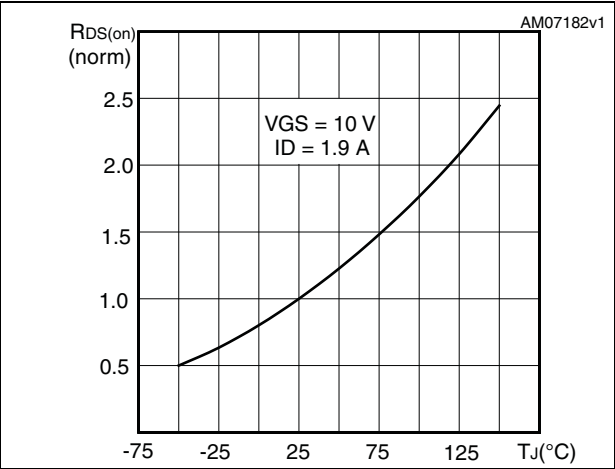


Figure 16. Maximum avalanche energy vs starting Tj

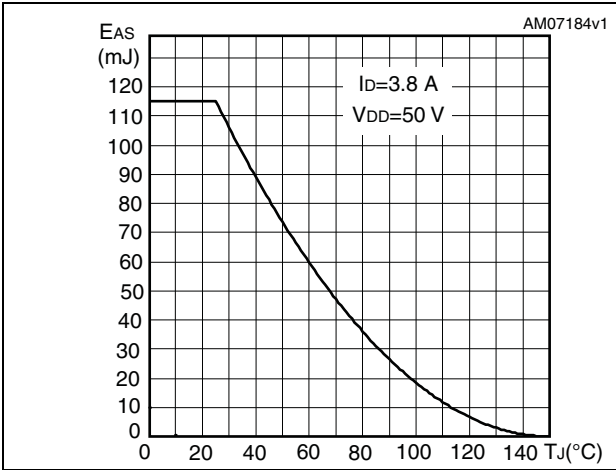


Figure 17. Normalized  $B_{VDSS}$  vs temperature

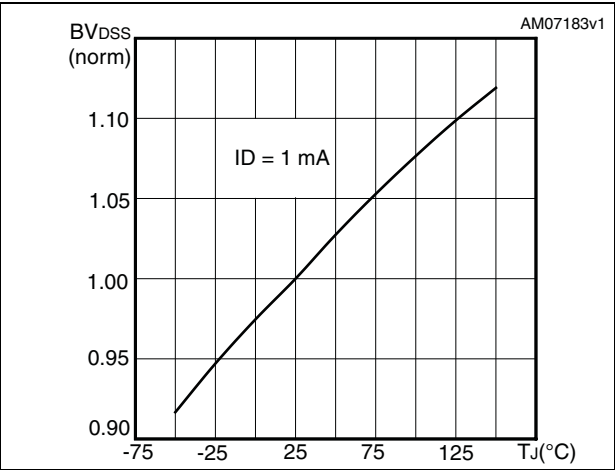
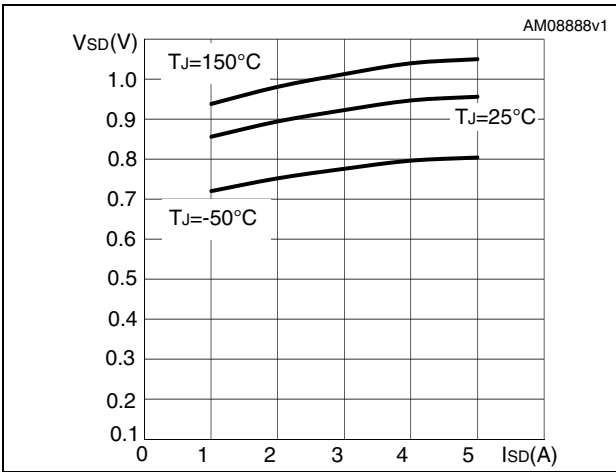
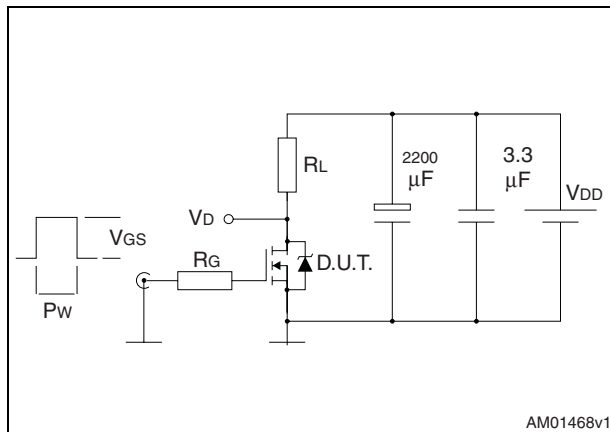


Figure 18. Source-drain diode forward characteristics

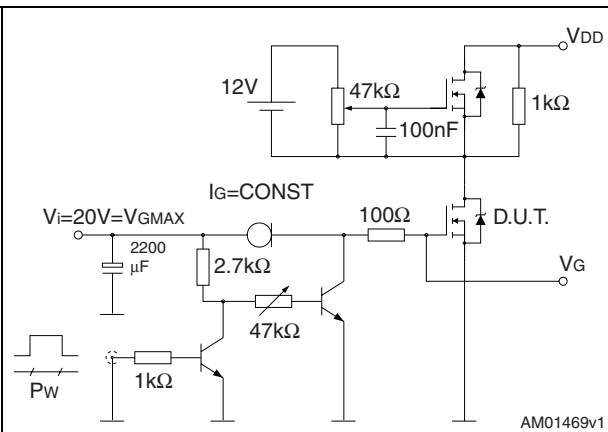


### 3 Test circuits

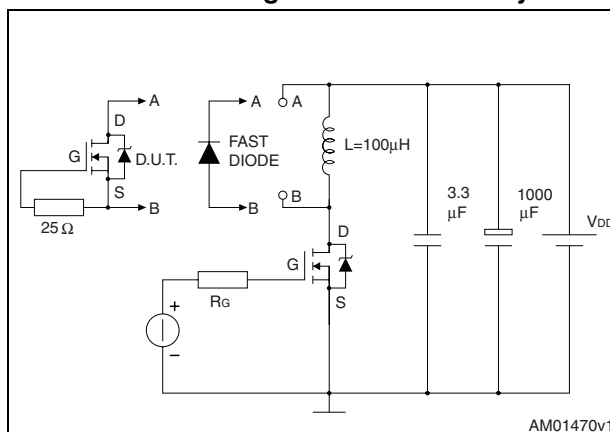
**Figure 19. Switching times test circuit for resistive load**



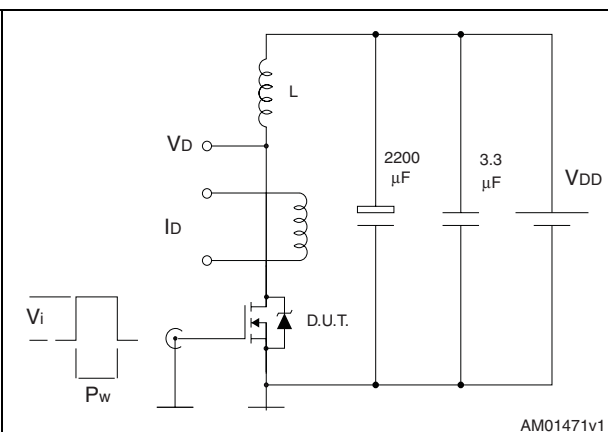
**Figure 20. Gate charge test circuit**



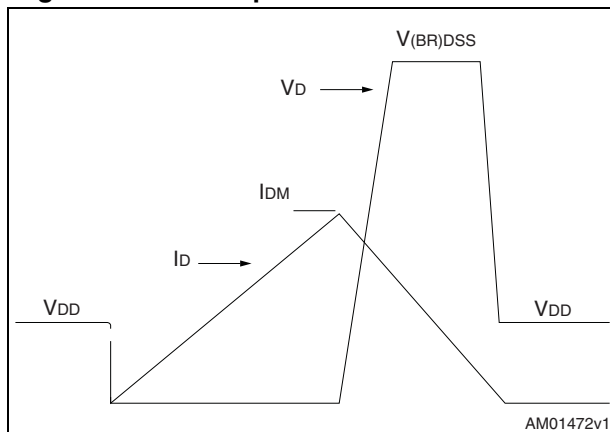
**Figure 21. Test circuit for inductive load switching and diode recovery times**



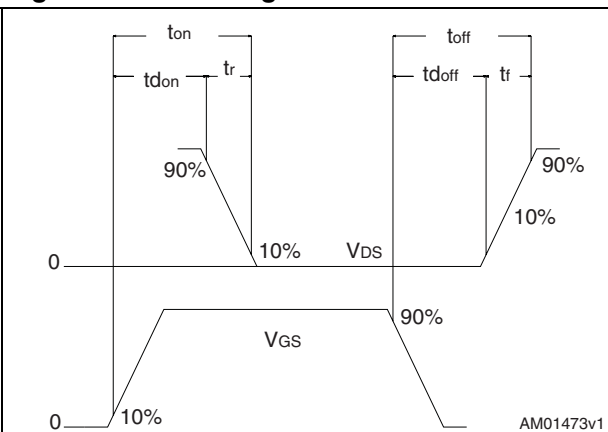
**Figure 22. Unclamped inductive load test circuit**



**Figure 23. Unclamped inductive waveform**



**Figure 24. Switching time waveform**



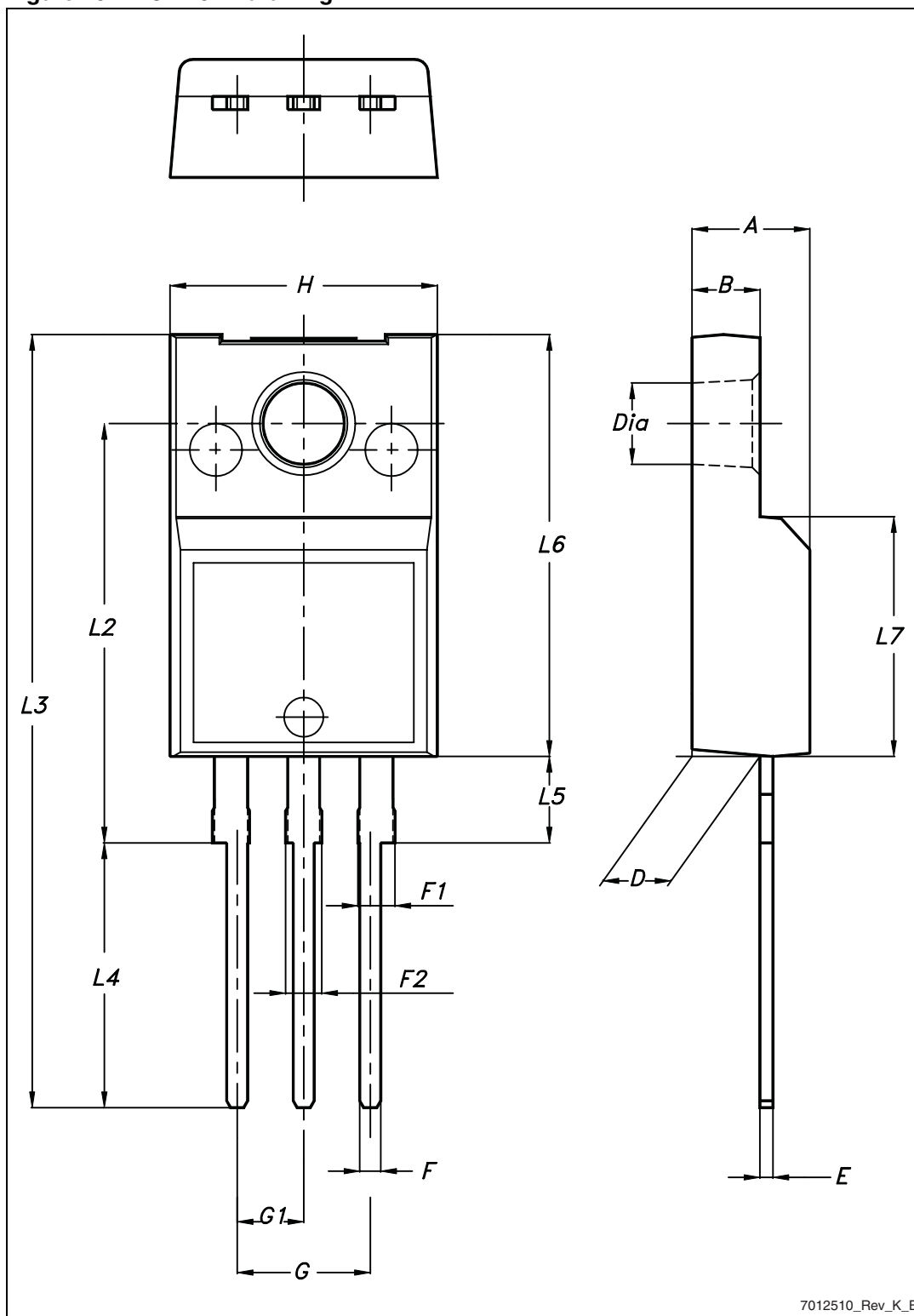
## 4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK is an ST trademark.

**Table 9. TO-220FP mechanical data**

| Dim. | mm   |      |      |
|------|------|------|------|
|      | Min. | Typ. | Max. |
| A    | 4.4  |      | 4.6  |
| B    | 2.5  |      | 2.7  |
| D    | 2.5  |      | 2.75 |
| E    | 0.45 |      | 0.7  |
| F    | 0.75 |      | 1    |
| F1   | 1.15 |      | 1.70 |
| F2   | 1.15 |      | 1.70 |
| G    | 4.95 |      | 5.2  |
| G1   | 2.4  |      | 2.7  |
| H    | 10   |      | 10.4 |
| L2   |      | 16   |      |
| L3   | 28.6 |      | 30.6 |
| L4   | 9.8  |      | 10.6 |
| L5   | 2.9  |      | 3.6  |
| L6   | 15.9 |      | 16.4 |
| L7   | 9    |      | 9.3  |
| Dia  | 3    |      | 3.2  |

Figure 25. TO-220FP drawing



**Table 10. I<sup>2</sup>PAKFP (TO-281) mechanical data**

| Dim. | mm    |      |       |
|------|-------|------|-------|
|      | Min.  | Typ. | Max.  |
| A    | 4.40  | -    | 4.60  |
| B    | 2.50  |      | 2.70  |
| D    | 2.50  |      | 2.75  |
| D1   | 0.65  |      | 0.85  |
| E    | 0.45  |      | 0.70  |
| F    | 0.75  |      | 1.00  |
| F1   |       |      | 1.20  |
| G    | 4.95  |      | 5.20  |
| H    | 10.00 |      | 10.40 |
| L1   | 21.00 |      | 23.00 |
| L2   | 13.20 |      | 14.10 |
| L3   | 10.55 |      | 10.85 |
| L4   | 2.70  |      | 3.20  |
| L5   | 0.85  |      | 1.25  |
| L6   | 7.30  |      | 7.50  |

**Figure 26. I<sup>2</sup>PAKFP (TO-281) drawing**

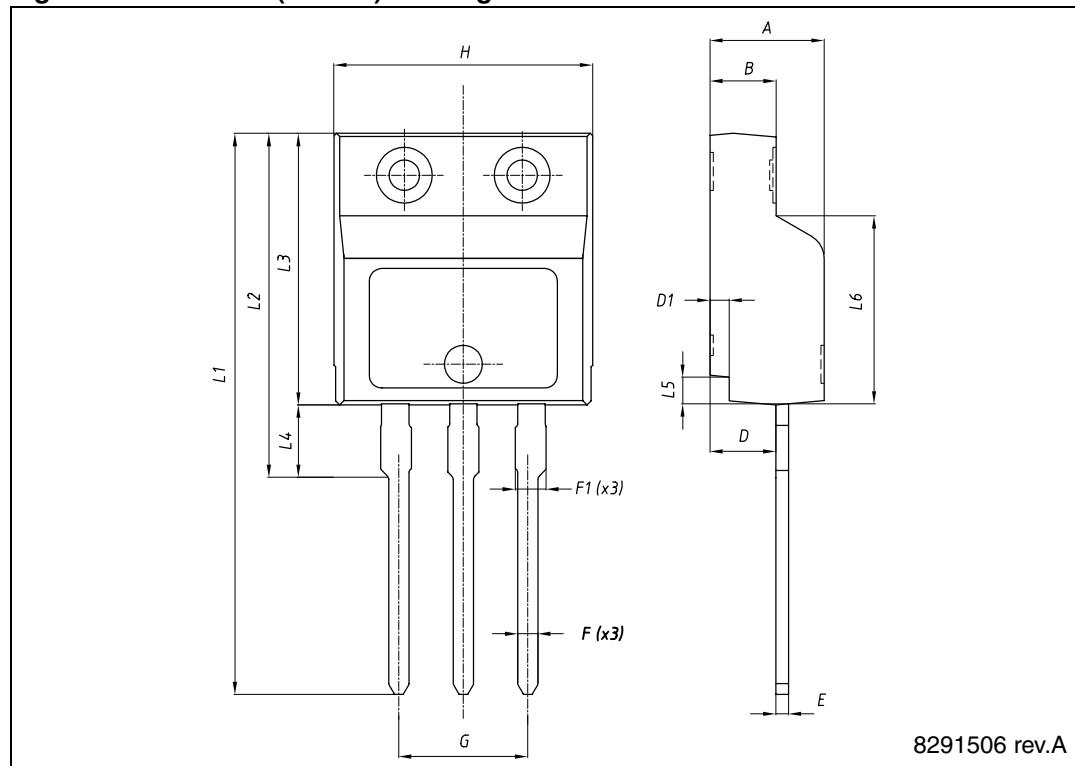


Table 11. I<sup>2</sup>PAK (TO-262) mechanical data

| DIM. | mm.  |     |       |
|------|------|-----|-------|
|      | min. | typ | max.  |
| A    | 4.40 |     | 4.60  |
| A1   | 2.40 |     | 2.72  |
| b    | 0.61 |     | 0.88  |
| b1   | 1.14 |     | 1.70  |
| c    | 0.49 |     | 0.70  |
| c2   | 1.23 |     | 1.32  |
| D    | 8.95 |     | 9.35  |
| e    | 2.40 |     | 2.70  |
| e1   | 4.95 |     | 5.15  |
| E    | 10   |     | 10.40 |
| L    | 13   |     | 14    |
| L1   | 3.50 |     | 3.93  |
| L2   | 1.27 |     | 1.40  |

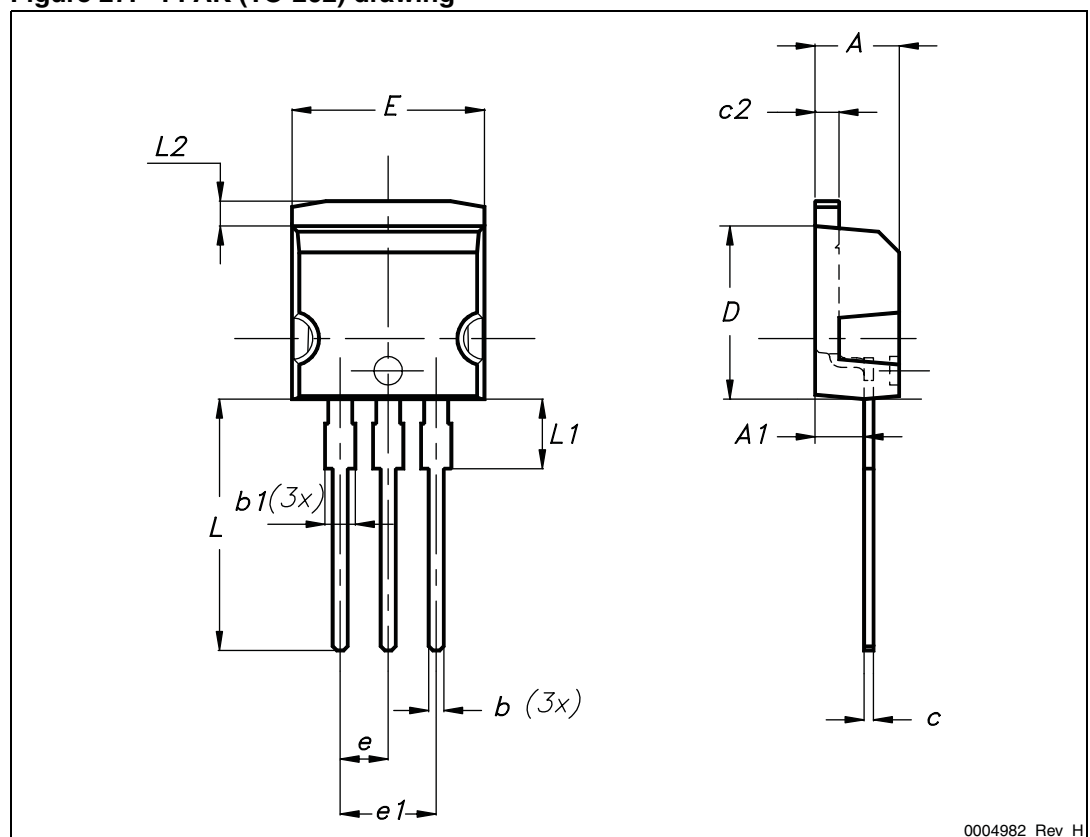
Figure 27. I<sup>2</sup>PAK (TO-262) drawing

Table 12. TO-220 type A mechanical data

| Dim. | mm    |       |       |
|------|-------|-------|-------|
|      | Min.  | Typ.  | Max.  |
| A    | 4.40  |       | 4.60  |
| b    | 0.61  |       | 0.88  |
| b1   | 1.14  |       | 1.70  |
| c    | 0.48  |       | 0.70  |
| D    | 15.25 |       | 15.75 |
| D1   |       | 1.27  |       |
| E    | 10    |       | 10.40 |
| e    | 2.40  |       | 2.70  |
| e1   | 4.95  |       | 5.15  |
| F    | 1.23  |       | 1.32  |
| H1   | 6.20  |       | 6.60  |
| J1   | 2.40  |       | 2.72  |
| L    | 13    |       | 14    |
| L1   | 3.50  |       | 3.93  |
| L20  |       | 16.40 |       |
| L30  |       | 28.90 |       |
| ØP   | 3.75  |       | 3.85  |
| Q    | 2.65  |       | 2.95  |

Figure 28. TO-220 type A drawing

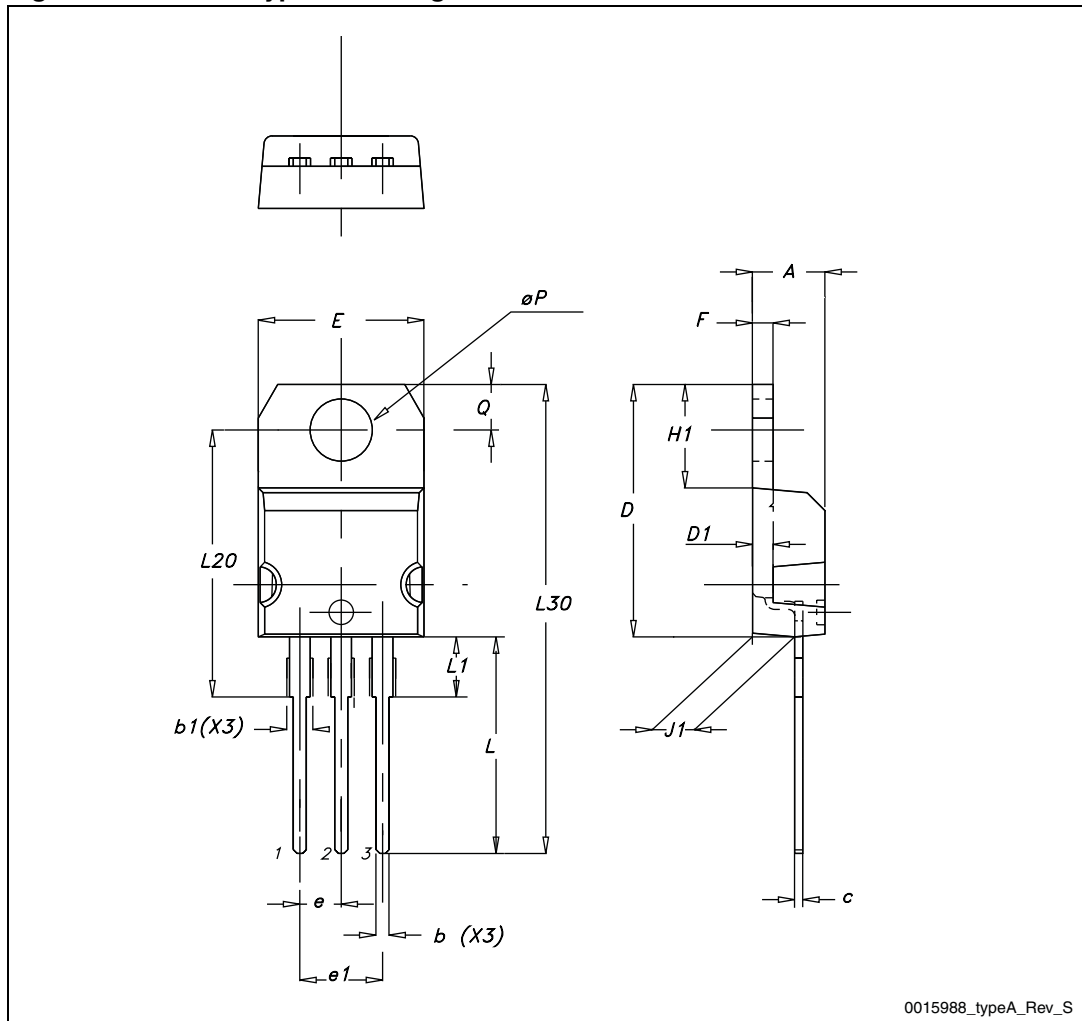
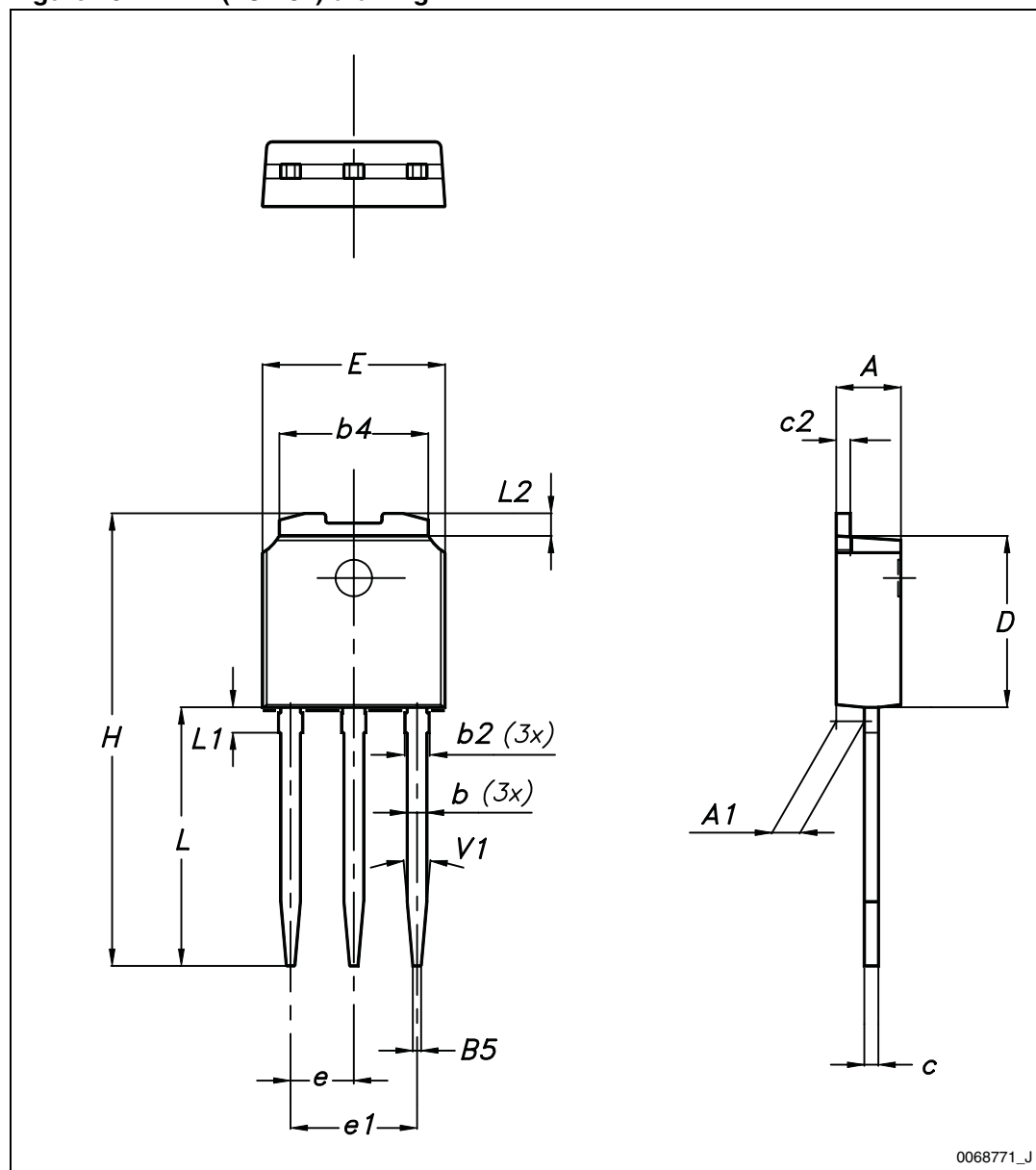


Table 13. IPAK (TO-251) mechanical data

| 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 |
| B5  |      | 0.30  |      |
| 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  | 1.00 |
| V1  |      | 10°   |      |

Figure 29. IPAK (TO-251) drawing



## 5 Revision history

**Table 14. Document revision history**

| Date        | Revision | Changes                                                                                                                                                                                                                                                                                                                                                                              |
|-------------|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 05-May-2010 | 1        | First release                                                                                                                                                                                                                                                                                                                                                                        |
| 16-Dec-2010 | 2        | Document status promoted from preliminary data to datasheet.                                                                                                                                                                                                                                                                                                                         |
| 27-Mar-2012 | 3        | Inserted max and min. values for $R_G$ in <a href="#">Table 5</a> .<br>Updated <a href="#">Section 4: Package mechanical data</a> .                                                                                                                                                                                                                                                  |
| 07-Aug-2012 | 4        | Added package, mechanical data: I <sup>2</sup> PAKFP.<br>Updated <a href="#">Table 1: Device summary</a> , <a href="#">Table 2: Absolute maximum ratings</a> , <a href="#">Table 3: Thermal data</a> , <a href="#">Table 4: On /off states</a> , <a href="#">Table 13: IPAK (TO-251) mechanical data</a> and <a href="#">Figure 29: IPAK (TO-251) drawing</a><br>Minor text changes. |

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