



STP13N95K3, STF13N95K3 STW13N95K3

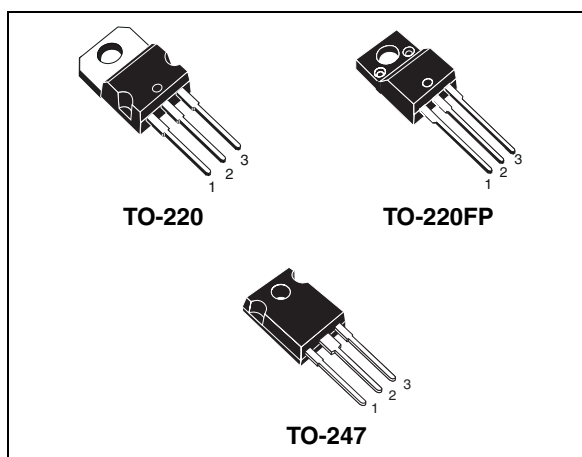
N-channel 950 V, 0.68 Ω , 10 A, TO-220, TO-220FP, TO-247
SuperMESH3™ Power MOSFET

Preliminary data

Features

| Type | V _{DSS} | R _{DS(on)} max | I _D | P _w |
|------------|------------------|-------------------------|----------------|----------------|
| STP13N95K3 | 950 V | < 0.85 Ω | 10 A | 190 W |
| STF13N95K3 | 950 V | < 0.85 Ω | 10 A | 40 W |
| STW13N95K3 | 950 V | < 0.85 Ω | 10 A | 190 W |

- 100% avalanche tested
- Extremely large avalanche performance
- Gate charge minimized
- Very low intrinsic capacitances
- Zener-protected



Application

- Switching applications

Description

The new SuperMESH3™ series of Power MOSFETS is the result of the fine-tuning of ST's well-established strip-based PowerMESH™ layout with a new optimized vertical structure. The innovative design offer significantly reduced on-resistance, exceptional dynamic performance and very large avalanche capability, making the device suitable for the most demanding applications.

Figure 1. Internal schematic diagram

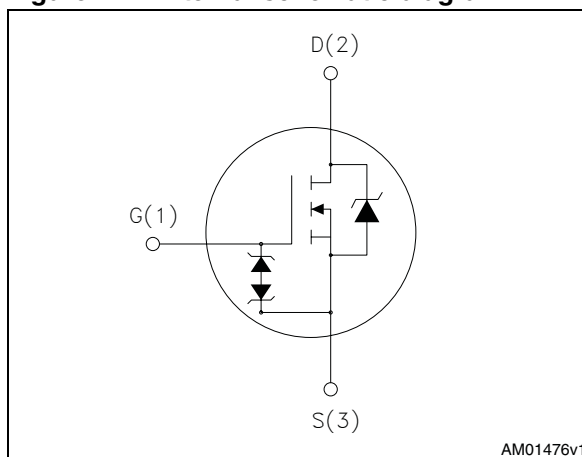


Table 1. Device summary

| Order code | Marking | Package | Packaging |
|------------|---------|----------|-----------|
| STF13N95K3 | 13N95K3 | TO-220FP | Tube |
| STP13N95K3 | 13N95K3 | TO-220 | Tube |
| STW13N95K3 | 13N95K3 | TO-247 | Tube |

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1 Electrical ratings

Table 2. Absolute maximum ratings

| Symbol | Parameter | Value | | | Unit |
|--------------------|--|------------|--------------------|--------|------|
| | | TO-220 | TO-220FP | TO-247 | |
| V_{GS} | Gate- source voltage | 30 | | | V |
| I_D | Drain current (continuous) at $T_C = 25\text{ °C}$ | 10 | 10 ⁽¹⁾ | 10 | A |
| I_D | Drain current (continuous) at $T_C = 100\text{ °C}$ | 6.3 | 6.3 ⁽¹⁾ | 6.3 | A |
| $I_{DM}^{(2)}$ | Drain current (pulsed) | 40 | 40 ⁽¹⁾ | 40 | A |
| P_{TOT} | Total dissipation at $T_C = 25\text{ °C}$ | 190 | 40 | 190 | W |
| I_{AR} | Avalanche current, repetitive or not-repetitive (pulse width limited by T_J max) | 13 | | | A |
| E_{AS} | Single pulse avalanche energy (starting $T_J = 25\text{ °C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$) | TBD | | | mJ |
| $dv/dt^{(3)}$ | Peak diode recovery voltage slope | 6 | | | V/ns |
| V_{ISO} | Insulation withstand voltage (AC) | | 2500 | | |
| T_J T_{stg} | Operating junction temperature Storage temperature | -55 to 150 | | | °C |

- Limited only by maximum temperature allowed
- Pulse width limited by safe operating area
- $I_{SD} \leq 10\text{ A}$, $di/dt \leq 100\text{ A}/\mu\text{s}$, peak $V_{DS} \leq V_{(BR)DSS}$

Table 3. Thermal data

| Symbol | Parameter | Value | | | Unit |
|----------------|--|--------|----------|--------|------|
| | | TO-220 | TO-220FP | TO-247 | |
| $R_{thj-case}$ | Thermal resistance junction-case max | 0.66 | 3.13 | 0.66 | °C/W |
| $R_{thj-amb}$ | Thermal resistance junction-ambient max | 62.50 | | 50.00 | °C/W |
| T_J | Maximum lead temperature for soldering purpose | 300 | | | °C/W |

2 Electrical characteristics

(T_{case} = 25°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 mA, V _{GS} = 0 | 950 | | | V |
| I _{DSS} | Zero gate voltage drain current (V _{GS} = 0) | V _{DS} = Max rating V _{DS} = Max rating, T _C = 125 °C | | | 1 50 | μA μA |
| I _{GSS} | Gate-body leakage current (V _{DS} = 0) | V _{GS} = ± 20 V; V _{DS} = 0 | | | 10 | μA |
| V _{GS(th)} | Gate threshold voltage | V _{DS} = V _{GS} , I _D = 100 μA | 3 | 4 | 5 | V |
| R _{DS(on)} | Static drain-source on resistance | V _{GS} = 10 V, I _D = 5 A | | 0.68 | 0.85 | Ω |

Table 5. Dynamic

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|--|---|---|------|------------------|------|----------------|
| g _{fs} ⁽¹⁾ | Forward transconductance | V _{DS} = 15 V, I _D = 13 A | - | TBD | - | S |
| C _{iss} C _{oss} C _{rss} | Input capacitance Output capacitance Reverse transfer capacitance | V _{DS} = 100 V, f = 1 MHz, V _{GS} = 0 | - | 1700 178 2 | - | pF pF pF |
| C _{o(tr)} ⁽²⁾ | Equivalent capacitance time related | V _{DS} = 0 to 760 V, V _{GS} = 0 | - | TBD | - | pF |
| C _{o(er)} ⁽³⁾ | Equivalent capacitance energy related | V _{DS} = 0 to 760 V, V _{GS} = 0 | - | TBD | - | pF |
| R _g | Gate input resistance | f = 1 MHz open drain | - | 2 | - | Ω |
| Q _g Q _{gs} Q _{gd} | Total gate charge Gate-source charge Gate-drain charge | V _{DD} = 760 V, I _D = 10 A, V _{GS} = 10 V (see Figure 3) | - | 49 TBD TBD | - | nC nC nC |

1. Pulsed: Pulse duration = 300 μs, duty cycle 1.5%
2. C_{oss eq.} time related 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}
3. C_{oss eq.} energy related is defined as a constant equivalent capacitance giving the same stored energy 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 | $V_{DD} = 475 \text{ V}$, $I_D = 5 \text{ A}$, $R_G = 4.7 \Omega$, $V_{GS} = 10 \text{ V}$ (see Figure 2) | - | TBD | - | ns |
| t_r | Rise time | | | TBD | | ns |
| $t_{d(off)}$ | Turn-off-delay time | | | TBD | | ns |
| t_f | Fall time | | | TBD | | ns |

Table 7. Source drain diode

| Symbol | Parameter | Test conditions | Min. | Typ. | Max | Unit |
|-----------------|-------------------------------|---|------|------|-----|---------------|
| I_{SD} | Source-drain current | | - | | 10 | A |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) | | | | 40 | A |
| $V_{SD}^{(2)}$ | Forward on voltage | $I_{SD} = 10 \text{ A}$, $V_{GS} = 0$ | - | | 1.5 | V |
| t_{rr} | Reverse recovery time | $I_{SD} = 10 \text{ A}$, $di/dt = 100 \text{ A}/\mu\text{s}$ $V_{DD} = 60 \text{ V}$ (see Figure 4) | - | TBD | | ns |
| Q_{rr} | Reverse recovery charge | | | TBD | | μC |
| I_{RRM} | Reverse recovery current | | | TBD | | A |
| t_{rr} | Reverse recovery time | $I_{SD} = 10 \text{ A}$, $di/dt = 100 \text{ A}/\mu\text{s}$ $V_{DD} = 60 \text{ V}$ $T_J = 150 \text{ }^\circ\text{C}$ (see Figure 4) | - | TBD | | ns |
| Q_{rr} | Reverse recovery charge | | | TBD | | μC |
| 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 8. Gate-source Zener diode

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

3 Test circuits

Figure 2. Switching times test circuit for resistive load

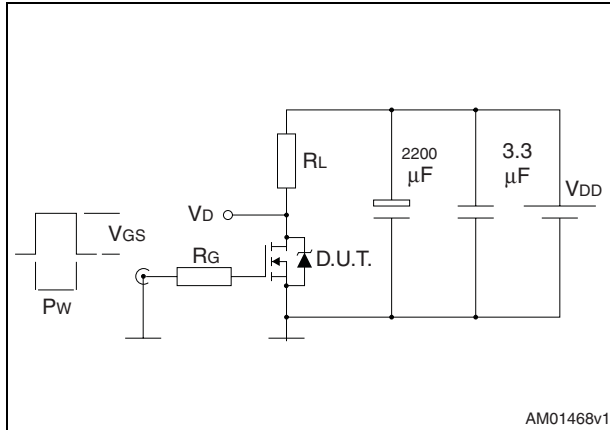


Figure 3. Gate charge test circuit

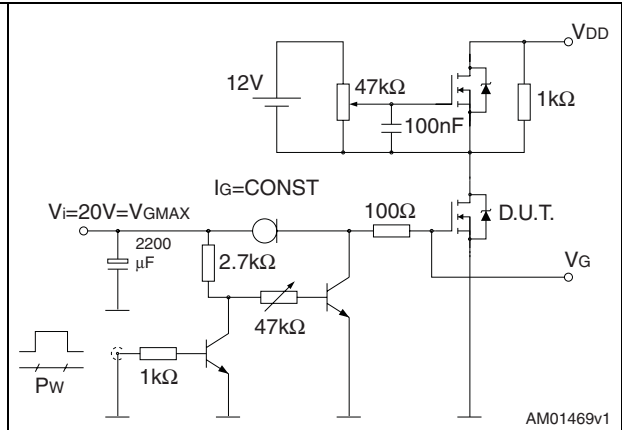


Figure 4. Test circuit for inductive load switching and diode recovery times

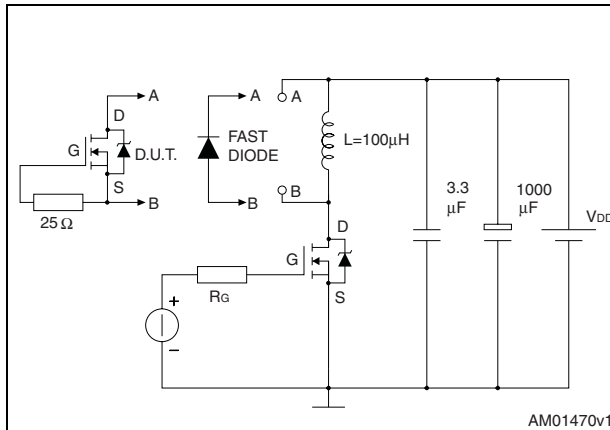


Figure 5. Unclamped inductive load test circuit

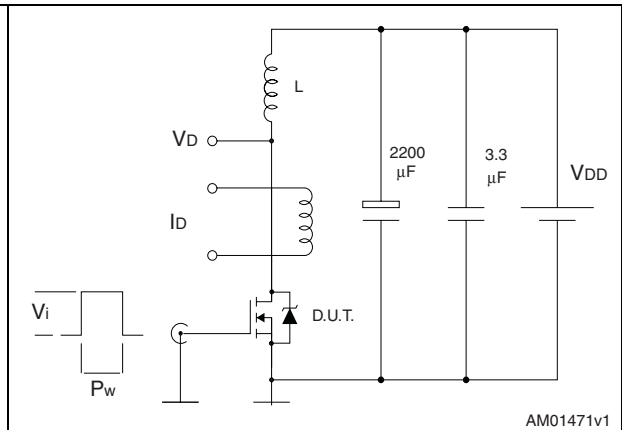


Figure 6. Unclamped inductive waveform

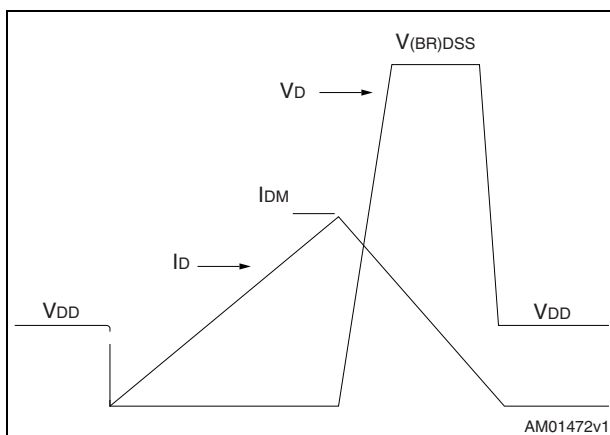
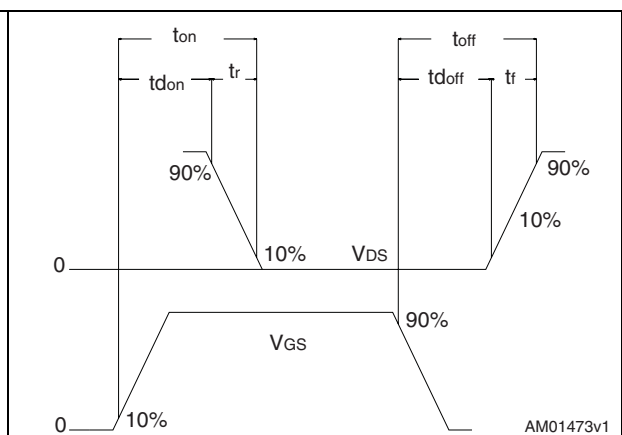


Figure 7. Switching time waveform

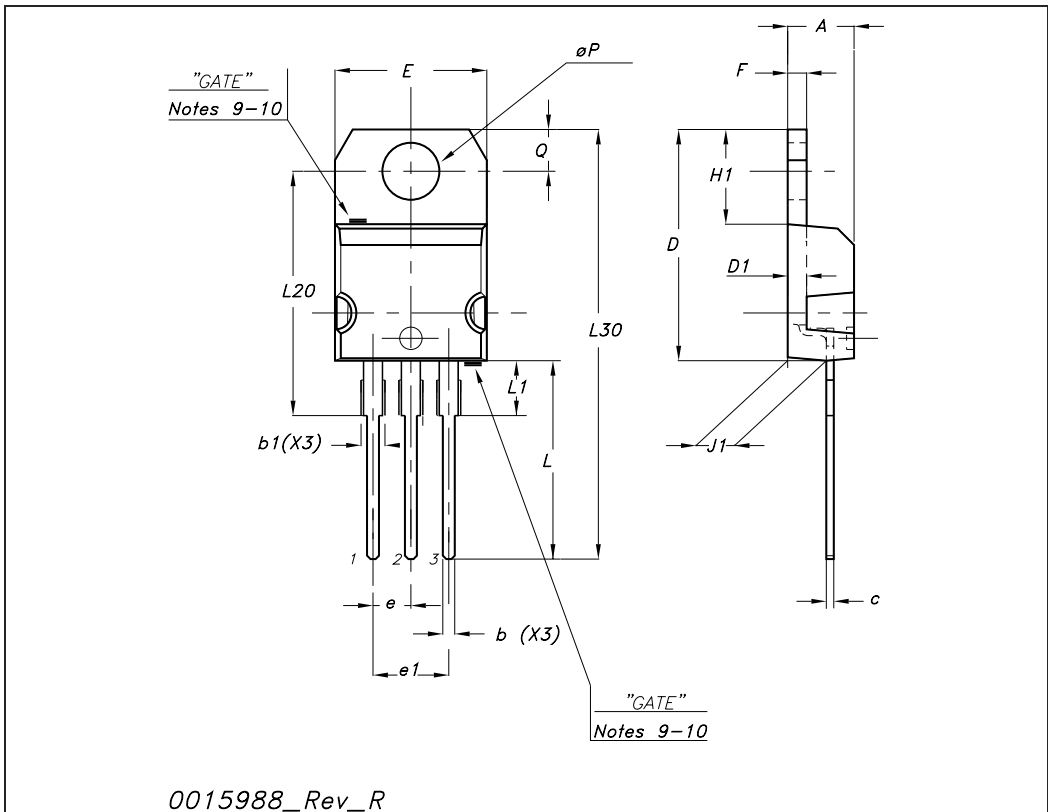


4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in 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. ECOPACK is an ST trademark.

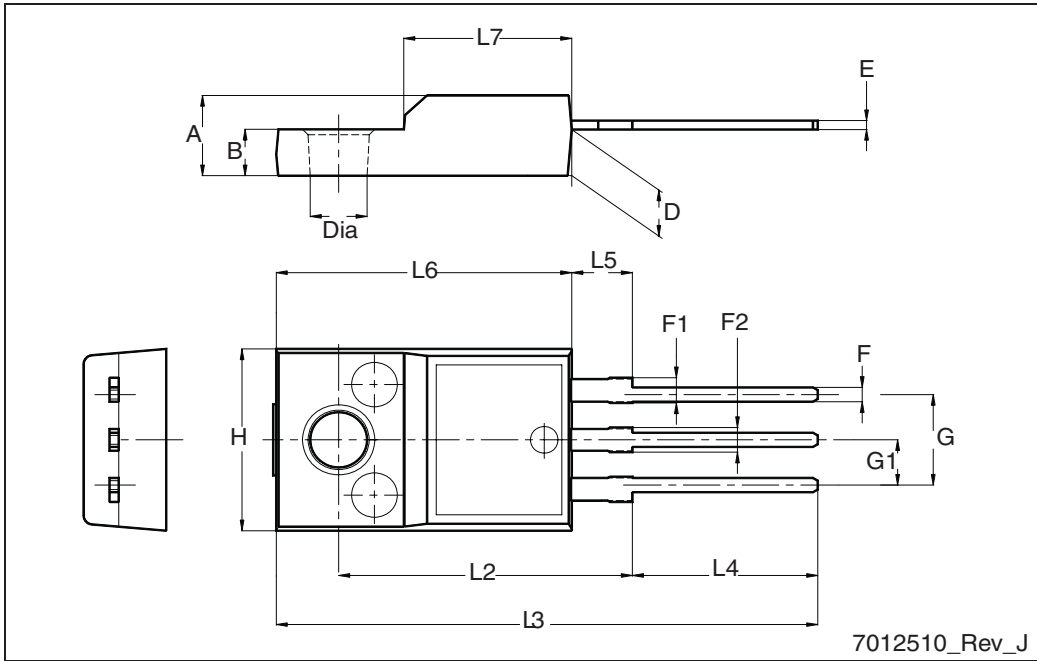
TO-220 mechanical data

| 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 |



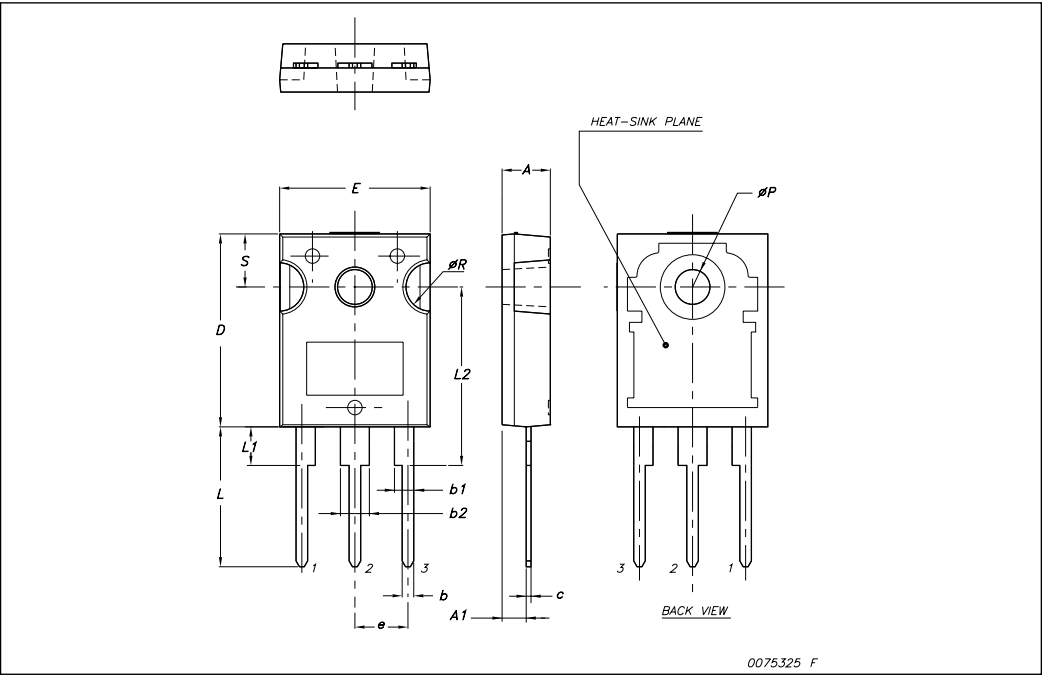
TO-220FP mechanical data

| Dim. | mm | | |
|------|------|------|------|
| | 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 | | 1.5 |
| 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 |



TO-247 Mechanical data

| Dim. | mm. | | |
|------|-------|-------|-------|
| | Min. | Typ | Max. |
| A | 4.85 | | 5.15 |
| A1 | 2.20 | | 2.60 |
| b | 1.0 | | 1.40 |
| b1 | 2.0 | | 2.40 |
| b2 | 3.0 | | 3.40 |
| c | 0.40 | | 0.80 |
| D | 19.85 | | 20.15 |
| E | 15.45 | | 15.75 |
| e | | 5.45 | |
| L | 14.20 | | 14.80 |
| L1 | 3.70 | | 4.30 |
| L2 | | 18.50 | |
| øP | 3.55 | | 3.65 |
| øR | 4.50 | | 5.50 |
| S | | 5.50 | |



5 Revision history

Table 9. Document revision history

| Date | Revision | Changes |
|-------------|----------|---------------|
| 15-May-2009 | 1 | First release |

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