



STD12N65M5, STF12N65M5 STP12N65M5, STU12N65M5

N-channel 650 V, 0.370 Ω , 8.5 A MDmesh™ V Power MOSFET
DPAK, TO-220FP, TO-220, IPAK

Preliminary Data

Features

| Type | V_{DSS} @ T_{Jmax} | $R_{DS(on)}$ max | I_D | P_W |
|------------|---------------------------|---------------------|----------------------|-------|
| STD12N65M5 | 710 V | < 0.41 Ω | 8.5 A | 70 W |
| STF12N65M5 | | | 8.5 A ⁽¹⁾ | 25 W |
| STP12N65M5 | | | 8.5 A | 70 W |
| STU12N65M5 | | | 8.5 A | 70 W |

1. Limited only by maximum temperature allowed

- Worldwide best $R_{DS(on)}$ * area
- Higher V_{DSS} rating
- High dv/dt capability
- Excellent switching performance
- Easy to drive
- 100% Avalanche tested

Application

- Switching applications

Description

MDmesh V is a revolutionary Power MOSFET technology, which combines an innovative proprietary vertical process with the well known company's PowerMESH™ horizontal layout. The resulting product has an extremely low on-resistance, unmatched among silicon-based Power MOSFETs, making it especially suited for applications which require superior power density and outstanding efficiencies.

Table 1. Device summary

| Order codes | Marking | Package | Packaging |
|-------------|---------|----------|---------------|
| STD12N65M5 | 12N65M5 | DPAK | Tape and reel |
| STF12N65M5 | 12N65M5 | TO-220FP | Tube |
| STP12N65M5 | 12N65M5 | TO-220 | Tube |
| STU12N65M5 | 12N65M5 | IPAK | Tube |

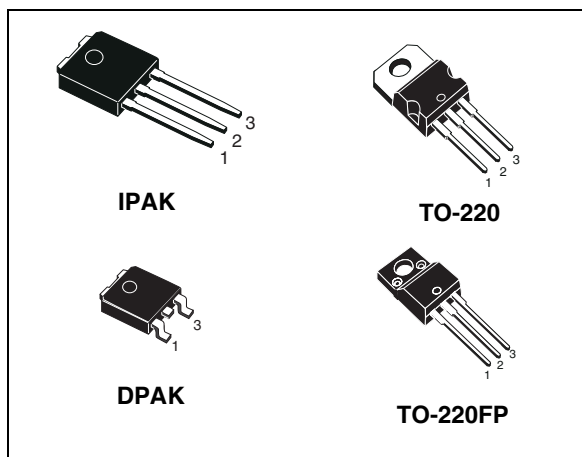
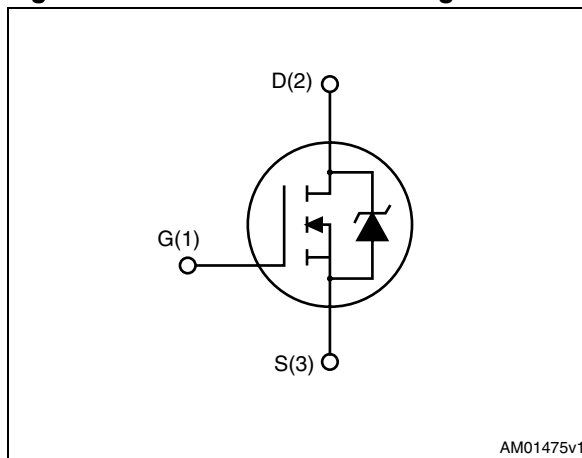


Figure 1. Internal schematic diagram



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1 Electrical ratings (a)

Table 2. Absolute maximum ratings

| Symbol | Parameter | Value | | Unit |
|-------------------------|---|--------------------|--------------------|------|
| | | TO-220, IPAK, DPAK | TO-220FP | |
| V_{DS} | Drain-source voltage ($V_{GS} = 0$) | 650 | | V |
| V_{GS} | Gate-source voltage | 25 | | V |
| I_D | Drain current (continuous) at $T_C = 25\text{ °C}$ | 8.5 | 8.5 ⁽¹⁾ | A |
| I_D | Drain current (continuous) at $T_C = 100\text{ °C}$ | 5.4 | 5.4 ⁽¹⁾ | A |
| I_{DM} ⁽²⁾ | Drain current (pulsed) | 34 | 34 ⁽¹⁾ | A |
| P_{TOT} | Total dissipation at $T_C = 25\text{ °C}$ | 70 | 25 | W |
| I_{AR} | Avalanche current, repetitive or not-repetitive (pulse width limited by T_j max) | TBD | | A |
| E_{AS} | Single pulse avalanche energy (starting $T_j = 25\text{ °C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$) | TBD | | mJ |
| dv/dt ⁽³⁾ | Peak diode recovery voltage slope | 15 | | V/ns |
| V_{ISO} | Insulation withstand voltage (RMS) from all three leads to external heat sink ($t = 1\text{ s}$; $T_C = 25\text{ °C}$) | | 2500 | V |
| T_{stg} | Storage temperature | - 55 to 150 | | °C |
| T_j | Max. operating junction temperature | 150 | | °C |

1. Limited only by maximum temperature allowed
2. Pulse width limited by safe operating area
3. $I_{SD} \leq 8.5\text{ A}$, $di/dt \leq 400\text{ A}/\mu\text{s}$; $V_{Peak} < V_{(BR)DSS}$

Table 3. Thermal data

| Symbol | Parameter | Value | | | | Unit |
|----------------|--|-------|------|--------|----------|------|
| | | DPAK | IPAK | TO-220 | TO-220FP | |
| $R_{thj-case}$ | Thermal resistance junction-case max | 1.79 | | 5 | | °C/W |
| $R_{thj-amb}$ | Thermal resistance junction-ambient max | | 100 | 62.5 | | °C/W |
| $R_{thj-pcb}$ | Thermal resistance junction-pcb max | 50 | | | | |
| T_l | Maximum lead temperature for soldering purpose | 300 | | | | °C |

a. All data which refers solely to the TO-220FP package is preliminary



2 Electrical characteristics

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

Table 4. On /off states

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---------------|--|--|------|------|----------|--------------------------------|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage | $I_D = 1\text{ mA}$, $V_{GS} = 0$ | 650 | | | V |
| I_{DSS} | Zero gate voltage drain current ($V_{GS} = 0$) | $V_{DS} = \text{Max rating}$ $V_{DS} = \text{Max rating}$, $T_C = 125\text{ °C}$ | | | 1 100 | μA μA |
| I_{GSS} | Gate-body leakage current ($V_{DS} = 0$) | $V_{GS} = \pm 20\text{ V}$ | | | 100 | nA |
| $V_{GS(th)}$ | Gate threshold voltage | $V_{DS} = V_{GS}$, $I_D = 250\text{ }\mu\text{A}$ | 3 | 4 | 5 | V |
| $R_{DS(on)}$ | Static drain-source on resistance | $V_{GS} = 10\text{ V}$, $I_D = 4.3\text{ A}$ | | 0.37 | 0.41 | Ω |

Table 5. Dynamic

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-------------------|---------------------------------------|---|------|------|------|----------|
| C_{iss} | Input capacitance | $V_{DS} = 100\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0$ | | 1000 | | pF |
| C_{oss} | Output capacitance | | | 24 | | pF |
| C_{rss} | Reverse transfer capacitance | | | 3.2 | | pF |
| $C_{o(tr)}^{(1)}$ | Equivalent capacitance time related | $V_{DS} = 0\text{ to }520\text{ V}$, $V_{GS} = 0$ | | TBD | | pF |
| $C_{o(er)}^{(2)}$ | Equivalent capacitance energy related | | | TBD | | pF |
| R_G | Intrinsic gate resistance | $f = 1\text{ MHz}$ open drain | | TBD | | Ω |
| Q_g | Total gate charge | $V_{DD} = 520\text{ V}$, $I_D = 4.3\text{ A}$, $V_{GS} = 10\text{ V}$ (see Figure 3) | | 19 | | nC |
| Q_{gs} | Gate-source charge | | | TBD | | nC |
| Q_{gd} | Gate-drain charge | | | TBD | | nC |

- $C_{oss\text{ eq}}$ 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}
- $C_{oss\text{ eq}}$ 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 | $V_{DD} = 400\text{ V}$, $I_D = 5\text{ A}$, $R_G = 4.7\ \Omega$, $V_{GS} = 10\text{ V}$ (see Figure 4) | | 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

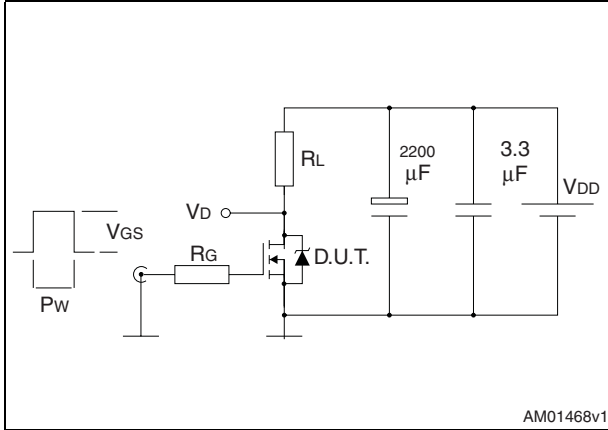
| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------------|-------------------------------|--|------|------|------|------|
| I_{SD} | Source-drain current | | | | 8.5 | A |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) | | | | 34 | A |
| $V_{SD}^{(2)}$ | Forward on voltage | $I_{SD} = 8.5\text{ A}$, $V_{GS} = 0$ | | | 1.5 | V |
| t_{rr} | Reverse recovery time | $I_{SD} = 8.5\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 100\text{ V}$ (see Figure 7) | | TBD | | ns |
| Q_{rr} | Reverse recovery charge | | | TBD | | nC |
| I_{RRM} | Reverse recovery current | | | TBD | | A |
| t_{rr} | Reverse recovery time | $I_{SD} = 8.5\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 100\text{ V}$, $T_j = 150\text{ }^\circ\text{C}$ (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%

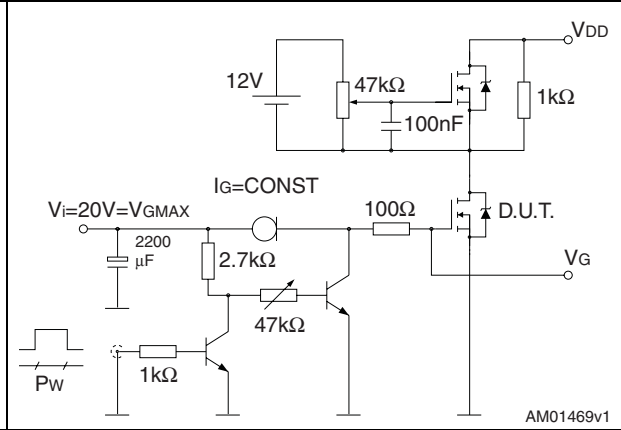
3 Test circuits

Figure 2. Switching times test circuit for resistive load



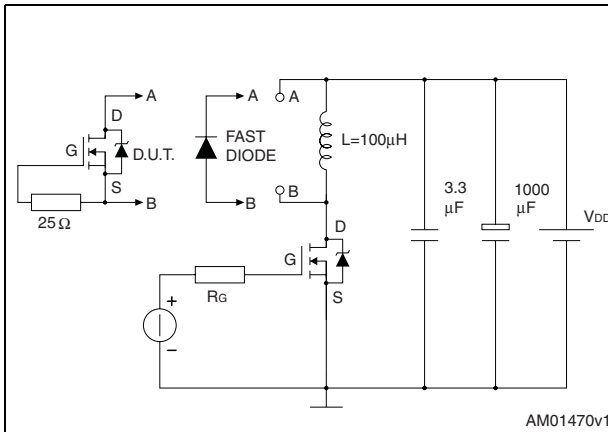
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Figure 3. Gate charge test circuit



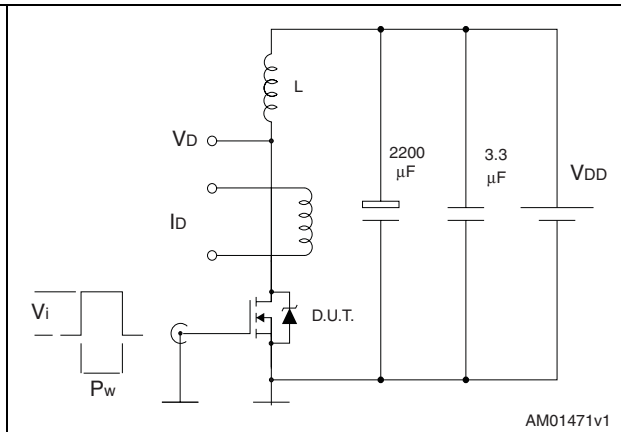
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Figure 4. Test circuit for inductive load switching and diode recovery times



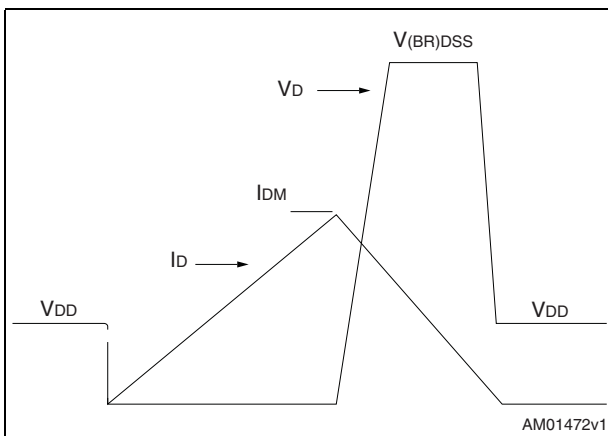
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Figure 5. Unclamped inductive load test circuit



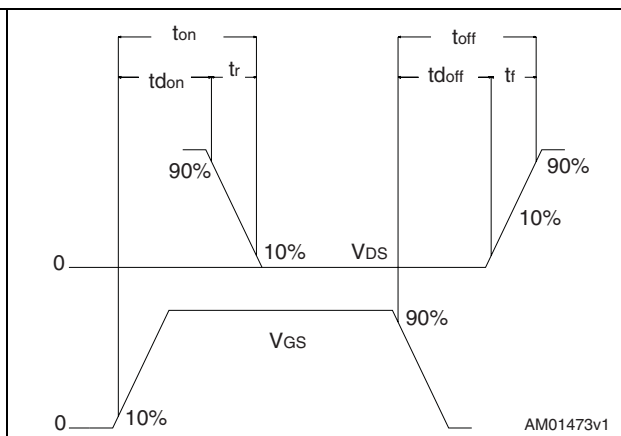
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Figure 6. Unclamped inductive waveform



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Figure 7. Switching time waveform



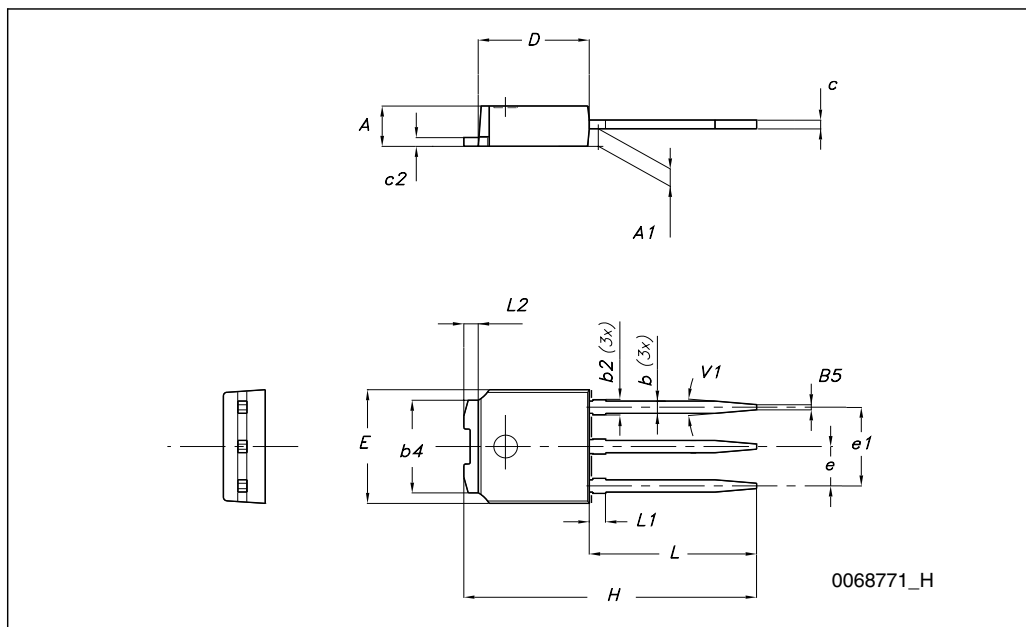
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4 Package mechanical data

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.

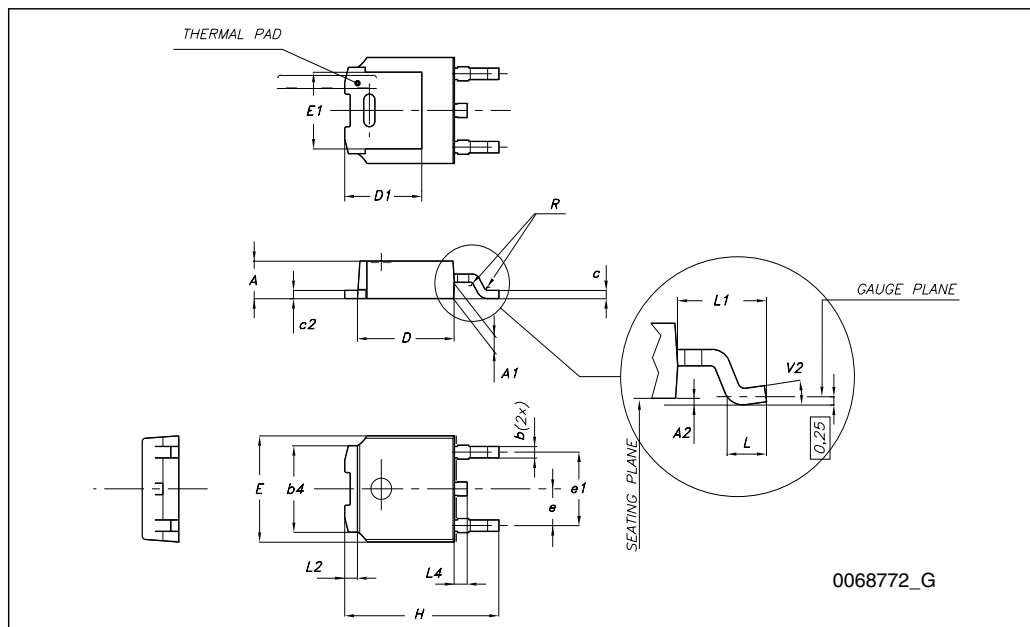
TO-251 (IPAK) mechanical data

| 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° | |



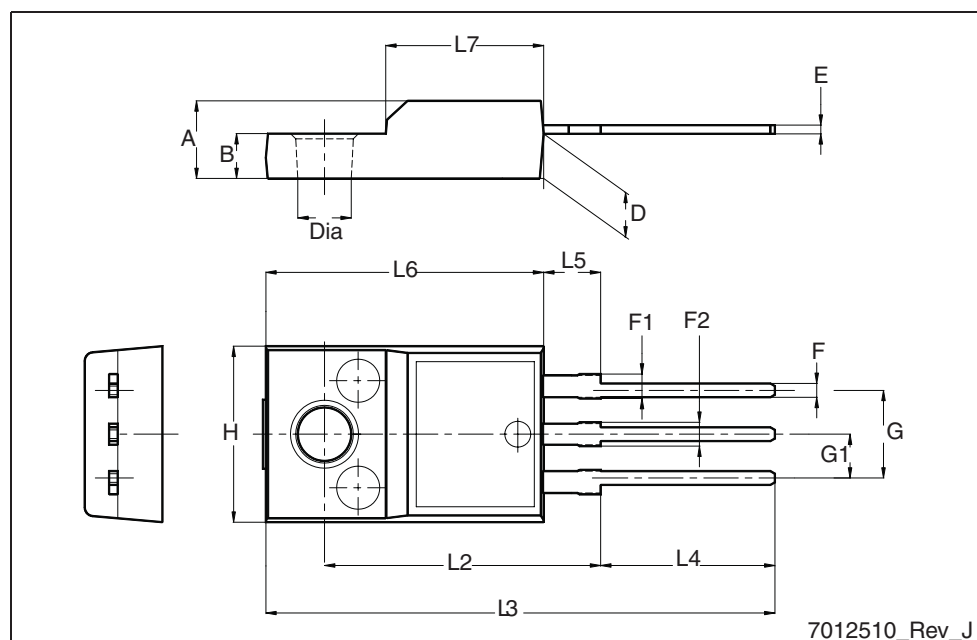
TO-252 (DPAK) mechanical data

| 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° |



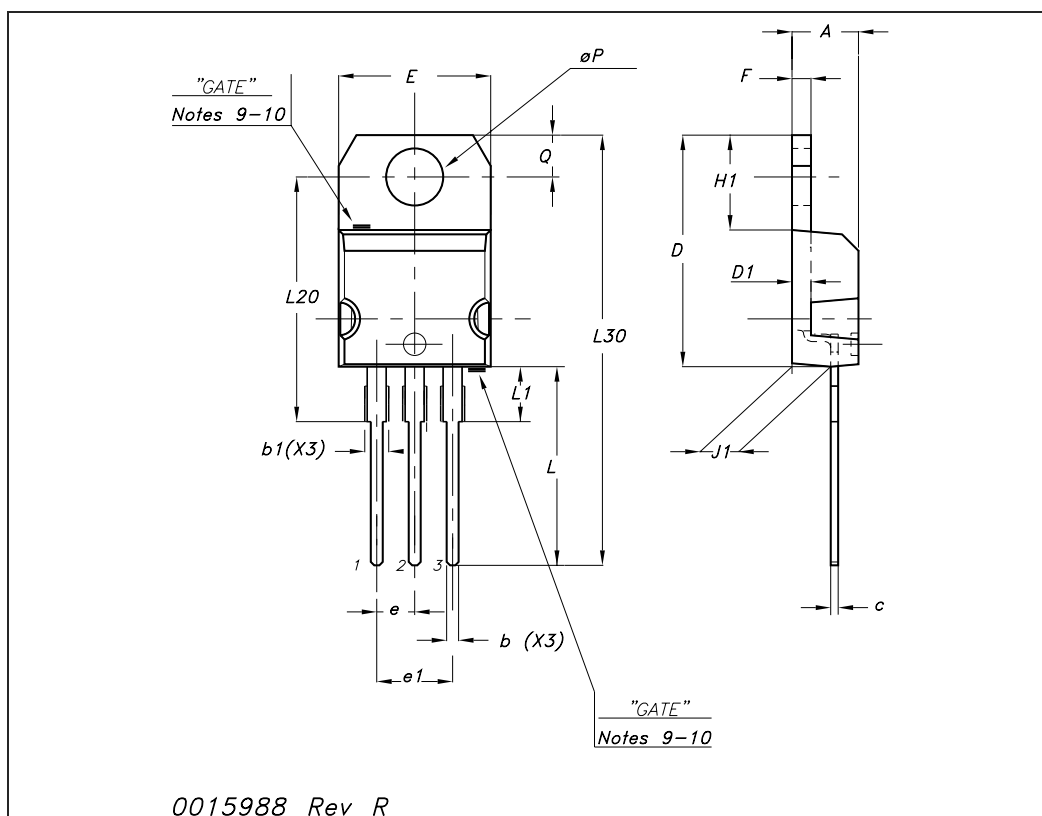
TO-220FP mechanical data

| 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 |



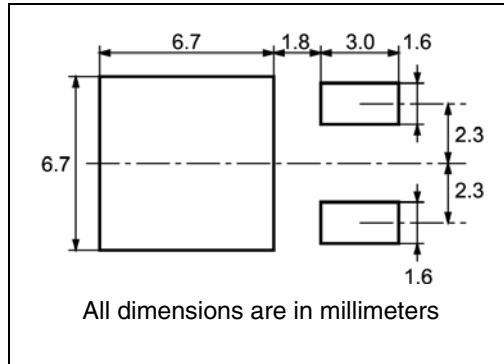
TO-220 mechanical data

| 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 |



5 Packaging mechanical data

DPAK FOOTPRINT



TAPE AND REEL SHIPMENT

| 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 |

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 |

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

6 Revision history

Table 8. Document revision history

| Date | Revision | Changes |
|-------------|-----------------|--|
| 24-Feb-2009 | 1 | First release |
| 27-Feb-2009 | 2 | Corrected package information on first page. |

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