



STP90NF03L STB90NF03L-1

N-channel 30V - 0.0056Ω -90A TO-220/I²PAK
Low gate charge STripFET™ Power MOSFET

General features

| Type | V _{DSS} (@T _{jmax}) | R _{DS(on)} | I _D |
|--------------|---|---------------------|----------------|
| STP90NF03L | 30V | <0.0065Ω | 90A |
| STB90NF03L-1 | 30V | <0.0065Ω | 90A |

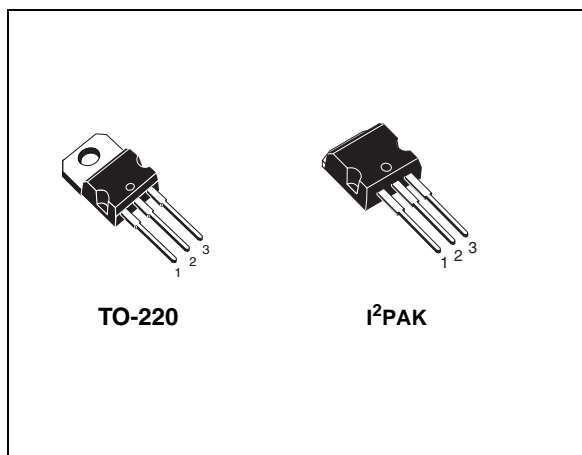
- Optimal R_{DS(on)} x Q_g trade-off
- Conduction losses reduced
- Switching losses reduced

Description

This application specific Power Mosfet is the third generation of STMicroelectronics unique “Single Feature Size™” strip-based process. The resulting transistor shows the best trade-off between on-resistance and gate charge. When used as high and low side in buck regulators, it gives the best performance in terms of both conduction and switching losses. This is extremely important for motherboards where fast switching and high efficiency are of paramount importance.

Applications

- Switching application



Internal schematic diagram



Order codes

| Part number | Marking | Package | Packaging |
|--------------|----------|--------------------|-----------|
| STP90NF03L | P90NF03L | TO-220 | Tube |
| STB90NF03L-1 | B90NF03L | I ² PAK | Tube |

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1 Electrical ratings

Table 1. Absolute maximum ratings

| Symbol | Parameter | Value | Unit |
|----------------|---|------------|---------------------|
| V_{DS} | Drain-source voltage ($V_{GS} = 0$) | 30 | V |
| V_{GS} | Gate-source voltage | ± 20 | V |
| I_D | Drain current (continuous) at $T_C = 25^\circ\text{C}$ | 90 | A |
| I_D | Drain current (continuous) at $T_C = 100^\circ\text{C}$ | 65 | A |
| $I_{DM}^{(1)}$ | Drain current (pulsed) | 360 | A |
| P_{TOT} | Total dissipation at $T_C = 25^\circ\text{C}$ | 150 | W |
| | Derating factor | 0.73 | W/ $^\circ\text{C}$ |
| T_J | Operating junction temperature | -65 to 175 | $^\circ\text{C}$ |
| T_{stg} | Storage temperature | 175 | $^\circ\text{C}$ |

1. Pulse width limited by safe operating area

Table 2. Thermal data

| | | | |
|----------------|--|------|---------------------------|
| $R_{thj-case}$ | Thermal resistance junction-case Max | 1 | $^\circ\text{C}/\text{W}$ |
| R_{thj-a} | Thermal resistance junction-ambient Max | 62.5 | $^\circ\text{C}/\text{W}$ |
| T_l | Maximum lead temperature for soldering purpose | 300 | $^\circ\text{C}$ |

2 Electrical characteristics

($T_{CASE}=25^{\circ}C$ unless otherwise specified)

Table 3. On/off states

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---------------|--|--|------|-----------------|-----------------|----------------------|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage | $I_D = 250 \mu A, V_{GS} = 0$ | 30 | | | V |
| I_{DSS} | Zero gate voltage drain current ($V_{GS} = 0$) | $V_{DS} = \text{Max rating},$ $V_{DS} = \text{Max rating} @ 125^{\circ}C$ | | | 1 10 | μA μA |
| I_{GSS} | Gate body leakage current ($V_{DS} = 0$) | $V_{GS} = \pm 20V$ | | | ± 100 | nA |
| $V_{GS(th)}$ | Gate threshold voltage | $V_{DS} = V_{GS}, I_D = 250 \mu A$ | 1 | | 2.5 | V |
| $R_{DS(on)}$ | Static drain-source on resistance | $V_{GS} = 10V, I_D = 45A$ $V_{GS} = 5V, I_D = 45A$ | | 0.0056 0.007 | 0.0065 0.012 | Ω Ω |

Table 4. Dynamic

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-------------------------------------|---|---|------|--------------------|------|----------------|
| $g_{fs}^{(1)}$ | Forward transconductance | $V_{DS} > I_{D(on)} \times R_{DS(on)max},$ $I_D = 45A$ | | 40 | | S |
| C_{iss} C_{oss} C_{rss} | Input capacitance Output capacitance Reverse transfer capacitance | $V_{DS} = 25V, f = 1 \text{ MHz}, V_{GS} = 0$ | | 2700 860 170 | | pF pF pF |
| Q_g Q_{gs} Q_{gd} | Total gate charge Gate-source charge Gate-drain charge | $V_{DD} = 24V, I_D = 90A$ $V_{GS} = 5V$ | | 35 10 18 | 47 | nC nC nC |

1. Pulsed: pulse duration=300 μs , duty cycle 1.5%

Table 5. Switching times

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------------------|----------------------------------|---|------|-----------|------|----------|
| $t_{d(on)}$ t_r | Turn-on delay time rise time | $V_{DD} = 15V, I_D = 45A,$ $R_G = 4.7\Omega, V_{GS} = 4.5V$ (see Figure 12) | | 30 200 | | ns ns |
| $t_{d(off)}$ t_f | Turn-off-delay time fall time | $V_{DD} = 15V, I_D = 45A,$ $R_G = 4.7\Omega, V_{GS} = 4.5V$ (see Figure 12) | | 50 105 | | ns ns |

Table 6. Source drain diode

| Symbol | Parameter | Test conditions | Min | Typ. | Max | Unit |
|-----------------|-------------------------------|--|-----|------|-----|---------|
| I_{SD} | Source-drain current | | | | 90 | A |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) | | | | 360 | A |
| $V_{SD}^{(2)}$ | Forward on voltage | $I_{SD}=90A, V_{GS}=0$ | | | 1.3 | V |
| t_{rr} | Reverse recovery time | $I_{SD}=90A,$ $di/dt = 100A/\mu s,$ $V_{DD}=15V, T_j=150^\circ C$ (see Figure 14) | | 80 | | ns |
| Q_{rr} | Reverse recovery charge | | | 90 | | μC |
| I_{RRM} | Reverse recovery current | | | 2.5 | | A |

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

2.1 Electrical characteristics (curves)

Figure 1. Safe operating area

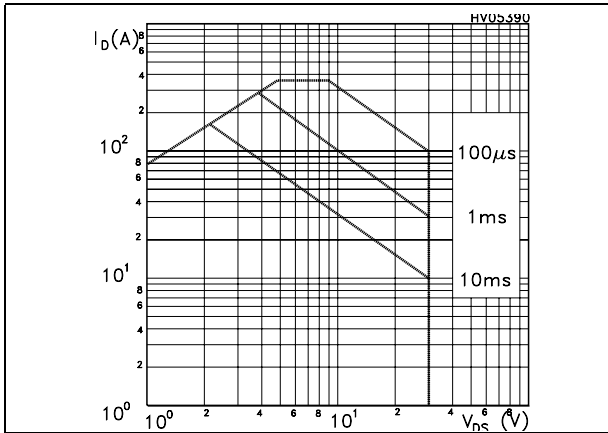


Figure 2. Thermal impedance

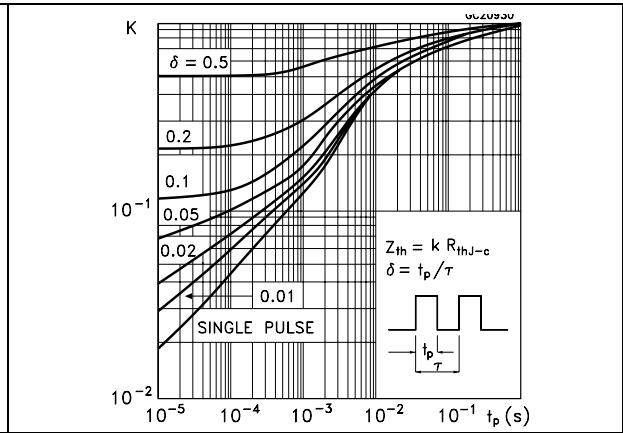


Figure 3. Output characteristics

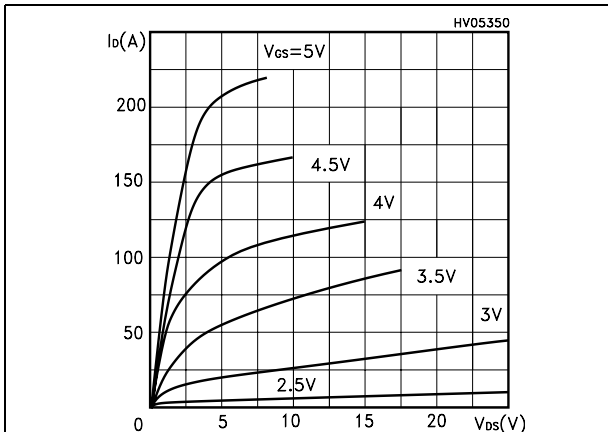


Figure 4. Transfer characteristics

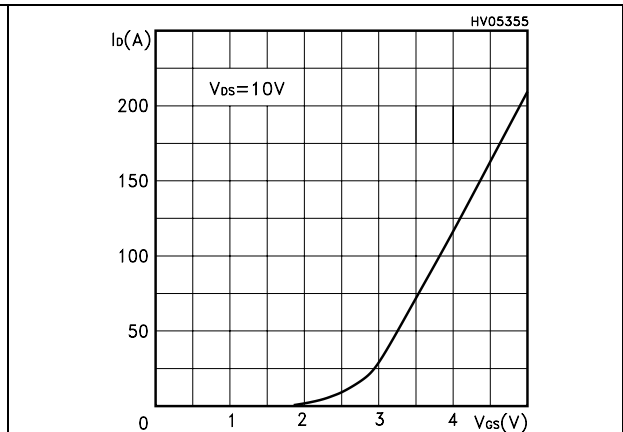


Figure 5. Transconductance

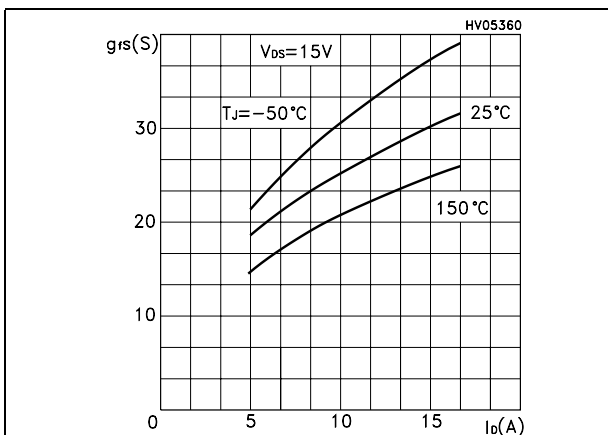


Figure 6. Static drain-source on resistance

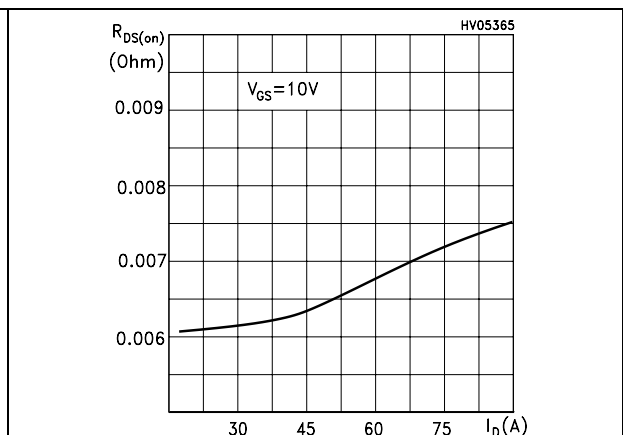


Figure 7. Gate charge vs gate-source voltage Figure 8. Capacitance variations

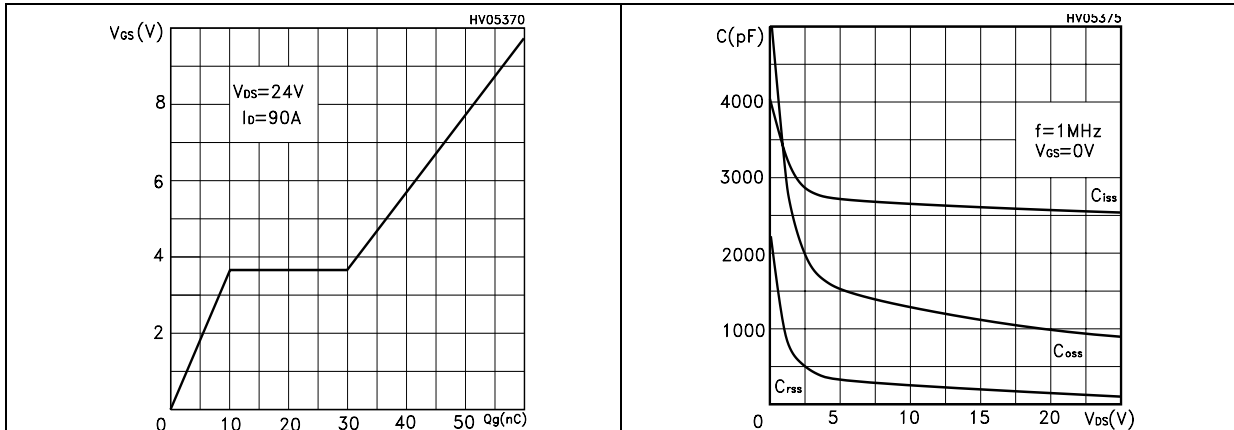


Figure 9. Normalized gate threshold voltage vs temperature Figure 10. Normalized on resistance vs temperature

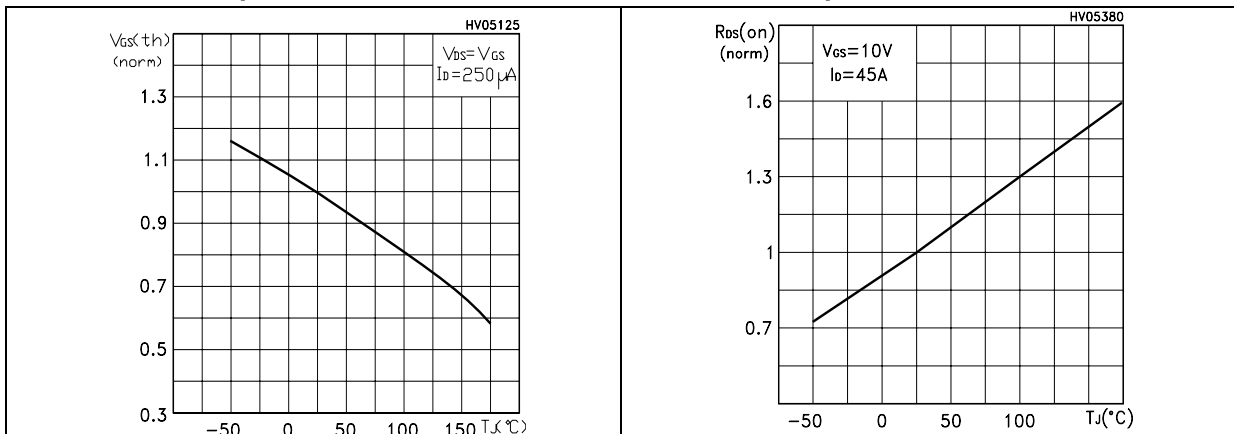
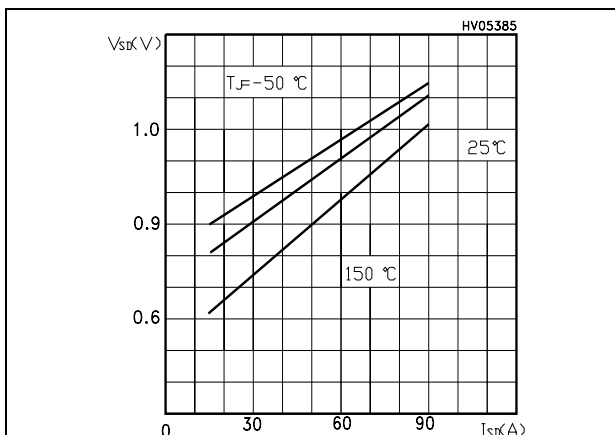


Figure 11. Source-drain diode forward characteristics



3 Test circuit

Figure 12. Switching times test circuit for resistive load

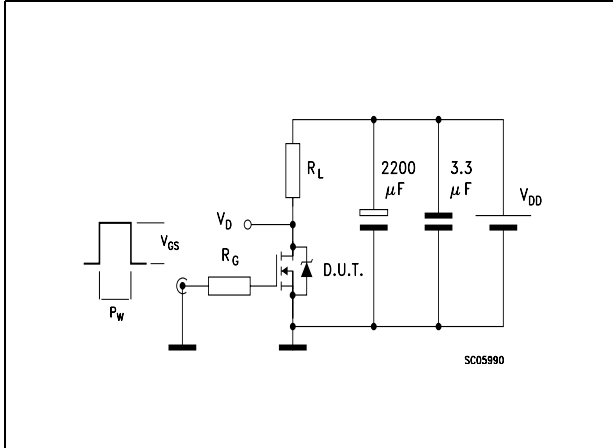


Figure 13. Gate charge test circuit

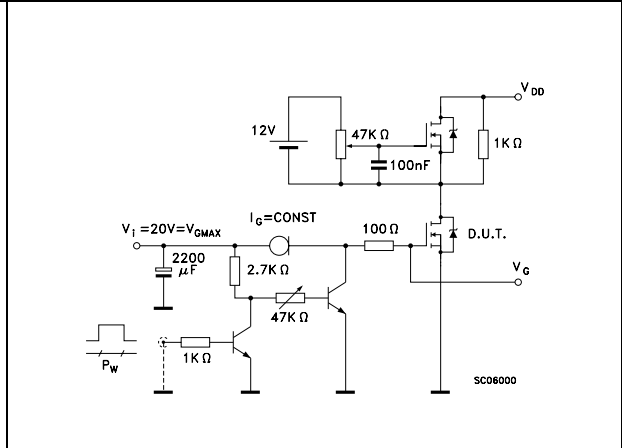


Figure 14. Test circuit for inductive load switching and diode recovery times



Figure 15. Unclamped Inductive load test circuit

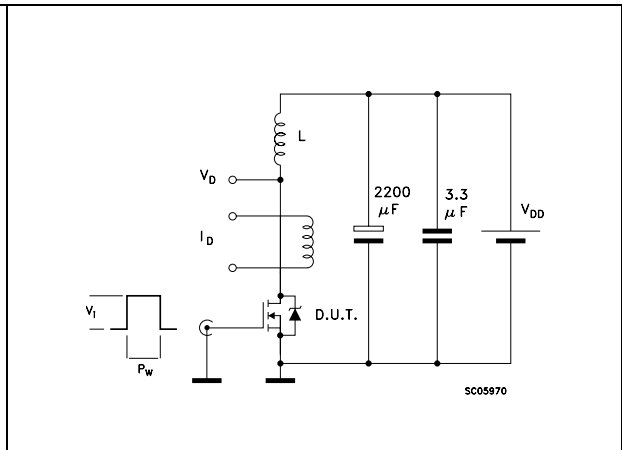


Figure 16. Unclamped inductive waveform

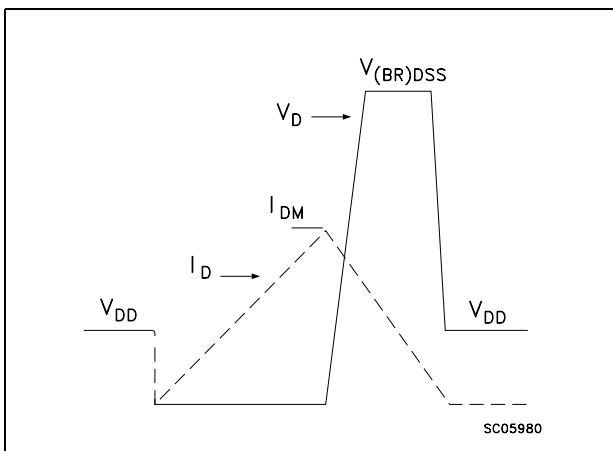
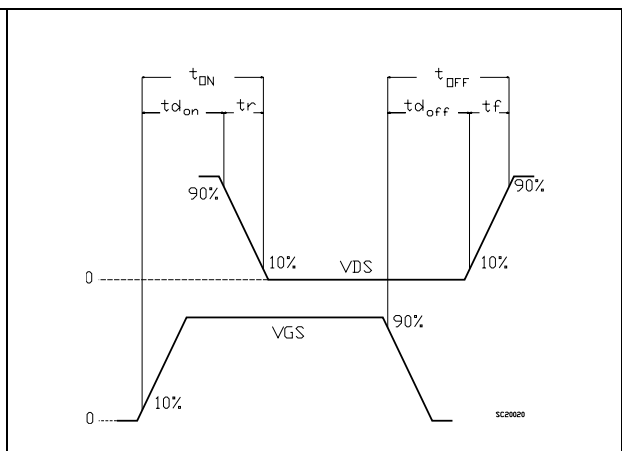


Figure 17. Switching time waveform

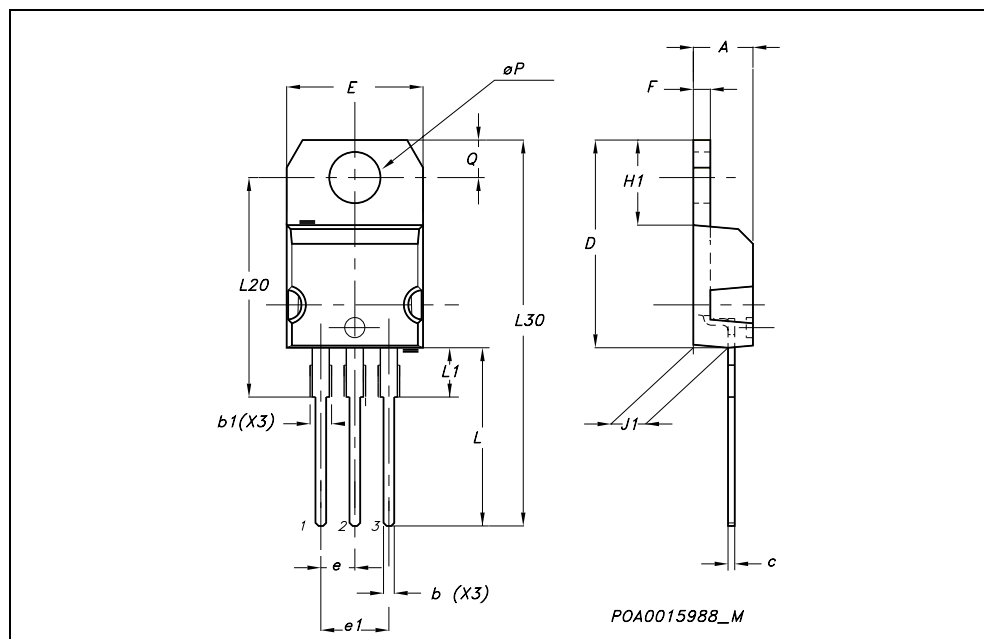


4 Package mechanical data

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

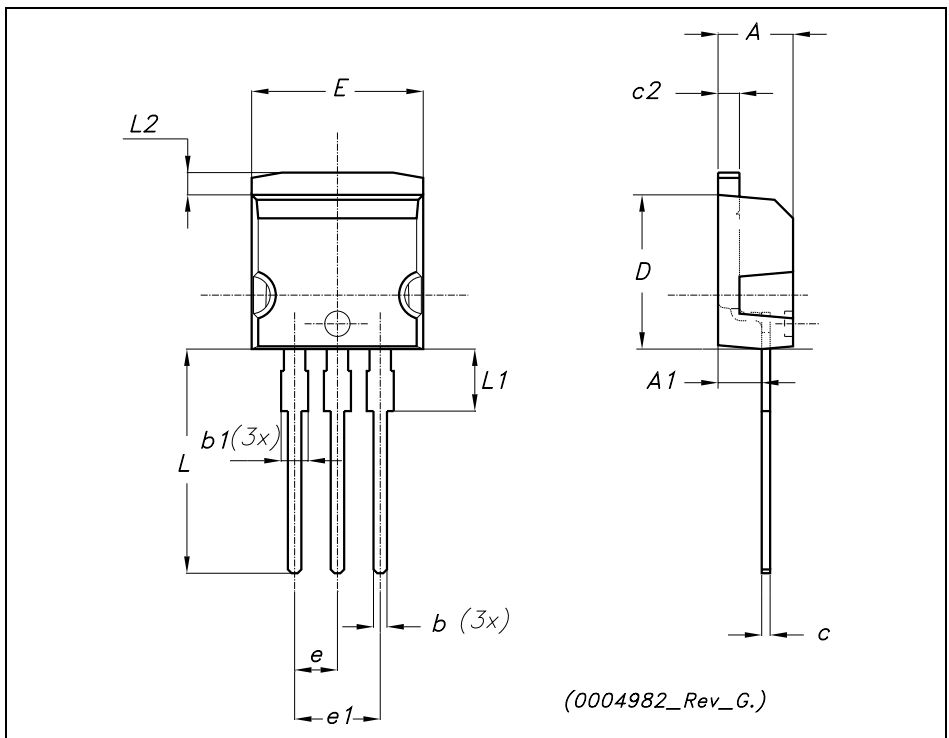
TO-220 MECHANICAL DATA

| 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 | 1.15 | | 1.70 | 0.045 | | 0.066 |
| c | 0.49 | | 0.70 | 0.019 | | 0.027 |
| D | 15.25 | | 15.75 | 0.60 | | 0.620 |
| 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 | | 0.052 |
| 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 | |
| øP | 3.75 | | 3.85 | 0.147 | | 0.151 |
| Q | 2.65 | | 2.95 | 0.104 | | 0.116 |



TO-262 (I²PAK) MECHANICAL DATA

| DIM. | mm. | | | inch | | |
|------|------|------|-------|-------|------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | 4.40 | | 4.60 | 0.173 | | 0.181 |
| A1 | 2.40 | | 2.72 | 0.094 | | 0.107 |
| b | 0.61 | | 0.88 | 0.024 | | 0.034 |
| b1 | 1.14 | | 1.70 | 0.044 | | 0.066 |
| c | 0.49 | | 0.70 | 0.019 | | 0.027 |
| c2 | 1.23 | | 1.32 | 0.048 | | 0.052 |
| D | 8.95 | | 9.35 | 0.352 | | 0.368 |
| e | 2.40 | | 2.70 | 0.094 | | 0.106 |
| e1 | 4.95 | | 5.15 | 0.194 | | 0.202 |
| E | 10 | | 10.40 | 0.393 | | 0.410 |
| L | 13 | | 14 | 0.511 | | 0.551 |
| L1 | 3.50 | | 3.93 | 0.137 | | 0.154 |
| L2 | 1.27 | | 1.40 | 0.050 | | 0.055 |



5 Revision history

Table 7. Revision history

| Date | Revision | Changes |
|-------------|-----------------|---------------------------------|
| 09-Sep-2004 | 4 | Complete version |
| 17-Aug-2006 | 5 | New template, no content change |

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