



STB150NF55 STP150NF55 - STW150NF55

N-channel 55V - 0.005Ω - 120A - D²PAK/TO-220/TO-247
STripFET™ II Power MOSFET

General features

| Type | V _{DSS} | R _{DS(on)} | I _D |
|------------|------------------|---------------------|---------------------|
| STB150NF55 | 55V | <0.006Ω | 120A ⁽¹⁾ |
| STP150NF55 | 55V | <0.006Ω | 120A ⁽¹⁾ |
| STW150NF55 | 55V | <0.006Ω | 120A ⁽¹⁾ |

1. Current limited by package

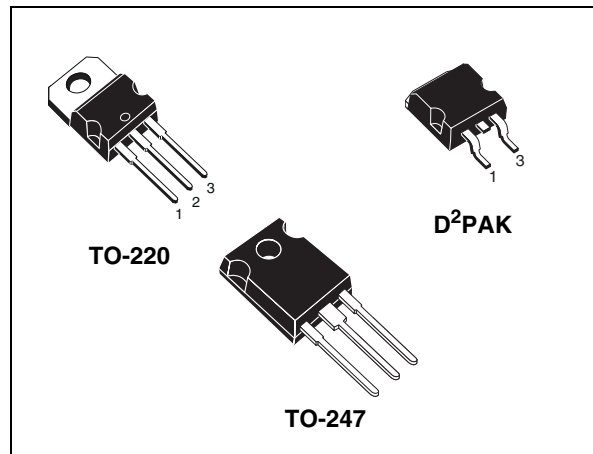
- 100% avalanche tested

Description

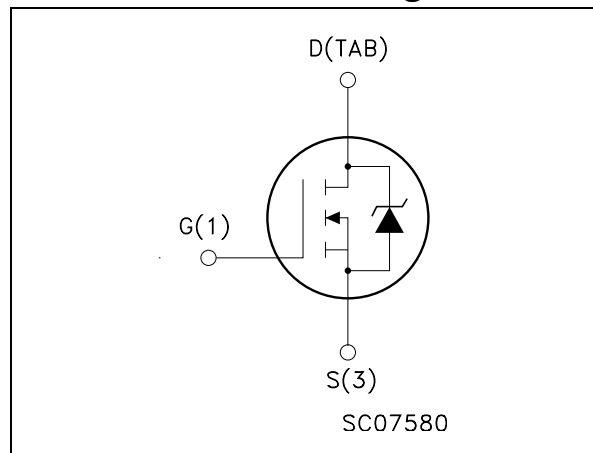
This Power MOSFET is the latest development of STMicroelectronics unique "Single Feature Size™" strip-based process. The resulting transistor shows extremely high packing density for low on-resistance, rugged avalanche characteristics and less critical alignment steps therefore a remarkable manufacturing reproducibility.

Applications

- Switching application



Internal schematic diagram



Order codes

| Sales type | Marking | Package | Packaging |
|--------------|----------|--------------------|-------------|
| STB150NF55T4 | B150NF55 | D ² PAK | Tape & reel |
| STP150NF55 | P150NF55 | TO-220 | Tube |
| STW150NF55 | W150NF55 | TO-247 | Tube |

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1 Electrical ratings

Table 1. Absolute maximum ratings

| Symbol | Parameter | Value | Unit |
|----------------|---|------------|---------------------|
| V_{DS} | Drain-source voltage ($V_{GS} = 0$) | 55 | V |
| V_{DGR} | Drain-gate voltage ($R_{GS} = 20\text{ k}\Omega$) | 55 | V |
| V_{GS} | Gate- source voltage | ± 20 | V |
| $I_D^{(1)}$ | Drain current (continuous) at $T_C = 25^\circ\text{C}$ | 120 | A |
| $I_D^{(1)}$ | Drain current (continuous) at $T_C = 100^\circ\text{C}$ | 106 | A |
| $I_{DM}^{(2)}$ | Drain current (pulsed) | 480 | A |
| P_{tot} | Total dissipation at $T_C = 25^\circ\text{C}$ | 300 | W |
| | Derating Factor | 2 | W/ $^\circ\text{C}$ |
| $dv/dt^{(3)}$ | Peak diode recovery voltage slope | 8 | V/ns |
| $E_{AS}^{(4)}$ | Single pulse avalanche energy | 850 | mJ |
| T_{stg} | Storage temperature | -55 to 175 | $^\circ\text{C}$ |
| T_j | Max. operating junction temperature | | |

1. Value limited by wire bonding
2. Pulse width limited by safe operating area.
3. $I_{SD} \leq 20\text{A}$, $di/dt \leq 200\text{A}/\mu\text{s}$, $V_{DD} \leq V_{(BR)DSS}$, $T_j \leq T_{JMAX}$
4. Starting $T_j = 25^\circ\text{C}$, $I_D = 60\text{A}$, $V_{DD} = 30\text{V}$

Table 2. Thermal data

| | | TO-220 | D ² PAK | TO-247 | |
|-----------|---|---|--------------------|--------|---------------------------|
| Rthj-case | Thermal resistance junction-case max | 0.5 | | | $^\circ\text{C}/\text{W}$ |
| Rthj-amb | Thermal resistance junction-ambient max | 62.5 | -- | 50 | $^\circ\text{C}/\text{W}$ |
| Rthj-pcb | Thermal resistance junction-pcb max | see Figure 15 and Figure 16 | | | $^\circ\text{C}/\text{W}$ |
| T_J | Maximum lead temperature for soldering purpose ⁽¹⁾ | 300 | | | $^\circ\text{C}$ |

1. for 10 sec. 1.6mm from case

2 Electrical characteristics

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

Table 3. On/off states

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---------------|--|---|------|-------|-----------|--------------------------------|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage | $I_D = 250\mu\text{A}$, $V_{GS} = 0$ | 55 | | | V |
| I_{DSS} | Zero gate voltage drain current ($V_{GS} = 0$) | $V_{DS} = \text{max ratings}$ $V_{DS} = \text{max ratings}$, $T_C = 125^{\circ}\text{C}$ | | | 1 10 | 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 | $V_{DS} = V_{GS}$, $I_D = 250\mu\text{A}$ | 2 | | 4 | V |
| $R_{DS(on)}$ | Static drain-source on resistance | $V_{GS} = 10\text{V}$, $I_D = 60\text{A}$ | | 0.005 | 0.006 | Ω |

Table 4. Dynamic

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|------|------------------------|------|----------------------|
| $g_{fs}^{(1)}$ | Forward transconductance | $V_{DS} = 15\text{V}$, $I_D = 60\text{A}$ | | 160 | | S |
| C_{iss} C_{oss} C_{rss} | Input capacitance Output capacitance Reverse transfer capacitance | $V_{DS} = 25\text{V}$, $f = 1\text{MHz}$, $V_{GS} = 0$ | | 4400 1050 350 | | pF pF pF |
| $t_{d(on)}$ t_r $t_{d(off)}$ t_f | Turn-on delay time Rise time Turn-off delay time Fall time | $V_{DD} = 27.5\text{V}$, $I_D = 60\text{A}$ $R_G = 4.7\Omega$, $V_{GS} = 10\text{V}$ (see Figure 19) | | 35 180 140 80 | | ns ns ns ns |
| Q_g Q_{gs} Q_{gd} | Total gate charge Gate-source charge Gate-drain charge | $V_{DD} = 27.5\text{V}$, $I_D = 120\text{A}$, $V_{GS} = 10\text{V}$ (see Figure 20) | | 140 35 70 | 190 | nC nC nC |

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

Table 5. Source drain diode

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------------------------------|--|--|------|-------------------|------------|---------------|
| I_{SD} $I_{SDM}^{(1)}$ | Source-drain current Source-drain current (pulsed) | | | | 120 480 | A A |
| $V_{SD}^{(2)}$ | Forward on voltage | $I_{SD} = 120A, V_{GS} = 0$ | | | 1.5 | V |
| t_{rr} Q_{rr} I_{RRM} | Reverse recovery time Reverse recovery charge Reverse recovery current | $I_{SD} = 120A,$ $di/dt = 100A/\mu s,$ $V_{DD} = 25V, T_j = 150^\circ C$ (see Figure 21) | | 130 350 7.5 | | ns nC 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

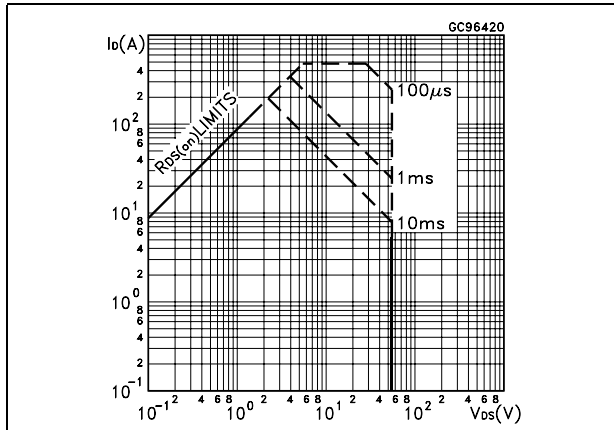


Figure 2. Thermal impedance

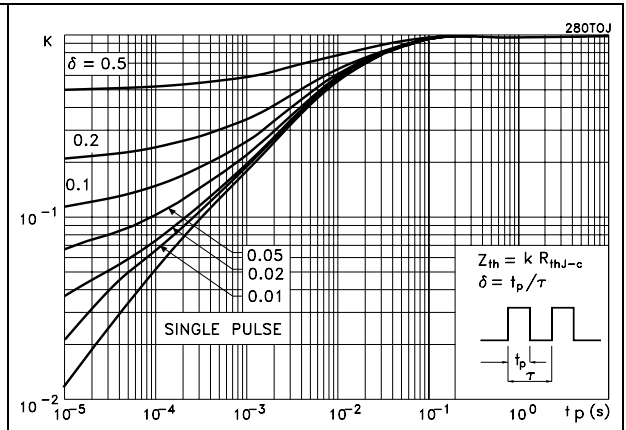


Figure 3. Output characteristics

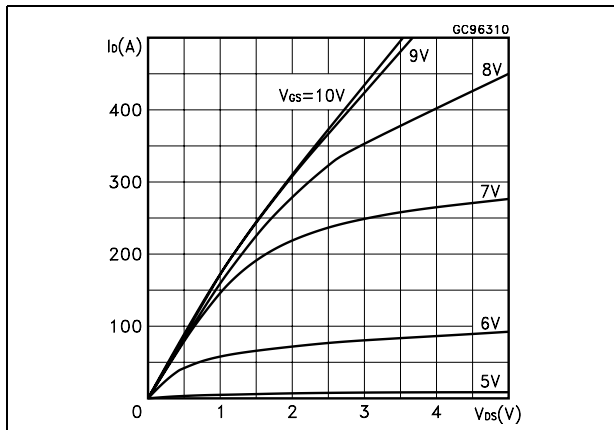


Figure 4. Transfer characteristics

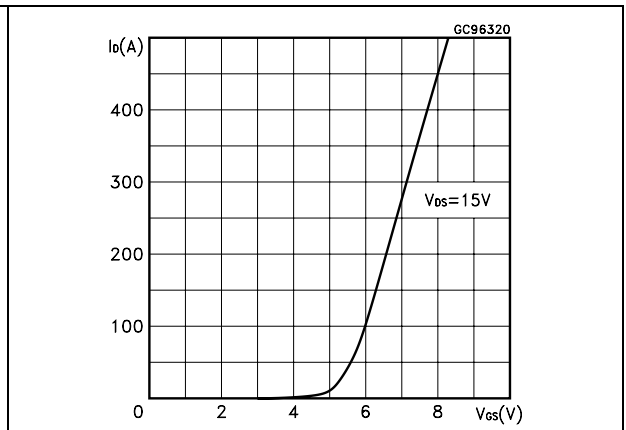


Figure 5. Transconductance

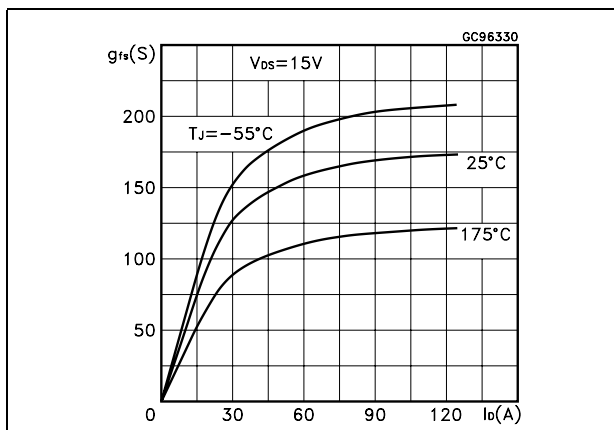


Figure 6. Static drain-source on resistance

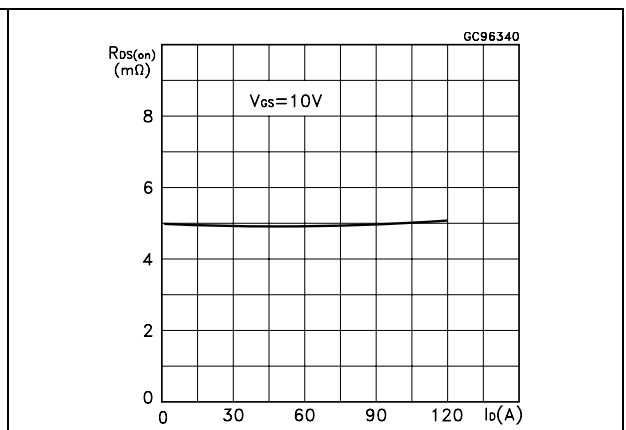


Figure 7. Gate charge vs gate-source voltage Figure 8. Capacitance variations

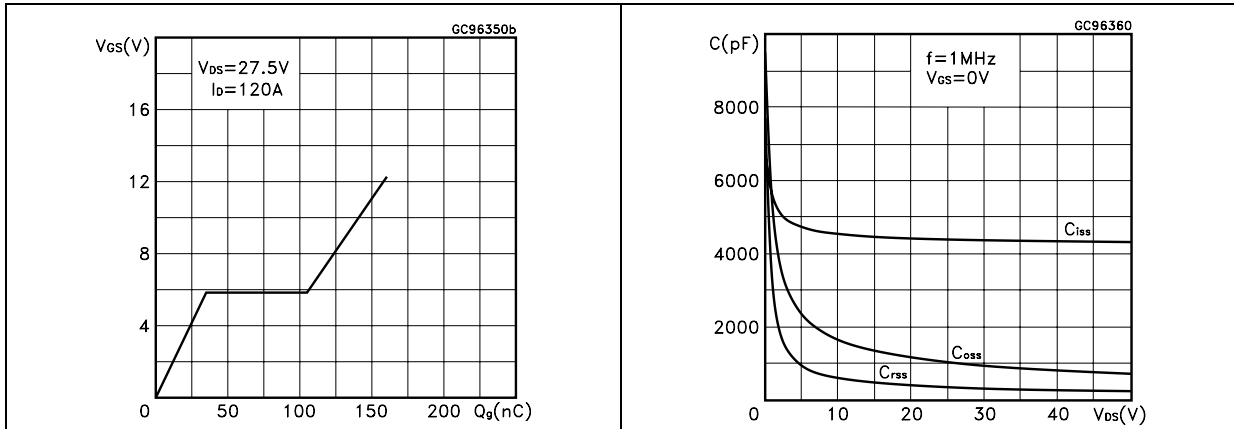


Figure 9. Normalized gate threshold voltage vs temperature Figure 10. Normalized on resistance vs temperature

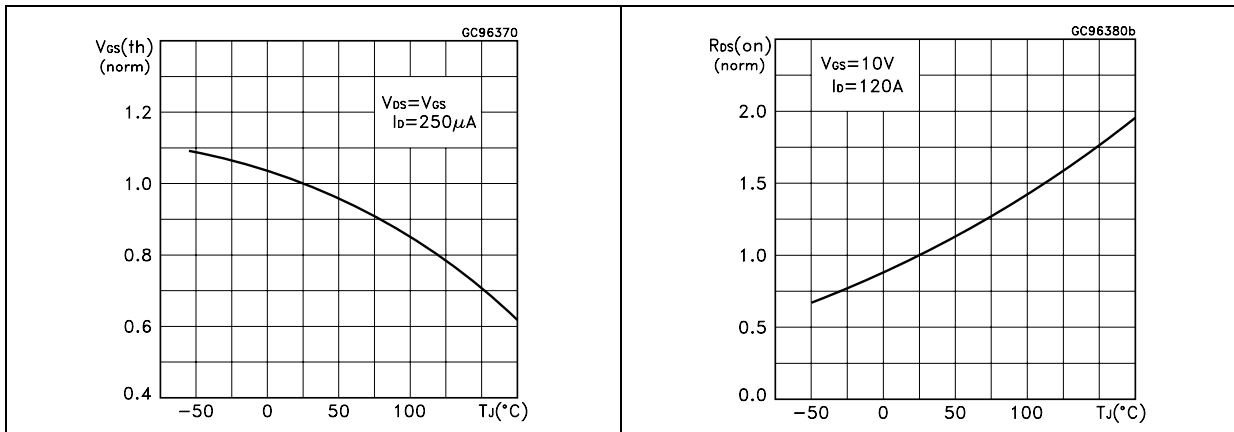


Figure 11. Source-drain diode forward characteristics Figure 12. Normalized $B_{V_{DSS}}$ vs temperature

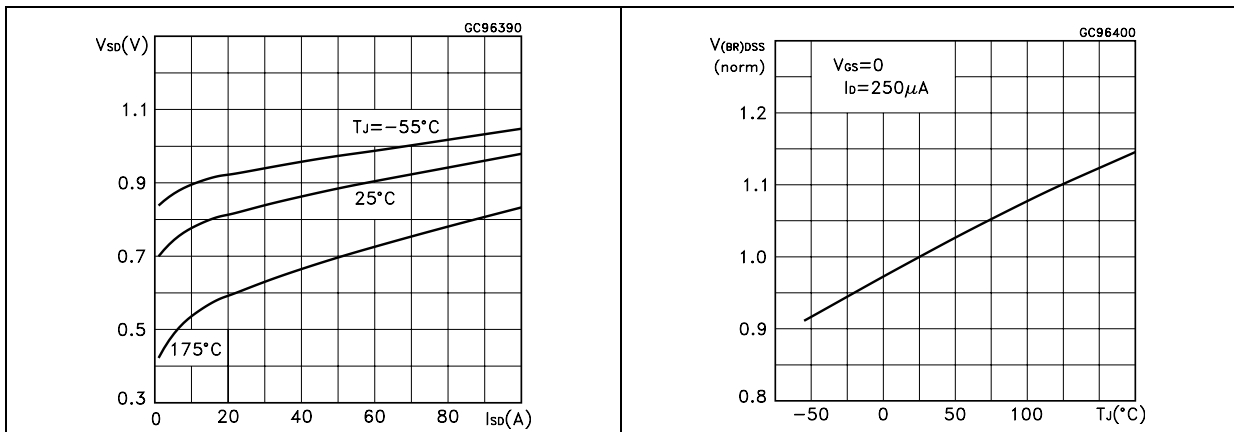


Figure 13. Power derating vs Tc

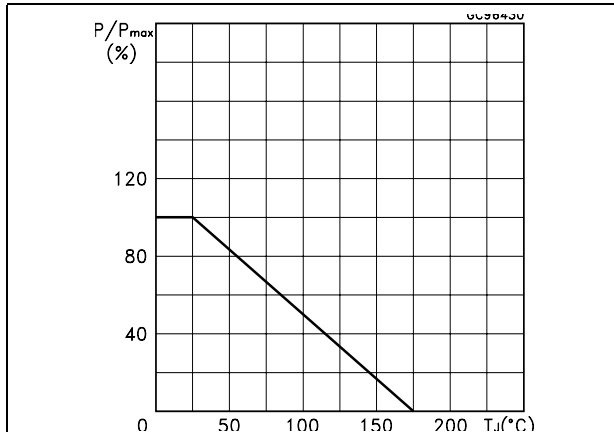


Figure 14. Max I_D current vs Tc

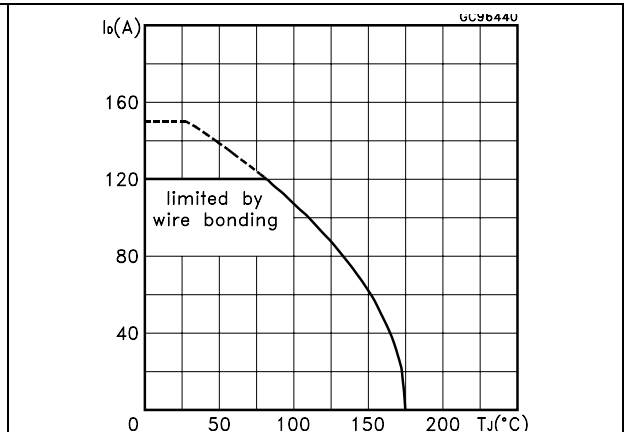


Figure 15. Thermal resistance R_{thj-a} vs PCB copper area

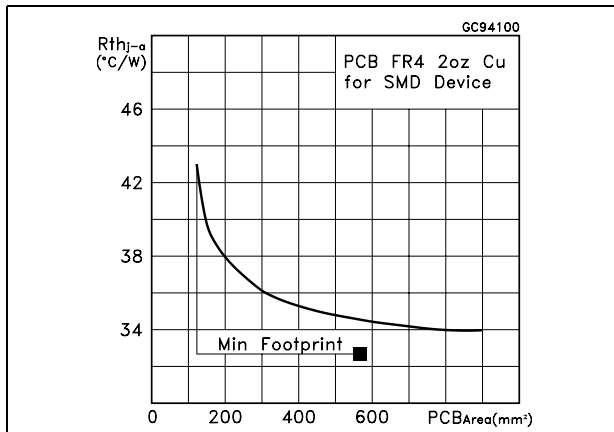


Figure 16. Max power dissipation vs PCB copper area

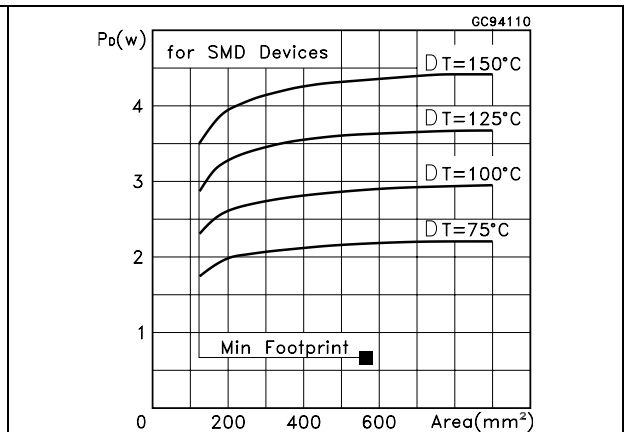
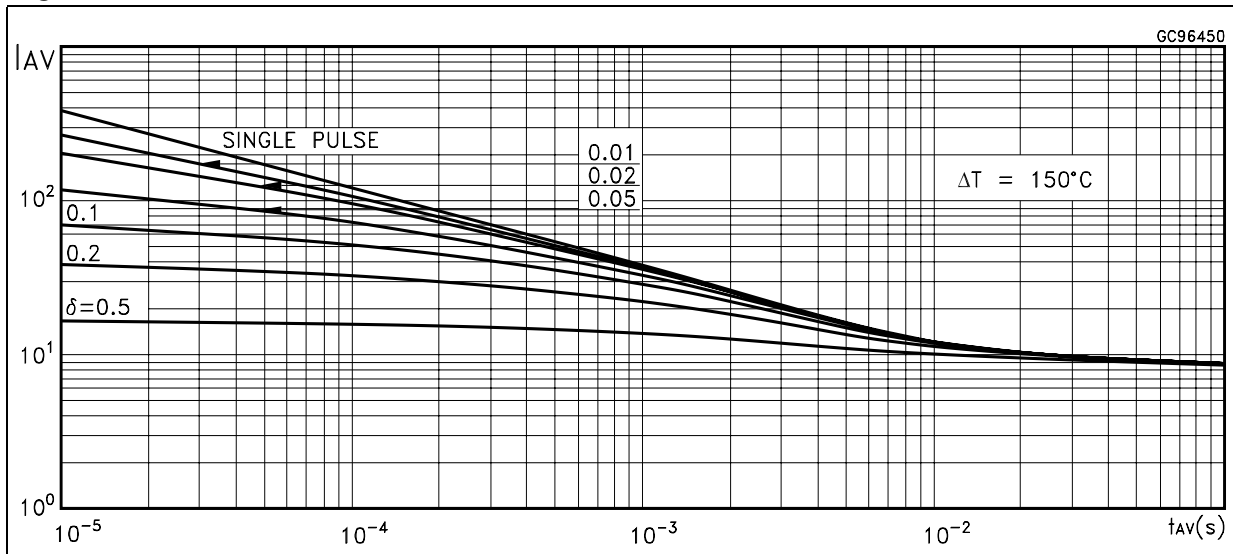


Figure 17. Allowable I_{AV} vs time in avalanche



The previous curve gives the safe operating area for unclamped inductive loads, single pulse or repetitive, under the following conditions:

$$P_{D(AVE)} = 0.5 * (1.3 * B_{VDSS} * I_{AV})$$

$$E_{AS(AR)} = P_{D(AVE)} * t_{AV}$$

Where:

I_{AV} is the allowable current in avalanche

$P_{D(AVE)}$ is the average power dissipation in avalanche (single pulse)

t_{AV} is the time in avalanche

To derate above 25 °C, at fixed I_{AV} , the following equation must be applied:

$$I_{AV} = 2 * (T_{jmax} - T_{CASE}) / (1.3 * B_{VDSS} * Z_{th})$$

Where:

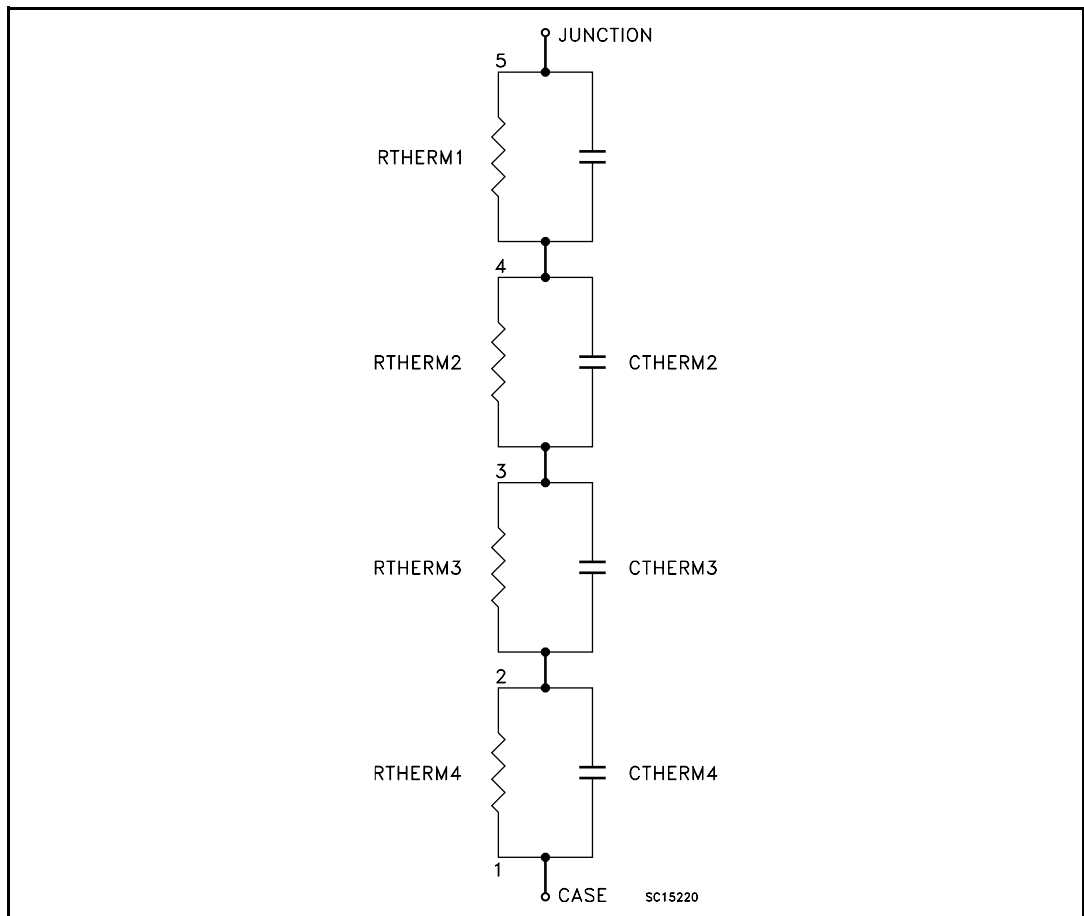
$Z_{th} = K * R_{th}$ is the value coming from normalized thermal response at fixed pulse width equal to T_{AV} .

3 Spice thermal model

Table 6. Parameters

| Parameter | Node | Value |
|-----------|-------|--------|
| CTHERM1 | 5 - 4 | 0.011 |
| CTHERM2 | 4 - 3 | 0.0012 |
| CTHERM3 | 3 - 2 | 0.05 |
| CTHERM4 | 2 - 1 | 0.1 |
| | | |
| RTHERM1 | 5 - 4 | 0.09 |
| RTHERM2 | 4 - 3 | 0.02 |
| RTHERM3 | 3 - 2 | 0.11 |
| RTHERM4 | 2 - 1 | 0.17 |

Figure 18. Scheme



4 Test circuit

Figure 19. Switching times test circuit for resistive load



Figure 20. Gate charge test circuit

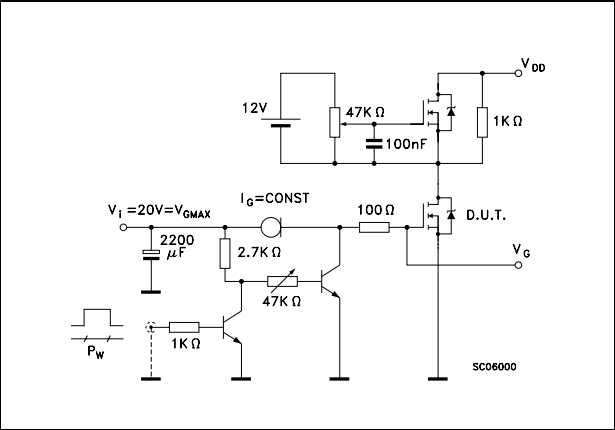


Figure 21. Test circuit for inductive load switching and diode recovery times



Figure 22. Unclamped Inductive load test circuit

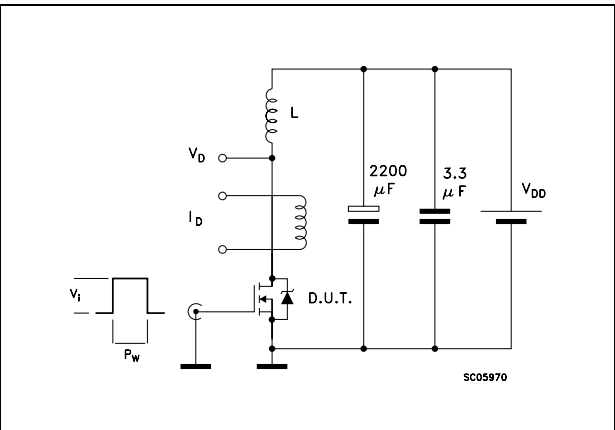


Figure 23. Unclamped inductive waveform

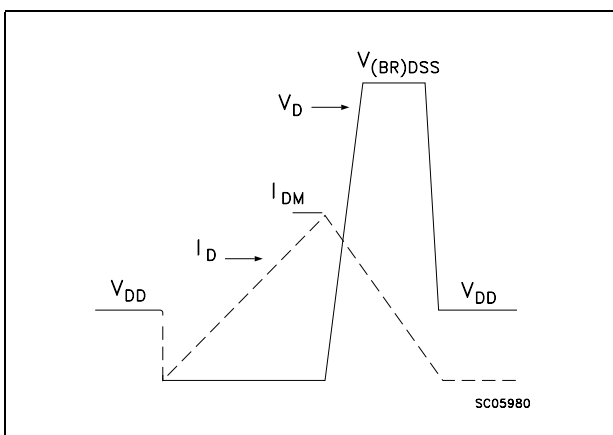


Figure 24. Switching time waveform

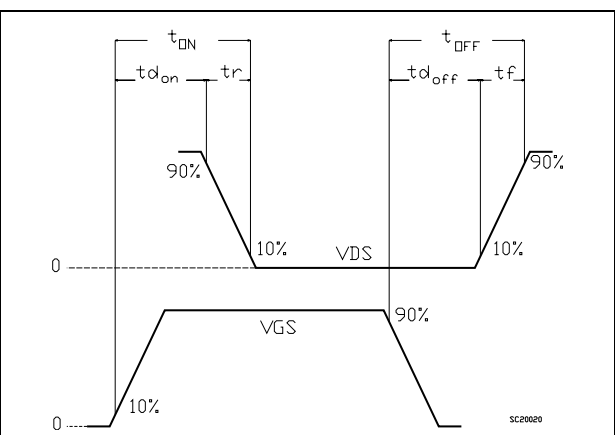
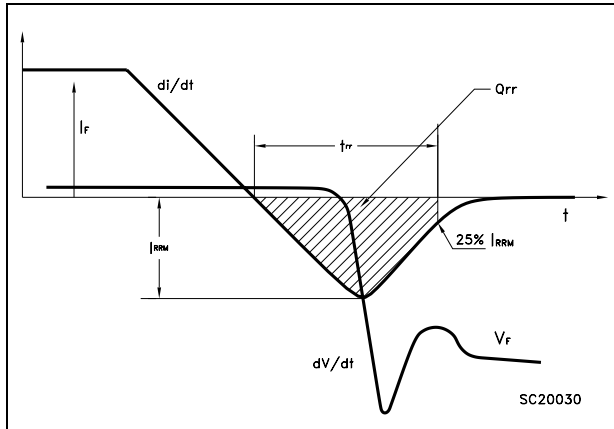


Figure 25. Diode recovery times waveform

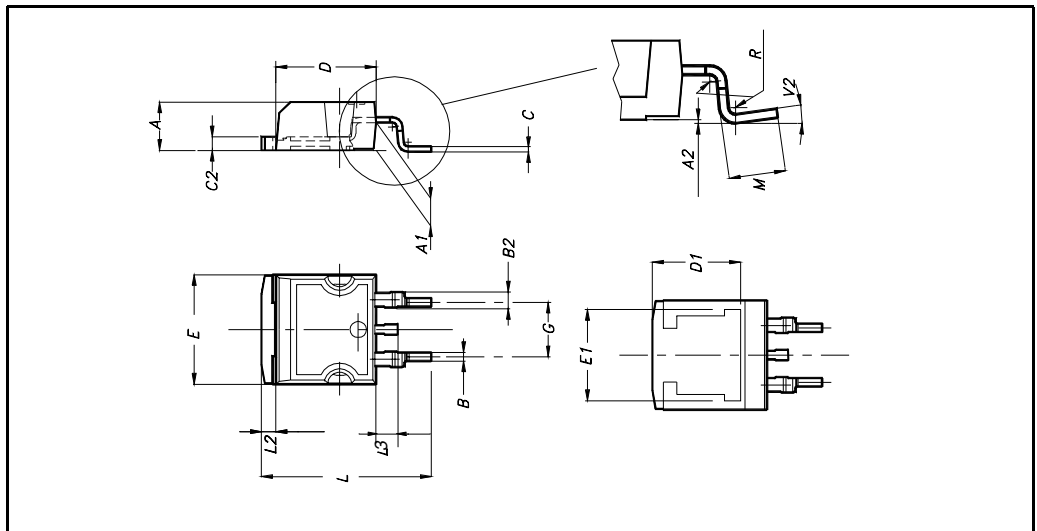


5 Package mechanical data

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

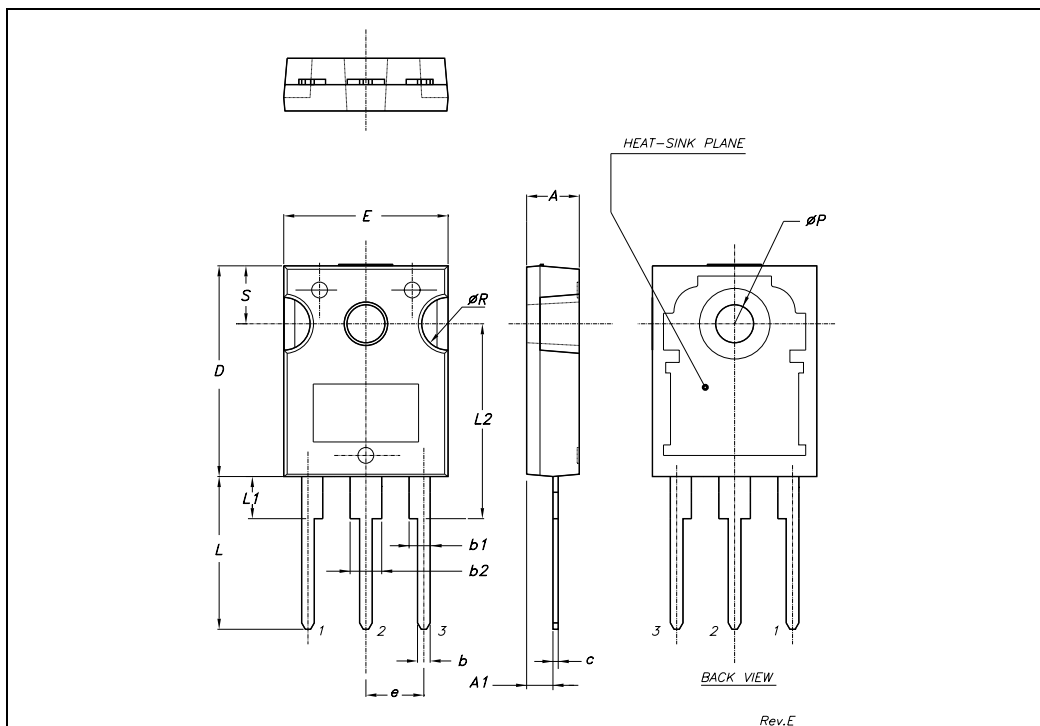
D²PAK MECHANICAL DATA

| DIM. | mm. | | | inch | | |
|------|------|------|-------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | 4.4 | | 4.6 | 0.173 | | 0.181 |
| A1 | 2.49 | | 2.69 | 0.098 | | 0.106 |
| A2 | 0.03 | | 0.23 | 0.001 | | 0.009 |
| B | 0.7 | | 0.93 | 0.027 | | 0.036 |
| B2 | 1.14 | | 1.7 | 0.044 | | 0.067 |
| C | 0.45 | | 0.6 | 0.017 | | 0.023 |
| C2 | 1.23 | | 1.36 | 0.048 | | 0.053 |
| D | 8.95 | | 9.35 | 0.352 | | 0.368 |
| D1 | | 8 | | | 0.315 | |
| E | 10 | | 10.4 | 0.393 | | |
| E1 | | 8.5 | | | 0.334 | |
| G | 4.88 | | 5.28 | 0.192 | | 0.208 |
| L | 15 | | 15.85 | 0.590 | | 0.625 |
| L2 | 1.27 | | 1.4 | 0.050 | | 0.055 |
| L3 | 1.4 | | 1.75 | 0.055 | | 0.068 |
| M | 2.4 | | 3.2 | 0.094 | | 0.126 |
| R | | 0.4 | | | 0.015 | |
| V2 | 0° | | 4° | | | |



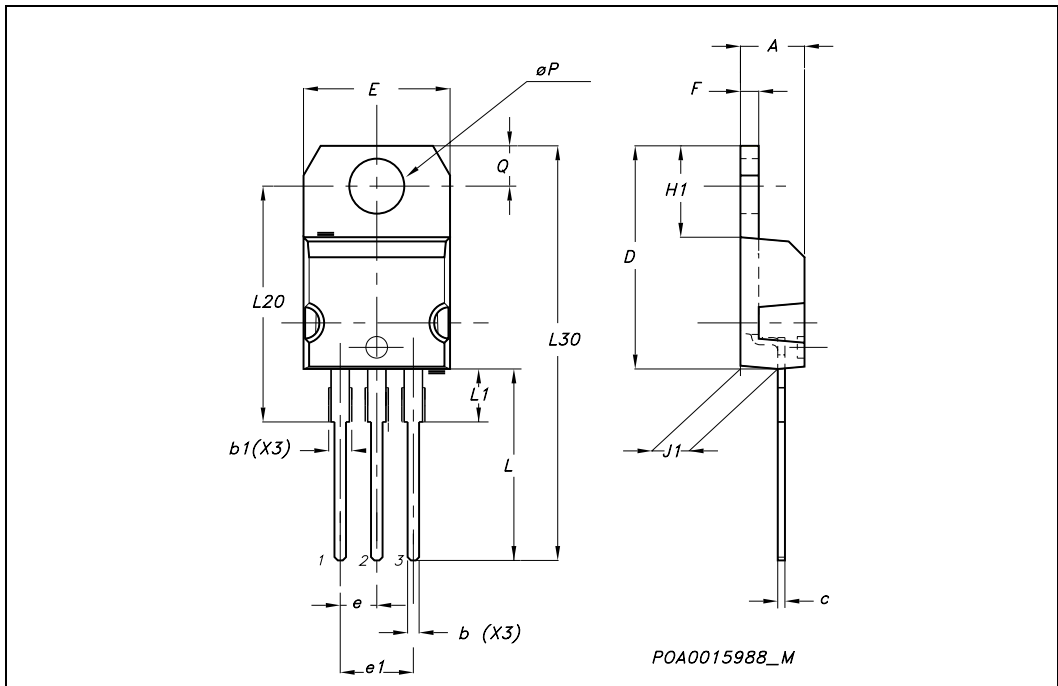
TO-247 MECHANICAL DATA

| DIM. | mm. | | | inch | | |
|------|-------|-------|-------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | 4.85 | | 5.15 | 0.19 | | 0.20 |
| A1 | 2.20 | | 2.60 | 0.086 | | 0.102 |
| b | 1.0 | | 1.40 | 0.039 | | 0.055 |
| b1 | 2.0 | | 2.40 | 0.079 | | 0.094 |
| b2 | 3.0 | | 3.40 | 0.118 | | 0.134 |
| c | 0.40 | | 0.80 | 0.015 | | 0.03 |
| D | 19.85 | | 20.15 | 0.781 | | 0.793 |
| E | 15.45 | | 15.75 | 0.608 | | 0.620 |
| e | | 5.45 | | | 0.214 | |
| L | 14.20 | | 14.80 | 0.560 | | 0.582 |
| L1 | 3.70 | | 4.30 | 0.14 | | 0.17 |
| L2 | | 18.50 | | | 0.728 | |
| øP | 3.55 | | 3.65 | 0.140 | | 0.143 |
| øR | 4.50 | | 5.50 | 0.177 | | 0.216 |
| S | | 5.50 | | | 0.216 | |



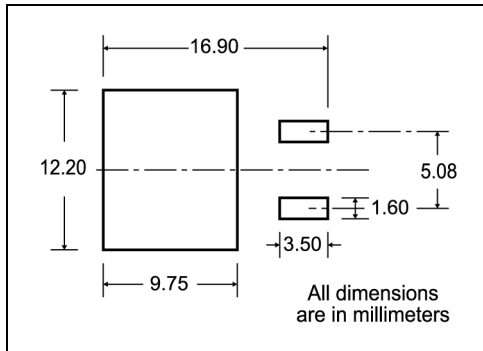
TO-220 MECHANICAL DATA

| 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 |



6 Packaging mechanical data

D²PAK FOOTPRINT



TAPE AND REEL SHIPMENT

TAPE MECHANICAL DATA

| DIM. | mm | | inch | |
|------|------|------|--------|--------|
| | MIN. | MAX. | MIN. | MAX. |
| A0 | 10.5 | 10.7 | 0.413 | 0.421 |
| B0 | 15.7 | 15.9 | 0.618 | 0.626 |
| D | 1.5 | 1.6 | 0.059 | 0.063 |
| D1 | 1.59 | 1.61 | 0.062 | 0.063 |
| E | 1.65 | 1.85 | 0.065 | 0.073 |
| F | 11.4 | 11.6 | 0.449 | 0.456 |
| K0 | 4.8 | 5.0 | 0.189 | 0.197 |
| P0 | 3.9 | 4.1 | 0.153 | 0.161 |
| P1 | 11.9 | 12.1 | 0.468 | 0.476 |
| P2 | 1.9 | 2.1 | 0.075 | 0.082 |
| R | 50 | | 1.574 | |
| T | 0.25 | 0.35 | 0.0098 | 0.0137 |
| W | 23.7 | 24.3 | 0.933 | 0.956 |

REEL MECHANICAL DATA

| 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 | 24.4 | 26.4 | 0.960 | 1.039 |
| N | 100 | | 3.937 | |
| T | | 30.4 | | 1.197 |

| BASE QTY | BULK QTY |
|----------|----------|
| 1000 | 1000 |

10 pitches cumulative tolerance on tape +/- 0.2 mm

Center line of cavity

User Direction of Feed

FEED DIRECTION

Bending radius R min.

* on sales type

7 Revision history

Table 7. Revision history

| Date | Revision | Changes |
|-------------|-----------------|---------------------------------|
| 21-Jun-2004 | 2 | Preliminary version |
| 26-Jun-2006 | 3 | New template, no content change |

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