



# STP120NF10, STB120NF10 STF120NF10, STW120NF10

N-channel 100 V, 0.009  $\Omega$ , 110 A STripFET™ II Power MOSFET  
 in TO-247, TO-220, D<sup>2</sup>PAK, TO-220FP

## Features

| Type       | V <sub>DSS</sub> | R <sub>DS(on)</sub> max | I <sub>D</sub> |
|------------|------------------|-------------------------|----------------|
| STW120NF10 | 100V             | <0.0105 $\Omega$        | 110 A          |
| STP120NF10 |                  |                         | 110 A          |
| STB120NF10 |                  |                         | 110 A          |
| STF120NF10 |                  |                         | 41 A           |

- Exceptional dv/dt capability
- 100% avalanche tested
- Application oriented characterization

## Application

- Switching applications

## Description

These devices are N-channel Power MOSFET realized with STMicroelectronics unique STripFET™ process has specifically been designed to minimize the on-resistance. It is therefore suitable as primary switch in advanced high-efficiency, high-frequency isolated DC-DC converters for telecom and computer application. It is also intended for any applications with low gate drive requirements.

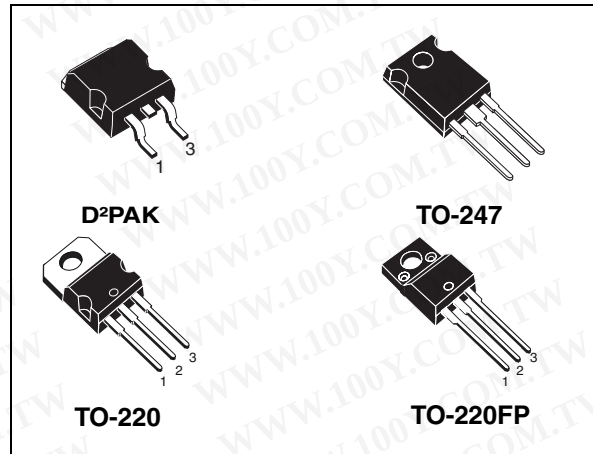


Figure 1. Internal schematic diagram

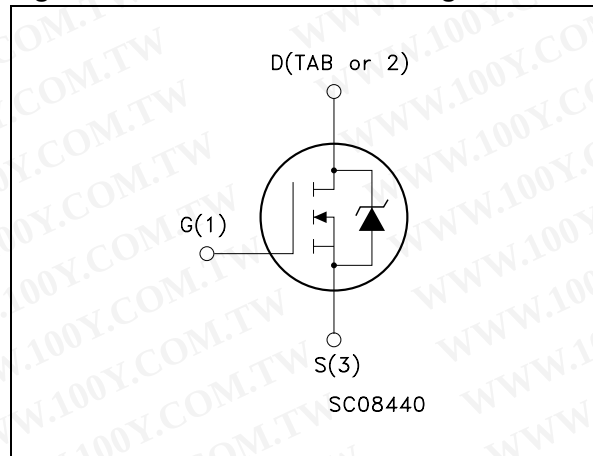


Table 1. Device summary

| Order codes | Marking  | Packages           | Packaging     |
|-------------|----------|--------------------|---------------|
| STB120NF10  | B120NF10 | D <sup>2</sup> PAK | Tape and reel |
| STF120NF10  | 120NF10  | TO-220FP           | Tube          |
| STP120NF10  | P120NF10 | TO-220             |               |
| STW120NF10  | W120NF10 | TO-247             |               |

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol             | Parameter                                                         | Value                              |                    | Unit                  |
|--------------------|-------------------------------------------------------------------|------------------------------------|--------------------|-----------------------|
|                    |                                                                   | TO-220, TO-247, D <sup>2</sup> PAK | TO-220FP           |                       |
| $V_{DS}$           | Drain-source voltage ( $V_{GS} = 0$ )                             | 100                                |                    | V                     |
| $V_{GS}$           | Gate-source voltage                                               | $\pm 20$                           |                    | V                     |
| $I_D$              | Drain current (continuous) at $T_C = 25\text{ }^{\circ}\text{C}$  | 110                                | 41 <sup>(1)</sup>  | A                     |
| $I_D$              | Drain current (continuous) at $T_C = 100\text{ }^{\circ}\text{C}$ | 77                                 | 29 <sup>(1)</sup>  | A                     |
| $I_{DM}^{(2)}$     | Drain current (pulsed)                                            | 440                                | 164 <sup>(1)</sup> | A                     |
| $P_{TOT}$          | Total dissipation at $T_C = 25\text{ }^{\circ}\text{C}$           | 312                                | 45                 | W                     |
|                    | Derating factor                                                   | 2.08                               | 0.30               | W/ $^{\circ}\text{C}$ |
| $dv/dt^{(3)}$      | Peak diode recovery voltage slope                                 | 10                                 |                    | V/ns                  |
| $E_{AS}^{(4)}$     | Single pulse avalanche energy                                     | 550                                |                    | mJ                    |
| $T_J$<br>$T_{stg}$ | Operating junction temperature<br>Storage temperature             | -55 to 175                         |                    | $^{\circ}\text{C}$    |

1. Limited only by maximum temperature allowed.
2. Pulse width limited by safe operating area.
3.  $I_{SD} \leq 120\text{ A}$ ,  $di/dt \leq 300\text{ A}/\mu\text{s}$ ,  $V_{DD} = 80\%V_{(BR)DSS}$
4. Starting  $T_J = 25\text{ }^{\circ}\text{C}$ ,  $I_D = 60\text{ A}$ ,  $V_{DD} = 50\text{ V}$

**Table 3. Thermal resistance**

| Symbol              | Parameter                                      | Value  |        |                    |          | Unit                        |
|---------------------|------------------------------------------------|--------|--------|--------------------|----------|-----------------------------|
|                     |                                                | TO-220 | TO-247 | D <sup>2</sup> PAK | TO-220FP |                             |
| $R_{thj-case}$      | Thermal resistance junction-case max           | 0.48   |        |                    | 3.33     | $^{\circ}\text{C}/\text{W}$ |
| $R_{thj-amb}$       | Thermal resistance junction-ambient max        | 62.5   |        |                    | 62.5     | $^{\circ}\text{C}/\text{W}$ |
| $R_{thj-pcb}^{(1)}$ | Thermal resistance junction-pcb max            |        |        | 35                 |          | $^{\circ}\text{C}/\text{W}$ |
| $T_L$               | Maximum lead temperature for soldering purpose | 300    |        |                    | 300      | $^{\circ}\text{C}$          |

1. When mounted on 1inch<sup>2</sup> FR-4 board, 2 oz Cu

## 2 Electrical characteristics

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

**Table 4. On/off states**

| Symbol        | Parameter                                        | Test conditions                                                                    | Min. | Typ.  | Max.      | Unit                           |
|---------------|--------------------------------------------------|------------------------------------------------------------------------------------|------|-------|-----------|--------------------------------|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage                   | $I_D = 250\text{ }\mu\text{A}$ , $V_{GS} = 0$                                      | 100  |       |           | V                              |
| $I_{DSS}$     | Zero gate voltage drain current ( $V_{GS} = 0$ ) | $V_{DS} = \text{Max rating}$ ,<br>$V_{DS} = \text{Max rating}@125^{\circ}\text{C}$ |      |       | 1<br>10   | $\mu\text{A}$<br>$\mu\text{A}$ |
| $I_{GSS}$     | Gate body leakage current ( $V_{DS} = 0$ )       | $V_{GS} = \pm 20\text{ V}$                                                         |      |       | $\pm 100$ | nA                             |
| $V_{GS(th)}$  | Gate threshold voltage                           | $V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$                                 | 2    |       | 4         | V                              |
| $R_{DS(on)}$  | Static drain-source on resistance                | $V_{GS} = 10\text{ V}$ , $I_D = 60\text{ A}$ <sup>(1)</sup>                        |      | 0.009 | 0.0105    | $\Omega$                       |

1. For TO-220FP  $I_D = 40\text{ A}$

**Table 5. Dynamic**

| Symbol                  | Parameter                    | Test conditions                                               | Min. | Typ. | Max. | Unit |
|-------------------------|------------------------------|---------------------------------------------------------------|------|------|------|------|
| $g_{fs}$ <sup>(1)</sup> | Forward transconductance     | $V_{DS} = 25\text{ V}$ , $I_D = 60\text{ A}$                  | -    | 90   |      | S    |
| $C_{iss}$               | Input capacitance            | $V_{DS} = 25\text{ V}$ , $f = 1\text{ MHz}$ ,<br>$V_{GS} = 0$ | -    | 5200 |      | pF   |
| $C_{oss}$               | Output capacitance           |                                                               |      | 785  |      | pF   |
| $C_{rss}$               | Reverse transfer capacitance |                                                               |      | 325  |      | pF   |
| $Q_g$                   | Total gate charge            | $V_{DD} = 80\text{ V}$ , $I_D = 120\text{ A}$                 | -    | 172  | 233  | nC   |
| $Q_{gs}$                | Gate-source charge           | $V_{GS} = 10\text{ V}$                                        |      | 32   |      | nC   |
| $Q_{gd}$                | Gate-drain charge            | (see Figure 16)                                               |      | 64   |      | nC   |

1. Pulsed: pulse duration=300 $\mu\text{s}$ , duty cycle 1.5%

**Table 6. Switching times**

| Symbol       | Parameter           | Test conditions                                                                                           | Min. | Typ. | Max. | Unit |
|--------------|---------------------|-----------------------------------------------------------------------------------------------------------|------|------|------|------|
| $t_{d(on)}$  | Turn-on delay time  | $V_{DD}=50\text{ V}$ , $I_D=60\text{ A}$ ,<br>$R_G=4.7\ \Omega$ , $V_{GS}=10\text{ V}$<br>(see Figure 15) | -    | 25   | -    | ns   |
| $t_r$        | Rise time           |                                                                                                           |      | 90   |      | ns   |
| $t_{d(off)}$ | Turn-off delay time |                                                                                                           |      | 132  |      | ns   |
| $t_f$        | Fall time           |                                                                                                           |      | 68   |      | ns   |

**Table 7. Source drain diode**

| Symbol          | Parameter                     | Test conditions                                                                                                                              | Min. | Typ. | Max. | Unit |
|-----------------|-------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| $I_{SD}$        | Source-drain current          |                                                                                                                                              | -    |      | 110  | A    |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) |                                                                                                                                              | -    |      | 440  | A    |
| $V_{SD}^{(2)}$  | Forward on voltage            | $I_{SD}=120\text{ A}$ , $V_{GS}=0$                                                                                                           | -    |      | 1.3  | V    |
| $t_{rr}$        | Reverse recovery time         | $I_{SD}=120\text{ A}$ ,<br>$di/dt = 100\text{ A}/\mu\text{s}$ ,<br>$V_{DD}=40\text{ V}$ , $T_J=150\text{ }^\circ\text{C}$<br>(see Figure 20) | -    | 152  |      | ns   |
| $Q_{rr}$        | Reverse recovery charge       |                                                                                                                                              |      | 760  |      | nC   |
| $I_{RRM}$       | Reverse recovery current      |                                                                                                                                              |      | 10   |      | A    |

1. Pulse width limited by safe operating area
2. Pulsed: pulse duration=300 $\mu\text{s}$ , duty cycle 1.5%

## 2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

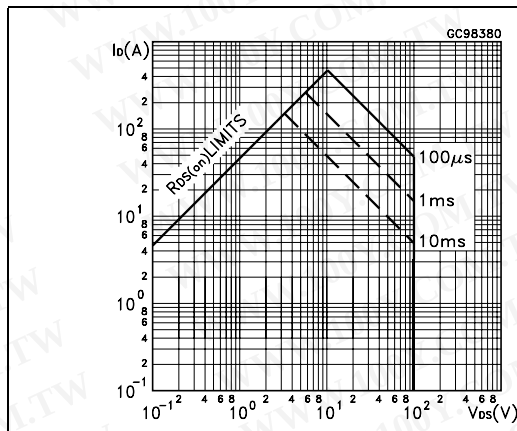


Figure 3. Thermal impedance

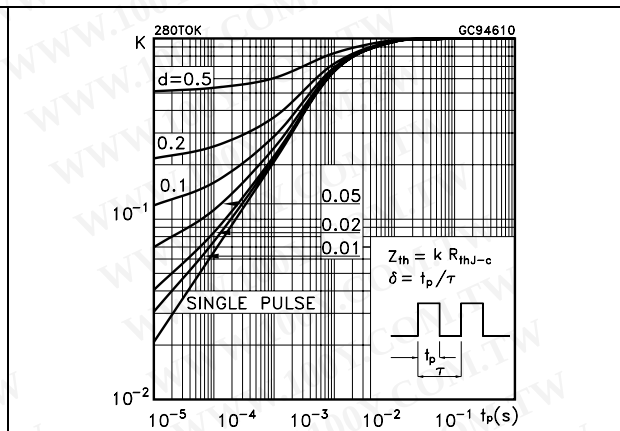


Figure 4. Safe operating area for TO-220FP

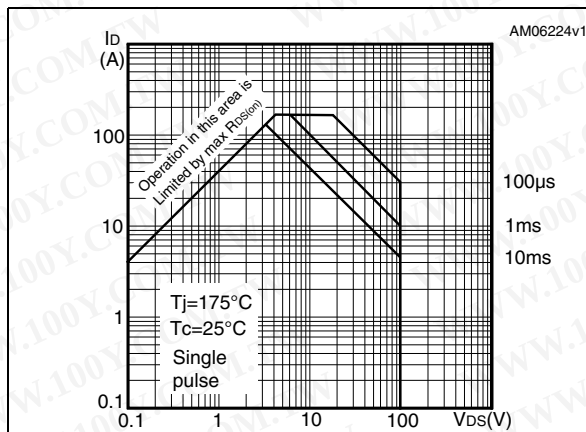


Figure 5. Thermal impedance for TO-220FP

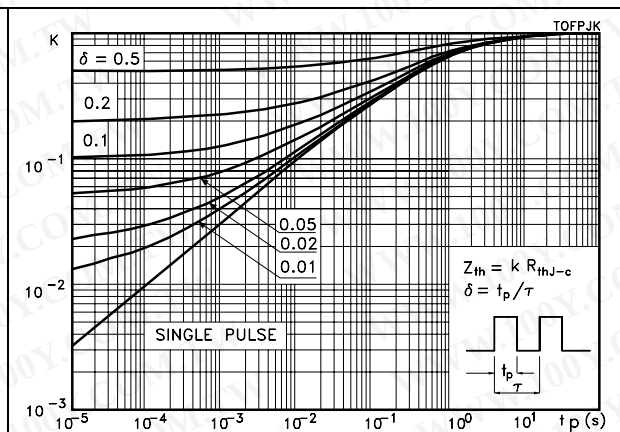


Figure 6. Output characteristics

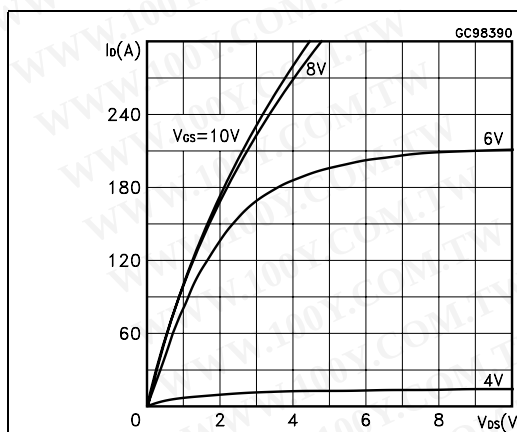


Figure 7. Transfer characteristics

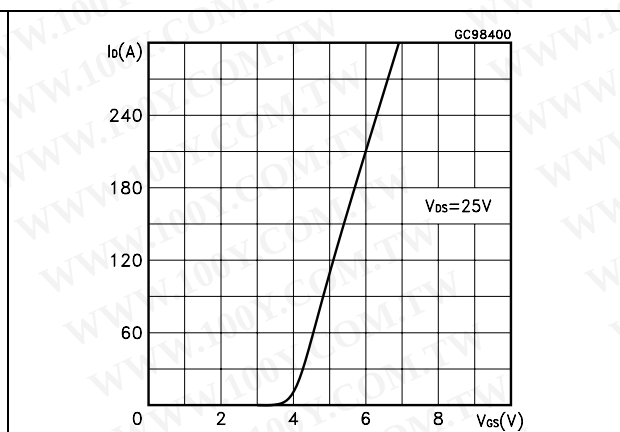


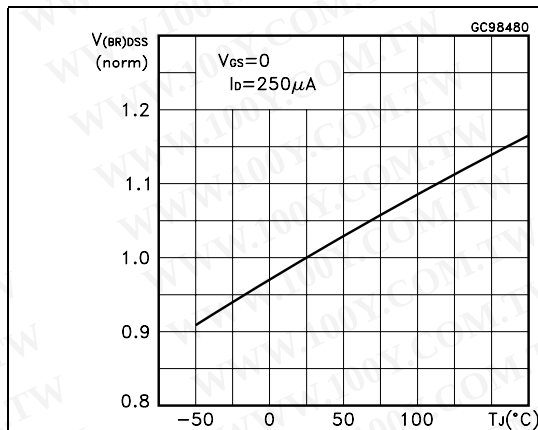
Figure 8. Normalized  $B_{V_{DS}}$  vs temperature

Figure 9. Static drain-source on resistance

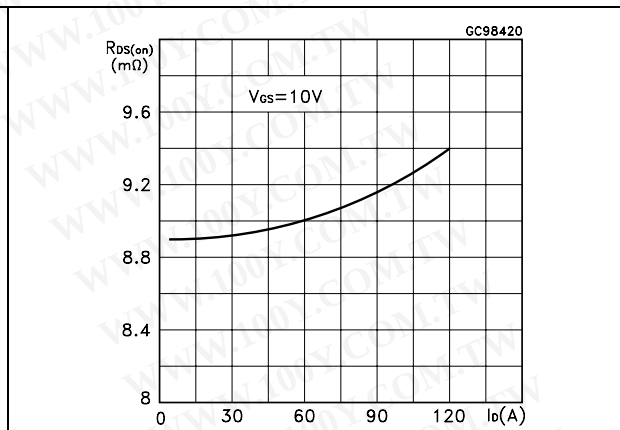


Figure 10. Gate charge vs gate-source voltage

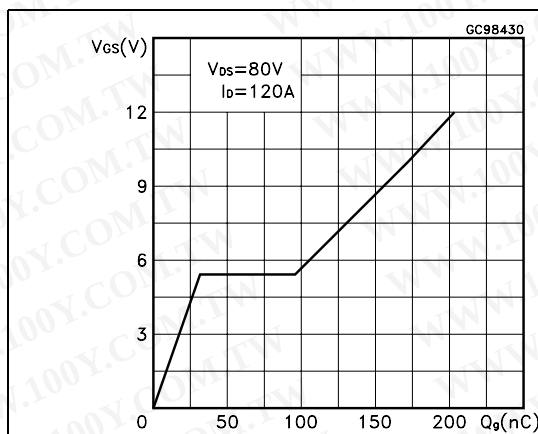


Figure 11. Capacitance variations

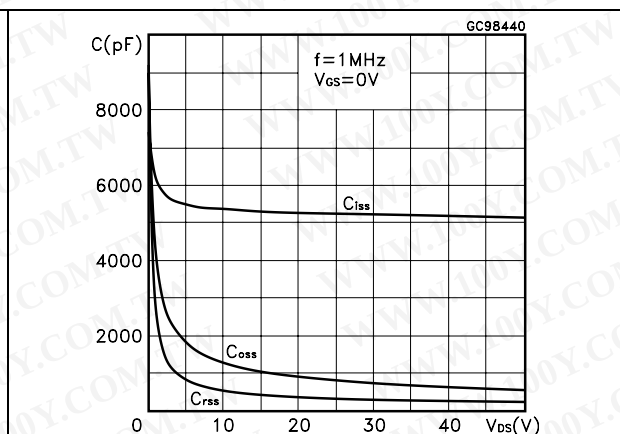


Figure 12. Normalized gate threshold voltage vs temperature

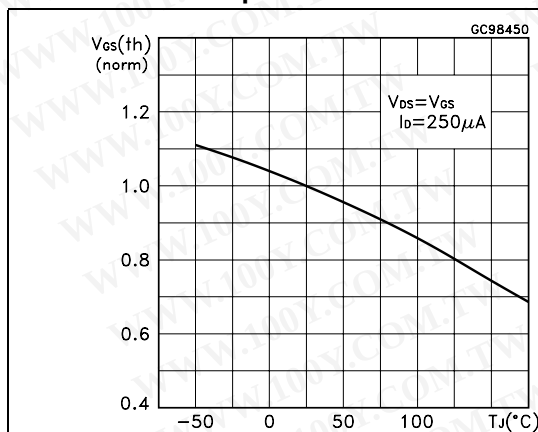


Figure 13. Normalized on resistance vs temperature

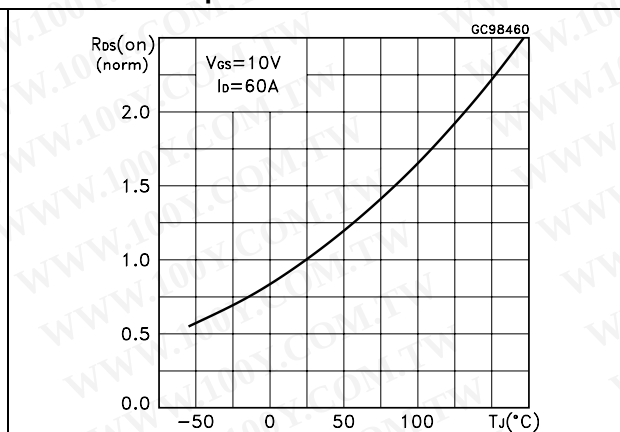
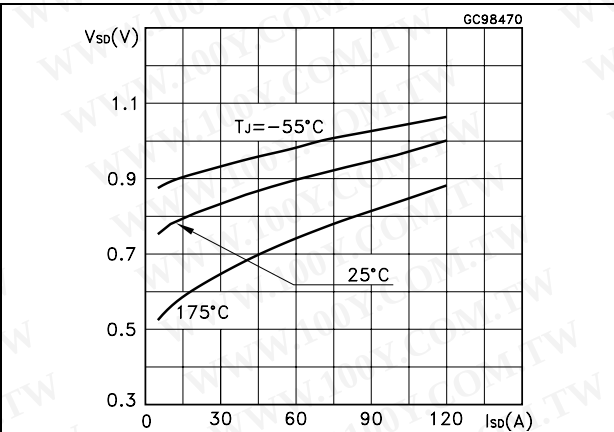
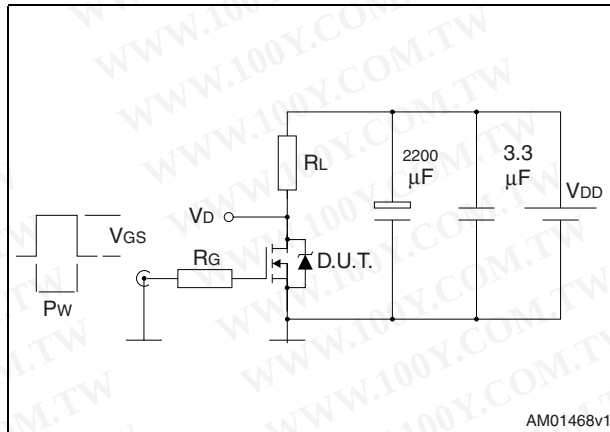


Figure 14. Source-drain diode forward characteristics

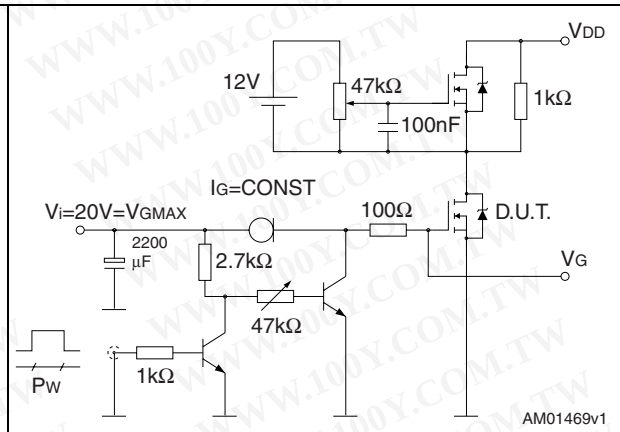


### 3 Test circuits

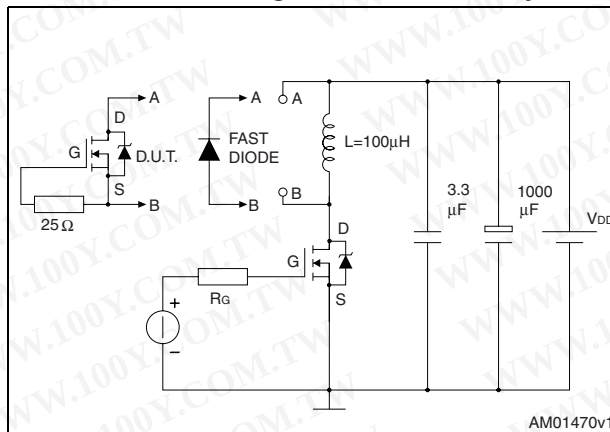
**Figure 15. Switching times test circuit for resistive load**



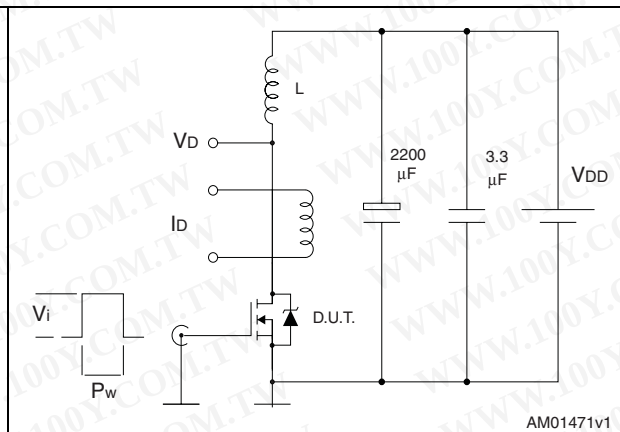
**Figure 16. Gate charge test circuit**



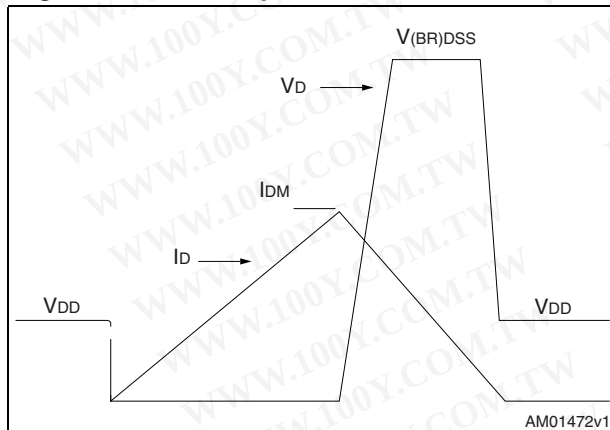
**Figure 17. Test circuit for inductive load switching and diode recovery times**



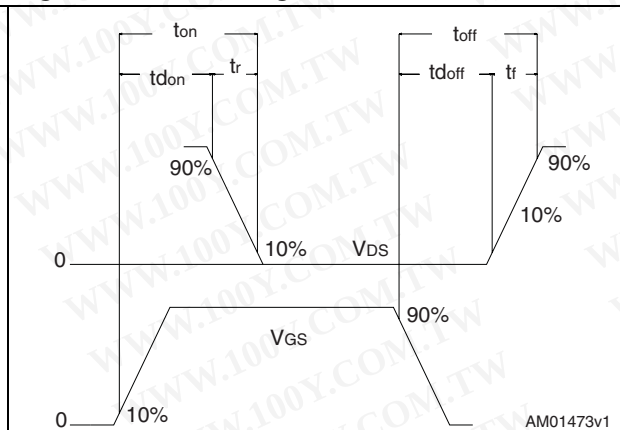
**Figure 18. Unclamped inductive load test circuit**



**Figure 19. Unclamped inductive waveform**



**Figure 20. Switching time waveform**



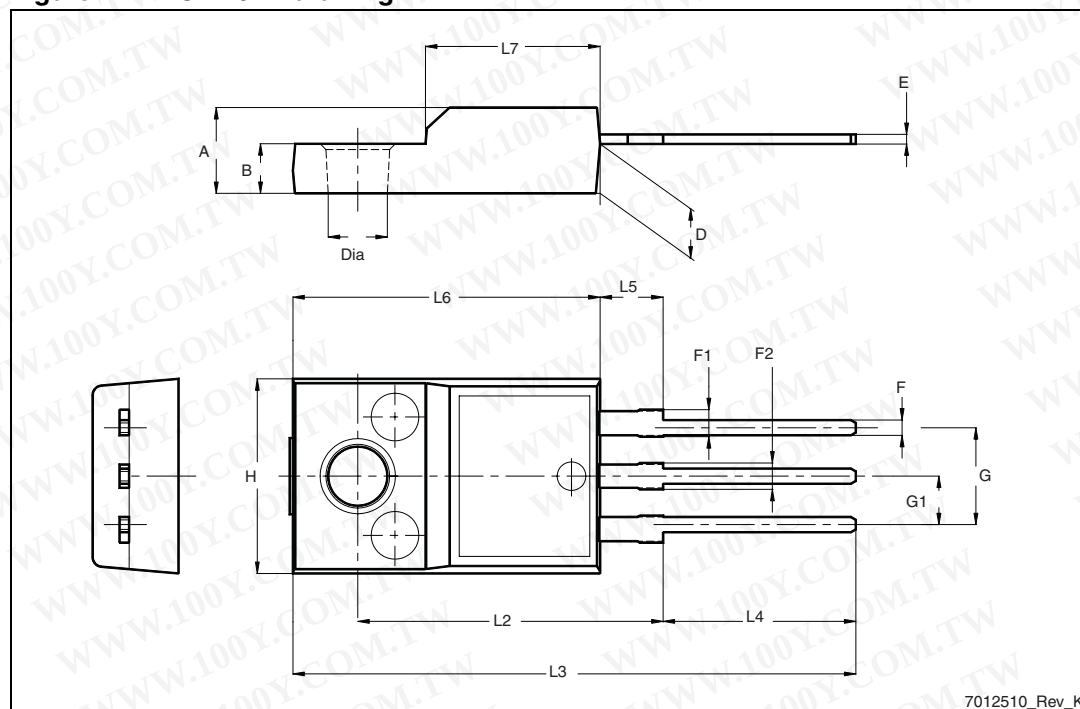
## 4 Package mechanical data

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 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 |      | 1.70 |
| 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  |

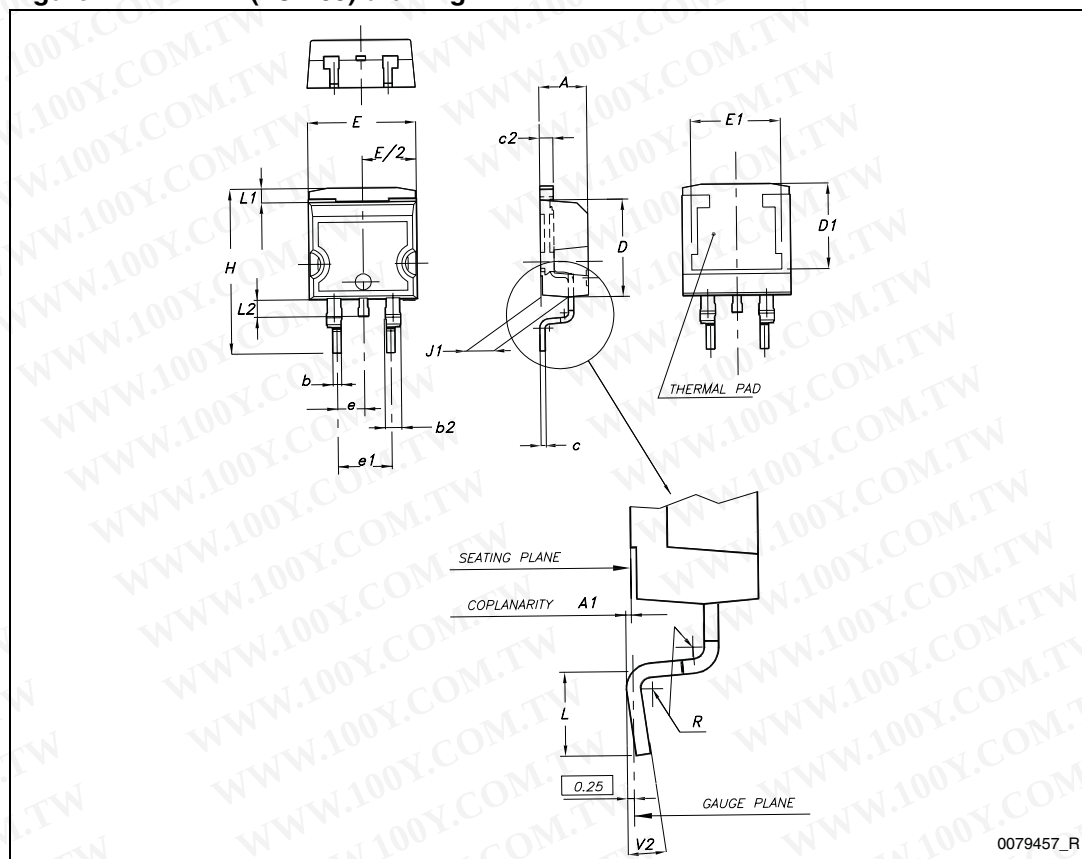
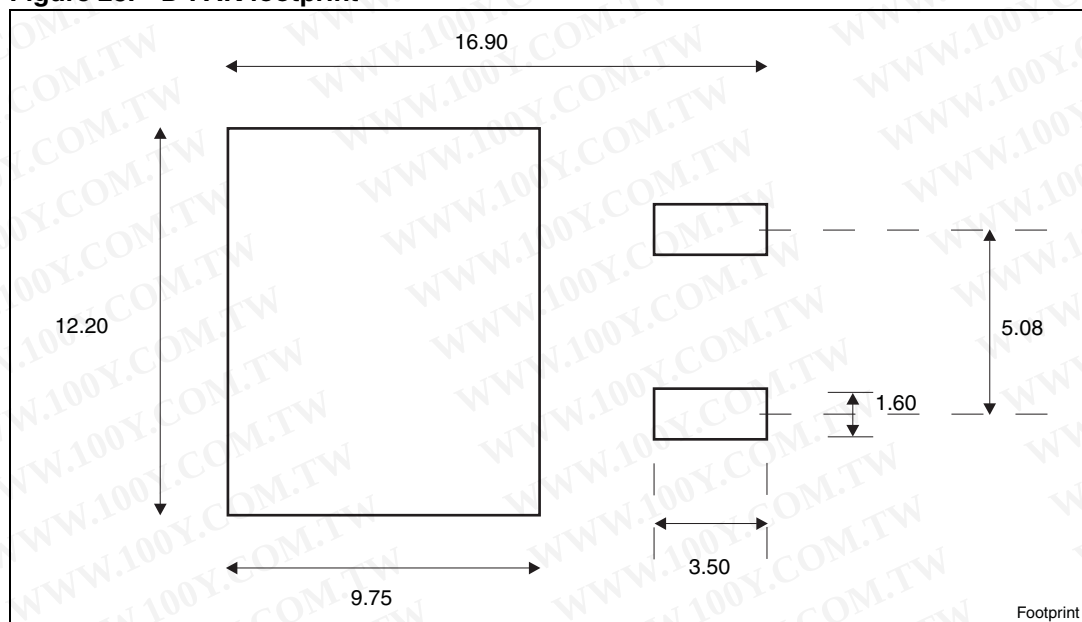
Figure 21. TO-220FP drawing



7012510\_Rev\_K

Table 9. D<sup>2</sup>PAK (TO-263) mechanical data

| Dim. | mm   |      |       |
|------|------|------|-------|
|      | Min. | Typ. | Max.  |
| A    | 4.40 |      | 4.60  |
| A1   | 0.03 |      | 0.23  |
| b    | 0.70 |      | 0.93  |
| b2   | 1.14 |      | 1.70  |
| c    | 0.45 |      | 0.60  |
| c2   | 1.23 |      | 1.36  |
| D    | 8.95 |      | 9.35  |
| D1   | 7.50 |      |       |
| E    | 10   |      | 10.40 |
| E1   | 8.50 |      |       |
| e    |      | 2.54 |       |
| e1   | 4.88 |      | 5.28  |
| H    | 15   |      | 15.85 |
| J1   | 2.49 |      | 2.69  |
| L    | 2.29 |      | 2.79  |
| L1   | 1.27 |      | 1.40  |
| L2   | 1.30 |      | 1.75  |
| R    |      | 0.4  |       |
| V2   | 0°   |      | 8°    |

Figure 22. D<sup>2</sup>PAK (TO-263) drawingFigure 23. D<sup>2</sup>PAK footprint<sup>(a)</sup>

a. All dimension are in millimeters

Table 10. 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 24. TO-220 type A drawing

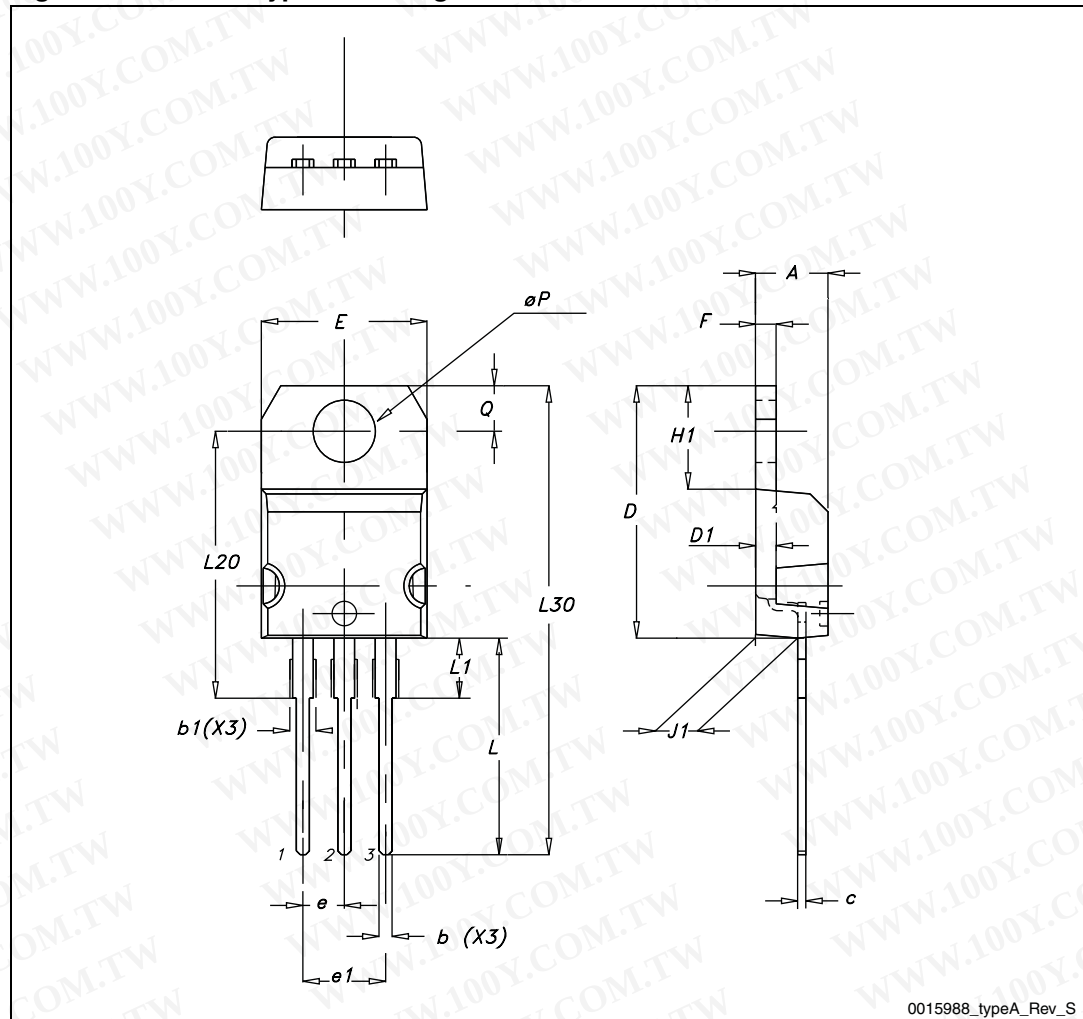
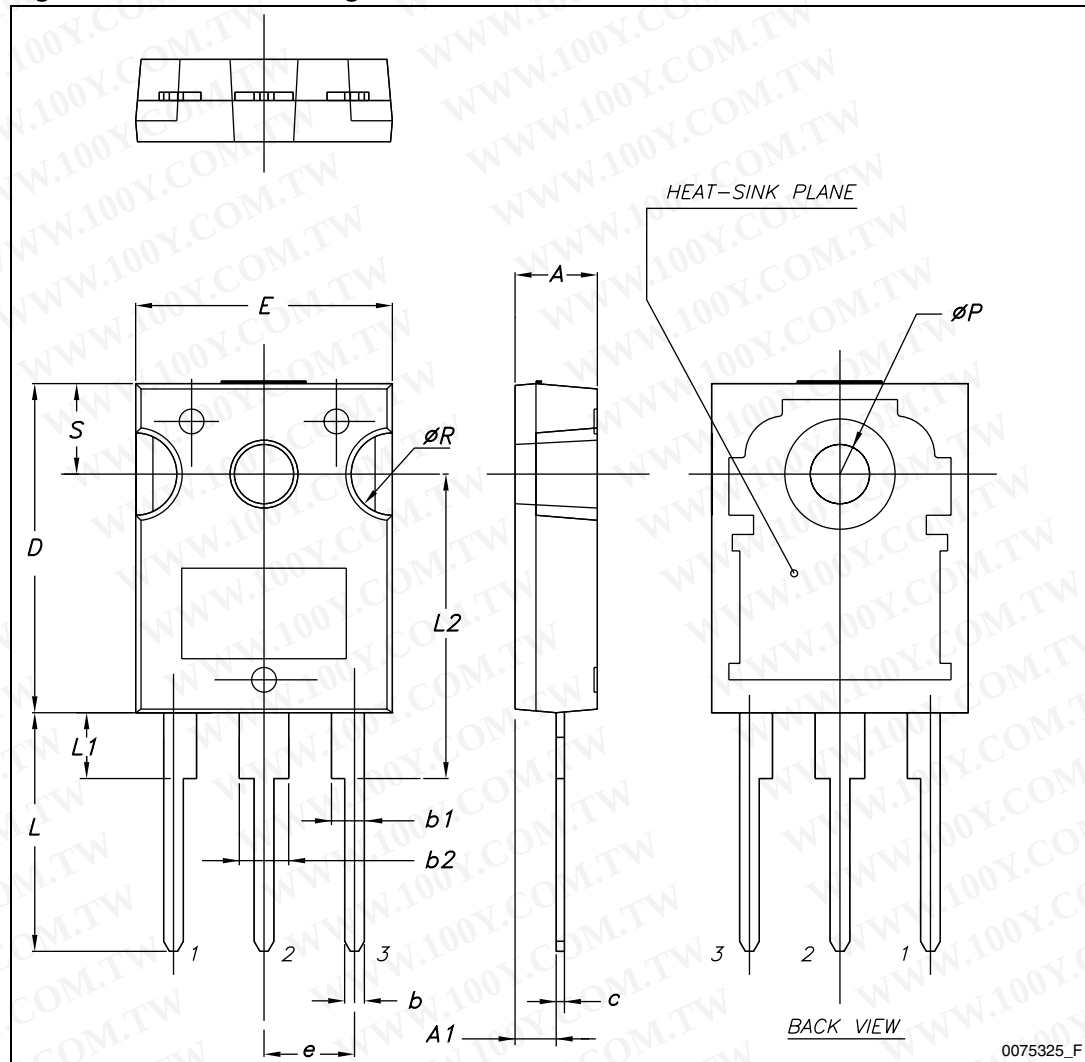


Table 11. TO-247 mechanical data

| 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  |       |

Figure 25. TO-247 drawing



## 5 Packaging mechanical data

Table 12. D<sup>2</sup>PAK (TO-263) tape and reel mechanical data

| Tape |      |      | Reel     |      |      |
|------|------|------|----------|------|------|
| Dim. | mm   |      | Dim.     | mm   |      |
|      | Min. | Max. |          | Min. | Max. |
| A0   | 10.5 | 10.7 | A        |      | 330  |
| B0   | 15.7 | 15.9 | B        | 1.5  |      |
| D    | 1.5  | 1.6  | C        | 12.8 | 13.2 |
| D1   | 1.59 | 1.61 | D        | 20.2 |      |
| E    | 1.65 | 1.85 | G        | 24.4 | 26.4 |
| F    | 11.4 | 11.6 | N        | 100  |      |
| K0   | 4.8  | 5.0  | T        |      | 30.4 |
| P0   | 3.9  | 4.1  |          |      |      |
| P1   | 11.9 | 12.1 | Base qty |      | 1000 |
| P2   | 1.9  | 2.1  | Bulk qty |      | 1000 |
| R    | 50   |      |          |      |      |
| T    | 0.25 | 0.35 |          |      |      |
| W    | 23.7 | 24.3 |          |      |      |

Figure 26. Tape

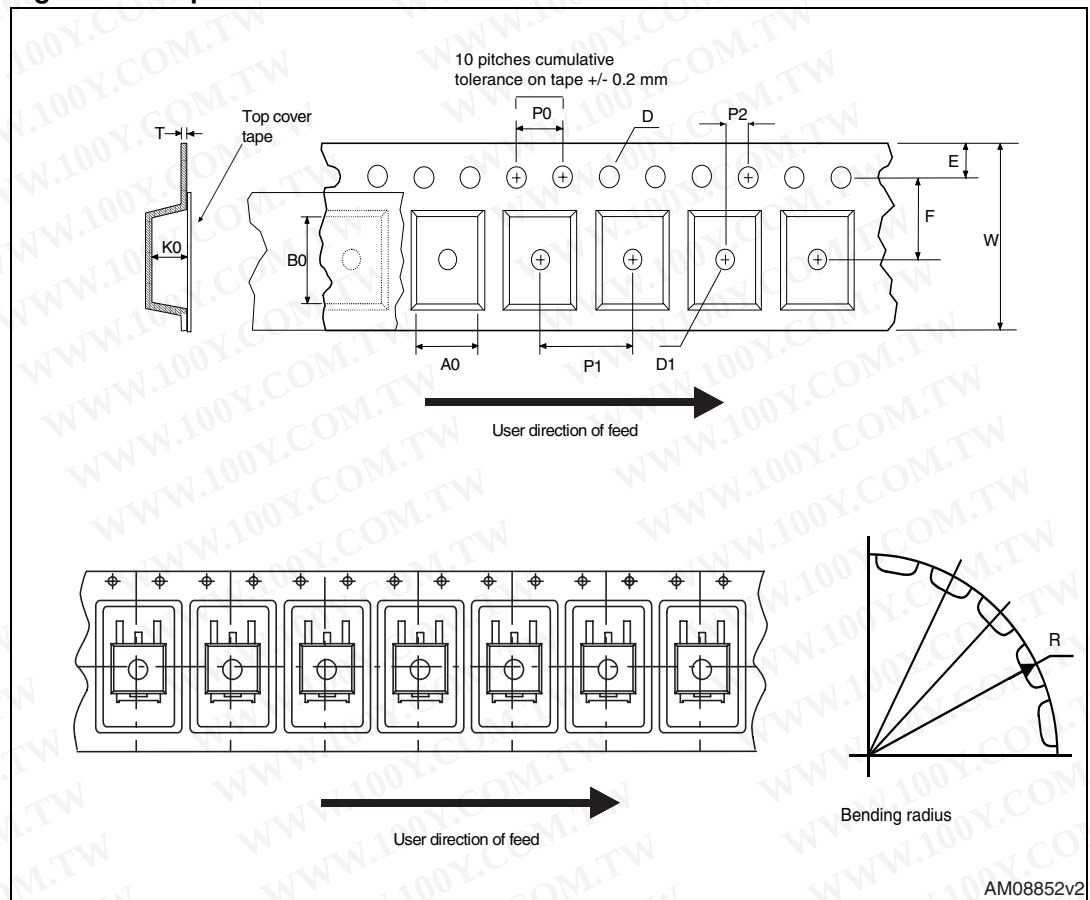
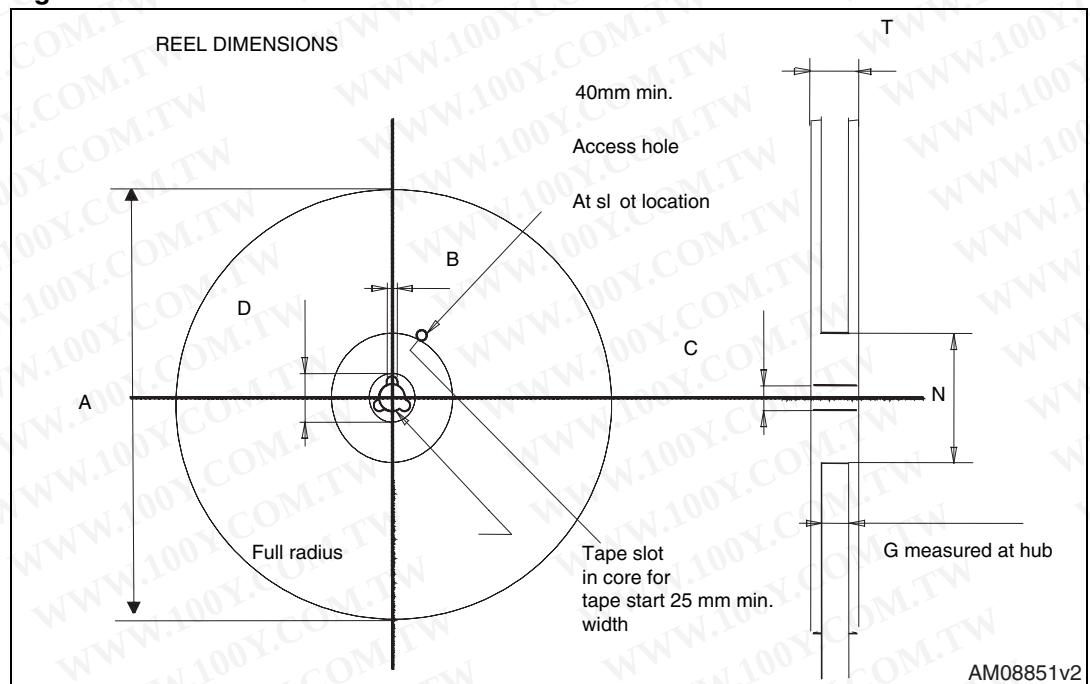


Figure 27. Reel



## 6 Revision history

**Table 13. Revision history**

| Date        | Revision | Changes                                           |
|-------------|----------|---------------------------------------------------|
| 20-Mar-2006 | 2        | Preliminary datasheet                             |
| 31-Mar-2006 | 3        | Typing error                                      |
| 19-Jun-2006 | 4        | New template, no content change                   |
| 28-Jun-2006 | 5        | New $I_D$ value on <a href="#">Table 2</a>        |
| 05-Oct-2006 | 6        | New value on <a href="#">Table 7</a>              |
| 11-May-2011 | 7        | Added new package and mechanicala data: TO-220FP. |

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勝特力电子(上海) 86-21-34970699  
勝特力电子(深圳) 86-755-83298787  
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