



# STB11NM80, STF11NM80 STP11NM80, STW11NM80

N-channel 800 V, 0.35  $\Omega$ , 11 A MDmesh™ Power MOSFET  
TO-220, TO-220FP, D<sup>2</sup>PAK, TO-247

## Features

| Type      | V <sub>DSS</sub> | R <sub>DS(on)</sub><br>max | R <sub>DS(on)</sub> *Q <sub>g</sub> | I <sub>D</sub> |
|-----------|------------------|----------------------------|-------------------------------------|----------------|
| STB11NM80 | 800 V            | < 0.40 $\Omega$            | 14 $\Omega$ *nC                     | 11 A           |
| STF11NM80 |                  |                            |                                     |                |
| STP11NM80 |                  |                            |                                     |                |
| STW11NM80 |                  |                            |                                     |                |

- Low input capacitance and gate charge
- Low gate input resistance
- Best R<sub>DS(on)</sub>\*Q<sub>g</sub> in the industry

## Application

- Switching applications

## Description

The MDmesh™ associates the multiple drain process with the company's PowerMesh™ horizontal layout assuring an outstanding low on-resistance. The adoption of the company's proprietary strip technique yields overall dynamic performance that is significantly better than that of similar competition's products.

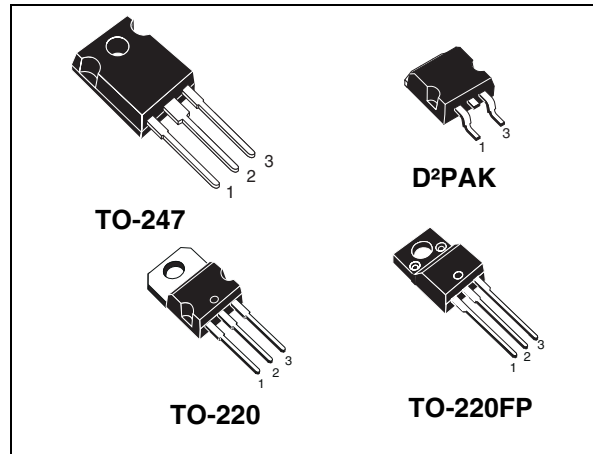
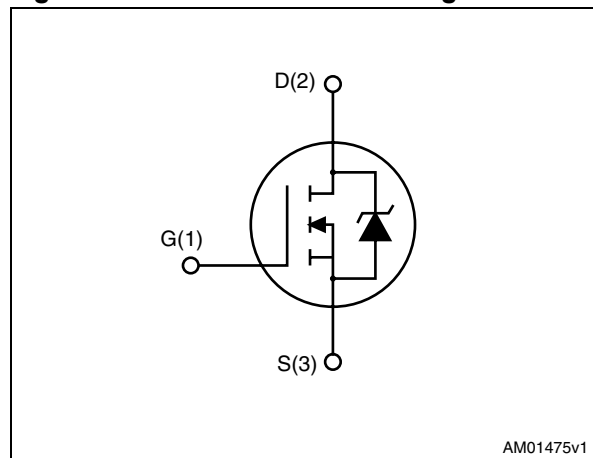


Figure 1. Internal schematic diagram



AM01475v1

Table 1. Device summary

| Order codes | Marking | Package            | Packaging     |
|-------------|---------|--------------------|---------------|
| STB11NM80   | B11NM80 | D <sup>2</sup> PAK | Tape and reel |
| STF11NM80   | F11NM80 | TO-220FP           | Tube          |
| STP11NM80   | P11NM80 | TO-220             |               |
| STW11NM80   | W11NM80 | TO-247             |               |

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol                             | Parameter                                             | Value                              |                   | Unit |
|------------------------------------|-------------------------------------------------------|------------------------------------|-------------------|------|
|                                    |                                                       | TO-220, D <sup>2</sup> PAK, TO-247 | TO-220FP          |      |
| V <sub>DS</sub>                    | Drain-source voltage (V <sub>GS</sub> = 0)            | 800                                |                   | V    |
| V <sub>GS</sub>                    | Gate-source voltage                                   | ±30                                |                   | V    |
| I <sub>D</sub>                     | Drain current (continuous) at T <sub>C</sub> = 25 °C  | 11                                 | 11 <sup>(1)</sup> | A    |
| I <sub>D</sub>                     | Drain current (continuous) at T <sub>C</sub> =100 °C  | 8                                  | 8 <sup>(1)</sup>  | A    |
| I <sub>DM</sub> <sup>(2)</sup>     | Drain current (pulsed)                                | 44                                 | 44 <sup>(1)</sup> | A    |
| P <sub>TOT</sub>                   | Total dissipation at T <sub>C</sub> = 25 °C           | 150                                | 35                | W    |
|                                    | Derating factor                                       | 1.2                                | 0.28              | W/°C |
| V <sub>ISO</sub>                   | Insulation withstand voltage (DC)                     |                                    | 2500              | V    |
| T <sub>J</sub><br>T <sub>stg</sub> | Operating junction temperature<br>Storage temperature | -65 to 150                         |                   | °C   |

1. Limited only by the maximum temperature allowed
2. Pulse width limited by safe operating area

**Table 3. Thermal data**

| Symbol                | Parameter                                      | Value                              |          | Unit |
|-----------------------|------------------------------------------------|------------------------------------|----------|------|
|                       |                                                | TO-220, D <sup>2</sup> PAK, TO-247 | TO-220FP |      |
| R <sub>thj-case</sub> | Thermal resistance junction-case max           | 0.83                               | 3.6      | °C/W |
| R <sub>thj-a</sub>    | Thermal resistance junction-ambient max        | 62.5                               |          | °C/W |
| T <sub>l</sub>        | Maximum lead temperature for soldering purpose | 300                                |          | °C   |

**Table 4. Avalanche characteristics**

| Symbol          | Parameter                                                                                                               | Value | Unit |
|-----------------|-------------------------------------------------------------------------------------------------------------------------|-------|------|
| I <sub>AS</sub> | Avalanche current, repetitive or not-repetitive (pulse width limited by T <sub>J</sub> max)                             | 2.5   | A    |
| E <sub>AS</sub> | Single pulse avalanche energy (starting T <sub>J</sub> =25 °C, I <sub>D</sub> =I <sub>AR</sub> , V <sub>DD</sub> =50 V) | 400   | mJ   |

## 2 Electrical characteristics

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

**Table 5. On/off states**

| Symbol        | Parameter                                        | Test conditions                                                                 | Min. | Typ. | Max.      | Unit                           |
|---------------|--------------------------------------------------|---------------------------------------------------------------------------------|------|------|-----------|--------------------------------|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage                   | $I_D = 250\ \mu\text{A}$ , $V_{GS} = 0$                                         | 800  |      |           | V                              |
| $dv/dt^{(1)}$ | Drain source voltage slope                       | $V_{DD} = 640\text{ V}$ , $I_D = 11\text{ A}$ ,<br>$V_{GS} = 10\text{ V}$       | 30   |      |           | V/ns                           |
| $I_{DSS}$     | Zero gate voltage drain current ( $V_{GS} = 0$ ) | $V_{DS} = \text{Max rating}$ ,<br>$V_{DS} = \text{Max rating @ } 125\text{ °C}$ |      |      | 10<br>100 | $\mu\text{A}$<br>$\mu\text{A}$ |
| $I_{GSS}$     | Gate body leakage current ( $V_{DS} = 0$ )       | $V_{GS} = \pm 30\text{ V}$                                                      |      |      | 100       | nA                             |
| $V_{GS(th)}$  | Gate threshold voltage                           | $V_{DS} = V_{GS}$ , $I_D = 250\ \mu\text{A}$                                    | 3    | 4    | 5         | V                              |
| $R_{DS(on)}$  | Static drain-source on resistance                | $V_{GS} = 10\text{ V}$ , $I_D = 5.5\text{ A}$                                   |      | 0.35 | 0.40      | $\Omega$                       |

1. Characteristic value at turn off on inductive load

**Table 6. Dynamic**

| Symbol                                        | Parameter                                                               | Test conditions                                                                                                      | Min. | Typ.                 | Max. | Unit                 |
|-----------------------------------------------|-------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|------|----------------------|------|----------------------|
| $g_{fs}^{(1)}$                                | Forward transconductance                                                | $V_{DS} > I_{D(on)} \times R_{DS(on)max}$ ,<br>$I_D = 7.5\text{ A}$                                                  | -    | 8                    | -    | S                    |
| $C_{iss}$<br>$C_{oss}$<br>$C_{rss}$           | Input capacitance<br>Output capacitance<br>Reverse transfer capacitance | $V_{DS} = 25\text{ V}$ , $f = 1\text{ MHz}$ ,<br>$V_{GS} = 0$                                                        | -    | 1630<br>750<br>30    | -    | pF<br>pF<br>pF       |
| $Q_g$<br>$Q_{gs}$<br>$Q_{gd}$                 | Total gate charge<br>Gate-source charge<br>Gate-drain charge            | $V_{DD} = 640\text{ V}$ , $I_D = 11\text{ A}$<br>$V_{GS} = 10\text{ V}$<br><i>Figure 10</i>                          | -    | 43.6<br>11.6<br>21   | -    | nC<br>nC<br>nC       |
| $R_g$                                         | Gate input resistance                                                   | $f = 1\text{ MHz}$ Gate DC Bias = 0<br>Test signal level = 20 mV<br>open drain                                       | -    | 2.7                  | -    | $\Omega$             |
| $t_{d(on)}$<br>$t_r$<br>$t_{d(off)}$<br>$t_f$ | Turn-on delay time<br>Rise time<br>Turn-off delay time<br>Fall time     | $V_{DD} = 400\text{ V}$ , $I_D = 5.5\text{ A}$ ,<br>$R_G = 4.7\ \Omega$ , $V_{GS} = 10\text{ V}$<br><i>Figure 17</i> | -    | 22<br>17<br>46<br>15 | -    | ns<br>ns<br>ns<br>ns |

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

Table 7. Source drain diode

| Symbol          | Parameter                     | Test conditions                                        | Min. | Typ.  | Max. | Unit          |
|-----------------|-------------------------------|--------------------------------------------------------|------|-------|------|---------------|
| $I_{SD}$        | Source-drain current          |                                                        | -    |       | 11   | A             |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) |                                                        | -    |       | 44   | A             |
| $V_{SD}^{(2)}$  | Forward on voltage            | $I_{SD}=11\text{ A}$ , $V_{GS}=0$                      | -    |       | 0.86 | V             |
| $t_{rr}$        | Reverse recovery time         | $I_{SD}=11\text{ A}$ ,                                 | -    | 612   |      | ns            |
| $Q_{rr}$        | Reverse recovery charge       | $di/dt = 100\text{ A}/\mu\text{s}$ ,                   | -    | 7.22  |      | $\mu\text{C}$ |
| $I_{RRM}$       | Reverse recovery current      | $V_{DD}=50\text{ V}$                                   | -    | 23.6  |      | A             |
| $t_{rr}$        | Reverse recovery time         | $I_{SD}=11\text{ A}$ ,                                 | -    | 970   |      | ns            |
| $Q_{rr}$        | Reverse recovery charge       | $di/dt = 100\text{ A}/\mu\text{s}$ ,                   | -    | 11.25 |      | $\mu\text{C}$ |
| $I_{RRM}$       | Reverse recovery current      | $V_{DD}=50\text{ V}$ , $T_j=150\text{ }^\circ\text{C}$ | -    | 23.2  |      | 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 for TO-220, D<sup>2</sup>PAK, TO-247

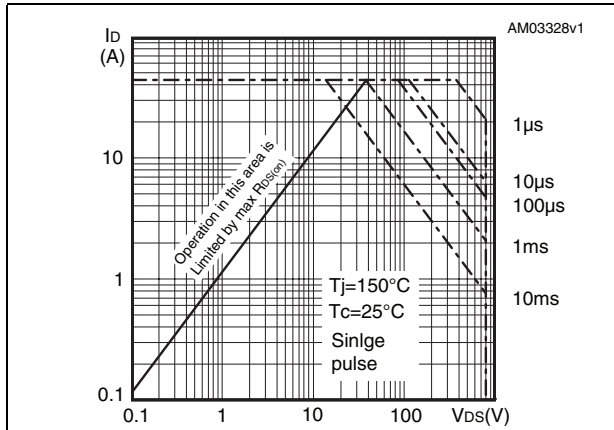


Figure 3. Thermal impedance for TO-220, D<sup>2</sup>PAK, TO-247

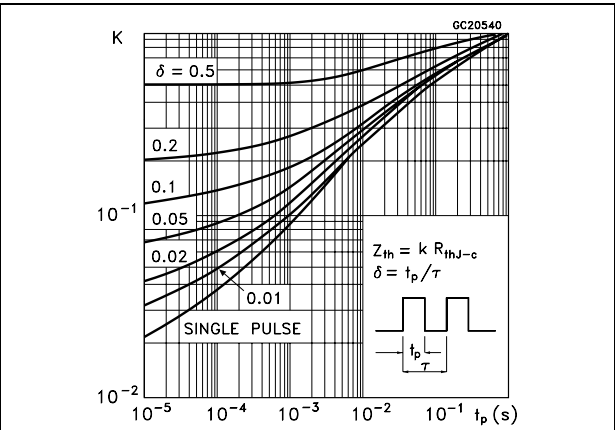


Figure 4. Safe operating area for TO-220FP

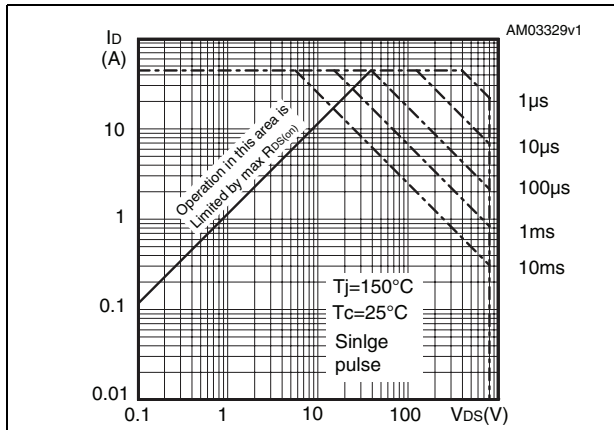


Figure 5. Thermal impedance for TO-220FP

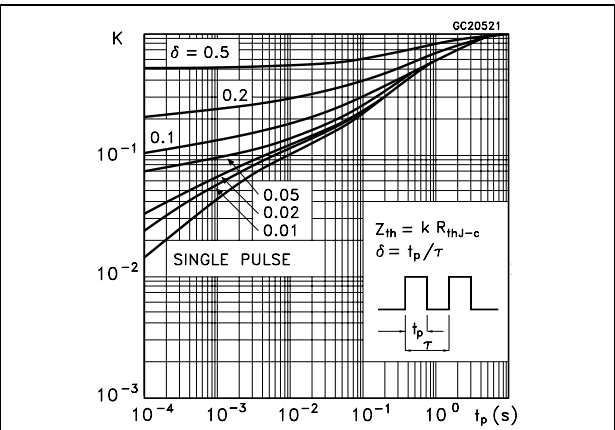


Figure 6. Output characteristics

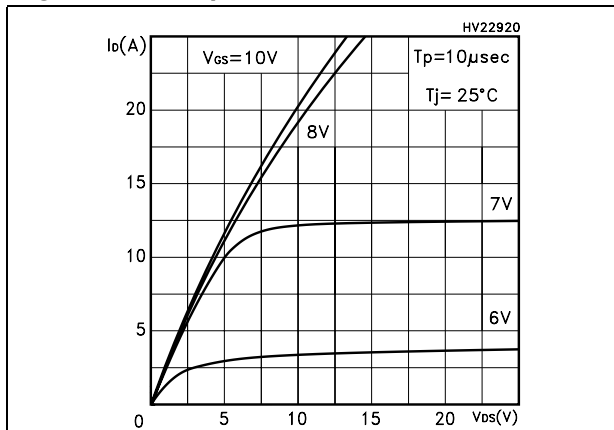


Figure 7. Output characteristics

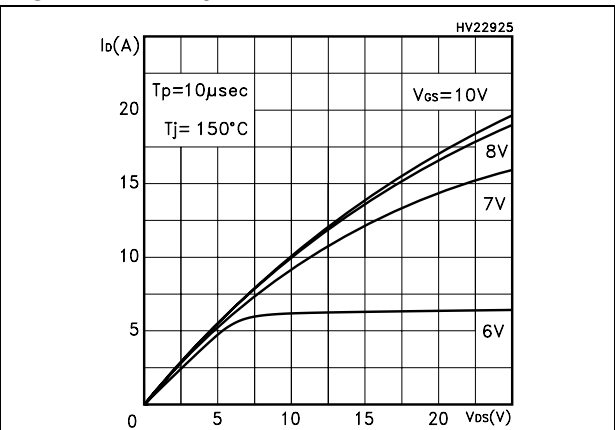


Figure 8. Transfer characteristics

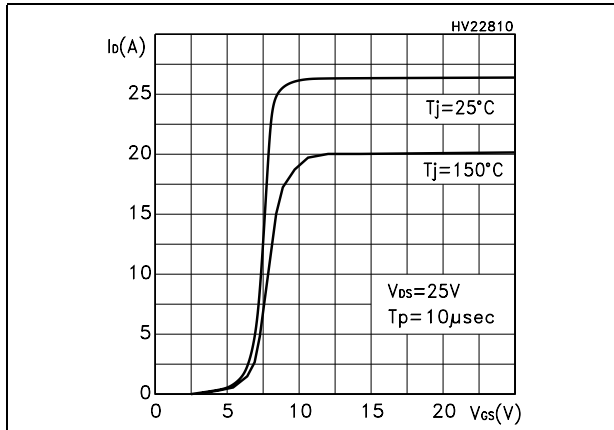


Figure 9. Transconductance

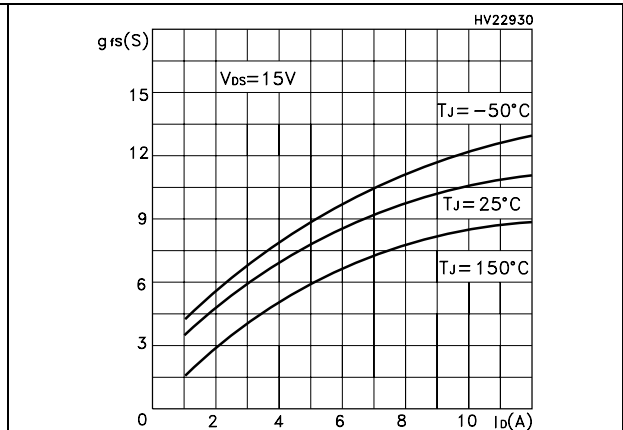


Figure 10. Gate charge vs gate-source voltage Figure 11. Capacitance variations

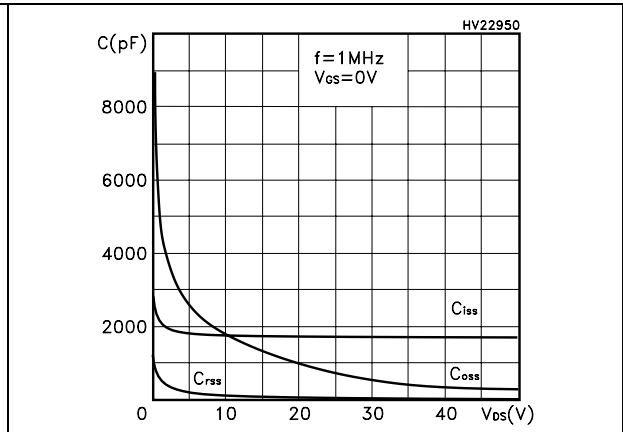
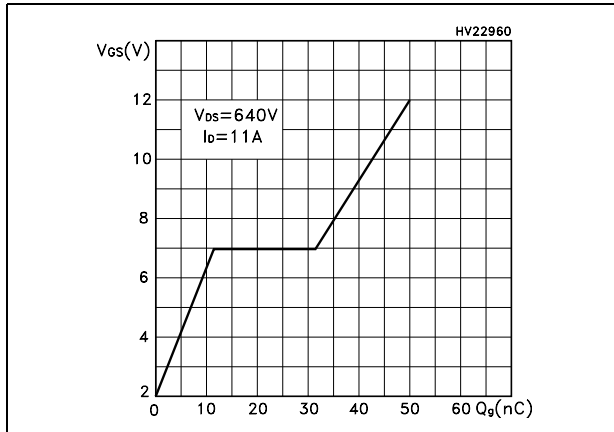


Figure 12. Normalized gate threshold voltage vs temperature Figure 13. Static drain-source on resistance vs temperature

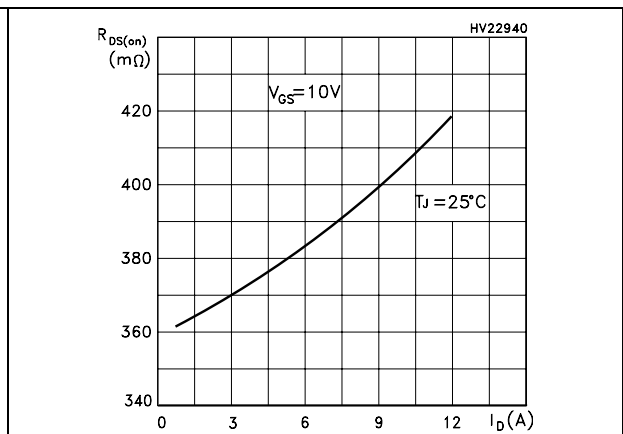
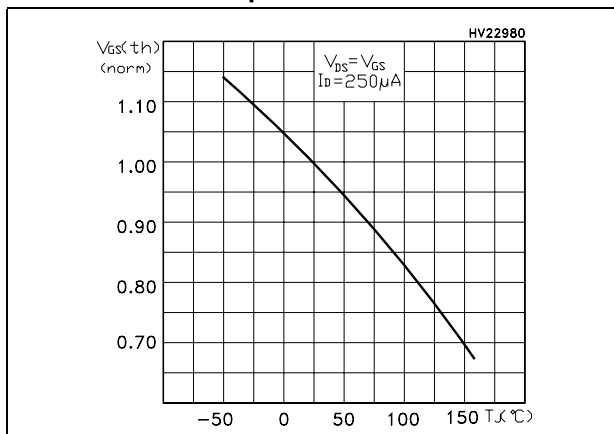


Figure 14. Source-drain diode forward characteristics

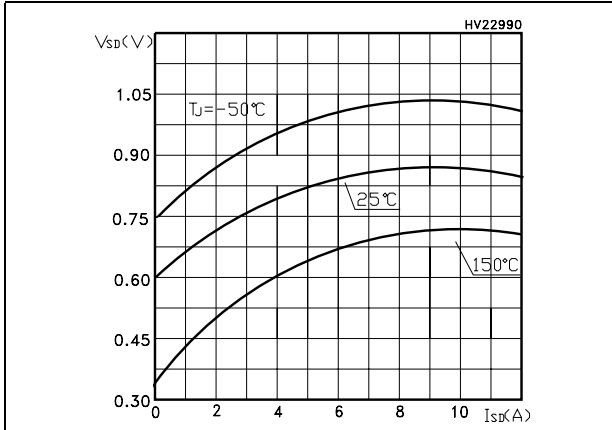


Figure 15. Normalized on resistance vs temperature

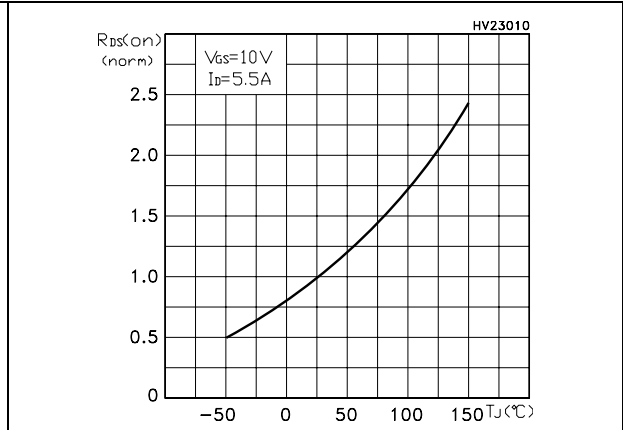
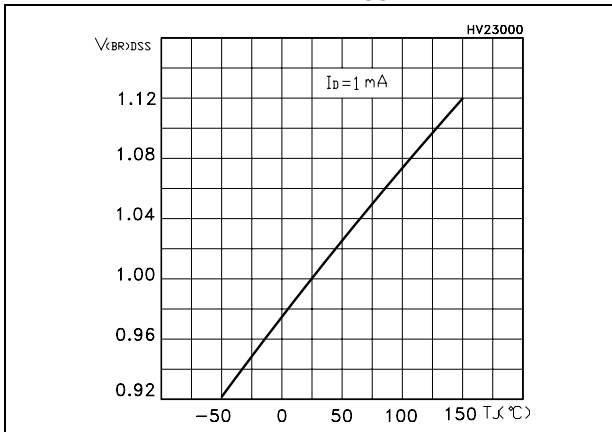


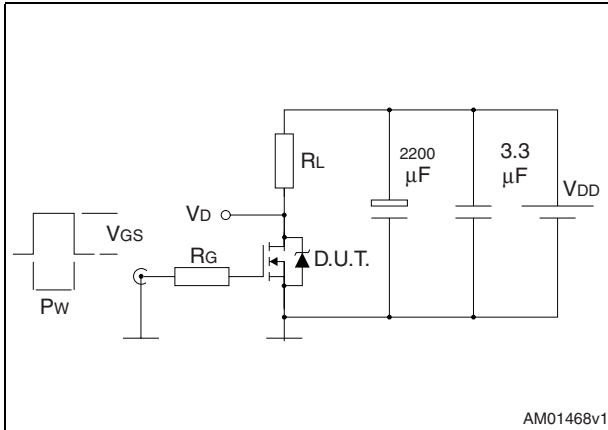
Figure 16. Normalized  $B_{V_{DSS}}$  vs temperature





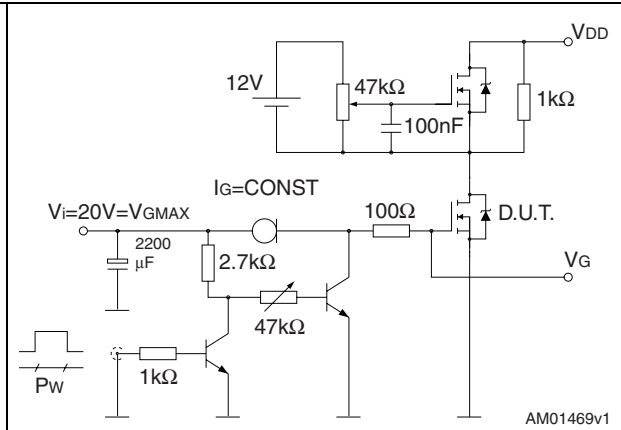
### 3 Test circuits

**Figure 17. Switching times test circuit for resistive load**



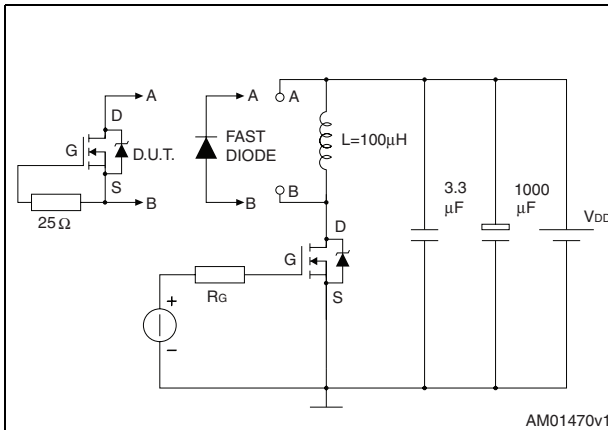
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**Figure 18. Gate charge test circuit**



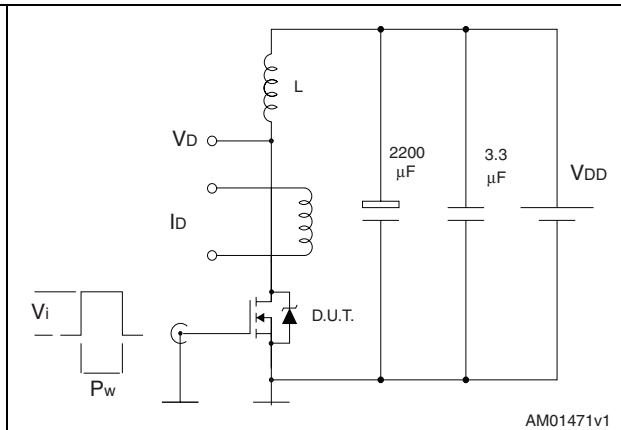
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**Figure 19. Test circuit for inductive load switching and diode recovery times**



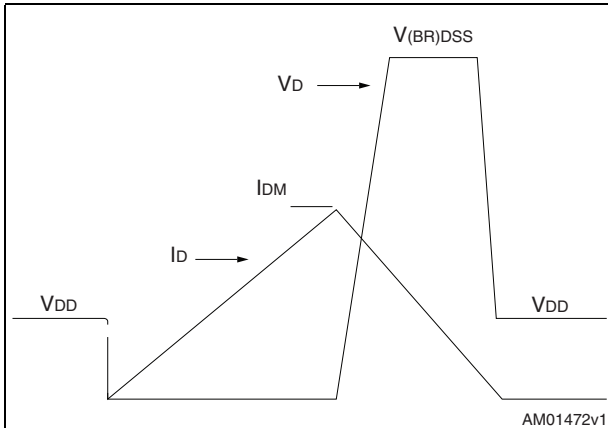
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**Figure 20. Unclamped inductive load test circuit**



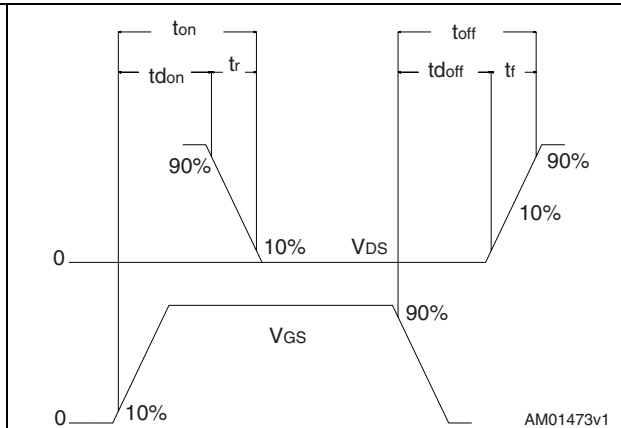
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**Figure 21. Unclamped inductive waveform**



AM01472v1

**Figure 22. Switching time waveform**



AM01473v1

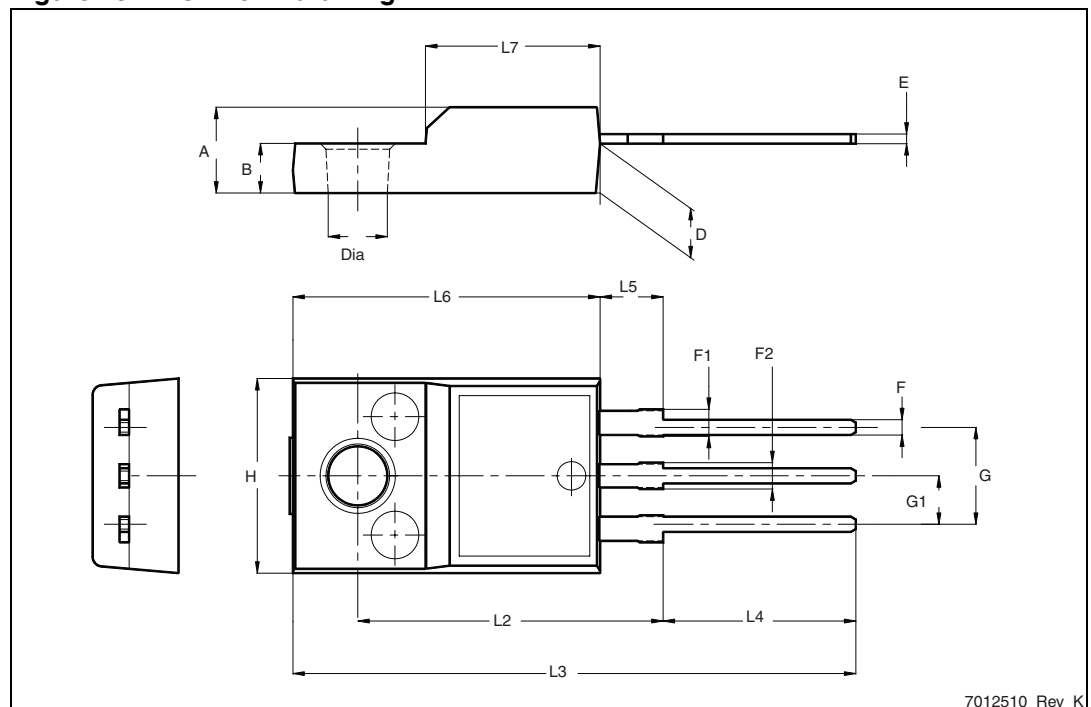
## 4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK<sup>®</sup> packages, depending on their level of environmental compliance. ECOPACK<sup>®</sup> 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  |

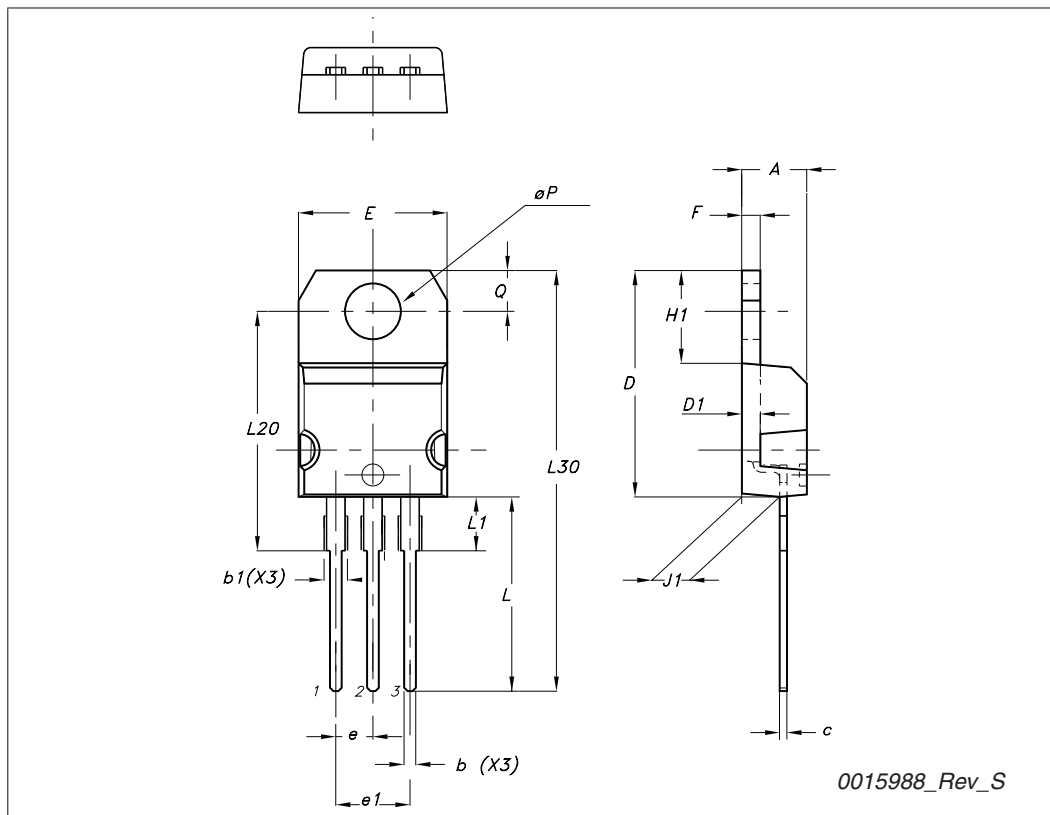
Figure 23. TO-220FP drawing



7012510\_Rev\_K

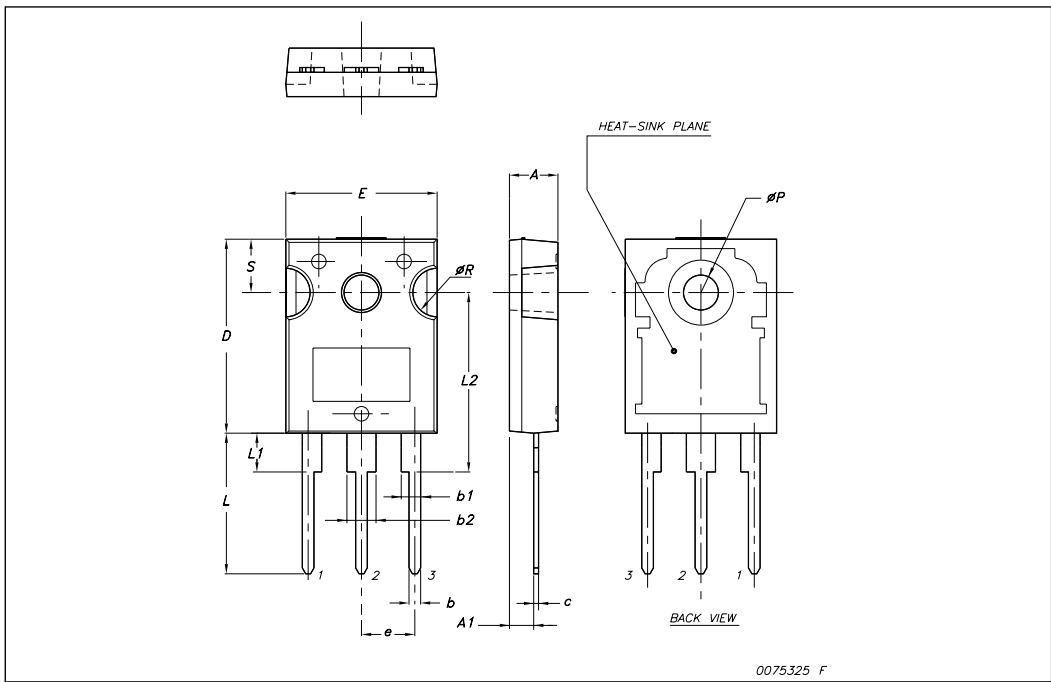
TO-220 type A mechanical data

| 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 |       |
| ∅P  | 3.75  |       | 3.85  |
| Q   | 2.65  |       | 2.95  |



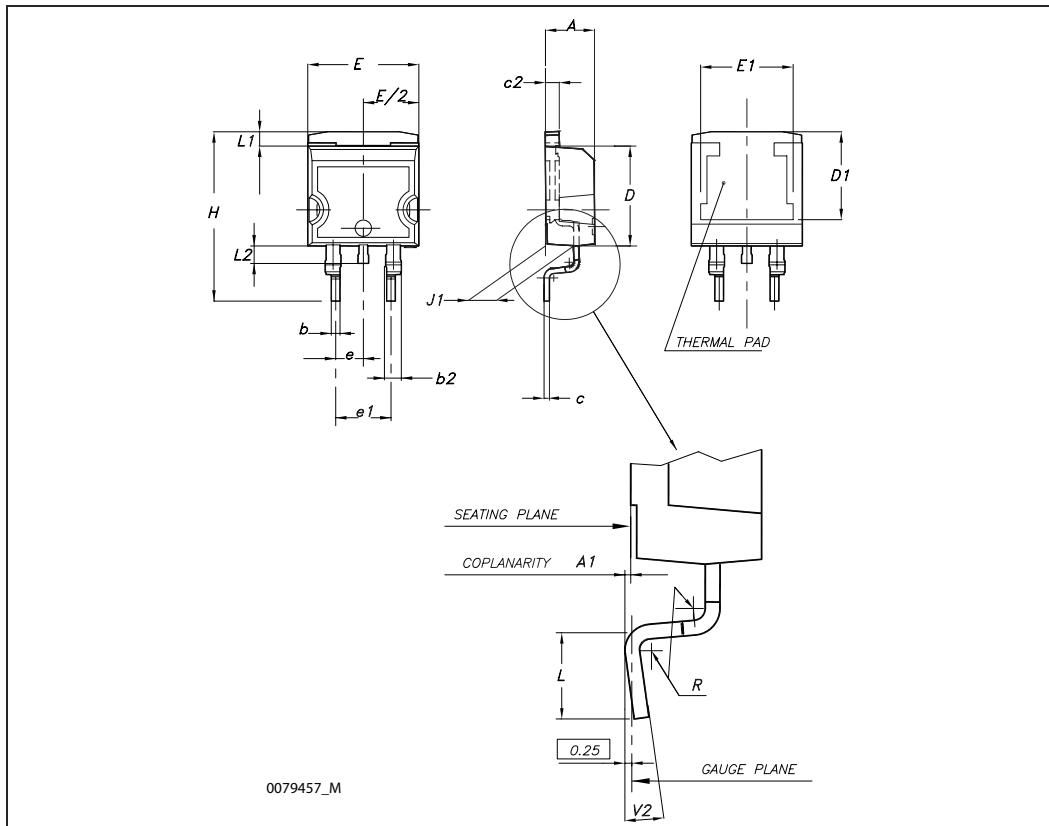
**TO-247 Mechanical data**

| 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  |       |



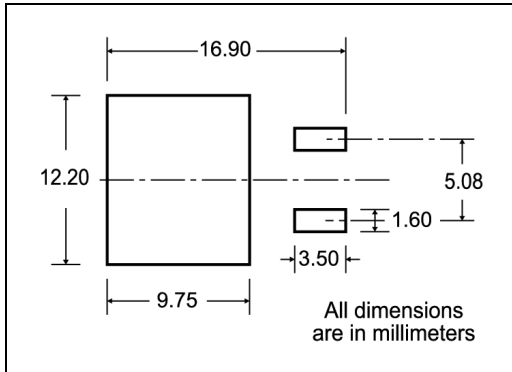
**D<sup>2</sup>PAK (TO-263) mechanical data**

| Dim | mm   |      |       | inch  |       |       |
|-----|------|------|-------|-------|-------|-------|
|     | Min  | Typ  | Max   | Min   | Typ   | Max   |
| A   | 4.40 |      | 4.60  | 0.173 |       | 0.181 |
| A1  | 0.03 |      | 0.23  | 0.001 |       | 0.009 |
| b   | 0.70 |      | 0.93  | 0.027 |       | 0.037 |
| b2  | 1.14 |      | 1.70  | 0.045 |       | 0.067 |
| c   | 0.45 |      | 0.60  | 0.017 |       | 0.024 |
| c2  | 1.23 |      | 1.36  | 0.048 |       | 0.053 |
| D   | 8.95 |      | 9.35  | 0.352 |       | 0.368 |
| D1  | 7.50 |      |       | 0.295 |       |       |
| E   | 10   |      | 10.40 | 0.394 |       | 0.409 |
| E1  | 8.50 |      |       | 0.334 |       |       |
| e   |      | 2.54 |       |       | 0.1   |       |
| e1  | 4.88 |      | 5.28  | 0.192 |       | 0.208 |
| H   | 15   |      | 15.85 | 0.590 |       | 0.624 |
| J1  | 2.49 |      | 2.69  | 0.099 |       | 0.106 |
| L   | 2.29 |      | 2.79  | 0.090 |       | 0.110 |
| L1  | 1.27 |      | 1.40  | 0.05  |       | 0.055 |
| L2  | 1.30 |      | 1.75  | 0.051 |       | 0.069 |
| R   |      | 0.4  |       |       | 0.016 |       |
| V2  | 0°   |      | 8°    | 0°    |       | 8°    |



# 5 Packaging mechanical data

## D<sup>2</sup>PAK FOOTPRINT



## TAPE AND REEL SHIPMENT

40 mm min. Access hole at slot location

Full radius

Tape slot in core for tape start 2.5mm min. width

### 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     |

### 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  |

10 pitches cumulative tolerance on tape +/- 0.2 mm

Center line of cavity

User Direction of Feed

TRL

FEED DIRECTION

Bending radius R min.

## 6 Revision history

**Table 9. Document revision history**

| Date        | Revision | Changes                                                                   |
|-------------|----------|---------------------------------------------------------------------------|
| 30-Sep-2004 | 4        | Preliminary version                                                       |
| 26-Nov-2005 | 5        | Complete version                                                          |
| 07-Apr-2006 | 6        | Modified value on <a href="#">Figure 8</a>                                |
| 15-May-2006 | 7        | New dv/dt value on <a href="#">Table 5</a>                                |
| 20-Jul-2006 | 8        | The document has been reformatted                                         |
| 20-Dec-2007 | 9        | Updated $I_D$ value on <a href="#">Table 2: Absolute maximum ratings</a>  |
| 24-Mar-2010 | 10       | Inserted dv/dt value in <a href="#">Table 2: Absolute maximum ratings</a> |



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