



# STB140N10F4, STF140N10F4 STP140N10F4

N-channel 100 V, 5.2 mΩ, 60 A TO-220, D<sup>2</sup>PAK, TO-220FP  
STripFET™ DeepGATE™ Power MOSFET

Preliminary Data

## Features

| Type        | V <sub>DSS</sub> | R <sub>DS(on)</sub> max | I <sub>D</sub> |
|-------------|------------------|-------------------------|----------------|
| STB140N10F4 | 100 V            | < 6.5 mΩ                | 140 A          |
| STF140N10F4 | 100 V            | < 6.5 mΩ                | 55 A           |
| STP140N10F4 | 100 V            | < 6.5 mΩ                | 140 A          |

- Exceptional dv/dt capability
- Extremely low on-resistance R<sub>DS(on)</sub>
- 100% avalanche tested

## Application

- Switching applications

## Description

This Power MOSFET is among the latest developments that use an advanced technology (STripFET™ DeepGATE™ technology), which has been especially tailored to minimize on-state resistance, provide superior switching performance and withstand high energy pulse in avalanche and commutation mode. 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.

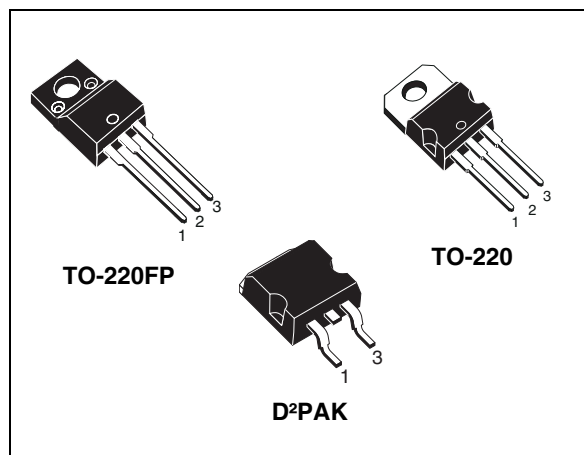


Figure 1. Internal schematic diagram

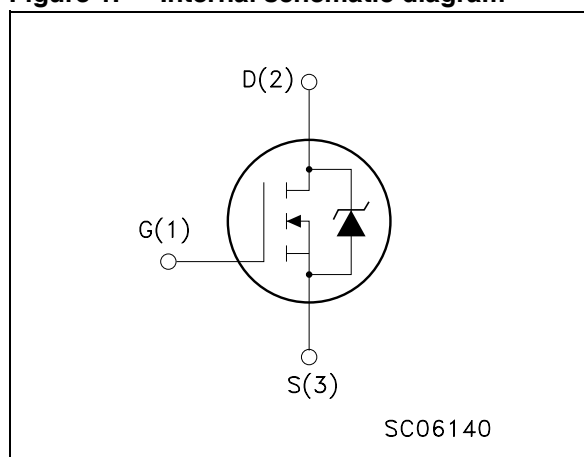


Table 1. Device summary

| Order codes | Marking  | Package            | Packaging     |
|-------------|----------|--------------------|---------------|
| STB140N10F4 | 140N10F4 | D <sup>2</sup> PAK | Tape and reel |
| STF140N10F4 | 140N10F4 | TO-220FP           | Tube          |
| STP140N10F4 | 140N10F4 | TO-220             | Tube          |

## Contents

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol         | Parameter                                                         | Value                      |          | Unit                  |
|----------------|-------------------------------------------------------------------|----------------------------|----------|-----------------------|
|                |                                                                   | TO-220, 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 $T_C = 25\text{ }^{\circ}\text{C}$  | 140                        | 55       | A                     |
| $I_D$          | Drain current (continuous) at $T_C = 100\text{ }^{\circ}\text{C}$ | 100                        | 38       | A                     |
| $I_{DM}^{(1)}$ | Drain current (pulsed)                                            | 560                        | 220      | A                     |
| $P_{TOT}$      | Total dissipation at $T_C = 25\text{ }^{\circ}\text{C}$           | 300                        | 48       | W                     |
|                | Derating factor                                                   | 2                          | 0.32     | W/ $^{\circ}\text{C}$ |
| $E_{AS}^{(2)}$ | Single pulse avalanche energy                                     | TBD                        |          | mJ                    |
| $T_{stg}$      | Storage temperature                                               | – 55 to 175                |          | $^{\circ}\text{C}$    |
| $T_j$          | Max. operating junction temperature                               |                            |          |                       |

1. Pulse width limited by safe operating area

2. Starting  $T_j = 25\text{ }^{\circ}\text{C}$ ,  $I_D = 32.5\text{ A}$ ,  $V_{DD} = 45\text{ V}$

**Table 3. Thermal data**

| Symbol         | Parameter                                      | Value   |                    |          | Unit                 |
|----------------|------------------------------------------------|---------|--------------------|----------|----------------------|
|                |                                                | TO-220, | D <sup>2</sup> PAK | TO-220FP |                      |
| $R_{thj-case}$ | Thermal resistance junction-case max           | 0.5     |                    | 3.1      | $^{\circ}\text{C/W}$ |
| $R_{thj-pcb}$  | Thermal resistance junction-pcb max            | --      | 35 <sup>(1)</sup>  | --       |                      |
| $R_{thj-a}$    | Thermal resistance junction-ambient max        | 62.5    | --                 | 62.5     | $^{\circ}\text{C/W}$ |
| $T_l$          | Maximum lead temperature for soldering purpose | 300     | --                 | 300      | $^{\circ}\text{C}$   |

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

## 2 Electrical characteristics

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

**Table 4. On/off states**

| Symbol        | Parameter                                        | Test conditions                                                                            | Min. | Typ. | Max.     | Unit                           |
|---------------|--------------------------------------------------|--------------------------------------------------------------------------------------------|------|------|----------|--------------------------------|
| $V_{(BR)DSS}$ | Drain-source Breakdown voltage                   | $I_D = 250\ \mu\text{A}$ , $V_{GS} = 0$                                                    | 100  |      |          | V                              |
| $I_{DSS}$     | Zero gate voltage Drain current ( $V_{GS} = 0$ ) | $V_{DS} = \text{max rating}$<br>$V_{DS} = \text{max rating}$ , $T_C = 125^{\circ}\text{C}$ |      |      | 1<br>100 | $\mu\text{A}$<br>$\mu\text{A}$ |
| $I_{GSS}$     | 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                | $V_{GS} = 10\ \text{V}$ , $I_D = 30\ \text{A}$                                             |      | 5.2  | 6.5      | $\text{m}\Omega$               |

**Table 5. Dynamic**

| Symbol    | Parameter                    | Test conditions                                                                               | Min. | Typ. | Max. | Unit |
|-----------|------------------------------|-----------------------------------------------------------------------------------------------|------|------|------|------|
| $C_{iss}$ | Input capacitance            | $V_{DS} = 25\ \text{V}$ , $f = 1\ \text{MHz}$ ,<br>$V_{GS} = 0$                               |      | 8980 |      | pF   |
| $C_{oss}$ | Output capacitance           |                                                                                               |      | 750  |      | pF   |
| $C_{rss}$ | Reverse transfer capacitance |                                                                                               |      | 300  |      | pF   |
| $Q_g$     | Total gate charge            | $V_{DD} = 80\ \text{V}$ , $I_D = 60\ \text{A}$ ,<br>$V_{GS} = 10\ \text{V}$<br>(see Figure 3) |      | 140  |      | nC   |
| $Q_{gs}$  | Gate-source charge           |                                                                                               |      | TBD  |      | nC   |
| $Q_{gd}$  | Gate-drain charge            |                                                                                               |      | TBD  |      | nC   |

**Table 6. Switching times**

| Symbol                | Parameter                        | Test conditions                                                                                                     | Min. | Typ.       | Max. | Unit     |
|-----------------------|----------------------------------|---------------------------------------------------------------------------------------------------------------------|------|------------|------|----------|
| $t_{d(on)}$<br>$t_r$  | Turn-on delay time<br>Rise time  | $V_{DD} = 50\ \text{V}$ , $I_D = 30\ \text{A}$<br>$R_G = 4.7\ \Omega$ , $V_{GS} = 10\ \text{V}$<br>(see Figure 2)   |      | TBD<br>TBD |      | ns<br>ns |
| $t_{d(off)}$<br>$t_f$ | Turn-off-delay time<br>Fall time | $V_{DD} = 50\ \text{V}$ , $I_D = 30\ \text{A}$ ,<br>$R_G = 4.7\ \Omega$ , $V_{GS} = 10\ \text{V}$<br>(see Figure 2) |      | TBD<br>TBD |      | ns<br>ns |

Table 7. Source drain diode

| Symbol                            | Parameter                                                                    |              | Test conditions                                                                                                                                  | Min. | Typ.              | Max | Unit          |
|-----------------------------------|------------------------------------------------------------------------------|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------|------|-------------------|-----|---------------|
| $I_{SD}$                          | Source-drain current                                                         | TO-220, DPAK |                                                                                                                                                  |      |                   | 140 | A             |
|                                   |                                                                              | TO-220FP     |                                                                                                                                                  |      |                   | 55  | A             |
| $I_{SDM}^{(1)}$                   | Source-drain current (pulsed)                                                | TO-220, DPAK |                                                                                                                                                  |      |                   | 560 | A             |
|                                   |                                                                              | TO-220FP     |                                                                                                                                                  |      |                   | 220 | A             |
| $V_{SD}^{(2)}$                    | Forward on voltage                                                           |              | $I_{SD} = 60\text{ A}$ , $V_{GS} = 0$                                                                                                            |      |                   | TBD | V             |
| $t_{rr}$<br>$Q_{rr}$<br>$I_{RRM}$ | Reverse recovery time<br>Reverse recovery charge<br>Reverse recovery current |              | $I_{SD} = 60\text{ A}$ , $V_{DD} = 25\text{ V}$<br>$di/dt = 100\text{ A}/\mu\text{s}$ ,<br>$T_j = 150\text{ }^{\circ}\text{C}$<br>(see Figure 4) |      | TBD<br>TBD<br>TBD |     | ns<br>nC<br>A |

1. Pulse width limited by safe operating area.

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

## Test circuit

## 3 Test circuit

Figure 2. Switching times test circuit for resistive load

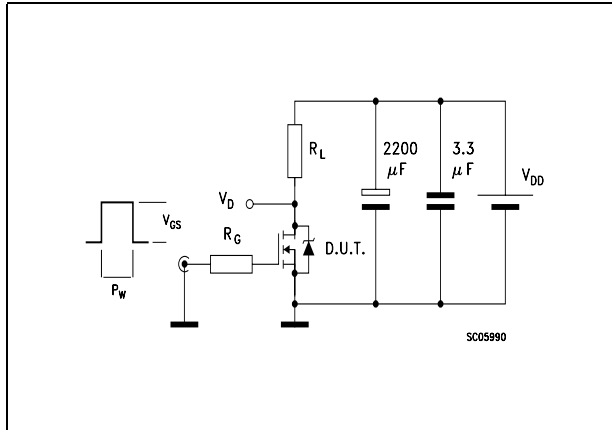


Figure 3. Gate charge test circuit

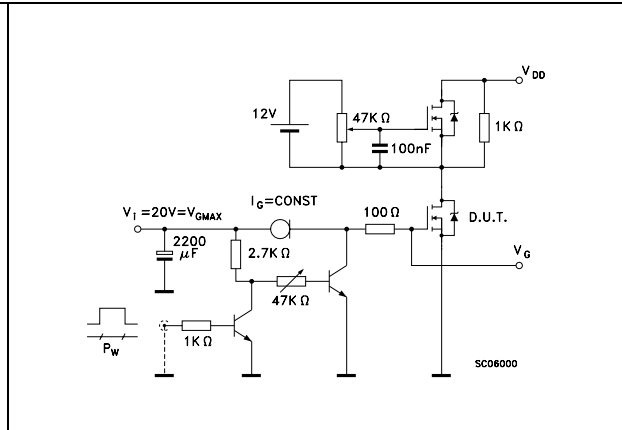


Figure 4. Test circuit for inductive load switching and diode recovery times

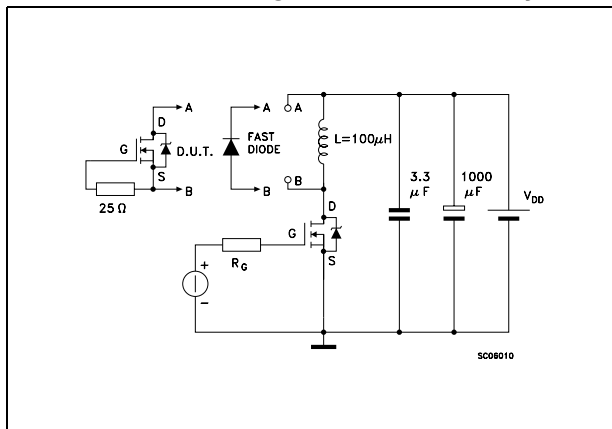


Figure 5. Unclamped inductive load test circuit

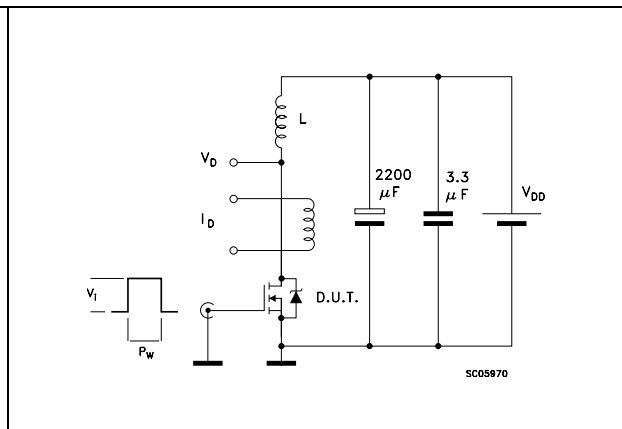


Figure 6. Unclamped inductive waveform

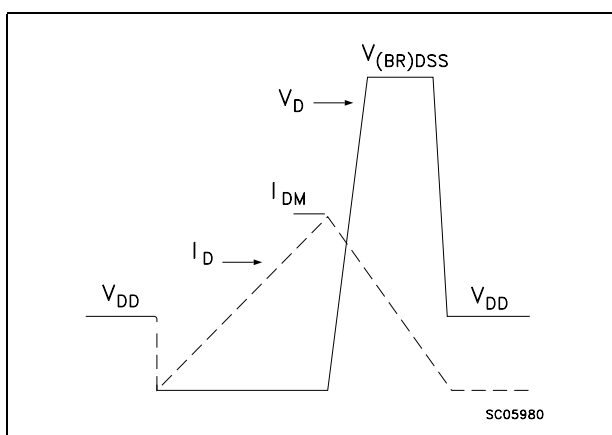
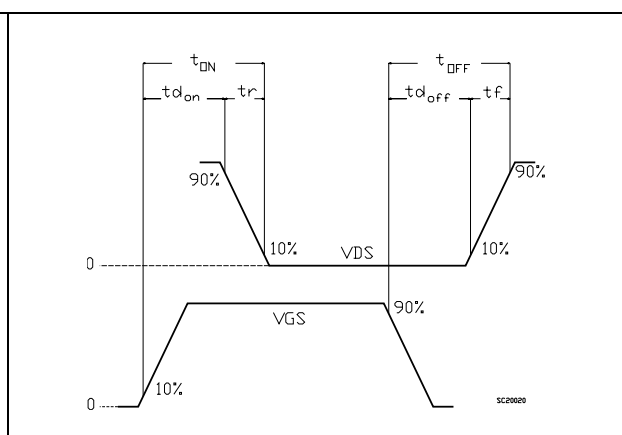


Figure 7. Switching time waveform

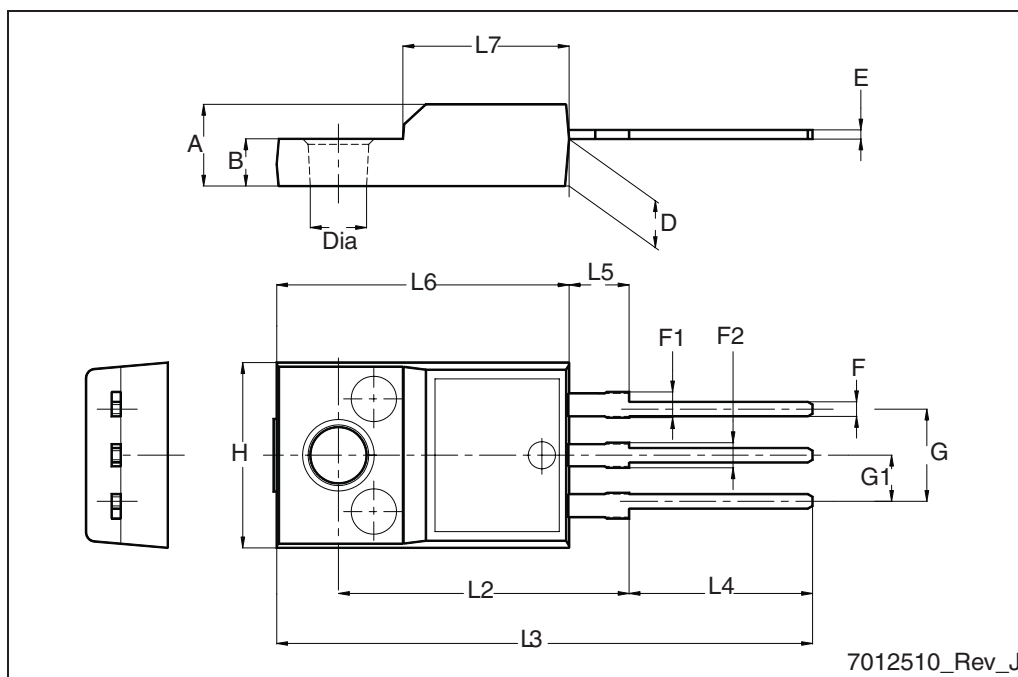


## 4 Package mechanical data

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.

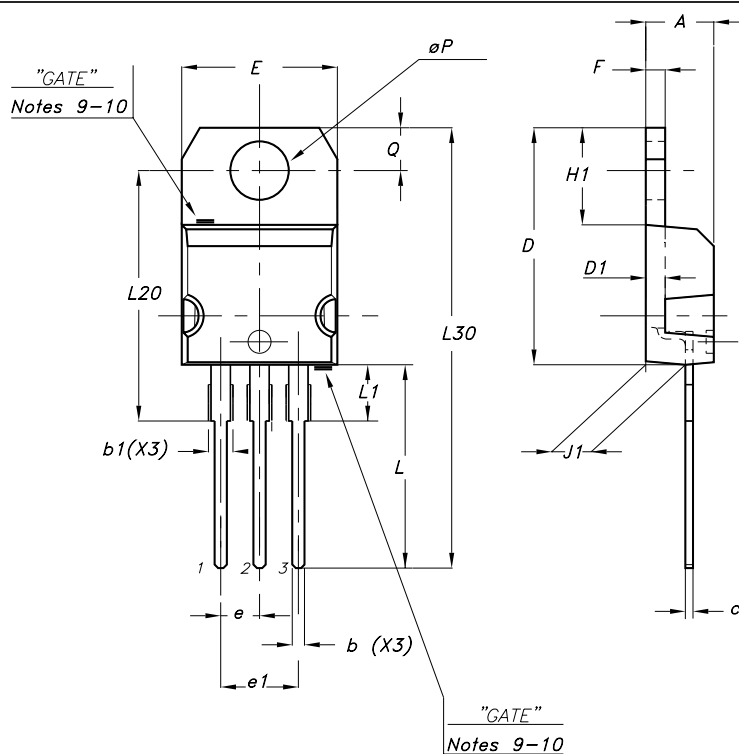
## TO-220FP mechanical data

| 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

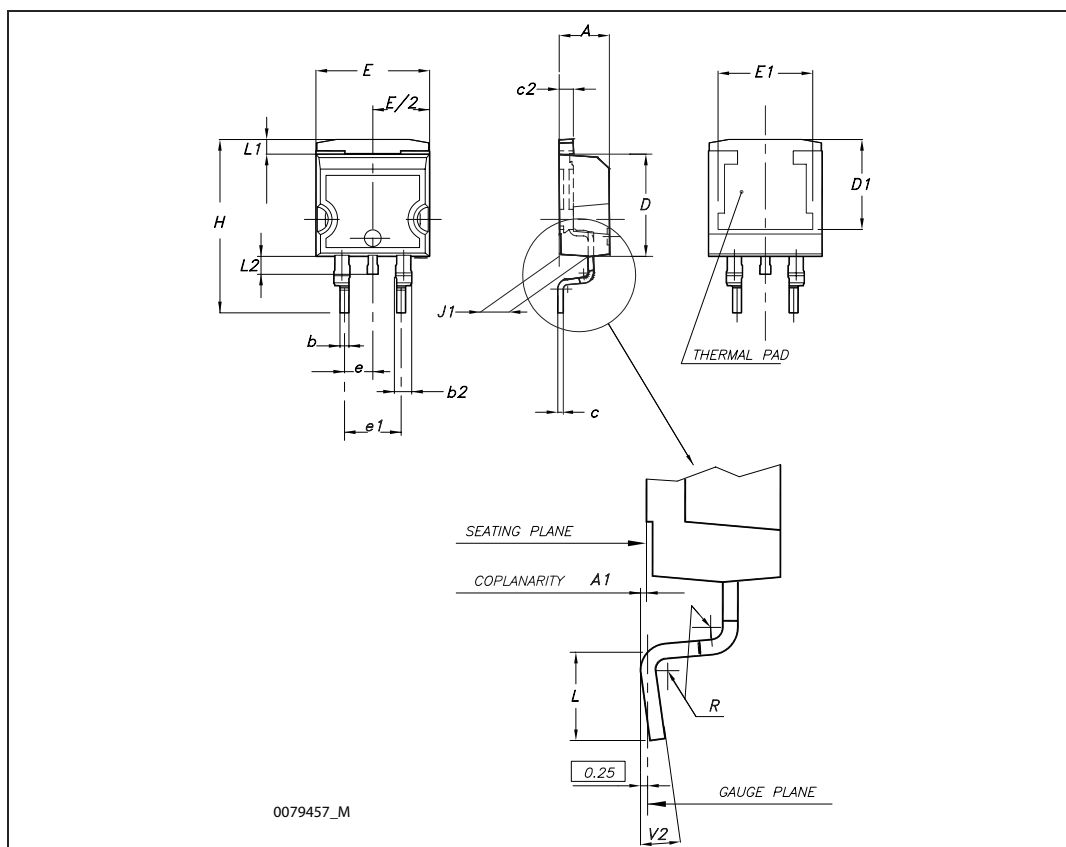
| Dim | mm    |       |       | inch  |       |       |
|-----|-------|-------|-------|-------|-------|-------|
|     | Min   | Typ   | Max   | Min   | Typ   | Max   |
| A   | 4.40  |       | 4.60  | 0.173 |       | 0.181 |
| b   | 0.61  |       | 0.88  | 0.024 |       | 0.034 |
| b1  | 1.14  |       | 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 |       |
| ØP  | 3.75  |       | 3.85  | 0.147 |       | 0.151 |
| Q   | 2.65  |       | 2.95  | 0.104 |       | 0.116 |



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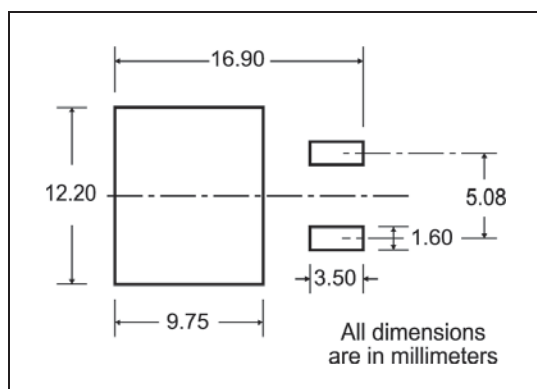
D<sup>2</sup>PAK (TO-263) mechanical data

| 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°    |

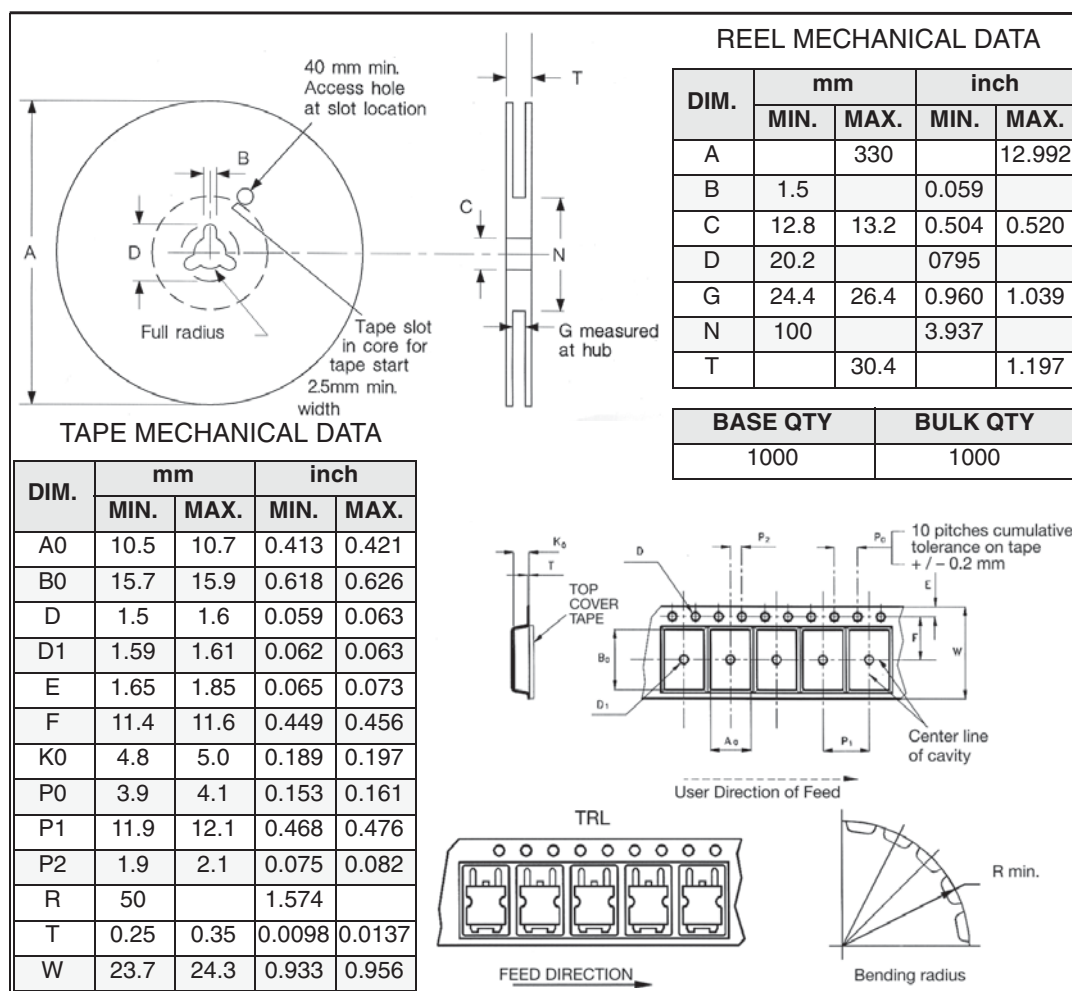


## 5 Packaging mechanical data

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



### TAPE AND REEL SHIPMENT



## 6 Revision history

**Table 8. Document revision history**

| Date        | Revision | Changes       |
|-------------|----------|---------------|
| 12-Jan-2008 | 1        | First release |

**STB140N10F4, STF140N10F4, STP140N10F4**

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