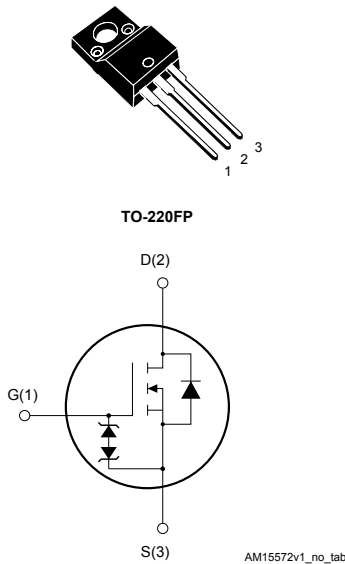


## N-channel 1000 V, 5.4 $\Omega$ typ., 2.5 A SuperMESH Power MOSFET in a TO-220FP package



### Features

| Order code | $V_{DS}$ | $R_{DS(on)}$ max. | $I_D$ |
|------------|----------|-------------------|-------|
| STF3NK100Z | 1000 V   | 6.0 $\Omega$      | 2.5 A |

- 100% avalanche tested
- Gate charge minimized
- Very low intrinsic capacitance
- Zener-protected

### Applications

- Switching applications

### Description

This high-voltage device is a Zener-protected N-channel Power MOSFET developed using the SuperMESH technology by STMicroelectronics, an optimization of the well-established PowerMESH. In addition to a significant reduction in on-resistance, this device is designed to ensure a high level of dv/dt capability for the most demanding applications.



#### Product status link

[STF3NK100Z](#)

#### Product summary

|                   |            |
|-------------------|------------|
| <b>Order code</b> | STF3NK100Z |
| <b>Marking</b>    | F3NK100Z   |
| <b>Package</b>    | TO-220FP   |
| <b>Packing</b>    | Tube       |

# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

| Symbol            | Parameter   | Value      | Unit |
|-------------------|---|------------|------|
| $V_{DS}$          | Drain-source voltage  | 1000       | V    |
| $V_{GS}$          | Gate-source voltage   | ±30        | V    |
| $I_D^{(1)}$       | Drain current (continuous) at $T_C = 25\text{ °C}$  | 2.5        | A    |
|                   | Drain current (continuous) at $T_C = 100\text{ °C}$   | 1.57       |      |
| $I_{DM}^{(1)(2)}$ | Drain current (pulsed)  | 10         | A    |
| $P_{TOT}$         | Total power dissipation at $T_C = 25\text{ °C}$   | 25         | W    |
| ESD               | Gate-source, human body model ( $R = 1.5\text{ k}\Omega$ , $C = 100\text{ pF}$ )  | 3          | kV   |
| $dv/dt^{(3)}$     | Peak diode recovery voltage slope   | 4.5        | V/ns |
| $V_{ISO}$         | Insulation withstand voltage (RMS) from all three leads to external heat sink ( $t = 1\text{ s}$ , $T_C = 25\text{ °C}$ ) | 2.5        | kV   |
| $T_{stg}$         | Storage temperature range   | -55 to 150 | °C   |
| $T_J$             | Operating junction temperature range  |            | °C   |

1. This value is limited by maximum junction temperature.
2. Pulse width limited by safe operating area.
3.  $I_{SD} \leq 2.5\text{ A}$ ,  $di/dt \leq 200\text{ A}/\mu\text{s}$ ,  $V_{DD} = 80\%V_{(BR)DSS}$ .

**Table 2. Thermal data**

| Symbol     | Parameter                               | Value | Unit |
|------------|---|-------|------|
| $R_{thJC}$ | Thermal resistance, junction-to-case    | 5     | °C/W |
| $R_{thJA}$ | Thermal resistance, junction-to-ambient | 62.5  | °C/W |

**Table 3. Avalanche characteristics**

| Symbol   | Parameter  | Value | Unit |
|----------|--|-------|------|
| $I_{AR}$ | Avalanche current, repetitive or not repetitive (pulse width is limited by $T_J$ max.)                   | 2.5   | A    |
| $E_{AS}$ | Single pulse avalanche energy (starting $T_J = 25\text{ °C}$ , $I_D = I_{AR}$ , $V_{DD} = 50\text{ V}$ ) | 110   | mJ   |

## 2 Electrical characteristics

$T_C = 25\text{ }^\circ\text{C}$  unless otherwise specified.

**Table 4. On/off states**

| Symbol        | Parameter                         | Test conditions  | Min. | Typ. | Max.     | Unit          |
|---------------|-----------------------------------|--|------|------|----------|---------------|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage    | $V_{GS} = 0\text{ V}$ , $I_D = 1\text{ mA}$  | 1000 |      |          | V             |
| $I_{DSS}$     | Zero gate voltage drain current   | $V_{GS} = 0\text{ V}$ , $V_{DS} = 1000\text{ V}$   |      |      | 1        | $\mu\text{A}$ |
|               |                                   | $V_{GS} = 0\text{ V}$ , $V_{DS} = 1000\text{ V}$ , $T_C = 125\text{ }^\circ\text{C}^{(1)}$ |      |      | 50       |               |
| $I_{GSS}$     | Gate-body leakage current         | $V_{DS} = 0\text{ V}$ , $V_{GS} = \pm 30\text{ V}$   |      |      | $\pm 10$ | $\mu\text{A}$ |
| $V_{GS(th)}$  | Gate threshold voltage            | $V_{DS} = V_{GS}$ , $I_D = 50\text{ }\mu\text{A}$  | 3.00 | 3.75 | 4.50     | V             |
| $R_{DS(on)}$  | Static drain-source on resistance | $V_{GS} = 10\text{ V}$ , $I_D = 1.25\text{ A}$   |      | 5.4  | 6.0      | $\Omega$      |

1. Specified by design, not tested in production.

**Table 5. Dynamic**

| Symbol                     | Parameter                     | Test conditions  | Min. | Typ. | Max. | Unit     |
|----------------------------|-------------------------------|--|------|------|------|----------|
| $C_{iss}$                  | Input capacitance             | $V_{DS} = 25\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0\text{ V}$  | -    | 601  | -    | pF       |
| $C_{oss}$                  | Output capacitance            |  | -    | 53   | -    | pF       |
| $C_{rss}$                  | Reverse transfer capacitance  |  | -    | 12   | -    | pF       |
| $C_{oss\text{ eq.}}^{(1)}$ | Equivalent output capacitance | $V_{GS} = 0\text{ V}$ , $V_{DS} = 0\text{ V to } 800\text{ V}$   | -    | 15   | -    | pF       |
| $R_G$                      | Gate input resistance         | $f = 1\text{ MHz}$ , open drain  | -    | 8.6  | -    | $\Omega$ |
| $Q_g$                      | Total gate charge             | $V_{DD} = 800\text{ V}$ , $I_D = 2.5\text{ A}$ , $V_{GS} = 0\text{ to } 10\text{ V}$<br>(see Figure 14. Test circuit for gate charge behavior) | -    | 18   | -    | nC       |
| $Q_{gs}$                   | Gate-source charge            |  | -    | 3.6  | -    | nC       |
| $Q_{gd}$                   | Gate-drain charge             |  | -    | 9.2  | -    | nC       |

1.  $C_{oss\text{ eq.}}$  is defined as a constant equivalent capacitance giving the same charging time as  $C_{oss}$  when  $V_{DS}$  increases from 0 to 80%  $V_{DSS}$ .

**Table 6. Switching times**

| Symbol       | Parameter           | Test conditions   | Min. | Typ. | Max. | Unit |
|--------------|---------------------|---|------|------|------|------|
| $t_{d(on)}$  | Turn-on delay time  | $V_{DD} = 500\text{ V}$ , $I_D = 1.25\text{ A}$ ,<br>$R_G = 4.7\text{ }\Omega$ , $V_{GS} = 10\text{ V}$ | -    | 15   | -    | ns   |
| $t_r$        | Rise time           |   | -    | 7.5  | -    | ns   |
| $t_{d(off)}$ | Turn-off delay time | (see Figure 13. Test circuit for resistive load switching times and Figure 18. Switching time waveform) | -    | 39   | -    | ns   |
| $t_f$        | Fall time           |   | -    | 32   | -    | ns   |

**Table 7. Source-drain diode**

| Symbol          | Parameter                     | Test conditions   | Min. | Typ. | Max. | Unit          |
|-----------------|-------------------------------|---|------|------|------|---------------|
| $I_{SD}^{(1)}$  | Source-drain current          |   | -    |      | 2.5  | A             |
| $I_{SDM}^{(2)}$ | Source-drain current (pulsed) |   | -    |      | 10   | A             |
| $V_{SD}^{(3)}$  | Forward on voltage            | $I_{SD} = 2.5 \text{ A}$ , $V_{GS} = 0 \text{ V}$                                   | -    |      | 1.6  | V             |
| $t_{rr}$        | Reverse recovery time         | $I_{SD} = 2.5 \text{ A}$ , $di/dt = 100 \text{ A}/\mu\text{s}$                      | -    | 584  |      | ns            |
| $Q_{rr}$        | Reverse recovery charge       | $V_{DD} = 100 \text{ V}$  | -    | 2.3  |      | $\mu\text{C}$ |
| $I_{RRM}$       | Reverse recovery current      | (see Figure 15. Test circuit for inductive load switching and diode recovery times) | -    | 8    |      | A             |
| $t_{rr}$        | Reverse recovery time         | $I_{SD} = 2.5 \text{ A}$ , $di/dt = 100 \text{ A}/\mu\text{s}$                      | -    | 628  |      | ns            |
| $Q_{rr}$        | Reverse recovery charge       | $V_{DD} = 100 \text{ V}$ , $T_J = 150 \text{ }^\circ\text{C}$                       | -    | 2.5  |      | $\mu\text{C}$ |
| $I_{RRM}$       | Reverse recovery current      | (see Figure 15. Test circuit for inductive load switching and diode recovery times) | -    | 8.1  |      | A             |

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

## 2.1 Electrical characteristics (curves)

Figure 1. Safe operating area

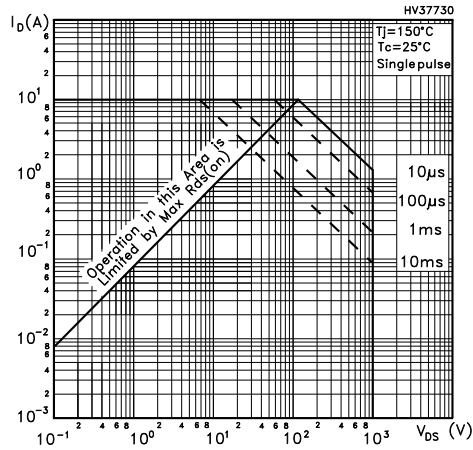


Figure 2. Thermal impedance

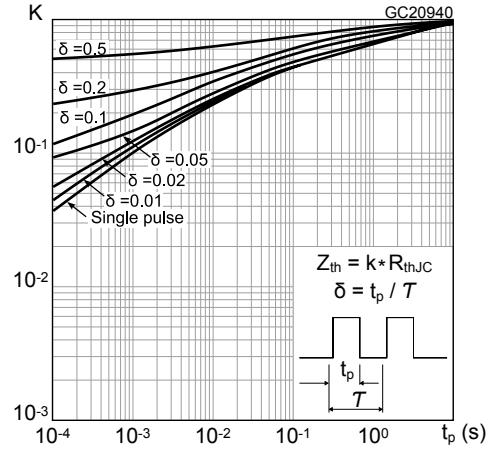


Figure 3. Output characteristics

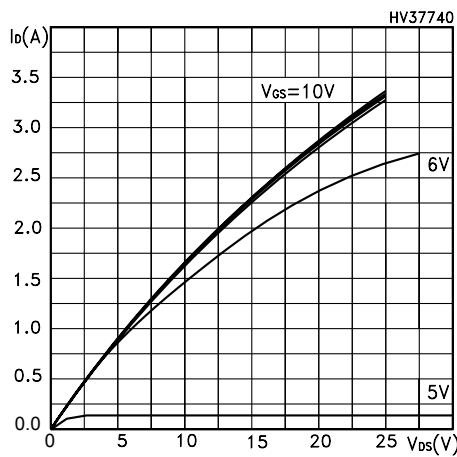


Figure 4. Transfer characteristics

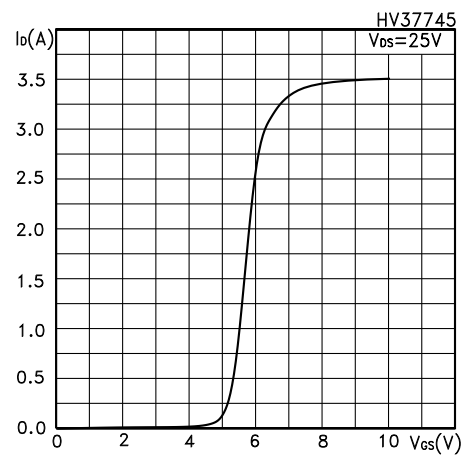


Figure 5. Normalized  $V_{(BR)DSS}$  vs temperature

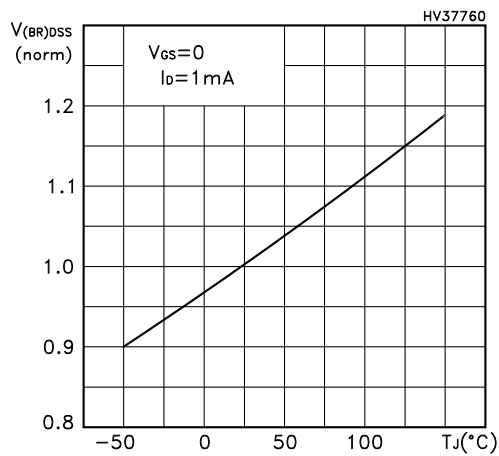
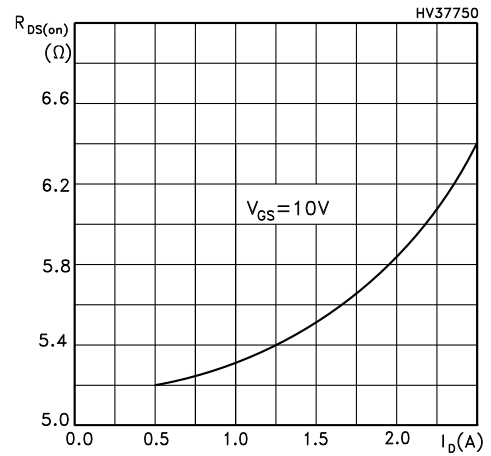
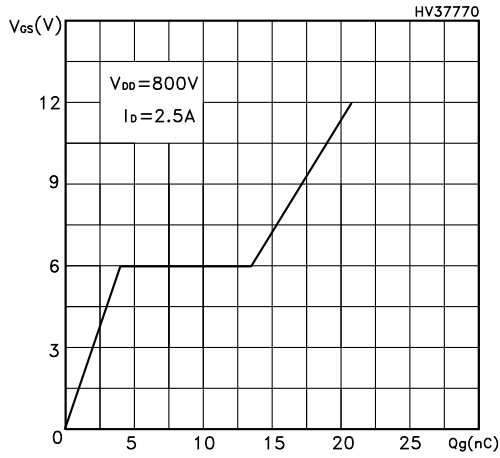


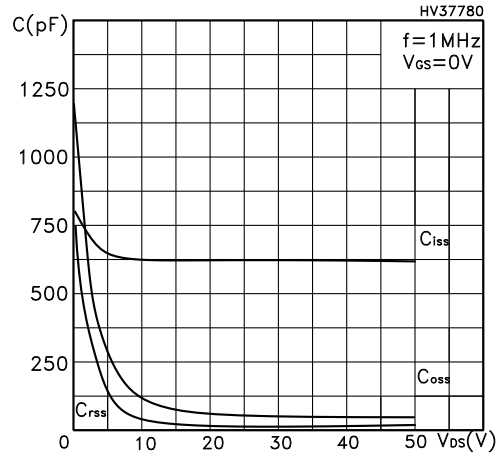
Figure 6. Static drain-source on resistance



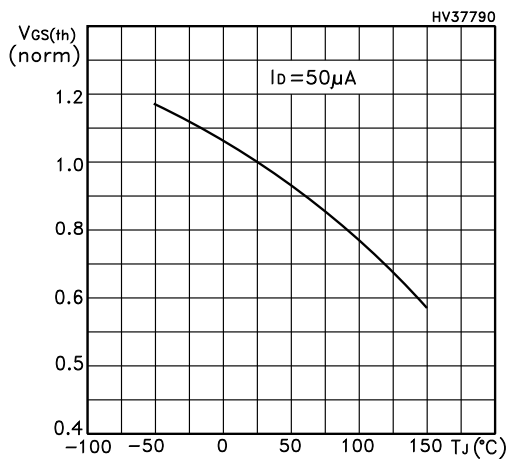
**Figure 7. Gate charge vs gate-source voltage**



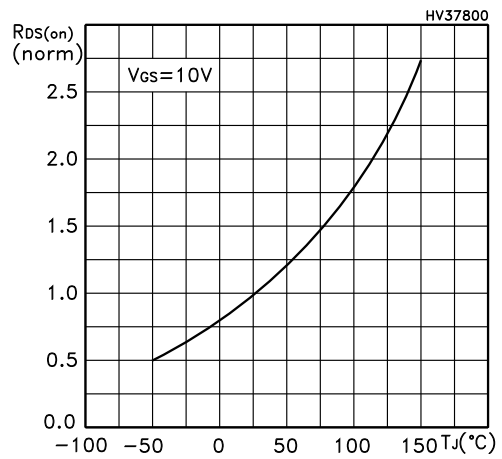
**Figure 8. Capacitance variations**



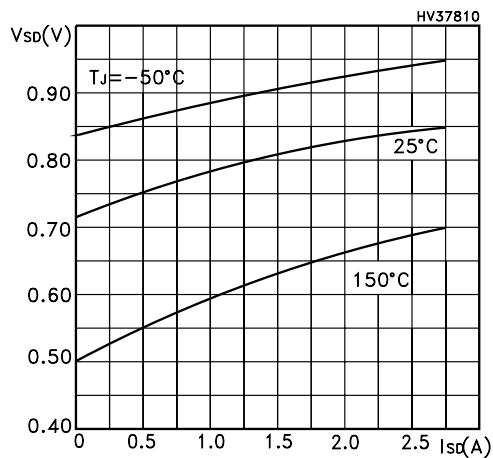
**Figure 9. Normalized gate threshold voltage vs temperature**



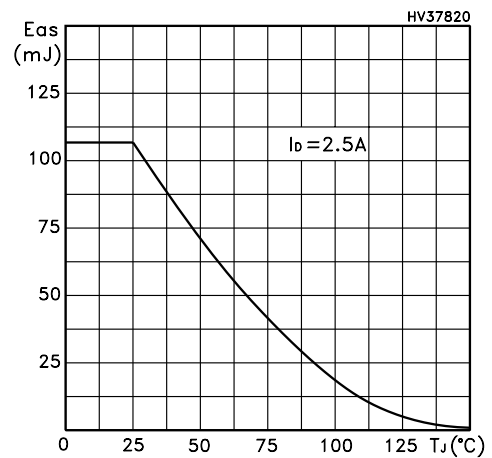
**Figure 10. Normalized on resistance vs temperature**



**Figure 11. Source-drain diode forward characteristics**



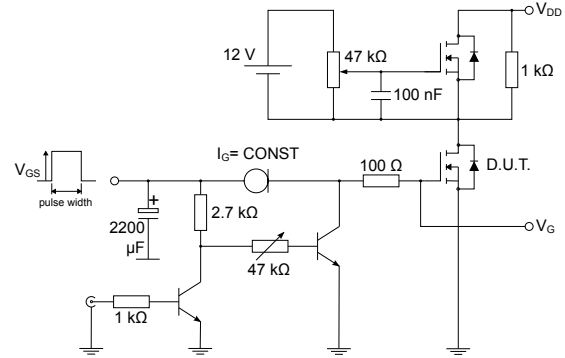
**Figure 12. Maximum avalanche energy vs temperature**



### 3 Test circuits

**Figure 13. Test circuit for resistive load switching times**


AM01468v1

**Figure 14. Test circuit for gate charge behavior**


AM01469v1

**Figure 15. Test circuit for inductive load switching and diode recovery times**


AM01470v1

**Figure 16. Unclamped inductive load test circuit**


AM01471v1

**Figure 17. Unclamped inductive waveform**


AM01472v1

**Figure 18. Switching time waveform**

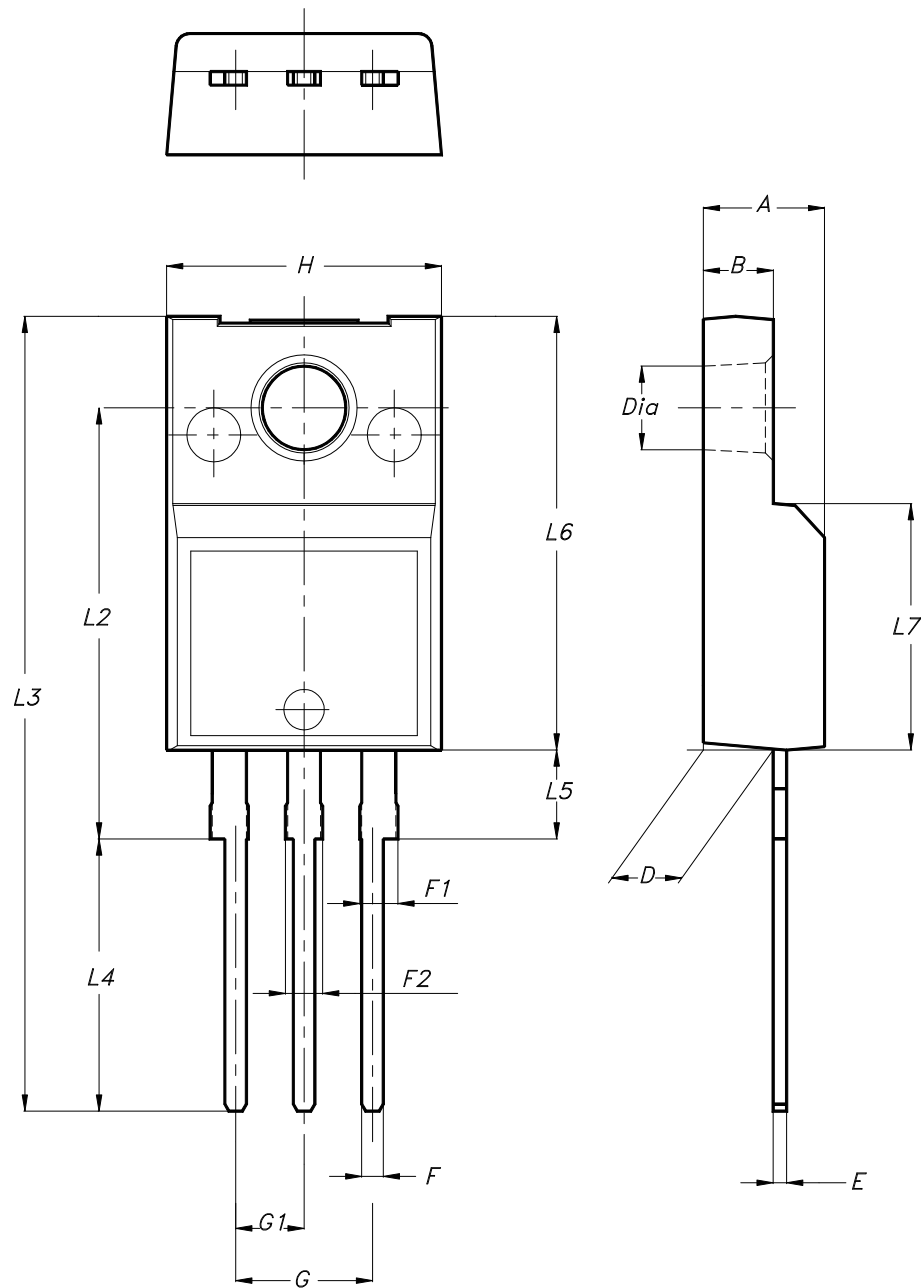

AM01473v1

## 4 Package information

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.

### 4.1 TO-220FP type B package information

Figure 19. TO-220FP type B package outline



7012510\_B\_rev.14



**Table 8. TO-220FP type B package mechanical data**

| Dim. | mm    |       |       |
|------|-------|-------|-------|
|      | Min.  | Typ.  | Max.  |
| A    | 4.40  |       | 4.60  |
| B    | 2.50  |       | 2.70  |
| D    | 2.50  |       | 2.75  |
| E    | 0.45  |       | 0.70  |
| F    | 0.75  |       | 1.00  |
| F1   | 1.15  |       | 1.70  |
| F2   | 1.15  |       | 1.70  |
| G    | 4.95  |       | 5.20  |
| G1   | 2.40  |       | 2.70  |
| H    | 10.00 |       | 10.40 |
| L2   |       | 16.00 |       |
| L3   | 28.60 |       | 30.60 |
| L4   | 9.80  |       | 10.60 |
| L5   | 2.90  |       | 3.60  |
| L6   | 15.90 |       | 16.40 |
| L7   | 9.00  |       | 9.30  |
| Dia  | 3.00  |       | 3.20  |

## Revision history

**Table 9. Document revision history**

| Date        | Revision | Changes  |
|-------------|----------|--|
| 27-Jun-2023 | 1        | First release. The part number STF3NK100Z was previously inserted in the DS5252. |

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