

## N-channel 80 V, 3.5 mΩ typ., 64 A STripFET™ F7 Power MOSFET in a TO-220FP package

Datasheet - production data

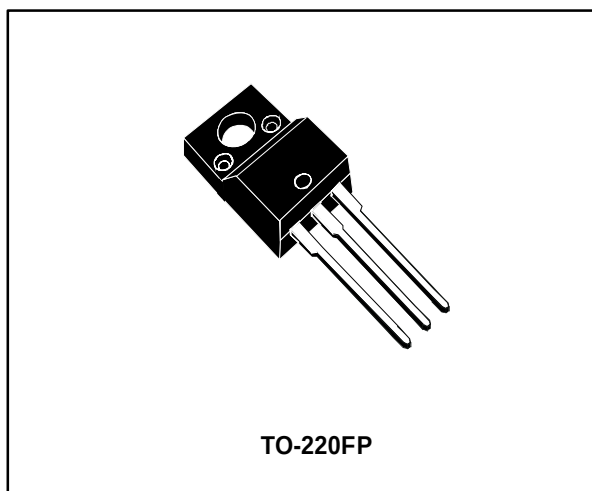
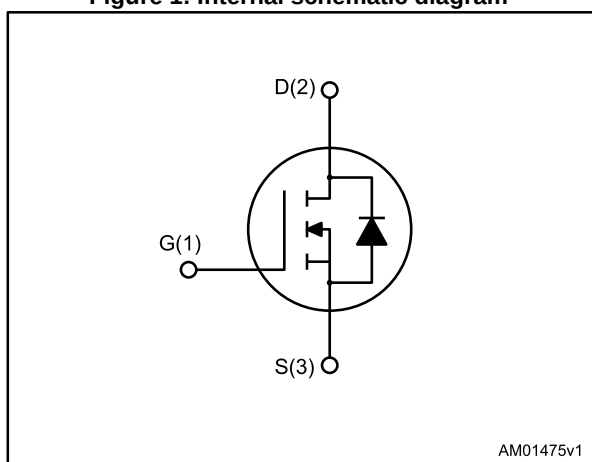


Figure 1: Internal schematic diagram



### Features

| Order code | V <sub>DS</sub> | R <sub>DS(on)</sub> max. | I <sub>D</sub> | P <sub>TOT</sub> |
|------------|-----------------|--------------------------|----------------|------------------|
| STF140N8F7 | 80 V            | 4.3 mΩ                   | 64 A           | 35 W             |

- Among the lowest R<sub>DS(on)</sub> on the market
- Excellent figure of merit (FoM)
- Low C<sub>rss</sub>/C<sub>iss</sub> ratio for EMI immunity
- High avalanche ruggedness

### Applications

- Switching applications

### Description

This N-channel Power MOSFET utilizes STripFET™ F7 technology with an enhanced trench gate structure that results in very low on-state resistance, while also reducing internal capacitance and gate charge for faster and more efficient switching.

Table 1: Device summary

| Order code | Marking | Package  | Packaging |
|------------|---------|----------|-----------|
| STF140N8F7 | 140N8F7 | TO-220FP | Tube      |

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## Contents

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# 1 Electrical ratings

Table 2: Absolute maximum ratings

| Symbol                  | Parameter                                                                                                                               | Value             | Unit               |
|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|-------------------|--------------------|
| $V_{DS}$                | Drain-source voltage                                                                                                                    | 80                | V                  |
| $V_{GS}$                | Gate-source voltage                                                                                                                     | $\pm 20$          | V                  |
| $I_D$                   | Drain current (continuous) at $T_C = 25\text{ }^{\circ}\text{C}$                                                                        | 64 <sup>(1)</sup> | A                  |
| $I_D$                   | Drain current (continuous) at $T_C = 100\text{ }^{\circ}\text{C}$                                                                       | 45 <sup>(1)</sup> | A                  |
| $I_{DM}$ <sup>(2)</sup> | Drain current (pulsed)                                                                                                                  | 256               | A                  |
| $P_{TOT}$               | Total dissipation at $T_C = 25\text{ }^{\circ}\text{C}$                                                                                 | 35                | W                  |
| $E_{AS}$ <sup>(3)</sup> | Single pulse avalanche energy                                                                                                           | 515               | mJ                 |
| $V_{ISO}$               | Insulation withstand voltage (RMS) from all three leads to external heat sink ( $t = 1\text{ s}$ , $T_C = 25\text{ }^{\circ}\text{C}$ ) | 2.5               | kV                 |
| $T_j$                   | Operating junction temperature                                                                                                          | -55 to 175        | $^{\circ}\text{C}$ |
| $T_{stg}$               | Storage temperature                                                                                                                     |                   |                    |

**Notes:**<sup>(1)</sup>Limited by package.<sup>(2)</sup>Pulse width is limited by safe operating area.<sup>(3)</sup>Starting  $T_j = 25\text{ }^{\circ}\text{C}$ ,  $I_D = 18.5\text{ A}$ ,  $V_{DD} = 50\text{ V}$ 

Table 3: Thermal data

| Symbol         | Parameter                           | Value | Unit                 |
|----------------|-------------------------------------|-------|----------------------|
| $R_{thj-case}$ | Thermal resistance junction-case    | 4.29  | $^{\circ}\text{C/W}$ |
| $R_{thj-amb}$  | Thermal resistance junction-ambient | 62.5  | $^{\circ}\text{C/W}$ |

## 2 Electrical characteristics

(T<sub>CASE</sub> = 25 °C unless otherwise specified)

Table 4: On/off states

| Symbol               | Parameter                          | Test conditions                                                         | Min. | Typ. | Max. | Unit |
|----------------------|------------------------------------|-------------------------------------------------------------------------|------|------|------|------|
| V <sub>(BR)DSS</sub> | Drain-source breakdown voltage     | V <sub>GS</sub> = 0, I <sub>D</sub> = 250 μA                            | 80   |      |      | V    |
| I <sub>DSS</sub>     | Zero gate voltage<br>Drain current | V <sub>GS</sub> = 0, V <sub>DS</sub> = 80 V                             |      |      | 1    | μA   |
|                      |                                    | V <sub>GS</sub> = 0, V <sub>DS</sub> = 80 V,<br>T <sub>J</sub> = 125 °C |      |      | 10   | μA   |
| I <sub>GSS</sub>     | Gate-source leakage<br>current     | V <sub>DS</sub> = 0, V <sub>GS</sub> = ±20 V                            |      |      | ±100 | nA   |
| V <sub>GS(th)</sub>  | Gate threshold voltage             | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA             | 2.5  |      | 4.5  | V    |
| R <sub>DS(on)</sub>  | Static drain-source on-resistance  | V <sub>GS</sub> = 10 V, I <sub>D</sub> = 32 A                           |      | 3.5  | 4.3  | mΩ   |

Table 5: Dynamic

| Symbol           | Parameter                    | Test conditions                                                          | Min. | Typ. | Max. | Unit |
|------------------|------------------------------|--------------------------------------------------------------------------|------|------|------|------|
| C <sub>iss</sub> | Input capacitance            | V <sub>GS</sub> = 0, V <sub>DS</sub> = 40 V,<br>f = 1 MHz                | -    | 6340 | -    | pF   |
| C <sub>oss</sub> | Output capacitance           |                                                                          | -    | 1195 | -    | pF   |
| C <sub>rss</sub> | Reverse transfer capacitance |                                                                          | -    | 105  | -    | pF   |
| Q <sub>g</sub>   | Total gate charge            | V <sub>DD</sub> = 40 V, I <sub>D</sub> = 64 A,<br>V <sub>GS</sub> = 10 V | -    | 96   | -    | nC   |
| Q <sub>gs</sub>  | Gate-source charge           |                                                                          | -    | 30   | -    | nC   |
| Q <sub>gd</sub>  | Gate-drain charge            |                                                                          | -    | 26   | -    | nC   |

Table 6: Switching times

| Symbol              | Parameter           | Test conditions                                                                                 | Min. | Typ. | Max. | Unit |
|---------------------|---------------------|-------------------------------------------------------------------------------------------------|------|------|------|------|
| t <sub>d(on)</sub>  | Turn-on delay time  | V <sub>DD</sub> = 40 V, I <sub>D</sub> = 45 A R <sub>G</sub> = 4.7 Ω,<br>V <sub>GS</sub> = 10 V | -    | 26   | -    | ns   |
| t <sub>r</sub>      | Rise time           |                                                                                                 | -    | 51   | -    | ns   |
| t <sub>d(off)</sub> | Turn-off-delay time |                                                                                                 | -    | 82   | -    | ns   |
| t <sub>f</sub>      | Fall time           |                                                                                                 | -    | 44   | -    | ns   |

Table 7: Source drain diode

| Symbol                          | Parameter                     | Test conditions                                                                              | Min. | Typ. | Max. | Unit |
|---------------------------------|-------------------------------|----------------------------------------------------------------------------------------------|------|------|------|------|
| I <sub>SD</sub>                 | Source-drain current          |                                                                                              | -    |      | 64   | A    |
| I <sub>SDM</sub> <sup>(1)</sup> | Source-drain current (pulsed) |                                                                                              | -    |      | 256  | A    |
| V <sub>SD</sub> <sup>(2)</sup>  | Forward on voltage            | V <sub>GS</sub> = 0, I <sub>SD</sub> = 64 A                                                  | -    |      | 1.2  | V    |
| t <sub>rr</sub>                 | Reverse recovery time         | I <sub>SD</sub> = 64 A, di/dt = 100 A/μs,<br>V <sub>DD</sub> = 60 V, T <sub>J</sub> = 150 °C | -    | 58   |      | ns   |
| Q <sub>rr</sub>                 | Reverse recovery charge       |                                                                                              | -    | 92   |      | nC   |
| I <sub>RRM</sub>                | Reverse recovery current      |                                                                                              | -    | 3.2  |      | A    |

### Notes:

<sup>(1)</sup>Pulse width is limited by safe operating area

<sup>(2)</sup>Pulse test: pulse duration = 300 μs, duty cycle 1.5%

## 2.1 Electrical characteristics (curves)

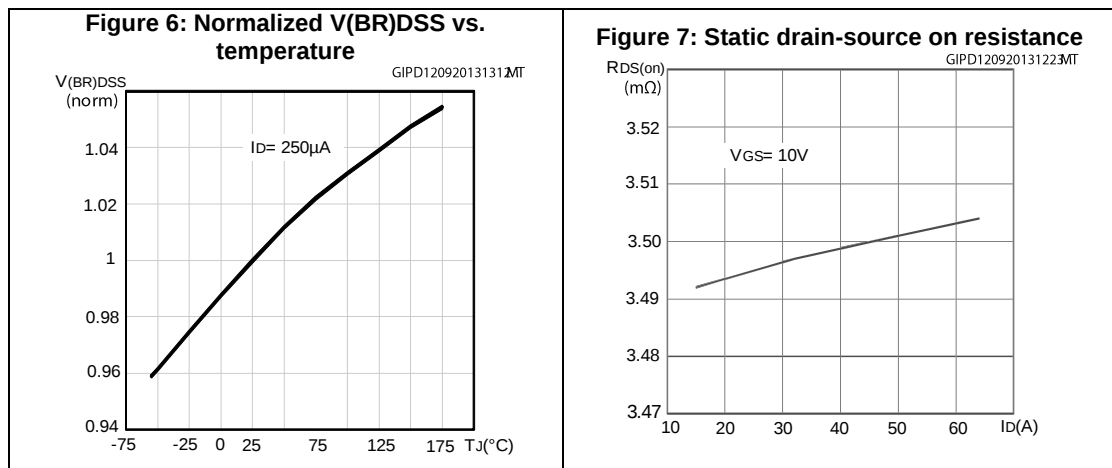
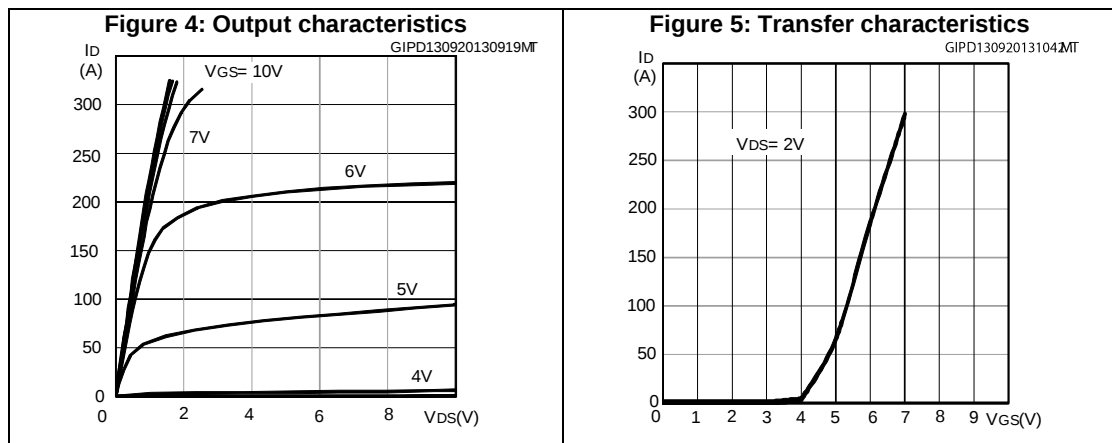
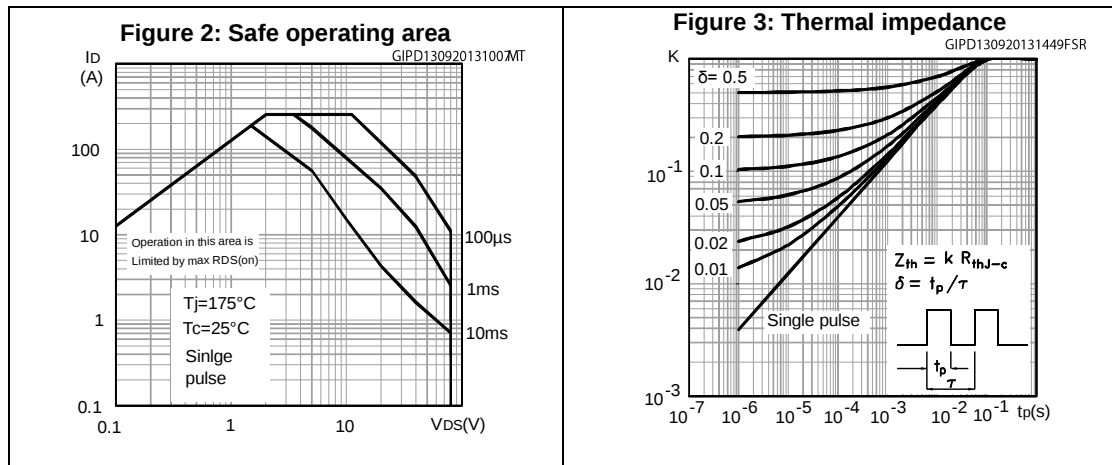


Figure 8: Gate charge vs. gate-source voltage

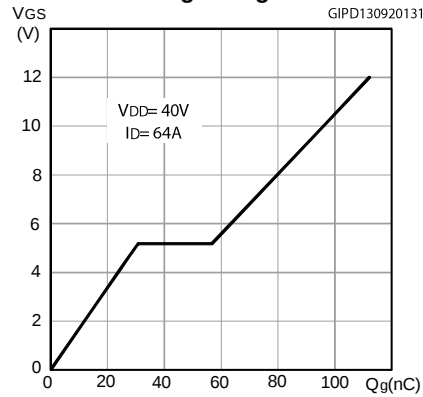


Figure 9: Capacitance variations

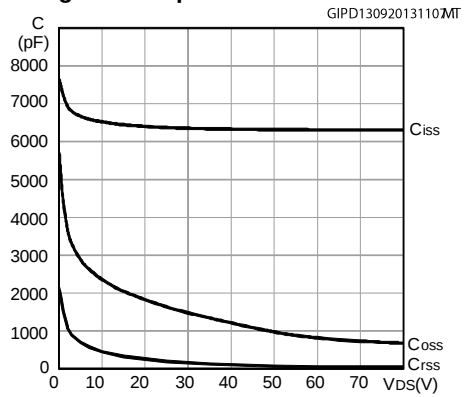


Figure 10: Normalized gate threshold voltage vs. temperature

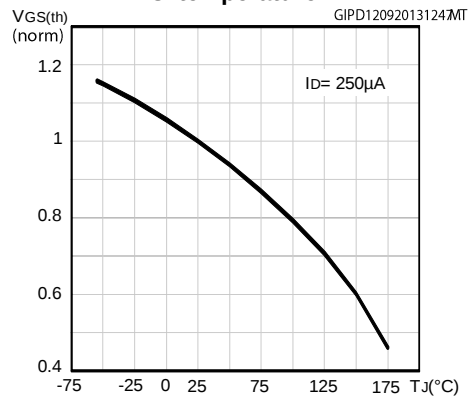


Figure 11: Normalized on resistance vs. temperature

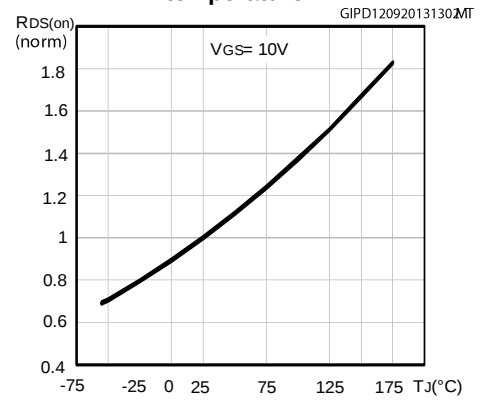
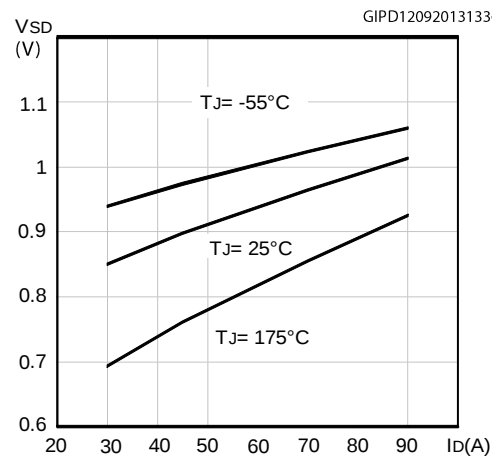
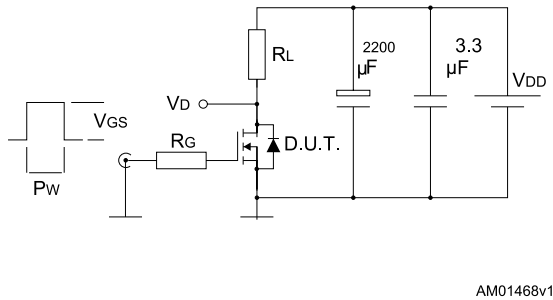


Figure 12: Source-drain diode forward characteristics

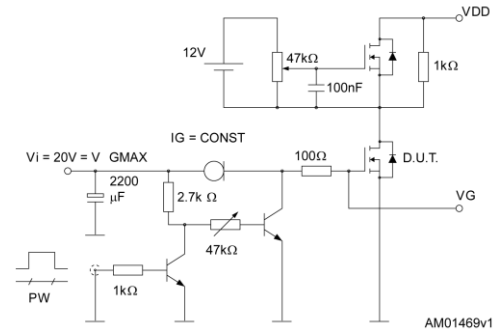


### 3 Test circuits

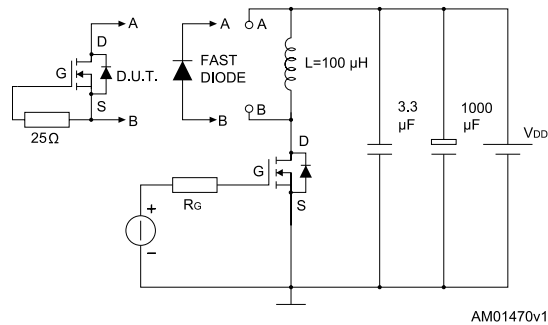
**Figure 13: Switching times test circuit for resistive load**



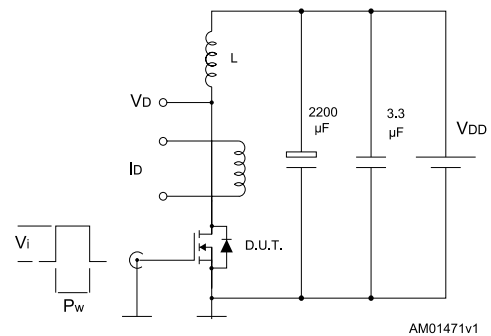
**Figure 14: Gate charge test circuit**



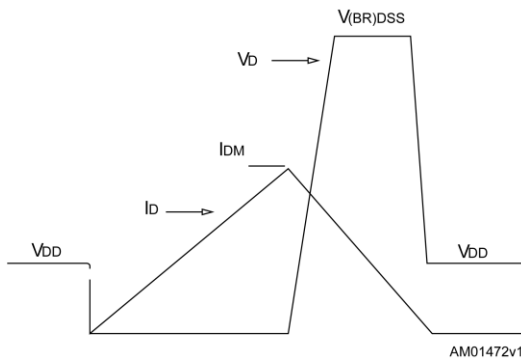
**Figure 15: Test circuit for inductive load switching and diode recovery times**



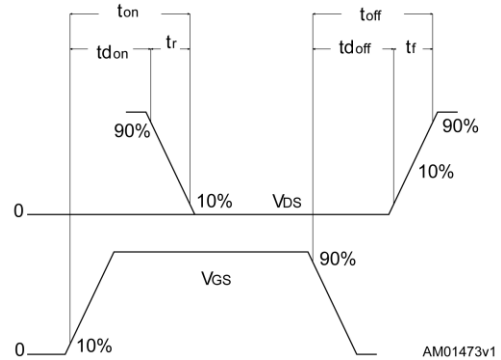
**Figure 16: Unclamped inductive load test circuit**



**Figure 17: Unclamped inductive waveform**



**Figure 18: 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.

#### 4.1 TO-220FP package information

**Figure 19: TO-220FP package outline**

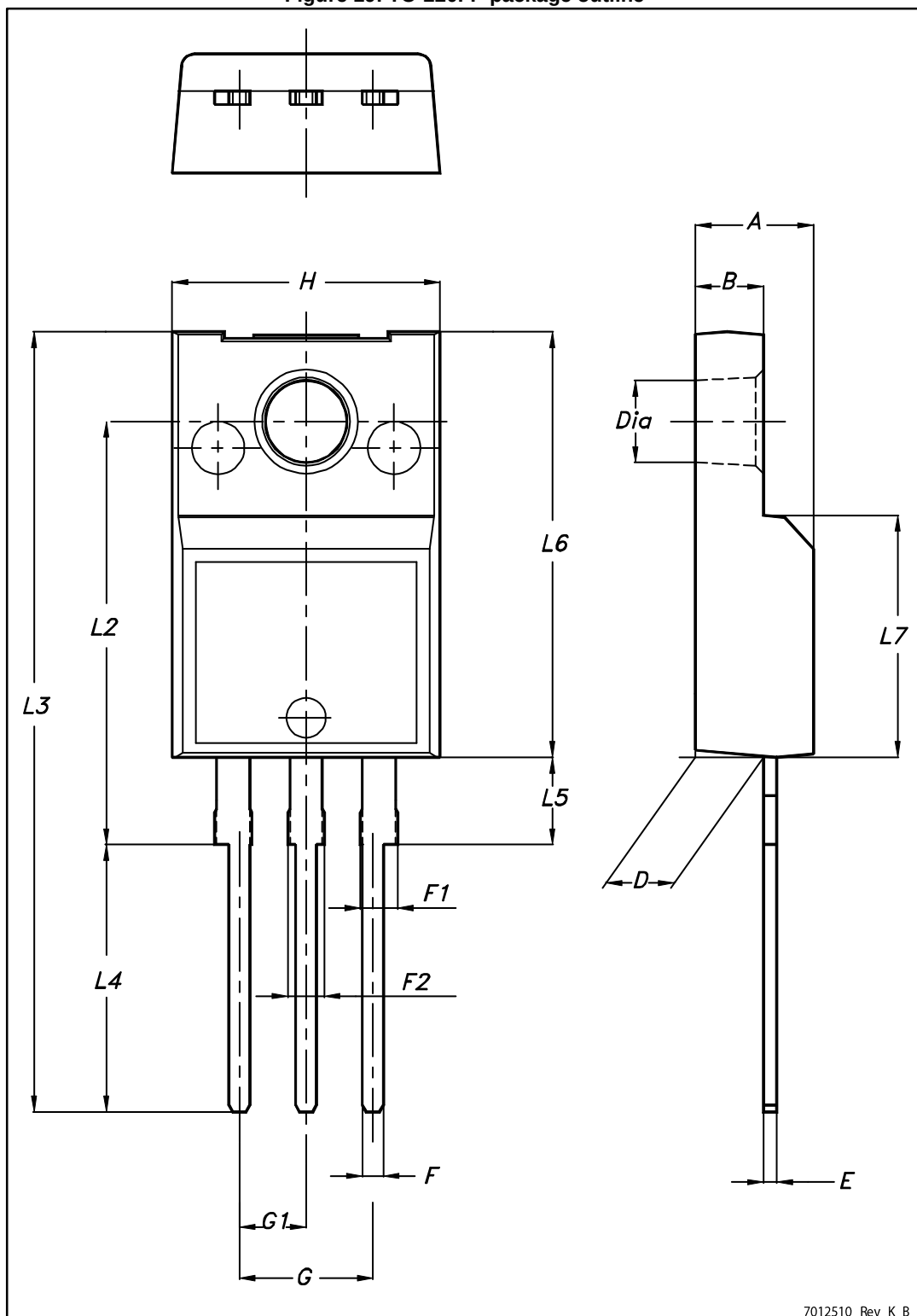


Table 8: TO-220FP mechanical data

| 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  |

## 5 Revision history

**Table 9: Document revision history**

| Date        | Revision | Changes                                                                                                                                                                                            |
|-------------|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 18-Sep-2013 | 1        | First release.                                                                                                                                                                                     |
| 22-Aug-2014 | 2        | <ul style="list-style-type: none"><li>• The part numbers STH140N8F7-2 and STP140N8F7 have been moved to a separate datasheet.</li><li>• Modified: not found</li><li>• Minor text changes</li></ul> |
| 10-Oct-2014 | 3        | <ul style="list-style-type: none"><li>• Updated <i>Figure 3: "Thermal impedance"</i></li></ul>                                                                                                     |

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