

## N-channel 60 V, 4.6 mΩ typ., 46 A STripFET™ F7 Power MOSFET in a TO-220FP package

Datasheet - production data

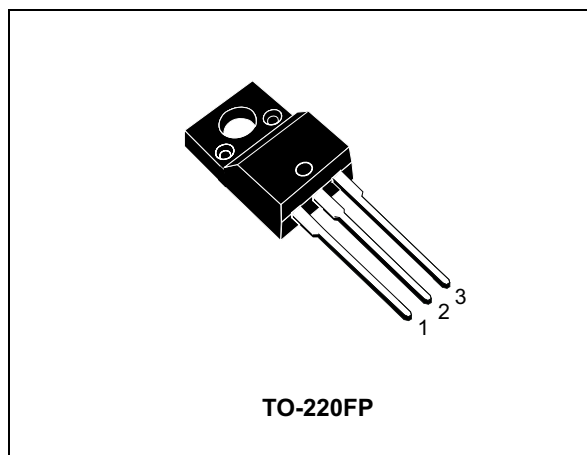
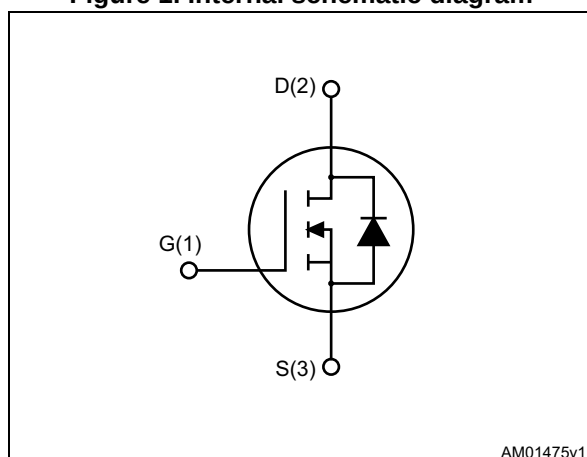


Figure 1. Internal schematic diagram



### Features

| Order code | V <sub>DS</sub> | R <sub>DS(on)</sub> max. | I <sub>D</sub> | P <sub>TOT</sub> |
|------------|-----------------|--------------------------|----------------|------------------|
| STF100N6F7 | 60 V            | 5.6 mΩ                   | 46 A           | 25 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 |
|------------|---------|----------|-----------|
| STF100N6F7 | 100N6F7 | TO-220FP | Tube      |

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol         | Parameter                                                                                                                               | Value             | Unit               |
|----------------|-----------------------------------------------------------------------------------------------------------------------------------------|-------------------|--------------------|
| $V_{DS}$       | Drain-source voltage                                                                                                                    | 60                | V                  |
| $V_{GS}$       | Gate-source voltage                                                                                                                     | $\pm 20$          | V                  |
| $I_D$          | Drain current (continuous) at $T_C = 25\text{ }^{\circ}\text{C}$                                                                        | 46 <sup>(1)</sup> | A                  |
| $I_D$          | Drain current (continuous) at $T_C = 100\text{ }^{\circ}\text{C}$                                                                       | 33 <sup>(1)</sup> | A                  |
| $I_{DM}^{(2)}$ | Drain current (pulsed)                                                                                                                  | 184               | A                  |
| $P_{TOT}$      | Total dissipation at $T_C = 25\text{ }^{\circ}\text{C}$                                                                                 | 25                | W                  |
| $E_{AS}^{(3)}$ | Single pulse avalanche energy                                                                                                           | 200               | mJ                 |
| $dV/dt^{(4)}$  | Drain-body diode dynamic $dV/dt$ ruggedness                                                                                             | 6                 | V/ns               |
| $V_{ISO}$      | Insulation withstand voltage (RMS) from all three leads to external heat sink ( $t = 1\text{ s}$ ; $T_C = 25\text{ }^{\circ}\text{C}$ ) | 2500              | V                  |
| $T_j$          | Operating junction temperature                                                                                                          | -55 to 175        | $^{\circ}\text{C}$ |
| $T_{stg}$      | Storage temperature                                                                                                                     |                   |                    |

1. Limited by package
2. Pulse width is limited by safe operating area
3. Starting  $T_j = 25\text{ }^{\circ}\text{C}$ ,  $I_D = 20\text{ A}$ ,  $V_{DD} = 30\text{ V}$
4.  $I_{SD} = 46\text{ A}$ ;  $di/dt = 600\text{ A}/\mu\text{s}$ ;  $V_{DD} = 48\text{ V}$ ;  $T_j < T_{jmax}$

**Table 3. Thermal data**

| Symbol         | Parameter                           | Value | Unit                        |
|----------------|-------------------------------------|-------|-----------------------------|
| $R_{thj-case}$ | Thermal resistance junction-case    | 6     | $^{\circ}\text{C}/\text{W}$ |
| $R_{thj-amb}$  | Thermal resistance junction-ambient | 62.5  | $^{\circ}\text{C}/\text{W}$ |

## 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    | $V_{GS} = 0\text{ V}$ , $I_D = 1\text{ mA}$                                             | 60   |      |      | V             |
| $I_{DSS}$     | Zero gate voltage Drain current   | $V_{GS} = 0\text{ V}$ , $V_{DS} = 60\text{ V}$                                          |      |      | 1    | $\mu\text{A}$ |
|               |                                   | $V_{GS} = 0\text{ V}$ , $V_{DS} = 60\text{ V}$ ,<br>$T_J = 125\text{ }^{\circ}\text{C}$ |      |      | 100  | $\mu\text{A}$ |
| $I_{GSS}$     | Gate-source leakage current       | $V_{DS} = 0\text{ V}$ , $V_{GS} = 20\text{ V}$                                          |      |      | 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 | $V_{GS} = 10\text{ V}$ , $I_D = 23\text{ A}$                                            |      | 4.6  | 5.6  | m $\Omega$    |

**Table 5. Dynamic**

| Symbol    | Parameter                    | Test conditions                                                          | Min. | Typ. | Max. | Unit |
|-----------|------------------------------|--------------------------------------------------------------------------|------|------|------|------|
| $C_{iss}$ | Input capacitance            | $V_{GS} = 0\text{ V}$ , $V_{DS} = 25\text{ V}$ ,<br>$f = 1\text{ MHz}$   | -    | 1980 | -    | pF   |
| $C_{oss}$ | Output capacitance           |                                                                          | -    | 970  | -    | pF   |
| $C_{rss}$ | Reverse transfer capacitance |                                                                          | -    | 86   | -    | pF   |
| $Q_g$     | Total gate charge            | $V_{DD} = 30\text{ V}$ , $I_D = 46\text{ A}$ ,<br>$V_{GS} = 10\text{ V}$ | -    | 30   | -    | nC   |
| $Q_{gs}$  | Gate-source charge           |                                                                          | -    | 12.6 | -    | nC   |
| $Q_{gd}$  | Gate-drain charge            |                                                                          | -    | 5.9  | -    | nC   |

**Table 6. Switching times**

| Symbol       | Parameter           | Test conditions                                                                                      | Min. | Typ. | Max. | Unit |
|--------------|---------------------|------------------------------------------------------------------------------------------------------|------|------|------|------|
| $t_{d(on)}$  | Turn-on delay time  | $V_{DD} = 30\text{ V}$ , $I_D = 23\text{ A}$ ,<br>$R_G = 4.7\text{ }\Omega$ , $V_{GS} = 10\text{ V}$ | -    | 21.6 | -    | ns   |
| $t_r$        | Rise time           |                                                                                                      | -    | 55.5 | -    | ns   |
| $t_{d(off)}$ | Turn-off-delay time |                                                                                                      | -    | 28.6 | -    | ns   |
| $t_f$        | Fall time           |                                                                                                      | -    | 15   | -    | ns   |

Table 7. Source drain diode

| Symbol         | Parameter                | Test conditions                                                                         | Min. | Typ. | Max. | Unit |
|----------------|--------------------------|-----------------------------------------------------------------------------------------|------|------|------|------|
| $V_{SD}^{(1)}$ | Forward on voltage       | $V_{GS} = 0\text{ V}$ , $I_{SD} = 46\text{ A}$                                          | -    |      | 1.2  | V    |
| $t_{rr}$       | Reverse recovery time    | $I_{SD} = 46\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ ,<br>$V_{DD} = 48\text{ V}$ | -    | 48.4 |      | ns   |
| $Q_{rr}$       | Reverse recovery charge  |                                                                                         | -    | 47   |      | nC   |
| $I_{RRM}$      | Reverse recovery current |                                                                                         | -    | 2.0  |      | A    |

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

## 2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

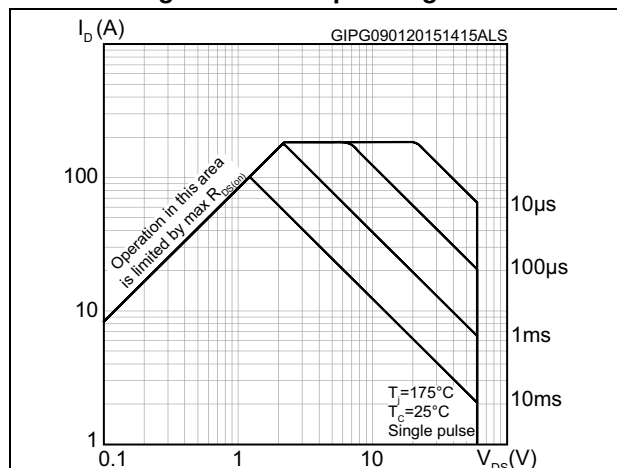


Figure 3. Thermal impedance

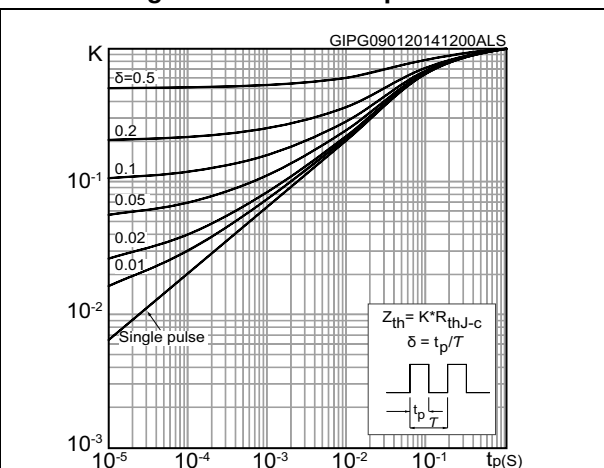


Figure 4. Output characteristics

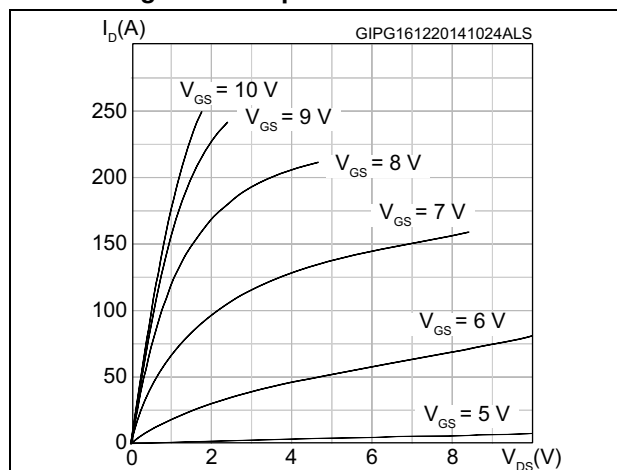


Figure 5. Transfer characteristics

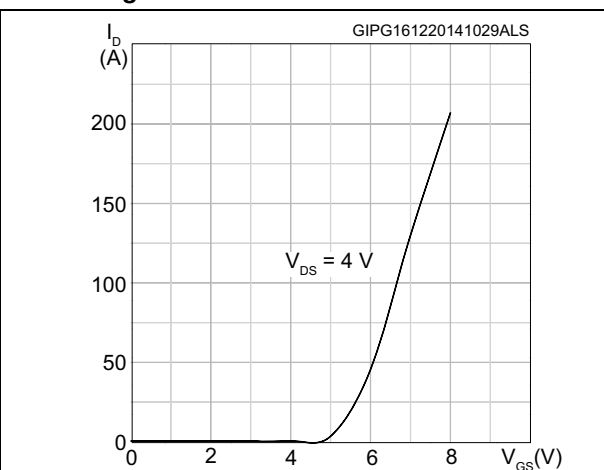


Figure 6. Gate charge vs gate-source voltage

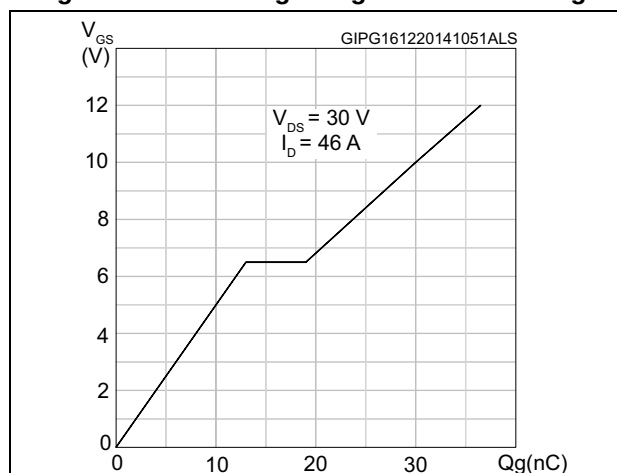


Figure 7. Static drain-source on-resistance

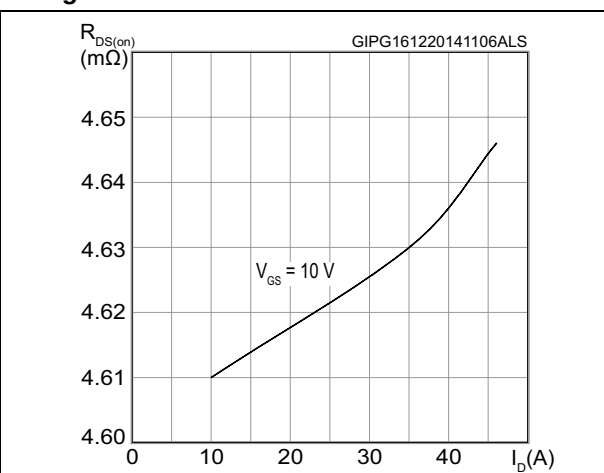


Figure 8. Capacitance variations

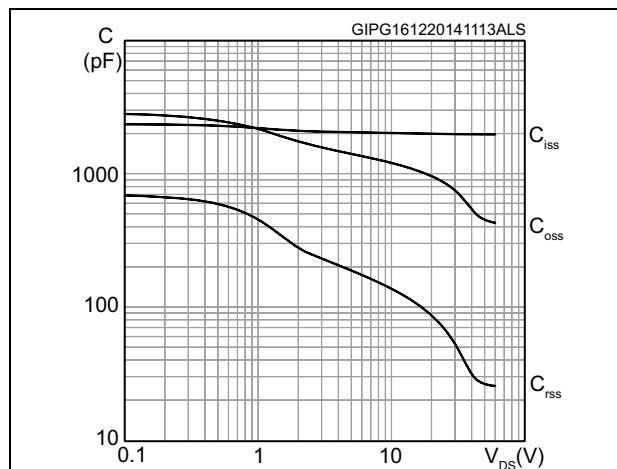


Figure 9. Normalized gate threshold voltage vs temperature

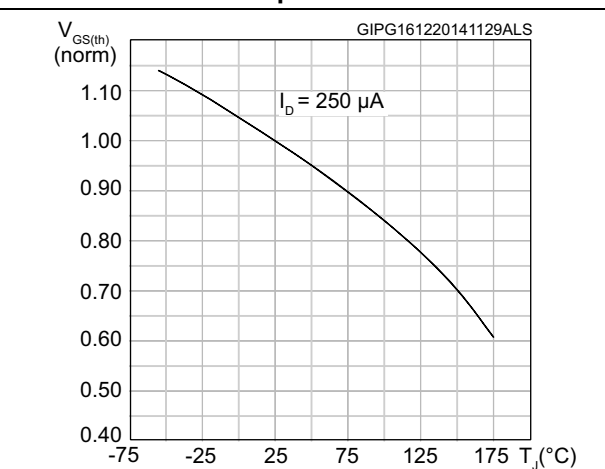


Figure 10. Normalized on-resistance vs temperature

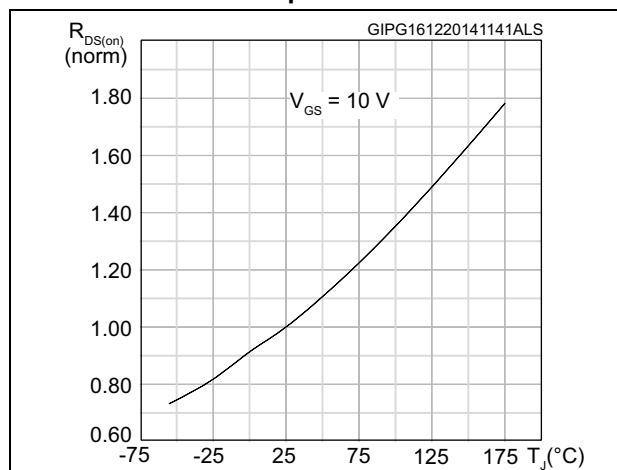
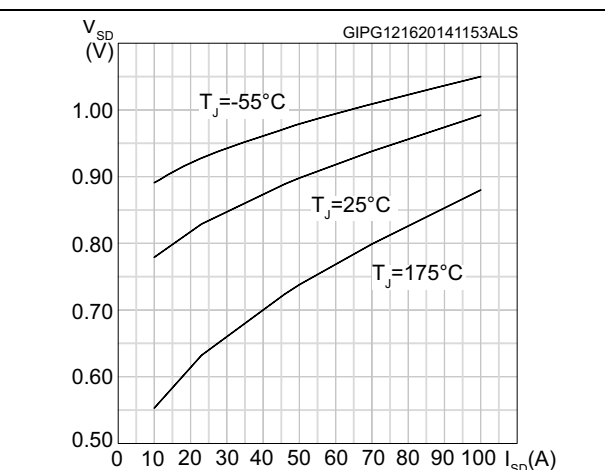
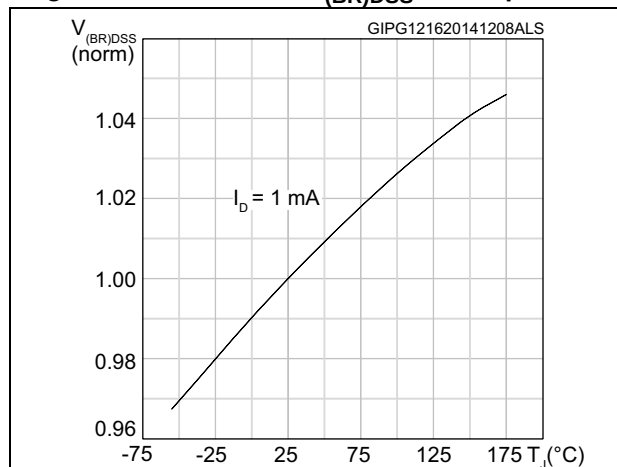


Figure 11. Source-drain diode forward characteristics

Figure 12. Normalized  $V_{(BR)DSS}$  vs temperature

### 3 Test circuits

Figure 13. Switching times test circuit for resistive load

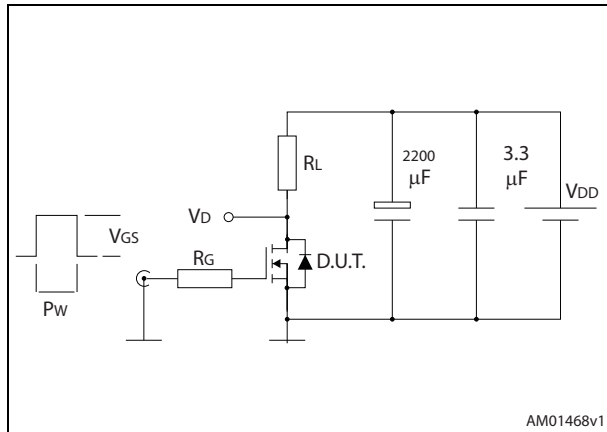


Figure 14. Gate charge test circuit

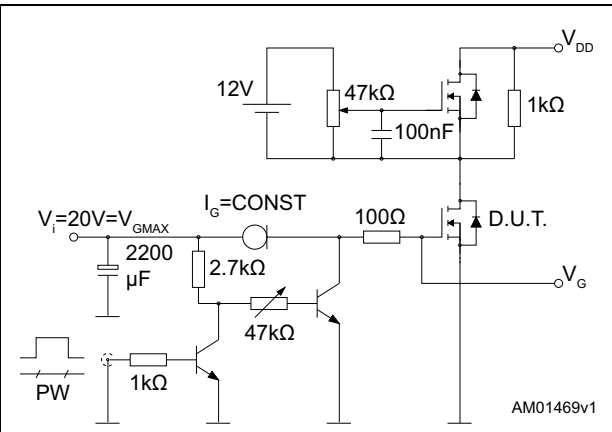


Figure 15. Test circuit for inductive load switching and diode recovery times

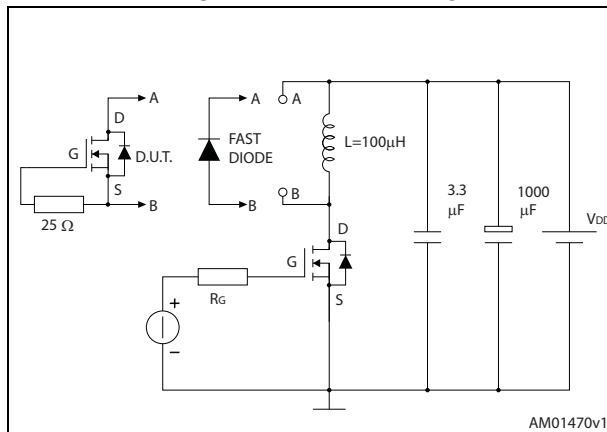


Figure 16. Unclamped inductive load test circuit

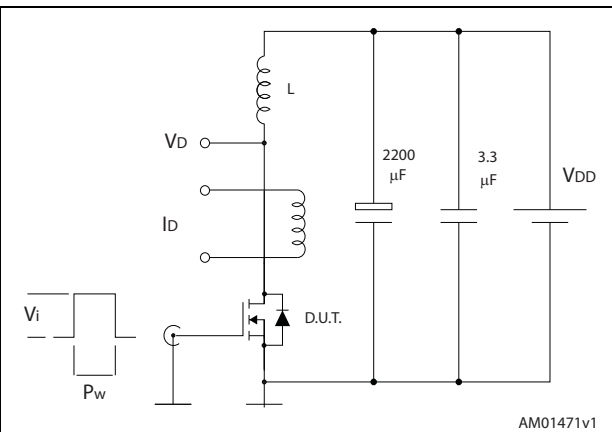


Figure 17. Unclamped inductive waveform

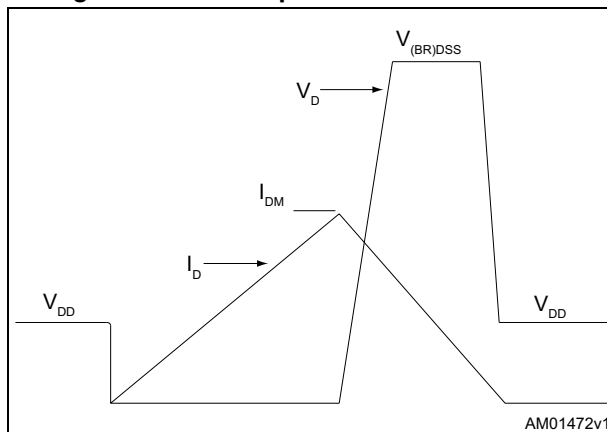
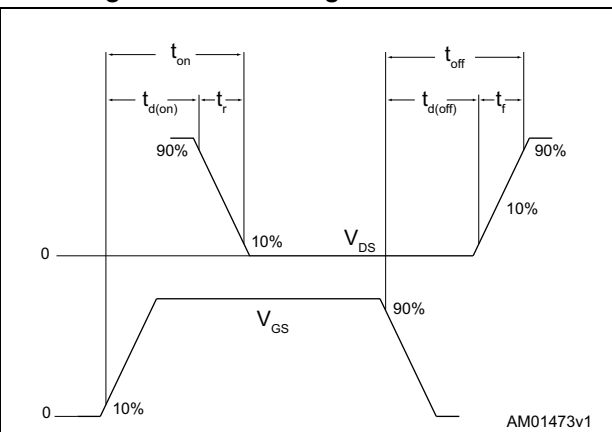


Figure 18. Switching time waveform



## 4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK<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<sup>®</sup> is an ST trademark.

Figure 19. TO-220FP drawing

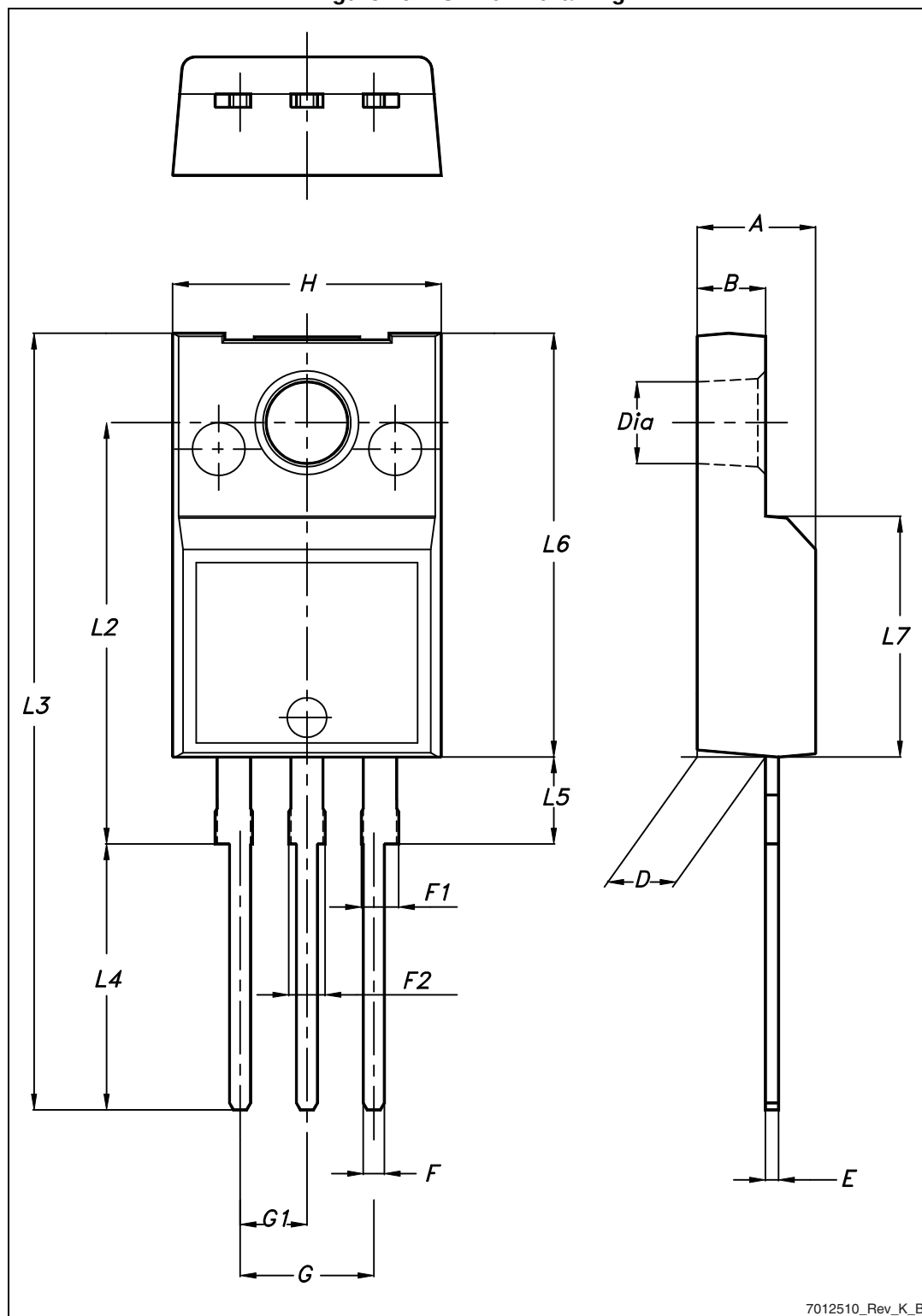


Table 8. TO-220FP mechanical data

| 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  |
| Ø    | 3    |      | 3.2  |

## 5 Revision history

**Table 9. Document revision history**

| Date        | Revision | Changes                                                                                                                                                                                                                                                                                                                                                                                                               |
|-------------|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 25-Nov-2014 | 1        | First release.                                                                                                                                                                                                                                                                                                                                                                                                        |
| 16-Jan-2015 | 2        | In <a href="#">Section 1</a> , updated <a href="#">Table 2: Absolute maximum ratings</a><br>In <a href="#">Section 2</a> ,<br>– updated <a href="#">Table 4: On/off states</a><br>– updated <a href="#">Table 5: Dynamic</a><br>– updated <a href="#">Table 6: Switching times</a><br>– updated <a href="#">Table 7: Source drain diode</a><br>Added <a href="#">Section 2.1: Electrical characteristics (curves)</a> |
| 10-Feb-2015 | 3        | Inserted dV/dt value in <a href="#">Table 2: Absolute maximum ratings</a> .                                                                                                                                                                                                                                                                                                                                           |

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