

## Automotive-grade N-channel 60 V, 2.3 mΩ typ., 180 A STripFET™ F6 Power MOSFET in a TO-220 package

Datasheet - production data

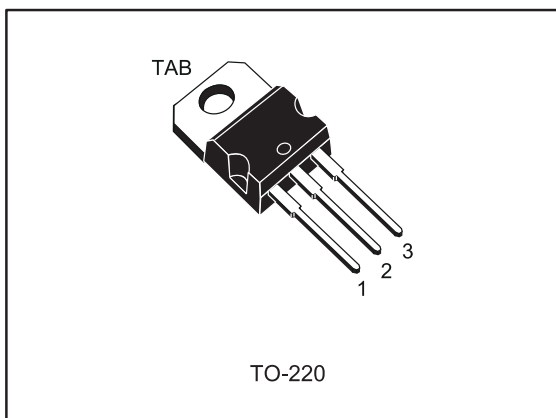
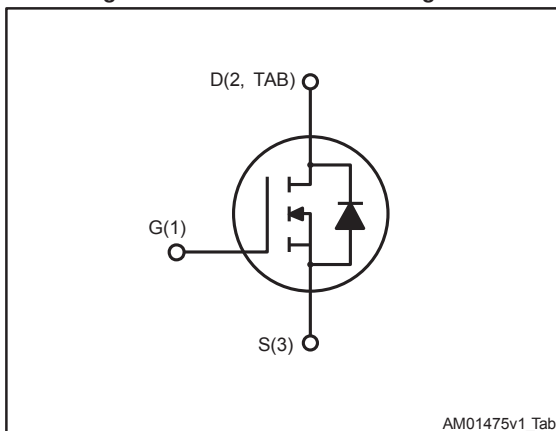


Figure 1: Internal schematic diagram



### Features

| Order code   | V <sub>DS</sub> | R <sub>DS(on)</sub> max | I <sub>D</sub> |
|--------------|-----------------|-------------------------|----------------|
| STP265N6F6AG | 60 V            | 2.85 mΩ                 | 180 A          |

- AEC-Q101 qualified
- Very low on-resistance
- Very low gate charge
- High avalanche ruggedness
- Low gate drive power loss



### Applications

- Switching applications

### Description

This device is an N-channel Power MOSFET developed using the STripFET™ F6 technology with a new trench gate structure. The resulting Power MOSFET exhibits very low R<sub>DS(on)</sub> in all packages.

Table 1: Device summary

| Order code   | Marking | Package | Packing |
|--------------|---------|---------|---------|
| STP265N6F6AG | 265N6F6 | TO-220  | 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                                                                               | 60          | V                  |
| $V_{GS}$       | Gate-source voltage                                                                                | $\pm 20$    | V                  |
| $I_D^{(1)}$    | Drain current (continuous) at $T_C = 25\text{ }^{\circ}\text{C}$                                   | 180         | A                  |
| $I_D^{(1)}$    | Drain current (continuous) at $T_C = 100\text{ }^{\circ}\text{C}$                                  | 180         | A                  |
| $I_{DM}^{(2)}$ | Drain current (pulsed)                                                                             | 720         | A                  |
| $P_{TOT}$      | Total dissipation at $T_C = 25\text{ }^{\circ}\text{C}$                                            | 300         | W                  |
| $E_{AS}$       | Single pulse avalanche energy (Starting $T_J = 25\text{ }^{\circ}\text{C}$ , $I_D = 80\text{ A}$ ) | 720         | mJ                 |
| $T_{stg}$      | Storage temperature range                                                                          | - 55 to 175 | $^{\circ}\text{C}$ |
| $T_J$          | Operating junction temperature range                                                               |             |                    |

**Notes:**

(1) Current limited by package.

(2) Pulse width limited by safe operating area.

Table 3: Thermal data

| Symbol         | Parameter                            | Value | Unit                 |
|----------------|--------------------------------------|-------|----------------------|
| $R_{thj-case}$ | Thermal resistance junction-case max | 0.5   | $^{\circ}\text{C/W}$ |
| $R_{thj-amb}$  | Thermal resistance junction-amb max  | 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    | I <sub>D</sub> = 250 μA,<br>V <sub>GS</sub> = 0 V                                          | 60   |      |       | V    |
| I <sub>DSS</sub>     | Zero gate voltage drain current   | V <sub>DS</sub> = 60 V,<br>V <sub>GS</sub> = 0 V                                           |      |      | 1     | μA   |
|                      |                                   | V <sub>DS</sub> = 60 V,<br>T <sub>C</sub> = 125 °C <sup>(1)</sup><br>V <sub>GS</sub> = 0 V |      |      | 100   | μA   |
| I <sub>GSS</sub>     | Gate-body leakage current         | V <sub>GS</sub> = ± 20 V,<br>V <sub>DS</sub> = 0 V                                         |      |      | ± 100 | nA   |
| V <sub>GS(th)</sub>  | Gate threshold voltage            | V <sub>DS</sub> = V <sub>GS</sub> ,<br>I <sub>D</sub> = 250 μA                             | 2    |      | 4     | V    |
| R <sub>DS(on)</sub>  | Static drain-source on-resistance | V <sub>GS</sub> = 10 V,<br>I <sub>D</sub> = 60 A                                           |      | 2.3  | 2.85  | mΩ   |

**Notes:**

<sup>(1)</sup>Defined by design, not subject to production test.

Table 5: Dynamic

| Symbol           | Parameter                    | Test conditions                                                                                                                                           | Min. | Typ.  | Max. | Unit |
|------------------|------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------|------|------|
| C <sub>iss</sub> | Input capacitance            | V <sub>DS</sub> = 25 V,<br>f = 1 MHz,<br>V <sub>GS</sub> = 0 V                                                                                            | -    | 11800 | -    | pF   |
| C <sub>oss</sub> | Output capacitance           |                                                                                                                                                           | -    | 1235  | -    | pF   |
| C <sub>rss</sub> | Reverse transfer capacitance |                                                                                                                                                           | -    | 488   | -    | pF   |
| Q <sub>g</sub>   | Total gate charge            | V <sub>DD</sub> = 30 V,<br>I <sub>D</sub> = 120 A,<br>V <sub>GS</sub> = 10 V<br>(see <a href="#">Figure 14: "Test circuit for gate charge behavior"</a> ) | -    | 183   | -    | nC   |
| Q <sub>gs</sub>  | Gate-source charge           |                                                                                                                                                           | -    | 53    | -    | nC   |
| Q <sub>gd</sub>  | Gate-drain charge            |                                                                                                                                                           | -    | 41    | -    | 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> = 30 V,<br>I <sub>D</sub> = 60 A<br>R <sub>G</sub> = 4.7 Ω,<br>V <sub>GS</sub> = 10 V<br>(see <a href="#">Figure 13: "Test circuit for resistive load switching times"</a> and <a href="#">Figure 18: "Switching time waveform"</a> ) | -    | 31   | -    | ns   |
| t <sub>r</sub>      | Rise time           |                                                                                                                                                                                                                                                       | -    | 165  | -    | ns   |
| t <sub>d(off)</sub> | Turn-off-delay time |                                                                                                                                                                                                                                                       | -    | 144  | -    | ns   |
| t <sub>f</sub>      | Fall time           |                                                                                                                                                                                                                                                       | -    | 63   | -    | ns   |

Table 7: Source drain diode

| Symbol          | Parameter                     | Test conditions                                                                                                                                                                                                                            | Min. | Typ. | Max. | Unit |
|-----------------|-------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| $I_{SD}$        | Source-drain current          |                                                                                                                                                                                                                                            |      |      | 180  | A    |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) |                                                                                                                                                                                                                                            |      |      | 720  | A    |
| $V_{SD}^{(2)}$  | Forward on voltage            | $I_{SD} = 180\text{ A}$ ,<br>$V_{GS} = 0\text{ V}$                                                                                                                                                                                         |      |      | 1.1  | V    |
| $t_{rr}$        | Reverse recovery time         | $I_{SD} = 120\text{ A}$ ,<br>$V_{DD} = 48\text{ V}$<br>$di/dt = 100\text{ A}/\mu\text{s}$ ,<br>$T_j = 150\text{ }^\circ\text{C}$<br>(see <a href="#">Figure 15: "Test circuit for inductive load switching and diode recovery times"</a> ) | -    | 56   | -    | ns   |
| $Q_{rr}$        | Reverse recovery charge       |                                                                                                                                                                                                                                            | -    | 116  | -    | nC   |
| $I_{RRM}$       | Reverse recovery current      |                                                                                                                                                                                                                                            | -    | 3.8  | -    | A    |

**Notes:**

(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

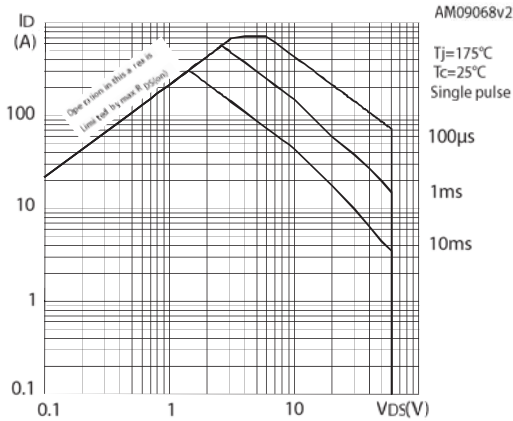


Figure 3: Thermal impedance

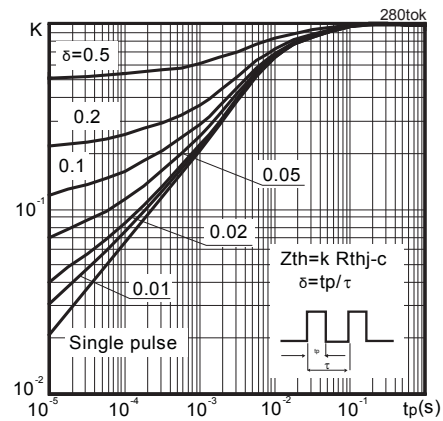


Figure 4: Output characteristics

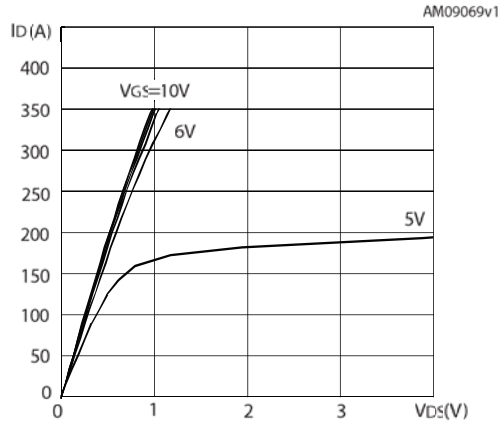


Figure 5: Transfer characteristics

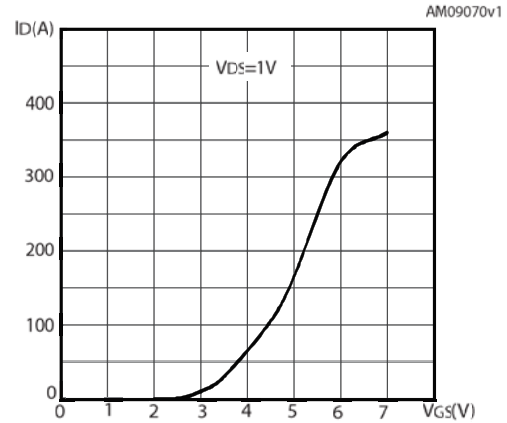
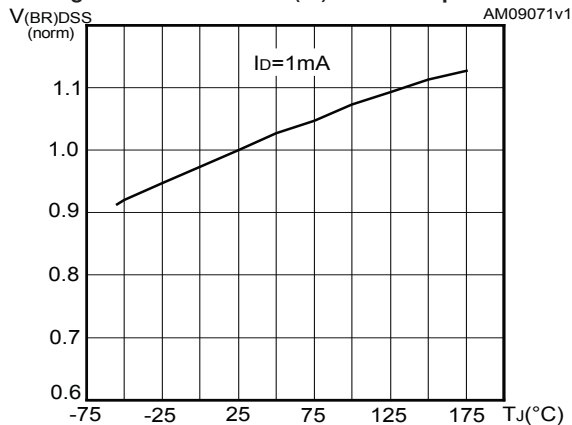
Figure 6: Normalized  $V_{(BR)DSS}$  vs. temperature

Figure 7: Static drain-source on-resistance

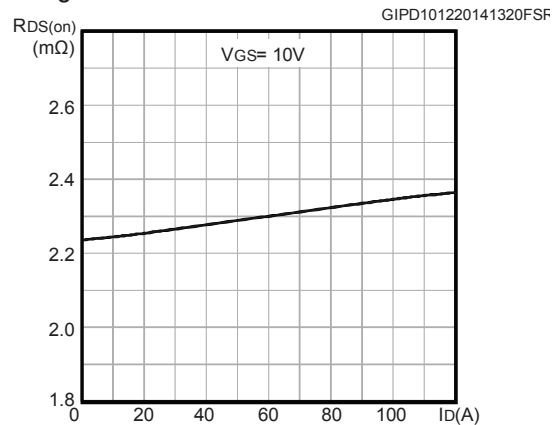


Figure 8: Gate charge vs. gate-source voltage

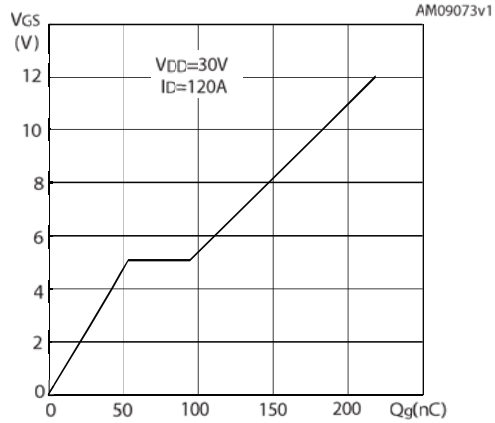


Figure 9: Capacitance variations

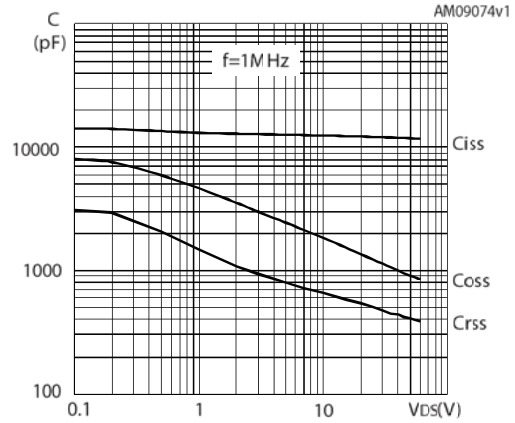


Figure 10: Normalized gate threshold voltage vs. temperature

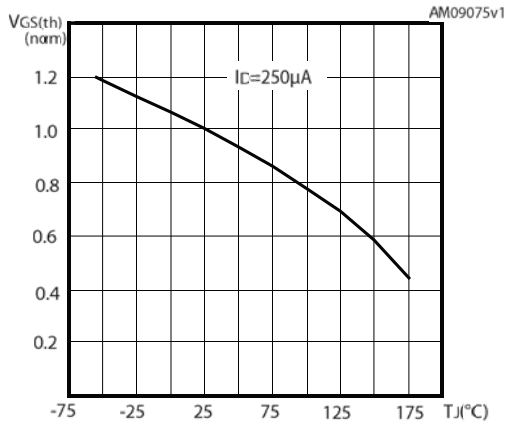


Figure 11: Normalized on resistance vs. temperature

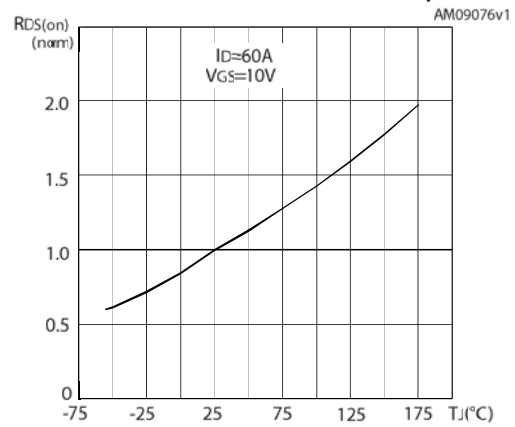
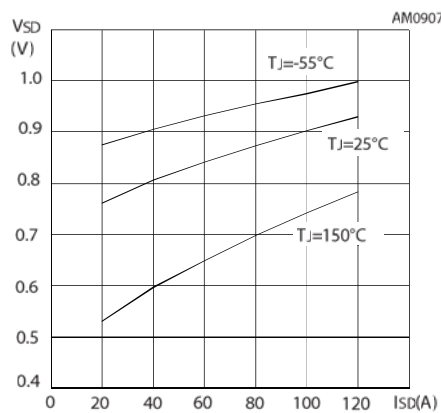
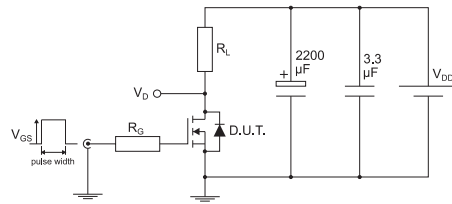


Figure 12: Source-drain diode forward characteristics



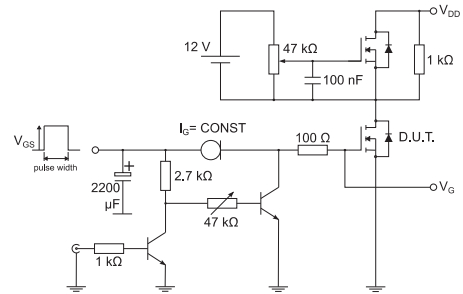
### 3 Test circuits

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



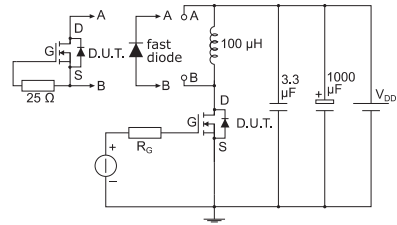
AM0146bv1

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



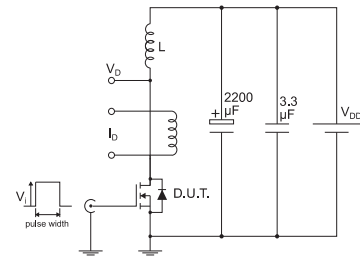
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**Figure 15: Test circuit for inductive load switching and diode recovery times**



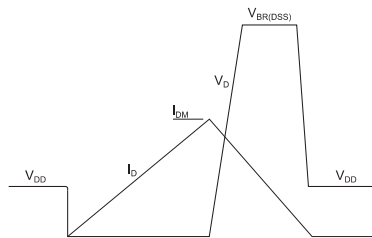
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**Figure 16: Unclamped inductive load test circuit**



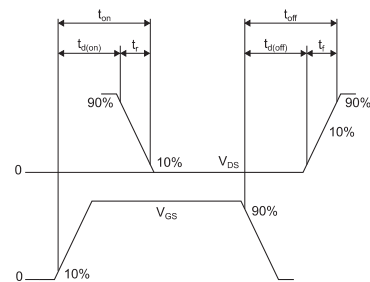
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**Figure 17: Unclamped inductive waveform**



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**Figure 18: Switching time waveform**



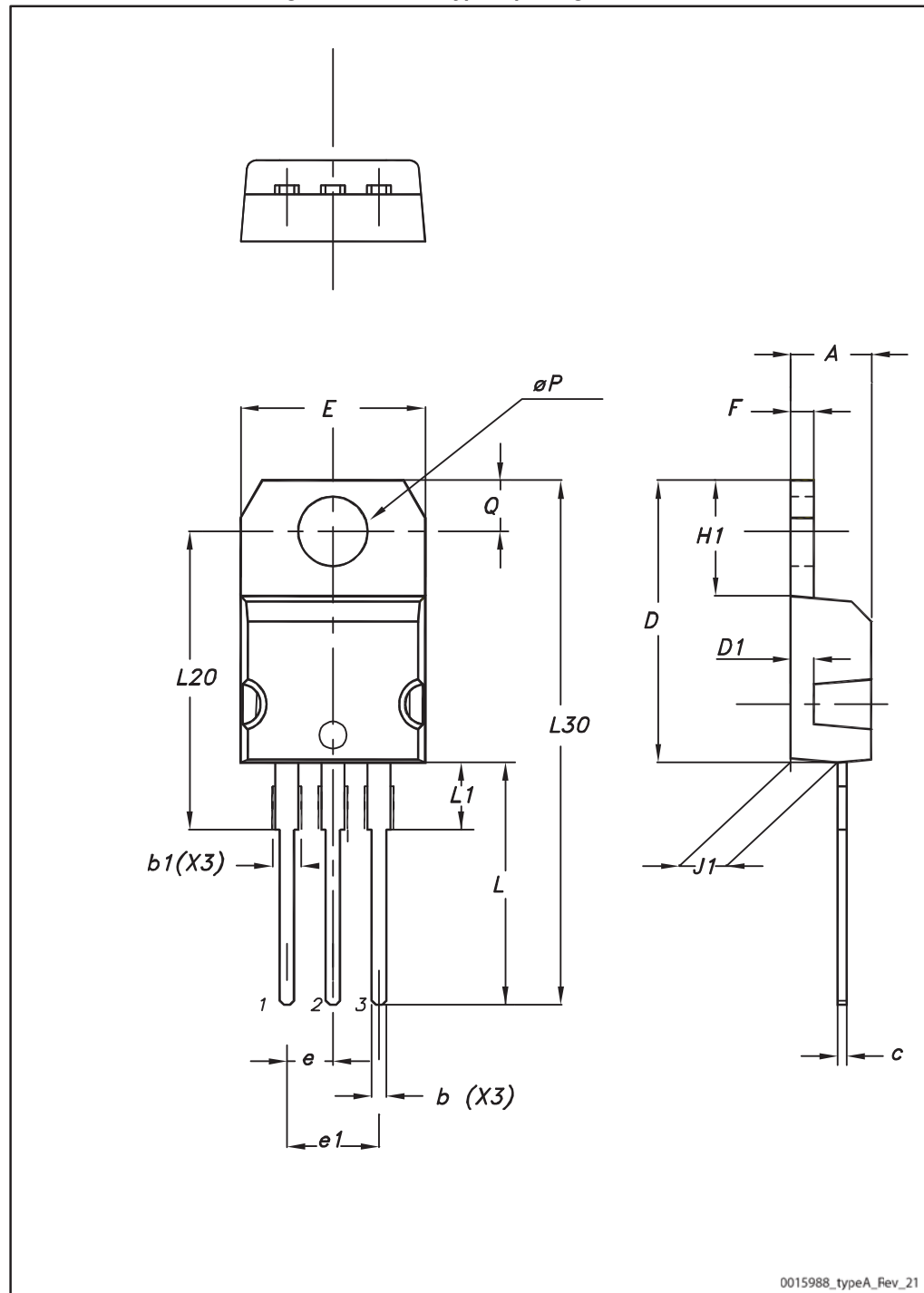
AM0147bv1

## 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-220 mechanical data

Figure 19: TO-220 type A package outline



0015988\_typeA\_Rev\_21

Table 8: TO-220 type A mechanical data

| Dim. | mm    |       |       |
|------|-------|-------|-------|
|      | Min.  | Typ.  | Max.  |
| A    | 4.40  |       | 4.60  |
| b    | 0.61  |       | 0.88  |
| b1   | 1.14  |       | 1.55  |
| c    | 0.48  |       | 0.70  |
| D    | 15.25 |       | 15.75 |
| D1   |       | 1.27  |       |
| E    | 10.00 |       | 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    | 13.00 |       | 14.00 |
| L1   | 3.50  |       | 3.93  |
| L20  |       | 16.40 |       |
| L30  |       | 28.90 |       |
| øP   | 3.75  |       | 3.85  |
| Q    | 2.65  |       | 2.95  |

## 5 Revision history

Table 9: Document revision history

| Date        | Revision | Changes                                                                                                                                                                                                                                                                                     |
|-------------|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 10-Dec-2014 | 1        | First release.                                                                                                                                                                                                                                                                              |
| 16-Dec-2014 | 2        | Document status promoted from preliminary to production data.                                                                                                                                                                                                                               |
| 16-Nov-2016 | 3        | The part number STW265N6F6AG has been moved to a separate datasheet.<br>Updated title, cover image, features and description in cover page.<br>Updated <i>Table 1: "Device summary"</i> , <i>Table 3: "Thermal data"</i> , <i>Section 4: "Package information"</i> .<br>Minor text changes. |

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