

## Automotive-grade high voltage ignition coil driver NPN power Darlington transistor

Datasheet - production data

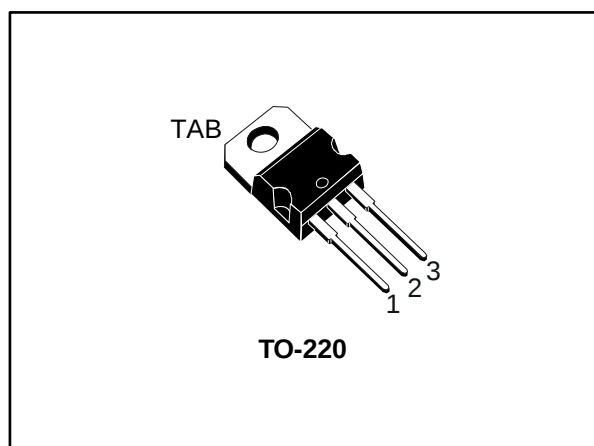


Figure 1: Internal schematic diagram

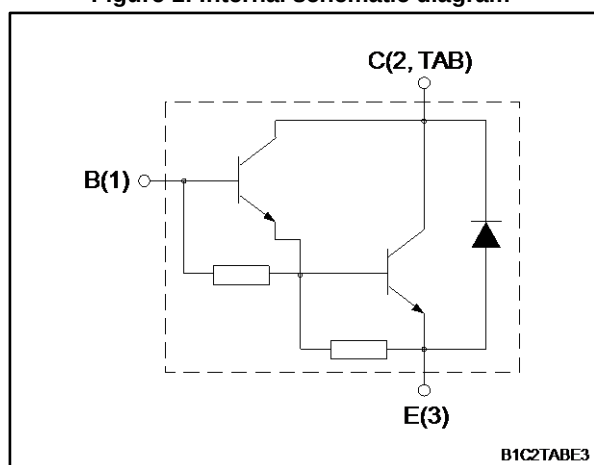


Table 1: Device summary

| Order code | Marking | Package | Packing |
|------------|---------|---------|---------|
| BU931T     | BU931T  | TO-220  | Tube    |

### Features

- AEC-Q101 qualified
- Very rugged Bipolar technology
- High operating junction temperature



### Applications

- High ruggedness electronic ignitions

### Description

This is a high voltage power Darlington transistor developed using multi-epitaxial planar technology. It has been properly designed for automotive environment as electronic ignition power actuators.

---

## Contents

|          |                                              |           |
|----------|----------------------------------------------|-----------|
| <b>1</b> | <b>Electrical ratings .....</b>              | <b>3</b>  |
| <b>2</b> | <b>Electrical characteristics .....</b>      | <b>4</b>  |
|          | 2.1 Electrical characteristics (curves)..... | 5         |
| <b>3</b> | <b>Test circuits .....</b>                   | <b>7</b>  |
| <b>4</b> | <b>Package information .....</b>             | <b>8</b>  |
|          | 4.1 TO-220 type A package information.....   | 9         |
| <b>5</b> | <b>Revision history .....</b>                | <b>11</b> |

# 1 Electrical ratings

Table 2: Absolute maximum ratings

| Symbol    | Parameter                                  | Value      | Unit |
|-----------|--------------------------------------------|------------|------|
| $V_{CES}$ | Collector-emitter voltage ( $V_{BE} = 0$ ) | 500        | V    |
| $V_{CEO}$ | Collector-emitter voltage ( $I_B = 0$ )    | 400        | V    |
| $V_{EBO}$ | Emitter-base voltage ( $I_C = 0$ )         | 5          | V    |
| $I_C$     | Collector current                          | 10         | A    |
| $I_{CM}$  | Collector peak current                     | 20         | A    |
| $I_B$     | Base current                               | 1          | A    |
| $I_{BM}$  | Base peak current                          | 5          | A    |
| $P_{TOT}$ | Total dissipation at $T_c = 25\text{ °C}$  | 125        | W    |
| $T_{stg}$ | Storage temperature range                  | -65 to 175 | °C   |
| $T_j$     | Operating junction temperature range       |            | °C   |

Table 3: Thermal data

| Symbol     | Parameter                           | Value | Unit |
|------------|-------------------------------------|-------|------|
| $R_{thJC}$ | Thermal resistance junction-case    | 1.2   | °C/W |
| $R_{thJA}$ | Thermal resistance junction-ambient | 62.5  | °C/W |

## 2 Electrical characteristics

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

**Table 4: Electrical characteristics**

| Symbol                        | Parameter                            | Test conditions                                                                                                                           | Min. | Typ. | Max. | Unit          |
|-------------------------------|--------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|---------------|
| $I_{CES}$                     | Collector cut-off current            | $V_{BE} = 0\text{ V}$ , $V_{CE} = 500\text{ V}$                                                                                           |      | -    | 100  | $\mu\text{A}$ |
|                               |                                      | $V_{BE} = 0\text{ V}$ , $V_{CE} = 500\text{ V}$ ,<br>$T_C = 125\text{ }^{\circ}\text{C}$ <sup>(1)</sup>                                   |      | -    | 0.5  | $\text{mA}$   |
| $I_{CEO}$                     | Collector cut-off current            | $I_B = 0\text{ A}$ , $V_{CE} = 450\text{ V}$                                                                                              |      | -    | 100  | $\mu\text{A}$ |
|                               |                                      | $I_B = 0\text{ A}$ , $V_{CE} = 450\text{ V}$ ,<br>$T_C = 125\text{ }^{\circ}\text{C}$ <sup>(1)</sup>                                      |      | -    | 0.5  | $\text{mA}$   |
| $I_{EBO}$                     | Emitter cut-off current              | $I_C = 0\text{ A}$ , $V_{EB} = 5\text{ V}$                                                                                                |      | -    | 20   | $\text{mA}$   |
| $V_{CEO(sus)}$ <sup>(2)</sup> | Collector-emitter sustaining voltage | $I_B = 0\text{ A}$ , $I_C = 100\text{ mA}$                                                                                                | 400  | -    |      | $\text{V}$    |
| $V_{CE(sat)}$ <sup>(2)</sup>  | Collector-emitter saturation voltage | $I_C = 7\text{ A}$ , $I_B = 70\text{ mA}$                                                                                                 |      | -    | 1.6  | $\text{V}$    |
|                               |                                      | $I_C = 8\text{ A}$ , $I_B = 100\text{ mA}$                                                                                                |      | -    | 1.8  | $\text{V}$    |
|                               |                                      | $I_C = 10\text{ A}$ , $I_B = 250\text{ mA}$                                                                                               |      | -    | 1.8  | $\text{V}$    |
| $V_{BE(sat)}$ <sup>(2)</sup>  | Base-emitter saturation voltage      | $I_C = 7\text{ A}$ , $I_B = 70\text{ mA}$                                                                                                 |      | -    | 2.2  | $\text{V}$    |
|                               |                                      | $I_C = 8\text{ A}$ , $I_B = 100\text{ mA}$                                                                                                |      | -    | 2.4  | $\text{V}$    |
|                               |                                      | $I_C = 10\text{ A}$ , $I_B = 250\text{ mA}$                                                                                               |      | -    | 2.5  | $\text{V}$    |
| $h_{FE}$ <sup>(2)</sup>       | DC current gain                      | $I_C = 5\text{ A}$ , $V_{CE} = 10\text{ V}$                                                                                               | 300  | -    |      |               |
| $V_F$                         | Diode forward voltage                | $I_F = 10\text{ A}$                                                                                                                       |      | -    | 2.5  | $\text{V}$    |
|                               | Functional test                      | $V_{CC} = 24\text{ V}$ , $L = 7\text{ mH}$ ,<br>$V_{clamp} = 400\text{ V}$<br>(see <a href="#">Figure 10: "Functional test circuit"</a> ) | 8    | -    |      | $\text{A}$    |

**Notes:**

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

<sup>(2)</sup>Pulse test: pulse duration  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$ .

**Table 5: Inductive load switching times**

| Symbol | Parameter    | Test conditions                                                                                                                                      | Min. | Typ. | Max. | Unit          |
|--------|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|---------------|
| $t_s$  | Storage time | $V_{CC} = 12\text{ V}$ , $V_{clamp} = 300\text{ V}$ , $L = 7\text{ mH}$ ,<br>$R_{BE} = 47\text{ }\Omega$ , $I_C = 7\text{ A}$ , $I_B = 70\text{ mA}$ | -    | 15   | -    | $\mu\text{s}$ |
| $t_f$  | Fall time    |                                                                                                                                                      | -    | 0.5  | -    | $\mu\text{s}$ |

## 2.1 Electrical characteristics (curves)

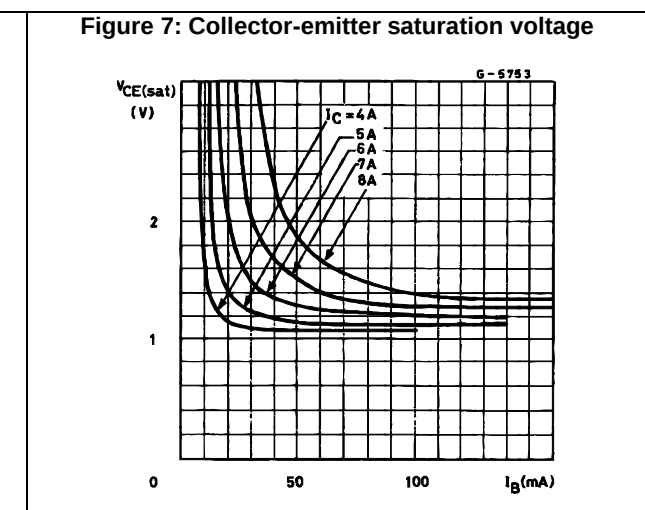
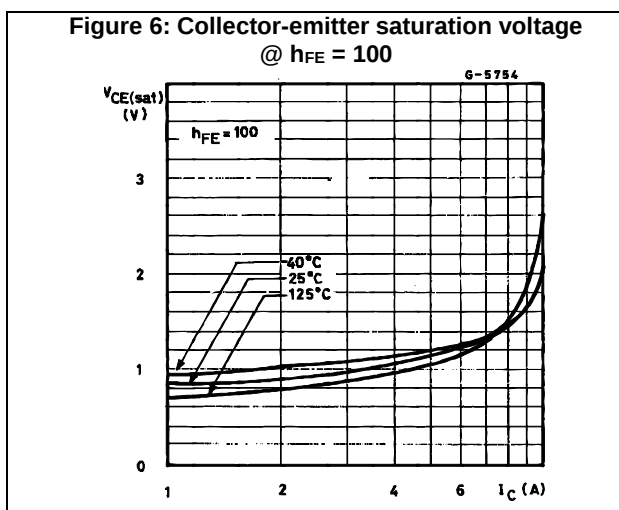
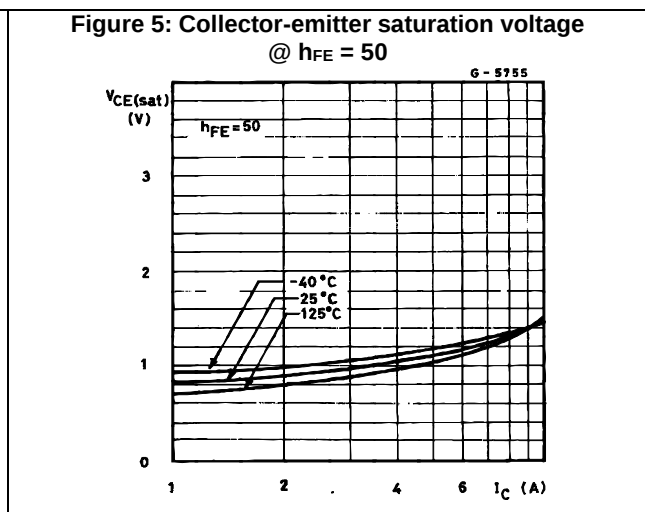
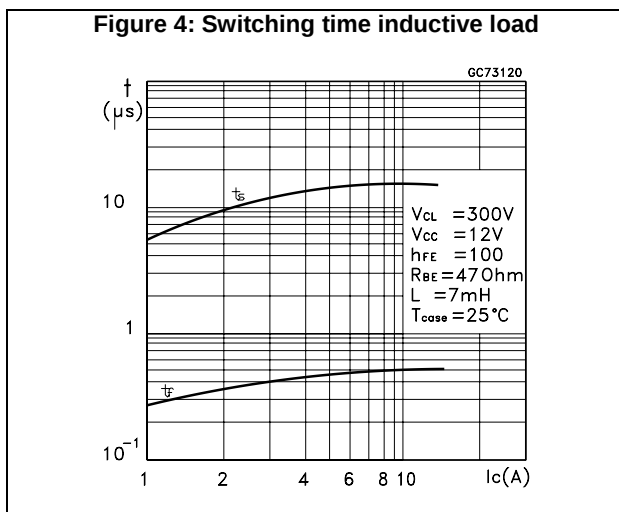
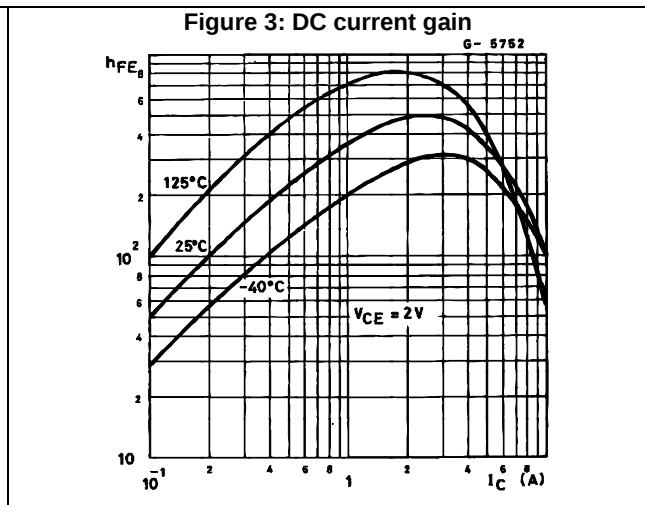
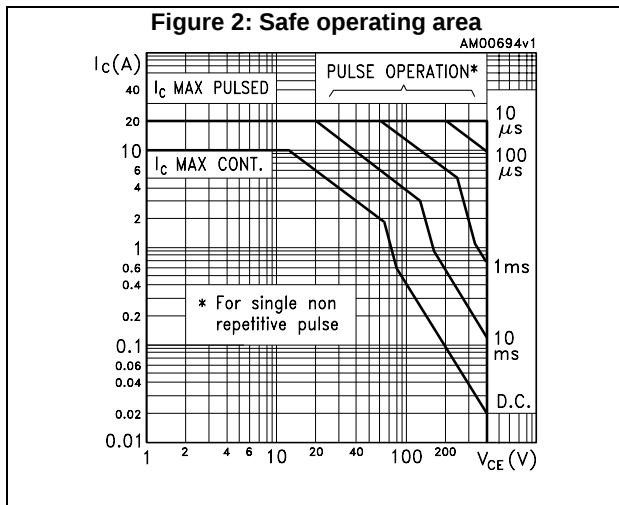
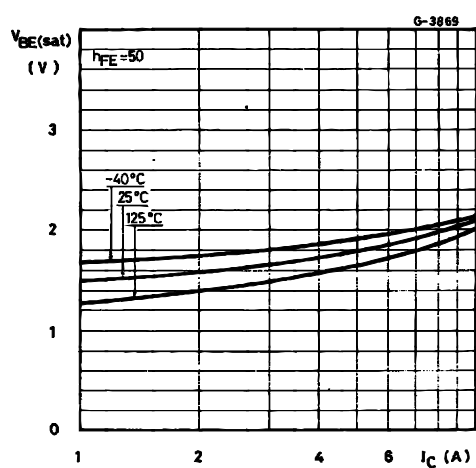
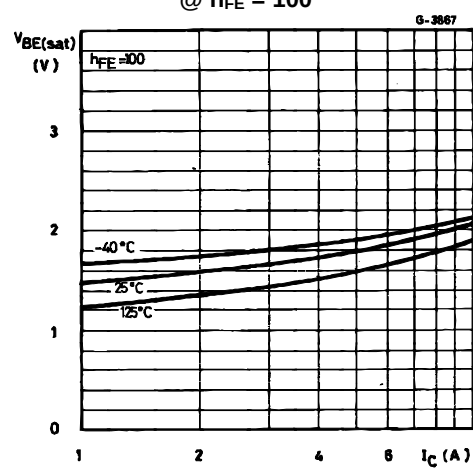


Figure 8: Base-emitter saturation voltage @  $h_{FE} = 50$ Figure 9: Base-emitter saturation voltage @  $h_{FE} = 100$ 

### 3 Test circuits

Figure 10: Functional test circuit

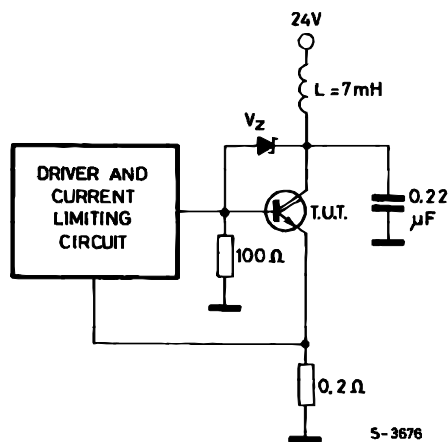


Figure 11: Functional test waveforms

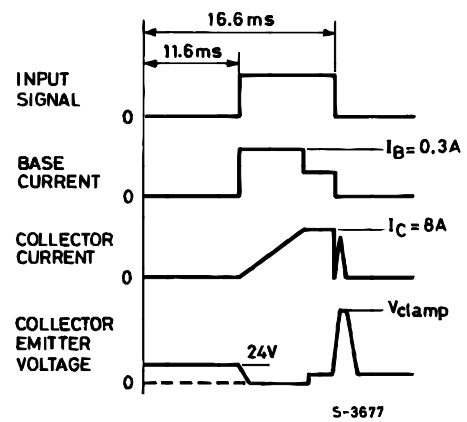


Figure 12: Switching time test circuit

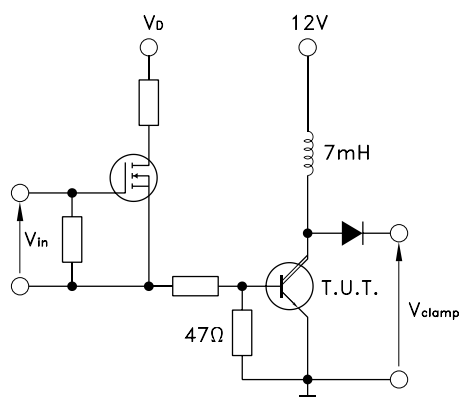
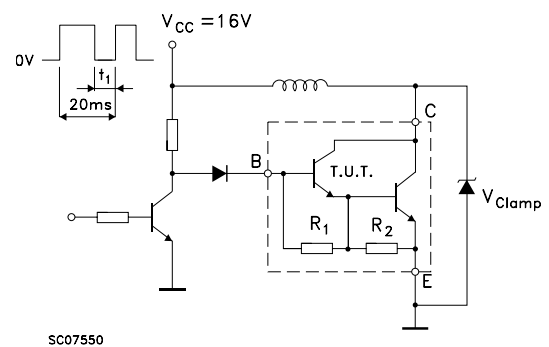


Figure 13: Sustaining voltage test circuit



## 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 type A package information

Figure 14: TO-220 type A package outline

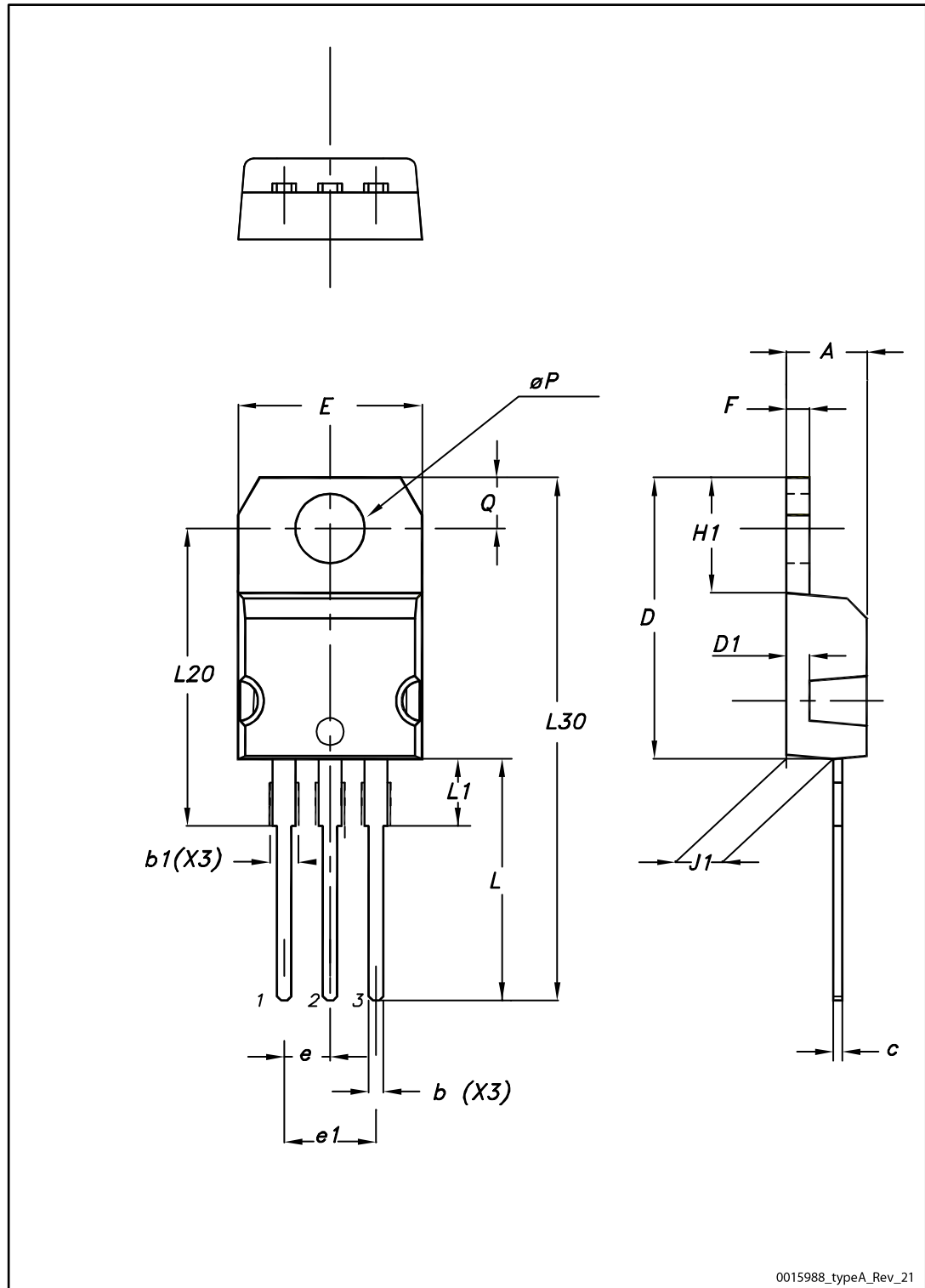


Table 6: TO-220 type A package mechanical data

| 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 7: Document revision history**

| Date        | Revision | Changes                                                                                                                                                                                                                                                                                              |
|-------------|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 18-Nov-2008 | 3        | Package changed from TO-218 to TO-247 for BU931P.<br>Inserted type in TO-220 (BU931T).                                                                                                                                                                                                               |
| 02-Dec-2009 | 4        | Modified $I_C$ test condition value of $V_{CEO(sus)}$ parameter <i>Table 4 on page 4</i> , updated TO-220 package mechanical data.                                                                                                                                                                   |
| 12-Oct-2017 | 5        | The part numbers BU931 and BU931P have been moved to two separate datasheets.<br>Modified <i>Table 2: "Absolute maximum ratings"</i> , <i>Table 3: "Thermal data"</i> and <i>Table 4: "Electrical characteristics"</i> .<br>Updated <i>Section 4: "Package information"</i> .<br>Minor text changes. |

**IMPORTANT NOTICE – PLEASE READ CAREFULLY**

STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, enhancements, modifications, and improvements to ST products and/or to this document at any time without notice. Purchasers should obtain the latest relevant information on ST products before placing orders. ST products are sold pursuant to ST's terms and conditions of sale in place at the time of order acknowledgement.

Purchasers are solely responsible for the choice, selection, and use of ST products and ST assumes no liability for application assistance or the design of Purchasers' products.

No license, express or implied, to any intellectual property right is granted by ST herein.

Resale of ST products with provisions different from the information set forth herein shall void any warranty granted by ST for such product.

ST and the ST logo are trademarks of ST. All other product or service names are the property of their respective owners.

Information in this document supersedes and replaces information previously supplied in any prior versions of this document.

© 2017 STMicroelectronics – All rights reserved