



# BU931 BU931P, BU931T

High voltage ignition coil driver  
NPN power Darlington transistors

## Features

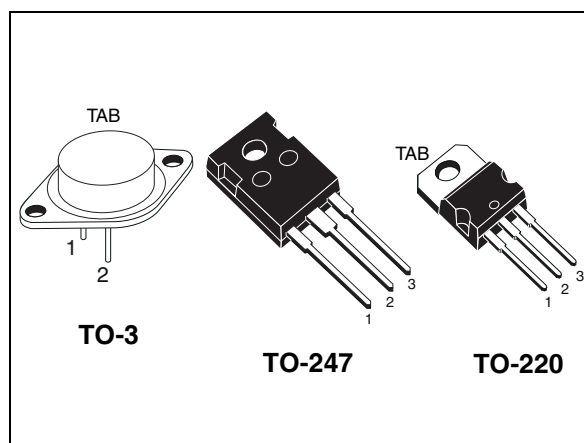
- Very rugged Bipolar technology
- High operating junction temperature
- Wide range of packages

## Application

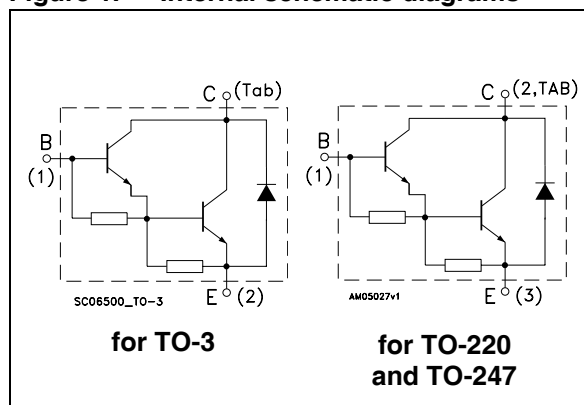
- High ruggedness electronic ignitions

## Description

The devices are bipolar Darlington transistors manufactured using multi-epitaxial planar technology. They have been properly designed to be used in automotive environment as electronic ignition power actuators.



**Figure 1. Internal schematic diagrams**



**Table 1. Device summary**

| Order codes | Marking | Packages | Packaging |
|-------------|---------|----------|-----------|
| BU931       | BU931   | TO-3     | Tray      |
| BU931P      | BU931P  | TO-247   | Tube      |
| BU931T      | BU931T  | TO-220   | Tube      |

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol           | Parameter                                       | Value      |            |        | Unit |
|------------------|-------------------------------------------------|------------|------------|--------|------|
|                  |                                                 | BU931      | BU931P     | BU931T |      |
| V <sub>CES</sub> | Collector-emitter voltage (V <sub>BE</sub> = 0) | 500        |            |        | V    |
| V <sub>CEO</sub> | Collector-emitter voltage (I <sub>B</sub> = 0)  | 400        |            |        | V    |
| V <sub>EBO</sub> | Emitter-base voltage (I <sub>C</sub> = 0)       | 5          |            |        | V    |
| I <sub>C</sub>   | Collector current                               | 15         |            | 10     | A    |
| I <sub>CM</sub>  | Collector peak current                          | 30         |            | 20     | A    |
| I <sub>B</sub>   | Base current                                    | 1          |            |        | A    |
| I <sub>BM</sub>  | Base peak current                               | 5          |            |        | A    |
| P <sub>TOT</sub> | Total dissipation at T <sub>C</sub> = 25 °C     | 175        | 135        | 125    | W    |
| T <sub>STG</sub> | Storage temperature                             | -65 to 200 | -65 to 175 |        | °C   |
| T <sub>J</sub>   | Max. operating junction temperature             | 200        | 175        |        |      |

**Table 3. Thermal data**

| Symbol     | Parameter                             | Value |        |        | Unit |
|------------|---------------------------------------|-------|--------|--------|------|
|            |                                       | BU931 | BU931P | BU931T |      |
| $R_{thJC}$ | Thermal resistance junction-case max. | 1     | 1.1    | 1.2    | °C/W |

## 2 Electrical characteristics

$T_{\text{case}} = 25\text{ }^{\circ}\text{C}$ ; unless otherwise specified.

**Table 4. Electrical characteristics**

| Symbol                           | Parameter                                                      | Test conditions                                                                                                                                                                                                                           | Min. | Typ.      | Max.              | Unit                                   |
|----------------------------------|----------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-----------|-------------------|----------------------------------------|
| $I_{\text{CES}}$                 | Collector cut-off current<br>( $V_{\text{BE}} = 0$ )           | $V_{\text{CE}} = 500\text{ V}$<br>$V_{\text{CE}} = 500\text{ V}$ $T_{\text{C}} = 125\text{ }^{\circ}\text{C}$                                                                                                                             |      |           | 100<br>0.5        | $\mu\text{A}$<br>$\text{mA}$           |
| $I_{\text{CEO}}$                 | Collector cut-off current<br>( $I_{\text{B}} = 0$ )            | $V_{\text{CE}} = 450\text{ V}$<br>$V_{\text{CE}} = 450\text{ V}$ $T_{\text{C}} = 125\text{ }^{\circ}\text{C}$                                                                                                                             |      |           | 100<br>0.5        | $\mu\text{A}$<br>$\text{mA}$           |
| $I_{\text{EBO}}$                 | Emitter cut-off current<br>( $I_{\text{C}} = 0$ )              | $V_{\text{EB}} = 5\text{ V}$                                                                                                                                                                                                              |      |           | 20                | $\text{mA}$                            |
| $V_{\text{CEO(sus)}}^{(1)}$      | Collector-emitter<br>sustaining voltage ( $I_{\text{B}} = 0$ ) | $I_{\text{C}} = 100\text{ mA}$ $L = 10\text{ mH}$<br>$V_{\text{clamp}} = 400\text{ V}$<br>see <a href="#">Figure 14</a>                                                                                                                   | 400  |           |                   | $\text{V}$                             |
| $V_{\text{CE(sat)}}^{(1)}$       | Collector-emitter<br>saturation voltage                        | $I_{\text{C}} = 7\text{ A}$ $I_{\text{B}} = 70\text{ mA}$<br>$I_{\text{C}} = 8\text{ A}$ $I_{\text{B}} = 100\text{ mA}$<br>$I_{\text{C}} = 10\text{ A}$ $I_{\text{B}} = 250\text{ mA}$                                                    |      |           | 1.6<br>1.8<br>1.8 | $\text{V}$<br>$\text{V}$<br>$\text{V}$ |
| $V_{\text{BE(sat)}}^{(1)}$       | Base-emitter saturation<br>voltage                             | $I_{\text{C}} = 7\text{ A}$ $I_{\text{B}} = 70\text{ mA}$<br>$I_{\text{C}} = 8\text{ A}$ $I_{\text{B}} = 100\text{ mA}$<br>$I_{\text{C}} = 10\text{ A}$ $I_{\text{B}} = 250\text{ mA}$                                                    |      |           | 2.2<br>2.4<br>2.5 | $\text{V}$<br>$\text{V}$<br>$\text{V}$ |
| $h_{\text{FE}}^{(1)}$            | DC current gain                                                | $I_{\text{C}} = 5\text{ A}$ $V_{\text{CE}} = 10\text{ V}$                                                                                                                                                                                 | 300  |           |                   |                                        |
| $V_{\text{F}}$                   | Diode forward voltage                                          | $I_{\text{F}} = 10\text{ A}$                                                                                                                                                                                                              |      |           | 2.5               | $\text{V}$                             |
|                                  | Functional test                                                | $V_{\text{CC}} = 24\text{ V}$ $L = 7\text{ mH}$<br>$V_{\text{clamp}} = 400\text{ V}$<br>see <a href="#">Figure 11</a>                                                                                                                     | 8    |           |                   | $\text{A}$                             |
| $t_{\text{s}}$<br>$t_{\text{f}}$ | Inductive Load<br>Storage time<br>Fall time                    | $I_{\text{C}} = 7\text{ A}$ $V_{\text{clamp}} = 300\text{ V}$<br>$I_{\text{B}} = 70\text{ mA}$ $L = 7\text{ mH}$<br>$V_{\text{BE}} = 0$ $R_{\text{BE}} = 47\text{ }\Omega$<br>$V_{\text{CC}} = 12\text{ V}$ see <a href="#">Figure 13</a> |      | 15<br>0.5 |                   | $\mu\text{s}$<br>$\mu\text{s}$         |

1. Pulse test: pulse duration  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$

2.1 Electrical characteristics (curves)

Figure 2. Safe operating area for BU931 and BU931P

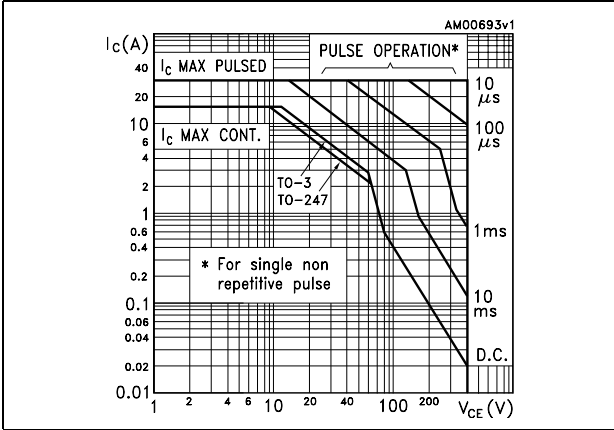


Figure 3. Safe operating area for BU931T

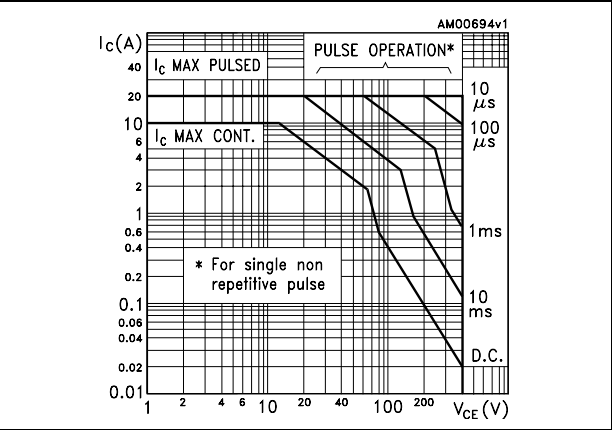


Figure 4. DC current gain

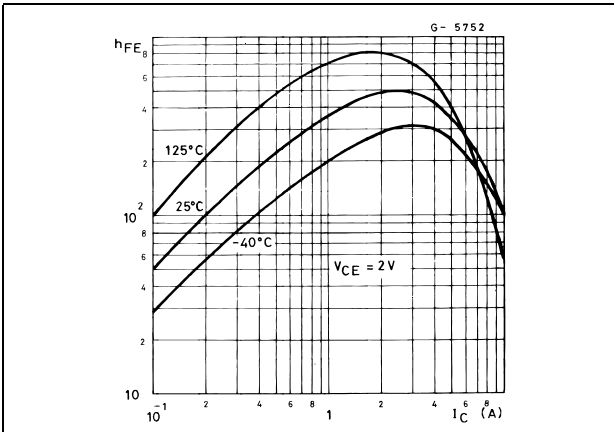


Figure 5. Switching time inductive load

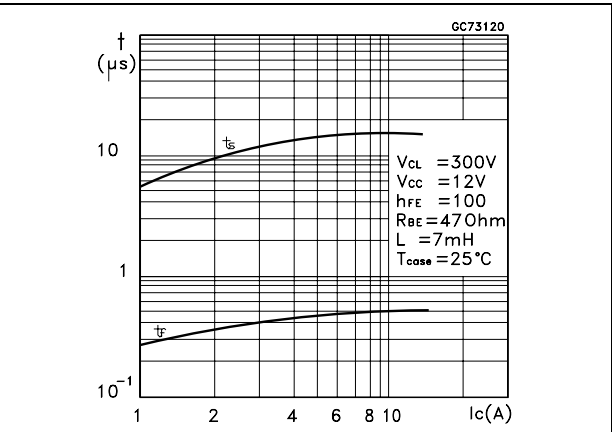


Figure 6. Collector-emitter saturation voltage @ h\_FE = 50

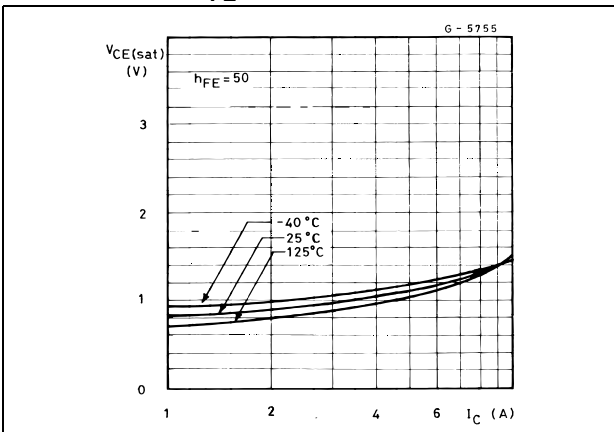


Figure 7. Collector-emitter saturation voltage @ h\_FE = 100

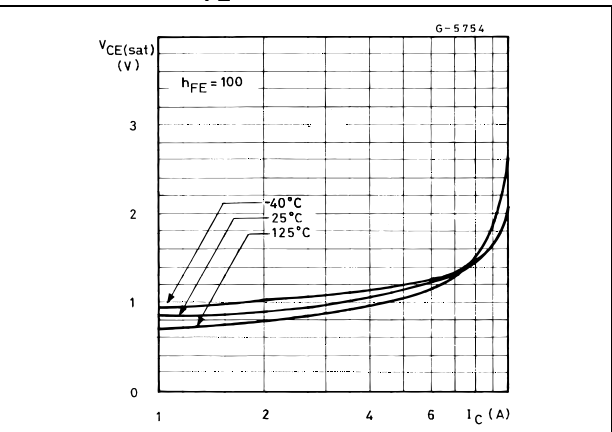


Figure 8. Collector-emitter saturation voltage Figure 9. Base-emitter saturation voltage @  $h_{FE} = 50$

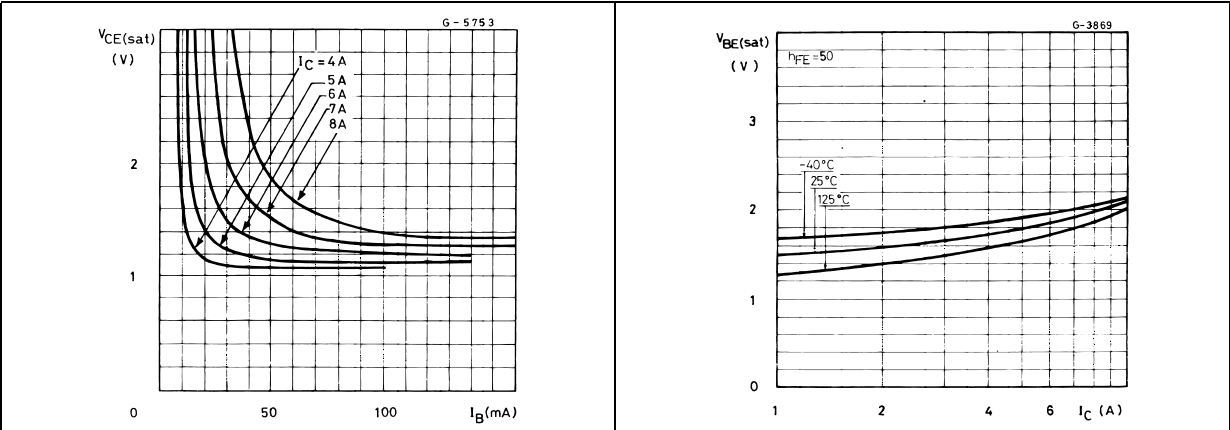
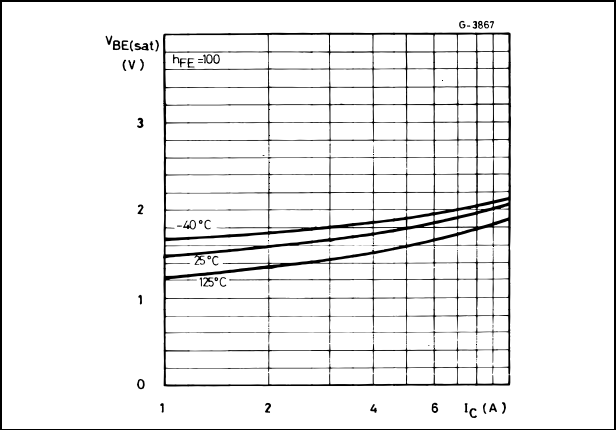


Figure 10. Base-emitter saturation voltage @  $h_{FE} = 100$



3 Test circuits

Figure 11. Functional test circuit

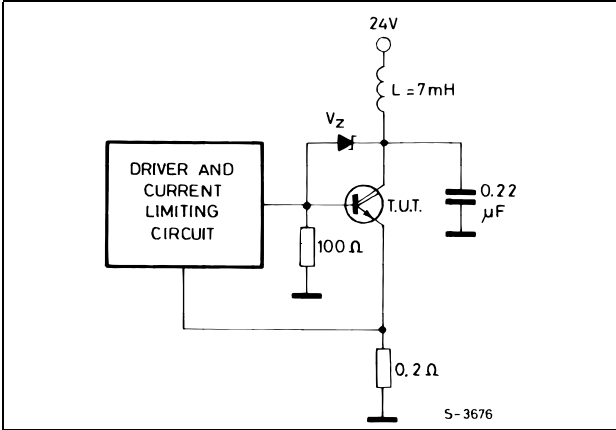


Figure 12. Functional test waveforms

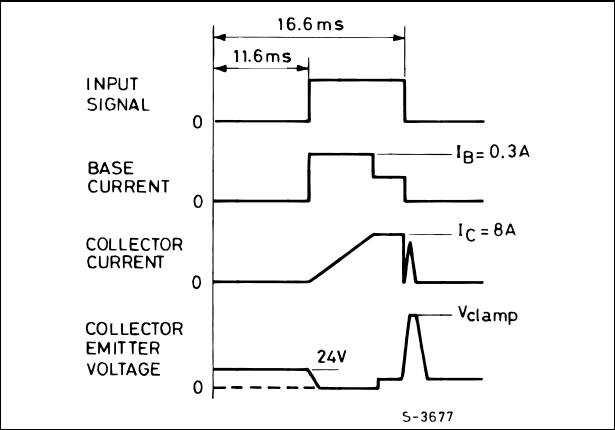


Figure 13. Switching time test circuit

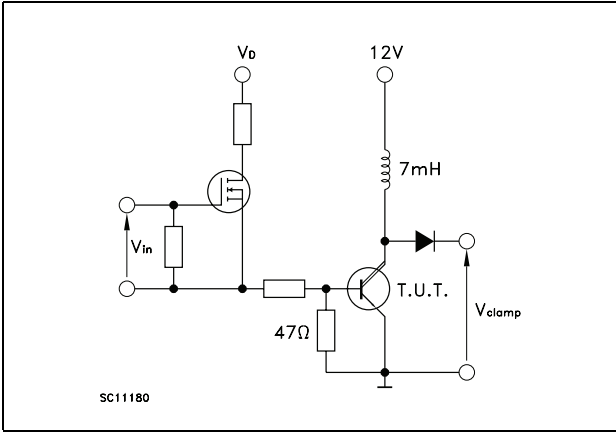
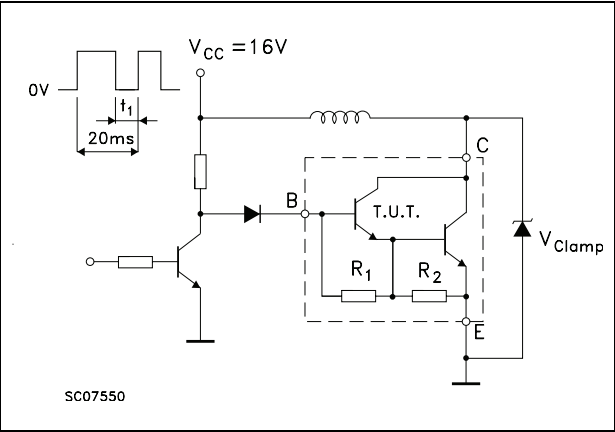


Figure 14. Sustaining voltage test circuit

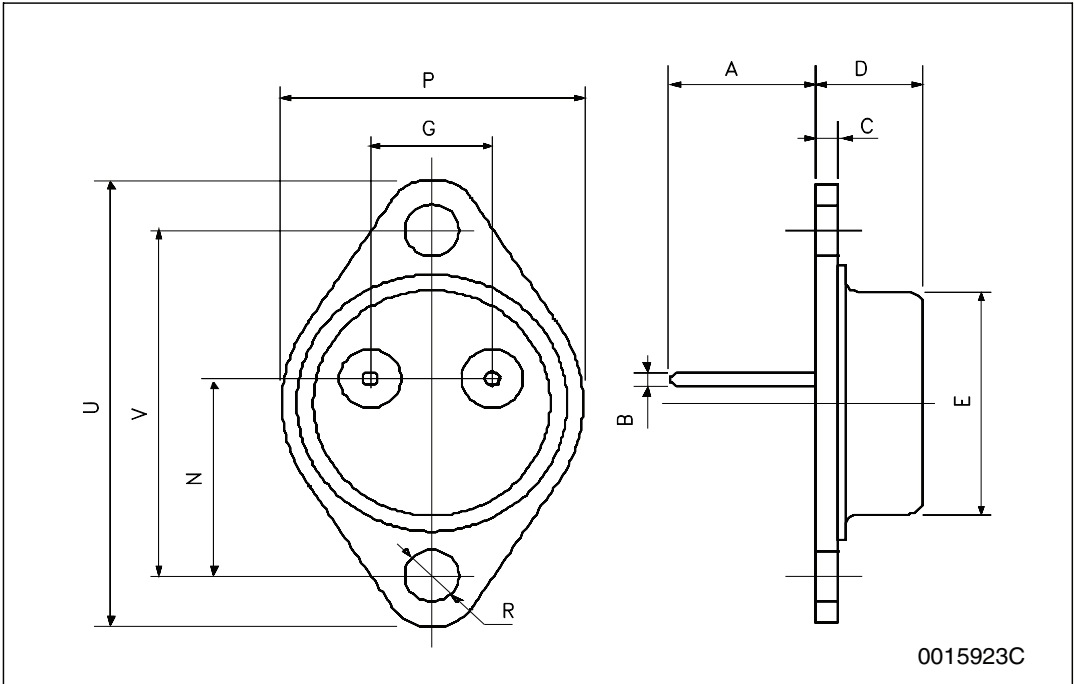


## 4 Package mechanical data

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.

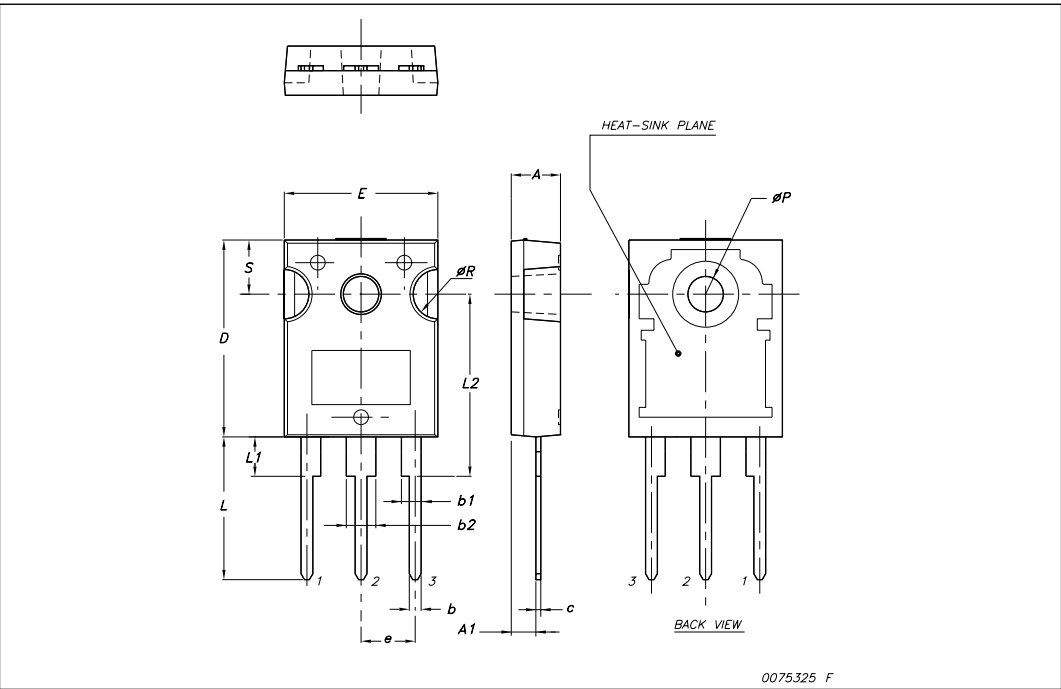
TO-3 mechanical data

| DIM. | mm.   |     |       |
|------|-------|-----|-------|
|      | min.  | typ | max.  |
| A    | 11.00 |     | 13.10 |
| B    | 0.97  |     | 1.15  |
| C    | 1.50  |     | 1.65  |
| D    | 8.32  |     | 8.92  |
| E    | 19.00 |     | 20.00 |
| G    | 10.70 |     | 11.10 |
| N    | 16.50 |     | 17.20 |
| P    | 25.00 |     | 26.00 |
| R    | 4.00  |     | 4.09  |
| U    | 38.50 |     | 39.30 |
| V    | 30.00 |     | 30.30 |



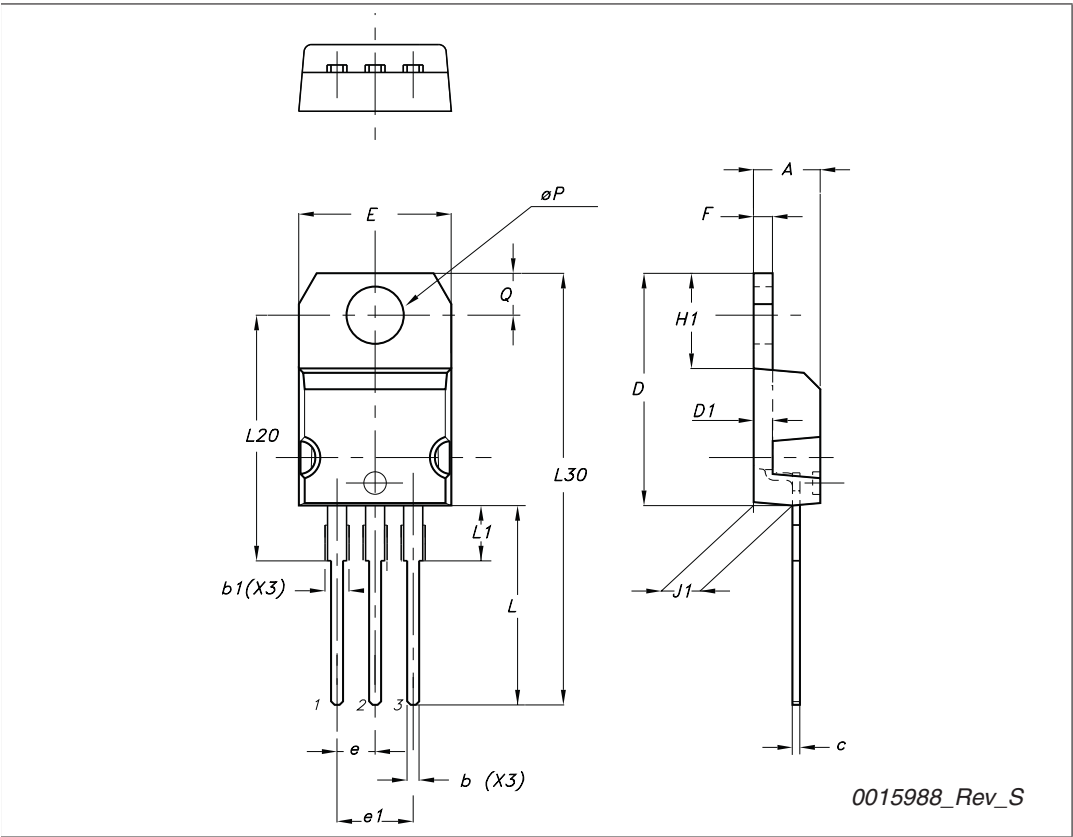
TO-247 Mechanical data

| Dim. | mm.   |       |       |
|------|-------|-------|-------|
|      | Min.  | Typ   | Max.  |
| A    | 4.85  |       | 5.15  |
| A1   | 2.20  |       | 2.60  |
| b    | 1.0   |       | 1.40  |
| b1   | 2.0   |       | 2.40  |
| b2   | 3.0   |       | 3.40  |
| c    | 0.40  |       | 0.80  |
| D    | 19.85 |       | 20.15 |
| E    | 15.45 |       | 15.75 |
| e    |       | 5.45  |       |
| L    | 14.20 |       | 14.80 |
| L1   | 3.70  |       | 4.30  |
| L2   |       | 18.50 |       |
| øP   | 3.55  |       | 3.65  |
| øR   | 4.50  |       | 5.50  |
| S    |       | 5.50  |       |



TO-220 type A mechanical data

| Dim | mm    |       |       |
|-----|-------|-------|-------|
|     | Min   | Typ   | Max   |
| A   | 4.40  |       | 4.60  |
| b   | 0.61  |       | 0.88  |
| b1  | 1.14  |       | 1.70  |
| c   | 0.48  |       | 0.70  |
| D   | 15.25 |       | 15.75 |
| D1  |       | 1.27  |       |
| E   | 10    |       | 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    |       | 14    |
| 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 5. 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 <a href="#">Table 4 on page 4</a> , updated TO-220 package mechanical data. |

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