



# 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.

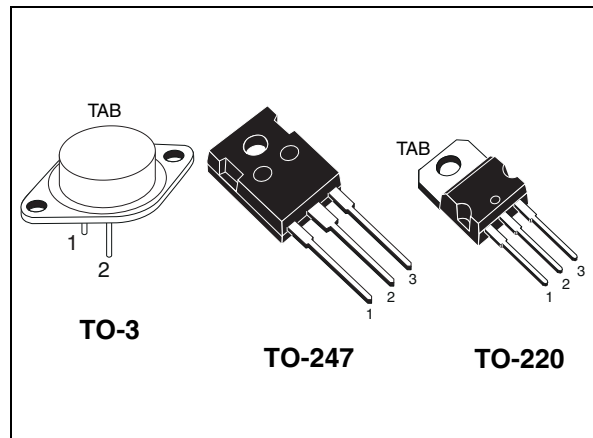


Figure 1. Internal schematic diagrams

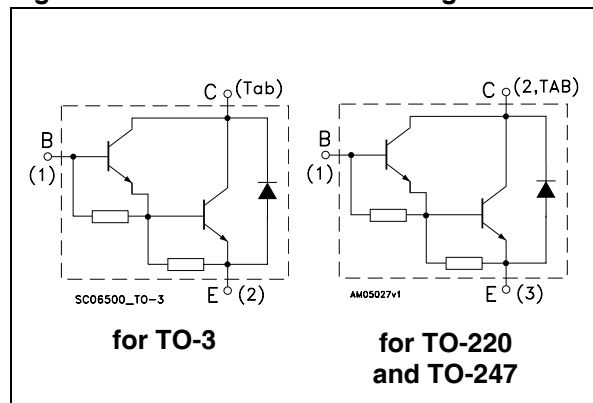


Table 1. Device summary

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	
$V_{CES}$	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	15		10	A
$I_{CM}$	Collector peak current	30		20	A
$I_B$	Base current	1			A
$I_{BM}$	Base peak current	5			A
$P_{TOT}$	Total dissipation at $T_c = 25\text{ °C}$	175	135	125	W
$T_{STG}$	Storage temperature	-65 to 200	-65 to 175		°C
$T_J$	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

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

**Table 4. Electrical characteristics**

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

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

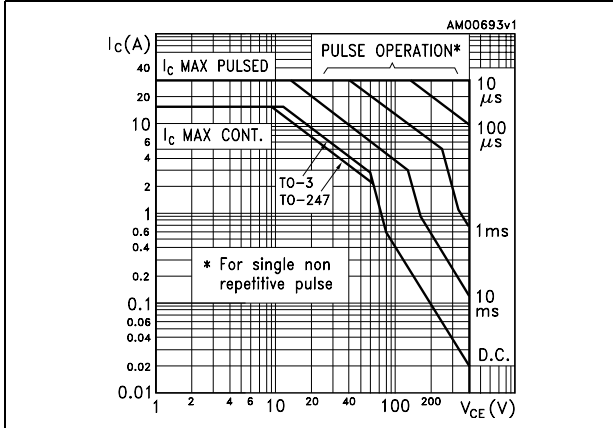


Figure 3. Safe operating area for BU931T

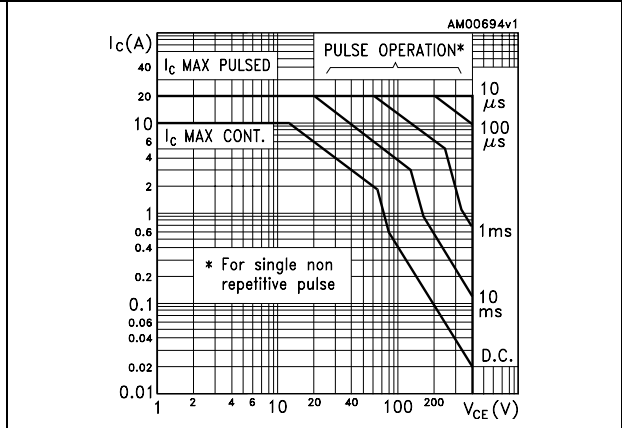


Figure 4. DC current gain

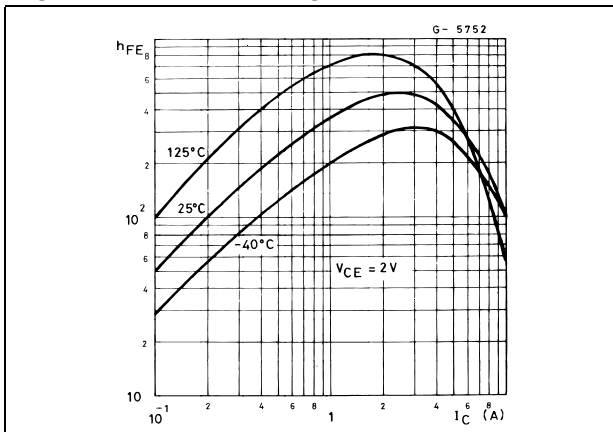


Figure 5. Switching time inductive load

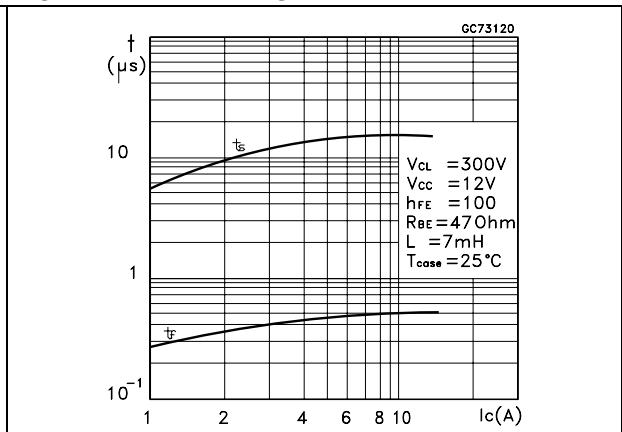


Figure 6. Collector-emitter saturation voltage @ h<sub>FE</sub> = 50

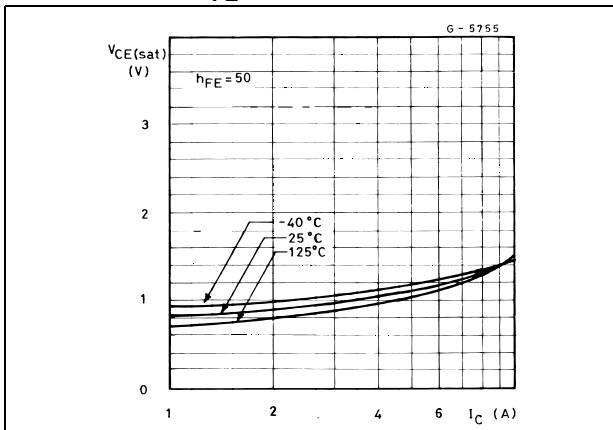


Figure 7. Collector-emitter saturation voltage @ h<sub>FE</sub> = 100

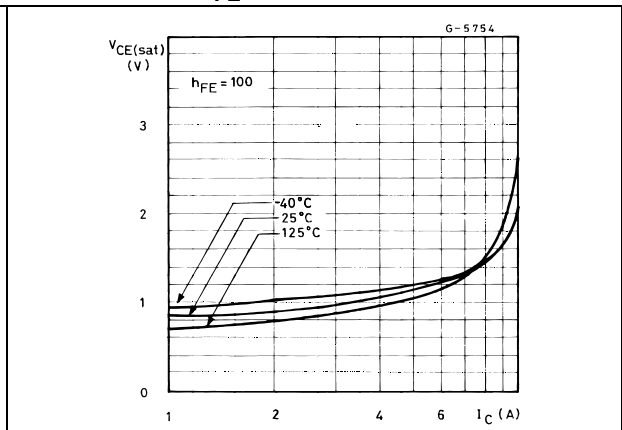


Figure 8. Collector-emitter saturation voltage Figure 9. Base-emitter saturation voltage @  $h_{FE} = 50$

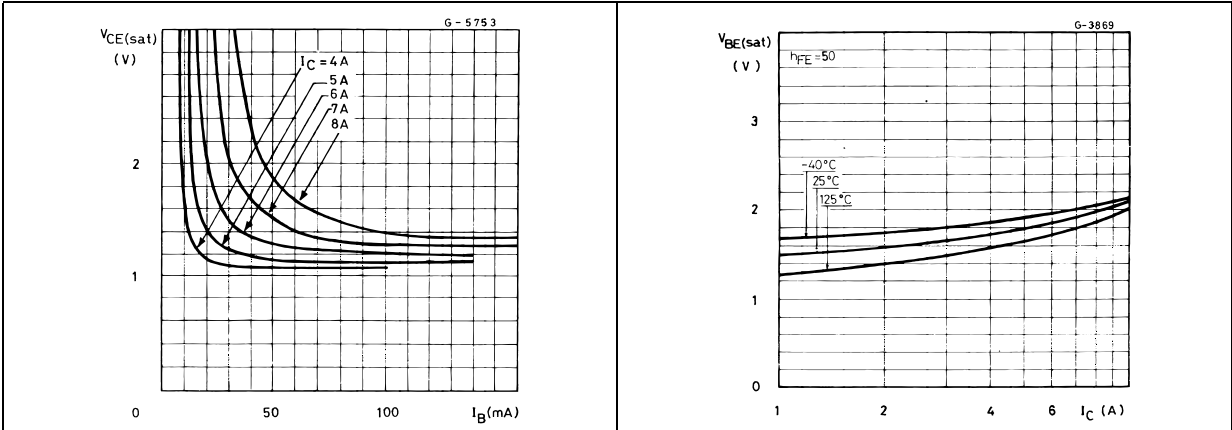
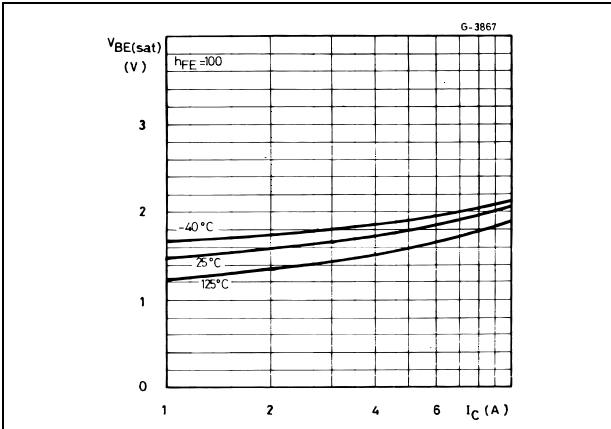


Figure 10. Base-emitter saturation voltage @  $h_{FE} = 100$



### 3 Test circuits

Figure 11. Functional test circuit

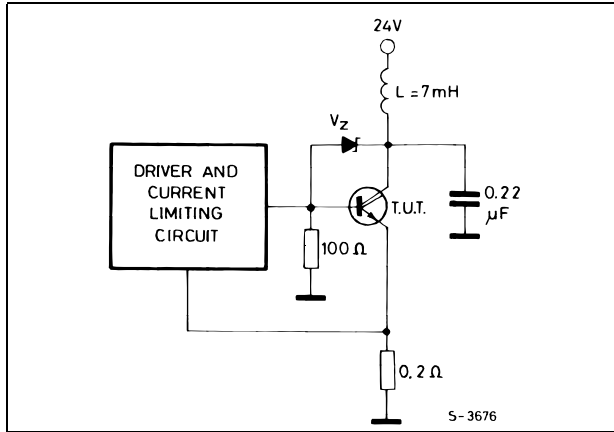


Figure 12. Functional test waveforms

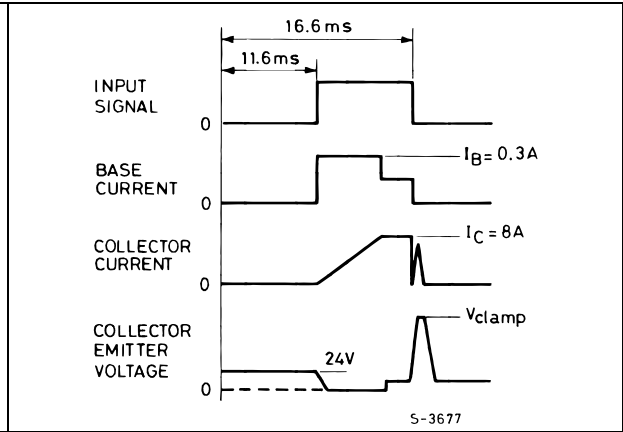


Figure 13. Switching time test circuit

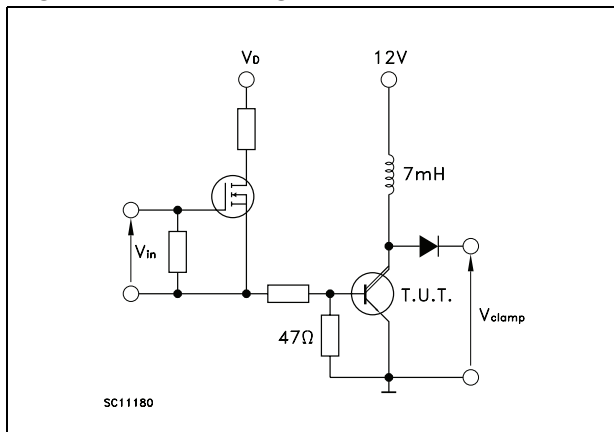
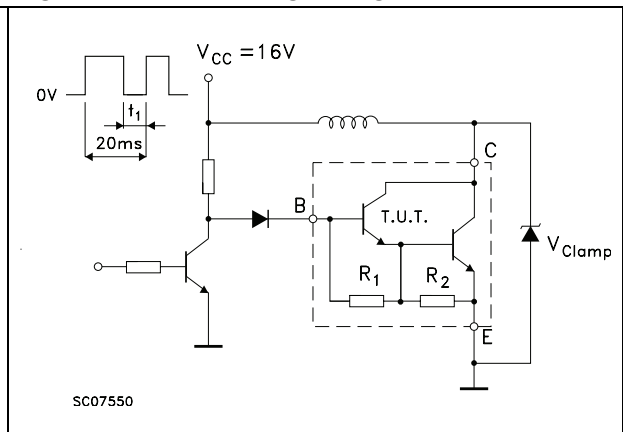


Figure 14. Sustaining voltage test circuit



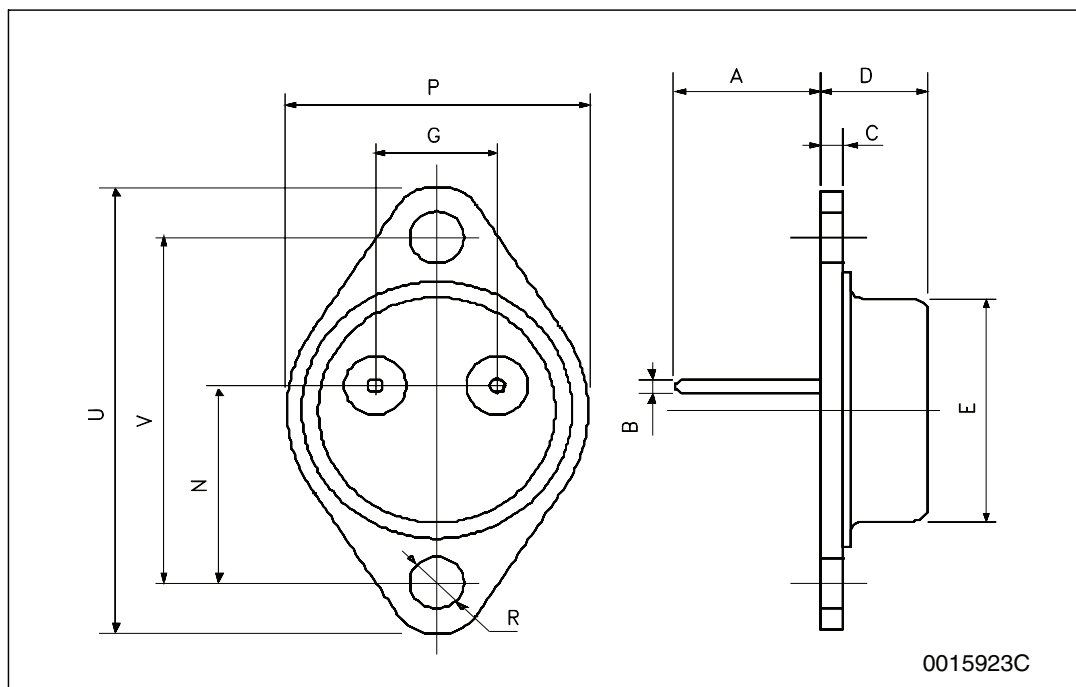
## 4 Package mechanical data

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.



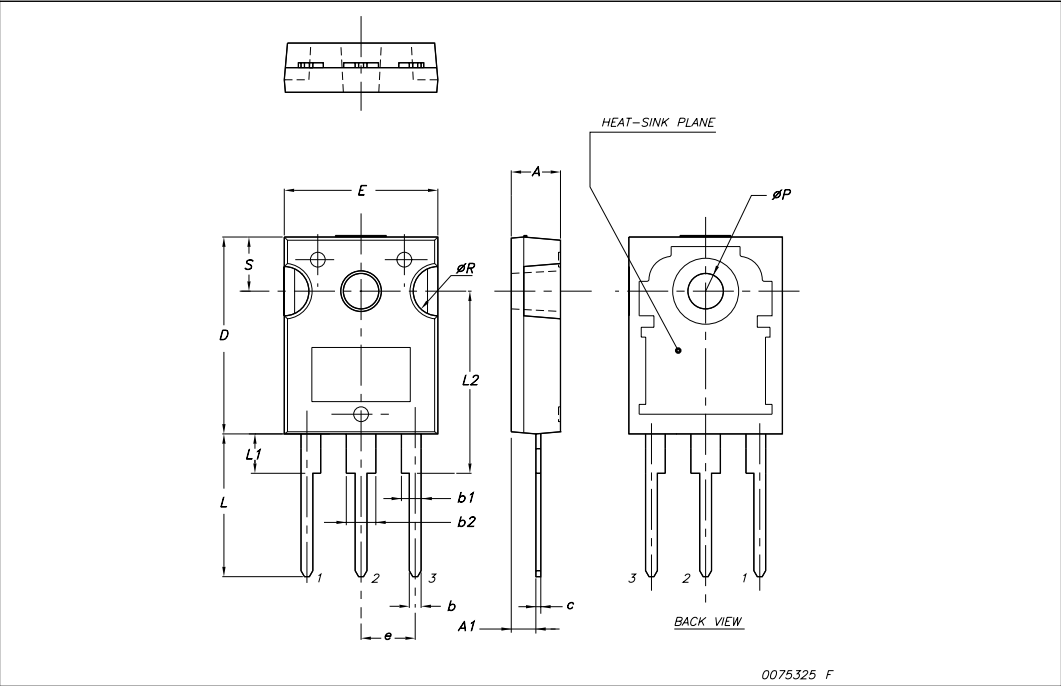
**TO-3 mechanical data**

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



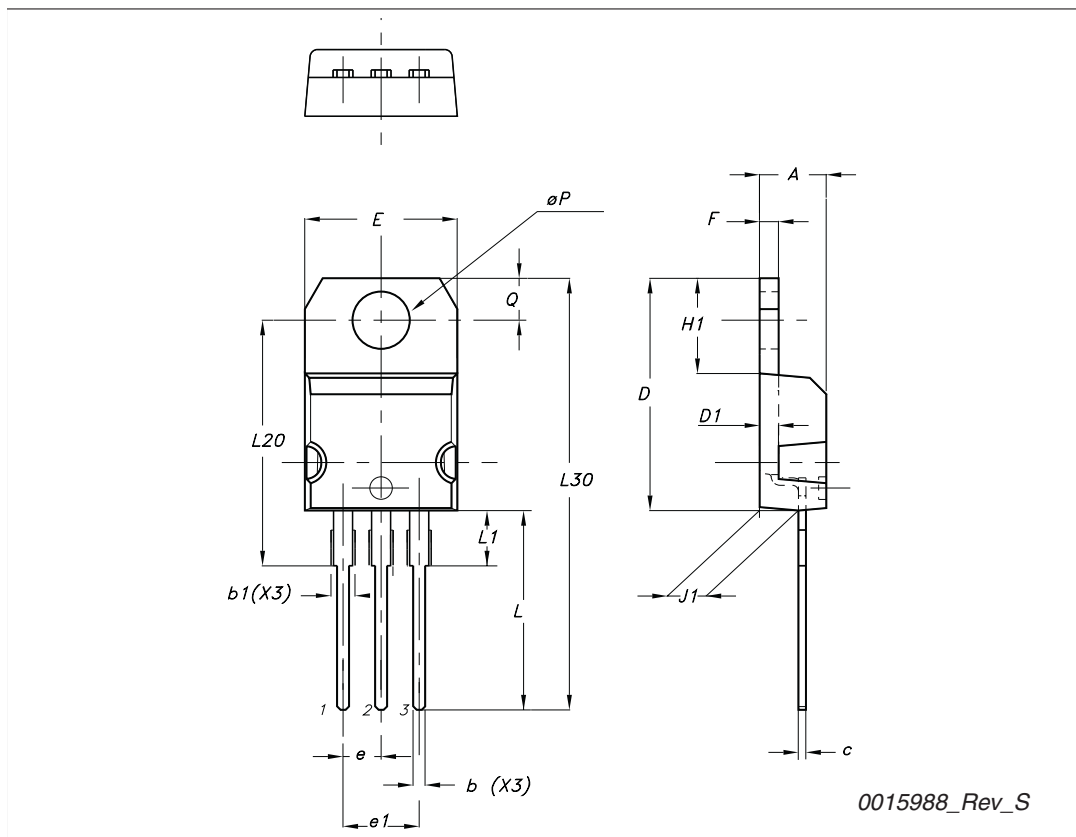
**TO-247 Mechanical data**

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	
∅P	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. 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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