



# 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

## Applications

- 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.

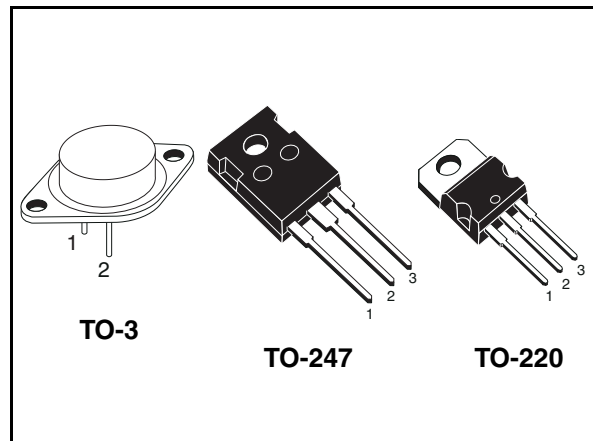


Figure 1. Internal schematic diagrams

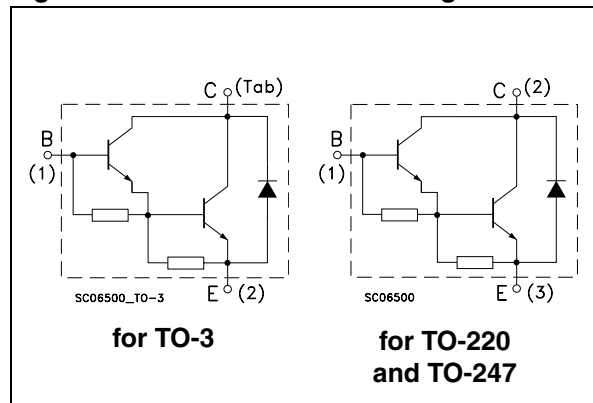


Table 1. Device summary

Order codes	Marking	Package	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	
$R_{thj-case}$	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 ( $I_{\text{B}} = 0$ )	$I_{\text{C}} = 10\text{ mA}$ $L = 10\text{ mH}$ $V_{\text{clamp}} = 400\text{ V}$ 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. Pulsed duration = 300  $\mu\text{s}$ , duty cycle  $\leq 1.5\%$

## 2.1 Electrical characteristics (curves)

Figure 2. Safe operating area for BU931 and BU931P      Figure 3. Safe operating area for BU931T and BU931P

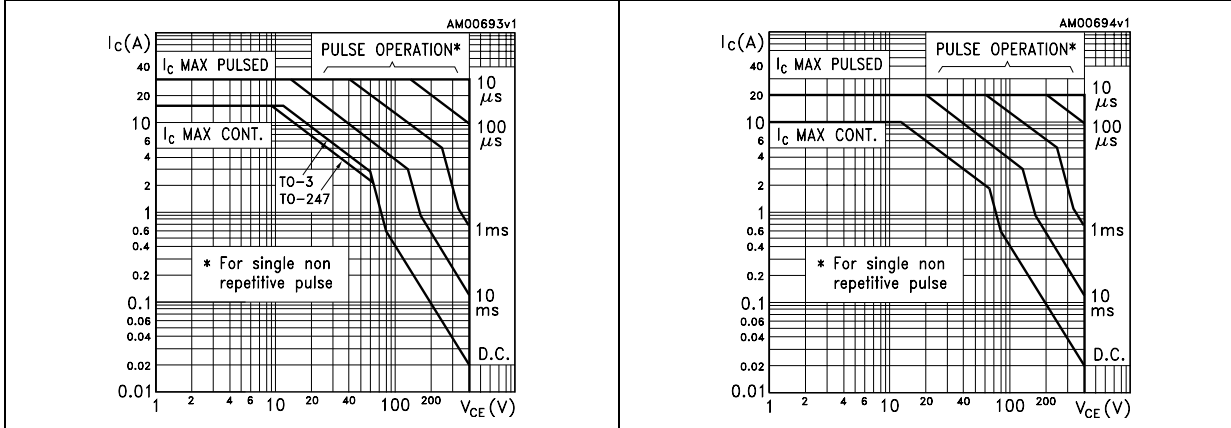


Figure 4. DC current gain

Figure 5. Switching time inductive load

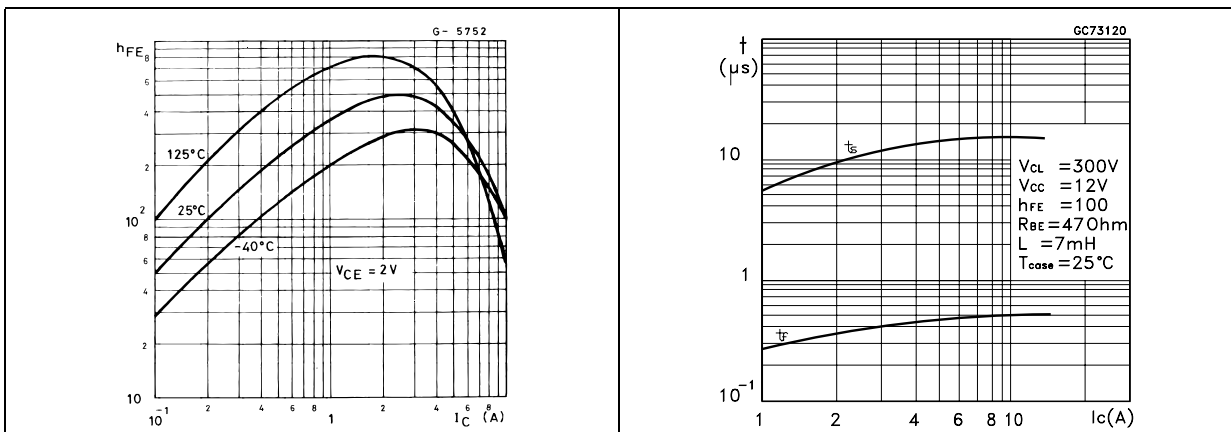


Figure 6. Collector-emitter saturation voltage @  $h_{FE} = 50$

Figure 7. Collector-emitter saturation voltage @  $h_{FE} = 100$

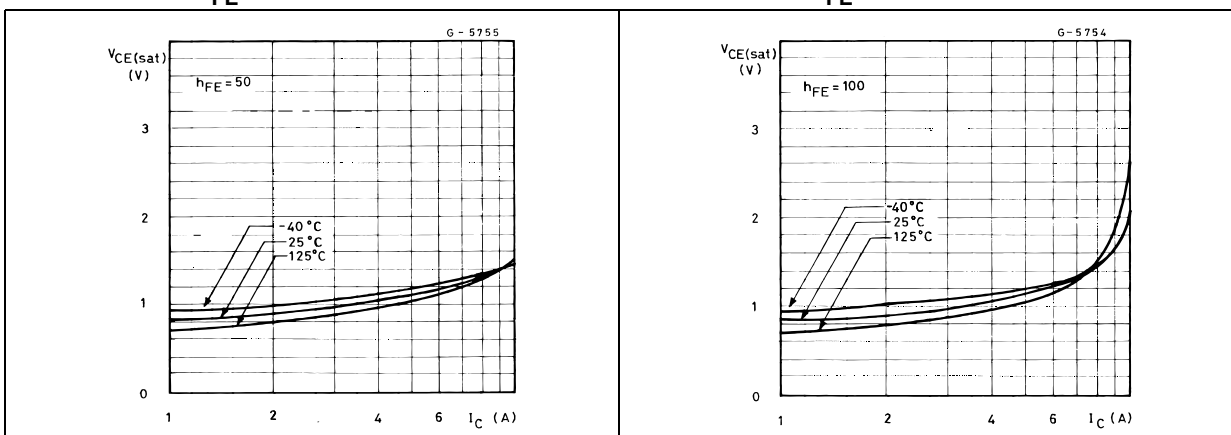


Figure 8. Collector-emitter saturation voltage Figure 9. Base-emitter saturation voltage @  $h_{FE} = 50$

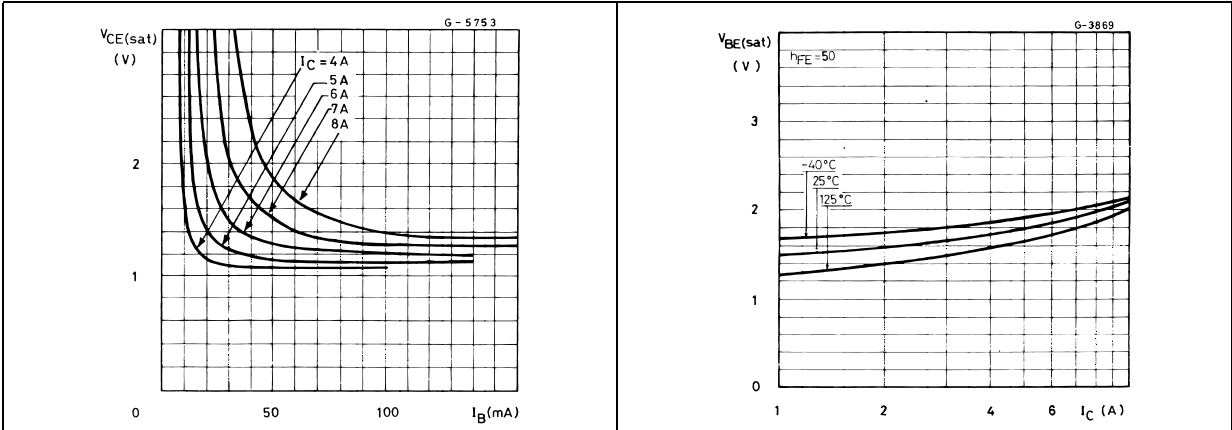
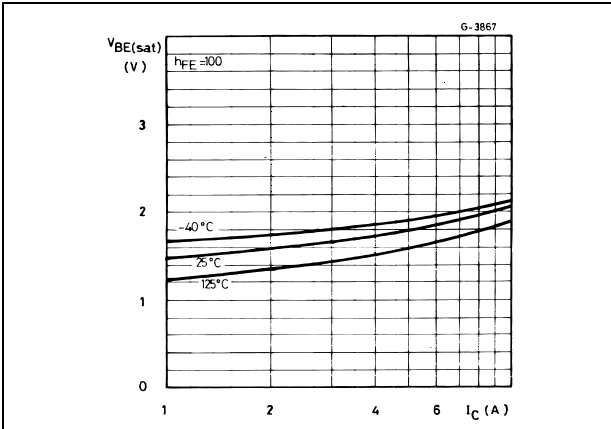


Figure 10. Base-emitter saturation voltage @  $h_{FE} = 100$



### 3 Test circuits

Figure 11. Functional test circuit

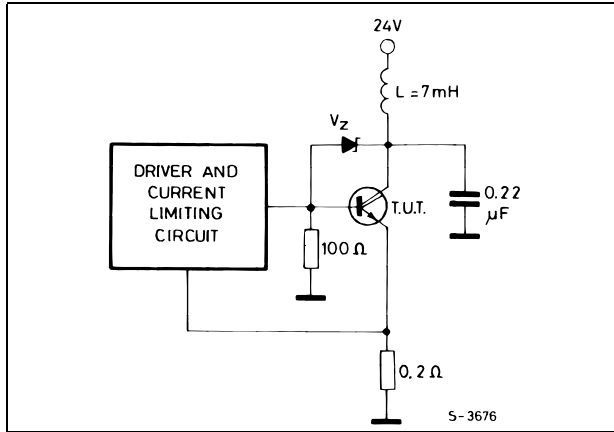


Figure 12. Functional test waveforms

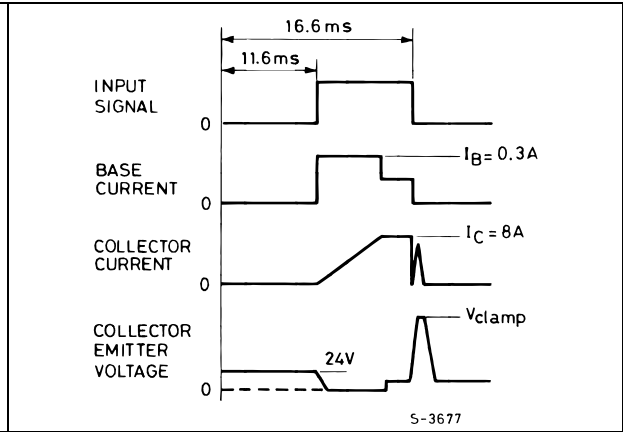


Figure 13. Switching time test circuit

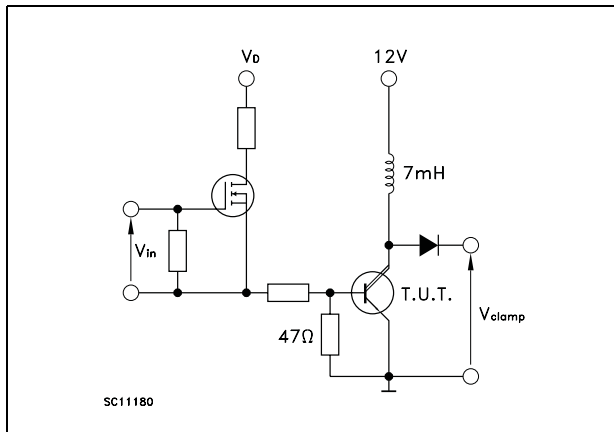
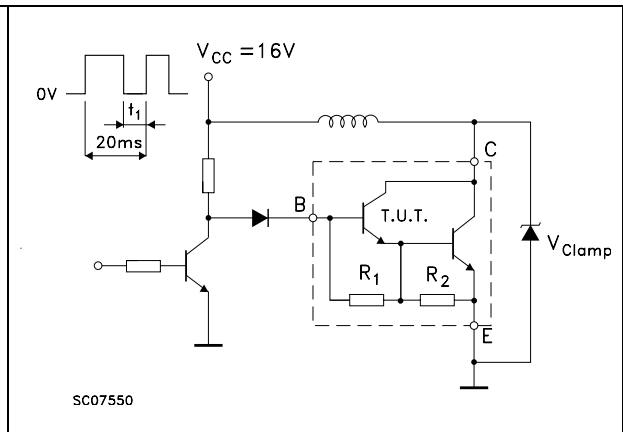


Figure 14. Sustaining voltage test circuit



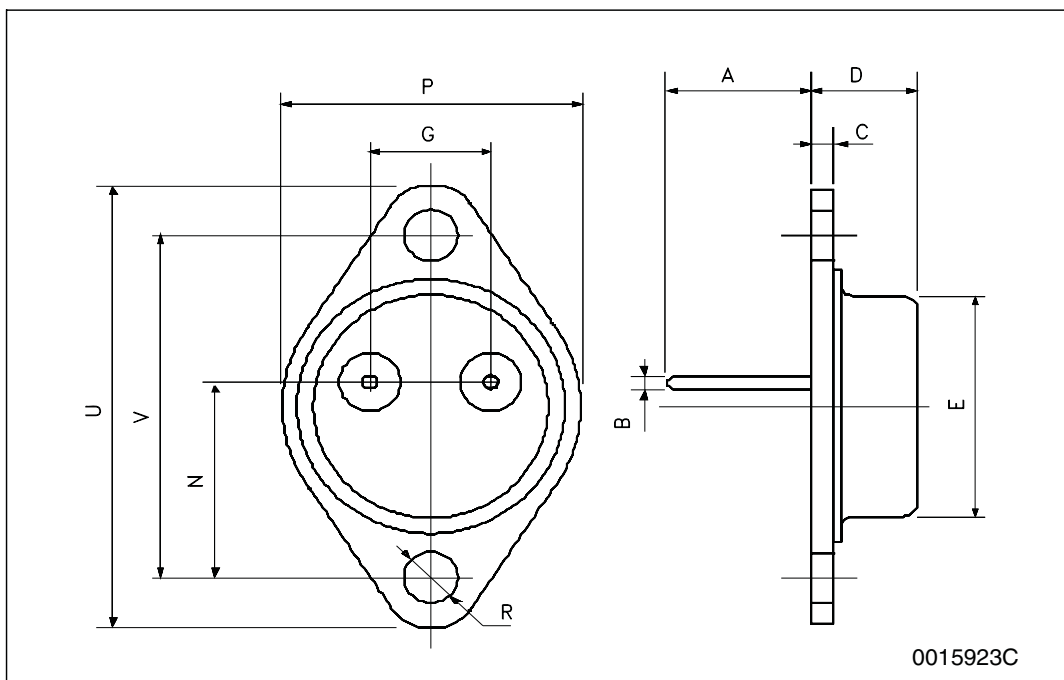
## 4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a lead-free second level interconnect . The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: [www.st.com](http://www.st.com)



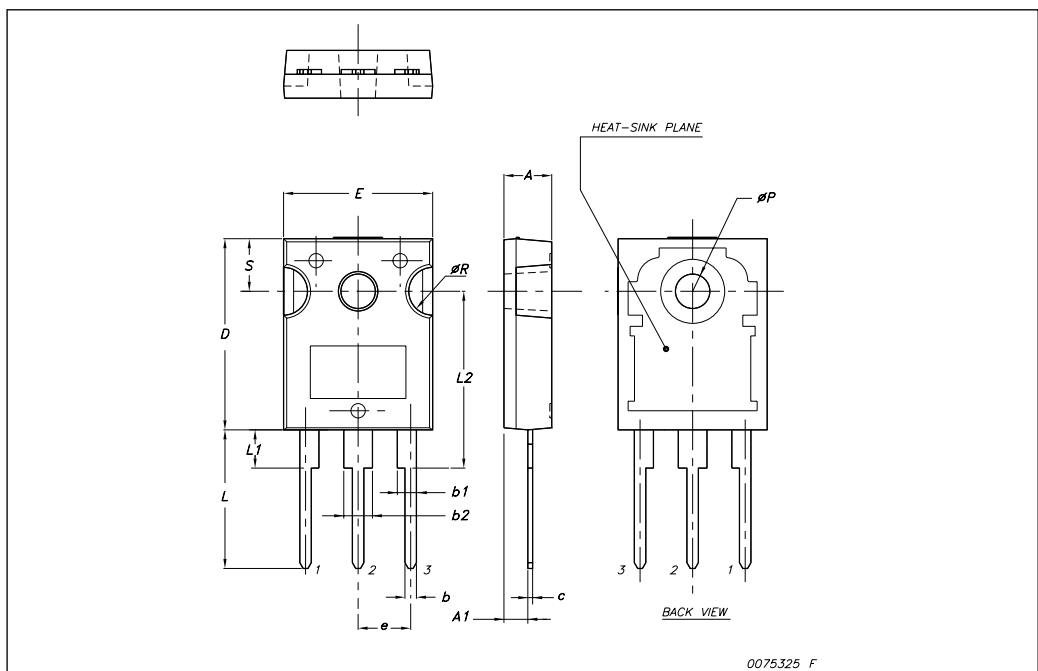
**TO-3 mechanical data**

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



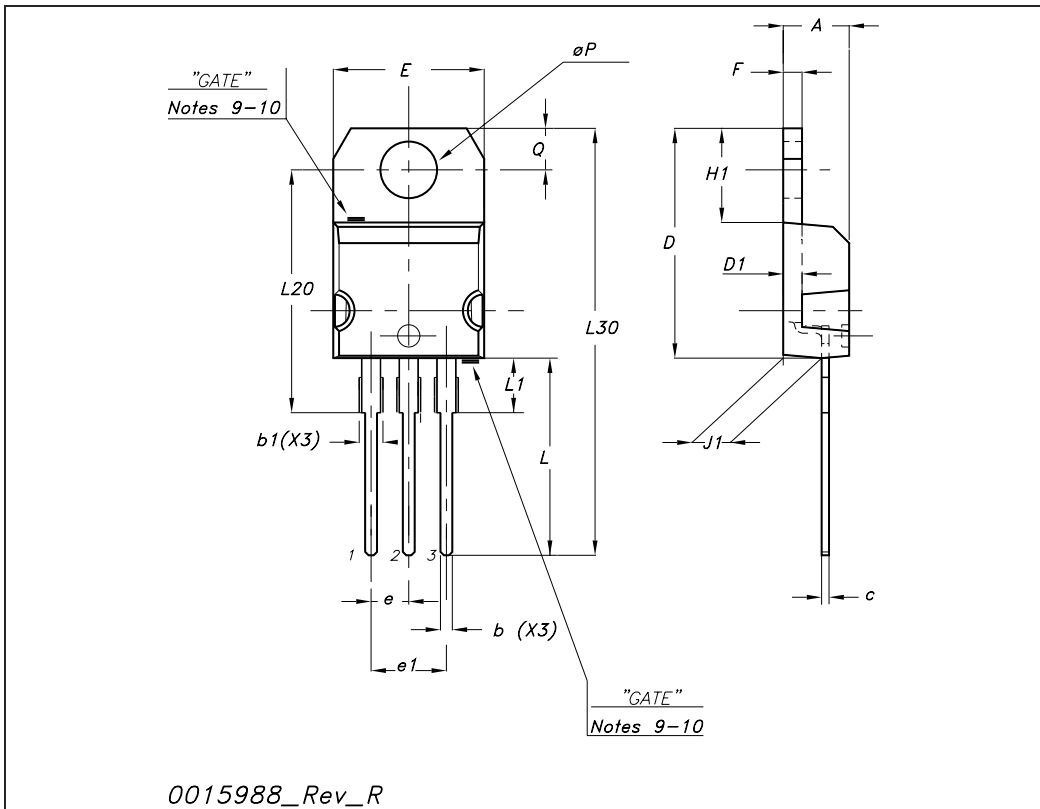
**TO-247 Mechanical data**

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 mechanical data

Dim	mm			inch		
	Min	Typ	Max	Min	Typ	Max
A	4.40		4.60	0.173		0.181
b	0.61		0.88	0.024		0.034
b1	1.14		1.70	0.044		0.066
c	0.48		0.70	0.019		0.027
D	15.25		15.75	0.6		0.62
D1		1.27			0.050	
E	10		10.40	0.393		0.409
e	2.40		2.70	0.094		0.106
e1	4.95		5.15	0.194		0.202
F	1.23		1.32	0.048		0.051
H1	6.20		6.60	0.244		0.256
J1	2.40		2.72	0.094		0.107
L	13		14	0.511		0.551
L1	3.50		3.93	0.137		0.154
L20		16.40			0.645	
L30		28.90			1.137	
ØP	3.75		3.85	0.147		0.151
Q	2.65		2.95	0.104		0.116



## 5 Revision history

**Table 5. Document revision history**

Date	Revision	Changes
21-Jun-2004	2	
18-Nov-2008	3	Package changed from TO-218 to TO-247 for BU931P. Inserted type in TO-220 (BU931T).

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