

### Features

- High voltage capability
- Very high switching speed

### Applications

Four lamp electronic ballast for:

- 120 V mains in push-pull configuration
- 277 V mains in half bridge current feed configuration

### Description

This is a high voltage fast switching NPN power transistor manufactured in multi epitaxial planar technology. It uses a cellular emitter structure with planar edge termination to enhance switching speeds while maintaining a wide RBSOA.

Thanks to an increased intermediate layer, it has an intrinsic ruggedness which enables the transistor to withstand a high collector current level during breakdown condition, without using the Transil™ protection usually necessary in typical converters for lamp ballast.

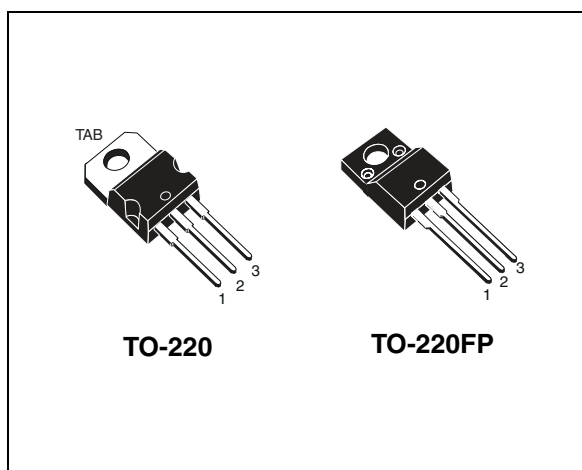


Figure 1. Internal schematic diagram

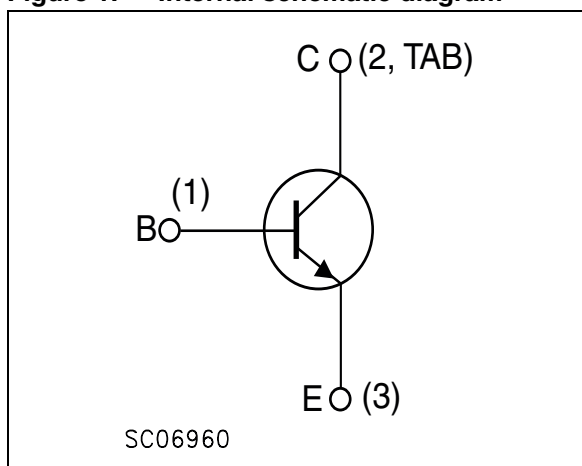


Table 1. Device summary

Order codes	Marking	Package	Packaging
BUL1102E	BUL1102E	TO-220	Tube
BUL1102EFP	BUL1102EFP	TO-220FP	Tube

# 1 Absolute maximum ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{CES}$	Collector-emitter voltage ( $V_{BE} = 0$ )	1100	V
$V_{CEO}$	Collector-emitter voltage ( $I_B = 0$ )	450	V
$V_{EBO}$	Emitter-base voltage ( $I_C = 0$ )	12	V
$I_C$	Collector current	4	A
$I_{CM}$	Collector peak current ( $t_P < 5$ ms)	8	A
$I_B$	Base current	2	A
$I_{BM}$	Base peak current ( $t_P < 5$ ms)	4	A
$P_{TOT}$	BUL1102E total dissipation at $T_C = 25^\circ\text{C}$	70	W
	BUL1102EFP total dissipation at $T_C = 25^\circ\text{C}$	30	
$V_{ISO}$	BUL1102EFP insulation withstand voltage (RMS) from all three leads to external heatsink	1500	V
$T_{STG}$	Storage temperature	-65 to 150	$^\circ\text{C}$
$T_J$	Max. operating junction temperature	150	$^\circ\text{C}$

**Table 3. Thermal data**

Symbol	Parameter	Value	Unit
$R_{thJC}$	BUL1203E thermal resistance junction-case	1.8	$^\circ\text{C}/\text{W}$
	BUL1203EFP thermal resistance junction-case	4.2	$^\circ\text{C}/\text{W}$

## 2 Electrical characteristics

( $T_J = 25\text{ °C}$ ; unless otherwise specified)

**Table 4. Electrical characteristics**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{CES}$	Collector cut-off current ( $V_{BE} = 0$ )	$V_{CE} = 1100\text{ V}$			100	$\mu\text{A}$
$I_{EBO}$	Emitter cut-off current ( $I_C = 0$ )	$V_{EB} = 12\text{ V}$			1	mA
$V_{CEO(sus)}^{(1)}$	Collector-emitter sustaining voltage ( $I_B = 0$ )	$I_C = 100\text{ mA}$	450			V
$V_{CE(sat)}^{(1)}$	Collector-emitter saturation voltage	$I_C = 2\text{ A}$ $I_B = 400\text{ mA}$			1.5	V
$V_{BE(sat)}^{(1)}$	Base-emitter saturation voltage	$I_C = 2\text{ A}$ $I_B = 400\text{ mA}$			1.5	V
$h_{FE}^{(1)}$	DC current gain	$I_C = 250\text{ mA}$ $V_{CE} = 5\text{ V}$ $I_C = 2\text{ A}$ , $V_{CE} = 5\text{ V}$ for BUL1102E $I_C = 2\text{ A}$ $V_{CE} = 5\text{ V}$ for BUL1102EFP	35 12 12		70 20 23	
$t_s$ $t_f$	Resistive load Storage time Fall time	$I_C = 2.5\text{ A}$ $V_{CC} = 250\text{ V}$ $I_{B1} = 0.5\text{ A}$ $I_{B2} = 1\text{ A}$ $T_P = 30\text{ }\mu\text{s}$ (see <a href="#">Figure 14</a> )			2.5 300	$\mu\text{s}$ ns
$E_{ar}$	Avalanche energy	$L = 2\text{ mH}$ $C = 1.8\text{ nF}$ $I_{BR} \leq 2.5\text{ A}$ $25\text{ °C} < T_C < 125\text{ °C}$ (see <a href="#">Figure 12</a> )	6			mJ

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

## 2.1 Typical characteristics (curves)

Figure 2. BUL1102E safe operating area

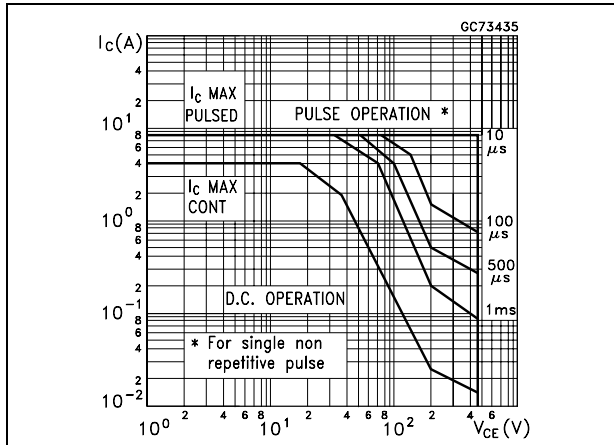


Figure 3. BUL1102EFP safe operating area

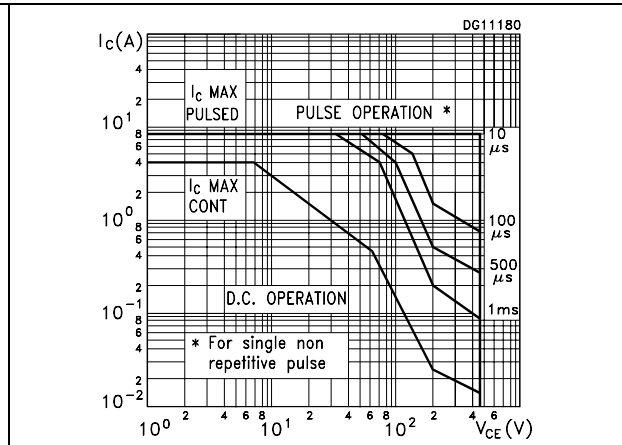


Figure 4. Derating curve

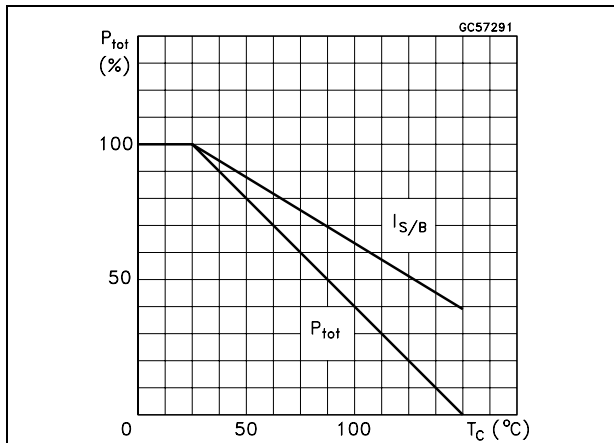


Figure 5. DC current gain ( $V_{CE} = 1 V$ )

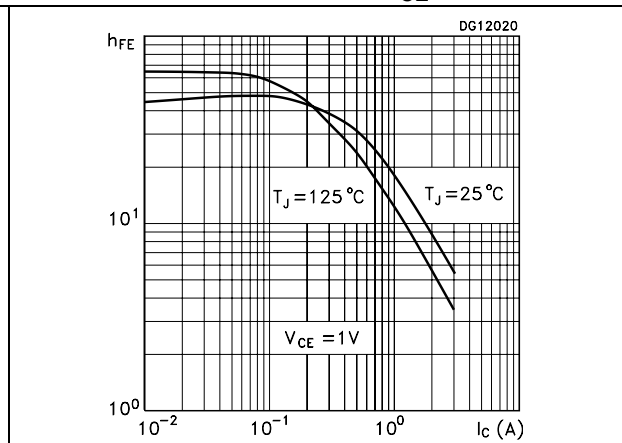


Figure 6. DC current gain ( $V_{CE} = 5 V$ )

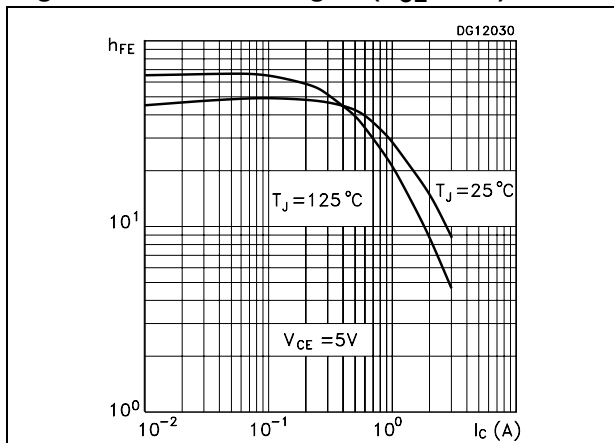


Figure 7. Collector emitter saturation voltage

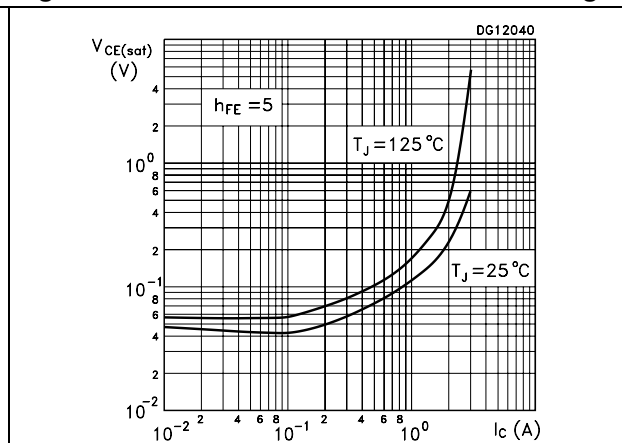


Figure 8. Base emitter saturation voltage

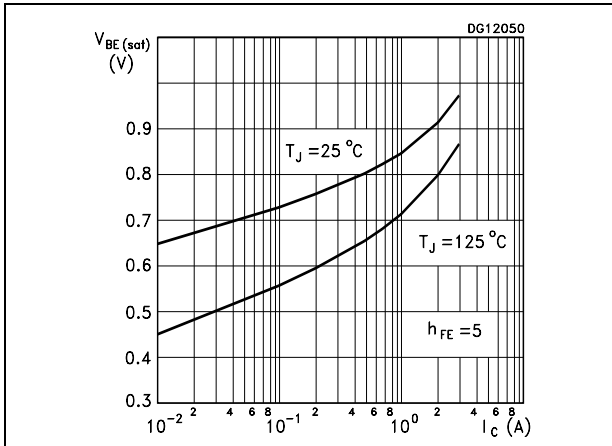


Figure 9. Resistive load switching times

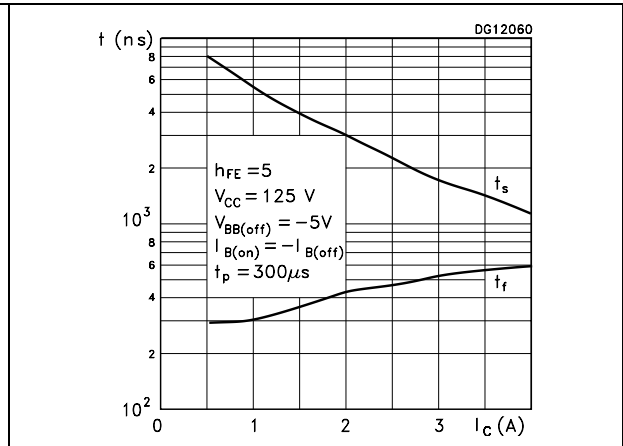


Figure 10. Inductive load switching times

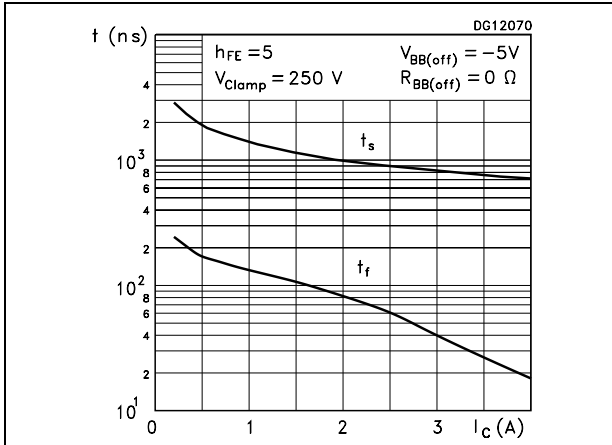


Figure 11. Reverse biased SOA

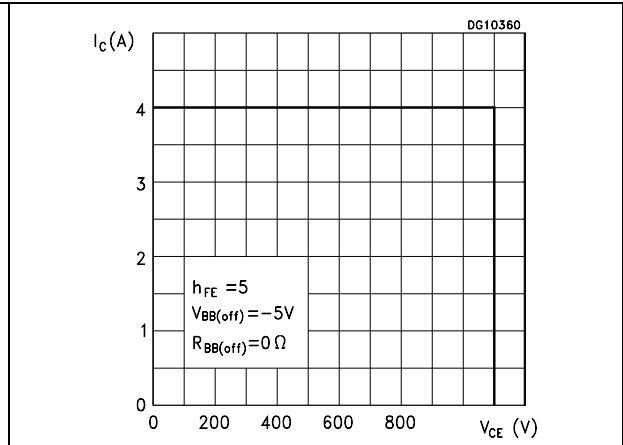


Figure 12. Energy rating test circuit

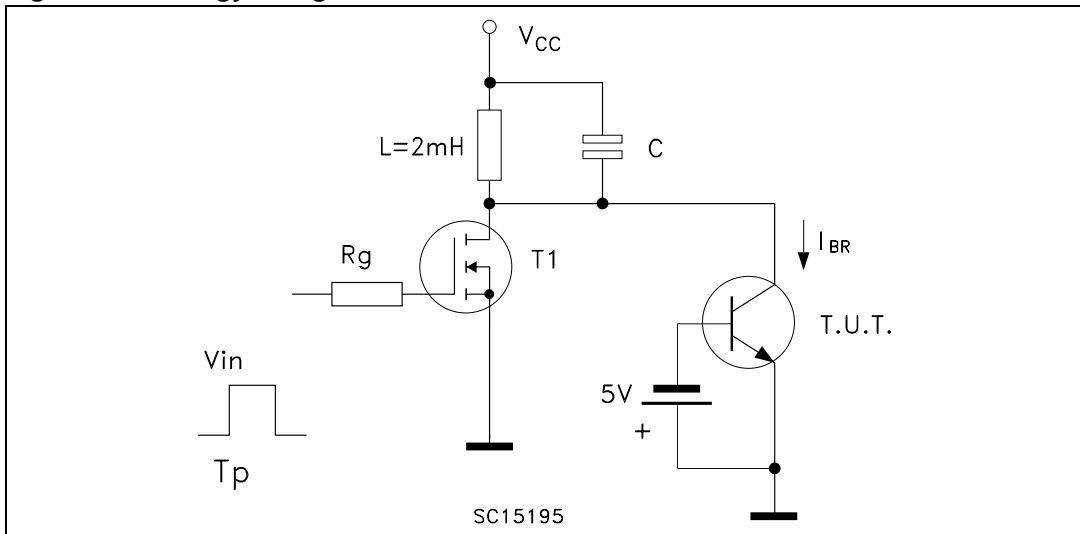


Figure 13. Inductive load switching test circuit

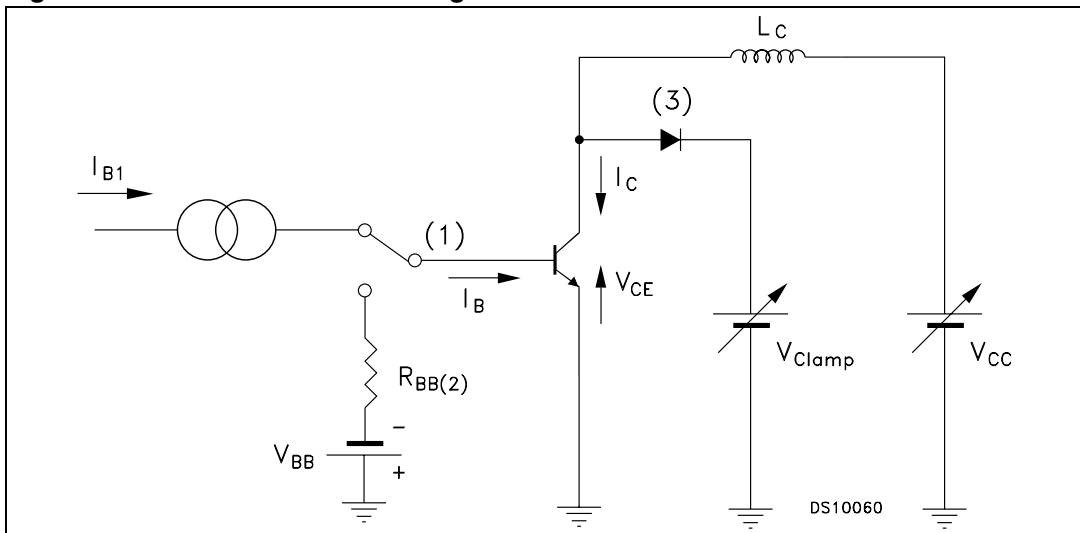
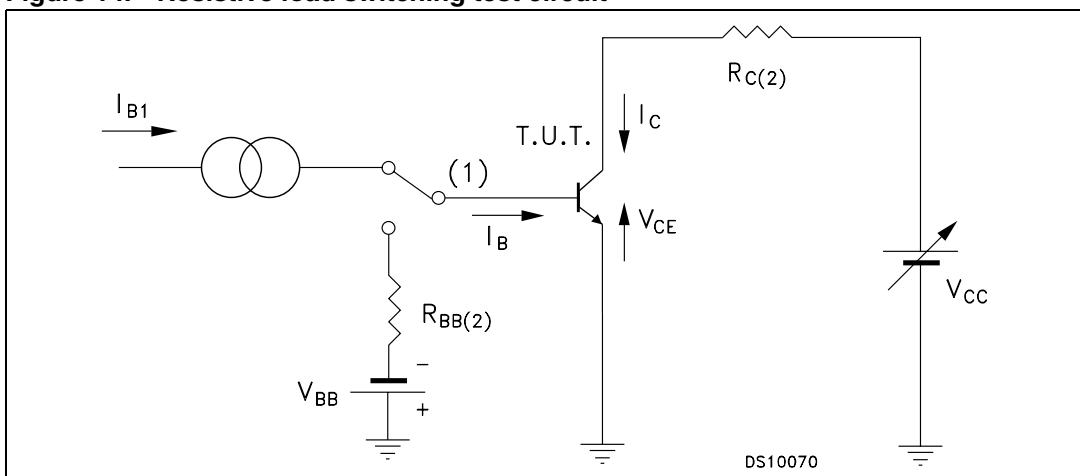


Figure 14. Resistive load switching test circuit



### 3 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.

Table 5. 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



Figure 15. TO-220 type A drawing

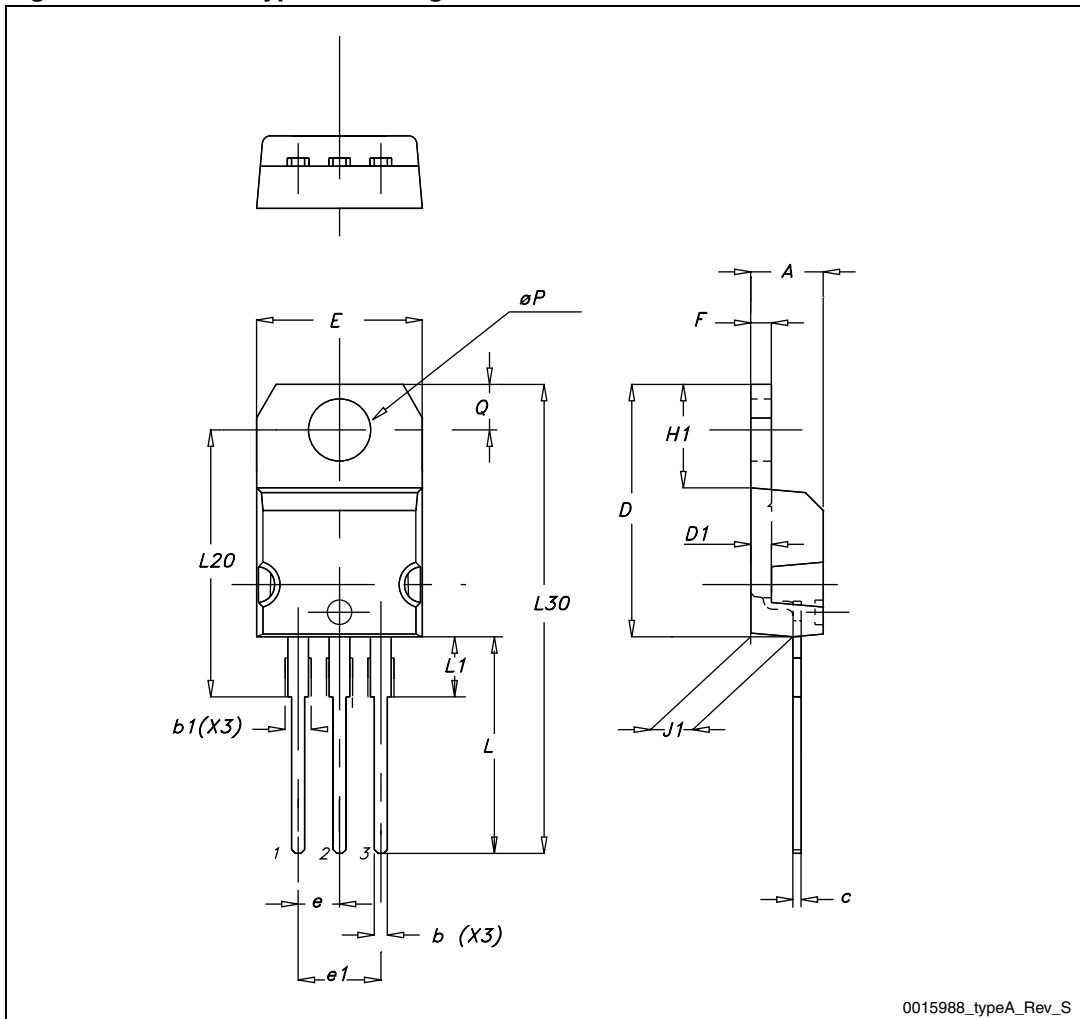
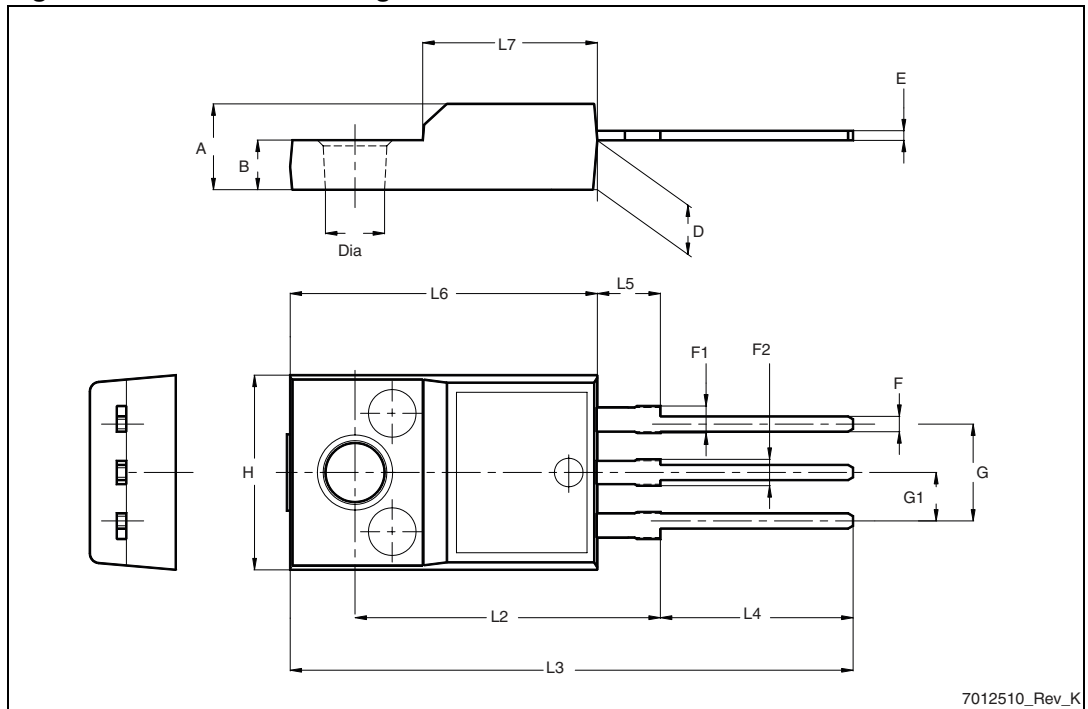


Table 6. TO-220FP mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.4		4.6
B	2.5		2.7
D	2.5		2.75
E	0.45		0.7
F	0.75		1
F1	1.15		1.70
F2	1.15		1.70
G	4.95		5.2
G1	2.4		2.7
H	10		10.4
L2		16	
L3	28.6		30.6
L4	9.8		10.6
L5	2.9		3.6
L6	15.9		16.4
L7	9		9.3
Dia	3		3.2

Figure 16. TO-220FP drawing



## 4 Revision history

**Table 7. Document revision history**

Date	Revision	Changes
17-Jan-2008	3	
24-Mar-2011	4	Inserted BUL1102EFP order code in TO-220FP package
15-Feb-2012	5	DC current gain values in <a href="#">Table 4</a> modified

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