

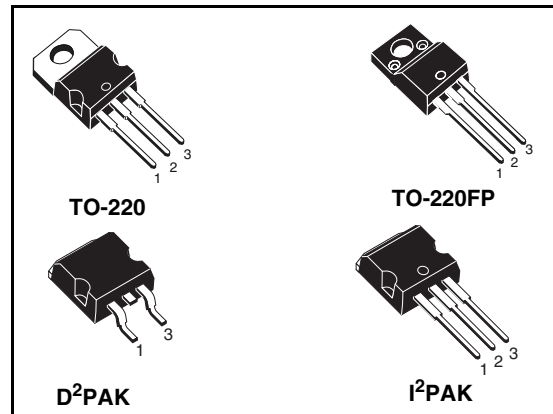
## High voltage fast-switching NPN power transistors

### Features

- High voltage capability
- Low spread of dynamic parameters
- Minimum lot-to-lot spread for reliable operation
- Very high switching speed
- High ruggedness

### Applications

- Electronic transformers for halogen lamps
- Flyback and forward single transistor low power converters



### Description

The devices are manufactured using high voltage multi-epitaxial planar technology for high switching speeds and high voltage capability. The devices are designed for use in electronic transformer for halogen lamps.

Figure 1. Internal schematic diagram

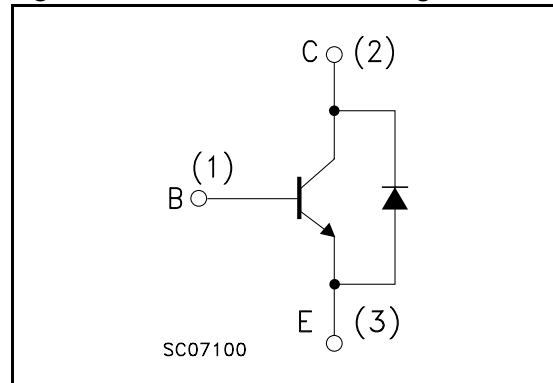


Table 1. Device summary

Order code	Marking	Package	Packaging
BUL49D	BUL49D	TO-220	Tube
BUL49DFP	BUL49DFP	TO-220FP	Tube
BULB49D-1	BULB49D	I <sup>2</sup> PAK	Tube
BULB49DT4	BULB49D	D <sup>2</sup> PAK	Tape and reel

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## Contents

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value		Unit
		D <sup>2</sup> PAK I <sup>2</sup> PAK TO-220	TO-220FP	
V <sub>CES</sub>	Collector-emitter voltage (V <sub>BE</sub> = 0)	850		V
V <sub>CEO</sub>	Collector-emitter voltage (I <sub>B</sub> = 0)	450		V
V <sub>EBO</sub>	Emitter-base voltage (I <sub>C</sub> = 0, I <sub>B</sub> < 2 A, t <sub>p</sub> < 10 ms)	V <sub>(BR)EBO</sub>		V
I <sub>C</sub>	Collector current	5		A
I <sub>CM</sub>	Collector peak current (t <sub>p</sub> < 5ms)	10		A
I <sub>B</sub>	Base current	2		A
I <sub>BM</sub>	Base peak current (t <sub>p</sub> < 5 ms)	4		A
P <sub>tot</sub>	Total dissipation at T <sub>c</sub> ≤ 25°C	80	34	W
T <sub>stg</sub>	Storage temperature	-65 to 150		°C
T <sub>J</sub>	Max. operating junction temperature	150		°C

**Table 3. Thermal data**

Symbol	Parameter	D <sup>2</sup> PAK I <sup>2</sup> PAK TO-220	TO-220FP	Unit
R <sub>thj-case</sub>	Thermal resistance junction-case max	1.56	3.67	°C/W
R <sub>thj-amb</sub>	Thermal resistance junction-ambient max	62.5	62.5	°C/W

## 2 Electrical characteristics

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

**Table 4. Electrical characteristics**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{\text{CES}}$	Collector cut-off current ( $V_{\text{BE}} = 0$ )	$V_{\text{CE}} = 850 \text{ V}$ $V_{\text{CE}} = 850 \text{ V}$ $T_c = 125^{\circ}\text{C}$			100 500	$\mu\text{A}$ $\mu\text{A}$
$I_{\text{EBO}}$	Emitter cut-off current ( $I_{\text{C}} = 0$ )	$V_{\text{EB}} = 9 \text{ V}$			100	$\mu\text{A}$
$V_{(\text{BR})\text{EBO}}$	Emitter-base breakdown voltage ( $I_{\text{C}} = 0$ )	$I_{\text{E}} = 10 \text{ mA}$	10		18	V
$V_{\text{CEO(sus)}}^{(1)}$	Collector-emitter sustaining voltage ( $I_{\text{B}} = 0$ )	$I_{\text{C}} = 10 \text{ mA}$	450			V
$V_{\text{CE(sat)}}^{(1)}$	Collector-emitter saturation voltage	$I_{\text{C}} = 1 \text{ A}$ $I_{\text{B}} = 0.2 \text{ A}$ $I_{\text{C}} = 2 \text{ A}$ $I_{\text{B}} = 0.4 \text{ A}$ $I_{\text{C}} = 4 \text{ A}$ $I_{\text{B}} = 0.8 \text{ A}$		0.1	0.3 0.6 1.2	V V V
$V_{\text{BE(sat)}}^{(1)}$	Base-emitter saturation voltage	$I_{\text{C}} = 1 \text{ A}$ $I_{\text{B}} = 0.2 \text{ A}$ $I_{\text{C}} = 4 \text{ A}$ $I_{\text{B}} = 0.8 \text{ A}$			1 1.3	V V
$h_{\text{FE}}^{(1)}$	DC current gain	$I_{\text{C}} = 10 \text{ mA}$ $V_{\text{CE}} = 5 \text{ V}$ $I_{\text{C}} = 500 \text{ mA}$ $V_{\text{CE}} = 5 \text{ V}$ $I_{\text{C}} = 7 \text{ A}$ $V_{\text{CE}} = 10 \text{ V}$	10 4		60 10	
$V_{\text{CEW}}^{(1)}$	Maximum collector- emitter voltage without snubber	$I_{\text{C}} = 8 \text{ A}$ $V_{\text{BB}} = -2.5 \text{ V}$ $L = 50 \mu\text{H}$ $R_{\text{BB}} = 0$ $t_p = 10 \mu\text{s}$	450			V
$t_s$ $t_f$	Resistive load Storage time Fall time	$V_{\text{CC}} = 250 \text{ V}$ $I_{\text{C}} = 2 \text{ A}$ $I_{\text{B1}} = -I_{\text{B2}} = 400 \text{ mA}$ (see <a href="#">Figure 12</a> )	2		3 0.8	$\mu\text{s}$ $\mu\text{s}$
$t_s$ $t_f$	Inductive load Storage time Fall time	$V_{\text{CL}} = 300 \text{ V}$ $I_{\text{C}} = 4 \text{ A}$ $I_{\text{B(on)}} = 800 \text{ mA}$ $R_{\text{BB(off)}} = 0$ $V_{\text{BE(off)}} = -5 \text{ V}$ $L = 1 \text{ mH}$ (see <a href="#">Figure 13</a> )		0.6 50	1.3 100	$\mu\text{s}$ ns
$V_{\text{F}}$	Diode forward voltage	$I_{\text{C}} = 3 \text{ A}$			1.5	V

1. Pulsed duration = 300 ms, duty cycle  $\leq 1.5\%$

## 2.1 Electrical characteristics (curves)

Figure 2. Safe operating area (for TO-220 - D<sup>2</sup>PAK - I<sup>2</sup>PAK)

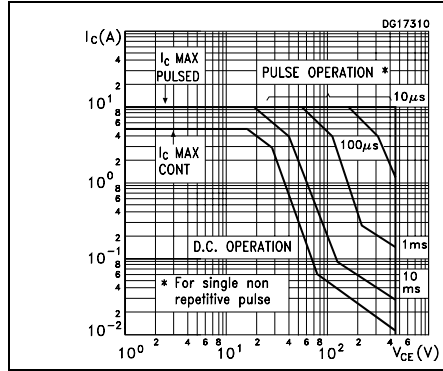


Figure 3. Safe operating area (for TO-220FP)

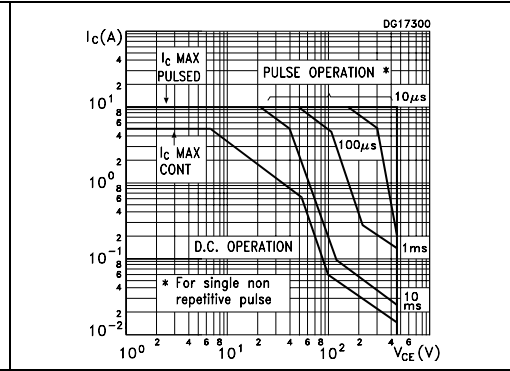


Figure 4. Derating curves

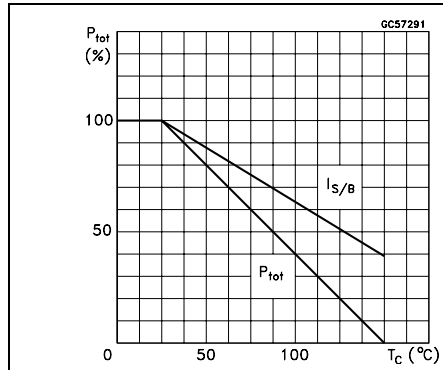


Figure 5. Output characteristics

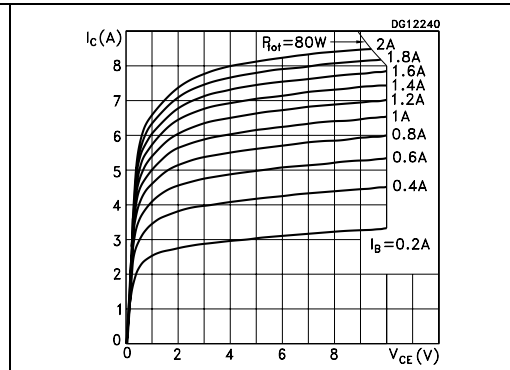


Figure 6. Collector-emitter saturation voltage

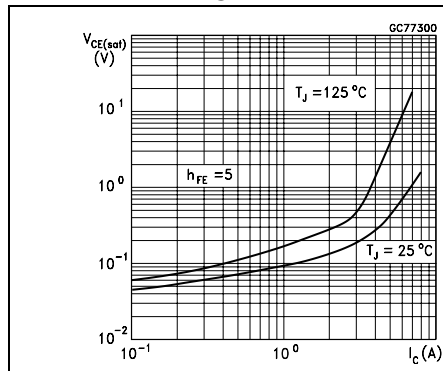


Figure 7. Base-emitter saturation voltage

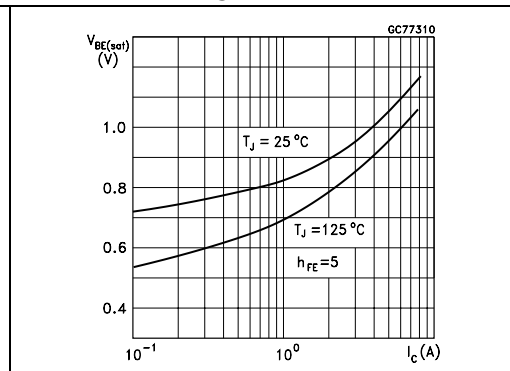


Figure 8. DC current gain

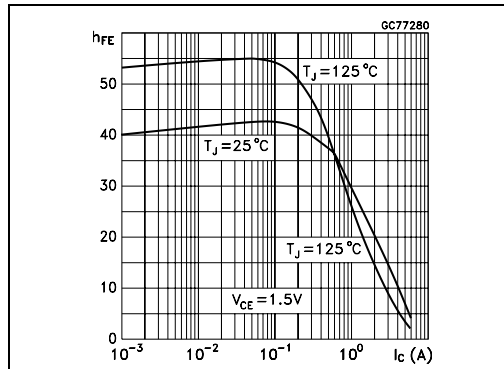


Figure 9. DC current gain

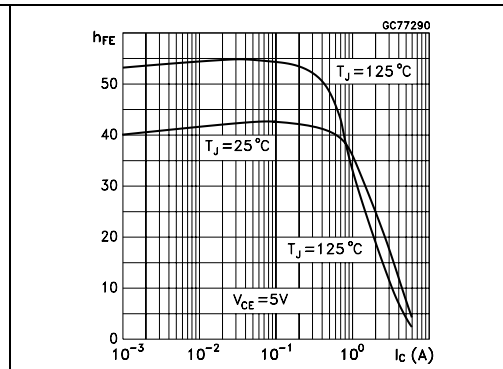


Figure 10. Inductive load storage time

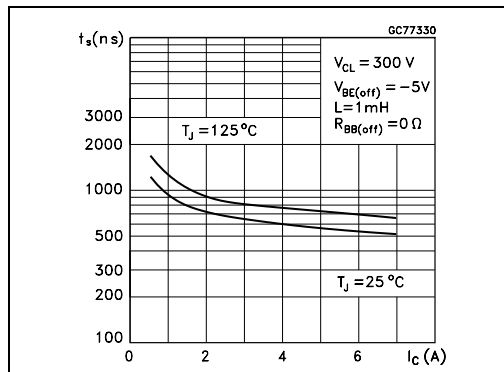


Figure 11. Inductive load fall time

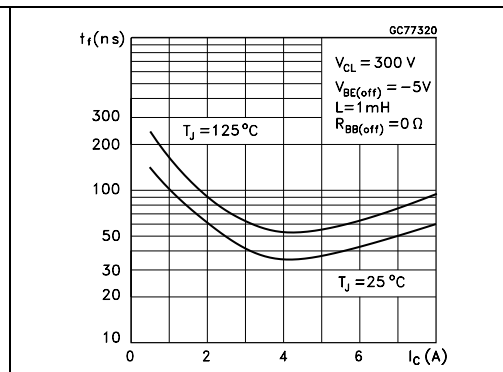
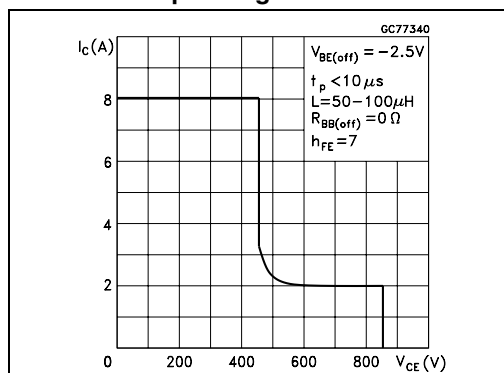


Figure 12. Reverse biased safe operating area



## 2.2 Test circuits

Figure 13. Resistive load switching test circuit

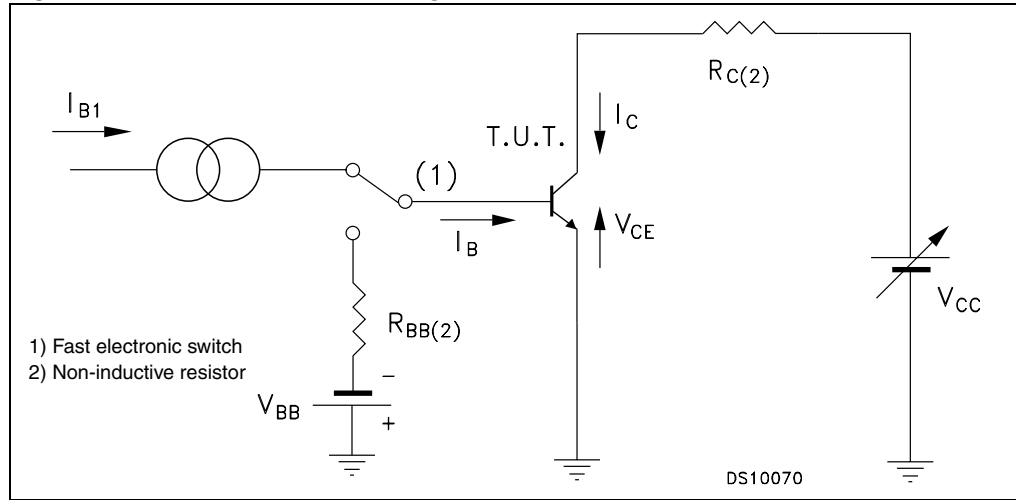
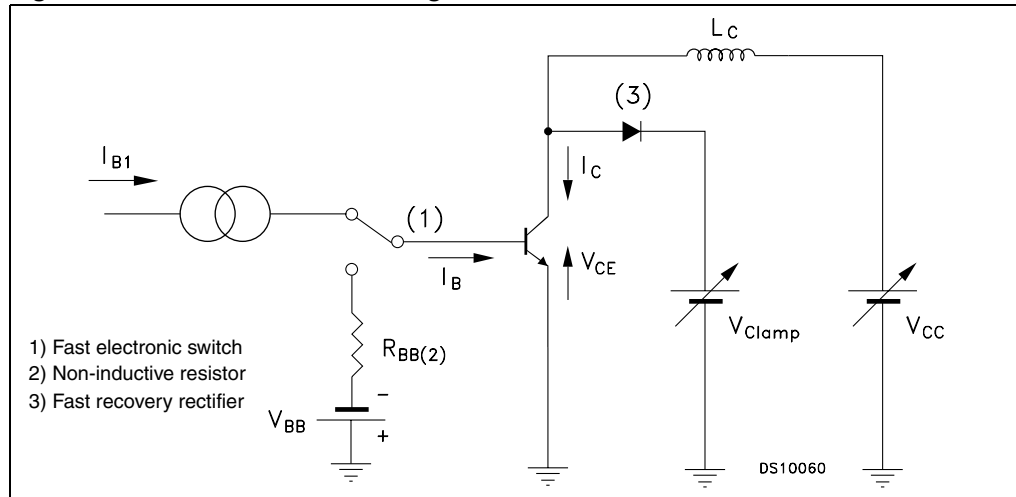


Figure 14. Inductive load switching test circuit



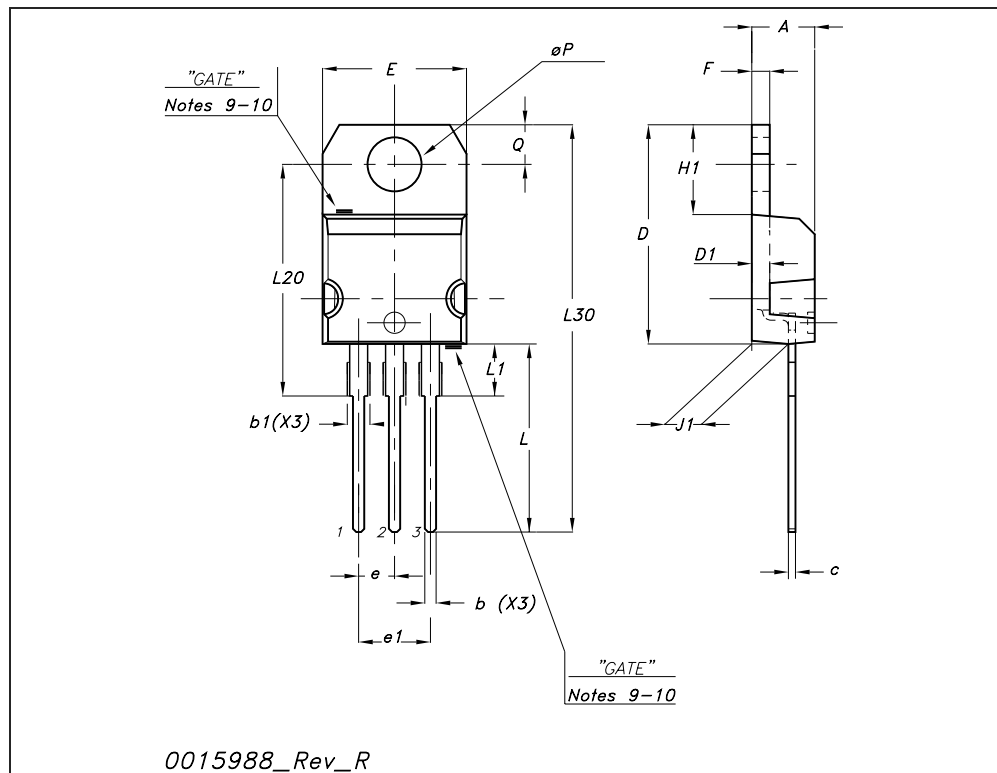
### 3 Package mechanical data

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)



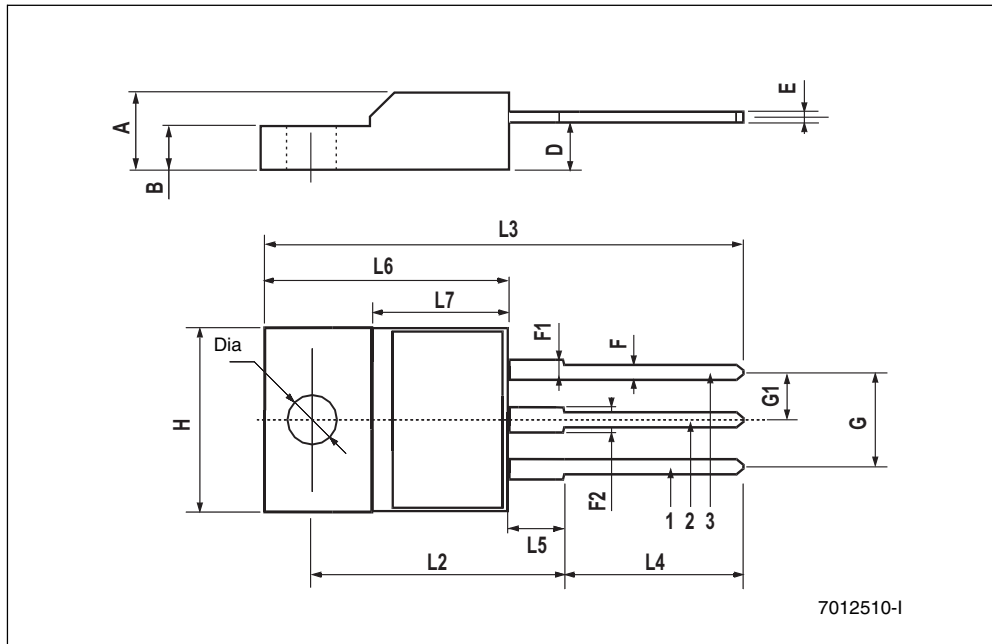
TO-220 mechanical data

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	
∅P	3.75		3.85	0.147		0.151
Q	2.65		2.95	0.104		0.116



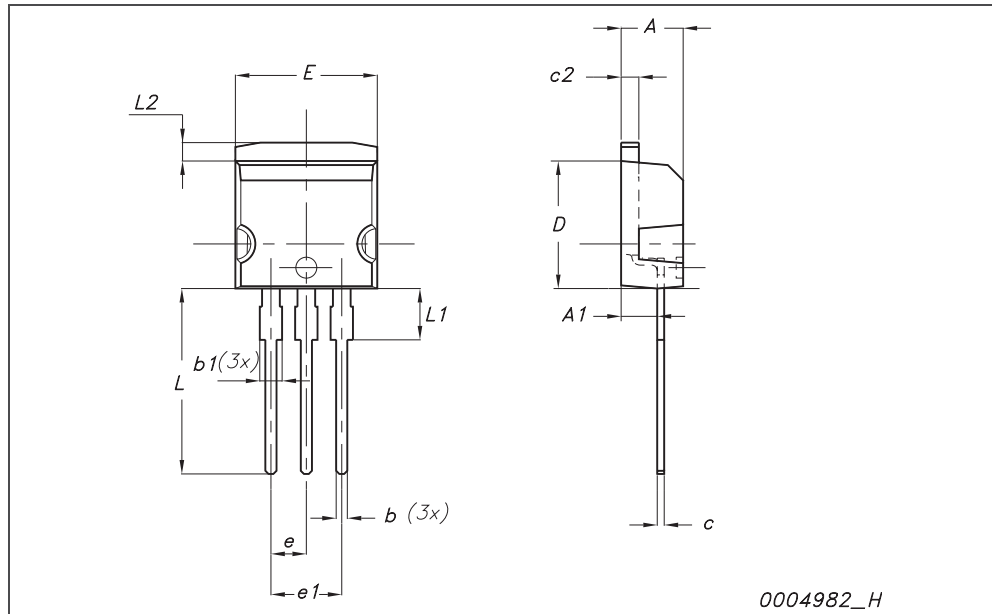
**TO-220FP mechanical data**

Dim.	mm.			inch		
	Min.	Typ	Max.	Min.	Typ.	Max.
A	4.40		4.60	0.173		0.181
B	2.5		2.7	0.098		0.106
D	2.5		2.75	0.098		0.108
E	0.45		0.70	0.017		0.027
F	0.75		1.00	0.030		0.039
F1	1.15		1.50	0.045		0.067
F2	1.15		1.50	0.045		0.067
G	4.95		5.20	0.195		0.204
G1	2.40		2.70	0.094		0.106
H	10		10.40	0.393		0.409
L2		16			0.630	
L3	28.6		30.6	1.126		1.204
L4	9.80		10.60	0.385		0.417
L5	2.9		3.6	0.114		0.141
L6	15.90		16.40	0.626		0.645
L7	9		9.30	0.354		0.366
Dia	3		3.2	0.118		0.126



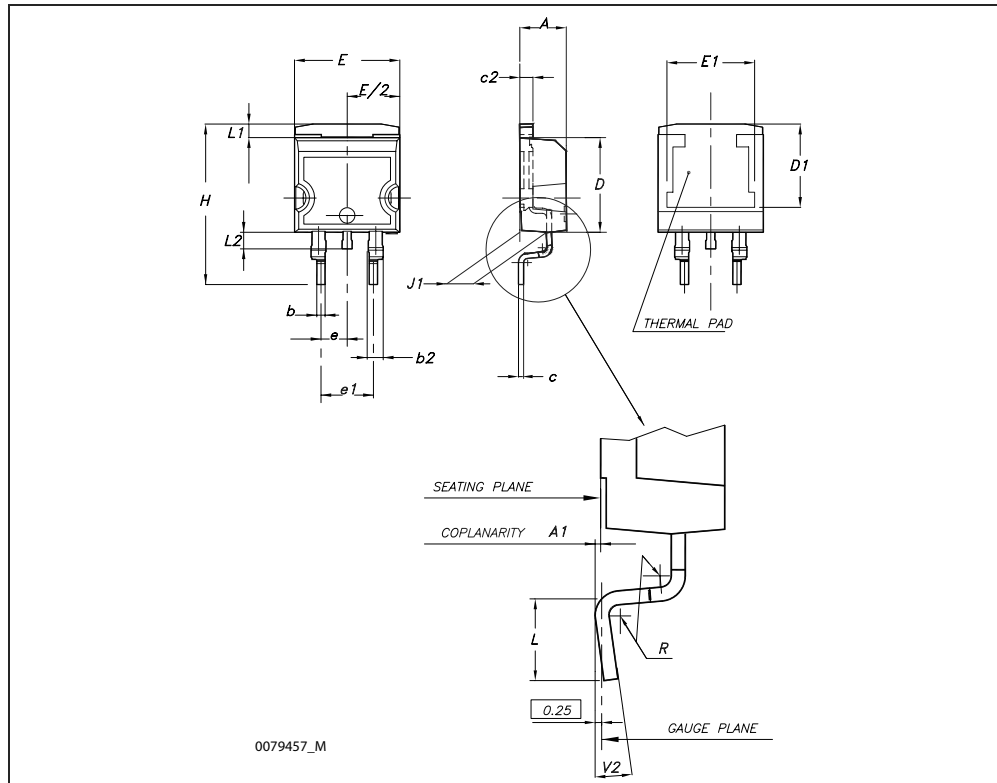
I<sup>2</sup>PAK (TO-262) mechanical data

Dim	mm			inch		
	Min	Typ	Max	Min	Typ	Max
A	4.40		4.60	0.173		0.181
A1	2.40		2.72	0.094		0.107
b	0.61		0.88	0.024		0.034
b1	1.14		1.70	0.044		0.066
c	0.49		0.70	0.019		0.027
c2	1.23		1.32	0.048		0.052
D	8.95		9.35	0.352		0.368
e	2.40		2.70	0.094		0.106
e1	4.95		5.15	0.194		0.202
E	10		10.40	0.393		0.410
L	13		14	0.511		0.551
L1	3.50		3.93	0.137		0.154
L2	1.27		1.40	0.050		0.055



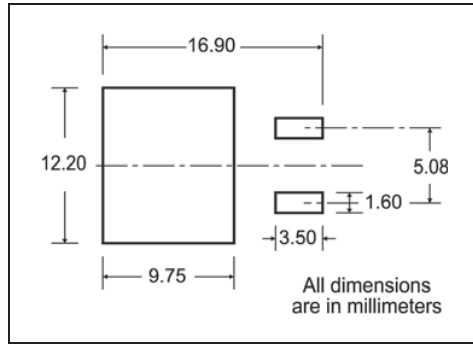
**D<sup>2</sup>PAK (TO-263) mechanical data**

Dim	mm			inch		
	Min	Typ	Max	Min	Typ	Max
A	4.40		4.60	0.173		0.181
A1	0.03		0.23	0.001		0.009
b	0.70		0.93	0.027		0.037
b2	1.14		1.70	0.045		0.067
c	0.45		0.60	0.017		0.024
c2	1.23		1.36	0.048		0.053
D	8.95		9.35	0.352		0.368
D1	7.50			0.295		
E	10		10.40	0.394		0.409
E1	8.50			0.334		
e		2.54			0.1	
e1	4.88		5.28	0.192		0.208
H	15		15.85	0.590		0.624
J1	2.49		2.69	0.099		0.106
L	2.29		2.79	0.090		0.110
L1	1.27		1.40	0.05		0.055
L2	1.30		1.75	0.051		0.069
R		0.4			0.016	
V2	0°		8°	0°		8°



# 4 Packaging information

D<sup>2</sup>PAK FOOTPRINT



TAPE AND REEL SHIPMENT

40 mm min. Access hole at slot location

Full radius

Tape slot in core for tape start 2.5mm min. width

G measured at hub

REEL MECHANICAL DATA

DIM.	mm		inch	
	MIN.	MAX.	MIN.	MAX.
A		330		12.992
B	1.5		0.059	
C	12.8	13.2	0.504	0.520
D	20.2		0.795	
G	24.4	26.4	0.960	1.039
N	100		3.937	
T		30.4		1.197

TAPE MECHANICAL DATA

DIM.	mm		inch	
	MIN.	MAX.	MIN.	MAX.
A0	10.5	10.7	0.413	0.421
B0	15.7	15.9	0.618	0.626
D	1.5	1.6	0.059	0.063
D1	1.59	1.61	0.062	0.063
E	1.65	1.85	0.065	0.073
F	11.4	11.6	0.449	0.456
K0	4.8	5.0	0.189	0.197
P0	3.9	4.1	0.153	0.161
P1	11.9	12.1	0.468	0.476
P2	1.9	2.1	0.075	0.082
R	50		1.574	
T	0.25	0.35	0.0098	0.0137
W	23.7	24.3	0.933	0.956

10 pitches cumulative tolerance on tape +/- 0.2 mm

Center line of cavity

User Direction of Feed

FEED DIRECTION

Bending radius R min.

## 5 Revision history

Table 5. Document revision history

Date	Revision	Changes
10-Sep-2003	1	First release.
04-May-2007	2	The document has been reformatted.
09-Jun-2008	3	Inserted devices in: D <sup>2</sup> PAK and I <sup>2</sup> PAK.

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