

## 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

### Applications

- Electronic ballast for fluorescent lighting
- Switch mode power supplies.

### Description

The devices are manufactured using high voltage multi-epitaxial planar technology for high switching speeds and high voltage capability.

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

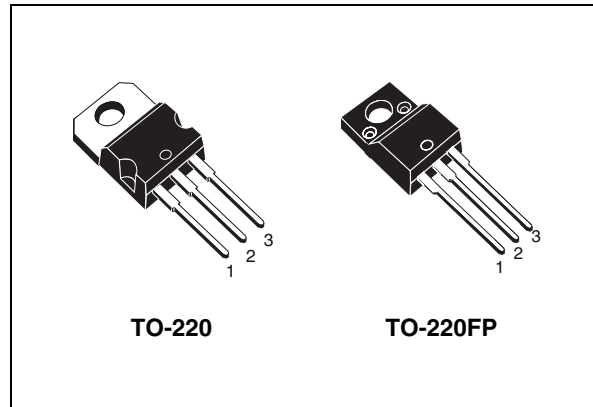


Figure 1. Internal schematic diagram

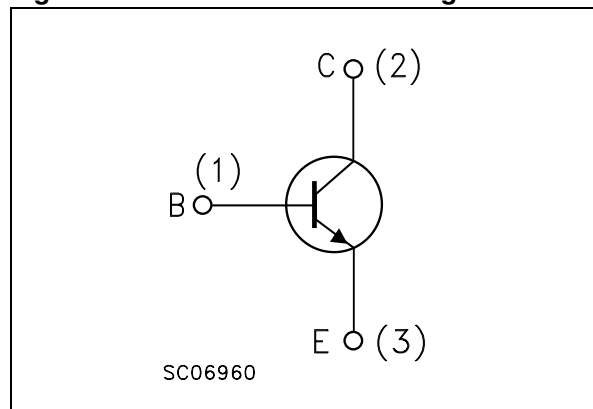


Table 1. Device summary

Order codes	Marking	Packages	Packaging
BUL741	BUL741	TO-220	Tube
BUL741FP	BUL741FP	TO-220FP	Tube

# Contents

<b>1</b>	<b>Electrical ratings</b> .....	<b>3</b>
<b>2</b>	<b>Electrical characteristics</b> .....	<b>4</b>
	2.1 Typical characteristic .....	4
	2.2 Test circuits .....	7
<b>3</b>	<b>Package mechanical data</b> .....	<b>8</b>
<b>4</b>	<b>Revision history</b> .....	<b>11</b>

# 1 Electrical ratings

**Table 2. Absolute maximum rating**

Symbol	Parameter	Value	Unit
$V_{CES}$	Collector-emitter voltage ( $V_{BE} = 0$ )	1050	V
$V_{CEO}$	Collector-emitter voltage ( $I_B = 0$ )	400	V
$V_{EBO}$	Emitter-base voltage ( $I_C = 0$ , $I_B = 2$ A, $t_P < 10$ ms)	$V_{(BR)EBO}$	V
$I_C$	Collector current	2.5	A
$I_{CM}$	Collector peak current ( $t_P < 5$ ms)	5	A
$I_B$	Base current	1.5	A
$I_{BM}$	Base peak current ( $t_P < 5$ ms)	3	A
$P_{tot}$	Total dissipation at $T_C = 25$ °C for TO-220	60	W
	Total dissipation at $T_C = 25$ °C for TO-220FP	30	
$T_{stg}$	Storage temperature	-65 to 150	°C
$T_J$	Max. operating junction temperature	150	°C

**Table 3. Thermal data**

Symbol	Parameter	TO-220	TO-220FP	Unit
$R_{thJC}$	Thermal resistance junction-case max	2.08	4.17	°C/W

## 2 Electrical characteristics

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

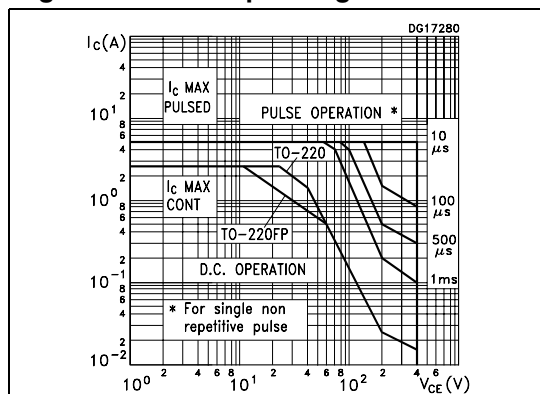
**Table 4. Electrical characteristics**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{CES}$	Collector cut-off current ( $V_{BE} = 0$ )	$V_{CE} = 1050\text{ V}$		0.2	10	$\mu\text{A}$
$I_{CEO}$	Collector cut-off current ( $I_B = 0$ )	$V_{CE} = 400\text{ V}$		10	250	$\mu\text{A}$
$V_{(BR)EBO}$	Emitter-base breakdown voltage ( $I_C = 0$ )	$I_E = 1\text{ mA}$	15	19	24	V
$V_{CEO(sus)}^{(1)}$	Collector-emitter sustaining voltage ( $I_B = 0$ )	$I_C = 10\text{ mA}$	400	450		V
$V_{CE(sat)}^{(1)}$	Collector-emitter saturation voltage	$I_C = 0.7\text{ A}$ $I_B = 0.14\text{ A}$ $I_C = 2\text{ A}$ $I_B = 0.6\text{ A}$		0.15 0.5	0.5 1.5	V V
$V_{BE(sat)}^{(1)}$	Base-emitter saturation voltage	$I_C = 2\text{ A}$ $I_B = 0.6\text{ A}$		1.1	1.5	V
$h_{FE}$	DC current gain	$I_C = 0.1\text{ A}$ $V_{CE} = 5\text{ V}$ $I_C = 0.45\text{ A}$ $V_{CE} = 3\text{ V}$	48 25	70 35	100 50	
$t_s$ $t_f$	Resistive load Storage time Fall time	$V_{CC} = 125\text{ V}$ $I_C = 1\text{ A}$ $I_{B(on)} = -I_{B(off)} = 0.2\text{ A}$ $t_p = 300\text{ }\mu\text{s}$ $V_{BB(off)} = -5\text{ V}$		2.5 350	3.5 500	$\mu\text{s}$ ns
$E_{ar}$	Repetitive avalanche energy	$L = 2\text{ mH}$ $C = 1.8\text{ nF}$ $V_{BB(off)} = -5\text{ V}$	5			mJ

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

### 2.1 Typical characteristic

**Figure 2. Safe operating area**



**Figure 3. Derating curve**

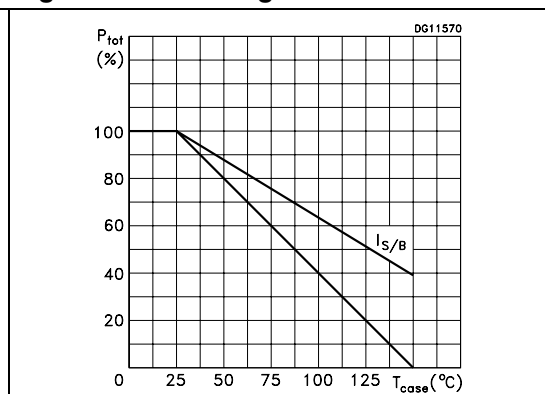


Figure 4. Output characteristics

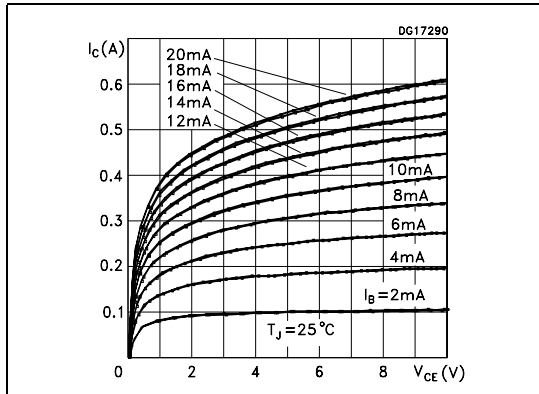


Figure 5. Reverse biased safe operating area

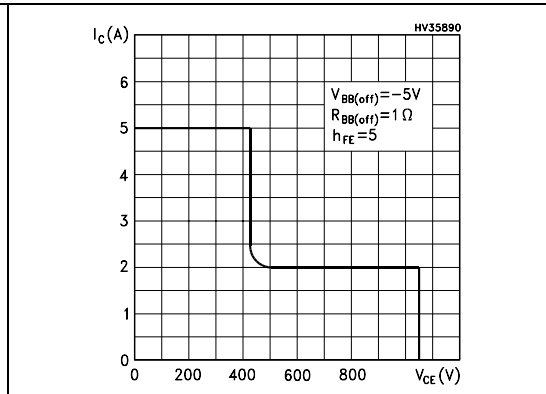


Figure 6. DC current gain ( $V_{CE} = 3\text{ V}$ )

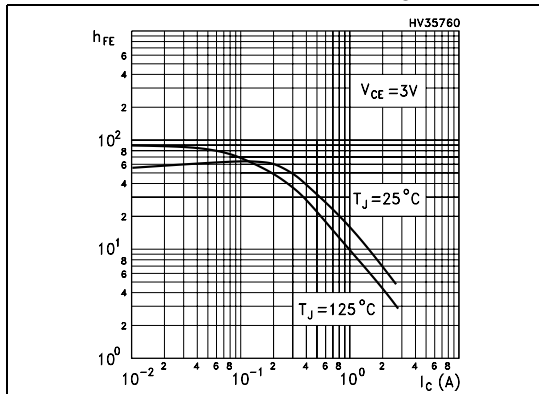


Figure 7. DC current gain ( $V_{CE} = 5\text{ V}$ )

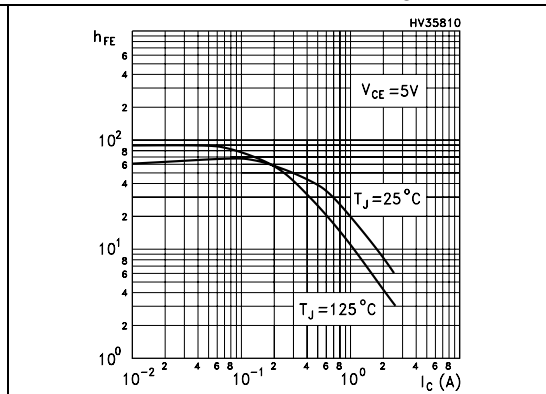


Figure 8. Base-emitter saturation voltage

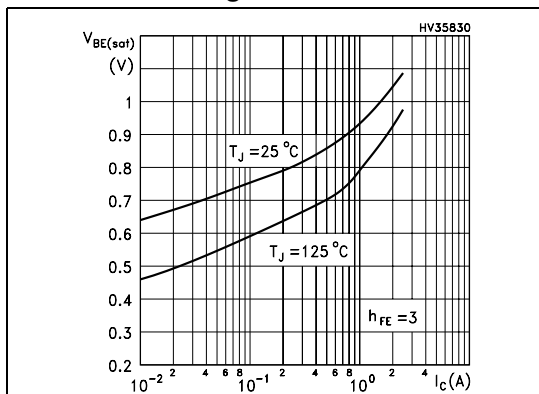


Figure 9. Collector-emitter saturation voltage

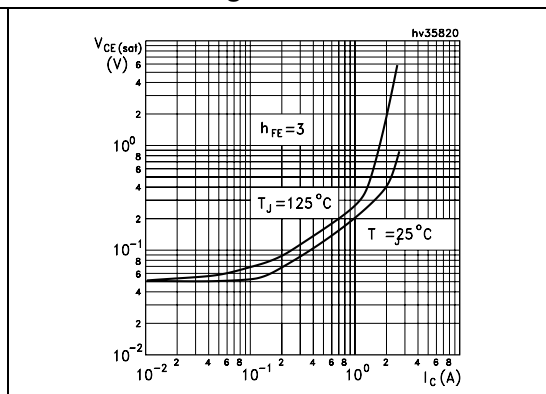


Figure 10. Resistive load switching on ( $h_{FE} = 5$ )

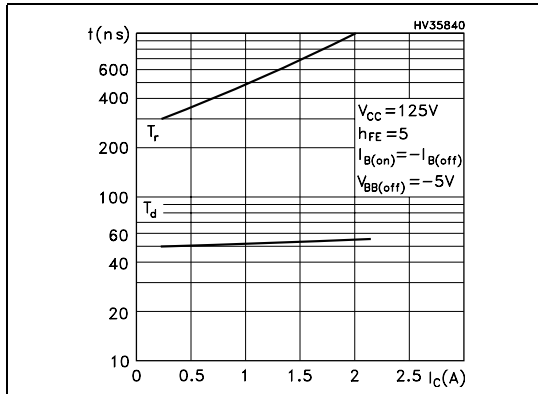


Figure 11. Resistive load switching on ( $h_{FE} = 10$ )

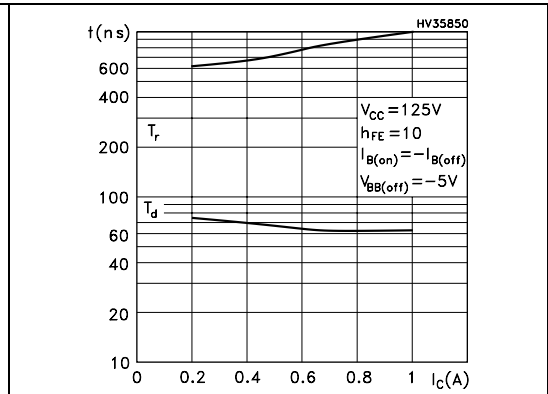


Figure 12. Resistive load switching off ( $h_{FE} = 5$ )

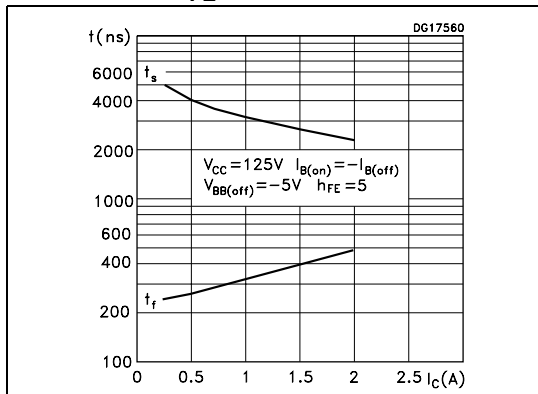
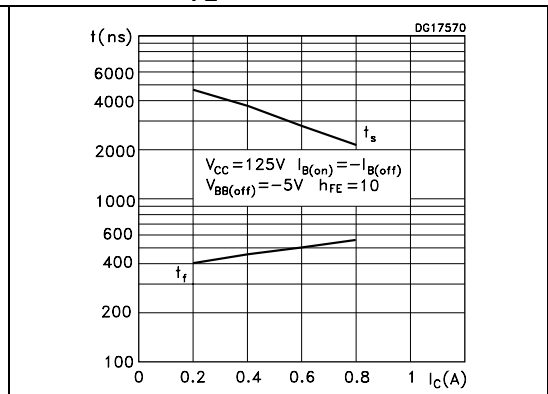
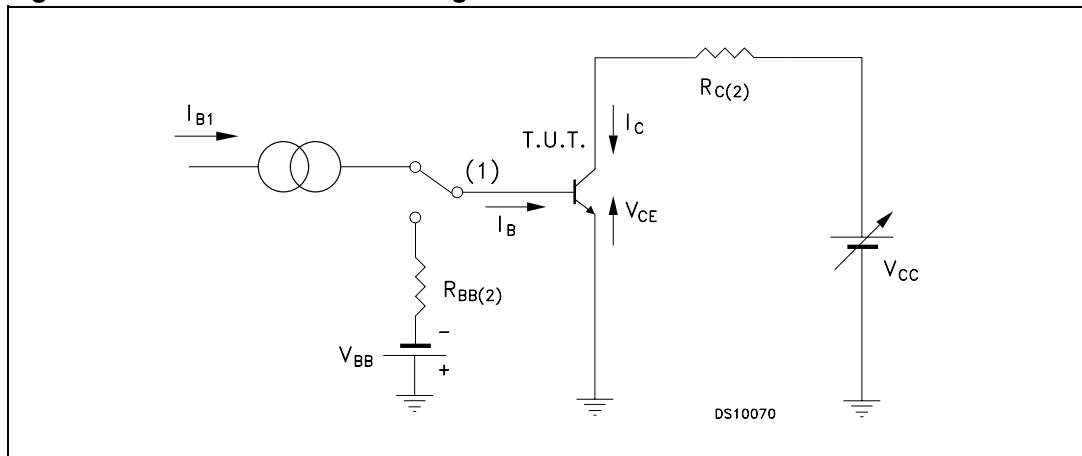


Figure 13. Resistive load switching off ( $h_{FE} = 10$ )



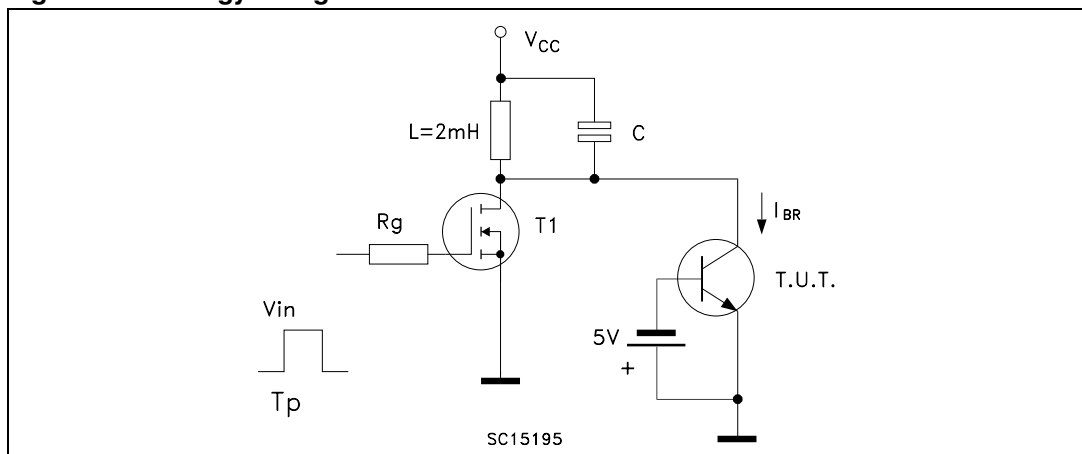
## 2.2 Test circuits

Figure 14. Resistive load switching test circuit



1. Fast electronic switch
2. Non-inductive resistor

Figure 15. Energy rating test circuit



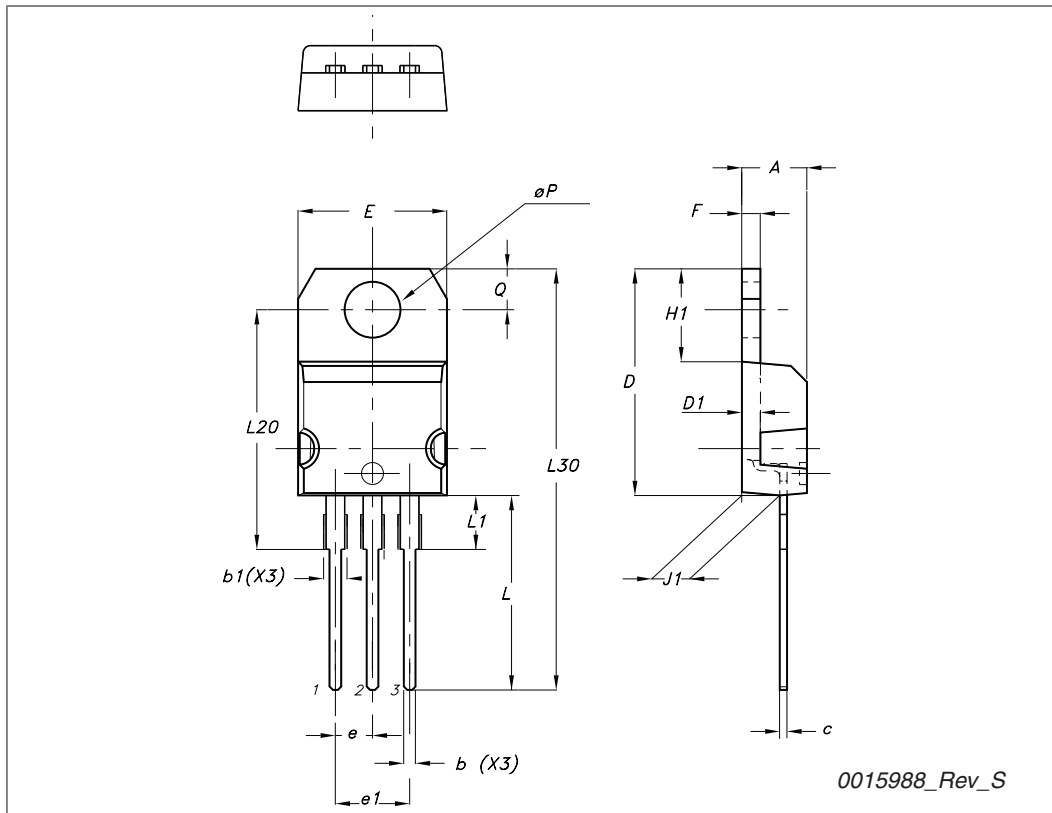
### 3 Package mechanical data

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.



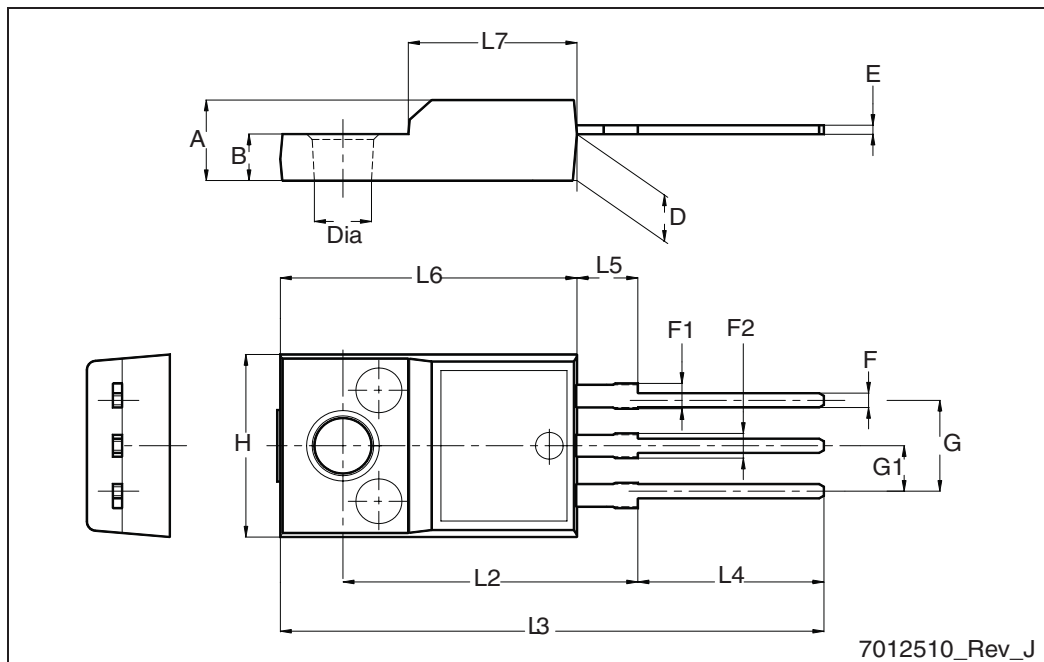
TO-220 type A mechanical data

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



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		1.5
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



## 4 Revision history

**Table 5. Document revision history**

<b>Date</b>	<b>Revision</b>	<b>Changes</b>
11-Apr-2007	1	Initial release.
10-Jul-2007	2	Figure 12 and 13 have been updated.
18-Aug-2009	3	Added new package TO-220FP and mechanical data.

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