

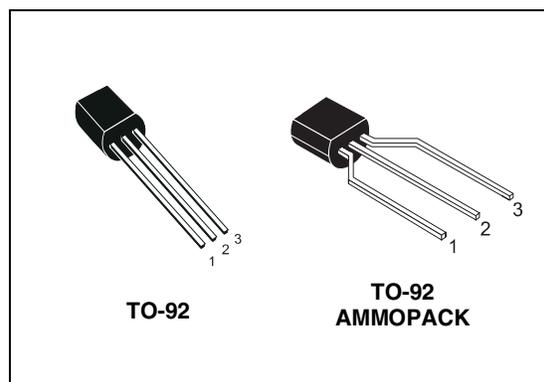
## High voltage fast-switching NPN power transistor

### Features

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

### Applications

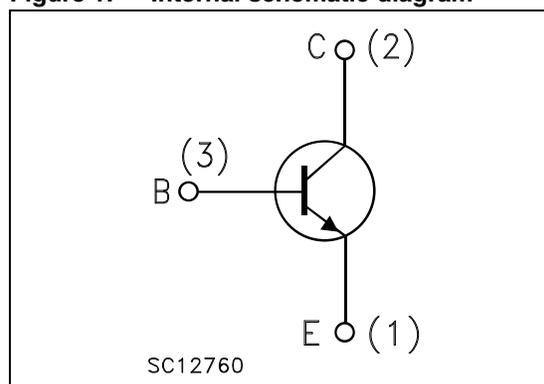
- Compact fluorescent lamp (CFL)
- Switch mode power supplies (AC-DC converters)



### Description

The device is manufactured using high voltage multi-epitaxial planar technology for high switching speeds and medium voltage capability. It uses a cellular emitter structure with planar edge termination to enhance switching speeds while maintaining the wide RBSOA.

**Figure 1. Internal schematic diagram**



**Table 1. Device summary<sup>(1)</sup>**

Order code	Marking	Package	Packaging
STX13005	X13005	TO-92	Bulk
STX13005G	X13005G		
STX13005-AP	X13005		Ammopack
STX13005G-AP	X13005G		

1. The letter "G" in the order code suffix identifies the product as ECOPACK<sup>®</sup>2 grade. Please see [Section 4](#) for details.

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{CES}$	Collector-emitter voltage ( $V_{BE} = 0$ )	700	V
$V_{CEO}$	Collector-emitter voltage ( $I_B = 0$ )	400	V
$V_{EBO}$	Emitter-base voltage ( $I_C = 0$ ; $I_B = 1.5$ A; $t_p < 10$ ms)	$V_{(BR)EBO}$	V
$I_C$	Collector current	3	A
$I_{CM}$	Collector peak current ( $t_p < 5$ ms)	6	A
$I_B$	Base current	1.5	A
$I_{BM}$	Base peak current ( $t_p < 5$ ms)	3	A
$P_{tot}$	Total dissipation at $T_c = 25^\circ\text{C}$	2.8	W
$T_{stg}$	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
$R_{thj-c}$	Thermal resistance junction-case max	45	$^\circ\text{C}/\text{W}$

## 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 ( $V_{\text{BE}} = 0$ )	$V_{\text{CE}} = 700 \text{ V}$			1	mA
		$V_{\text{CE}} = 700 \text{ V}$ $T_{\text{C}} = 125^{\circ}\text{C}$			5	mA
$I_{\text{CEO}}$	Collector-cut-off current ( $I_{\text{B}} = 0$ )	$V_{\text{CE}} = 400 \text{ V}$			1	mA
$V_{(\text{BR})\text{EBO}}$	Emitter base breakdown voltage ( $I_{\text{C}} = 0$ )	$I_{\text{E}} = 10 \text{ mA}$	9		18	V
$V_{\text{CEO(sus)}}^{(1)}$	Collector-emitter sustaining voltage ( $I_{\text{B}} = 0$ )	$I_{\text{C}} = 10 \text{ mA}$	400			V
$V_{\text{CE(sat)}}^{(1)}$	Collector-emitter saturation voltage	$I_{\text{C}} = 1 \text{ A}$ $I_{\text{B}} = 200 \text{ mA}$			0.5	V
		$I_{\text{C}} = 2 \text{ A}$ $I_{\text{B}} = 500 \text{ mA}$			0.6	V
		$I_{\text{C}} = 3 \text{ A}$ $I_{\text{B}} = 750 \text{ mA}$			5	V
$V_{\text{BE(sat)}}^{(1)}$	Base-emitter saturation voltage	$I_{\text{C}} = 1 \text{ A}$ $I_{\text{B}} = 200 \text{ mA}$			1.2	V
		$I_{\text{C}} = 2 \text{ A}$ $I_{\text{B}} = 500 \text{ mA}$			1.6	V
$h_{\text{FE}}^{(1)}$	DC current gain	$I_{\text{C}} = 1 \text{ A}$ $V_{\text{CE}} = 5 \text{ V}$	10		30	
		$I_{\text{C}} = 2 \text{ A}$ $V_{\text{CE}} = 5 \text{ V}$	8		24	
$t_{\text{s}}$ $t_{\text{f}}$	Resistive load	$I_{\text{C}} = 2 \text{ A}$ $V_{\text{CC}} = 125 \text{ V}$				
	Storage time	$I_{\text{B1}} = -I_{\text{B2}} = 400 \text{ mA}$		1.65		$\mu\text{s}$
	Fall time	$t_{\text{p}} = 30 \mu\text{s}$		260		ns
$t_{\text{s}}$ $t_{\text{f}}$	Inductive load	$I_{\text{C}} = 1 \text{ A}$ $V_{\text{clamp}} = 300 \text{ V}$				
	Storage time	$I_{\text{B1}} = 200 \text{ mA}$ $V_{\text{BE(off)}} = -5 \text{ V}$		0.8		$\mu\text{s}$
	Fall time	$L = 50 \text{ mH}$ $R_{\text{BB}} = 0$		150		ns

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

## 2.1 Electrical characteristics (curves)

Figure 2. Safe operating area @ $T_C = 25^\circ\text{C}$

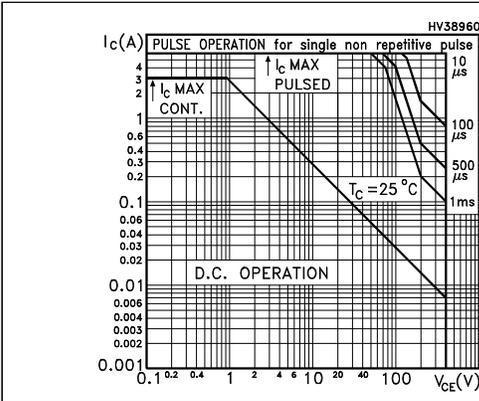


Figure 3. Safe operating area @ $T_C = 135^\circ\text{C}$

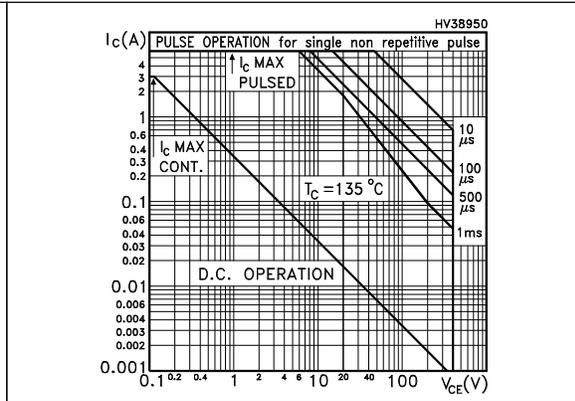


Figure 4. Derating curve

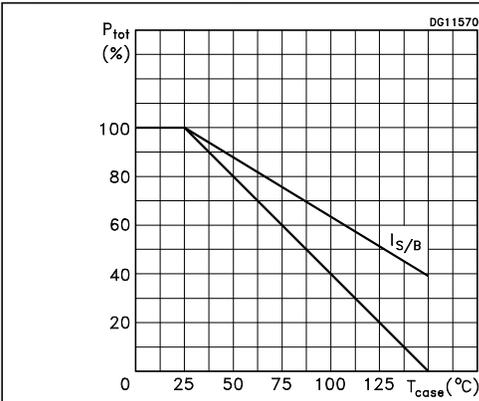


Figure 5. Output characteristics

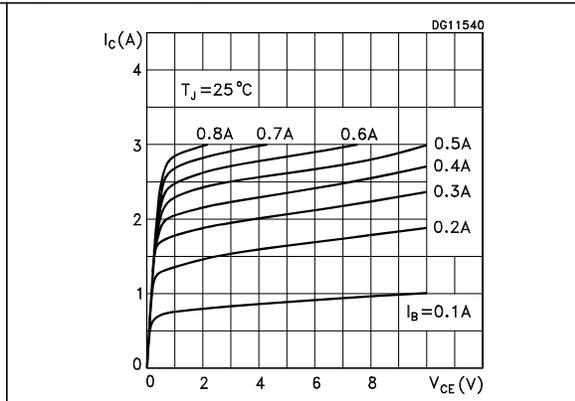


Figure 6. DC current gain @ $V_{CE} = 1\text{ V}$

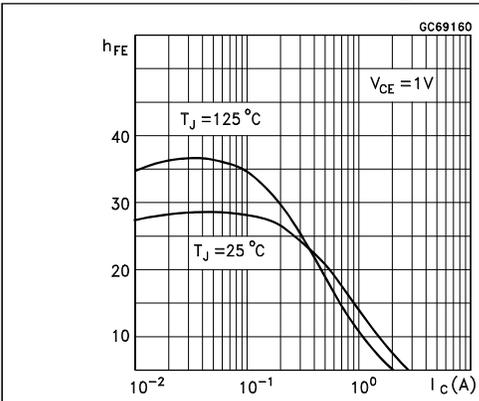


Figure 7. DC current gain @ $V_{CE} = 5\text{ V}$

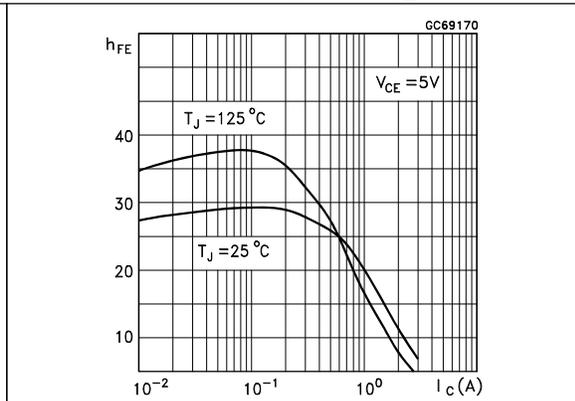


Figure 8. Collector-emitter saturation voltage Figure 9. Base-emitter saturation voltage

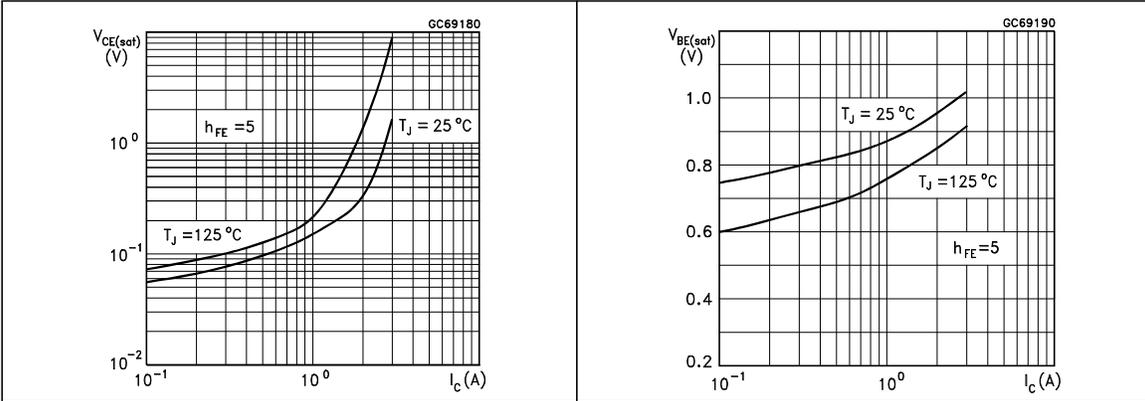


Figure 10. Inductive load fall time

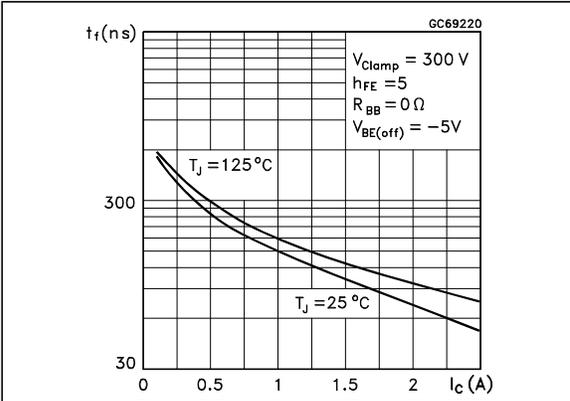


Figure 11. Inductive load storage time

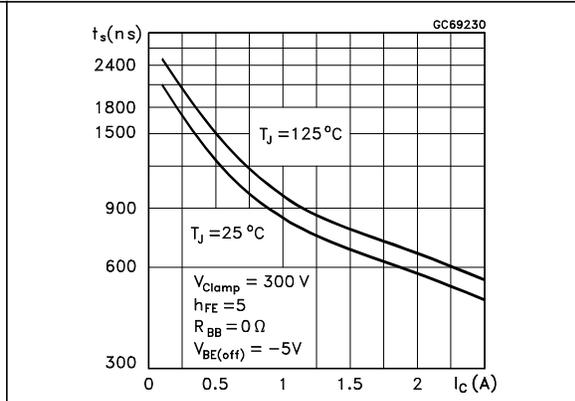


Figure 12. Resistive load fall time

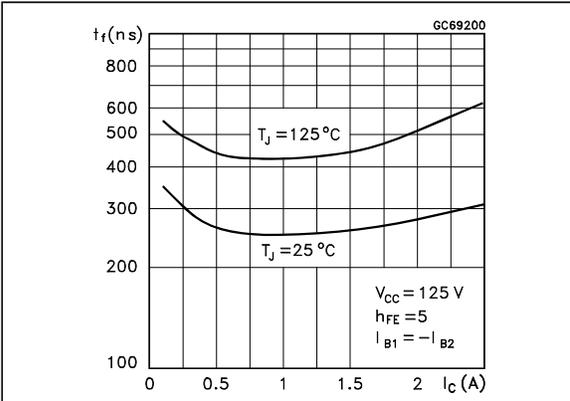


Figure 13. Resistive load storage time

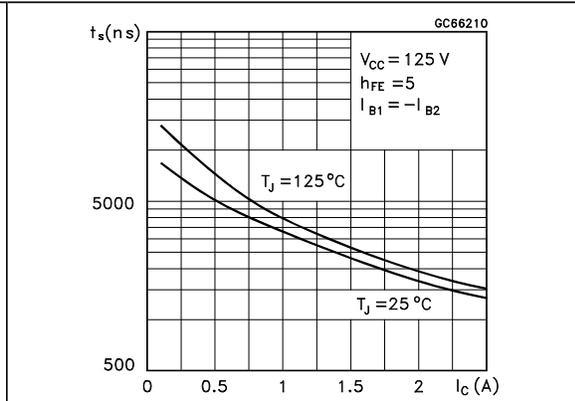
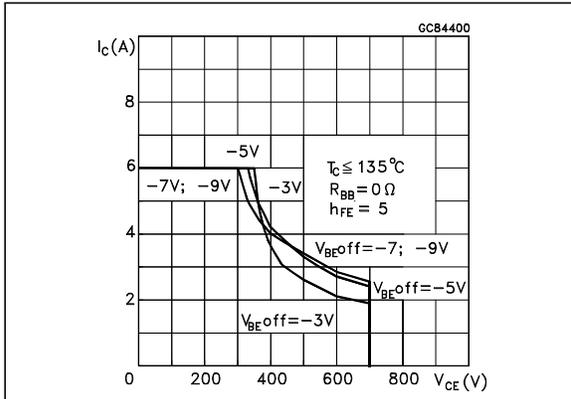
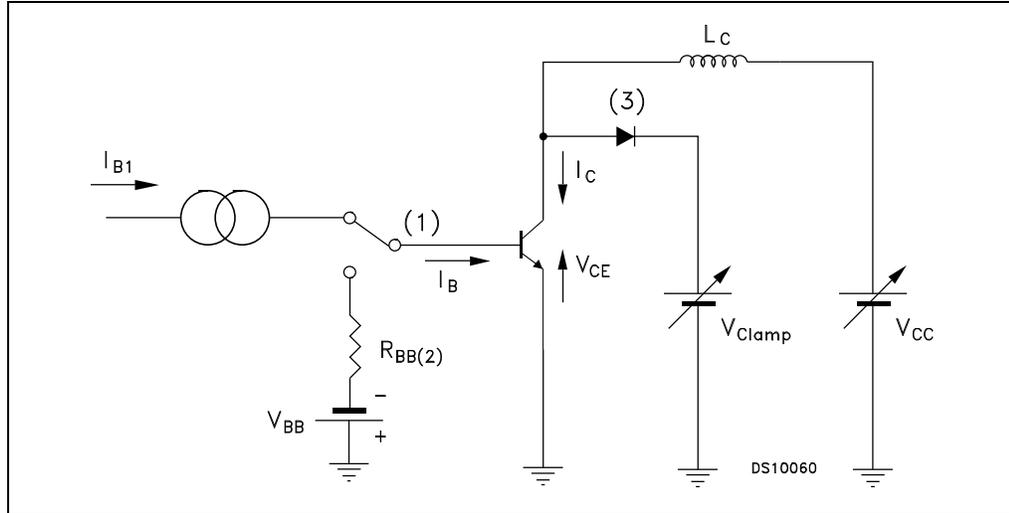


Figure 14. Reverse biased SOA



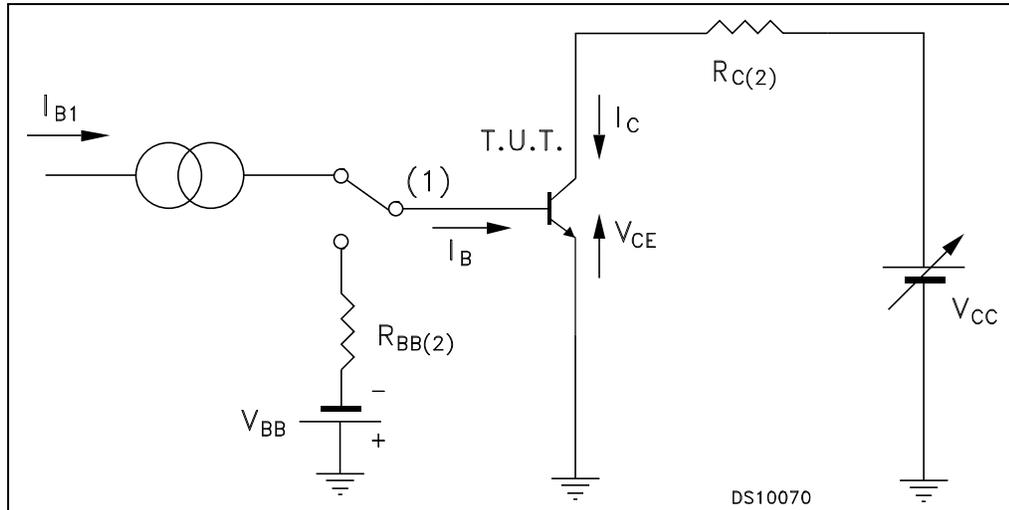
### 3 Test circuits

Figure 15. Inductive load switching test circuit



- 1) Fast electronic switch
- 2) Non-inductive resistor
- 3) Fast recovery rectifier

Figure 16. Resistive load switching test circuit



- 1) Fast electronic switch
- 2) Non-inductive resistor

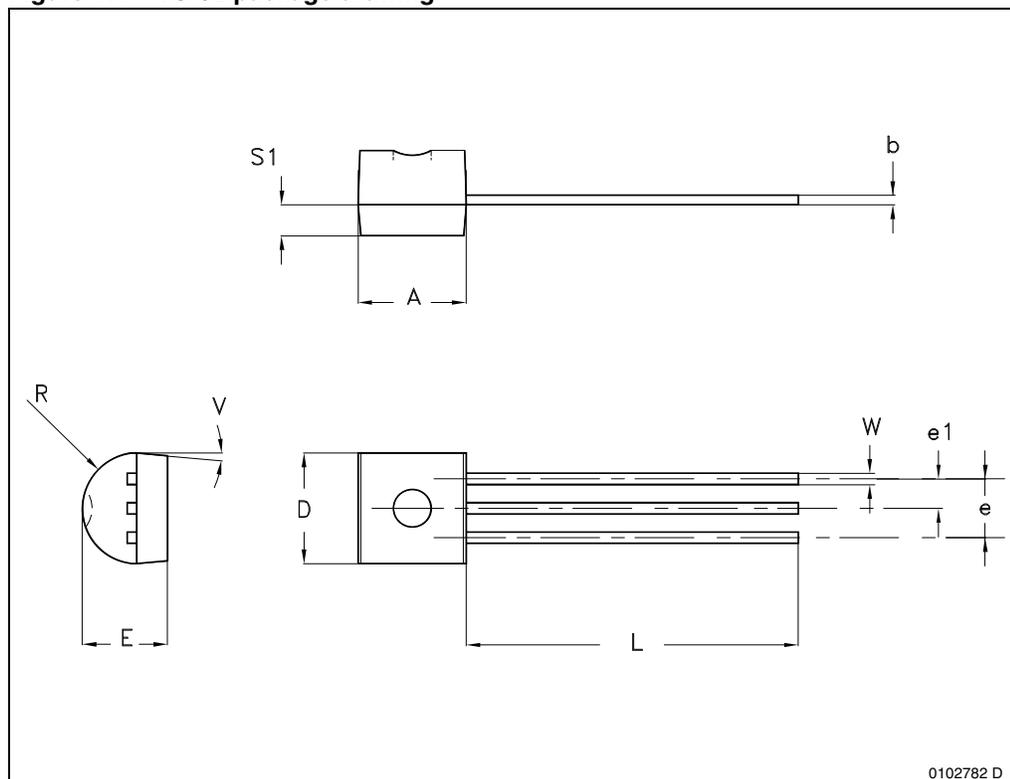
## 4 Package mechanical data

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.

Table 5. TO-92 package mechanical data

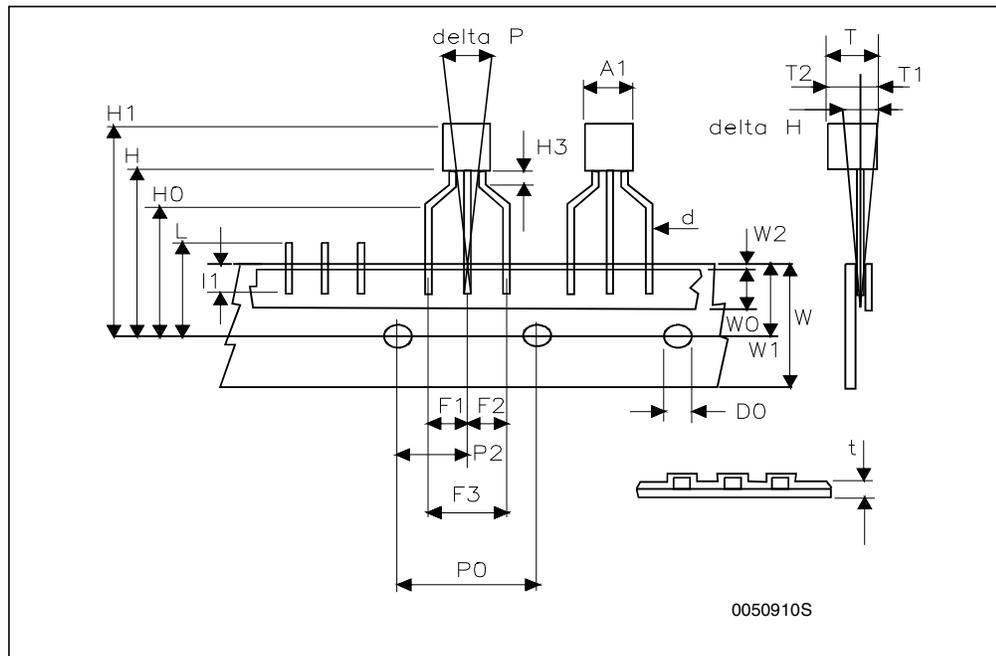
Dim.	mm		
	Min.	Typ.	Max.
A	4.32		4.95
b	0.36		0.51
D	4.45		4.95
E	3.30		3.94
e	2.41		2.67
e1	1.14		1.40
L	12.70		15.49
R	2.16		2.41
S1	0.92		1.52
W	0.41		0.56
V		5°	

Figure 17. TO-92 package drawing



## TO-92 ammpack hipment (uffix"-AP") mechanical data

Dim.	mm		
	Min	Typ	Max
A1			4.80
T			3.80
T1			1.60
T2			2.30
d			0.48
P0	12.50	12.70	12.90
P2	5.65	6.35	7.05
F1,F2	2.44	2.54	2.94
F3	4.98	5.08	5.48
delta H	-2.00		2.00
W	17.50	18.00	19.00
W0	5.70	6.00	6.30
W1	8.50	9.00	9.25
W2			0.50
H	18.50		20.50
H3	0.5	1	1.5
H0	15.50	16.00	16.50
H1			25.00
D0	3.80	4.00	4.20
t			0.90
L			11.00
I1	3.00		
delta P	-1.00		1.00



## 5 Revision history

Table 6. Document revision history

Date	Revision	Changes
01-Jul-2004	1	First release.
11-Feb-2005	2	New table on page 1
02-Aug-2007	3	New <a href="#">Figure 3</a> and updated <a href="#">Figure 14</a>
28-Sep-2007	4	Updated <a href="#">Figure 2</a> and <a href="#">Figure 3</a>
16-Dec-2008	5	Added ECOPACK <sup>®</sup> 2 grade products with suffix "G"
11-Aug-2009	6	Updated TO-92 mechanical data and <a href="#">Figure 1: Internal schematic diagram</a>

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