

## 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

- SMPS for battery charger

### Description

The device is manufactured using high voltage multi epitaxial planar technology for high switching speeds and high voltage capability. It uses a cellular emitter structure with planar edge termination to enhance switching speeds while maintaining the wide RBSOA. The STX13004G and STX13004G-AP are supplied using halogen-free molding compound.

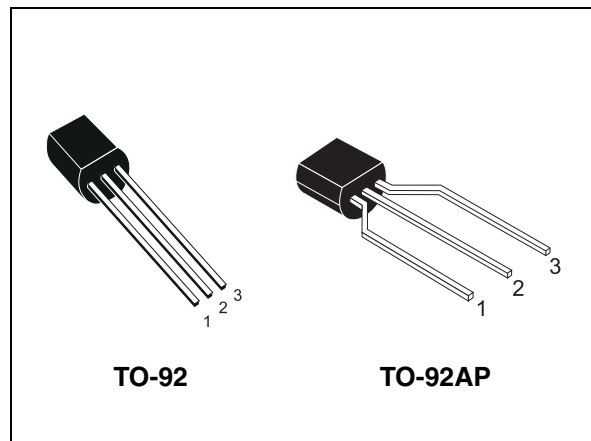


Figure 1. Internal schematic diagram

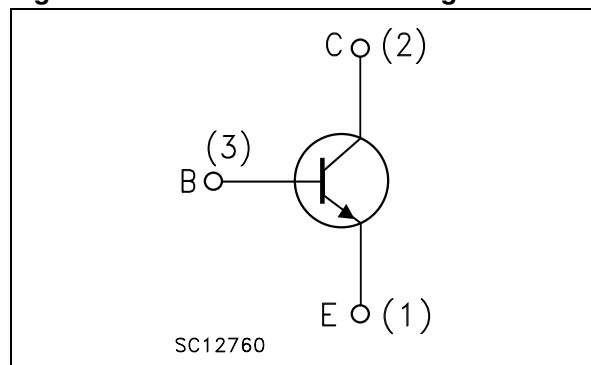


Table 1. Device summary

Order codes	Marking	Package	Packaging
STX13004	X13004	TO-92	Bulk
STX13004G	X13004G	TO-92	Bulk
STX13004-AP	X13004	TO-92AP	Ammopack
STX13004G-AP	X13004G	TO-92AP	Ammopack

# Contents

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<b>1</b>	<b>Electrical ratings</b> .....	<b>3</b>
<b>2</b>	<b>Electrical characteristics</b> .....	<b>4</b>
2.1	Electrical characteristics (curves) .....	5
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

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**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
$V_{EBO}$	Collector-base voltage ( $I_C = 0, I_B = 1\text{ A}, t_P < 10\text{ ms}$ )	$V_{(BR)EBO}$	V
$I_C$	Collector current	2	A
$I_{CM}$	Collector peak current ( $t_P < 5\text{ ms}$ )	4	A
$I_B$	Base current	1	A
$I_{BM}$	Base peak current ( $t_P < 5\text{ ms}$ )	2	A
$P_{TOT}$	Total dissipation at $T_C = 25\text{ °C}$	2.5	W
$T_{stg}$	Storage temperature	-65 to 150	°C
$T_J$	Max. operating junction temperature	150	

**Table 3. Thermal data**

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case max	50	°C/W

## 2 Electrical characteristics

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

**Table 4. Electrical characteristics**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{CES}$	Collector cut-off current ( $V_{BE} = 0$ )	$V_{CE} = 700\text{ V}$			1	mA
		$V_{CE} = 700\text{ V}$ $T_C = 125\text{ }^{\circ}\text{C}$			5	mA
$I_{CEO}$	Collector cut-off current ( $I_B = 0$ )	$V_{CE} = 400\text{ V}$			1	mA
$V_{(BR)EBO}$	Emitter-base breakdown voltage ( $I_C = 0$ )	$I_E = 10\text{ mA}$	9		18	V
$V_{CEQ(sus)}^{(1)}$	Collector-emitter sustaining voltage ( $I_B = 0$ )	$I_C = 10\text{ mA}$	400			V
$V_{CE(sat)}^{(1)}$	Collector-emitter saturation voltage	$I_C = 1\text{ A}$ $I_B = 200\text{ mA}$			0.5	V
		$I_C = 2\text{ A}$ $I_B = 500\text{ mA}$			1	V
$V_{BE(sat)}^{(1)}$	Base-emitter saturation voltage	$I_C = 1\text{ A}$ $I_B = 200\text{ mA}$			1.2	V
		$I_C = 2\text{ A}$ $I_B = 500\text{ mA}$			1.6	V
$h_{FE}$	DC current gain	$I_C = 0.5\text{ mA}$ $V_{CE} = 2\text{ V}$	15	35		
		$I_C = 425\text{ mA}$ $V_{CE} = 2\text{ V}$	24			
		$I_C = 1\text{ A}$ $V_{CE} = 5\text{ V}$	10		30	
		$I_C = 2\text{ A}$ $V_{CE} = 5\text{ V}$	6		16	
$t_s$ $t_f$	Resistive load Storage time	$I_C = 2\text{ A}$ $t_p = 30\text{ }\mu\text{s}$ $I_{B(on)} = -I_{B(off)} = 400\text{ mA}$ $V_{CC} = 125\text{ V}$ $V_{BB(off)} = -5\text{ V}$ (see <a href="#">Figure 12</a> )		1.1		$\mu\text{s}$
	Fall time			300		ns
$t_s$ $t_f$	Inductive load Storage time	$I_C = 1\text{ A}$ $V_{clamp} = 300\text{ V}$ $I_{B(on)} = 200\text{ mA}$ $V_{BB(off)} = -5\text{ V}$ $L = 50\text{ mH}$ $R_{BB(off)} = 0$ (see <a href="#">Figure 13</a> )		0.6		$\mu\text{s}$
	Fall time			80		ns

1. Pulsed duration = 300  $\mu\text{s}$ , duty cycle  $\leq 1.5\%$

## 2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

Figure 3. Derating curve

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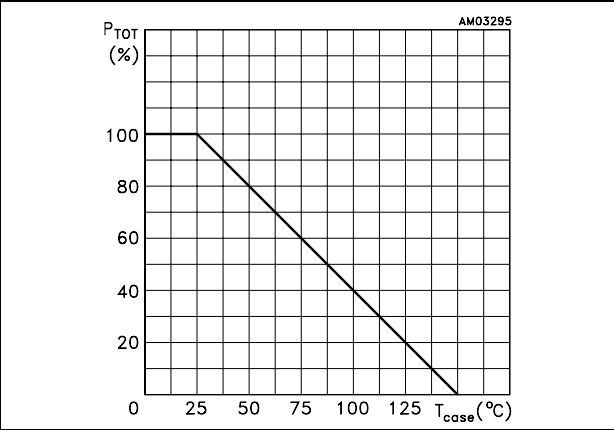
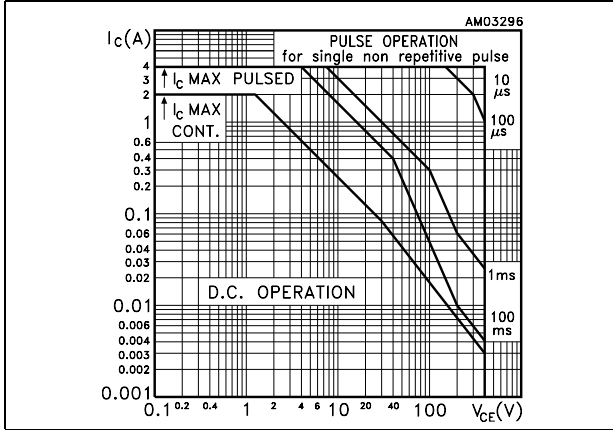


Figure 4. DC current gain @  $V_{CE} = 2\text{ V}$

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

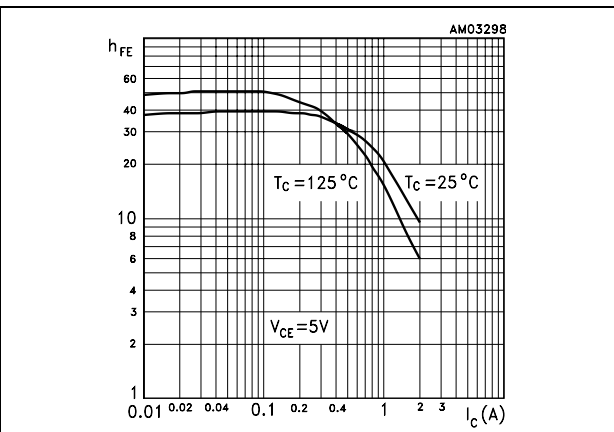
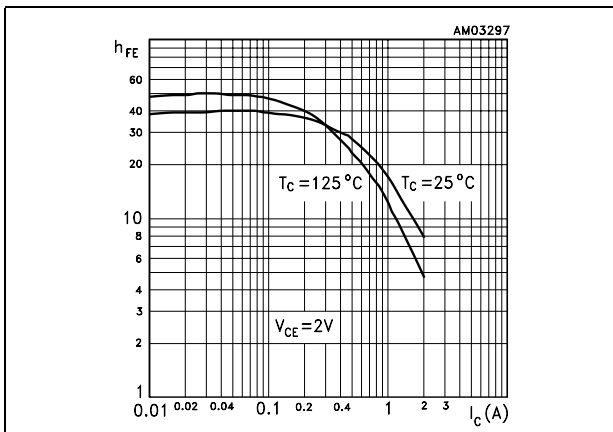


Figure 6. Collector-emitter saturation voltage

Figure 7. Base-emitter saturation voltage

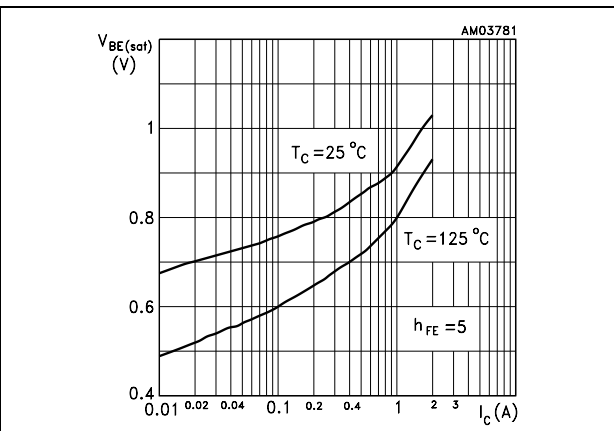
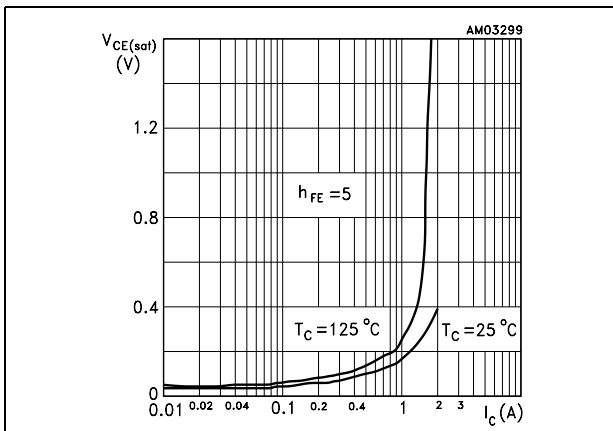


Figure 8. Output characteristics

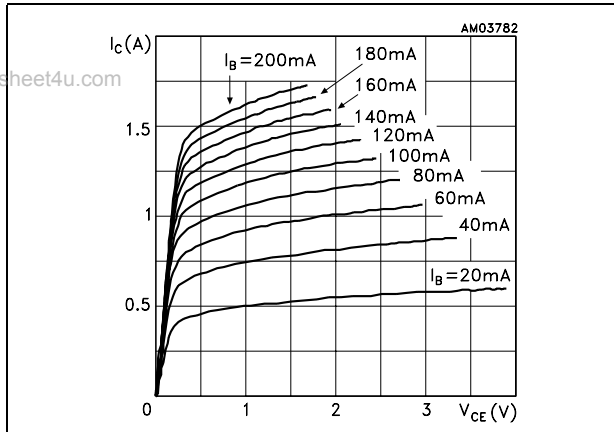


Figure 9. Reverse biased SOA

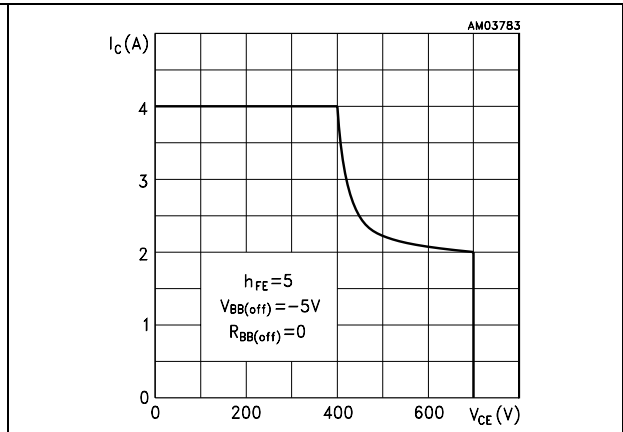


Figure 10. Resistive load switching times

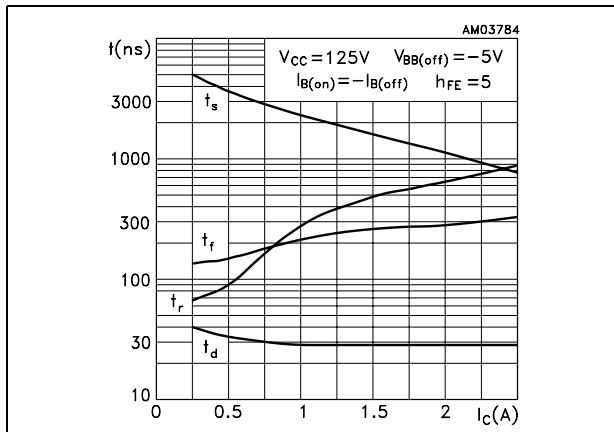
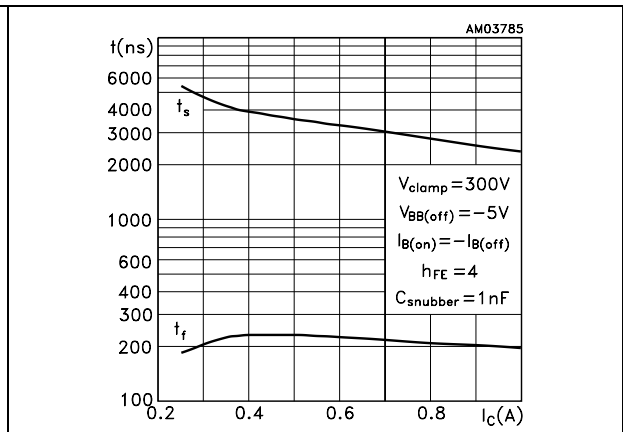


Figure 11. Inductive load switching times



## 2.2 Test circuits

Figure 12. Resistive load switching test circuit

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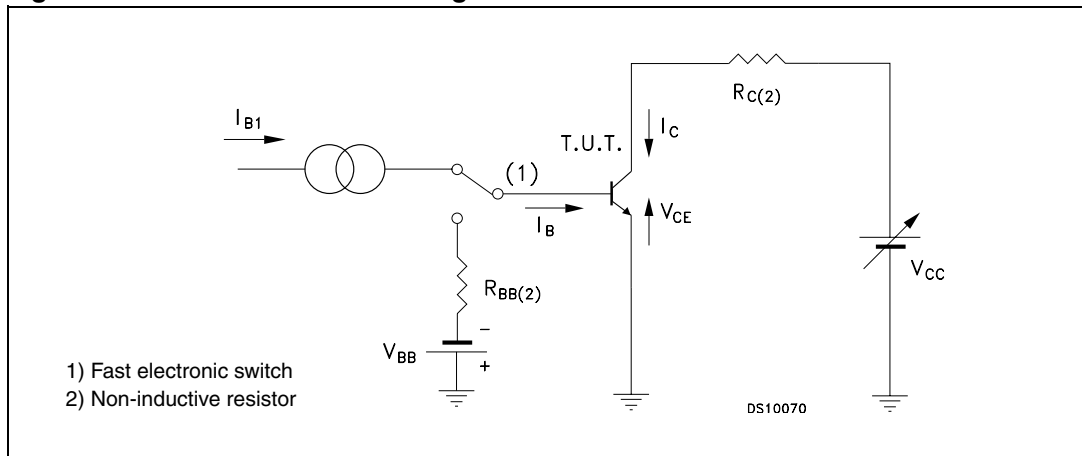
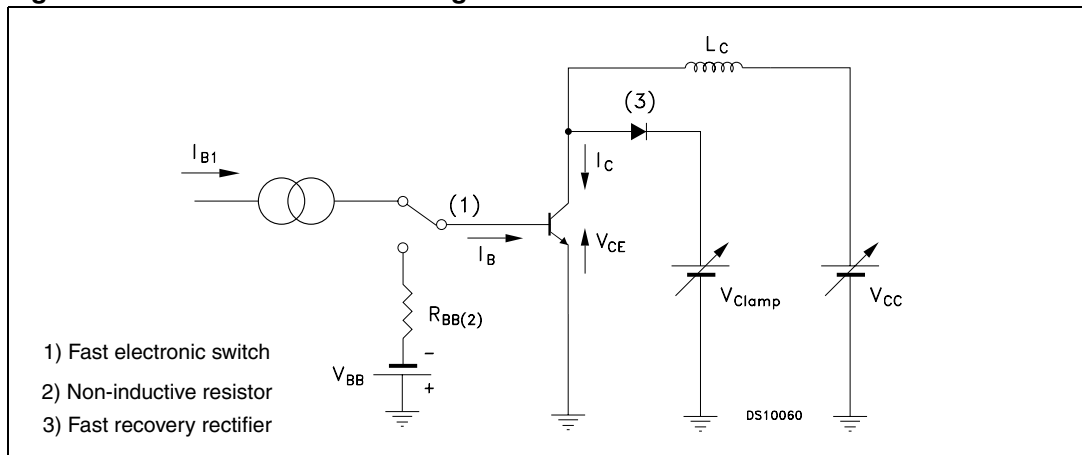


Figure 13. Inductive load switching test circuit



### 3 Package mechanical data

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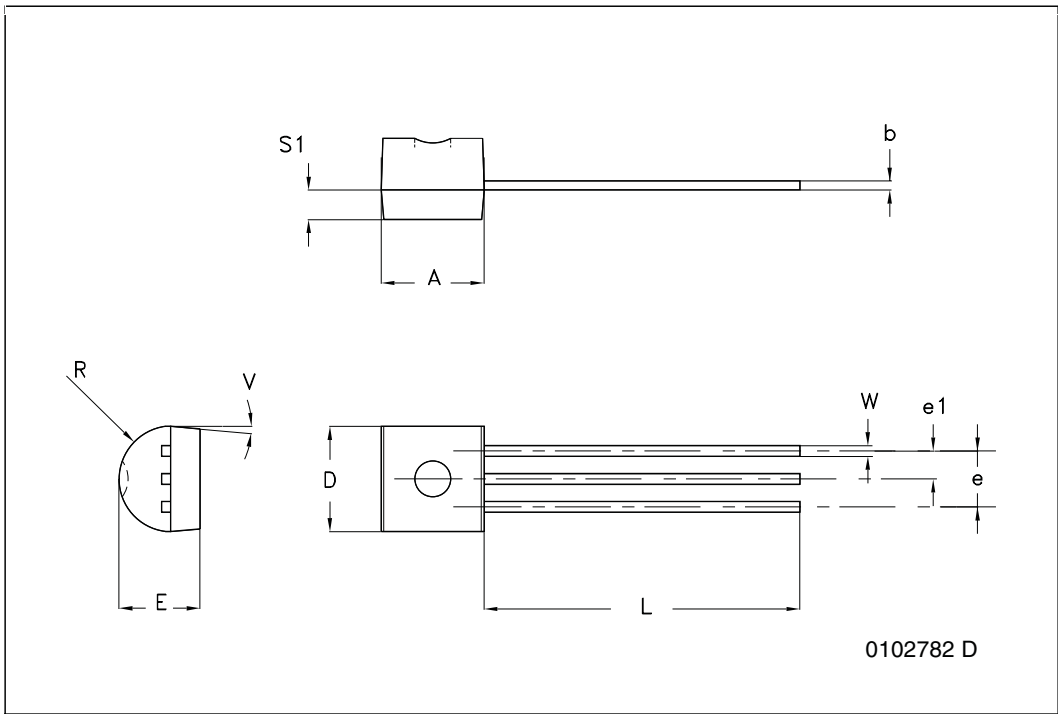
In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK is an ST trademark.



**TO-92 bulk shipment mechanical data**

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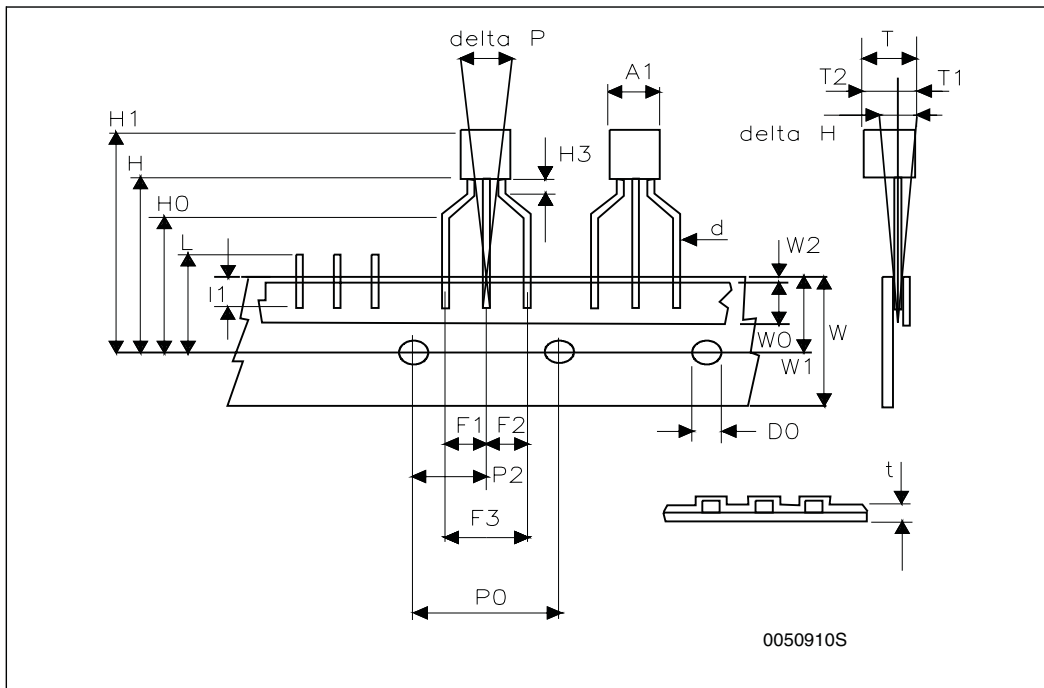
DIM.	mm.		
	MIN.	TYP	MAX.
A	4.32		4.95
b	0.36		0.51
D	4.45		4.95
E	3.30		3.94
e	2.41		2.67
e1	1.14		1.40
L	12.70		15.49
R	2.16		2.41
S1	0.92		1.52
W	0.41		0.56
V		5°	



**TO-92 ammpack shipment (suffix"-AP") mechanical data**

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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



## 4 Revision history

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**Table 5. Document revision history**

Date	Revision	Changes
01-Apr-2009	1	First release.

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