



## 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

## **Application**

■ 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.

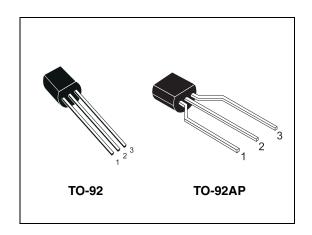


Figure 1. Internal schematic diagram

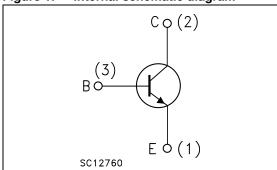


Table 1. Device summary

Order codes	Marking	Package	Packaging
STX13004	X13004	TO-92	Bulk
STX13004G <sup>(1)</sup>	X13004G	TO-92	Bulk
STX13004-AP	X13004	TO-92AP	Ammopack
STX13004G-AP <sup>(1)</sup>	X13004G	TO-92AP	Ammopack

<sup>1.</sup> The letter "G" in the order code identifies the product as ECOPACK@2 grade. Please see Section 3 for details.

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Electrical ratings STX13004

# 1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit	
V <sub>CES</sub>	Collector-emitter voltage (V <sub>BE</sub> = 0)	700	V	
V <sub>CEO</sub>	Collector-emitter voltage (I <sub>B</sub> = 0)	400	V	
$V_{EBO}$	Collector-base voltage ( $I_C = 0$ , $I_B = 1$ A, $t_P < 10$ ms)	V <sub>(BR)EBO</sub>	V	
I <sub>C</sub>	Collector current	2	Α	
I <sub>CM</sub>	Collector peak current (t <sub>P</sub> < 5 ms)	4	Α	
Ι <sub>Β</sub>	Base current	1	Α	
I <sub>BM</sub>	Base peak current (t <sub>P</sub> < 5 ms) 2		Α	
P <sub>TOT</sub>	Total dissipation at T <sub>c</sub> = 25 °C	2.5	W	
T <sub>STG</sub>	Storage temperature	-65 to 150	°C	
T <sub>J</sub>	Max. operating junction temperature	150	<u> </u>	

Table 3. Thermal data

Symbol	Parameter	Value	Unit
R <sub>thJC</sub>	Thermal resistance junction-case max	50	°C/W
R <sub>thJA</sub>	Thermal resistance junction-ambient max	150	°C/W

# 2 Electrical characteristics

 $T_{case}$  = 25 °C; unless otherwise specified.

Table 4. Electrical characteristics

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
I <sub>CES</sub>	Collector cut-off current (V <sub>BE</sub> = 0)	V <sub>CE</sub> = 700 V			10	μΑ
I <sub>CEO</sub>	Collector cut-off current (I <sub>B</sub> = 0)	V <sub>CE</sub> = 400 V			1	mA
V <sub>(BR)EBO</sub>	Emitter-base breakdown voltage $(I_C = 0)$	I <sub>E</sub> = 10 mA	9		18	V
V <sub>CEO(sus)</sub> <sup>(1)</sup>	Collector-emitter sustaining voltage (I <sub>B</sub> = 0)	I <sub>C</sub> = 10 mA	400			٧
V <sub>CE(sat)</sub> (1)	Collector-emitter saturation voltage	$I_C = 1 \text{ A}$ $I_B = 200 \text{ mA}$ $I_C = 2 \text{ A}$ $I_B = 500 \text{ mA}$			0.5 1	V V
V <sub>BE(sat)</sub> (1)	Base-emitter saturation voltage	$I_C = 1 \text{ A}$ $I_B = 200 \text{ mA}$ $I_C = 2 \text{ A}$ $I_B = 500 \text{ mA}$			1.2 1.6	V V
h <sub>FE</sub>	DC current gain	$\begin{split} I_{C} &= 0.5 \text{ mA} & V_{CE} &= 2 \text{ V} \\ I_{C} &= 400 \text{ mA} & V_{CE} &= 2 \text{ V} \\ I_{C} &= 1 \text{ A} & V_{CE} &= 5 \text{ V} \\ I_{C} &= 2 \text{ A} & V_{CE} &= 5 \text{ V} \end{split}$	26	35	30 16	
t <sub>s</sub>	Resistive load Storage time Fall time	$\begin{array}{l} I_{C} = 2 \text{ A} & t_{p} = 30  \mu s \\ I_{B(on)} = -I_{B(off)} = 400  mA \\ V_{CC} = 125 \text{ V} & V_{BB(off)} = -5 \text{ V} \\ (\text{see \textit{Figure 12}}) \end{array}$		1.1 300		μs ns
t <sub>s</sub>	Inductive load Storage time Fall time	$\begin{split} I_{C} &= 1 \text{ A} & V_{clamp} = 300 \text{ V} \\ I_{B(on)} &= 250 \text{ mA} & V_{BB(off)} = -5 \text{ N} \\ C_{snubber} &= 1 \text{ nF} & R_{BB(off)} = 0 \\ (\text{see } \textit{Figure } 13) \end{split}$		2.4 200		μs ns

<sup>1.</sup> Pulse test: pulse duration  $\leq$  300  $\mu$ s, duty cycle  $\leq$  2 %.

Electrical characteristics STX13004

## 2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

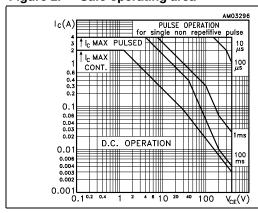


Figure 3. Derating curve

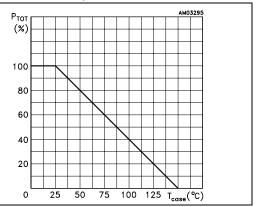


Figure 4. DC current gain  $@V_{CE} = 2 V$ 

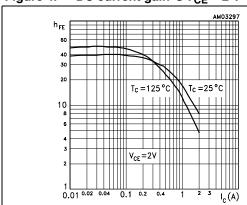


Figure 5. DC current gain @V<sub>CE</sub> = 5 V

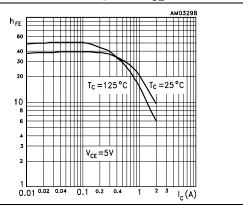
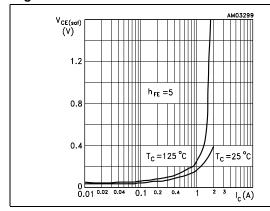
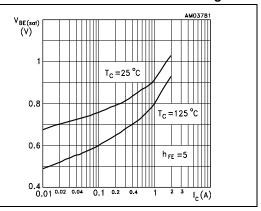


Figure 6. Collector-emitter saturation voltage Figure 7. Base-emitter saturation voltage





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Figure 8. Output characteristics

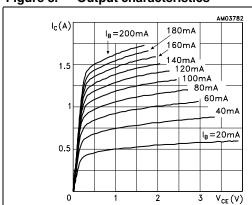


Figure 9. Reverse biased SOA

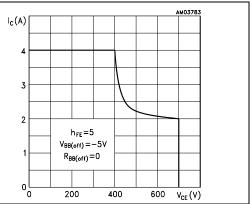
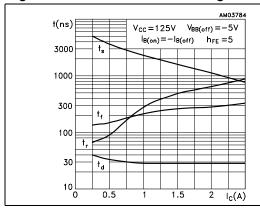
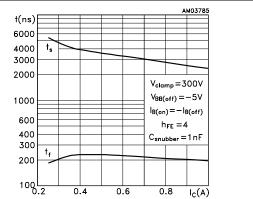


Figure 10. Resistive load switching times

Figure 11. Inductive load switching times

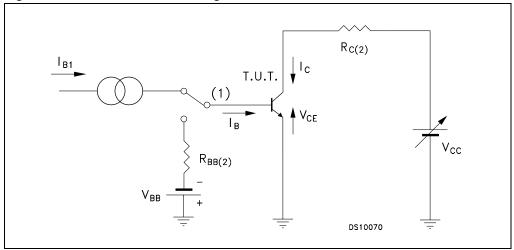




Electrical characteristics STX13004

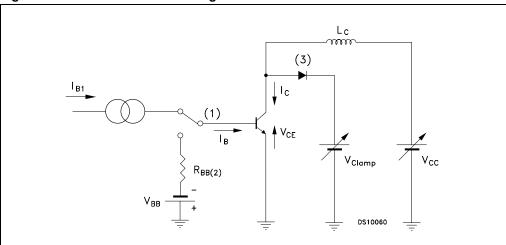
## 2.2 Test circuits

Figure 12. Resistive load switching test circuit



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

Figure 13. Inductive load switching test circuit



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

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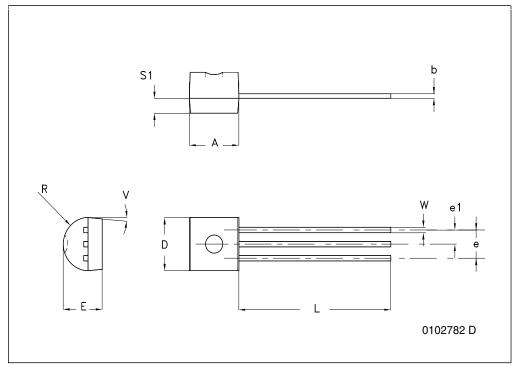
## 3 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of  $\mathsf{ECOPACK}^{\mathbb{B}}$  packages, depending on their level of environmental compliance.  $\mathsf{ECOPACK}^{\mathbb{B}}$  specifications, grade definitions and product status are available at:  $\mathit{www.st.com}$ .  $\mathsf{ECOPACK}^{\mathbb{B}}$  is an ST trademark.

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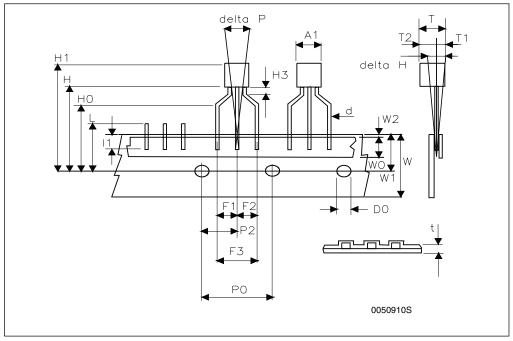
TO-92 bulk shipment med	hanical data
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DIM	mm.		
DIM.	MIN.	ТҮР	MAX.
Α	4.32		4.95
b	0.36		0.51
D	4.45		4.95
E	3.30		3.94
е	2.41		2.67
e1	1.14		1.40
L	12.70		15.49
R	2.16		2.41
S1	0.92		1.52
W	0.41		0.56
V		5°	



## TO-92 ammopack shipment (suffix"-AP") mechanical data

Dim.	mm		
	Min	Тур	Max
A1			4.80
Т			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
Н	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



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Revision history STX13004

# 4 Revision history

Table 5. Document revision history

Date	Revision	Changes
01-Apr-2009	1	First release.
21-Apr-2010	2	Updated h <sub>FE</sub> specification <i>Table 4 on page 3</i> .
06-Jul-2010	3	Added R <sub>thJA</sub> value <i>Table 3 on page 2</i> and updated I <sub>CES</sub> maximum value <i>Table 4 on page 3</i> .

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