

## 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.

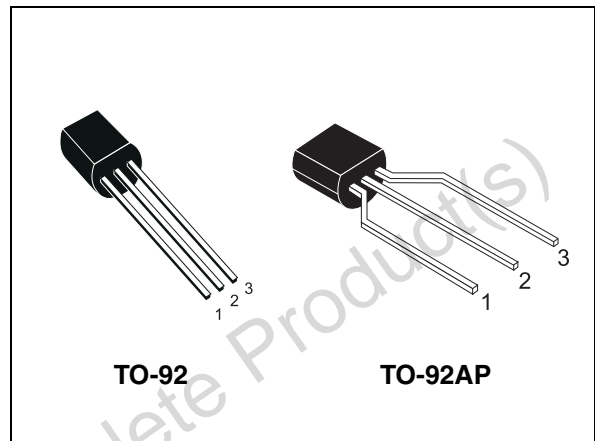


Figure 1. Internal schematic diagram

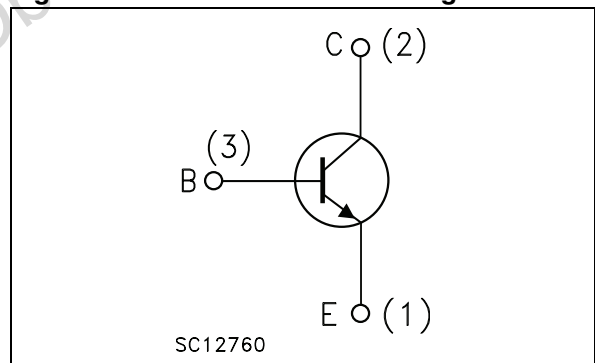


Table 1. Device summary

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

1. The letter "G" in the order code identifies the product as ECOPACK@2 grade. Please see [Section 3](#) for details.

# 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
$V_{EBO}$	Collector-base voltage ( $I_C = 0$ , $I_B = 1$ A, $t_P < 10$ ms)	$V_{(BR)EBO}$	V
$I_C$	Collector current	2	A
$I_{CM}$	Collector peak current ( $t_P < 5$ ms)	4	A
$I_B$	Base current	1	A
$I_{BM}$	Base peak current ( $t_P < 5$ ms)	2	A
$P_{TOT}$	Total dissipation at $T_C = 25$ °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
$R_{thJC}$	Thermal resistance junction-case max	50	°C/W
$R_{thJA}$	Thermal resistance junction-ambient max	150	°C/W

## 2 Electrical characteristics

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

**Table 4. Electrical characteristics**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{\text{CES}}$	Collector cut-off current ( $V_{\text{BE}} = 0$ )	$V_{\text{CE}} = 700\text{ V}$			10	$\mu\text{A}$
$I_{\text{CEO}}$	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	$I_{\text{C}} = 1\text{ A}$ $I_{\text{B}} = 200\text{ mA}$ $I_{\text{C}} = 2\text{ A}$ $I_{\text{B}} = 500\text{ mA}$			0.5 1	V V
$V_{\text{BE(sat)}}^{(1)}$	Base-emitter saturation voltage	$I_{\text{C}} = 1\text{ A}$ $I_{\text{B}} = 200\text{ mA}$ $I_{\text{C}} = 2\text{ A}$ $I_{\text{B}} = 500\text{ mA}$			1.2 1.6	V V
$h_{\text{FE}}$	DC current gain	$I_{\text{C}} = 0.5\text{ mA}$ $V_{\text{CE}} = 2\text{ V}$ $I_{\text{C}} = 400\text{ mA}$ $V_{\text{CE}} = 2\text{ V}$ $I_{\text{C}} = 1\text{ A}$ $V_{\text{CE}} = 5\text{ V}$ $I_{\text{C}} = 2\text{ A}$ $V_{\text{CE}} = 5\text{ V}$	15 26 10 6	35	30 16	
$t_{\text{s}}$ $t_{\text{f}}$	Resistive load Storage time Fall time	$I_{\text{C}} = 2\text{ A}$ $t_{\text{p}} = 30\text{ }\mu\text{s}$ $I_{\text{B(on)}} = -I_{\text{B(off)}} = 400\text{ mA}$ $V_{\text{CC}} = 125\text{ V}$ $V_{\text{BB(off)}} = -5\text{ V}$ (see <a href="#">Figure 12</a> )		1.1 300		$\mu\text{s}$ ns
$t_{\text{s}}$ $t_{\text{f}}$	Inductive load Storage time Fall time	$I_{\text{C}} = 1\text{ A}$ $V_{\text{clamp}} = 300\text{ V}$ $I_{\text{B(on)}} = 250\text{ mA}$ $V_{\text{BB(off)}} = -5\text{ V}$ $C_{\text{snubber}} = 1\text{ nF}$ $R_{\text{BB(off)}} = 0$ (see <a href="#">Figure 13</a> )		2.4 200		$\mu\text{s}$ ns

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

2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

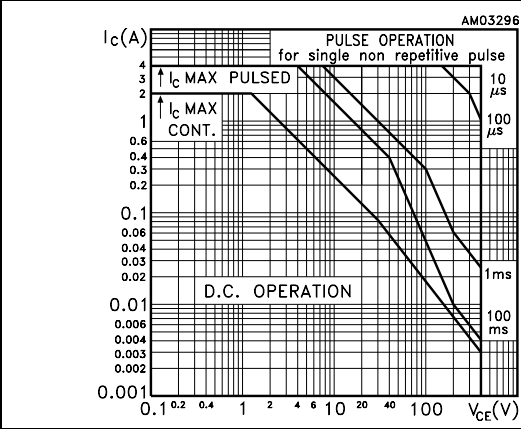


Figure 3. Derating curve

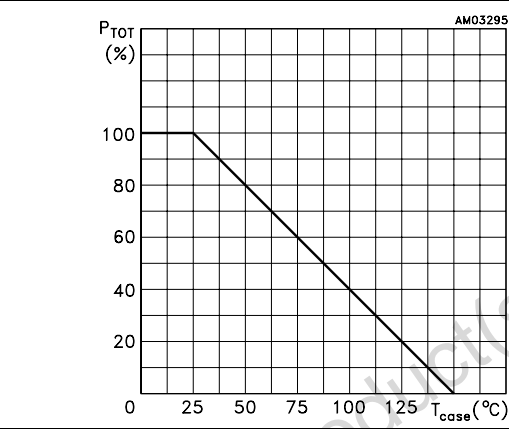


Figure 4. DC current gain @  $V_{CE} = 2$  V

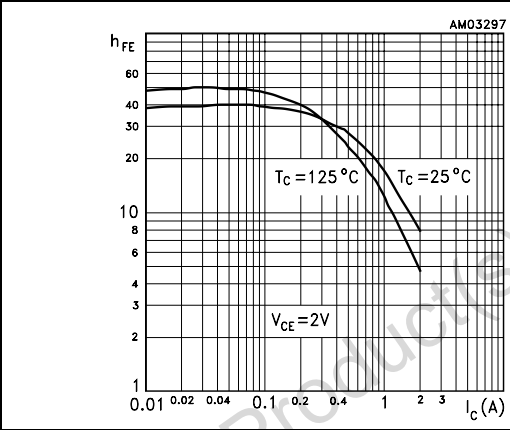


Figure 5. DC current gain @  $V_{CE} = 5$  V

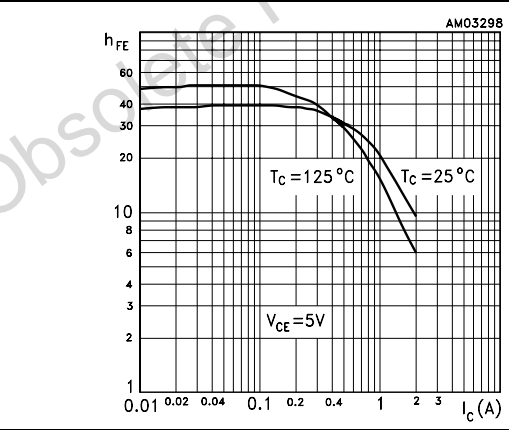


Figure 6. Collector-emitter saturation voltage Figure 7. Base-emitter saturation voltage

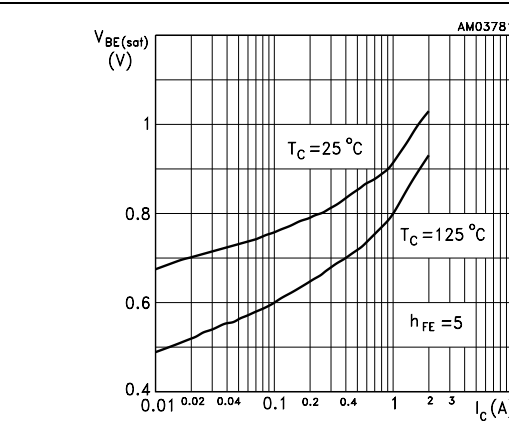
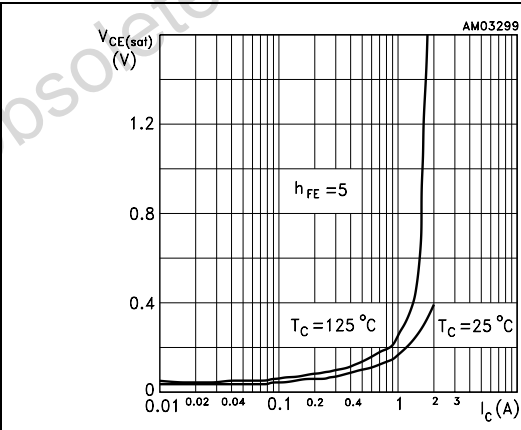


Figure 8. Output characteristics

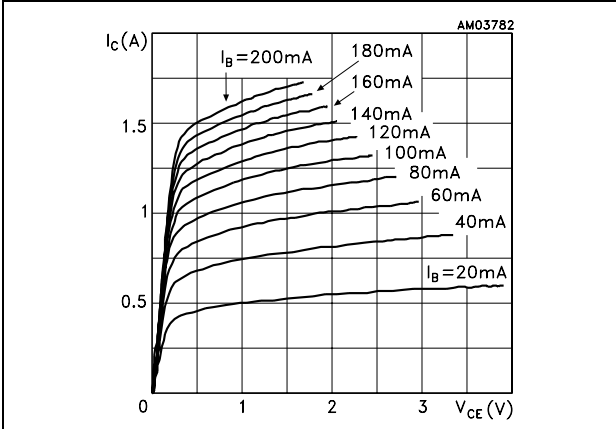


Figure 9. Reverse biased SOA

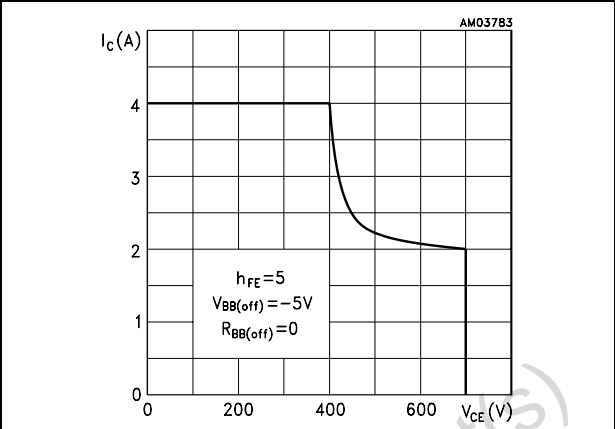


Figure 10. Resistive load switching times

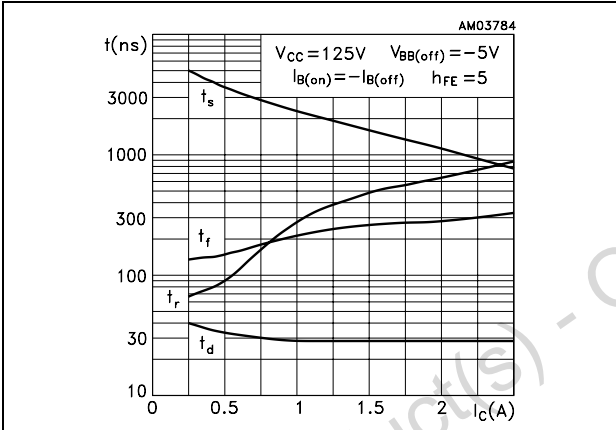
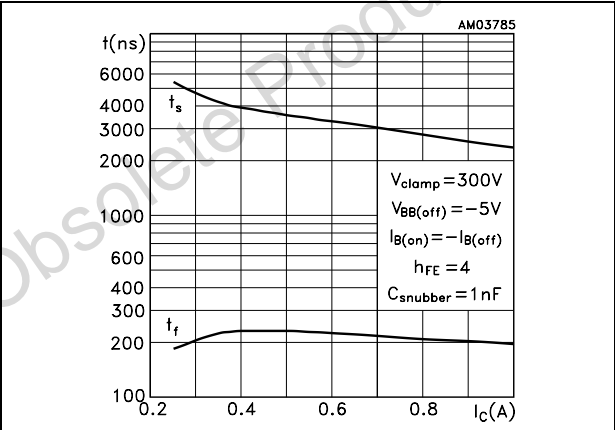
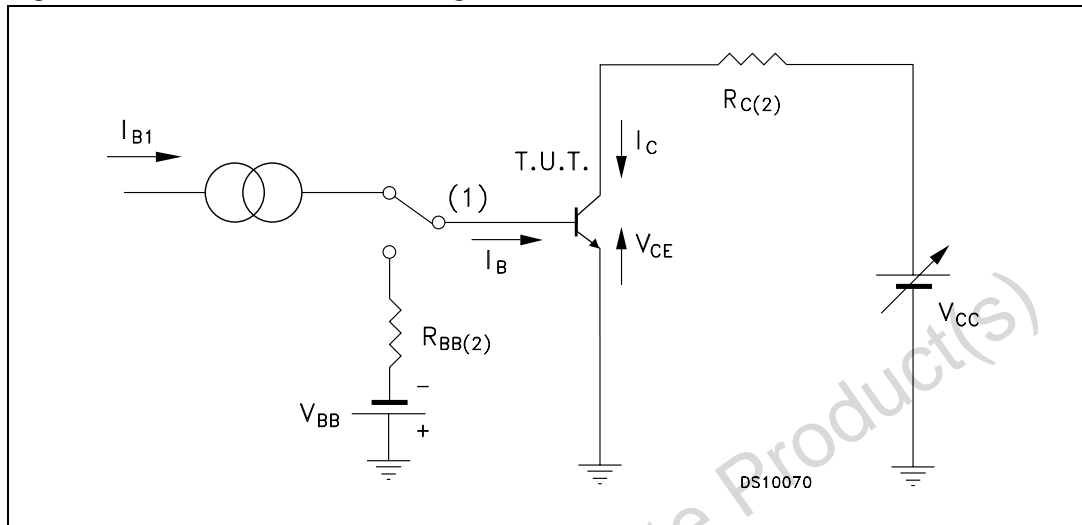


Figure 11. Inductive load switching times



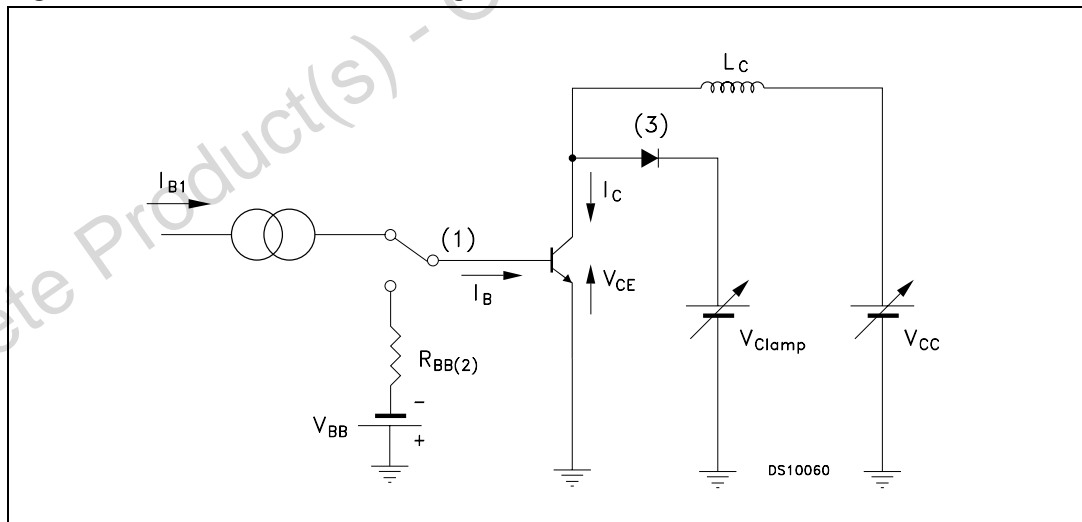
## 2.2 Test circuits

**Figure 12. Resistive load switching test circuit**



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

### 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.

Obsolete Product(s) - Obsolete Product(s)

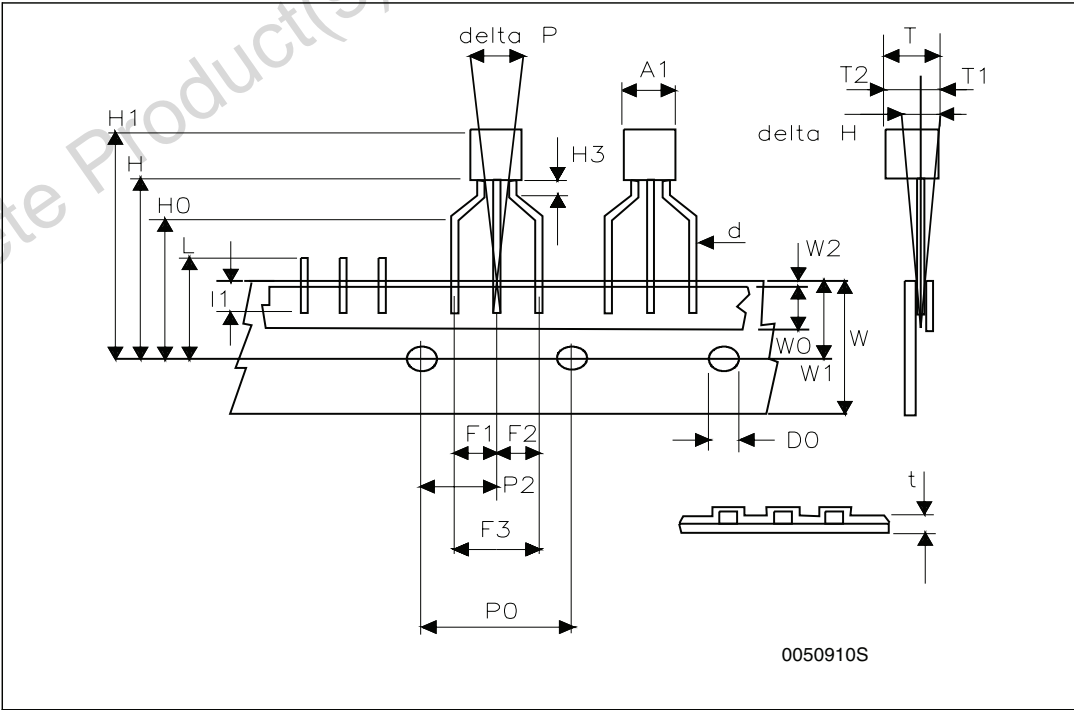
TO-92 bulk shipment mechanical data			
DIM.	mm.		
	MIN.	TYP	MAX.
A	4.32		4.95
b	0.36		0.51
D	4.45		4.95
E	3.30		3.94
e	2.41		2.67
e1	1.14		1.40
L	12.70		15.49
R	2.16		2.41
S1	0.92		1.52
W	0.41		0.56
V		5°	

The diagram illustrates the mechanical specifications of a TO-92 package. It includes three views: a top view showing dimensions A (body width), b (lead thickness), and S1 (lead height); a side view showing dimensions D (body diameter), E (body length), R (lead radius), and V (lead angle); and a front view showing dimensions L (lead length), W (lead width), e1 (lead thickness at base), and e (lead thickness at tip). The drawing is labeled with the identifier 0102782 D.



TO-92 ammpack shipment (suffix"-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



## 4 Revision history

**Table 5. Document revision history**

Date	Revision	Changes
01-Apr-2009	1	First release.
21-Apr-2010	2	Updated $h_{FE}$ specification <a href="#">Table 4 on page 3</a> .
06-Jul-2010	3	Added $R_{thJA}$ value <a href="#">Table 3 on page 2</a> and updated $I_{CES}$ maximum value <a href="#">Table 4 on page 3</a> .

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