

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.

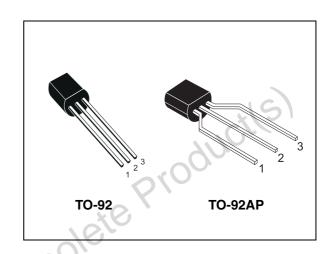


Figure 1. Internal schematic diagram

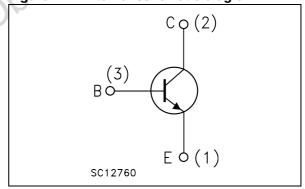


Table 1. Device summary

Order codes	ler codes Marking Package		Packaging	
STX13004	X13004	TO-92	Bulk	
STX13004G ⁽¹⁾	X13004G	TO-92	Bulk	
STX13004-AP	X13004	TO-92AP	Ammopack	
STX13004G-AP ⁽¹⁾	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.

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Electrical ratings STX13004

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	Α
I _{CM}	Collector peak current (t _P < 5 ms)	4	Α
I _B	Base current	1	Α
I _{BM}	Base peak current (t _P < 5 ms)	2	Α
P _{TOT}	Total dissipation at T _c = 25 °C	2.5	W
T _{STG}	Storage temperature	-65 to 150	°C
TJ	Max. operating junction temperature	150	

Table 3. Thermal data

	Symbol	Parameter	Value	Unit °C/W °C/W	
	R _{thJC}	Thermal resistance junction-case max	50		
	R _{thJA}	Thermal resistance junction-ambient max	150		
Obsole	ie P	COGIO			

2 Electrical characteristics

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

Table 4. Electrical characteristics

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
I _{CES}	Collector cut-off current (V _{BE} = 0)	V _{CE} = 700 V			10	μΑ
I _{CEO}	Collector cut-off current (I _B = 0)	V _{CE} = 400 V			1	mA
V _{(BR)EBO}	Emitter-base breakdown voltage $(I_C = 0)$	I _E = 10 mA	9	Ċ	18	V
V _{CEO(sus)} ⁽¹⁾	Collector-emitter sustaining voltage (I _B = 0)	I _C = 10 mA	400	70		V
V _{CE(sat)} (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 _{BE(sat)} (1)	Base-emitter saturation voltage	$I_C = 1 \text{ A}$ $I_B = 200 \text{ mA}$ $I_B = 500 \text{ mA}$			1.2 1.6	V V
h _{FE}	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 _s	Resistive load Storage time Fall time	$I_C = 2 \text{ A}$ $t_p = 30 \text{ µs}$ $I_{B(on)} = -I_{B(off)} = 400 \text{ mA}$ $V_{CC} = 125 \text{ V}$ $V_{BB(off)} = -5 \text{ V}$ (see <i>Figure 12</i>)		1.1		μs ns
t _s	Inductive load Storage time Fall time	$\begin{split} I_{C} &= 1 \text{ A} & V_{clamp} &= 300 \text{ V} \\ I_{B(on)} &= 250 \text{ mA} & V_{BB(off)} &= -5 \text{ V} \\ C_{snubber} &= 1 \text{ nF} & R_{BB(off)} &= 0 \\ (\text{see } \textit{Figure } \textit{13}) & \end{split}$		2.4 200		μs ns

^{1.} Pulse test: pulse duration \leq 300 μ s, duty cycle \leq 2 %.

Electrical characteristics STX13004

2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

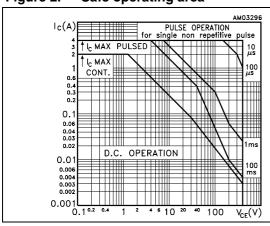


Figure 3. Derating curve

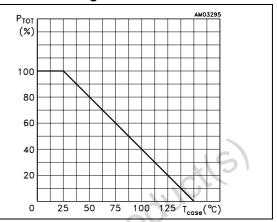


Figure 4. DC current gain @V_{CE} = 2 V

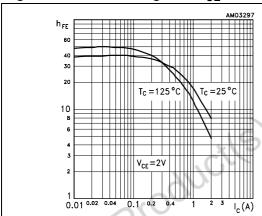


Figure 5. DC current gain $@V_{CE} = 5 \text{ V}$

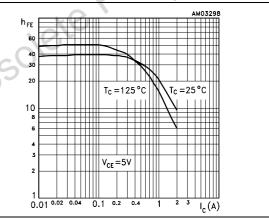
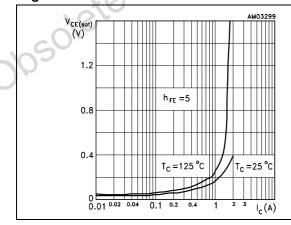


Figure 6. Collector-emitter saturation voltage Figure 7. Base-emitter saturation voltage



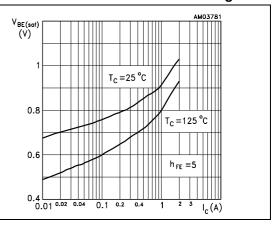


Figure 8. Output characteristics

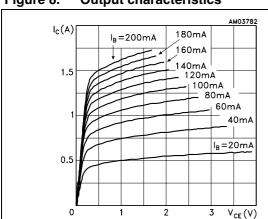


Figure 9. Reverse biased SOA

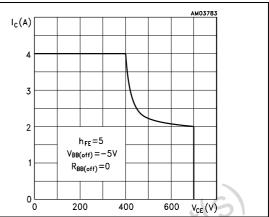


Figure 10. Resistive load switching times

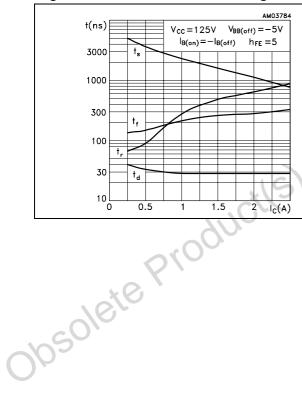
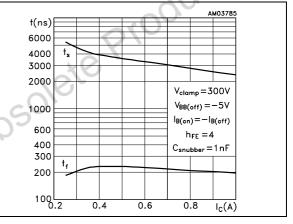


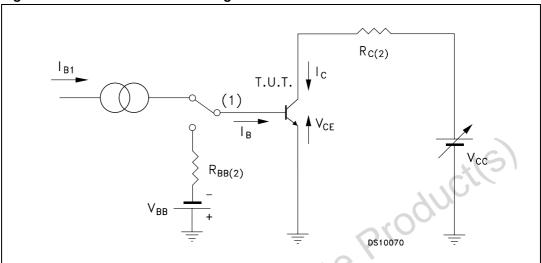
Figure 11. Inductive load switching times



Electrical characteristics STX13004

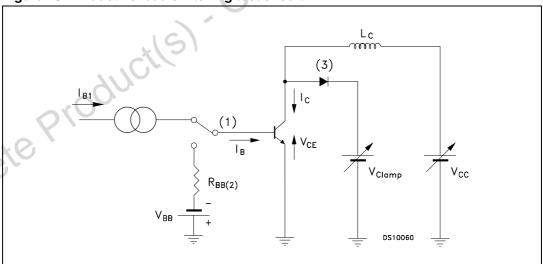
2.2 Test circuits

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

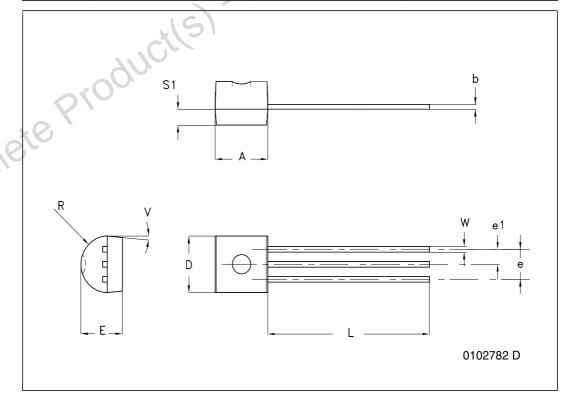
3 Package mechanical data

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. ECOPACK[®] is an ST trademark.

Obsolete Product(s). Obsolete Product(s)

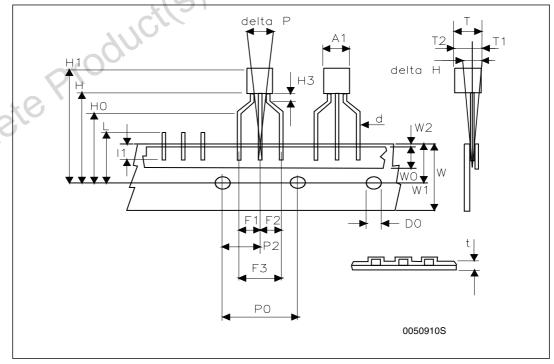
TO-92 bulk shipment r	mechanical	data
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DIM	mm.				
DIM.	MIN.	ТҮР	MAX.		
Α	4.32		4.95		
b	0.36		0.51		
D	4.45		4.95		
E	3.30		3.94		
е	2.41		2.67		
e1	1.14		1.40		
L	12.70	8	15.49		
R	2.16	9/0	2.41		
S1	0.92	0/6	1.52		
W	0.41	10 ⁵	0.56		
V		5°			



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

Dim.		mm					
Dim.	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	10	1.5				
H0	15.50	16.00	16.50				
H1		CO.	25.00				
D0	3.80	4.00	4.20				
t			0.90				
L			11.00				
l1	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.
1	21-Apr-2010	2	Updated h _{FE} specification <i>Table 4 on page 3</i> .
	06-Jul-2010	3	Added R _{thJA} value <i>Table 3 on page 2</i> and updated I _{CES} maximum value <i>Table 4 on page 3</i> .
200	ie Pro	ductl	Added R _{thJA} value <i>Table 3 on page 2</i> and updated I _{CES} maximum value <i>Table 4 on page 3</i> .

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