

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.

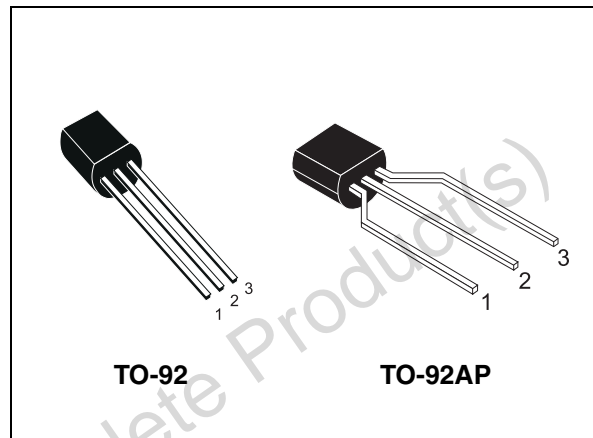


Figure 1. Internal schematic diagram

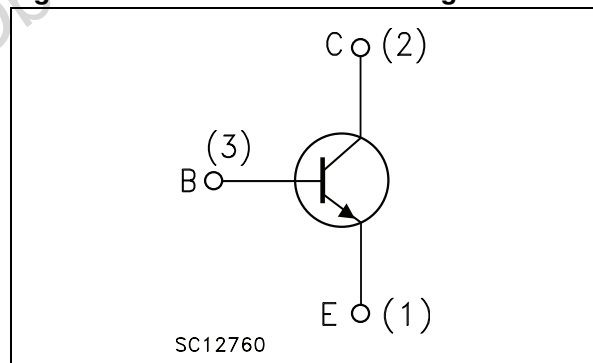


Table 1. Device summary

Order codes	Marking	Package	Packaging
STX13004	X13004	TO-92	Bulk
STX13004G ⁽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.

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 ($I_C = 0, I_B = 1\text{ A}, t_P < 10\text{ ms}$)	$V_{(BR)EBO}$	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_{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_{CES}	Collector cut-off current ($V_{\text{BE}} = 0$)	$V_{\text{CE}} = 700\text{ V}$			10	μA
I_{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_{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		
t_{s} t_{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 Figure 12)		1.1 300		μs ns
t_{s} t_{f}	Inductive load Storage time Fall time	$I_{\text{C}} = 1\text{ A}$ $V_{\text{clamp}} = 300\text{ V}$ $I_{\text{B(on)}} = 250\text{ mA}$ $V_{\text{BB(off)}} = -5\text{ V}$ $C_{\text{snuubber}} = 1\text{ nF}$ $R_{\text{BB(off)}} = 0$ (see Figure 13)		2.4 200		μs 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

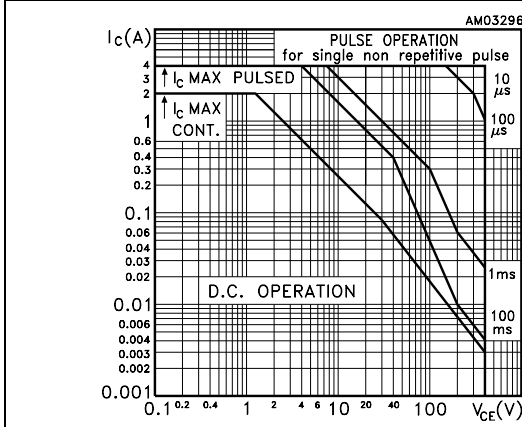


Figure 3. Derating curve

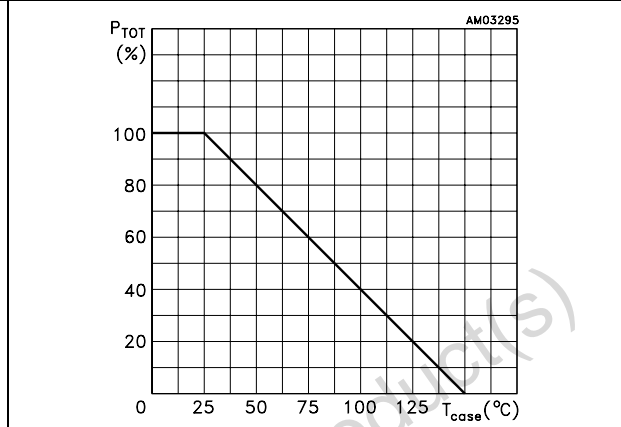


Figure 4. DC current gain @ $V_{CE} = 2$ V

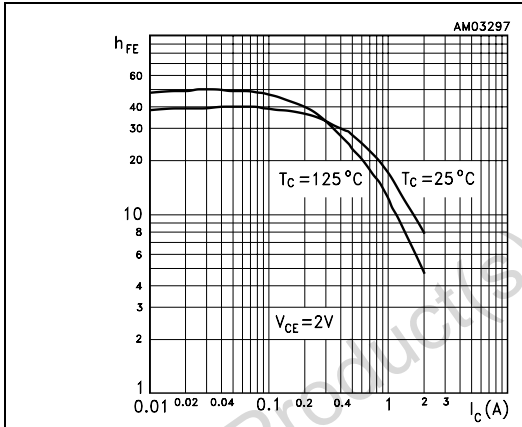


Figure 5. DC current gain @ $V_{CE} = 5$ V

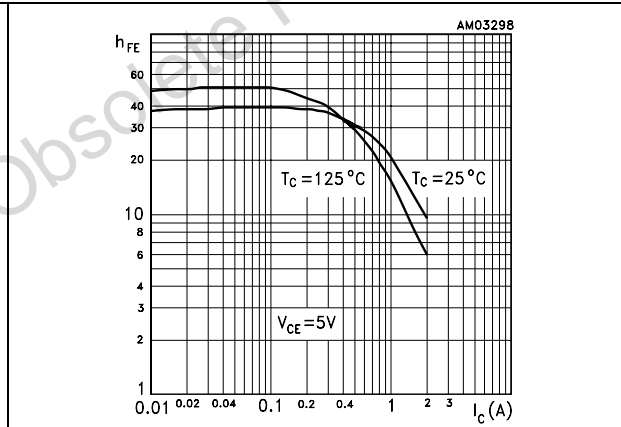


Figure 6. Collector-emitter saturation voltage

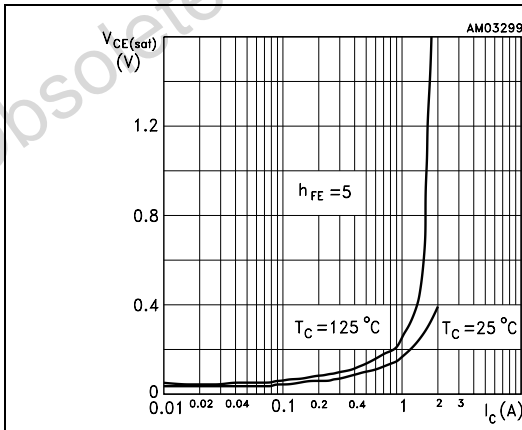


Figure 7. Base-emitter saturation voltage

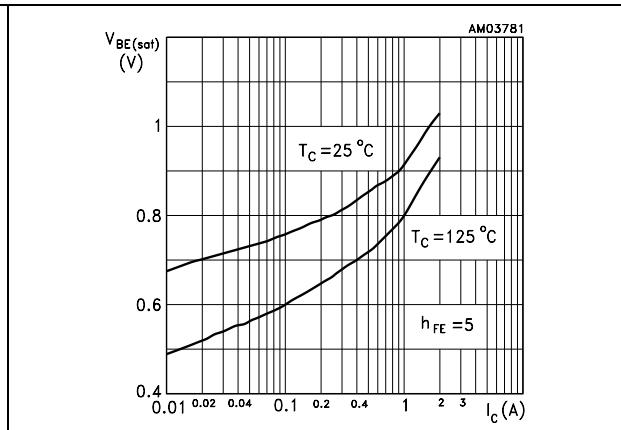


Figure 8. Output characteristics

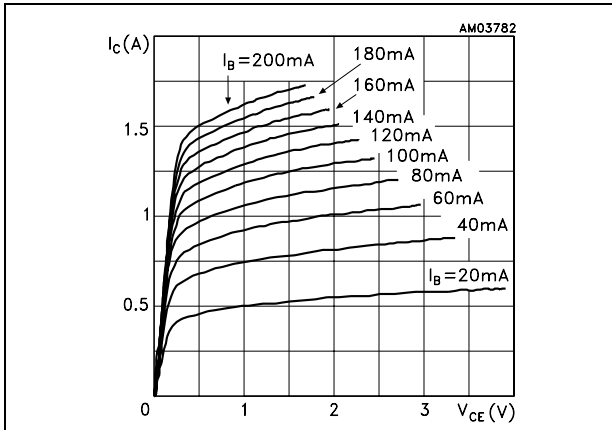


Figure 9. Reverse biased SOA

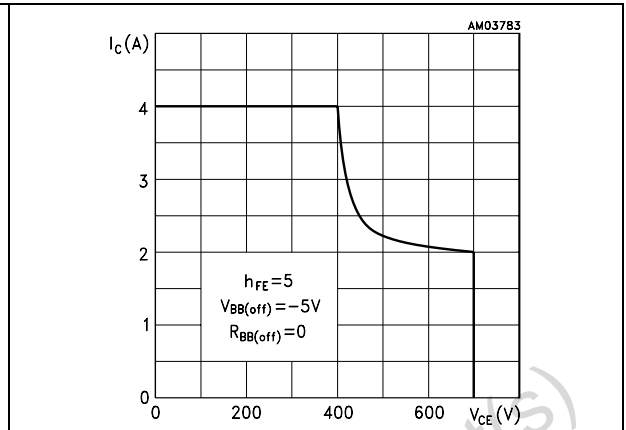


Figure 10. Resistive load switching times

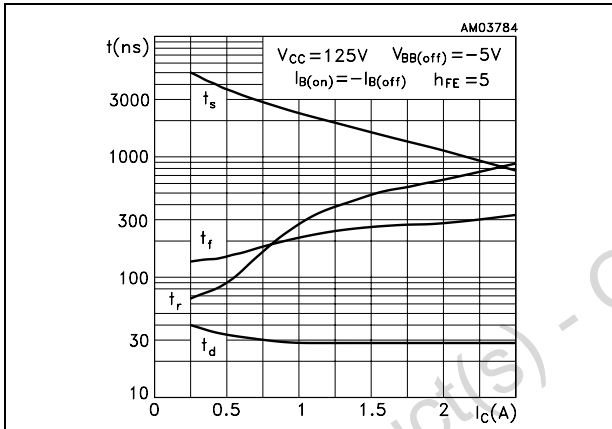
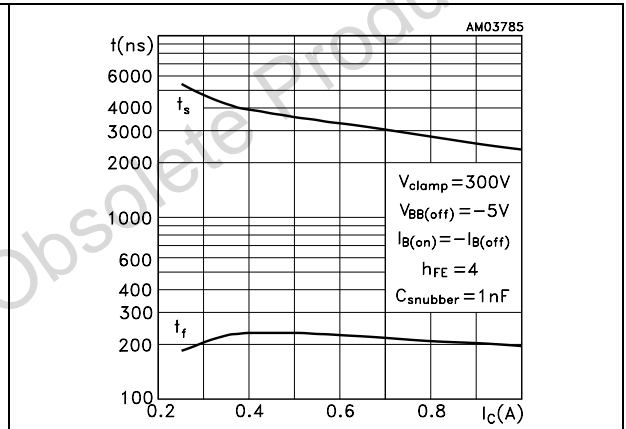
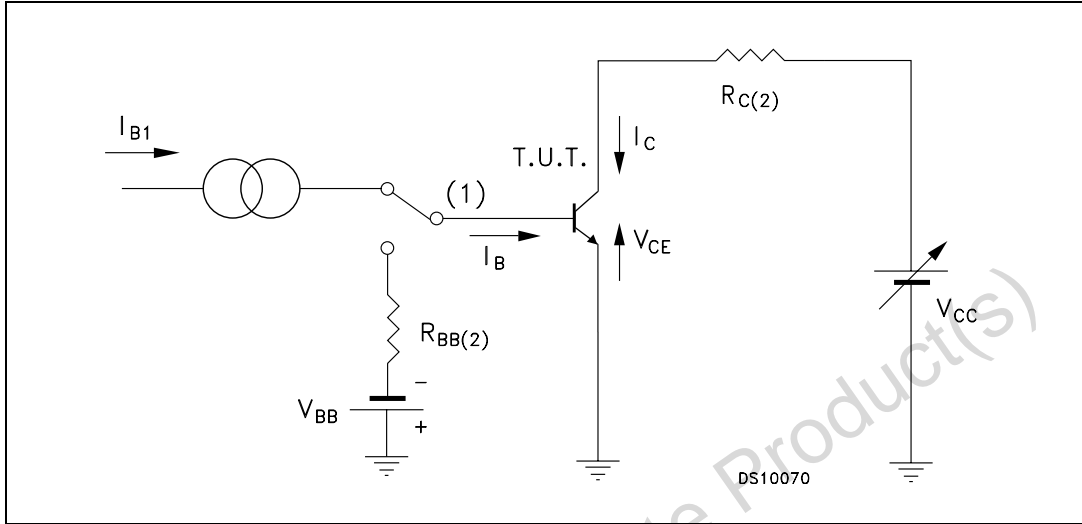


Figure 11. Inductive load switching times



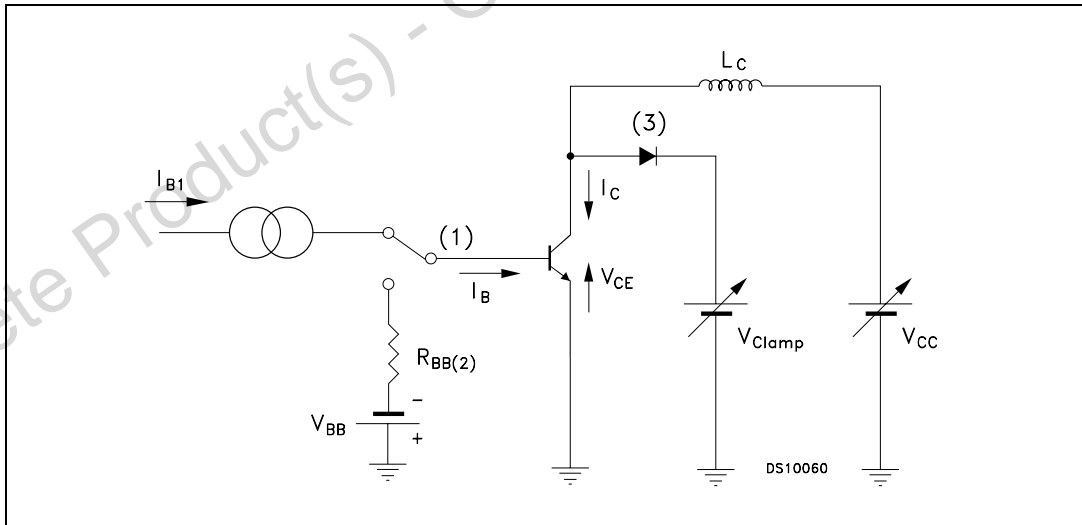
2.2 Test circuits

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

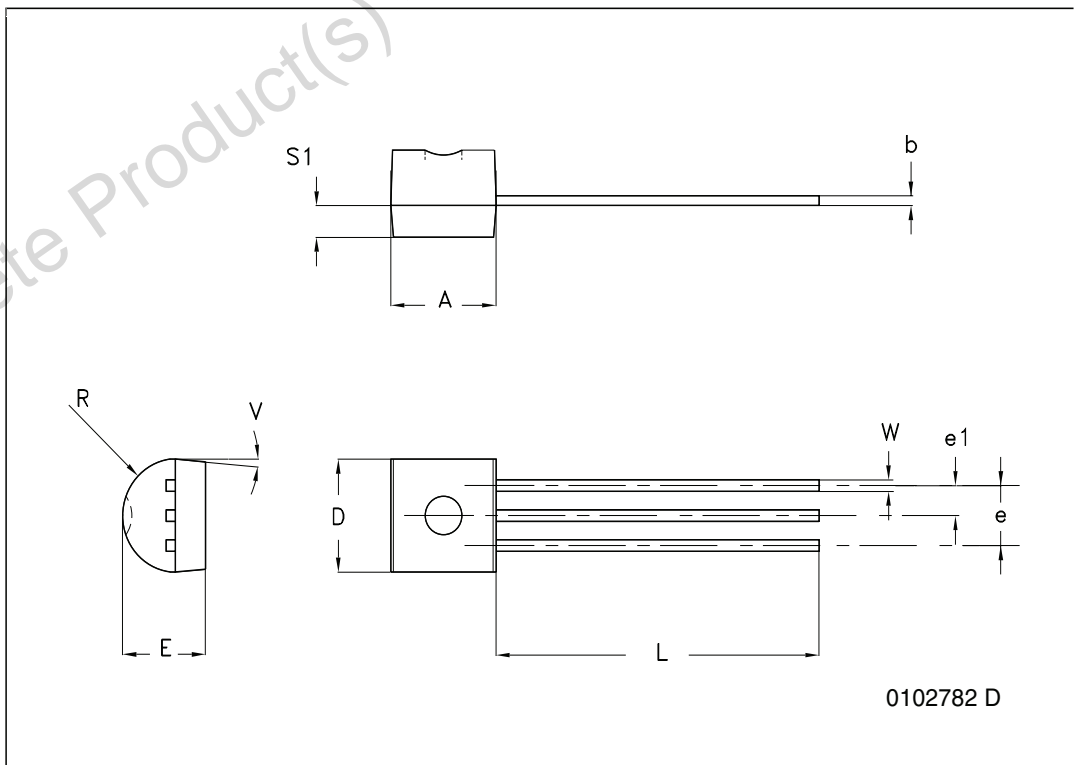
3 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® 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)

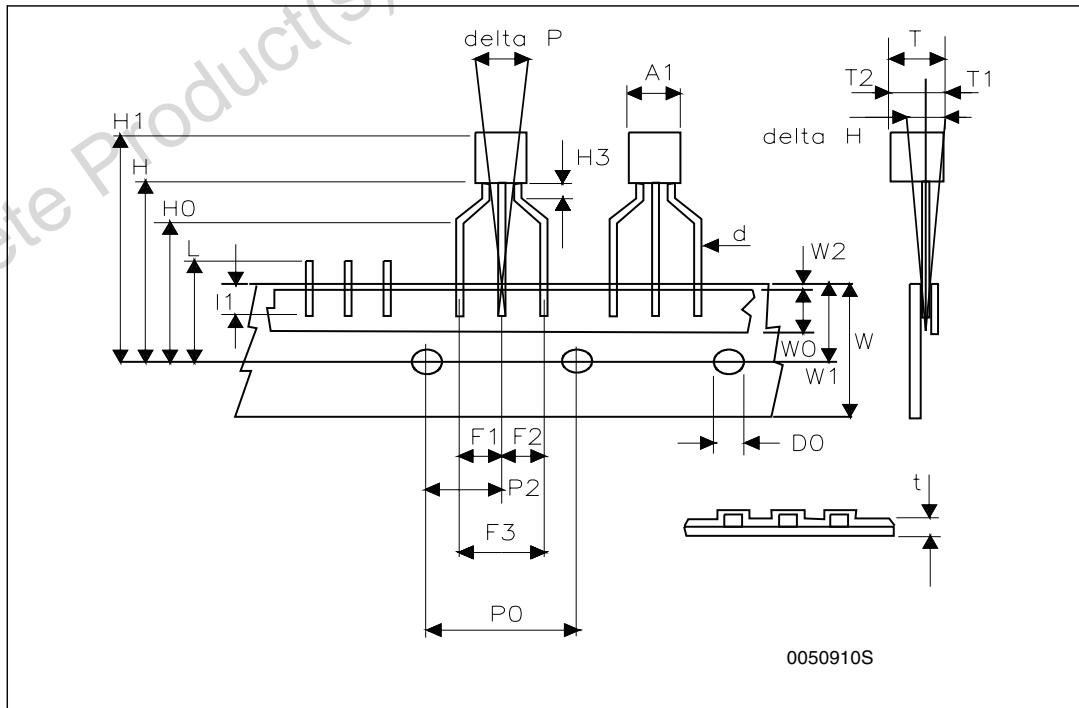
TO-92 bulk shipment mechanical data

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°	



TO-92 ammopack 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 Table 4 on page 3 .
06-Jul-2010	3	Added R_{thJA} value Table 3 on page 2 and updated I_{CES} maximum value Table 4 on page 3 .

Obsolete Product(s) - Obsolete Product(s)

Please Read Carefully:

Information in this document is provided solely in connection with ST products. STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, modifications or improvements, to this document, and the products and services described herein at any time, without notice.

All ST products are sold pursuant to ST's terms and conditions of sale.

Purchasers are solely responsible for the choice, selection and use of the ST products and services described herein, and ST assumes no liability whatsoever relating to the choice, selection or use of the ST products and services described herein.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted under this document. If any part of this document refers to any third party products or services it shall not be deemed a license grant by ST for the use of such third party products or services, or any intellectual property contained therein or considered as a warranty covering the use in any manner whatsoever of such third party products or services or any intellectual property contained therein.

UNLESS OTHERWISE SET FORTH IN ST'S TERMS AND CONDITIONS OF SALE ST DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY WITH RESPECT TO THE USE AND/OR SALE OF ST PRODUCTS INCLUDING WITHOUT LIMITATION IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION), OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.

UNLESS EXPRESSLY APPROVED IN WRITING BY AN AUTHORIZED ST REPRESENTATIVE, ST PRODUCTS ARE NOT RECOMMENDED, AUTHORIZED OR WARRANTED FOR USE IN MILITARY, AIR CRAFT, SPACE, LIFE SAVING, OR LIFE SUSTAINING APPLICATIONS, NOR IN PRODUCTS OR SYSTEMS WHERE FAILURE OR MALFUNCTION MAY RESULT IN PERSONAL INJURY, DEATH, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE. ST PRODUCTS WHICH ARE NOT SPECIFIED AS "AUTOMOTIVE GRADE" MAY ONLY BE USED IN AUTOMOTIVE APPLICATIONS AT USER'S OWN RISK.

Resale of ST products with provisions different from the statements and/or technical features set forth in this document shall immediately void any warranty granted by ST for the ST product or service described herein and shall not create or extend in any manner whatsoever, any liability of ST.

ST and the ST logo are trademarks or registered trademarks of ST in various countries.

Information in this document supersedes and replaces all information previously supplied.

The ST logo is a registered trademark of STMicroelectronics. All other names are the property of their respective owners.

© 2010 STMicroelectronics - All rights reserved

STMicroelectronics group of companies

Australia - Belgium - Brazil - Canada - China - Czech Republic - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan - Malaysia - Malta - Morocco - Philippines - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States of America

www.st.com