# STX13005

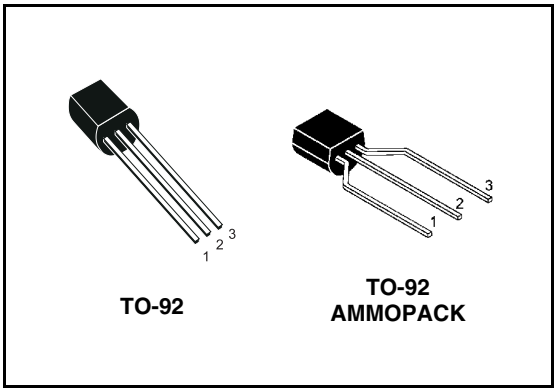
## High voltage fast-switching NPN power transistor

### Features

- High voltage capability
- Low spread of dynamic parameters
- Minimum lot-to-lot spread for reliable operation
- Very high switching speed

### Applications

- Compact fluorescent lamp (CFL)
- Switch mode power supplies (AC/DC converters)




TO-92 | TO-92 AMMOPACK

### Description

The device is manufactured using high voltage Multi-Epitaxial Planar technology for high switching speeds and medium 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**

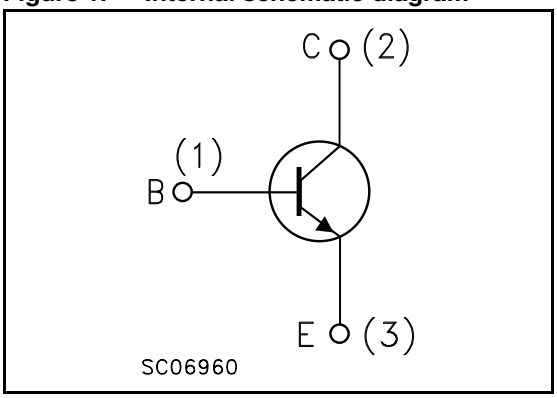



**Table 1. Device summary**

| Order code | Marking | Package | Packaging |
|---|---|---|---|
| STX13005 | X13005 | TO-92 | Bulk |
| STX13005-AP | X13005 | TO-92 | Ammopack |

# Contents

# 1 Electrical ratings

**Table 2. Absolute maximum rating**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_{CES}$ | Collector-emitter voltage ($V_{BE}$ = 0) | 700 | V |
| $V_{CEO}$ | Collector-emitter voltage ($I_B$ = 0) | 400 | V |
| $V_{EBO}$ | Emitter-base voltage ($I_C$ = 0; $I_B$ = 1.5 A; $t_p$ < 10 ms) | $V_{(BR)EBO}$ | V |
| $I_C$ | Collector current | 3 | A |
| $I_{CM}$ | Collector peak current ($t_P$ < 5ms) | 6 | A |
| $I_B$ | Base current | 1.5 | A |
| $I_{BM}$ | Base peak current ($t_P$ < 5ms) | 3 | A |
| $P_{tot}$ | Total dissipation at $T_c$ = 25°C | 2.8 | W |
| $T_{stg}$ | Storage temperature | -65 to 150 | °C |
| $T_J$ | Max. operating junction temperature | 150 | °C |

# 2 Electrical characteristics

($T_{case}$ = 25°C unless otherwise specified)

**Table 3. Electrical characteristics**

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $I_{CES}$ | Collector cut-off current ($V_{BE}$ =0) | $V_{CE}$ =700 V<br>$V_{CE}$ =700 V $T_C$ = 125°C | | | 1<br>5 | mA<br>mA |
| $I_{CEO}$ | 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 | | 18 | V |
| $V_{CEO(sus)}$ (1) | Collector-emitter sustaining voltage ($I_B$ = 0) | $I_C$ =10 mA | 400 | | | V |
| $V_{CE(sat)}$ (1) | Collector-emitter saturation voltage | $I_C$ = 1A $I_B$ = 200 mA<br>$I_C$ = 2A $I_B$ = 500 mA<br>$I_C$ = 3A $I_B$ = 750 mA | | | 0.5<br>0.6<br>5 | V<br>V<br>V |
| $V_{BE(sat)}$ (1) | Base-emitter saturation voltage | $I_C$ = 1A $I_B$ = 200 mA<br>$I_C$ = 2A $I_B$ = 500 mA | | | 1.2<br>1.6 | V<br>V |
| $h_{FE}$ (1) | DC current gain | $I_C$ = 1 A $V_{CE}$ = 5 V<br>$I_C$ = 2 A $V_{CE}$ = 5 V | 10<br>8 | | 30<br>24 | |
| $t_s$<br>$t_f$ | Resistive load<br>Storage time<br>Fall time | $I_C$ = 2 A $V_{CC}$ = 125 V<br>$I_{B1}$ = $-I_{B2}$ = 400 mA<br>$t_p$ = 30 µs | | 1.65<br>260 | | µs<br>ns |
| $t_s$<br>$t_f$ | Inductive load<br>Storage time<br>Fall time | $I_C$ = 1 A $V_{clamp}$ =300 V<br>$I_{B1}$ = 200 mA $V_{BE(off)}$ = -5 V<br>L = 50 mH $R_{BB}$ = 0 | | 0.8<br>150 | | µs<br>ns |

1. Pulsed duration = 300 ms, duty cycle ≤1.5 %

## 2.1 Electrical characteristics (curves)

**Figure 2. Safe operating area**

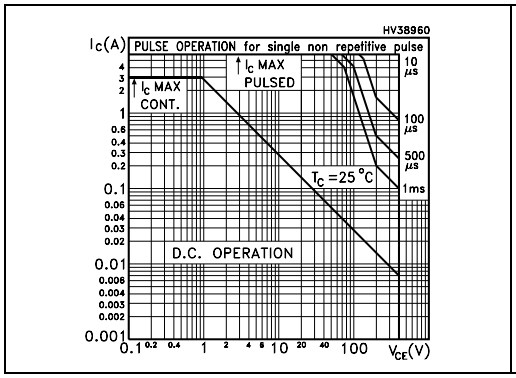



**Figure 3. Safe operating area**

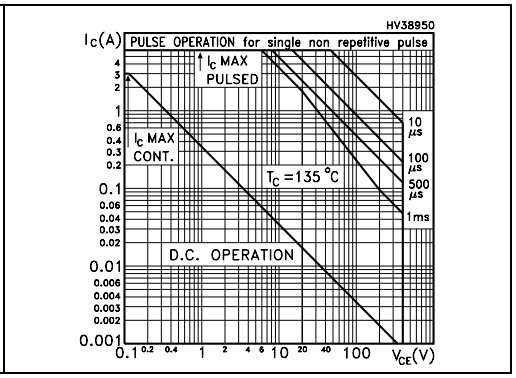



**Figure 4. Derating curve**

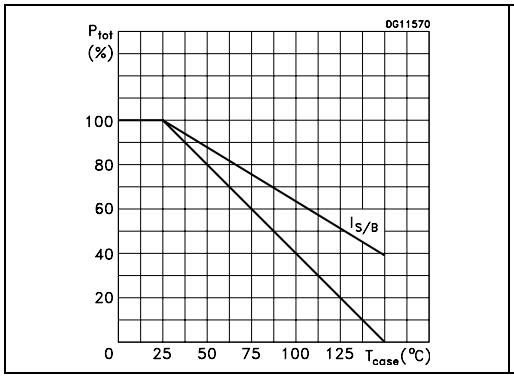



**Figure 5. Output characteristics**

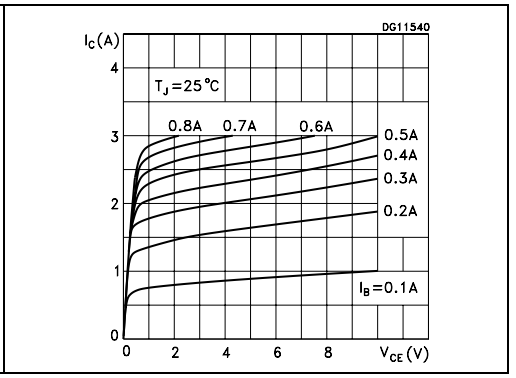



**Figure 6. DC Current Gain**

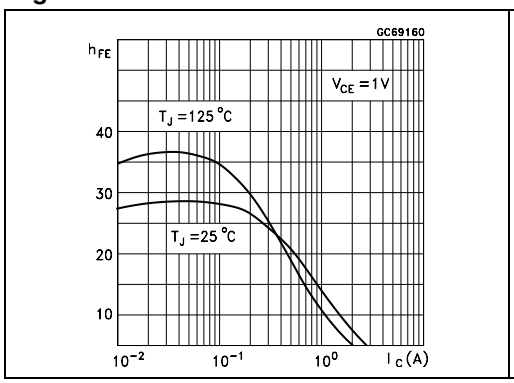



**Figure 7. DC Current Gain**

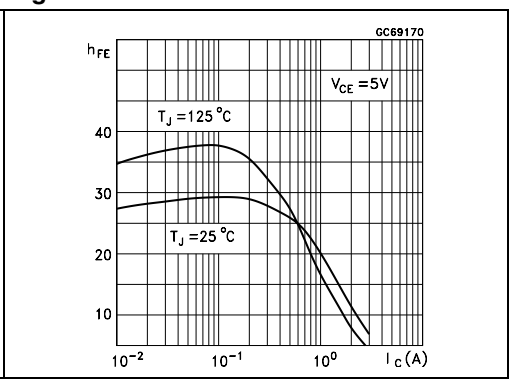


**Figure 8. Collector-emitter saturation voltage**

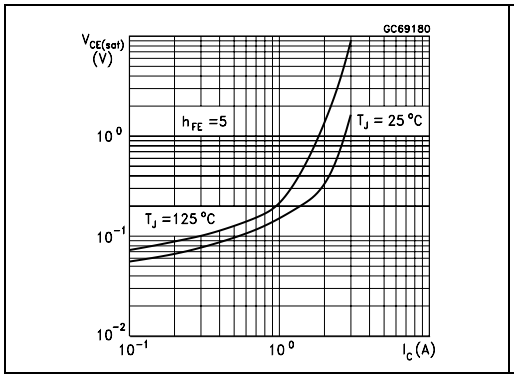



**Figure 9. Base-emitter saturation voltage**

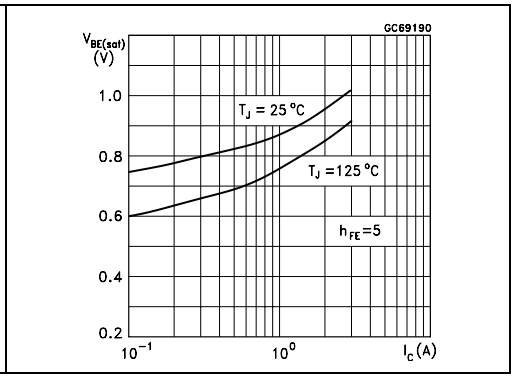



**Figure 10. Inductive load fall time**

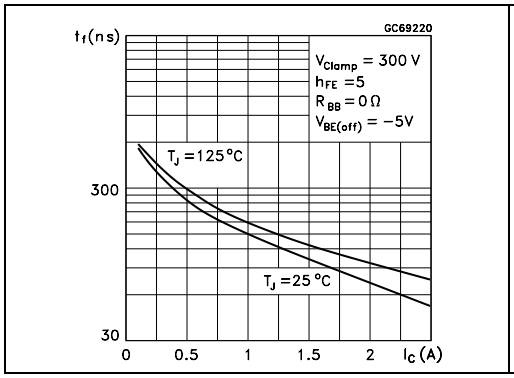



**Figure 11. Inductive load storage time**

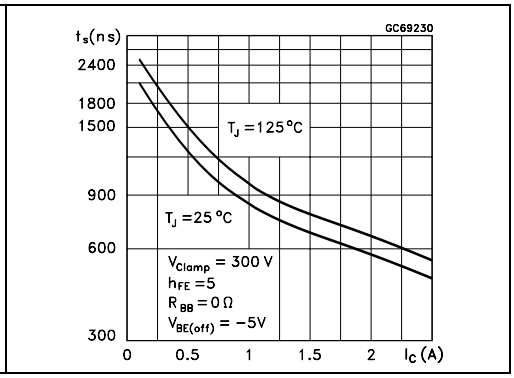



**Figure 12. Resistive load fall time**

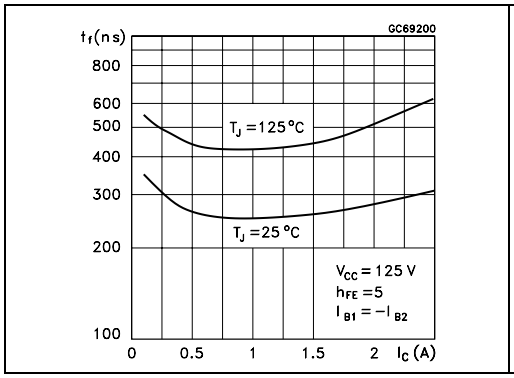



**Figure 13. Resistive load storage time**

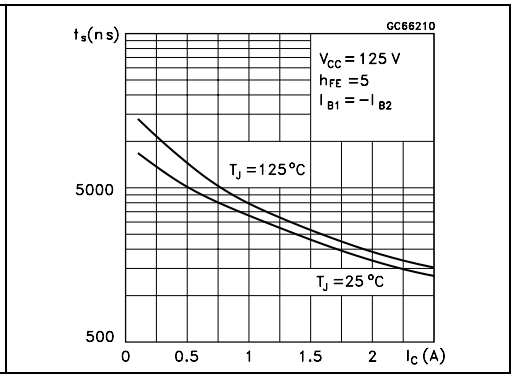
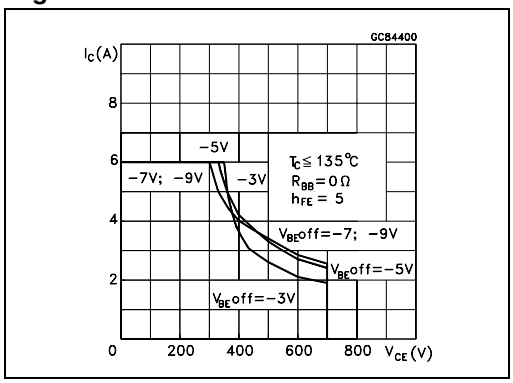
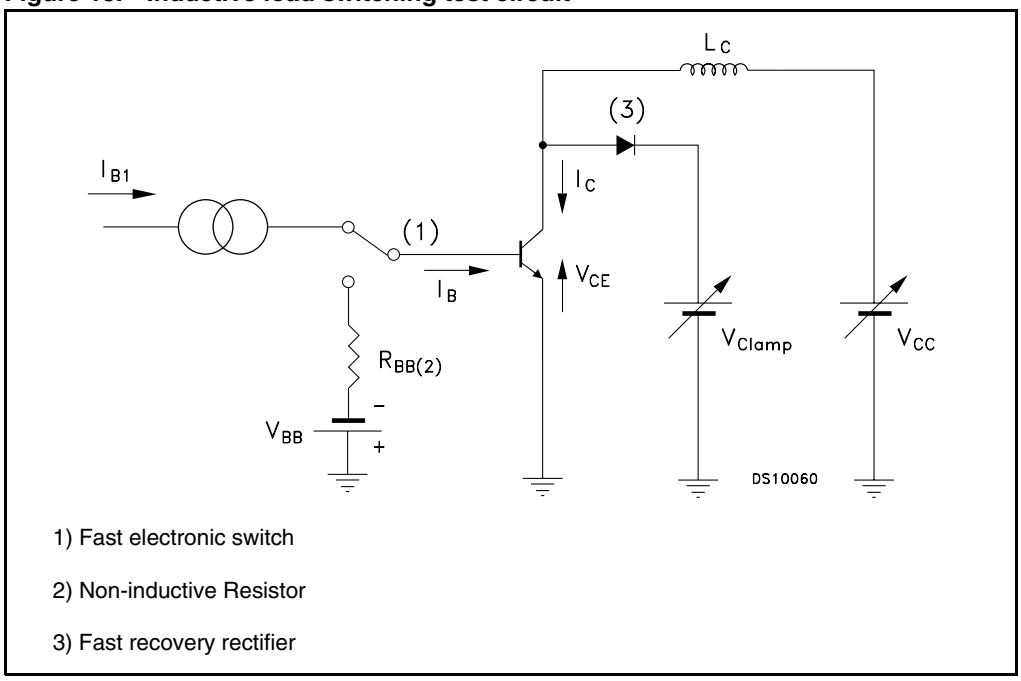


**Figure 14. Reverse biased SOA**



# 3 Test circuit

**Figure 15. Inductive load switching test circuit**

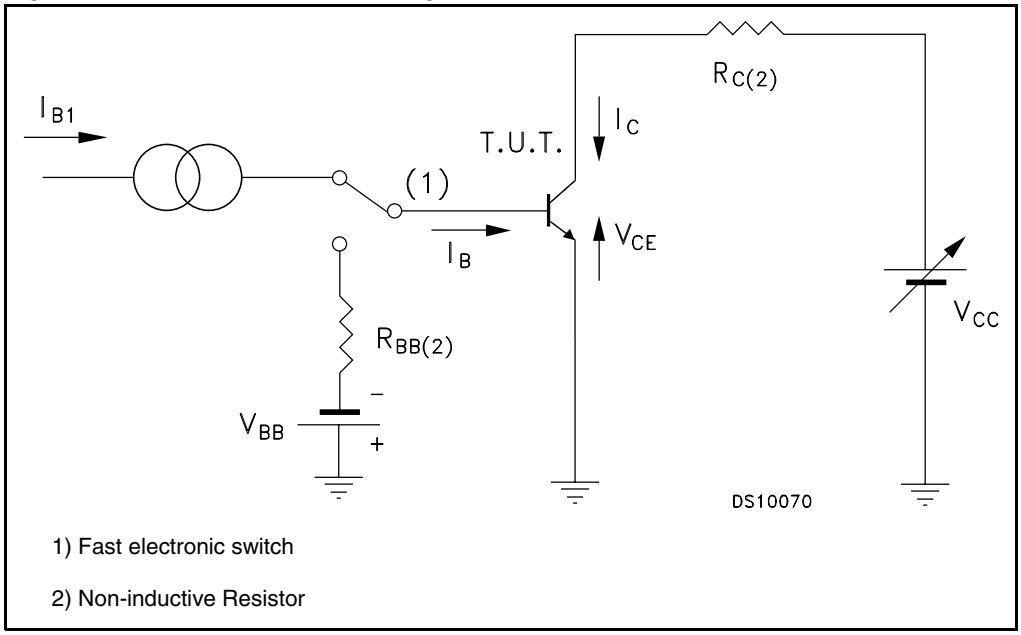



1) Fast electronic switch

2) Non-inductive Resistor

3) Fast recovery rectifier

**Figure 16. Resistive load switching test circuit**




1) Fast electronic switch

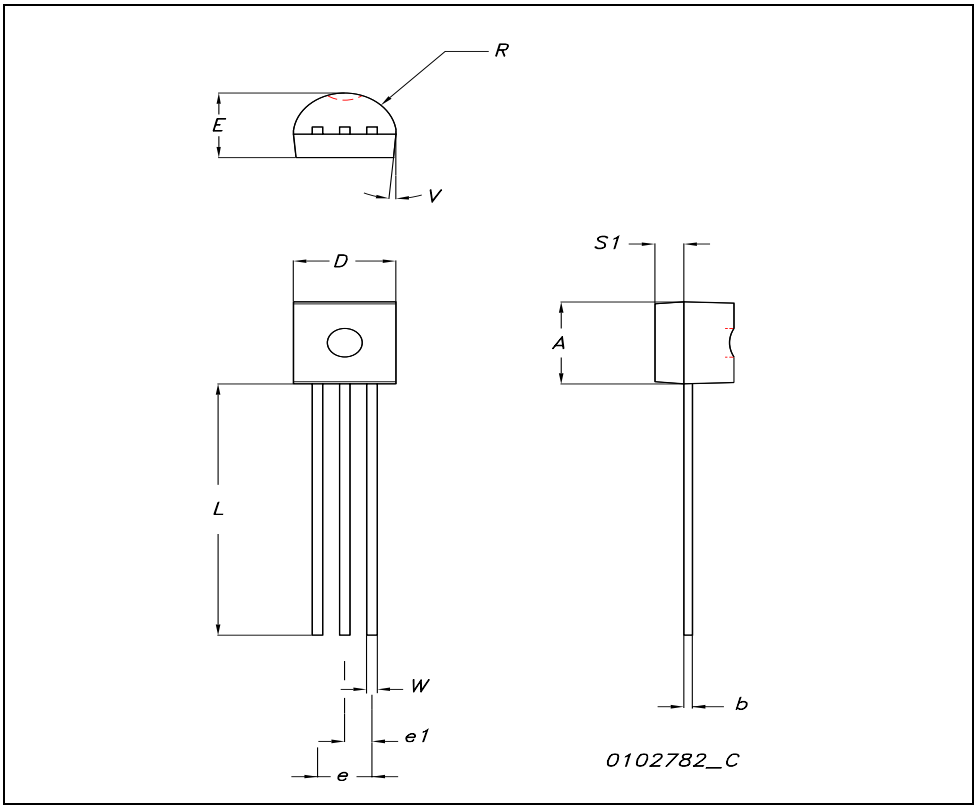
2) Non-inductive Resistor

# 4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a Lead-free second level interconnect. The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: www.st.com

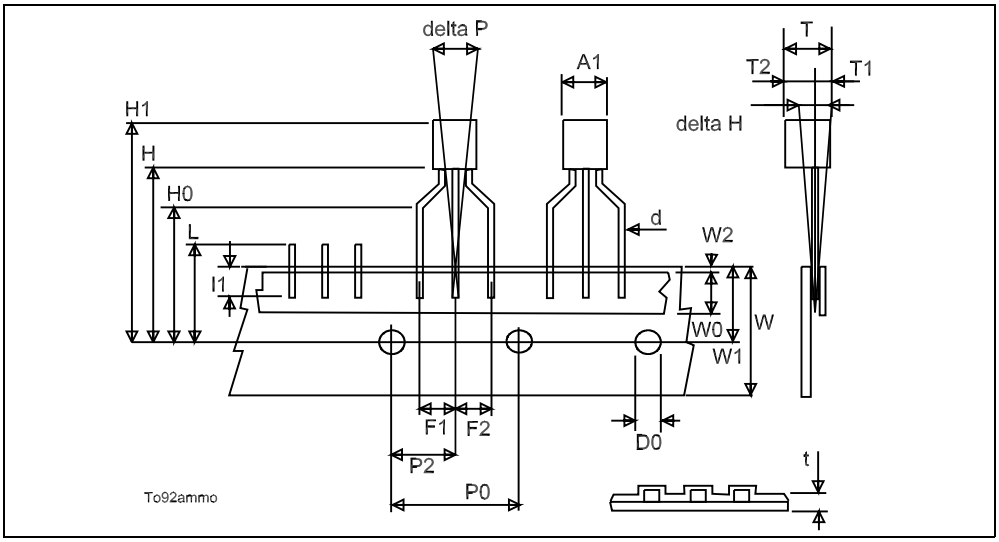
## TO-92 MECHANICAL DATA

| DIM. | mm. | | | inch | | |
|---|---|---|---|---|---|---|
| | MIN. | TYP | MAX. | MIN. | TYP. | MAX. |
| A | 4.32 | | 4.95 | 0.170 | | 0.194 |
| b | 0.36 | | 0.51 | 0.014 | | 0.020 |
| D | 4.45 | | 4.95 | 0.175 | | 0.194 |
| E | 3.30 | | 3.94 | 0.130 | | 0.155 |
| e | 2.41 | | 2.67 | 0.094 | | 0.105 |
| e1 | 1.14 | | 1.40 | 0.044 | | 0.055 |
| L | 12.70 | | 15.49 | 0.50 | | 0.610 |
| R | 2.16 | | 2.41 | 0.085 | | 0.094 |
| S1 | 0.92 | | 1.52 | 0.036 | | 0.060 |
| W | 0.41 | | 0.56 | 0.016 | | 0.022 |
| V | | 5° | | | 5° | |



## TO-92 AMMOPACK

| DIM. | mm. | | | inch | | |
|---|---|---|---|---|---|---|
| | MIN. | TYP | MAX. | MIN. | TYP. | MAX. |
| A1 | 4.45 | | 4.95 | 0.170 | | 0.194 |
| T | 3.30 | | 3.94 | 0.130 | | 0.155 |
| T1 | | | 1.6 | | | 0.06 |
| T2 | | | 2.3 | | | 0.09 |
| d | 0.41 | | 0.56 | 0.016 | | 0.022 |
| P0 | 12.5 | 12.7 | 12.9 | 0.49 | 0.5 | 0.51 |
| P2 | 5.65 | 6.35 | 7.05 | 0.22 | 0.25 | 0.27 |
| F1, F2 | 2.44 | 2.54 | 2.94 | 0.09 | 0.1 | 0.11 |
| delta H | -2 | | 2 | -0.08 | | 0.08 |
| W | 17.5 | 18 | 19 | 0.69 | 0.71 | 0.74 |
| W0 | 5.7 | 6 | 6.3 | 0.22 | 0.23 | 0.24 |
| W1 | 8.5 | 9 | 9.25 | 0.33 | 0.35 | 0.36 |
| W2 | | | 0.5 | | | 0.02 |
| H | 18.5 | | 20.5 | 0.72 | | 0.80 |
| H0 | 15.5 | 16 | 16.5 | 0.61 | 0.63 | 0.65 |
| H1 | | | 25 | | | 0.98 |
| D0 | 3.8 | 4 | 4.2 | 0.15 | 0.157 | 0.16 |
| t | | | 0.9 | | | 0.035 |
| L | | | 11 | | | 0.43 |
| I1 | 3 | | | 0.11 | | |
| delta P | -1 | | 1 | -0.04 | | 0.04 |



# 5 Revision history

**Table 4. Document revision history**

| Date | Revision | Changes |
|---|---|---|
| 01-Jul-2004 | 1 | First release. |
| 11-Feb-2005 | 2 | New table on page 1 |
| 02-Aug-2007 | 3 | New *Figure 3* and updated *Figure 14* |
| 28-Sep-2007 | 4 | Updated *Figure 2* and *Figure 3* |

**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 AUTHORIZE REPRESENTATIVE OF ST, 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.



STMicroelectronics group of companies

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

**www.st.com**