

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)

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.

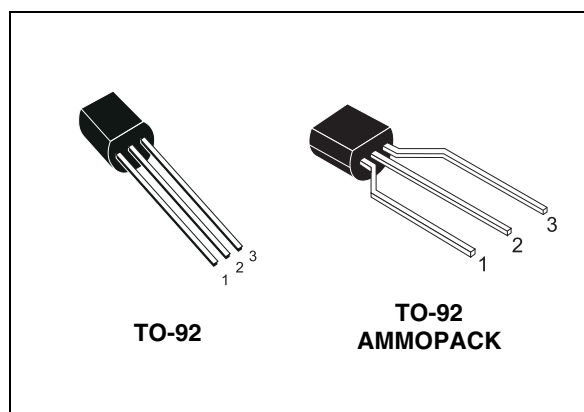


Figure 1. Internal schematic diagram

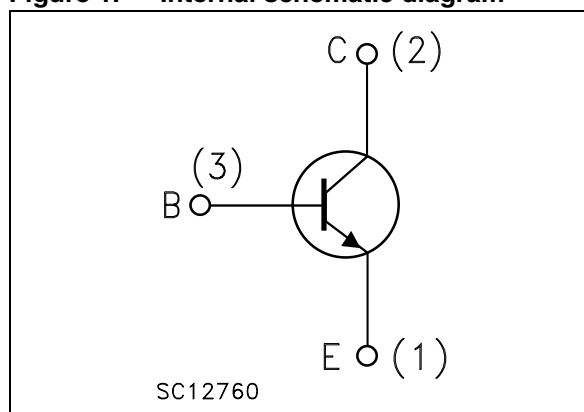


Table 1. Device summary⁽¹⁾

| Order code | Marking | Package | Packaging |
|--------------|---------|---------|-----------|
| STX13005 | X13005 | TO-92 | Bulk |
| STX13005G | X13005G | | |
| STX13005-AP | X13005 | | Ammopack |
| STX13005G-AP | X13005G | | |

1. The letter "G" in the order code suffix identifies the product as ECOPACK[®]2 grade. Please see [Section 4](#) for details.

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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} | 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 ($t_p < 5$ ms) | 6 | A |
| I_B | Base current | 1.5 | A |
| I_{BM} | Base peak current ($t_p < 5$ ms) | 3 | A |
| P_{tot} | Total dissipation at $T_c = 25^\circ\text{C}$ | 2.8 | W |
| T_{stg} | Storage temperature | -65 to 150 | $^\circ\text{C}$ |
| T_J | Max. operating junction temperature | 150 | $^\circ\text{C}$ |

Table 3. Thermal data

| Symbol | Parameter | Value | Unit |
|-------------|---|-------|---------------------------|
| R_{thj-c} | Thermal resistance junction-case max | 45 | $^\circ\text{C}/\text{W}$ |

2 Electrical characteristics

($T_{case} = 25^{\circ}C$ unless otherwise specified)

Table 4. Electrical characteristics

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|----------------------|--|---|------|------|------|---------------|
| I_{CES} | Collector cut-off current ($V_{BE} = 0$) | $V_{CE} = 700\text{ V}$ | | | 1 | mA |
| | | $V_{CE} = 700\text{ V}$ $T_C = 125^{\circ}C$ | | | 5 | mA |
| I_{CEO} | Collector-cut-off current ($I_B = 0$) | $V_{CE} = 400\text{ V}$ | | | 1 | mA |
| $V_{(BR)EBO}$ | Emitter base breakdown voltage ($I_C = 0$) | $I_E = 10\text{ mA}$ | 9 | | 18 | V |
| $V_{CEO(sus)}^{(1)}$ | Collector-emitter sustaining voltage ($I_B = 0$) | $I_C = 10\text{ mA}$ | 400 | | | V |
| $V_{CE(sat)}^{(1)}$ | Collector-emitter saturation voltage | $I_C = 1\text{ A}$ $I_B = 200\text{ mA}$ | | | 0.5 | V |
| | | $I_C = 2\text{ A}$ $I_B = 500\text{ mA}$ | | | 0.6 | V |
| | | $I_C = 3\text{ A}$ $I_B = 750\text{ mA}$ | | | 5 | V |
| $V_{BE(sat)}^{(1)}$ | Base-emitter saturation voltage | $I_C = 1\text{ A}$ $I_B = 200\text{ mA}$ | | | 1.2 | V |
| | | $I_C = 2\text{ A}$ $I_B = 500\text{ mA}$ | | | 1.6 | V |
| $h_{FE}^{(1)}$ | DC current gain | $I_C = 1\text{ A}$ $V_{CE} = 5\text{ V}$ | 10 | | 30 | |
| | | $I_C = 2\text{ A}$ $V_{CE} = 5\text{ V}$ | 8 | | 24 | |
| t_s t_f | Resistive load Storage time | $I_C = 2\text{ A}$ $V_{CC} = 125\text{ V}$ $I_{B1} = -I_{B2} = 400\text{ mA}$ | | 1.65 | | μs |
| | Fall time | $t_p = 30\text{ }\mu\text{s}$ | | 260 | | ns |
| t_s t_f | Inductive load Storage time | $I_C = 1\text{ A}$ $V_{clamp} = 300\text{ V}$ $I_{B1} = 200\text{ mA}$ $V_{BE(off)} = -5\text{ V}$ | | 0.8 | | μs |
| | Fall time | $L = 50\text{ mH}$ $R_{BB} = 0$ | | 150 | | 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 @ $T_C = 25^\circ\text{C}$

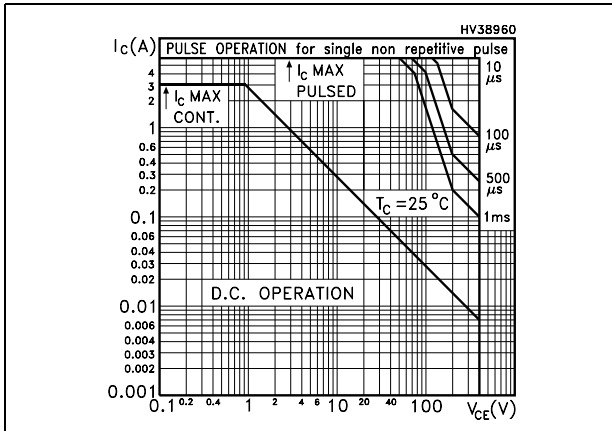


Figure 3. Safe operating area @ $T_C = 135^\circ\text{C}$

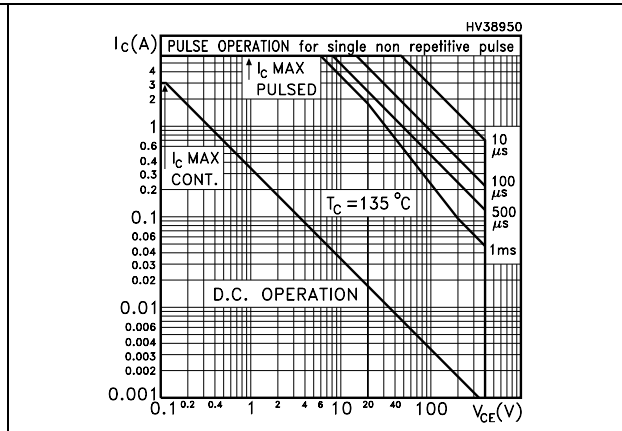


Figure 4. Derating curve

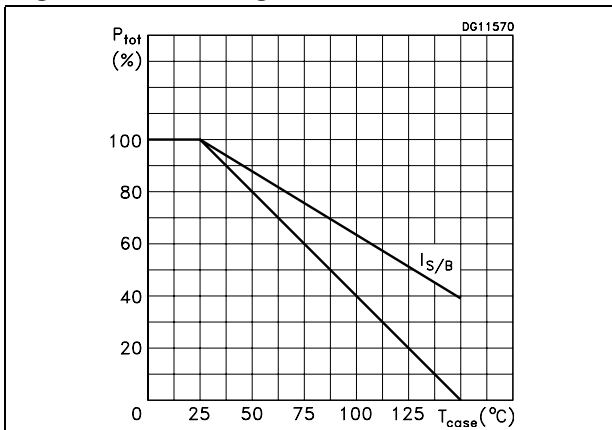


Figure 5. Output characteristics

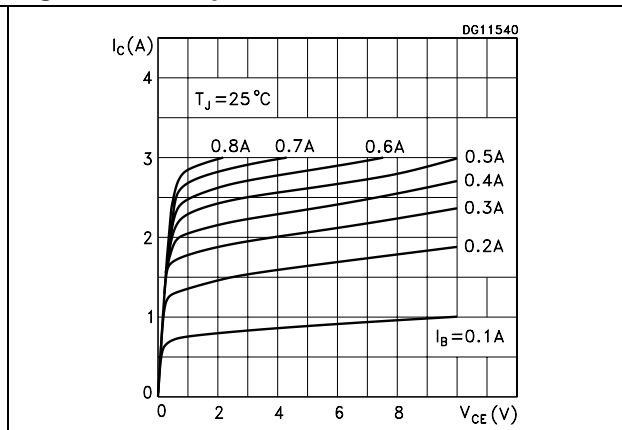


Figure 6. DC current gain @ $V_{CE} = 1\text{ V}$

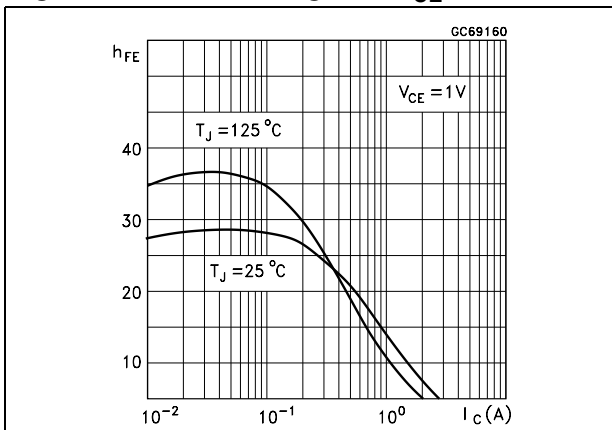


Figure 7. DC current gain @ $V_{CE} = 5\text{ V}$

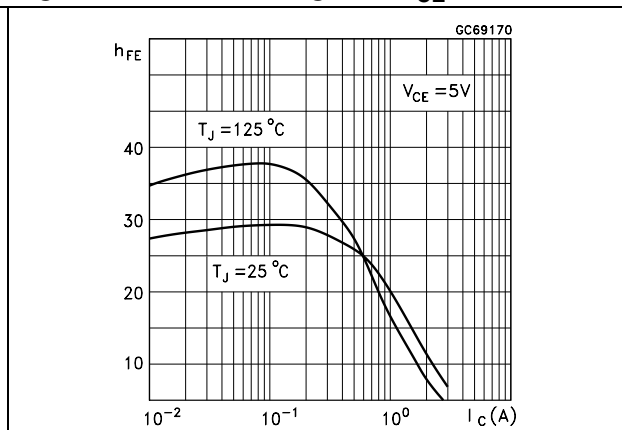


Figure 8. Collector-emitter saturation voltage Figure 9. Base-emitter saturation voltage

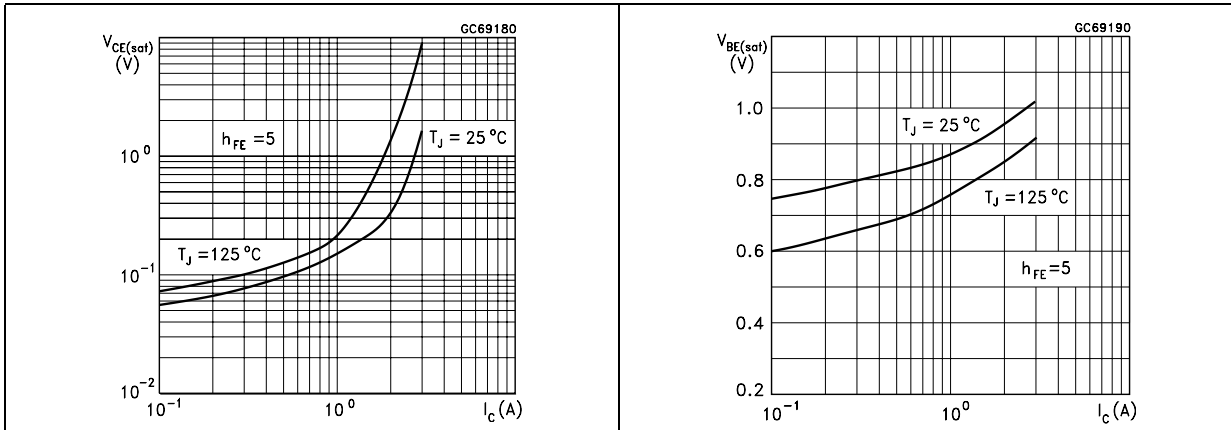


Figure 10. Inductive load fall time Figure 11. Inductive load storage time

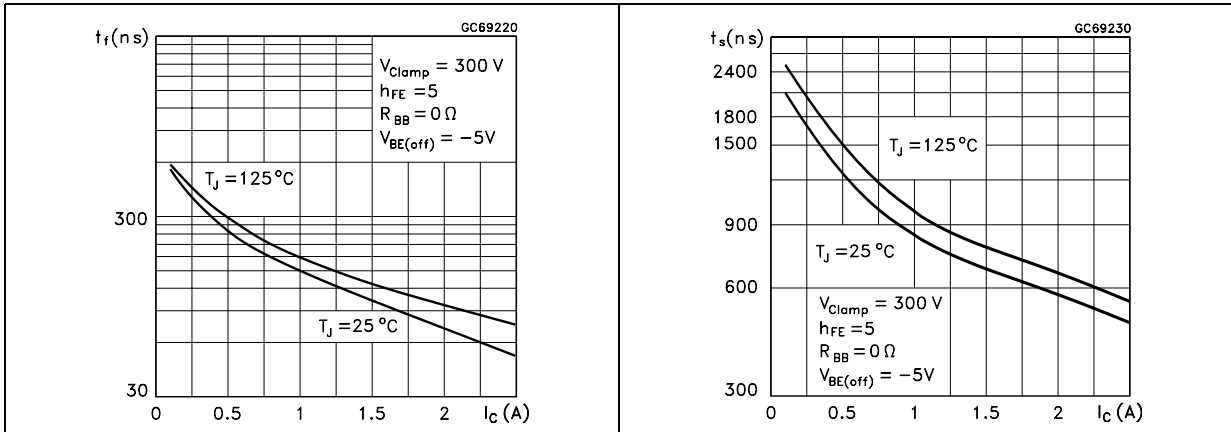


Figure 12. Resistive load fall time Figure 13. Resistive load storage time

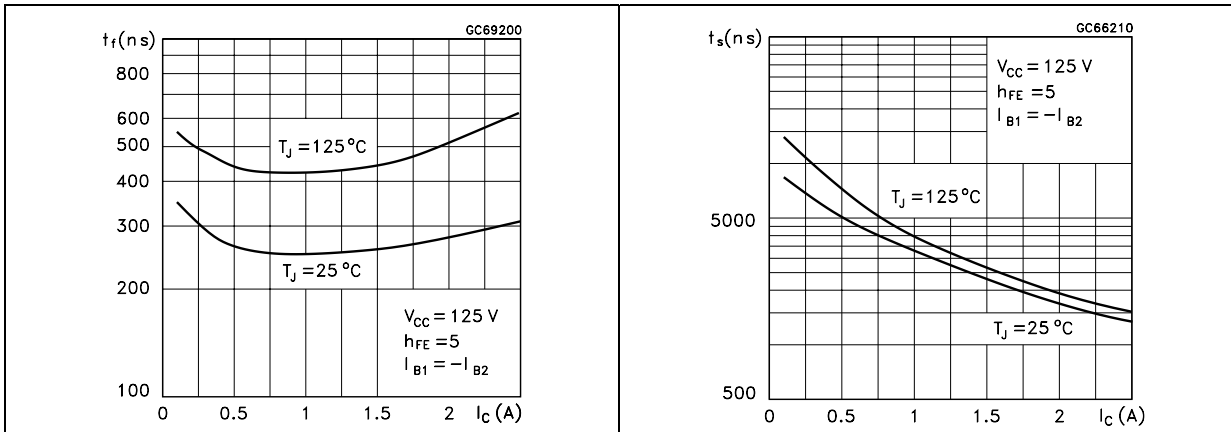
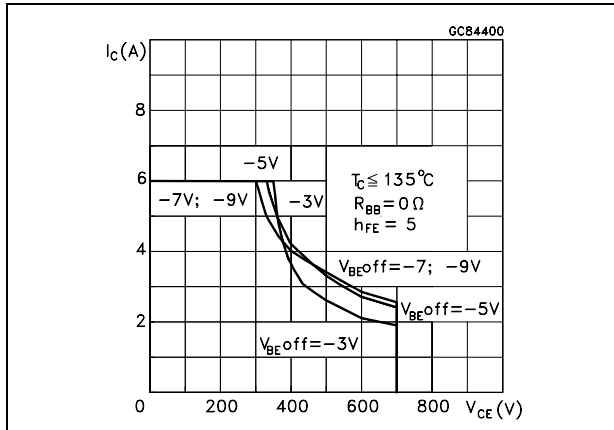
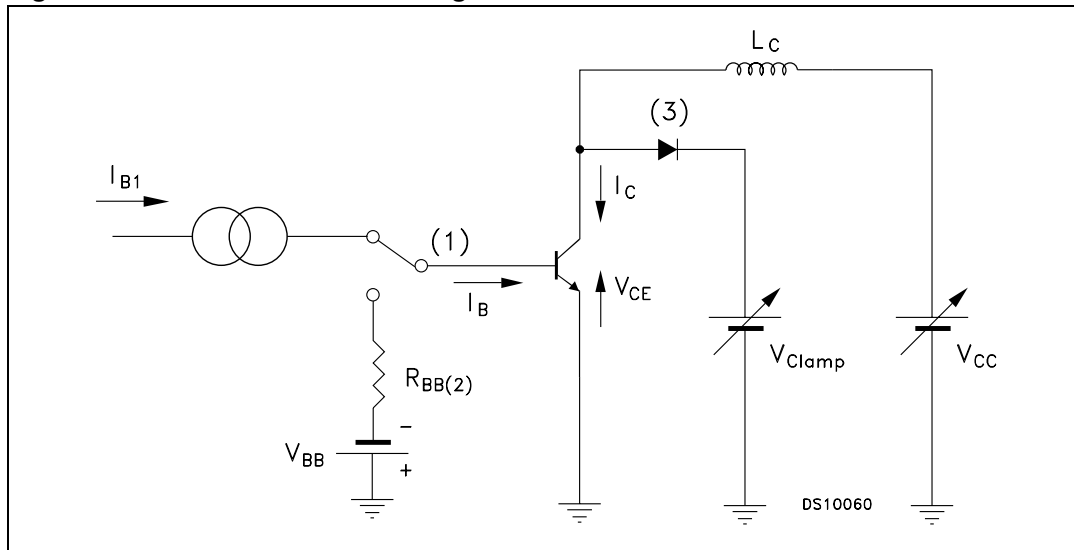


Figure 14. Reverse biased SOA



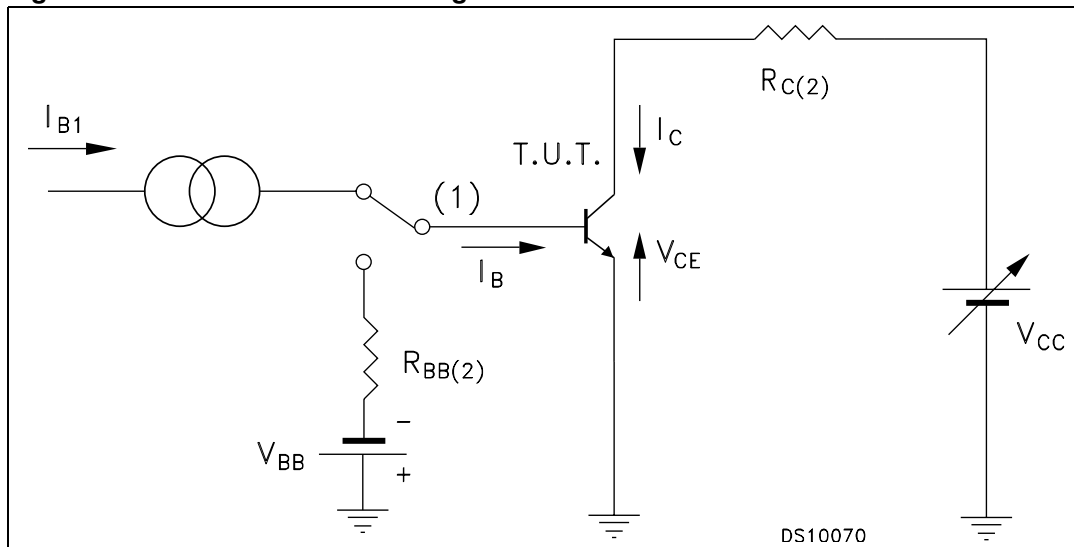
3 Test circuits

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

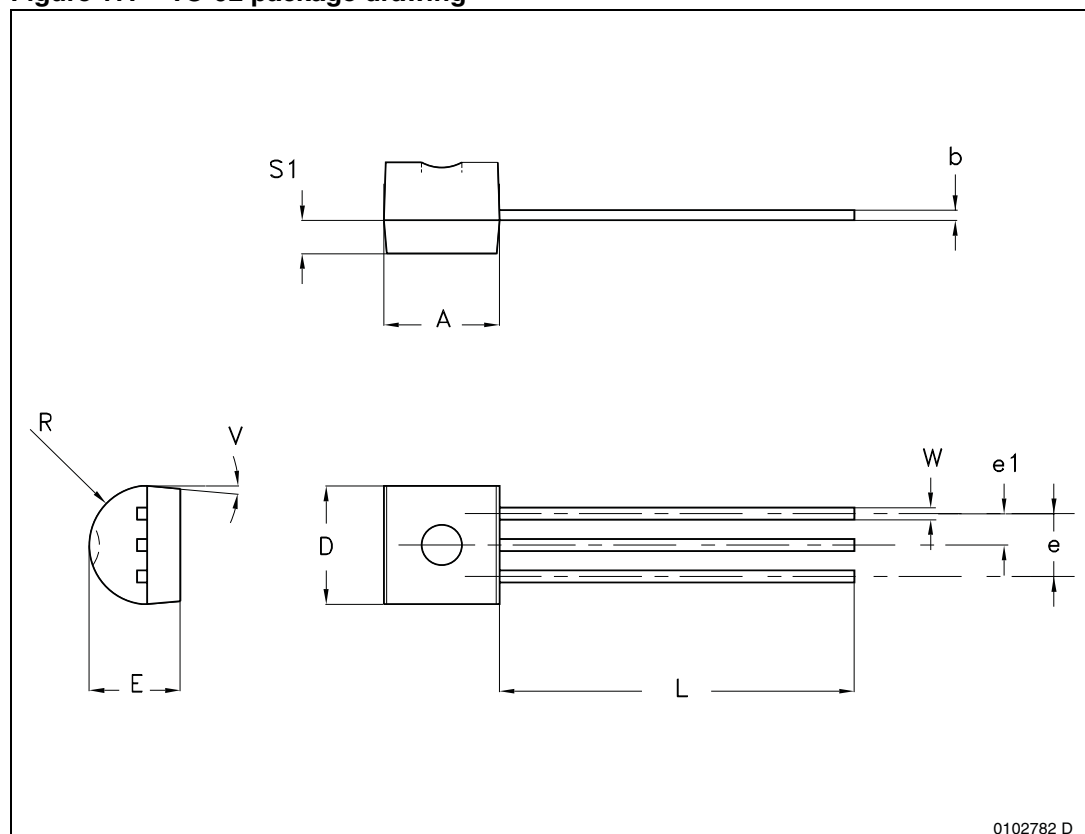
4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in 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.

Table 5. TO-92 package mechanical data

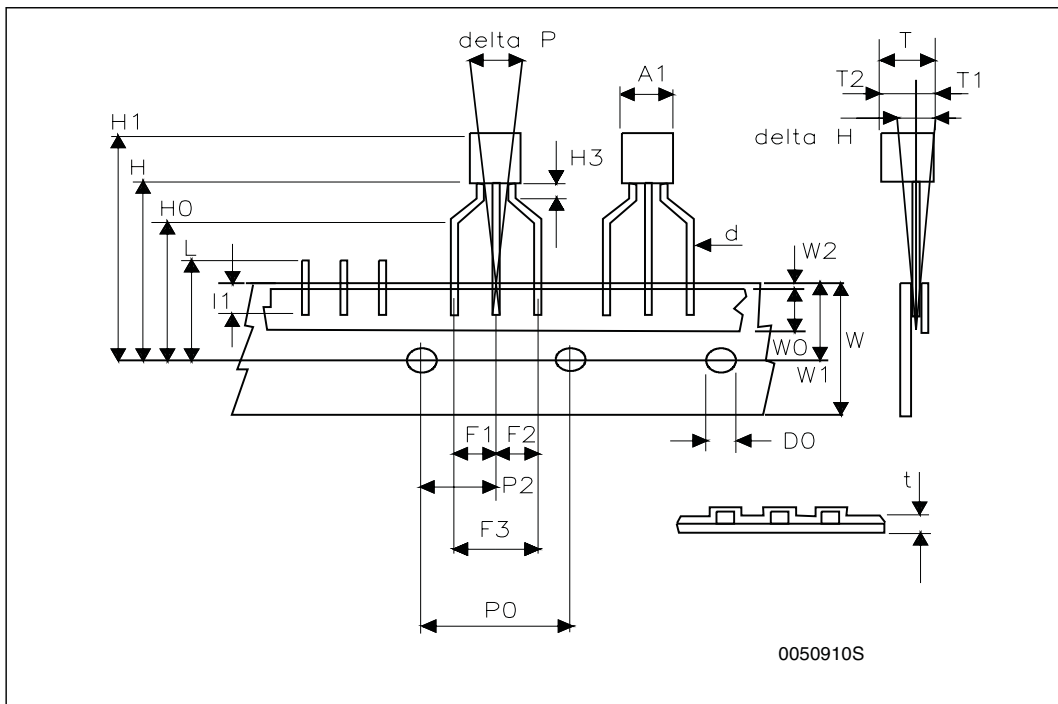
| Dim. | mm | | |
|------|-------|------|-------|
| | Min. | Typ. | Max. |
| A | 4.32 | | 4.95 |
| b | 0.36 | | 0.51 |
| D | 4.45 | | 4.95 |
| E | 3.30 | | 3.94 |
| e | 2.41 | | 2.67 |
| e1 | 1.14 | | 1.40 |
| L | 12.70 | | 15.49 |
| R | 2.16 | | 2.41 |
| S1 | 0.92 | | 1.52 |
| W | 0.41 | | 0.56 |
| V | | 5° | |

Figure 17. TO-92 package drawing



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 |
| l1 | 3.00 | | |
| delta P | -1.00 | | 1.00 |



5 Revision history

Table 6. 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 |
| 16-Dec-2008 | 5 | Added ECOPACK [®] 2 grade products with suffix "G" |
| 11-Aug-2009 | 6 | Updated TO-92 mechanical data and Figure 1: Internal schematic diagram |

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