

## High voltage fast-switching NPN Power Transistor

### General features

- NPN Transistor
- High voltage capability
- Low spread of dynamic parameters
- Minimum lot-to-lot spread for reliable operation
- Very high switching speed
- In compliance with the 2002/93/EC European Directive

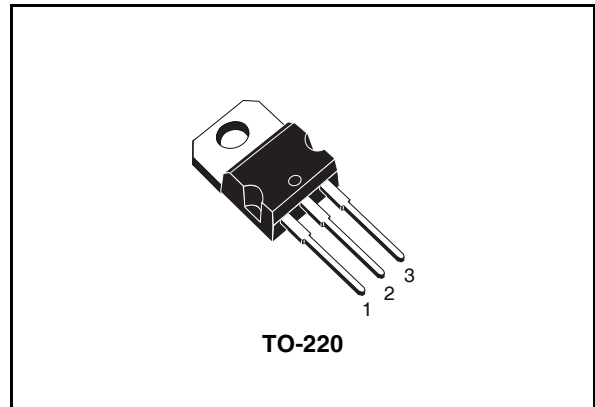
### Description

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

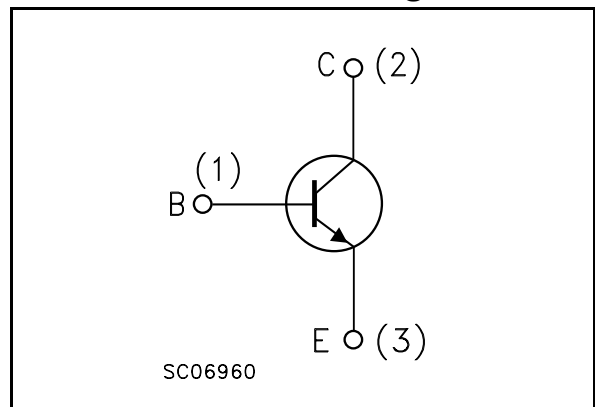
It uses a Cellular Emitter structure with planar edge termination to enhance switching speeds while maintaining the wide RBSOA.

### Applications

- Electronic ballast for fluorescent lighting
- Dedicated for PFC solution in HF ballast half-bridge voltage fed



### Internal schematic diagram



### Order codes

| Part Number | Marking | Package | Packing |
|-------------|---------|---------|---------|
| BUL704      | BUL704  | TO-220  | Tube    |

## Contents

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# 1 Electrical ratings

**Table 1. 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 ( $I_C = 0$ )            | 10         | V                |
| $I_C$     | Collector current                             | 4          | A                |
| $I_{CM}$  | Collector peak current ( $t_P < 5\text{ms}$ ) | 8          | A                |
| $I_B$     | Base current                                  | 2          | A                |
| $I_{BM}$  | Base peak current ( $t_P < 5\text{ms}$ )      | 4          | A                |
| $P_{tot}$ | Total dissipation at $T_C = 25^\circ\text{C}$ | 70         | W                |
| $T_{stg}$ | Storage temperature                           | -65 to 150 | $^\circ\text{C}$ |
| $T_J$     | Max. operating junction temperature           | 150        | $^\circ\text{C}$ |

**Table 2. Thermal data**

| Symbol         | Parameter                            | Value | Unit               |
|----------------|--------------------------------------|-------|--------------------|
| $R_{thj-case}$ | Thermal resistance junction-case max | 1.78  | $^\circ\text{C/W}$ |
| $R_{thj-amb}$  | Thermal resistance junction-amb max  | 62.5  | $^\circ\text{C/W}$ |

## 2 Electrical characteristics

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

**Table 3. Electrical characteristics**

| Symbol                           | Parameter                                                         | Test Conditions                                                                                                                                                          | Min.     | Typ.       | Max.       | Unit                           |
|----------------------------------|-------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|------------|------------|--------------------------------|
| $I_{\text{CES}}$                 | Collector cut-off current<br>( $V_{\text{BE}} = -1.5\text{V}$ )   | $V_{\text{CE}} = 700\text{V}$<br>$V_{\text{CE}} = 700\text{V}$ $T_{\text{J}} = 125^{\circ}\text{C}$                                                                      |          |            | 100<br>500 | $\mu\text{A}$<br>$\mu\text{A}$ |
| $I_{\text{CEO}}$                 | Collector cut-off current<br>( $I_{\text{B}} = 0$ )               | $V_{\text{CE}} = 400\text{V}$                                                                                                                                            |          |            | 250        | $\mu\text{A}$                  |
| $V_{\text{EBO}}$                 | Emitter-base voltage<br>( $I_{\text{C}} = 0$ )                    | $I_{\text{E}} = 10\text{mA}$                                                                                                                                             | 10       |            |            | V                              |
| $V_{\text{CEO(sus)}}^{(1)}$      | Collector-emitter<br>sustaining voltage<br>( $I_{\text{B}} = 0$ ) | $I_{\text{C}} = 100\text{mA}$ $L = 25\text{mH}$                                                                                                                          | 400      |            |            | V                              |
| $V_{\text{CE(sat)}}^{(1)}$       | Collector-emitter<br>saturation voltage                           | $I_{\text{C}} = 1\text{A}$ $I_{\text{B}} = 0.2\text{A}$<br>$I_{\text{C}} = 2.5\text{A}$ $I_{\text{B}} = 0.5\text{A}$                                                     |          |            | 0.5<br>0.8 | V<br>V                         |
| $V_{\text{BE(sat)}}^{(1)}$       | Base-emitter saturation<br>voltage                                | $I_{\text{C}} = 1\text{A}$ $I_{\text{B}} = 0.2\text{A}$<br>$I_{\text{C}} = 2.5\text{A}$ $I_{\text{B}} = 0.5\text{A}$                                                     |          |            | 1.1<br>1.2 | V<br>V                         |
| $h_{\text{FE}}$                  | DC current gain                                                   | $I_{\text{C}} = 10\text{mA}$ $V_{\text{CE}} = 5\text{V}$<br>$I_{\text{C}} = 2\text{A}$ $V_{\text{CE}} = 5\text{V}$                                                       | 10<br>14 |            | 28         |                                |
| $t_{\text{s}}$<br>$t_{\text{f}}$ | Resistive load<br>Storage time<br>Fall time                       | $V_{\text{CC}} = 125\text{V}$ $I_{\text{C}} = 2\text{A}$<br>$I_{\text{B1}} = -I_{\text{B2}} = 0.4\text{A}$<br>$t_{\text{p}} = 30\mu\text{s}$ (see fig.12 )               | 1.5      | 0.2        | 3<br>0.4   | $\mu\text{s}$<br>$\mu\text{s}$ |
| $t_{\text{s}}$<br>$t_{\text{f}}$ | Inductive load<br>Storage time<br>Fall time                       | $I_{\text{C}} = 2\text{A}$ $I_{\text{B1}} = 0.4\text{A}$<br>$V_{\text{BE(off)}} = -5\text{V}$ $R_{\text{BB}} = 0\Omega$<br>$V_{\text{clamp}} = 200\text{V}$ (see fig.13) |          | 0.6<br>0.1 | 1<br>0.2   | $\mu\text{s}$<br>$\mu\text{s}$ |

Note (1) Pulsed duration = 300  $\mu\text{s}$ , duty cycle  $\leq 1.5\%$

2.1 Electrical characteristics (curves)

Figure 1. Safe operating area

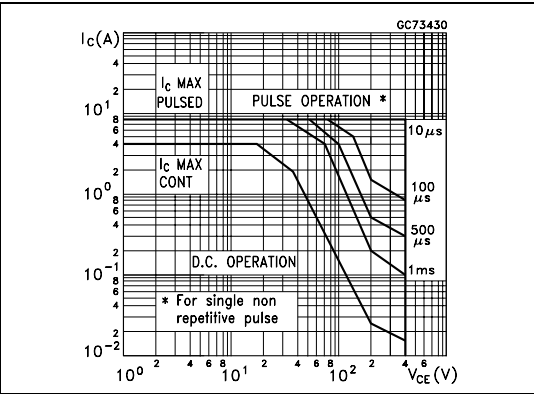


Figure 2. Derating Curve

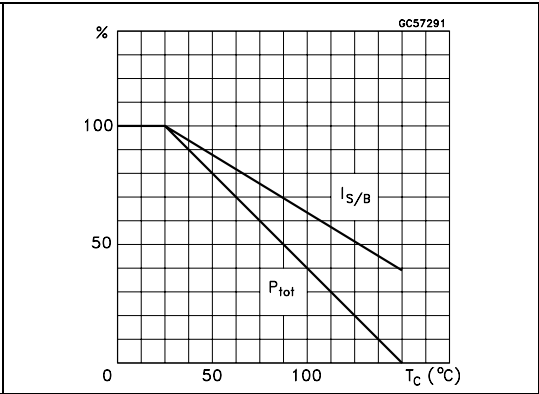


Figure 3. DC current gain

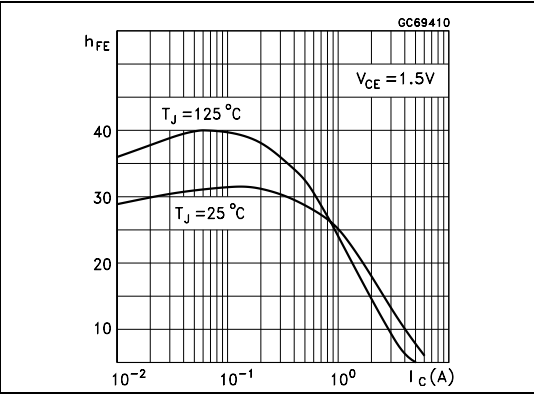


Figure 4. DC current gain

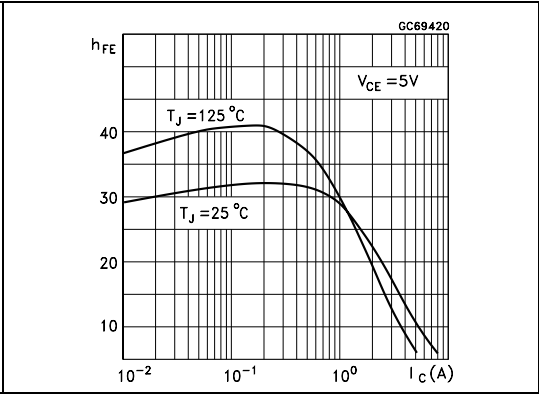


Figure 5. Collector-emitter saturation voltage

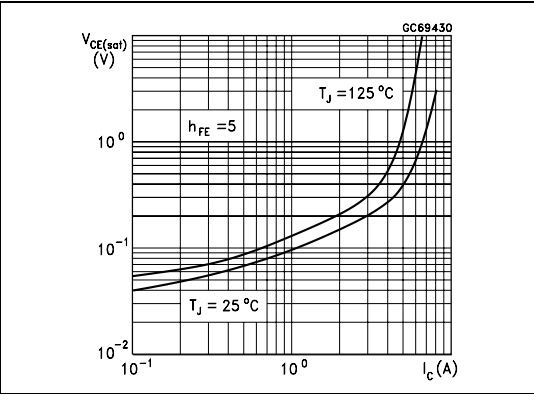


Figure 6. Base-emitter saturation voltage

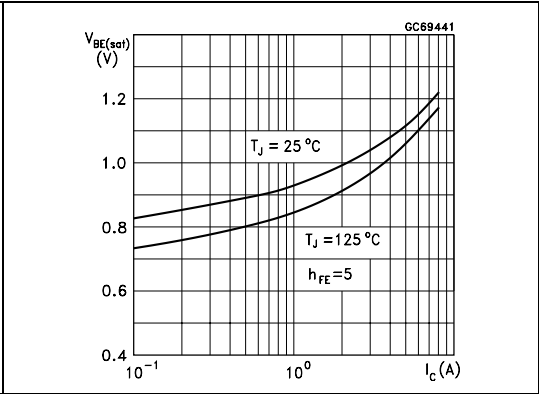


Figure 7. Inductive load fall time

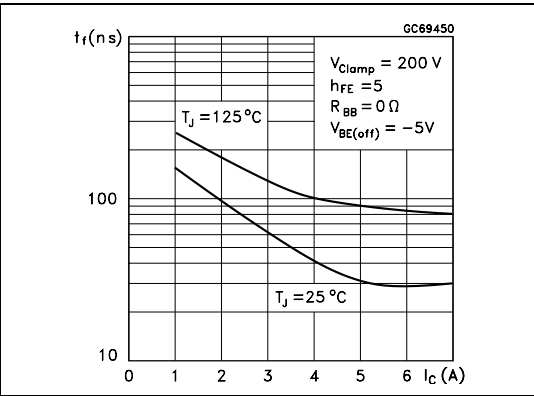


Figure 8. Inductive load storage time

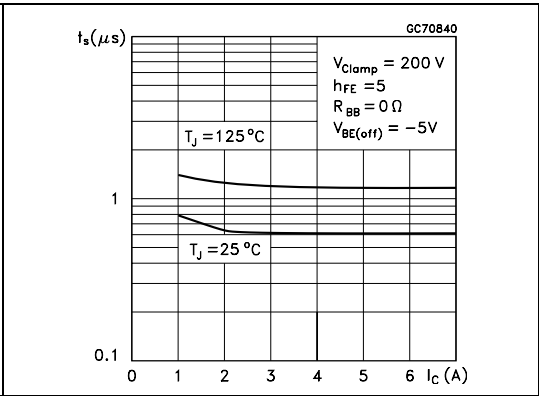


Figure 9. Resistive load fall time

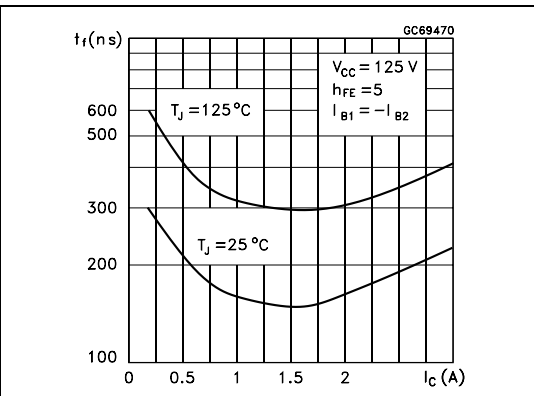


Figure 10. Resistive load storage time

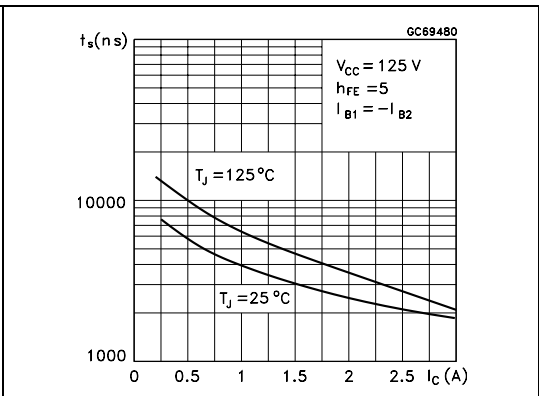
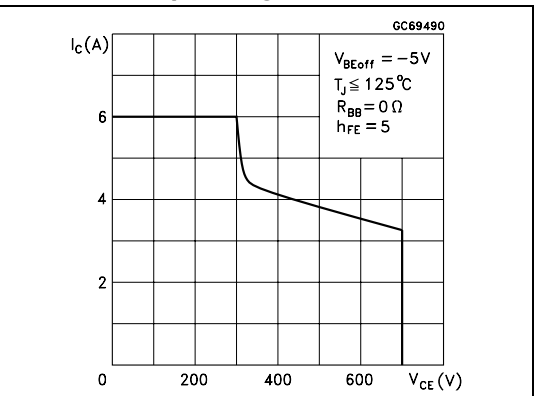


Figure 11. Reverse biased safe operating area



## 2.2 Test circuits

Figure 12. Resistive load switching test circuit

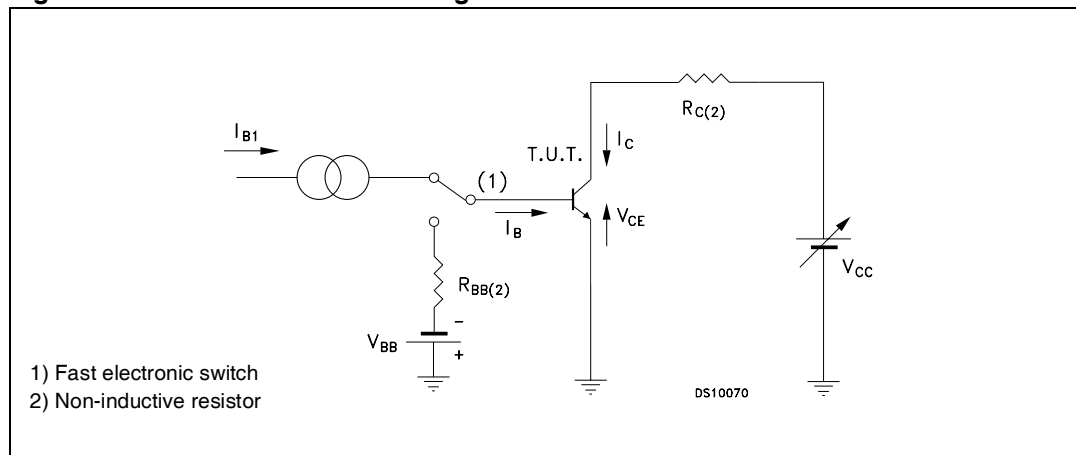
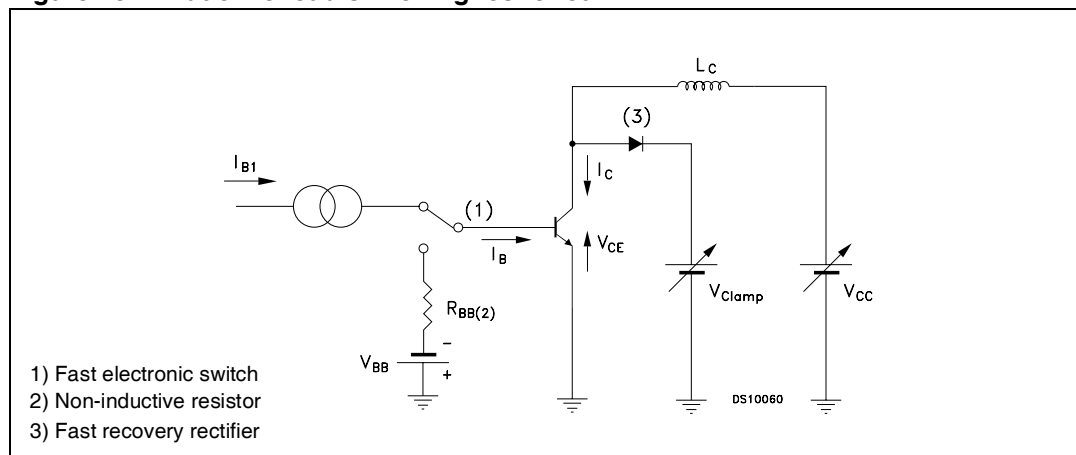


Figure 13. Inductive load switching test circuit

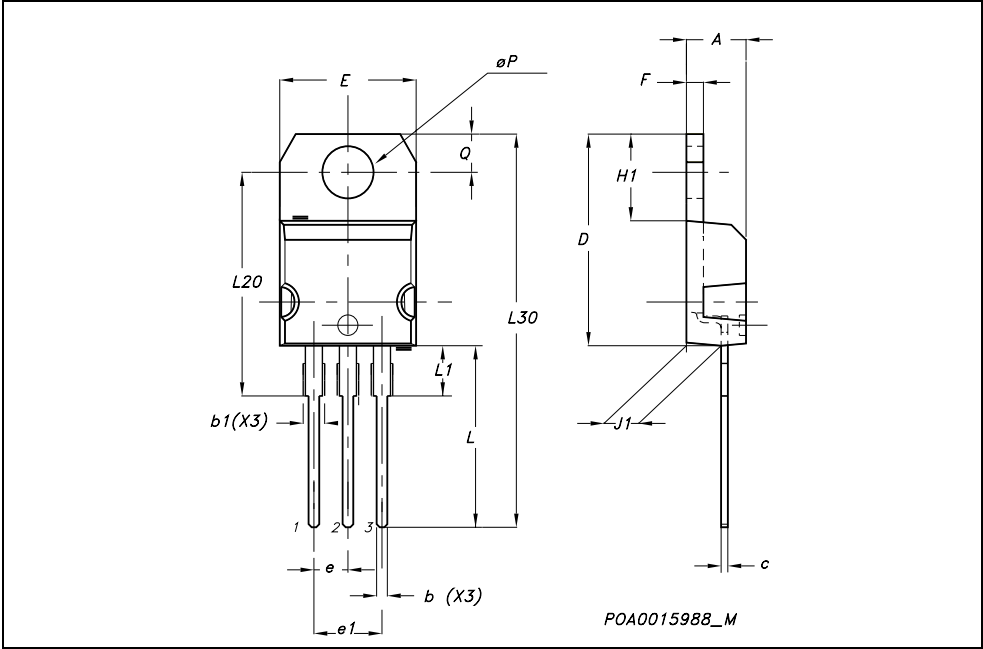


### 3      **Package mechanical data**

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](http://www.st.com)



| TO-220 MECHANICAL DATA |       |       |       |       |       |       |
|------------------------|-------|-------|-------|-------|-------|-------|
| DIM.                   | mm.   |       |       | inch  |       |       |
|                        | MIN.  | TYP   | MAX.  | MIN.  | TYP.  | MAX.  |
| A                      | 4.40  |       | 4.60  | 0.173 |       | 0.181 |
| b                      | 0.61  |       | 0.88  | 0.024 |       | 0.034 |
| b1                     | 1.15  |       | 1.70  | 0.045 |       | 0.066 |
| c                      | 0.49  |       | 0.70  | 0.019 |       | 0.027 |
| D                      | 15.25 |       | 15.75 | 0.60  |       | 0.620 |
| E                      | 10    |       | 10.40 | 0.393 |       | 0.409 |
| e                      | 2.40  |       | 2.70  | 0.094 |       | 0.106 |
| e1                     | 4.95  |       | 5.15  | 0.194 |       | 0.202 |
| F                      | 1.23  |       | 1.32  | 0.048 |       | 0.052 |
| H1                     | 6.20  |       | 6.60  | 0.244 |       | 0.256 |
| J1                     | 2.40  |       | 2.72  | 0.094 |       | 0.107 |
| L                      | 13    |       | 14    | 0.511 |       | 0.551 |
| L1                     | 3.50  |       | 3.93  | 0.137 |       | 0.154 |
| L20                    |       | 16.40 |       |       | 0.645 |       |
| L30                    |       | 28.90 |       |       | 1.137 |       |
| øP                     | 3.75  |       | 3.85  | 0.147 |       | 0.151 |
| Q                      | 2.65  |       | 2.95  | 0.104 |       | 0.116 |



## 4 Revision history

**Table 4. Revision history**

| Date        | Revision | Changes          |
|-------------|----------|------------------|
| 30-May-2006 | 1        | Initial release. |

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