

## High voltage fast-switching NPN power transistors

### Features

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

### Applications

- Electronic ballast for fluorescent lighting
- Switch mode power supplies.

### Description

The devices are manufactured using high voltage multi-epitaxial planar technology for high switching speeds and high voltage capability.

Thanks to an increased intermediate layer, it has an intrinsic ruggedness which enables the transistor to withstand an high collector current level during breakdown condition, without using the transil protection usually necessary in typical converters for lamp ballast.

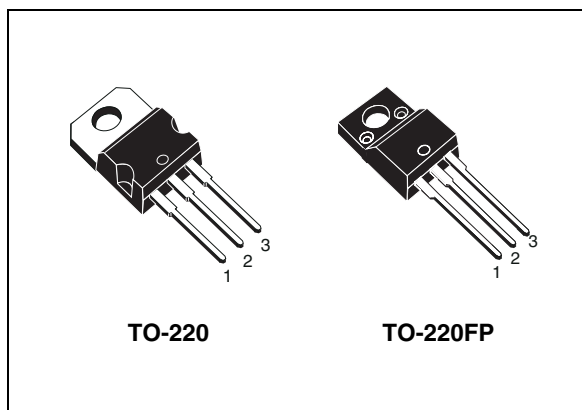


Figure 1. Internal schematic diagram

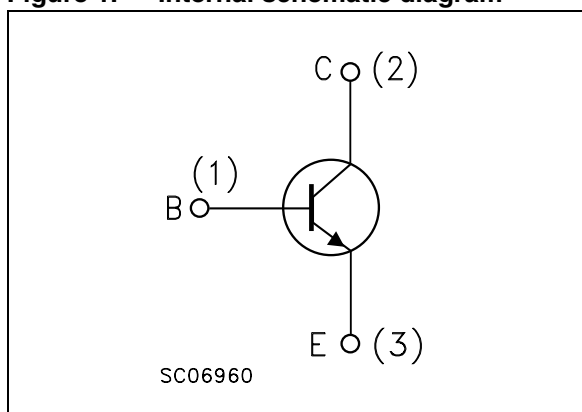


Table 1. Device summary

| Order codes | Marking  | Packages | Packaging |
|-------------|----------|----------|-----------|
| BUL741      | BUL741   | TO-220   | Tube      |
| BUL741FP    | BUL741FP | TO-220FP | Tube      |

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# 1 Electrical ratings

**Table 2. Absolute maximum rating**

| Symbol    | Parameter                                                      | Value         | Unit |
|-----------|----------------------------------------------------------------|---------------|------|
| $V_{CES}$ | Collector-emitter voltage ( $V_{BE} = 0$ )                     | 1050          | V    |
| $V_{CEO}$ | Collector-emitter voltage ( $I_B = 0$ )                        | 400           | V    |
| $V_{EBO}$ | Emitter-base voltage ( $I_C = 0$ , $I_B = 2$ A, $t_P < 10$ ms) | $V_{(BR)EBO}$ | V    |
| $I_C$     | Collector current                                              | 2.5           | A    |
| $I_{CM}$  | Collector peak current ( $t_P < 5$ ms)                         | 5             | A    |
| $I_B$     | Base current                                                   | 1.5           | A    |
| $I_{BM}$  | Base peak current ( $t_P < 5$ ms)                              | 3             | A    |
| $P_{tot}$ | Total dissipation at $T_C = 25$ °C for TO-220                  | 60            | W    |
|           | Total dissipation at $T_C = 25$ °C for TO-220FP                | 30            |      |
| $T_{stg}$ | Storage temperature                                            | -65 to 150    | °C   |
| $T_J$     | Max. operating junction temperature                            | 150           | °C   |

**Table 3. Thermal data**

| Symbol     | Parameter                            | TO-220 | TO-220FP | Unit |
|------------|--------------------------------------|--------|----------|------|
| $R_{thJC}$ | Thermal resistance junction-case max | 2.08   | 4.17     | °C/W |

## 2 Electrical characteristics

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

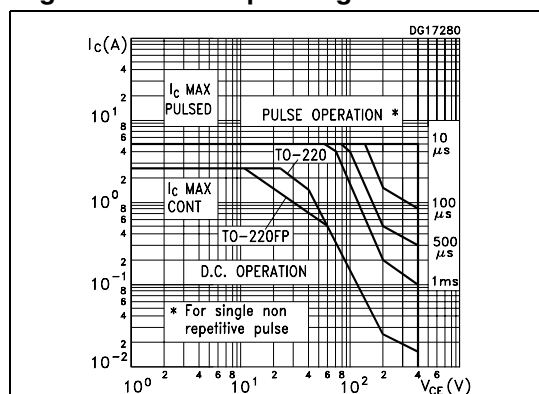
**Table 4. Electrical characteristics**

| Symbol                           | Parameter                                                   | Test conditions                                                                                                                                                                                    | Min.     | Typ.        | Max.       | Unit                |
|----------------------------------|-------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|-------------|------------|---------------------|
| $I_{\text{CES}}$                 | Collector cut-off current ( $V_{\text{BE}} = 0$ )           | $V_{\text{CE}} = 1050\text{ V}$                                                                                                                                                                    |          | 0.2         | 10         | $\mu\text{A}$       |
| $I_{\text{CEO}}$                 | Collector cut-off current ( $I_{\text{B}} = 0$ )            | $V_{\text{CE}} = 400\text{ V}$                                                                                                                                                                     |          | 10          | 250        | $\mu\text{A}$       |
| $V_{(\text{BR})\text{EBO}}$      | Emitter-base breakdown voltage ( $I_{\text{C}} = 0$ )       | $I_{\text{E}} = 1\text{ mA}$                                                                                                                                                                       | 15       | 19          | 24         | V                   |
| $V_{\text{CEO(sus)}}^{(1)}$      | Collector-emitter sustaining voltage ( $I_{\text{B}} = 0$ ) | $I_{\text{C}} = 10\text{ mA}$                                                                                                                                                                      | 400      | 450         |            | V                   |
| $V_{\text{CE(sat)}}^{(1)}$       | Collector-emitter saturation voltage                        | $I_{\text{C}} = 0.7\text{ A}$ $I_{\text{B}} = 0.14\text{ A}$<br>$I_{\text{C}} = 2\text{ A}$ $I_{\text{B}} = 0.6\text{ A}$                                                                          |          | 0.15<br>0.5 | 0.5<br>1.5 | V<br>V              |
| $V_{\text{BE(sat)}}^{(1)}$       | Base-emitter saturation voltage                             | $I_{\text{C}} = 2\text{ A}$ $I_{\text{B}} = 0.6\text{ A}$                                                                                                                                          |          | 1.1         | 1.5        | V                   |
| $h_{\text{FE}}$                  | DC current gain                                             | $I_{\text{C}} = 0.1\text{ A}$ $V_{\text{CE}} = 5\text{ V}$<br>$I_{\text{C}} = 0.45\text{ A}$ $V_{\text{CE}} = 3\text{ V}$                                                                          | 48<br>25 | 70<br>35    | 100<br>50  |                     |
| $t_{\text{s}}$<br>$t_{\text{f}}$ | Resistive load<br>Storage time<br>Fall time                 | $V_{\text{CC}} = 125\text{ V}$ $I_{\text{C}} = 1\text{ A}$<br>$I_{\text{B(on)}} = -I_{\text{B(off)}} = 0.2\text{ A}$<br>$t_{\text{p}} = 300\text{ }\mu\text{s}$ $V_{\text{BB(off)}} = -5\text{ V}$ |          | 2.5<br>350  | 3.5<br>500 | $\mu\text{s}$<br>ns |
| $E_{\text{ar}}$                  | Repetitive avalanche energy                                 | $L = 2\text{ mH}$ $C = 1.8\text{ nF}$<br>$V_{\text{BB(off)}} = -5\text{ V}$                                                                                                                        | 5        |             |            | mJ                  |

1. Pulse test: pulse duration  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$

### 2.1 Typical characteristic

**Figure 2. Safe operating area**



**Figure 3. Derating curve**

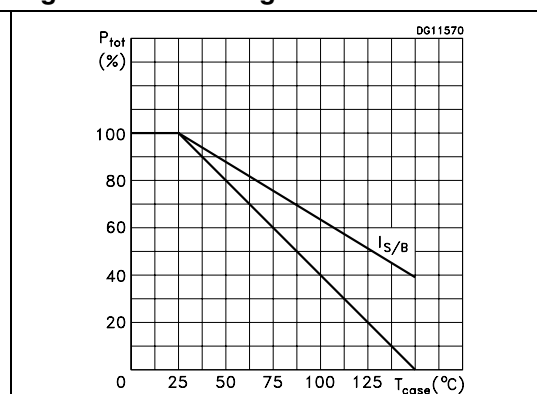


Figure 4. Output characteristics

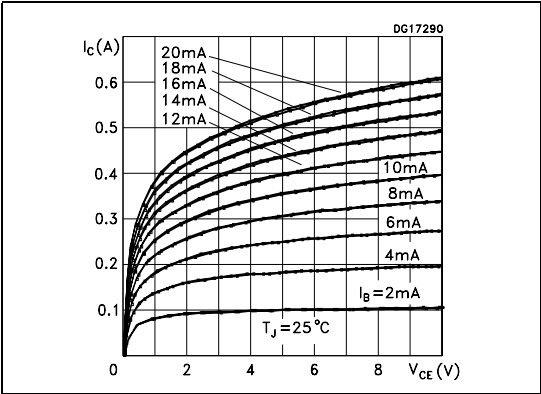


Figure 5. Reverse biased safe operating area

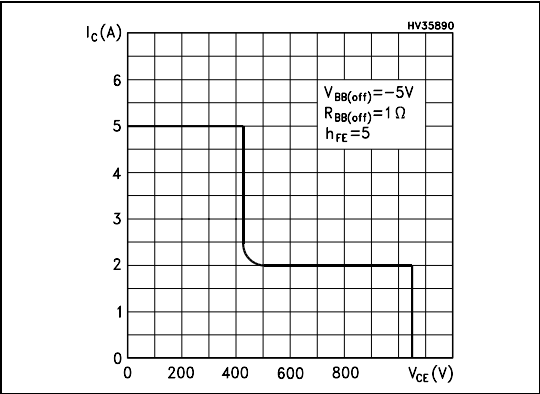


Figure 6. DC current gain ( $V_{CE} = 3$  V)

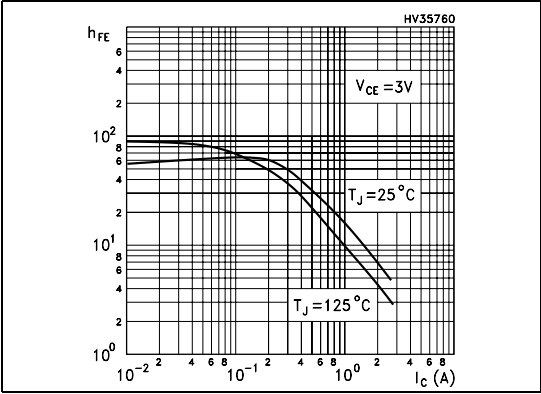


Figure 7. DC current gain ( $V_{CE} = 5$  V)

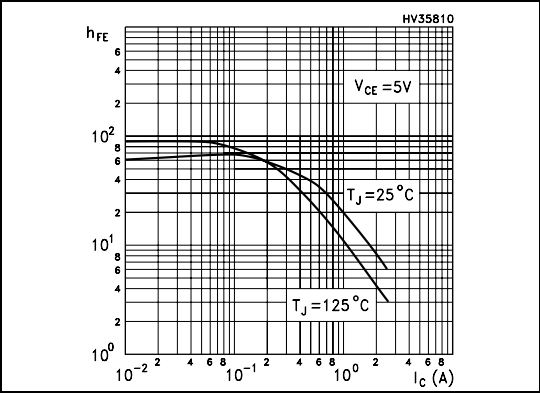


Figure 8. Base-emitter saturation voltage

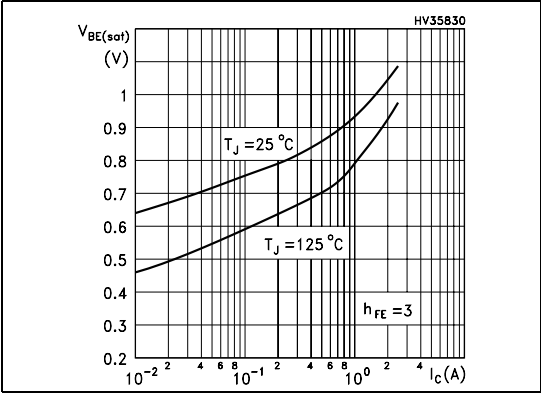


Figure 9. Collector-emitter saturation voltage

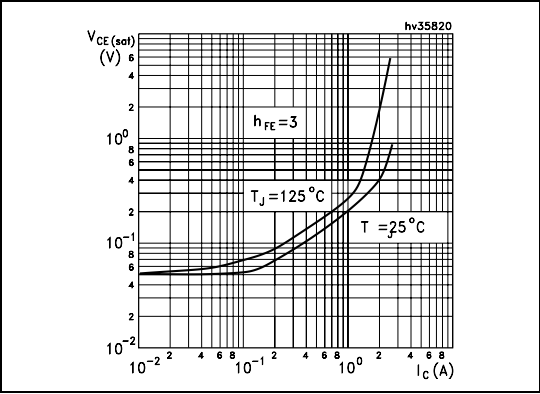


Figure 10. Resistive load switching on  
( $h_{FE} = 5$ )

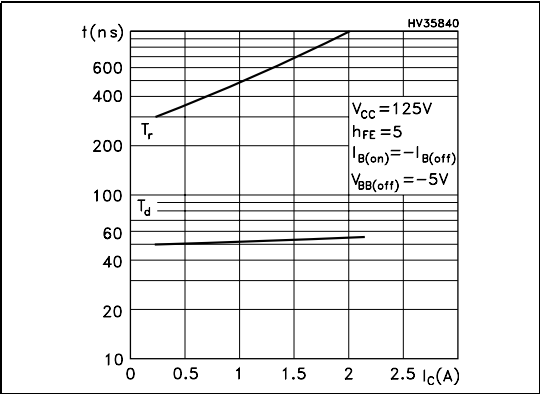


Figure 11. Resistive load switching on  
( $h_{FE} = 10$ )

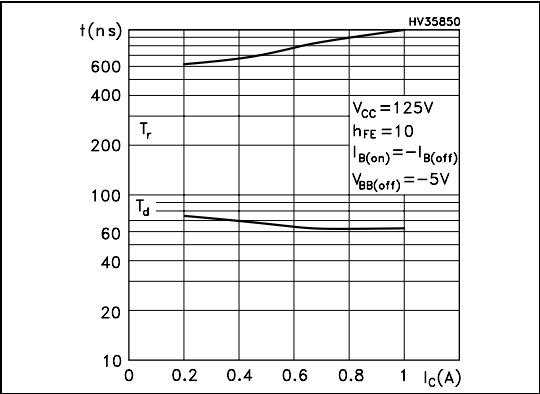


Figure 12. Resistive load switching off  
( $h_{FE} = 5$ )

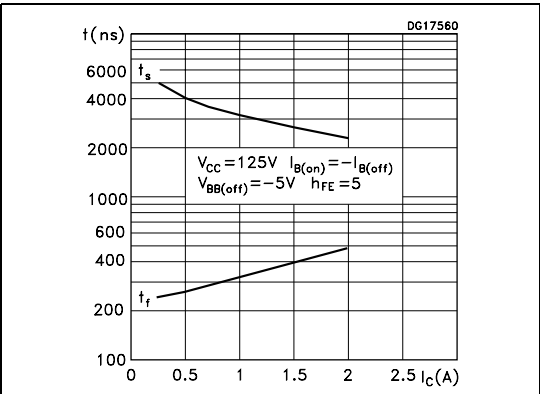
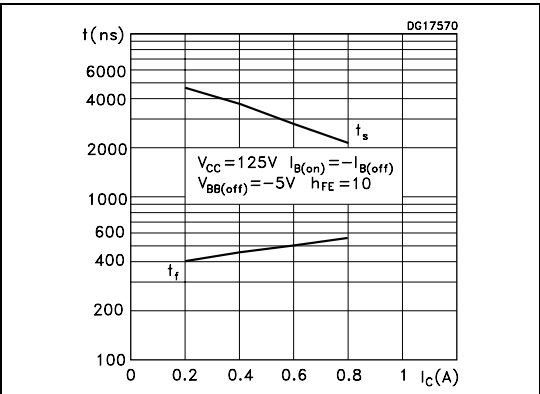
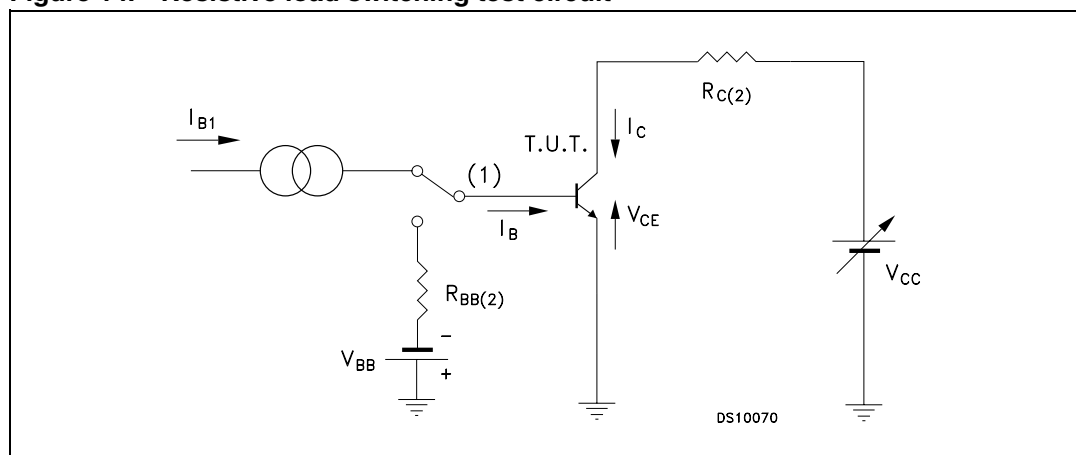


Figure 13. Resistive load switching off  
( $h_{FE} = 10$ )



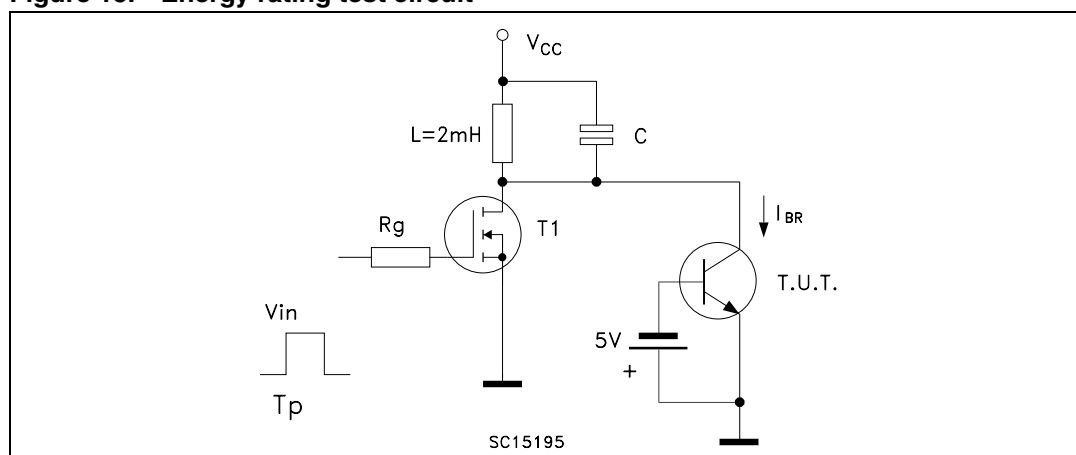
## 2.2 Test circuits

**Figure 14. Resistive load switching test circuit**



1. Fast electronic switch
2. Non-inductive resistor

**Figure 15. Energy rating test circuit**

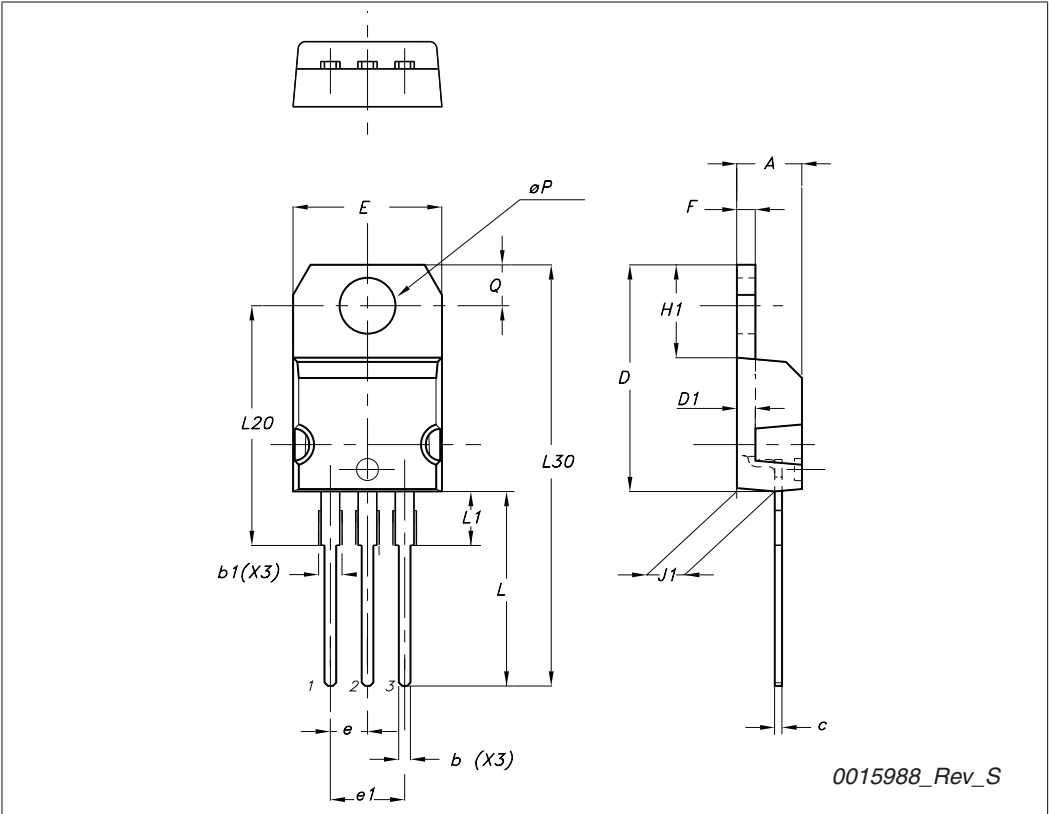


### 3      **Package mechanical data**

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK<sup>®</sup> packages, depending on their level of environmental compliance. ECOPACK<sup>®</sup> specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK<sup>®</sup> is an ST trademark.

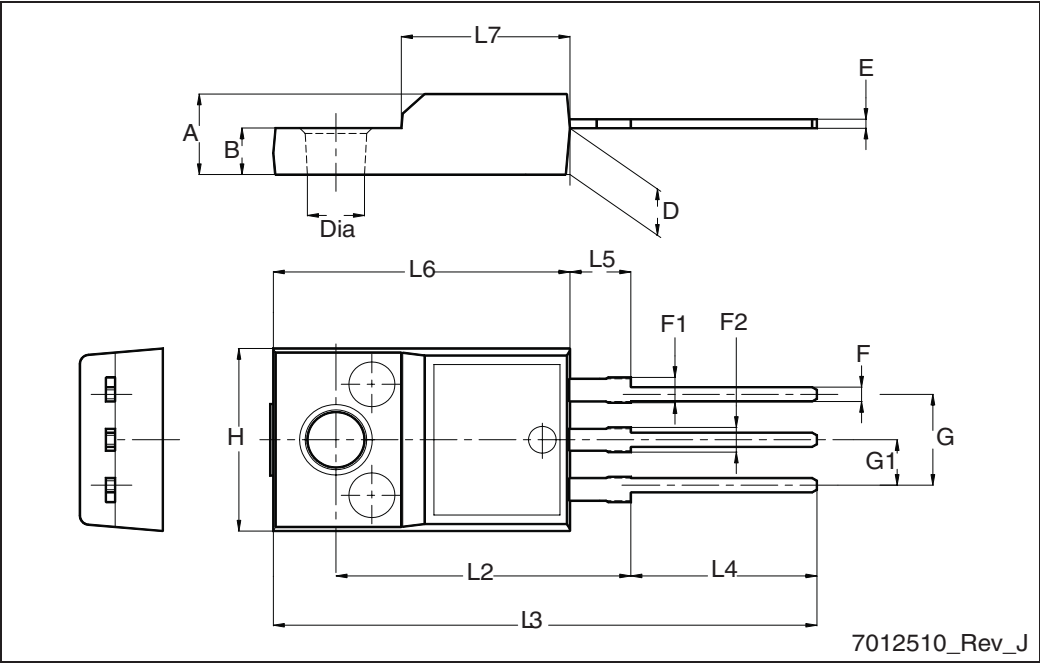
TO-220 type A mechanical data

| Dim | mm    |       |       |
|-----|-------|-------|-------|
|     | Min   | Typ   | Max   |
| A   | 4.40  |       | 4.60  |
| b   | 0.61  |       | 0.88  |
| b1  | 1.14  |       | 1.70  |
| c   | 0.48  |       | 0.70  |
| D   | 15.25 |       | 15.75 |
| D1  |       | 1.27  |       |
| E   | 10    |       | 10.40 |
| e   | 2.40  |       | 2.70  |
| e1  | 4.95  |       | 5.15  |
| F   | 1.23  |       | 1.32  |
| H1  | 6.20  |       | 6.60  |
| J1  | 2.40  |       | 2.72  |
| L   | 13    |       | 14    |
| L1  | 3.50  |       | 3.93  |
| L20 |       | 16.40 |       |
| L30 |       | 28.90 |       |
| ØP  | 3.75  |       | 3.85  |
| Q   | 2.65  |       | 2.95  |



TO-220FP mechanical data

| Dim. | mm   |      |      |
|------|------|------|------|
|      | Min. | Typ. | Max. |
| A    | 4.4  |      | 4.6  |
| B    | 2.5  |      | 2.7  |
| D    | 2.5  |      | 2.75 |
| E    | 0.45 |      | 0.7  |
| F    | 0.75 |      | 1    |
| F1   | 1.15 |      | 1.70 |
| F2   | 1.15 |      | 1.5  |
| G    | 4.95 |      | 5.2  |
| G1   | 2.4  |      | 2.7  |
| H    | 10   |      | 10.4 |
| L2   |      | 16   |      |
| L3   | 28.6 |      | 30.6 |
| L4   | 9.8  |      | 10.6 |
| L5   | 2.9  |      | 3.6  |
| L6   | 15.9 |      | 16.4 |
| L7   | 9    |      | 9.3  |
| Dia  | 3    |      | 3.2  |



## 4 Revision history

**Table 5. Document revision history**

| Date        | Revision | Changes                                         |
|-------------|----------|-------------------------------------------------|
| 11-Apr-2007 | 1        | Initial release.                                |
| 10-Jul-2007 | 2        | Figure 12 and 13 have been updated.             |
| 18-Aug-2009 | 3        | Added new package TO-220FP and mechanical data. |

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