



**BUL416**

## HIGH VOLTAGE FAST-SWITCHING NPN POWER TRANSISTOR

- n STMicroelectronics PREFERRED SALES TYPE
- n NPN TRANSISTOR
- n HIGH VOLTAGE CAPABILITY
- n VERY HIGH SWITCHING SPEED
- n FULLY CHARACTERIZED AT 125 °C
- n LOW SPREAD OF DYNAMIC PARAMETERS

### APPLICATIONS

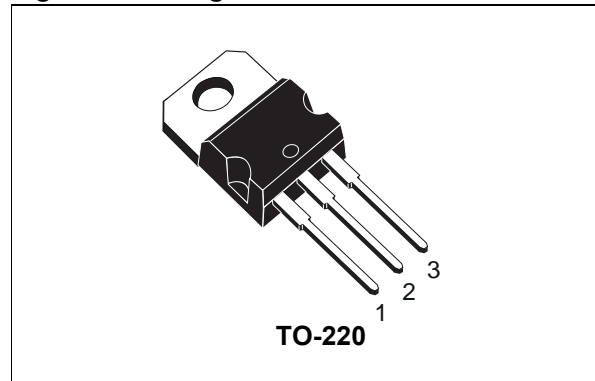
- n ELECTRONIC BALLAST FOR FLUORESCENT LIGHTING
- n SWITCH MODE POWER SUPPLIES

### DESCRIPTION

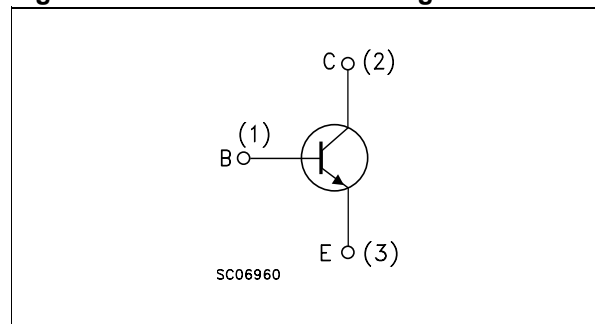
The device is manufactured using high voltage Multi-Epitaxial Mesa technology for cost-effective high performance. It uses a Hollow Emitter structure to enhance switching speeds.

The BUL series is designed for use in lighting applications and low cost switch-mode power supplies.

**Figure 1: Package**



**Figure 2: Internal Schematic Diagram**



**Table 1: Order Codes**

| Part Number | Marking                      | Package | Packaging |
|-------------|------------------------------|---------|-----------|
| BUL416      | BUL416A<br>or (#)<br>BUL416B | TO-220  | Tube      |

# See:note on page 2

**Table 2: Absolute Maximum Ratings**

| Symbol    | Parameter                                  | Value      | Unit |
|-----------|--|------------|------|
| $V_{CES}$ | Collector-Emitter Voltage ( $V_{BE} = 0$ ) | 1600       | V    |
| $V_{CEO}$ | Collector-Emitter Voltage ( $I_B = 0$ )    | 800        | V    |
| $V_{EBO}$ | Emitter-Base Voltage ( $I_C = 0$ )         | 9          | V    |
| $I_C$     | Collector Current                          | 6          | A    |
| $I_{CM}$  | Collector Peak Current ( $t_p < 5ms$ )     | 9          | A    |
| $I_B$     | Base Current                               | 5          | A    |
| $I_{BM}$  | Base Peak Current ( $t_p < 5ms$ )          | 8          | A    |
| $P_{tot}$ | Total Dissipation at $T_C = 25\text{ °C}$  | 110        | W    |
| $T_{stg}$ | Storage Temperature                        | -65 to 150 | °C   |

## BUL416

| Symbol | Parameter                           | Value | Unit |
|--------|-------------------------------------|-------|------|
| $T_J$  | Max. Operating Junction Temperature | 150   | °C   |

**Table 3: Thermal Data**

|                |                                     |     |      |      |
|----------------|-------------------------------------|-----|------|------|
| $R_{thj-case}$ | Thermal Resistance Junction-Case    | Max | 1.14 | °C/W |
| $R_{thj-amb}$  | Thermal Resistance Junction-Ambient | Max | 62.5 | °C/W |

**Table 4: Electrical Characteristics ( $T_{case} = 25\text{ °C}$  unless otherwise specified)**

| Symbol           | Parameter  | Test Conditions   | Min. | Typ.       | Max. | Unit                |
|------------------|--|---|------|------------|------|---------------------|
| $I_{CES}$        | Collector Cut-off Current<br>( $V_{BE} = 0\text{ V}$ )   | $V_{CE} = 1600\text{ V}$  |      |            | 100  | $\mu\text{A}$       |
|                  |  | $V_{CE} = 1600\text{ V}$<br>$T_j = 125\text{ °C}$   |      |            | 500  | $\mu\text{A}$       |
| $I_{CEO}$        | Collector Cut-off Current<br>( $I_B = 0$ )               | $V_{CE} = 800\text{ V}$   |      |            | 250  | $\mu\text{A}$       |
| $V_{CEO(sus)}^*$ | Collector-Emitter<br>Sustaining Voltage<br>( $I_B = 0$ ) | $I_C = 100\text{ mA}$<br>$L = 25\text{ mH}$   | 800  |            |      | V                   |
| $V_{EBO}$        | Emitter-Base Voltage<br>( $I_C = 0$ )                    | $I_E = 10\text{ mA}$  | 9    |            |      | V                   |
| $V_{CE(sat)}^*$  | Collector-Emitter<br>Saturation Voltage                  | $I_C = 2\text{ A}$<br>$I_B = 0.4\text{ A}$  |      |            | 1.5  | V                   |
|                  |  | $I_C = 4\text{ A}$<br>$I_B = 1.33\text{ A}$   |      |            | 3    | V                   |
| $V_{BE(sat)}^*$  | Base-Emitter Saturation<br>Voltage                       | $I_C = 2\text{ A}$<br>$I_B = 0.4\text{ A}$  |      |            | 1.2  | V                   |
|                  |  | $I_C = 4\text{ A}$<br>$I_B = 1.33\text{ A}$   |      |            | 1.5  | V                   |
| $h_{FE}^*$       | DC Current Gain  | $I_C = 10\text{ mA}$<br>$V_{CE} = 5\text{ V}$   | 10   |            |      |                     |
|                  |  | $I_C = 0.7\text{ A}$<br>$V_{CE} = 5\text{ V}$   | 12   |            | 27   |                     |
|                  |  | Group A<br>Group B  | 25   |            | 40   |                     |
| $t_s$<br>$t_f$   | INDUCTIVE LOAD<br>Storage Time<br>Fall Time              | $I_C = 3\text{ A}$<br>$V_{BE(off)} = -5\text{ V}$<br>$V_{clamp} = 200\text{ V}$<br>(see figure 12)                          |      | 2.3<br>650 |      | $\mu\text{s}$<br>ns |
|                  |  | $I_{B1} = 1\text{ A}$<br>$R_{BB} = 0\ \Omega$<br>$L = 200\ \mu\text{H}$   |      |            |      |                     |
| $t_s$<br>$t_f$   | INDUCTIVE LOAD<br>Storage Time<br>Fall Time              | $I_C = 3\text{ A}$<br>$V_{BE(off)} = -5\text{ V}$<br>$V_{clamp} = 200\text{ V}$<br>$T_j = 100\text{ °C}$<br>(see figure 12) |      | 3<br>680   |      | $\mu\text{s}$<br>ns |
|                  |  | $I_{B1} = 1\text{ A}$<br>$R_{BB} = 0\ \Omega$<br>$L = 200\ \mu\text{H}$   |      |            |      |                     |

\* Pulsed: Pulsed duration = 300  $\mu\text{s}$ , duty cycle  $\leq 1.5\%$ .

# Note: Product is pre-selected in DC current gain (Group A and Group B). STMicroelectronics reserves the right to ship either groups according to production availability. Please contact your nearest STMicroelectronics sales office for delivery details.

Figure 3: Safe Operating Area

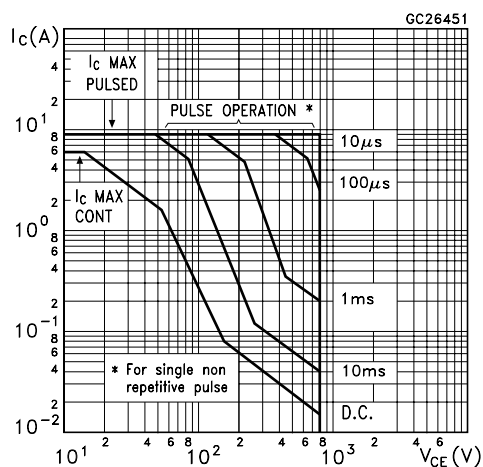


Figure 4: DC Current Gain

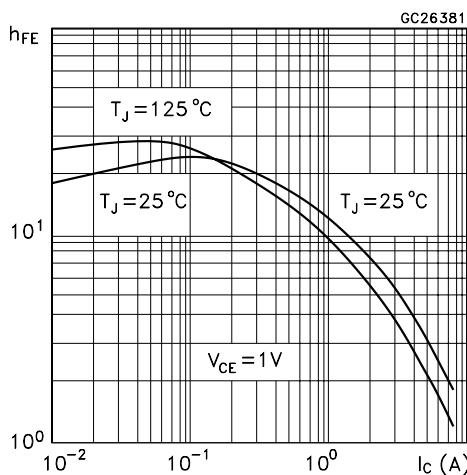


Figure 5: Collector-Emitter Saturation Voltage

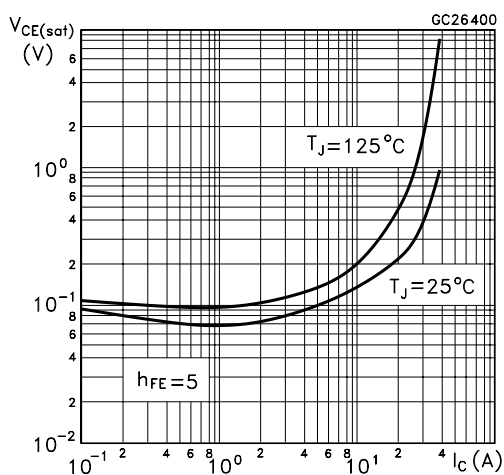


Figure 6: Derating Curve

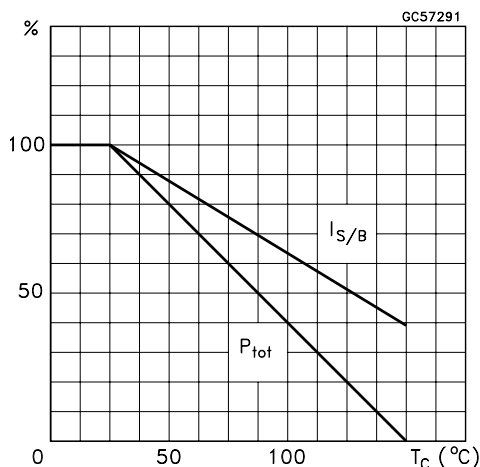


Figure 7: DC Current Gain

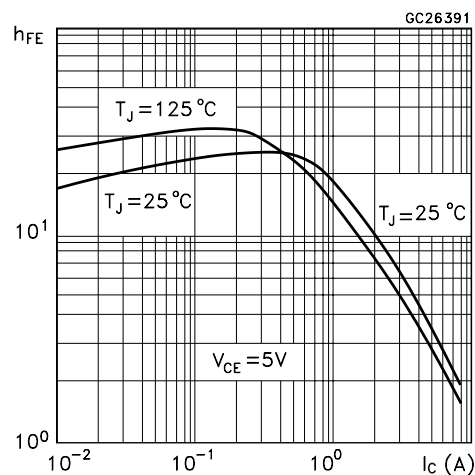


Figure 8: Base-Emitter Saturation Voltage

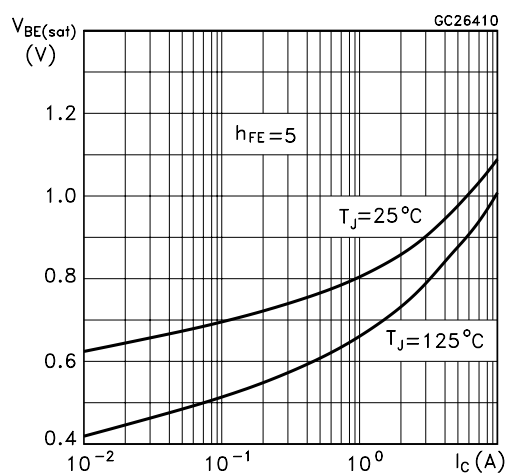


Figure 9: Inductive Load Fall Time

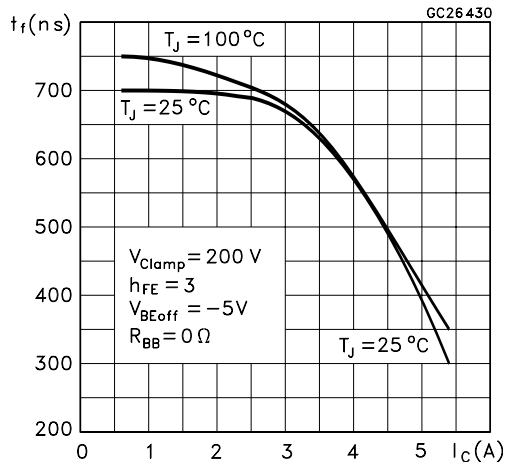


Figure 11: Resistive Load Storage Time

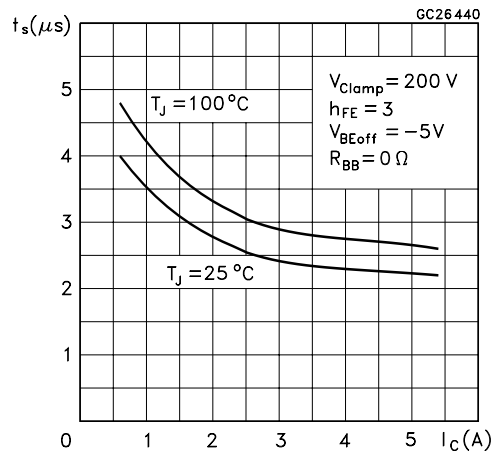


Figure 10: Reverse Biased SOA

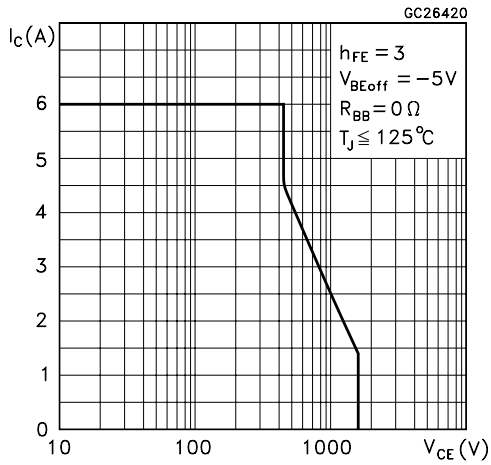
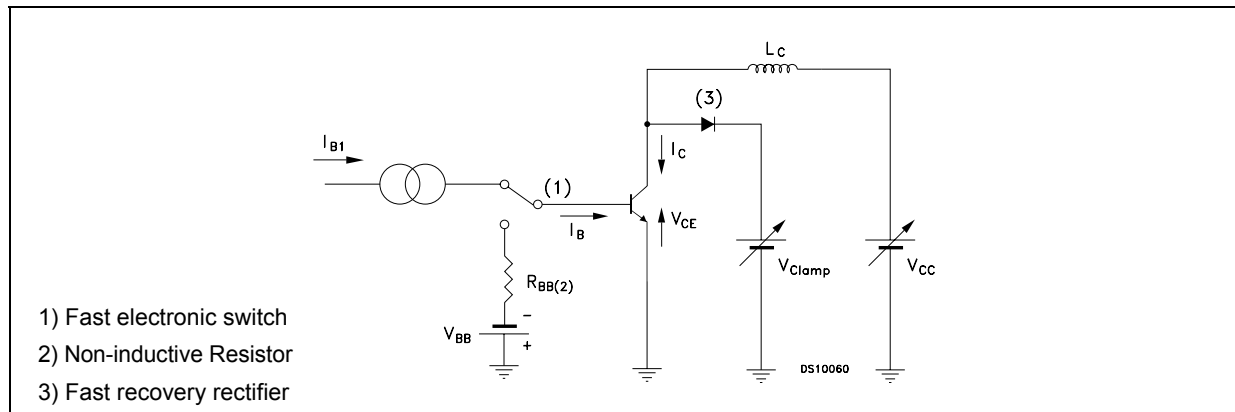
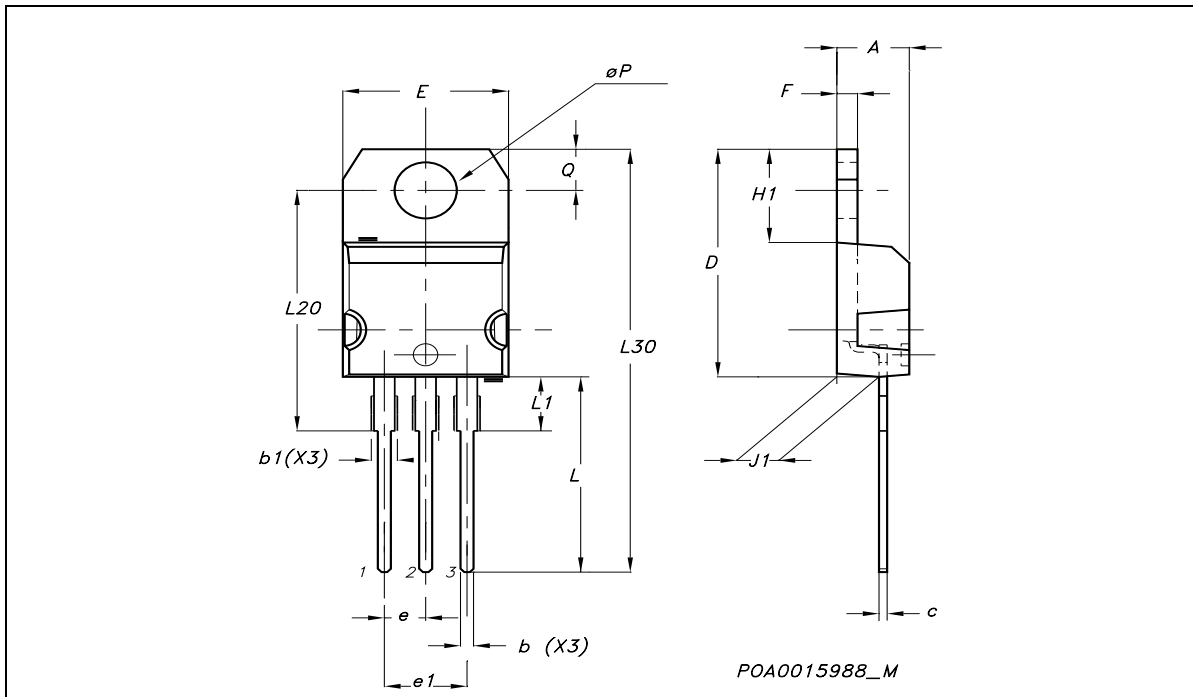


Figure 12: Inductive Load Switching Test Circuit



**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 |



**Table 5:**

| <b>Version</b> | <b>Release Date</b> | <b>Change Designator</b> |
|----------------|---------------------|--------------------------|
| 14-Jan-2004    | 1                   | First Release.           |
| 09-Sep-2004    | 2                   | Second Release.          |
| 26-Jan-2005    | 3                   | Third Release.           |

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