BUL791
NPN SILICON POWER TRANSISTOR

- Designed Specifically for High Frequency Electronic Ballasts up to 125 W
- $h_{FE} = 6$ to 22 at $V_{CE} = 1$ V, $I_C = 2$ A
- Low Power Losses (On-state and Switching)
- Key Parameters Characterised at High Temperature
- Tight and Reproducible Parametric Distributions

![Pinout Diagram]

Pin 2 is in electrical contact with the mounting base.

absolute maximum ratings at 25°C ambient temperature (unless otherwise noted)

<table>
<thead>
<tr>
<th>RATING</th>
<th>SYMBOL</th>
<th>VALUE</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collector-emitter voltage ($V_{BE} = 0$)</td>
<td>$V_{CES}$</td>
<td>700</td>
<td>V</td>
</tr>
<tr>
<td>Collector-base voltage ($I_E = 0$)</td>
<td>$V_{CBO}$</td>
<td>700</td>
<td>V</td>
</tr>
<tr>
<td>Collector-emitter voltage ($I_B = 0$)</td>
<td>$V_{CEO}$</td>
<td>400</td>
<td>V</td>
</tr>
<tr>
<td>Emitter-base voltage</td>
<td>$V_{EBO}$</td>
<td>9</td>
<td>V</td>
</tr>
<tr>
<td>Continuous collector current</td>
<td>$I_C$</td>
<td>4</td>
<td>A</td>
</tr>
<tr>
<td>Peak collector current (see Note 1)</td>
<td>$I_{CM}$</td>
<td>8</td>
<td>A</td>
</tr>
<tr>
<td>Peak collector current (see Note 2)</td>
<td>$I_{CM}$</td>
<td>14</td>
<td>A</td>
</tr>
<tr>
<td>Continuous base current</td>
<td>$I_B$</td>
<td>2.5</td>
<td>A</td>
</tr>
<tr>
<td>Peak base current (see Note 2)</td>
<td>$I_{BM}$</td>
<td>3.5</td>
<td>A</td>
</tr>
<tr>
<td>Continuous device dissipation at (or below) 25°C case temperature</td>
<td>$P_{tot}$</td>
<td>75</td>
<td>W</td>
</tr>
<tr>
<td>Operating junction temperature range</td>
<td>$T_J$</td>
<td>-65 to +150</td>
<td>°C</td>
</tr>
<tr>
<td>Storage temperature range</td>
<td>$T_{stg}$</td>
<td>-65 to +150</td>
<td>°C</td>
</tr>
</tbody>
</table>

NOTES: 1. This value applies for $t_p = 10$ ms, duty cycle $\leq 2\%$.
2. This value applies for $t_p = 300$ µs, duty cycle $\leq 2\%$.

PRODUCT INFORMATION

JULY 1991 - REVISED SEPTEMBER 2002
Specifications are subject to change without notice.
electrical characteristics at 25°C case temperature (unless otherwise noted)

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>TEST CONDITIONS</th>
<th>MIN</th>
<th>TYP</th>
<th>MAX</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{CEO(sus)}$</td>
<td>Collector-emitter sustaining voltage</td>
<td>$I_C = 100 \text{ mA}$</td>
<td>$L = 25 \text{ mH}$</td>
<td>(see Note 3)</td>
<td>400</td>
</tr>
<tr>
<td>$I_{CES}$</td>
<td>Collector-emitter cut-off current</td>
<td>$V_{CE} = 700 \text{ V}$</td>
<td>$V_{BE} = 0$</td>
<td>$T_C = 90^\circ \text{C}$</td>
<td>10</td>
</tr>
<tr>
<td>$I_{EBO}$</td>
<td>Emitter cut-off current</td>
<td>$V_{EB} = 9 \text{ V}$</td>
<td>$I_C = 0$</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>$V_{BE(at)}$</td>
<td>Base-emitter saturation voltage</td>
<td>$I_B = 400 \text{ mA}$</td>
<td>$I_C = 2 \text{ A}$</td>
<td>(see Notes 4 and 5)</td>
<td>0.94</td>
</tr>
<tr>
<td>$V_{CE(at)}$</td>
<td>Collector-emitter saturation voltage</td>
<td>$I_B = 400 \text{ mA}$</td>
<td>$I_C = 2 \text{ A}$</td>
<td>$T_C = 90^\circ \text{C}$</td>
<td>0.25</td>
</tr>
<tr>
<td>$h_{FE}$</td>
<td>Forward current transfer ratio</td>
<td>$V_{CE} = 1 \text{ V}$</td>
<td>$I_C = 2 \text{ A}$</td>
<td>(see Notes 4 and 5)</td>
<td>10</td>
</tr>
<tr>
<td>$V_{FCB}$</td>
<td>Collector-base forward bias diode voltage</td>
<td>$I_{CB} = 60 \text{ mA}$</td>
<td></td>
<td></td>
<td>850</td>
</tr>
</tbody>
</table>

NOTES: 3. Inductive loop switching measurement.
4. These parameters must be measured using pulse techniques, $t_p = 300 \mu\text{s}$, duty cycle $\leq 2\%$.
5. These parameters must be measured using voltage-sensing contacts, separate from the current carrying contacts, and located within 3.2 mm from the device body.

thermal characteristics

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>MIN</th>
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<th>MAX</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>$R_{JJA}$</td>
<td>Junction to free air thermal resistance</td>
<td>62.5</td>
<td>°C/W</td>
<td></td>
</tr>
<tr>
<td>$R_{JJC}$</td>
<td>Junction to case thermal resistance</td>
<td>1.86</td>
<td>°C/W</td>
<td></td>
</tr>
</tbody>
</table>

inductive-load switching characteristics at 25°C case temperature

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>TEST CONDITIONS</th>
<th>MIN</th>
<th>TYP</th>
<th>MAX</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>$t_{SV}$</td>
<td>Storage time</td>
<td>$I_C = 2 \text{ A}$</td>
<td>$I_{B(on)} = 400 \text{ mA}$</td>
<td>$V_{CC} = 40 \text{ V}$</td>
<td>2.2</td>
</tr>
<tr>
<td>$t_S$</td>
<td>Current fall time</td>
<td>$L = 1 \text{ mH}$</td>
<td>$I_{B(off)} = 800 \text{ mA}$</td>
<td>$V_{CLAMP} = 300 \text{ V}$</td>
<td>95</td>
</tr>
<tr>
<td>$t_{SO}$</td>
<td>Cross over time</td>
<td>$I_C = 2 \text{ A}$</td>
<td>$I_{B(on)} = 400 \text{ mA}$</td>
<td>$V_{CC} = 40 \text{ V}$</td>
<td>210</td>
</tr>
<tr>
<td>$t_{SV}$</td>
<td>Storage time</td>
<td>$I_C = 2 \text{ A}$</td>
<td>$I_{B(on)} = 400 \text{ mA}$</td>
<td>$V_{CC} = 40 \text{ V}$</td>
<td>4</td>
</tr>
<tr>
<td>$t_S$</td>
<td>Current fall time</td>
<td>$L = 1 \text{ mH}$</td>
<td>$I_{B(off)} = 250 \text{ mA}$</td>
<td>$V_{CLAMP} = 300 \text{ V}$</td>
<td>120</td>
</tr>
</tbody>
</table>

resistive-load switching characteristics at 25°C case temperature

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>TEST CONDITIONS</th>
<th>MIN</th>
<th>TYP</th>
<th>MAX</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>$t_{SV}$</td>
<td>Storage time</td>
<td>$I_C = 2 \text{ A}$</td>
<td>$I_{B(on)} = 400 \text{ mA}$</td>
<td></td>
<td>2.2</td>
</tr>
<tr>
<td>$t_S$</td>
<td>Current fall time</td>
<td>$V_{CC} = 300 \text{ V}$</td>
<td>$I_{B(off)} = 400 \text{ mA}$</td>
<td></td>
<td>160</td>
</tr>
</tbody>
</table>
TYPICAL CHARACTERISTICS

FORWARD CURRENT TRANSFER RATIO

\[ \frac{I_C}{I_B} \quad \text{vs} \quad I_C \]

\[ h_{FE} = \frac{I_C}{I_B} \]

\[ V_{CE} = 1 \text{ V}, \quad V_{CE} = 5 \text{ V} \]

\[ T_C = 25^\circ C, \quad T_C = 90^\circ C \]

Figure 1.

COLLECTOR-EMITTER SATURATION VOLTAGE

\[ V_{CE(sat)} \quad \text{vs} \quad I_C \]

\[ V_{CE(sat)} = \text{Collector-Emitter Saturation Voltage} \quad V \]

\[ I_B = I_C / 5 \]

\[ T_C = 25^\circ C, \quad T_C = 90^\circ C \]

Figure 2.

INDUCTIVE SWITCHING TIMES

\[ t_{sv}, t_{tx}, t_{fi} \quad \text{vs} \quad I_C \]

\[ t_{sv}, t_{tx}, t_{fi} \quad \text{Inductive Switching Time} \quad \mu s \]

\[ I_B(on) = I_C / 5 \]
\[ I_B(off) = I_C / 2.5 \]
\[ V_{CC} = 40 \text{ V} \]
\[ V_{CLAMP} = 300 \text{ V} \]
\[ L = 1 \text{ mH} \]
\[ T_C = 25^\circ C \]

Figure 3.

INDUCTIVE SWITCHING TIMES

\[ t_{sv}, t_{tx}, t_{fi} \quad \text{vs} \quad T_C \]

\[ t_{sv}, t_{tx}, t_{fi} \quad \text{Inductive Switching Time} \quad \mu s \]

\[ I_B(on) = 400 \text{ mA}, \quad V_{CC} = 40 \text{ V}, \quad L = 1 \text{ mH} \]
\[ I_B(off) = 800 \text{ mA}, \quad V_{CLAMP} = 300 \text{ V}, \quad I_C = 2 \text{ A} \]

Figure 4.

OBSOLETE
TYPICAL CHARACTERISTICS

INDUCTIVE SWITCHING TIMES

VS COLLECTOR CURRENT

IC - Collector Current - A

0.1 1.0 10

Inductive Switching Time - µs

0.1

1.0

10

L791CI2

IB(on) = IC / 5

IB(off) = IC / 8

VCC = 40 V

VCLAMP = 300 V

L = 1 mH

TC = 25°C

Figure 5.

Figure 6.

RESISTIVE SWITCHING TIMES

VS COLLECTOR CURRENT

IC - Collector Current - A

0.1 1.0 10

Resistive Switching Time - µs

0.1

1.0

10

L791CR1

IB(on) = IC / 5, VCC = 300 V

IB(off) = IC / 5, TC = 25°C

Figure 7.

Figure 8.

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**MAXIMUM SAFE OPERATING REGIONS**

### MAXIMUM FORWARD-BIAS SAFE OPERATING AREA

![Graph of MAXIMUM FORWARD-BIAS SAFE OPERATING AREA]

- **$V_{CE}$ - Collector-Emitter Voltage - V**
- **$I_C$ - Collector Current - A**
- **$T_C = 25^\circ C$**
- **$t_p = 10 \mu s$**
- **$t_p = 100 \mu s$**
- **$t_p = 1 \text{ ms}$**
- **$t_p = 10 \text{ ms}$**
- **DC Operation**

**Figure 9.**

### MAXIMUM REVERSE-BIAS SAFE OPERATING AREA

![Graph of MAXIMUM REVERSE-BIAS SAFE OPERATING AREA]

- **$I_B(on) = I_C / 5$**
- **$V_{BE(on)} = -5 \text{ V}$**
- **$T_C = 25^\circ C$**
- **$I_C = 2 \text{ A}$**
- **$V_{CE} = 8 \text{ V}$**

**Figure 10.**