BUL770
NPN SILICON POWER TRANSISTOR

- Designed Specifically for High Frequency Electronic Ballasts up to 50 W
- $h_{FE}$ 7 to 21 at $V_{CE} = 1$ V, $I_C = 800$ mA
- Low Power Losses (On-state and Switching)
- Key Parameters Characterised at High Temperature
- Tight and Reproducible Parametric Distributions

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

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>2.5</td>
<td>A</td>
</tr>
<tr>
<td>Peak collector current (see Note 1)</td>
<td>$I_{CM}$</td>
<td>6</td>
<td>A</td>
</tr>
<tr>
<td>Peak collector current (see Note 2)</td>
<td>$I_{CM}$</td>
<td>8</td>
<td>A</td>
</tr>
<tr>
<td>Continuous base current</td>
<td>$I_B$</td>
<td>1.5</td>
<td>A</td>
</tr>
<tr>
<td>Peak base current (see Note 2)</td>
<td>$I_{BM}$</td>
<td>2.5</td>
<td>A</td>
</tr>
<tr>
<td>Continuous device dissipation at (or below) 25°C case temperature</td>
<td>$P_{tot}$</td>
<td>50</td>
<td>W</td>
</tr>
<tr>
<td>Operating junction temperature</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>

Specifications are subject to change without notice.

PRODUCT INFORMATION

JULY 1991 - REVISED SEPTEMBER 2002

This series is OBSOLETE and not recommended for new designs.
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>$V_{CEO(sus)}$ Collector-emitter sustaining voltage</td>
<td>$I_C = 100$ mA $L = 25$ mH (see Note 3)</td>
<td>400</td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>$I_{CES}$ Collector-emitter cut-off current</td>
<td>$V_{CE} = 700$ V $V_{BE} = 0$ $T_C = 90^\circ$C</td>
<td>10</td>
<td>200</td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td>$I_{EBO}$ Emitter cut-off current</td>
<td>$V_{EB} = 9$ V $I_C = 0$</td>
<td>1</td>
<td></td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td>$V_{BE(sat)}$ Base-emitter saturation voltage</td>
<td>$I_B = 160$ mA</td>
<td>0.83</td>
<td>0.9</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>$V_{CE(sat)}$ Collector-emitter saturation voltage</td>
<td>$I_B = 160$ mA $I_C = 800$ mA (see Notes 4 and 5) $T_C = 90^\circ$C</td>
<td>0.18</td>
<td>0.22</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>$h_{FE}$ Forward current transfer ratio</td>
<td>$V_{CE} = 1$ V</td>
<td>10</td>
<td>18.5</td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td>$V_{CEB} = 1$ V</td>
<td>$I_C = 10$ mA</td>
<td>7</td>
<td>14.5</td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td>$V_{CEB} = 5$ V</td>
<td>$I_C = 800$ mA</td>
<td>2</td>
<td>7.5</td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td>$I_{CB} = 3.2$ A</td>
<td>$I_C = 800$ mA</td>
<td>(see Notes 4 and 5) $T_C = 90^\circ$C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$V_{FB}$ Collector-base forward bias diode voltage</td>
<td>$I_{CB} = 60$ mA</td>
<td>870</td>
<td></td>
<td></td>
<td>mV</td>
</tr>
</tbody>
</table>

NOTES: 3. Inductive loop switching measurement.
4. These parameters must be measured using pulse techniques, $t_p = 300$ µs, 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>
<th>TYP</th>
<th>MAX</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>$R_{JJA}$ Junction to free air thermal resistance</td>
<td>62.5</td>
<td>76.5</td>
<td></td>
<td>°C/W</td>
</tr>
<tr>
<td>$R_{JJC}$ Junction to case thermal resistance</td>
<td>2.9</td>
<td>2.5</td>
<td></td>
<td>°C/W</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>$t_{sv}$ Storage time</td>
<td>$I_C = 800$ mA</td>
<td>2.5</td>
<td>3</td>
<td></td>
<td>µs</td>
</tr>
<tr>
<td>$t_f$ Current fall time</td>
<td>$I_B(ON) = 160$ mA $V_{CC} = 40$ V $V_{CLAMP} = 300$ V</td>
<td>150</td>
<td>190</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>$t_{xo}$ Cross over time</td>
<td>$I_B(ON) = 320$ mA</td>
<td>300</td>
<td>400</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>$t_{sv}$ Storage time</td>
<td>$I_C = 800$ mA $I_B(ON) = 160$ mA $V_{CC} = 40$ V $V_{CLAMP} = 300$ V</td>
<td>4.3</td>
<td>5</td>
<td></td>
<td>µs</td>
</tr>
<tr>
<td>$t_f$ Current fall time</td>
<td>$I_B(ON) = 100$ mA</td>
<td>140</td>
<td>200</td>
<td></td>
<td>µs</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>$t_{sv}$ Storage time</td>
<td>$I_C = 800$ mA $I_B(ON) = 160$ mA</td>
<td>2.5</td>
<td>3.4</td>
<td></td>
<td>µs</td>
</tr>
<tr>
<td>$t_f$ Current fall time</td>
<td>$V_{CC} = 300$ V $I_B(ON) = 160$ mA</td>
<td>150</td>
<td>250</td>
<td></td>
<td>ns</td>
</tr>
</tbody>
</table>
TYPICAL CHARACTERISTICS

FORWARD CURRENT TRANSFER RATIO

\[ h_{FE} - \text{Forward Current Transfer Ratio} \]

\[ I_{C} - \text{Collector Current} \quad \text{A} \]

\[ T_{C} = 25^\circ C \]

\[ V_{CE} = 1 \text{ V} \]

\[ V_{CE} = 5 \text{ V} \]

Figure 1.

COLLECTOR-EMITTER SATURATION VOLTAGE

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

\[ I_{C} - \text{Collector Current} \quad \text{A} \]

\[ T_{C} = 25^\circ C \]

\[ T_{C} = 90^\circ C \]

Figure 2.

INDUCTIVE SWITCHING TIMES

\[ \text{Inductive Switching Time} \quad \mu s \]

\[ I_{C} - \text{Collector Current} \quad \text{A} \]

\[ I_{B(on)} = I_{C} / 5 \]

\[ I_{B(off)} = I_{C} / 2.5 \]

\[ V_{CC} = 40 \text{ V} \]

\[ V_{CLAMP} = 300 \text{ V} \]

\[ L = 1 \text{ mH} \]

\[ T_{C} = 25^\circ C \]

Figure 3.

INDUCTIVE SWITCHING TIMES

\[ \text{Inductive Switching Time} \quad \mu s \]

\[ T_{C} - \text{Case Temperature} \quad ^\circ C \]

\[ I_{B(on)} = 160 \text{ mA}, \quad V_{CC} = 40 \text{ V}, \quad L = 1 \text{ mH} \]

\[ I_{B(off)} = 320 \text{ mA}, \quad V_{CLAMP} = 300 \text{ V}, \quad I_{C} = 800 \text{ mA} \]

Figure 4.

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**TYPICAL CHARACTERISTICS**

**INDUCTIVE SWITCHING TIMES**

**vs**

**COLLECTOR CURRENT**

![Figure 5](image1)

**Inductive Switching Time - µs**

- $I_{B(on)} = I_c / 5$
- $I_{B(off)} = I_c / 8$
- $V_{CC} = 40 \text{ V}$
- $V_{CLAMP} = 300 \text{ V}$
- $L = 1 \text{ mH}$
- $T_C = 25^\circ \text{C}$

**RESISTIVE SWITCHING TIMES**

**vs**

**COLLECTOR CURRENT**

![Figure 7](image2)

**Resistive Switching Time - µs**

- $I_{B(on)} = I_c / 5$, $V_{CC} = 300 \text{ V}$
- $I_{B(off)} = I_c / 5$, $T_C = 25^\circ \text{C}$

**INDUCTIVE SWITCHING TIMES**

**vs**

**CASE TEMPERATURE**

![Figure 6](image3)

**Resistive Switching Time - µs**

- $I_{B(on)} = 160 \text{ mA}$, $V_{CC} = 40 \text{ V}$, $L = 1 \text{ mH}$
- $I_{B(off)} = 100 \text{ mA}$, $V_{CLAMP} = 300 \text{ V}$, $I_c = 800 \text{ mA}$

**RESISTIVE SWITCHING TIMES**

**vs**

**CASE TEMPERATURE**

![Figure 8](image4)

- $I_{B(on)} = 160 \text{ mA}$, $V_{CC} = 300 \text{ V}$
- $I_{B(off)} = 160 \text{ mA}$, $I_c = 800 \text{ mA}$

OBSOLETE

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MAXIMUM SAFE OPERATING REGIONS

MAXIMUM FORWARD-BIAS SAFE OPERATING AREA

- Collector-Emitter Voltage - \( V_{ce} \)
- Collector Current - \( I_c \)
- DC Operation

\[ V_{ce} \] = Collector-Emitter Voltage - V
\[ I_c \] = Collector Current - A
\[ T_C \] = 25°C
\[ t_p \] = 10 µs
\[ t_v \] = 1 ms
\[ t_r \] = 10 ms

IB(on) = \( I_c / 5 \)
VBE(off) = -5 V
TC = 25°C

Figure 9.

MAXIMUM REVERSE-BIAS SAFE OPERATING AREA

- Collector-Emitter Voltage - \( V_{ce} \)

\[ V_{ce} \] = Collector-Emitter Voltage - V

Figure 10.

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