

## HIGH VOLTAGE FAST-SWITCHING NPN POWER TRANSISTOR

| Ordering Code | Marking | Shipment |
| :---: | :---: | :---: |
| BULB128D-1 | BULB128D | Tube |

- STMicroelectronics PREFERRED SALESTYPE
- NPN TRANSISTOR
- HIGH VOLTAGE CAPABILITY
- LOW SPREAD OF DYNAMIC PARAMETERS
- MINIMUM LOT-TO-LOT SPREAD FOR RELIABLE OPERATION
- VERY HIGH SWITCHING SPEED
- INTEGRATED ANTIPARALLEL

COLLECTOR-EMITTER DIODE

## APPLICATIONS:

- ELECTRONIC BALLASTS FOR FLUORESCENT LIGHTING
- FLYBACK AND FORWARD SINGLE TRANSISTOR LOW POWER CONVERTERS


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


## INTERNAL SCHEMATIC DIAGRAM



## ABSOLUTE MAXIMUM RATINGS

| Symbol | Parameter | Value | Unit |
| :---: | :--- | :---: | :---: |
| $\mathrm{V}_{\mathrm{CES}}$ | Collector-Emitter Voltage $\left(\mathrm{V}_{\mathrm{BE}}=0\right)$ | 700 | V |
| $\mathrm{~V}_{\mathrm{CEO}}$ | Collector-Emitter Voltage $\left(\mathrm{I}_{\mathrm{B}}=0\right)$ | 400 | V |
| $\mathrm{~V}_{\mathrm{EBO}}$ | Emitter-Base Voltage <br> $\left(\mathrm{I}_{\mathrm{C}}=0, \quad \mathrm{I}_{\mathrm{B}}=2 \mathrm{~A}, \quad \mathrm{t}_{\mathrm{p}}<10 \mu \mathrm{~s}, \mathrm{~T}_{\mathrm{j}}<150^{\circ} \mathrm{C}\right)$ | $\mathrm{V}_{(\mathrm{BR}) \mathrm{EBO}}$ | V |
| $\mathrm{I}_{\mathrm{C}}$ | Collector Current | 4 | A |
| $\mathrm{I}_{\mathrm{CM}}$ | Collector Peak Current $\left(\mathrm{t}_{\mathrm{p}}<5 \mathrm{~ms}\right)$ | 8 | A |
| $\mathrm{I}_{\mathrm{B}}$ | Base Current | 2 | A |
| $\mathrm{I}_{\mathrm{BM}}$ | Base Peak Current $\left(\mathrm{t}_{\mathrm{p}}<5 \mathrm{~ms}\right)$ | 4 | A |
| $\mathrm{P}_{\text {tot }}$ | Total Dissipation at $\mathrm{T}_{\mathrm{C}}=25^{\circ} \mathrm{C}$ | 70 | W |
| $\mathrm{~T}_{\text {stg }}$ | Storage Temperature | -65 to 150 | ${ }^{\circ} \mathrm{C}$ |
| $\mathrm{T}_{\mathrm{j}}$ | Max. Operating Junction Temperature | 150 | ${ }^{\circ} \mathrm{C}$ |

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## THERMAL DATA

| $\mathrm{R}_{\mathrm{th} j \text {-case }}$ | Thermal | Resistance Junction-Case | Max | 1.78 | ${ }^{\circ} \mathrm{C} / \mathrm{W}$ |
| :---: | :--- | :--- | :--- | :--- | :--- |
| $\mathrm{R}_{\mathrm{thj}-\mathrm{amb}}$ | Thermal | Resistance | Junction-Ambient | Max | 62.5 |

ELECTRICAL CHARACTERISTICS ( $\mathrm{T}_{\text {case }}=25^{\circ} \mathrm{C}$ unless otherwise specified)

| Symbol | Parameter | Test Conditions |  | Min. | Typ. | Max. | Unit |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Ices | Collector Cut-off Current ( V BE $=0 \mathrm{~V}$ ) | $\begin{aligned} & \mathrm{V}_{\mathrm{CE}}=700 \mathrm{~V} \\ & \mathrm{~V}_{\mathrm{CE}}=700 \mathrm{~V} \end{aligned}$ | $\mathrm{T}_{\mathrm{C}}=125{ }^{\circ} \mathrm{C}$ |  |  | $\begin{aligned} & 100 \\ & 500 \end{aligned}$ | $\begin{aligned} & \mu \mathrm{A} \\ & \mu \mathrm{~A} \end{aligned}$ |
| $I_{\text {CEE }}$ | Collector Cut-off Current ( $\mathrm{I}_{\mathrm{B}}=0$ ) | $\mathrm{V}_{\mathrm{CE}}=400 \mathrm{~V}$ |  |  |  | 250 | $\mu \mathrm{A}$ |
| $\mathrm{V}_{\text {(bR) }{ }^{\text {ebo }} \text { ( }}$ | Emitter-Base Breakdown Voltage $(\mathrm{IC}=0)$ | $\mathrm{I}_{\mathrm{E}}=10 \mathrm{~mA}$ |  | 9 |  | 18 | V |
| $\mathrm{V}_{\text {CEO }}$ (sus)* | Collector-Emitter Sustaining Voltage $\left(\mathrm{IB}_{\mathrm{B}}=0\right)$ | $\mathrm{IC}=100 \mathrm{~mA}$ | $\mathrm{L}=25 \mathrm{mH}$ | 400 |  |  | V |
| $\mathrm{V}_{\mathrm{CE} \text { (sat)* }}$ | Collector-Emitter Saturation Voltage | $\begin{aligned} & \mathrm{I}_{\mathrm{C}}=0.5 \mathrm{~A} \\ & \mathrm{I}=1 \mathrm{~A} \\ & \mathrm{I}=2.5 \mathrm{~A} \\ & \mathrm{I}=2 \mathrm{~A} \end{aligned}$ | $\begin{aligned} & \mathrm{I}_{\mathrm{B}}=0.1 \mathrm{~A} \\ & \mathrm{I}_{\mathrm{B}}=0.2 \mathrm{~A} \\ & \mathrm{I}_{\mathrm{B}}=0.5 \mathrm{~A} \\ & \mathrm{I}_{\mathrm{B}}=1 \mathrm{~A} \end{aligned}$ |  | 0.5 | $\begin{gathered} 0.7 \\ 1 \\ 1.5 \end{gathered}$ | $\begin{aligned} & \mathrm{V} \\ & \mathrm{~V} \\ & \mathrm{~V} \\ & \mathrm{~V} \end{aligned}$ |
| $\mathrm{V}_{\mathrm{BE}(\text { sat) }}{ }^{*}$ | Base-Emitter Saturation Voltage | $\begin{aligned} & \mathrm{I}_{\mathrm{C}}=0.5 \mathrm{~A} \\ & \mathrm{I}=1 \mathrm{~A} \\ & \mathrm{I}=2.5 \mathrm{~A} \end{aligned}$ | $\begin{aligned} & \mathrm{I}_{\mathrm{B}}=0.1 \mathrm{~A} \\ & \mathrm{I}_{\mathrm{B}}=0.2 \mathrm{~A} \\ & \mathrm{I}_{\mathrm{B}}=0.5 \mathrm{~A} \end{aligned}$ |  |  | $\begin{aligned} & 1.1 \\ & 1.2 \\ & 1.3 \end{aligned}$ | $\begin{aligned} & \mathrm{V} \\ & \mathrm{~V} \\ & \mathrm{~V} \end{aligned}$ |
| $\mathrm{h}_{\text {FE* }}$ | DC Current Gain | $\begin{aligned} & \mathrm{I}_{\mathrm{C}}=10 \mathrm{~mA} \\ & \mathrm{I}_{\mathrm{C}}=2 \mathrm{~A} \end{aligned}$ | $\begin{aligned} & \mathrm{V}_{\mathrm{CE}}=5 \mathrm{~V} \\ & \mathrm{~V}_{\mathrm{CE}}=5 \mathrm{~V} \end{aligned}$ | $\begin{aligned} & 10 \\ & 12 \end{aligned}$ |  | 32 |  |
| $V_{f}$ | Forward Voltage Drop | $\mathrm{I}_{\mathrm{f}}=2 \mathrm{~A}$ |  |  |  | 2.5 | V |
| $\begin{aligned} & \mathrm{t}_{\mathrm{s}} \\ & \mathrm{t}_{\mathrm{f}} \end{aligned}$ | INDUCTIVE LOAD <br> Storage Time Fall Time | $\begin{aligned} & \mathrm{V}_{\mathrm{CC}}=200 \mathrm{~V} \\ & \mathrm{I}_{\mathrm{B} 1}=0.4 \mathrm{~A} \\ & \mathrm{R}_{\mathrm{BB}}=0 \Omega \\ & (\text { see fig.1) } \end{aligned}$ | $\begin{aligned} & \mathrm{I} \mathrm{C}=2 \mathrm{~A} \\ & \mathrm{~V}_{\mathrm{BE}(\text { off })}=-5 \mathrm{~V} \\ & \mathrm{~L}=200 \mu \mathrm{H} \end{aligned}$ |  | $\begin{aligned} & 0.6 \\ & 0.1 \end{aligned}$ |  | $\begin{aligned} & \mu \mathrm{s} \\ & \mu \mathrm{~s} \end{aligned}$ |
| $\begin{aligned} & \mathrm{t}_{\mathrm{s}} \\ & \mathrm{t}_{\mathrm{f}} \end{aligned}$ | RESISTIVE LOAD <br> Storage Time <br> Fall Time | $\begin{aligned} & \mathrm{V}_{\mathrm{CC}}=250 \mathrm{~V} \\ & \mathrm{I}_{\mathrm{B} 1}=0.4 \mathrm{~A} \\ & \mathrm{~T}_{\mathrm{p}}=300 \mu \mathrm{~s} \end{aligned}$ | $\begin{aligned} & \mathrm{I}_{\mathrm{C}}=2 \mathrm{~A} \\ & \mathrm{I}_{\mathrm{B} 2}=-0.4 \mathrm{~A} \\ & (\text { see fig.2) } \end{aligned}$ | 2 | 0.2 | 2.9 | $\begin{aligned} & \mu \mathrm{s} \\ & \mu \mathrm{~s} \end{aligned}$ |

* Pulsed: Pulse duration = $300 \mu \mathrm{~s}$, duty cycle $1.5 \%$

Safe Operating Areas


DC Current Gain


Collector Emitter Saturation Voltage


## Derating Curve



DC Current Gain


Base Emitter Saturation Voltage


## Inductive Fall Time



Resistive Load Fall Time


Reverse Biased SOA


Inductive Storage Time


Resistive Load Storage Time


Figure 1: Inductive Load Switching Test Circuits.


Figure 2: Resistive Load Switching Test Circuits.


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TO-262 ( ${ }^{2}$ PAK) MECHANICAL DATA

| DIM. | mm |  |  | inch |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | 4.4 |  | 4.6 | 0.173 |  | 0.181 |
| A1 | 2.49 |  | 2.69 | 0.098 |  | 0.106 |
| B | 0.7 |  | 0.93 | 0.027 |  | 0.036 |
| B2 | 1.14 |  | 1.7 | 0.044 |  | 0.067 |
| C | 0.45 |  | 0.6 | 0.017 |  | 0.023 |
| C2 | 1.23 |  | 1.36 | 0.048 |  | 0.053 |
| D | 8.95 |  | 9.35 | 0.352 |  | 0.368 |
| e | 2.4 |  | 10.4 | 0.393 |  | 0.106 |
| E | 10 |  | 13.6 | 0.515 |  | 0.409 |
| L | 13.1 |  | 3.78 | 0.137 |  | 0.531 |
| L1 | 3.48 |  | 1.4 | 0.050 |  | 0.149 |
| L2 | 1.27 |  |  |  | 0.055 |  |



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