BUH1215

## HIGH VOLTAGE FAST-SWITCHING NPN POWER TRANSISTOR

- STMicroelectronics PREFERRED SALESTYPE
- HIGH VOLTAGE CAPABILITY
- VERY HIGH SWITCHING SPEED


## APPLICATIONS:

- HORIZONTAL DEFLECTION FOR COLOUR TV AND MONITORS


## DESCRIPTION

The BUH1215 is manufactured using Multiepitaxial Mesa technology for cost-effective high performance and uses a Hollow Emitter structure to enhance switching speeds.
The BUH series is designed for use in horizontal deflection circuits in televisions and monitors.


ABSOLUTE MAXIMUM RATINGS

| Symbol | Parameter | Value | Unit |
| :---: | :--- | :---: | :---: |
| $\mathrm{V}_{\text {CBO }}$ | Collector-Base Voltage $\left(\mathrm{I}_{\mathrm{E}}=0\right)$ | 1500 | V |
| $\mathrm{~V}_{\text {CEO }}$ | Collector-Emitter Voltage $\left(\mathrm{I}_{\mathrm{B}}=0\right)$ | 700 | V |
| $\mathrm{~V}_{\text {EBO }}$ | Emitter-Base Voltage $\left(\mathrm{I}_{\mathrm{C}}=0\right)$ | 10 | V |
| $\mathrm{I}_{\mathrm{C}}$ | Collector Current | 16 | A |
| $\mathrm{I}_{\mathrm{CM}}$ | Collector Peak Current $\left(\mathrm{t}_{\mathrm{p}}<5 \mathrm{~ms}\right)$ | 22 | A |
| $\mathrm{I}_{\mathrm{B}}$ | Base Current | 9 | A |
| $\mathrm{I}_{\mathrm{BM}}$ | Base Peak Current $\left(\mathrm{t}_{\mathrm{p}}<5 \mathrm{~ms}\right)$ | 12 | A |
| $\mathrm{P}_{\text {tot }}$ | Total Dissipation at $\mathrm{T}_{\mathrm{C}}=25^{\circ} \mathrm{C}$ | 200 | W |
| $\mathrm{~T}_{\text {stg }}$ | Storage Temperature | -65 to 150 | ${ }^{\circ} \mathrm{C}$ |
| $\mathrm{T}_{\mathrm{j}}$ | Max. Operating Junction Temperature | 150 | ${ }^{\circ} \mathrm{C}$ |

## THERMAL DATA

| $\mathrm{R}_{\mathrm{thj} \text {-case }}$ | Thermal Resistance Junction-case | Max | 0.63 | ${ }^{\circ} \mathrm{C} / \mathrm{W}$ |
| :--- | :--- | :--- | :--- | :--- |

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 $=0$ ) | $\begin{array}{ll} \mathrm{V}_{C E}=1500 \mathrm{~V} & \\ \mathrm{~V}_{C E}=1500 \mathrm{~V} & \mathrm{~T}_{\mathrm{j}}=125^{\circ} \mathrm{C} \end{array}$ |  |  | $\begin{gathered} 0.2 \\ 2 \end{gathered}$ | $\begin{aligned} & \mathrm{mA} \\ & \mathrm{~mA} \end{aligned}$ |
| Iebo | Emitter Cut-off Current ( $\mathrm{IC}_{\mathrm{C}}=0$ ) | $\mathrm{V}_{\text {Eb }}=5 \mathrm{~V}$ |  |  | 100 | $\mu \mathrm{A}$ |
| $\mathrm{V}_{\text {ceo (sus) }}$ | Collector-Emitter Sustaining Voltage | $\mathrm{IC}=100 \mathrm{~mA}$ | 700 |  |  | V |
| $V_{\text {ebo }}$ | Emitter-Base Voltage ( $\mathrm{IC}=0$ ) | $\mathrm{I}_{\mathrm{E}}=10 \mathrm{~mA}$ | 10 |  |  | V |
| $\mathrm{V}_{\text {CE(sat)* }}$ | Collector-Emitter Saturation Voltage | $\mathrm{I}_{\mathrm{C}}=12 \mathrm{~A} \quad \mathrm{I}_{\mathrm{B}}=2.4 \mathrm{~A}$ |  |  | 1.5 | V |
| $\mathrm{V}_{\mathrm{BE}(\text { (sat)* }}$ | Base-Emitter Saturation Voltage | $\mathrm{I}_{\mathrm{C}}=12 \mathrm{~A} \quad \mathrm{I}_{\mathrm{B}}=2.4 \mathrm{~A}$ |  |  | 1.5 | V |
| $h_{\text {FE* }}$ | DC Current Gain | $\begin{array}{\|lll} \hline I_{C}=12 \mathrm{~A} & V_{C E}=5 \mathrm{~V} & \\ \mathrm{I}_{\mathrm{C}}=12 \mathrm{~A} & \mathrm{~V}_{\mathrm{CE}}=5 \mathrm{~V} & \mathrm{~T}_{\mathrm{j}}=10{ }^{\circ} \mathrm{C} \\ \hline \end{array}$ | $\begin{aligned} & 7 \\ & 5 \end{aligned}$ | 10 | 14 |  |
| $\begin{aligned} & \mathrm{t}_{\mathrm{s}} \\ & \mathrm{t}_{\mathrm{f}} \end{aligned}$ | RESISTIVE LOAD <br> Storage Time <br> Fall Time | $\begin{array}{ll} \hline \mathrm{V}_{\mathrm{CC}}=400 \mathrm{~V} & \mathrm{I}_{\mathrm{C}}=12 \mathrm{~A} \\ \mathrm{I}_{\mathrm{B} 1}=2 \mathrm{~A} & \mathrm{I}_{\mathrm{B} 2}=-6 \mathrm{~A} \end{array}$ |  | $\begin{array}{r} 1.5 \\ 110 \end{array}$ |  | $\begin{aligned} & \mu \mathrm{s} \\ & \mathrm{~ns} \end{aligned}$ |
| $\begin{aligned} & \mathrm{t}_{\mathrm{s}} \\ & \mathrm{tf}_{\mathrm{f}} \end{aligned}$ | INDUCTIVE LOAD <br> Storage Time Fall Time | $\begin{aligned} & \mathrm{I}_{\mathrm{C}}=12 \mathrm{~A} \quad \mathrm{f}=31250 \mathrm{~Hz} \\ & \mathrm{I}_{\mathrm{B} 1}=2 \mathrm{~A} \quad \quad \mathrm{I}_{\mathrm{B} 2}=-1.5 \mathrm{~A} \\ & \mathrm{~V}_{\text {ceflyback }}=1050 \sin \left(\frac{\pi}{5} 10^{6}\right) \mathrm{t} \end{aligned}$ |  | $\begin{gathered} 4 \\ 220 \end{gathered}$ |  | $\begin{aligned} & \mu \mathrm{s} \\ & \mathrm{~ns} \end{aligned}$ |
| $\begin{aligned} & \mathrm{t}_{\mathrm{s}} \\ & \mathrm{t}_{\mathrm{f}} \end{aligned}$ | INDUCTIVE LOAD <br> Storage Time <br> Fall Time | $\begin{array}{lc} \mathrm{IC}=6 \mathrm{~A} & \mathrm{f}=64 \mathrm{KHz} \\ \mathrm{I}_{\mathrm{B} 1}=1 \mathrm{~A} & \mathrm{~V} \quad \mathrm{BE}(\text { off })=-2 \mathrm{~A} \\ \mathrm{~V}_{\text {ceflyback }}=1200 & \sin \left(\frac{\pi}{5} 10^{6}\right) \mathrm{t} \quad \mathrm{~V} \end{array}$ |  | $\begin{aligned} & 3.5 \\ & 180 \end{aligned}$ |  | $\begin{aligned} & \mu \mathrm{s} \\ & \mathrm{~ns} \end{aligned}$ |

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

Safe Operating Area


Thermal Impedance


Derating Curve


Collector Emitter Saturation Voltage


Power Losses at 64 KHz


DC Current Gain


Base Emitter Saturation Voltage


Switching Time Inductive Load at 64 KHz (see figure 2)


GII

Reverse Biased SOA


## BASE DRIVE INFORMATION

In order to saturate the power switch and reduce conduction losses, adequate direct base current $\mathrm{I}_{\mathrm{B} 1}$ has to be provided for the lowest gain $\mathrm{h}_{\text {FE }}$ at $100{ }^{\circ} \mathrm{C}$ (line scan phase). On the other hand, negative base current $\mathrm{I}_{\mathrm{B} 2}$ must be provided the transistor to turn off (retrace phase).
Most of the dissipation, especially in the deflection application, occurs at switch-off so it is essential to determine the value of $\mathrm{I}_{\mathrm{B} 2}$ which minimizes power losses, fall time $t_{f}$ and, consequently, $\mathrm{T}_{\mathrm{j}}$. A new set of curves have been defined to give total power losses, $\mathrm{ts}_{\mathrm{s}}$ and $\mathrm{t}_{\mathrm{f}}$ as a function of $\mathrm{l}_{\mathrm{B} 1}$ at 64 KHz scanning frequencies for
choosing the optimum negative drive. The test circuit is illustrated in figure 1.
The values of $L$ and $C$ are calculated from the following equations:
$\frac{1}{2} L(I C)^{2}=\frac{1}{2} C\left(V_{C E f l y}\right)^{2}$
$\omega=2 \pi f=\frac{1}{\sqrt{L C}}$
Where $\mathrm{I}_{\mathrm{C}}=$ operating collector current, $\mathrm{V}_{\text {CEfly }}=$ flyback voltage, $f=$ frequency of oscillation during retrace.

Figure 1: Inductive Load Switching Test Circuits.


Figure 2: Switching Waveforms in a Deflection Circuit


| TO-218 (SOT-93) MECHANICAL DATA |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| DIM. | mm |  |  | inch |  |  |
|  | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | 4.7 |  | 4.9 | 0.185 |  | 0.193 |
| C | 1.17 |  | 1.37 | 0.046 |  | 0.054 |
| D |  | 2.5 |  |  | 0.098 |  |
| E | 0.5 |  | 0.78 | 0.019 |  | 0.030 |
| F | 1.1 |  | 1.3 | 0.043 |  | 0.051 |
| G | 10.8 |  | 11.1 | 0.425 |  | 0.437 |
| H | 14.7 |  | 15.2 | 0.578 |  | 0.598 |
| L2 | - |  | 16.2 | - |  | 0.637 |
| L3 |  | 18 |  |  | 0.708 |  |
| L5 | 3.95 |  | 4.15 | 0.155 |  | 0.163 |
| L6 |  | 31 |  |  | 1.220 |  |
| R | - |  | 12.2 | - |  | 0.480 |
| $\varnothing$ | 4 |  | 4.1 | 0.157 |  | 0.161 |



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