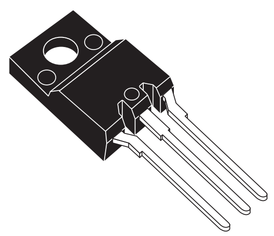
# BUH315DFH

## HIGH VOLTAGE FAST-SWITCHING NPN POWER TRANSISTOR

- NEW Fully Plastic TO-220 for HIGH VOLTAGE APPLICATIONS
- HIGH VOLTAGE CAPABILITY ( > 1500 V )
- FULLY INSULATED PACKAGE (U.L. COMPLIANT) FOR EASY MOUNTING
- NPN TRANSISTOR WITH INTEGRATED FREEWHEELING DIODE
- CREEPAGE DISTANCE PATH > 4 mm



TO-220FH

### APPLICATIONS

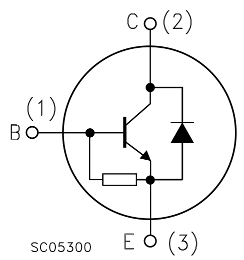
- HORIZONTAL DEFLECTION FOR COLOUR TVS

### DESCRIPTION

The device 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.

### INTERNAL SCHEMATIC DIAGRAM




### ABSOLUTE MAXIMUM RATINGS

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_{CBO}$ | Collector-Base Voltage ($I_E$ = 0) | 1500 | V |
| $V_{CEO}$ | Collector-Emitter Voltage ($I_B$ = 0) | 700 | V |
| $V_{EBO}$ | Emitter-Base Voltage ($I_C$ = 0) | 10 | V |
| $I_C$ | Collector Current | 6 | A |
| $I_{CM}$ | Collector Peak Current ($t_p$ < 5 ms) | 12 | A |
| $I_B$ | Base Current | 3 | A |
| $I_{BM}$ | Base Peak Current ($t_p$ < 5 ms) | 5 | A |
| $P_{tot}$ | Total Dissipation at $T_c$ = 25 $^o$C | 40 | W |
| $V_{isol}$ | Insulation Withstand Voltage (RMS) from All Three Leads to Exernal Heatsink | 2500 | V |
| $T_{stg}$ | Storage Temperature | -65 to 150 | $^o$C |
| $T_j$ | Max. Operating Junction Temperature | 150 | $^o$C |

## THERMAL DATA

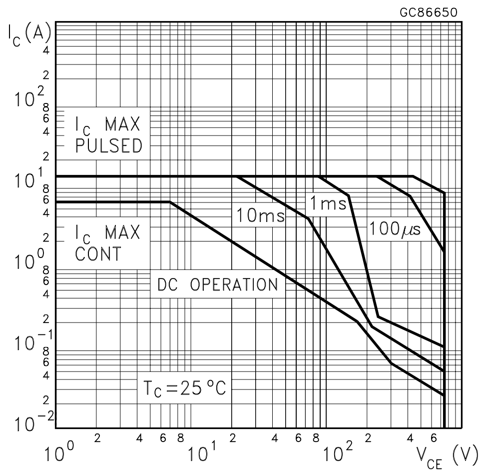
| | | | | |
|---|---|---|---|---|
| $R_{thj\text{-}case}$ | Thermal Resistance Junction-case | Max | 3.125 | $^oC/W$ |

## ELECTRICAL CHARACTERISTICS ($T_{case}$ = 25 $^oC$ unless otherwise specified)

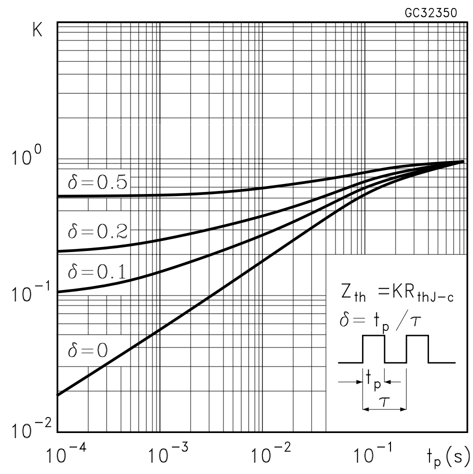
| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $I_{CES}$ | Collector Cut-off Current ($V_{BE}$ = 0) | $V_{CE}$ = 1500 V | | | 200 | µA |
| $I_{EBO}$ | Emitter Cut-off Current ($I_C$ = 0) | $V_{EB}$ = 5 V | | | 300 | mA |
| $V_{CE(sat)}$∗ | Collector-Emitter Saturation Voltage | $I_C$ = 3 A $I_B$ = 1 A | | | 1.5 | V |
| $V_{BE(sat)}$∗ | Base-Emitter Saturation Voltage | $I_C$ = 3 A $I_B$ = 1 A | | | 1.5 | V |
| $h_{FE}$∗ | DC Current Gain | $I_C$ = 3 A $V_{CE}$ = 5 V<br>$I_C$ = 3 A $V_{CE}$ = 5 V $T_j$ = 100 $^oC$ | 4<br>2.5 | | 9 | |
| $t_s$<br>$t_f$ | RESISTIVE LOAD<br>Storage Time<br>Fall Time | $V_{CC}$ = 400 V $I_C$ = 3 A<br>$I_{B1}$ = 1 A $I_{B2}$ = -1.5 A | | 1.8<br>200 | 2.7<br>300 | µs<br>ns |
| $t_s$<br>$t_f$ | INDUCTIVE LOAD<br>Storage Time<br>Fall Time | $I_C$ = 3 A f = 15625 Hz<br>$I_{B1}$ = 1 A $I_{B2}$ = 1.5 A<br>$V_{ceflyback} = 1050 \sin\left(\frac{\pi}{5}10^6\right)t$ V | | 2.7<br>350 | | µs<br>ns |
| $V_F$ | Diode Forward Voltage | $I_F$ = 3 A | | | 2.5 | V |

∗ Pulsed: Pulse duration = 300 µs, duty cycle 1.5 %

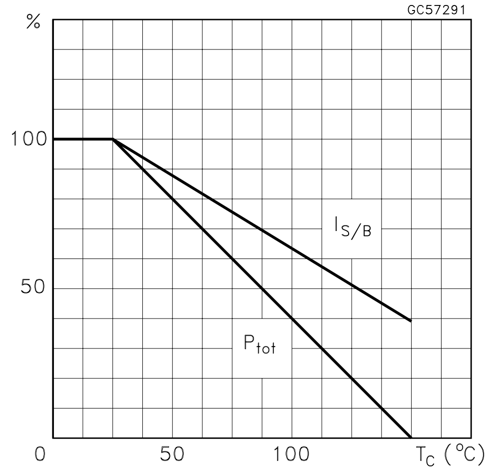
Safe Operating Area



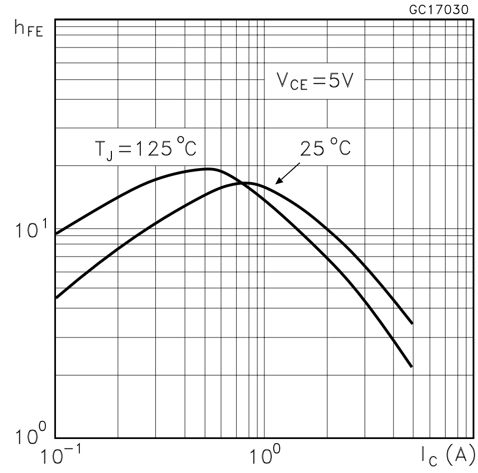

Thermal Impedance



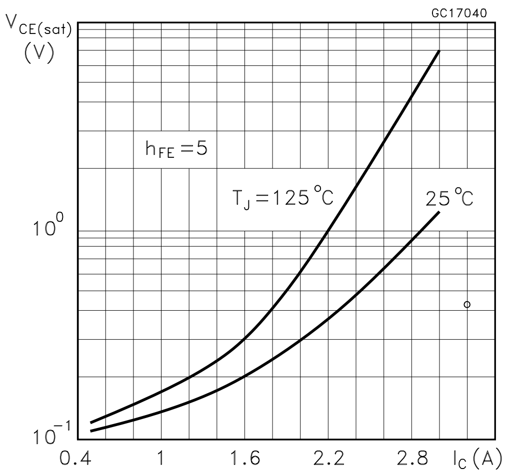
Derating Curve



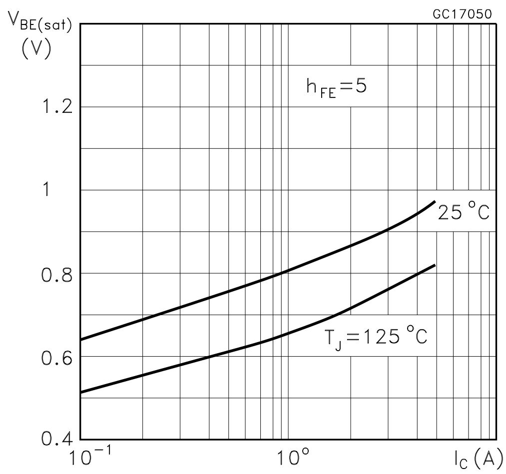

DC Current Gain



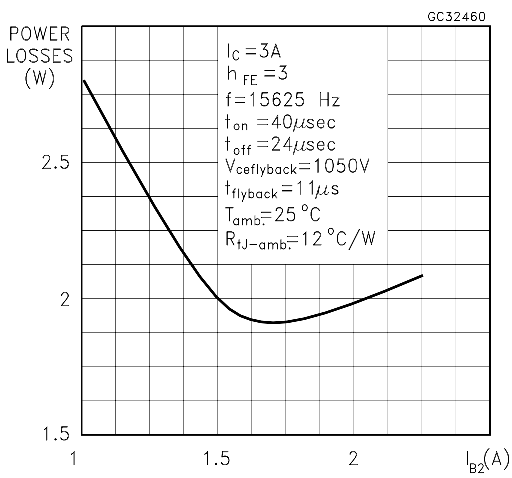

Collector Emitter Saturation Voltage



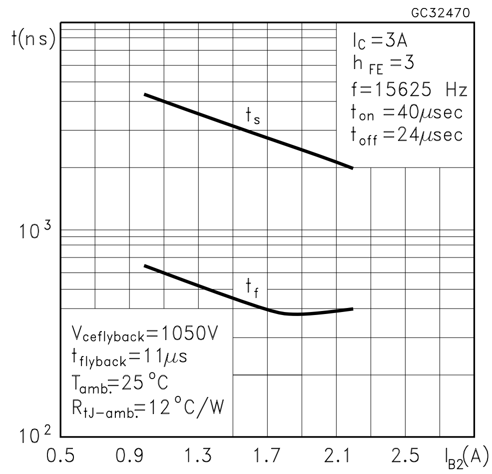

Base Emitter Saturation Voltage



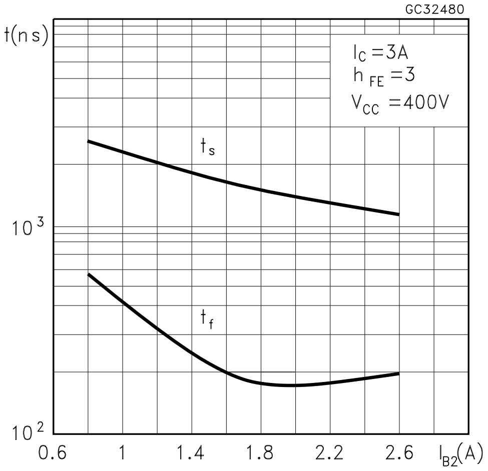

Power Losses at 16 KHz




Switching Time Inductive Load at 16KHz (see figure 2)



Switching Time Resistive Load at 16 KHz




## BASE DRIVE INFORMATION

In order to saturate the power switch and reduce conduction losses, adequate direct base current $I_{B1}$ has to be provided for the lowest gain $h_{FE}$ at 100 $^{o}$C (line scan phase). On the other hand, negative base current $I_{B2}$ must be provided to turn off the power transistor (retrace phase).

Most of the dissipation, in the deflection application, occurs at switch-off. Therefore it is essential to determine the value of $I_{B2}$ which minimizes power losses, fall time $t_f$ and, consequently, $T_j$. A new set of curves have been defined to give total power losses, $t_s$ and $t_f$ as a function of $I_{B2}$ at 16 KHz scanning frequencies the optimum negative drive. The test circuit is illustrated in fig. 1.

Inductance $L_1$ serves to control the slope of the negative base current $I_{B2}$ to recombine the excess carrier in the collector when base current is still present, this would avoid any tailing phenomenon in the collector current.

The values of L and C are calculated from the following equations:

$$\frac{1}{2} L\,(I_C)^2 = \frac{1}{2} C\,(V_{CEfly})^2$$

$$\omega = 2\,\pi f = \frac{1}{\sqrt{L\,C}}$$

Where $I_C$= operating collector current, $V_{CEfly}$= flyback voltage, f= frequency of oscillation during retrace.

**Figure 1:** Inductive Load Switching Test Circuits.

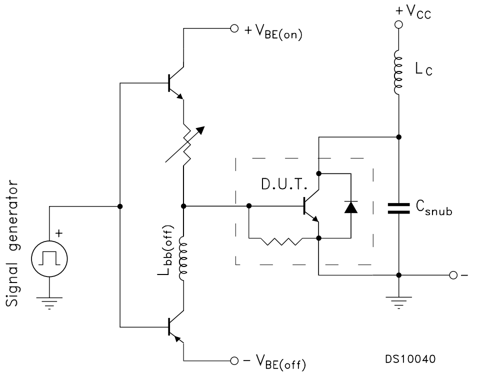
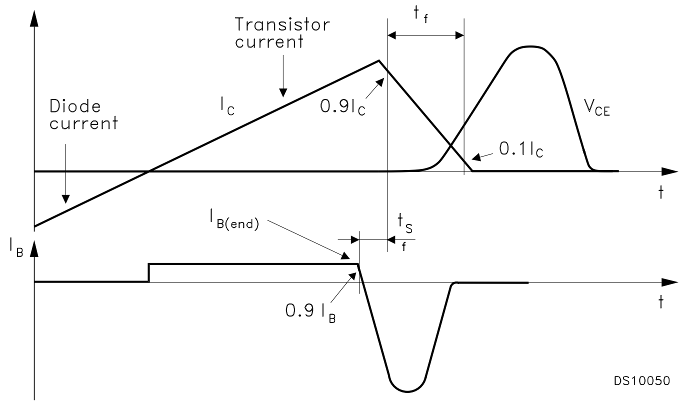
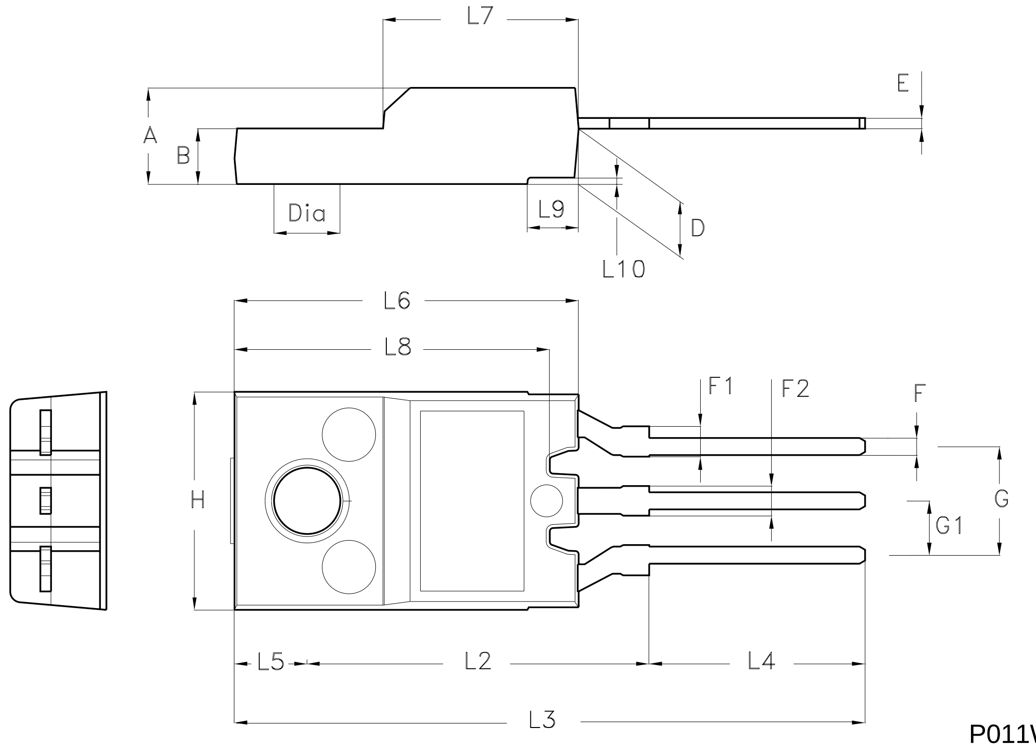



**Figure 2:** Switching Waveforms in a Deflection Circuit



# TO-220FH (Fully plastic High voltage) MECHANICAL DATA

| DIM. | mm | | | inch | | |
|---|---|---|---|---|---|---|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | 4.4 | | 4.6 | 0.173 | | 0.181 |
| B | 2.5 | | 2.7 | 0.098 | | 0.106 |
| D | 2.5 | | 2.75 | 0.098 | | 0.108 |
| E | 0.45 | | 0.7 | 0.017 | | 0.027 |
| F | 0.75 | | 1 | 0.030 | | 0.039 |
| F1 | 1.3 | | 1.8 | 0.051 | | 0.070 |
| F2 | 1.3 | | 1.8 | 0.051 | | 0.070 |
| G | 4.95 | | 5.2 | 0.195 | | 0.204 |
| G1 | 2.4 | | 2.7 | 0.094 | | 0.106 |
| H | 10 | | 10.4 | 0.393 | | 0.409 |
| L2 | | 16 | | | 0.630 | |
| L3 | 28.6 | | 30.6 | 1.126 | | 1.204 |
| L4 | 9.8 | | 10.6 | 0.385 | | 0.417 |
| L5 | | 3.4 | | | 0.134 | |
| L6 | 15.9 | | 16.4 | 0.626 | | 0.645 |
| L7 | 9 | | 9.3 | 0.354 | | 0.366 |
| L8 | 14.5 | | 15 | 0.570 | | 0.590 |
| L9 | | 2.4 | | | 0.094 | |

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