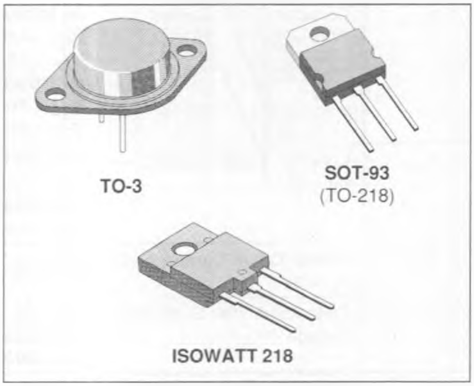
SGS-THOMSON
MICROELECTRONICS

BU931R/RP/RPFI
BU932R/RP/RPFI

NPN POWER DARLINGTON

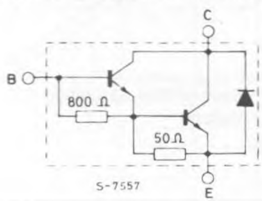
- AUTOMOTIVE MARKET
- HIGH PERFORMANCE ELECTRONIC IGNITION DARLINGTON
- HIGH RUGGEDNESS



DESCRIPTION

These devices are multiepitaxial biplanar NPN transistors in monolithic darlington configuration mounted in TO-3, SOT-93 and ISOWATT218 packages. They are specially intended for automotive ignition applications and invertes circuits for motor controls. Controlled performances in the linear region make them particularly suitable for car ignitions where current limiting is achieved desaturing the darlington.

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

<table>
<tr><th rowspan="2">Symbol</th><th>Parameter</th><th colspan="6">Value</th><th rowspan="2">Unit</th></tr>
<tr><th>TO-3
SOT-93
ISOWATT218</th><th colspan="3">BU931R
BU931RP
BU931RPFI</th><th colspan="3">BU932R
BU932RP
BU932RPFI</th></tr>
<tr><td>V_{CES}</td><td>Collector-emitter Voltage (V_{BE} = 0)</td><td colspan="3">450</td><td colspan="3">500</td><td>V</td></tr>
<tr><td>V_{CEO}</td><td>Collector-emitter Voltage (I_{BE} = 0)</td><td colspan="3">400</td><td colspan="3">450</td><td>V</td></tr>
<tr><td>V_{EBO}</td><td>Emitter-base Voltage (I_C = 0)</td><td colspan="6">5</td><td>V</td></tr>
<tr><td>I_C</td><td>Collector Current</td><td colspan="6">15</td><td>A</td></tr>
<tr><td>I_{CM}</td><td>Collector Peak Current ($t_p \leq 10$ ms)</td><td colspan="6">30</td><td>A</td></tr>
<tr><td>I_B</td><td>Base Current</td><td colspan="6">1</td><td>A</td></tr>
<tr><td>I_{BM}</td><td>Base Peak Current ($t_p \leq$ 10 ms)</td><td colspan="6">5</td><td>A</td></tr>
<tr><td></td><td></td><td colspan="2">TO-3</td><td colspan="2">SOT-93</td><td colspan="2">ISOWATT218</td><td></td></tr>
<tr><td>P_{tot}</td><td>Total Dissipation at $T_C \leq 25°C$</td><td colspan="2">175</td><td colspan="2">125</td><td colspan="2">60</td><td>W</td></tr>
<tr><td>T_{stg}</td><td>Storage Temperature</td><td colspan="2">– 40 to 200</td><td colspan="2">– 40 to 150</td><td colspan="2">– 40 to 150</td><td>°C</td></tr>
<tr><td>T_J</td><td>Max. Operating Junction Temperature</td><td colspan="2">200</td><td colspan="2">150</td><td colspan="2">150</td><td>°C</td></tr>
</table>

THERMAL DATA

			TO-3	SOT-93	ISOWATT218	
$R_{th\ j-case}$	Thermal Resistance Junction-case	Max	1	1	2.08•	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

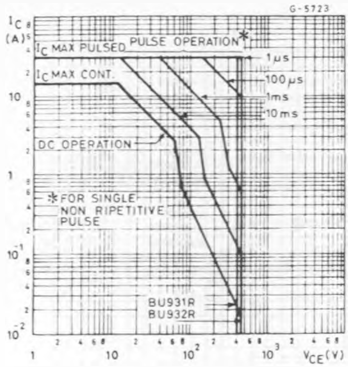
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cutoff Current (V_{BE} = 0)	for **BU931R/BU931RP/BU931RPFI** V_{CE} = 450 V V_{CE} = 450 V T_c = 125 °C for **BU932R/BU932RP/BU932RPFI** V_{CE} = 500 V V_{CE} = 500 V T_c = 125 °C			 1 5 1 5	 mA mA mA mA
I_{CEO}	Collector Cutoff Current (I_B = 0)	for **BU931R/BU931RP/BU931RPFI** V_{CE} = 400 V for **BU932R/BU932RP/BU932RPFI** V_{CE} = 450 V			 1 1	 mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			50	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage	I_C = 100 mA for **BU931R/BU931RP/BU931RPFI** for **BU932R/BU932RP/BU932RPFI**	 400 450			 V V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	for **BU931R/BU931RP/BU931RPFI** I_C = 7 A I_B = 70 mA I_C = 8 A I_B = 100 mA I_C = 10 A I_B = 250 mA for **BU932R/BU932RP/BU932RPFI** I_C = 8 A I_B = 150 mA		 1.05 1.09 1.13 1.09	 1.6 1.8 1.8 1.8	 V V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	for **BU932R5BU932RP/BU932RPFI** I_C = 8 A I_B = 100 mA I_C = 10 A I_B = 250 mA for **BU932R/BU932RP/BU932RPFI** I_C = 8 A I_B = 150 mA		 1.75 1.92 1.77	 2.2 2.5 2.2	 V V V
h_{FE}*	DC Current Gain	I_C = 5 A V_{CE} = 10 V	300			
V_F*	Diode Forward Voltage	I_F = 10 A		1.43	2.8	V
	USE TEST (see fig. 2)	V_{CC} = 24 V V_{clamp} = 400 V L = 7 mH	8			A

INDUCTIVE LOAD

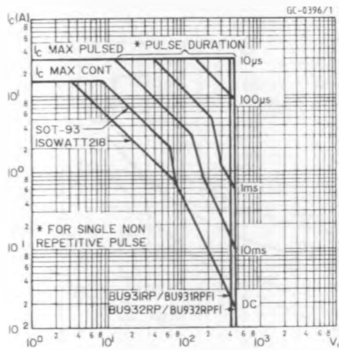
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
  t_s t_f	 (see fig. 3) Storage Time Fall Time	V_{CC} = 12 V V_{clamp} = 300 V L = 7 mH I_C = 7 A I_B = 70 mA V_{BE} = 0 R_{BE} = 47 Ω		 15 0.5		 μs μs

* Pulsed : pulse duration = 300 μs, duty cycle = 1.5 %.

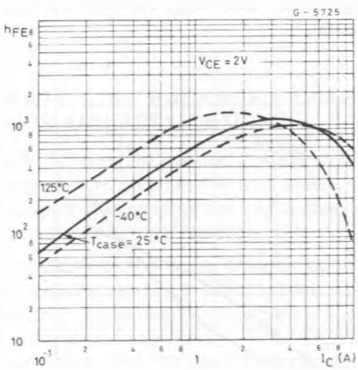
Safe Operating Areas.



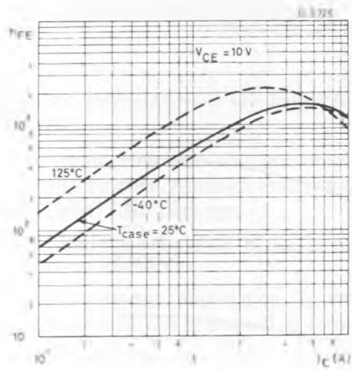
Safe Operating Areas.



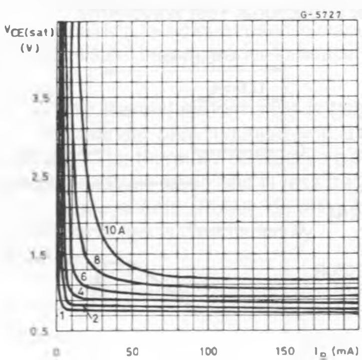
DC Current Gain.



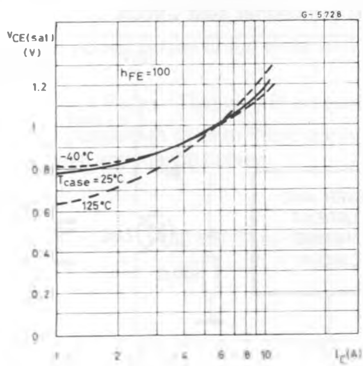
DC Current Gain.



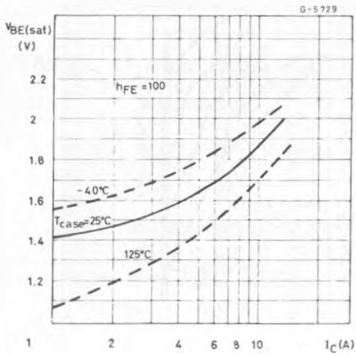
Collector-emitter Saturation Voltage.



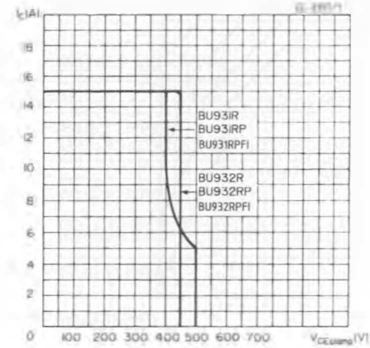
Collector-emitter Saturation Voltage.



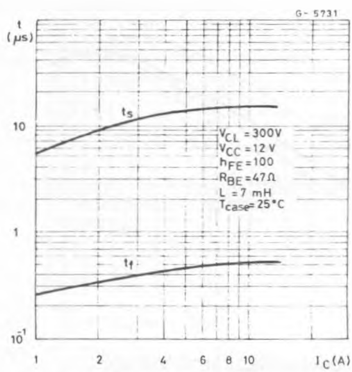
Base-emitter Saturation Voltage.



Clamped Reverse Bias Safe Operating Areas (see fig. 4).



Saturated Switching Characteristics (inductive load) (see fig. 3).



Switching Times Percentage Variation vs. T_{case} Inductive Load.

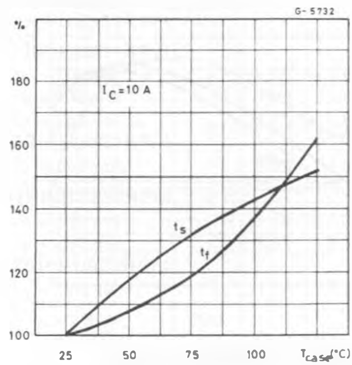


Figure 1: Functional Test Circuit.

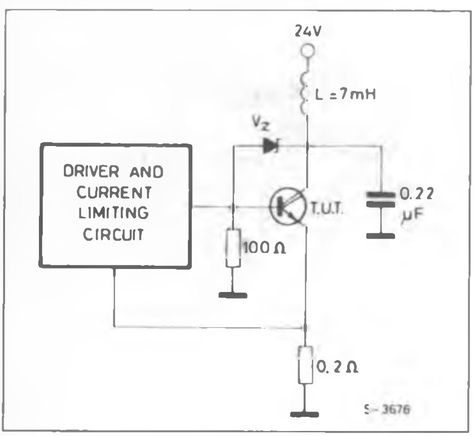


Figure 2 : Functional Test Waveforms.

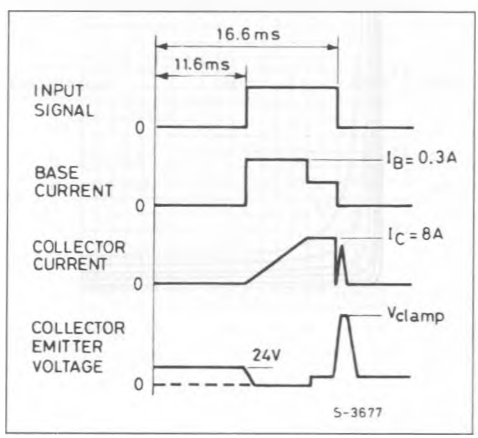


Figure 3 : Switching Times Test Circuit.

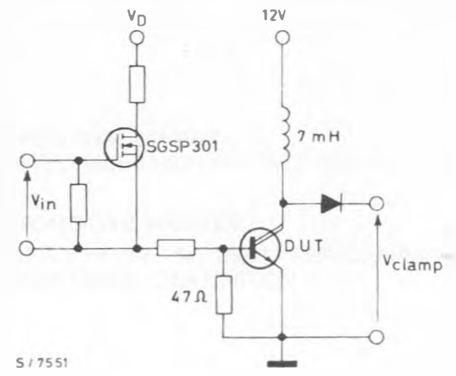
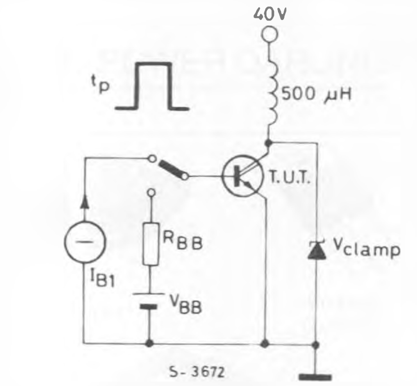


Figure 4 : Clamped $E_{s/b}$ Test Circuit.



Test conditions :
$5\ V > |-V_{BB}| > 0$
$I_C/I_B = 40$
$2\ I_{B1} > |-I_{B2}| > I_{B1}$
t_p = adjusted for nominal I_C
$R_{BB} = 1\ \Omega$

ISOWATT 218 PACKAGE CHARACTERISTICS AND APPLICATION

ISOWATT218 is fully isolated to 4000 V dc. Its thermal impedance, given in the data sheet, is optimised to give efficient thermal conduction together with excellent electrical isolation.

The structure of the case ensures optimum distances between the pins and heatsink. These distances are in agreement with VDE and UL creepage and clearance standards. The ISOWATT218 package eliminates the need for external isolation so reducing fixing hardware.

The package is supplied with leads longer than the standard TO-218 to allow easy mounting on pcbs. Accurate moulding techniques used in manufacture assures consistent heat spreader-to-heatsink capacitance.

ISOWATT218 thermal performance is better than that of the standard part, mounted with a 0.1 mm mica washer. The thermally conductive plastic has a higher breakdown rating and is less fragile than mica or plastic sheets. Power derating for ISOWATT218 packages is determined by :

$$P_D = \frac{T_j - T_c}{R_{th}}$$

THERMAL IMPEDANCE OF ISOWATT 218 PACKAGE

Fig. 5 illustrates the elements contributing to the thermal resistance of transistor heatsink assembly, using ISOWATT218 package.

The total thermal resistance $R_{th(tot)}$ is the sum of each of these elements.

The transient thermal impedance, Z_{th} for different pulse durations can be estimated as follows :

1. for a short duration power pulse less than 1 ms ;

$$Z_{th} < R_{thJ\text{-}C}$$

2. for an intermediate power pulse of 5 ms to 50 ms ;

$$Z_{th} = R_{thJ\text{-}C}$$

3. for long power pulses of the order of 500 ms or greater :

$$Z_{th} = R_{thJ\text{-}C} + R_{thC\text{-}HS} + R_{thHS\text{-}amb}$$

It is often possible to discern these areas on transient thermal impedance curves.

Figure 5