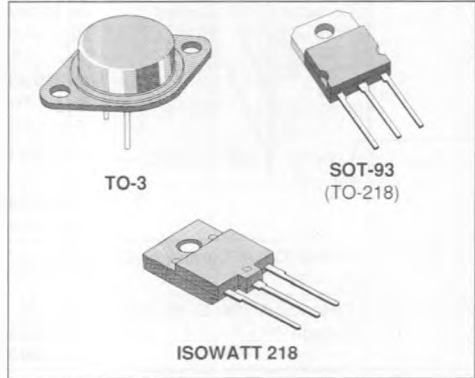


## NPN POWER DARLINGTON

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

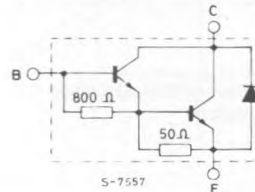
ELECTRONIC



### DESCRIPTION

These devices are multi-epitaxial 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 inverters circuits for motor controls. Controlled performances in the linear region make them particularly suitable for car ignitions where current limiting is achieved desaturating the darlington.

### INTERNAL SCHEMATIC DIAGRAM



### ABSOLUTE MAXIMUM RATINGS

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

**THERMAL DATA**

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

**ELECTRICAL CHARACTERISTICS** ( $T_{case} = 25\text{ °C}$  unless otherwise specified)

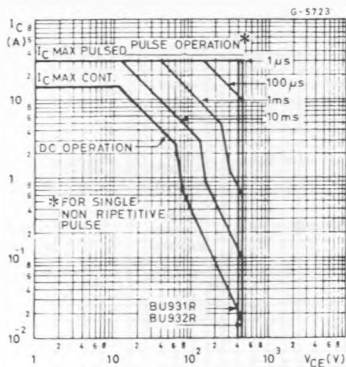
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$I_{CES}$	Collector Cutoff Current ( $V_{BE} = 0$ )	for <b>BU931R/BU931RP/BU931RPFI</b> $V_{CE} = 450\text{ V}$			1	mA
		$V_{CE} = 450\text{ V}$ $T_C = 125\text{ °C}$ for <b>BU932R/BU932RP/BU932RPFI</b> $V_{CE} = 500\text{ V}$			5	mA
$I_{CEO}$	Collector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

**INDUCTIVE LOAD**

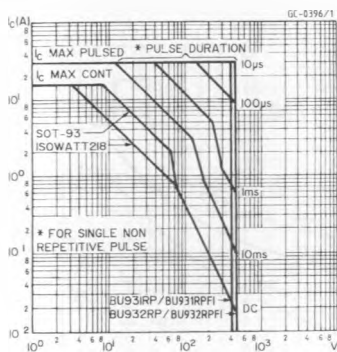
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_s$	(see fig. 3) Storage Time	$V_{CC} = 12\text{ V}$ $V_{clamp} = 300\text{ V}$ $L = 7\text{ mH}$				
		$I_C = 7\text{ A}$ $I_B = 70\text{ mA}$		15		$\mu\text{s}$
$t_f$	Fall Time	$V_{BE} = 0$ $R_{BE} = 47\text{ }\Omega$		0.5		$\mu\text{s}$

\* Pulsed : pulse duration = 300  $\mu\text{s}$ , duty cycle = 1.5 %.

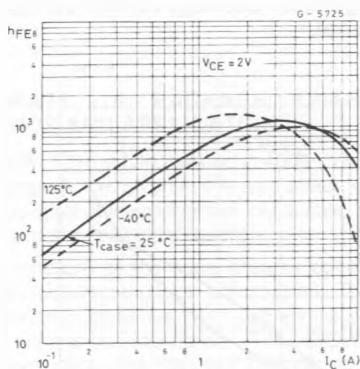
Safe Operating Areas.



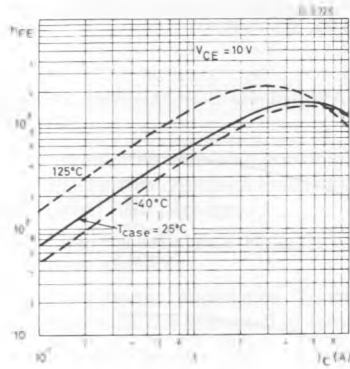
Safe Operating Areas.



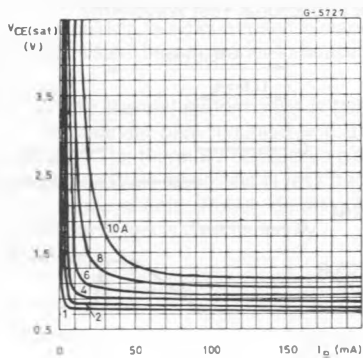
DC Current Gain.



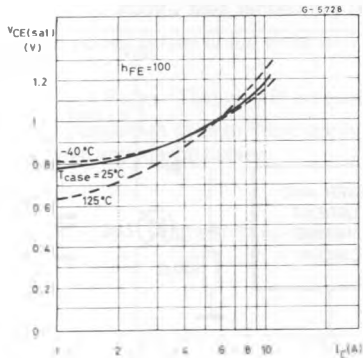
DC Current Gain.



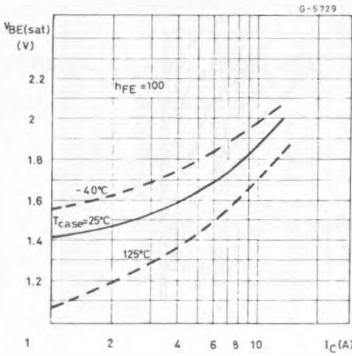
Collector-emitter Saturation Voltage.



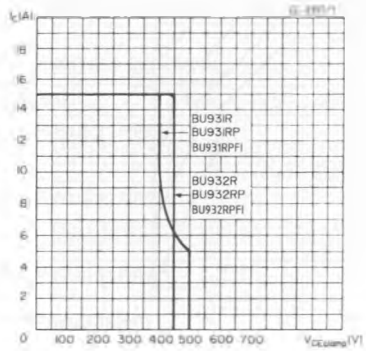
Collector-emitter Saturation Voltage.



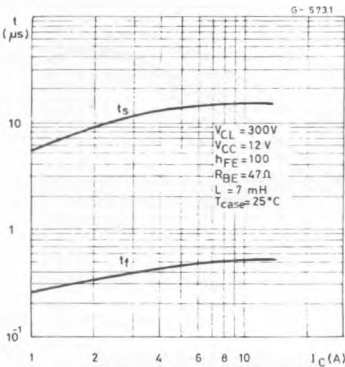
Base-emitter Saturation Voltage.



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.

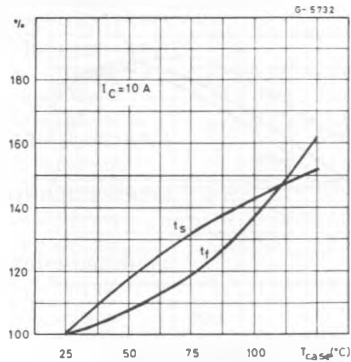


Figure 1: Functional Test Circuit.

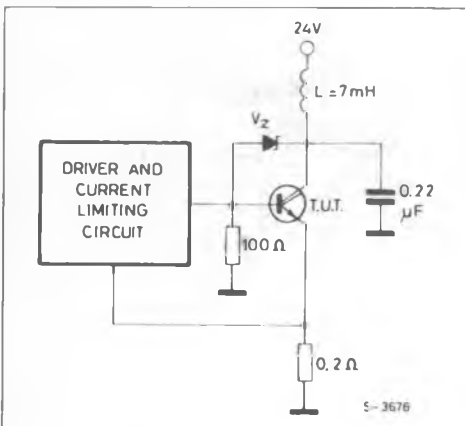


Figure 2 : Functional Test Waveforms.

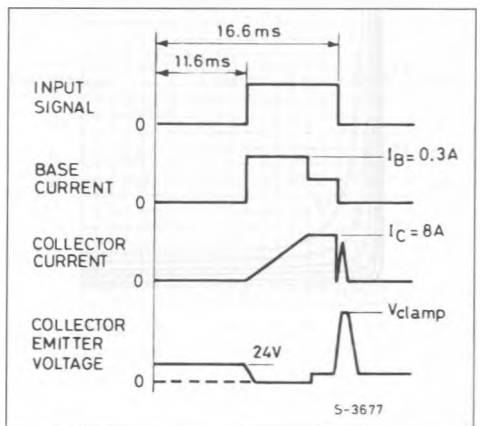


Figure 3 : Switching Times Test Circuit.

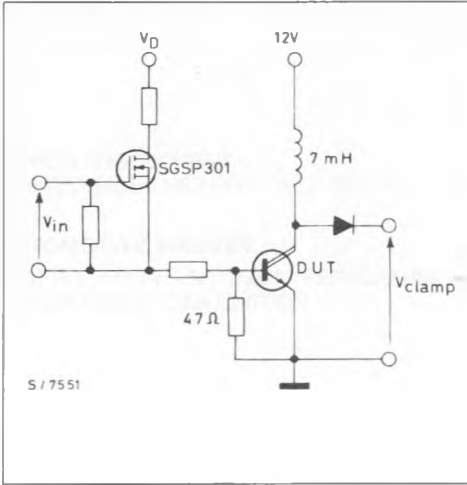
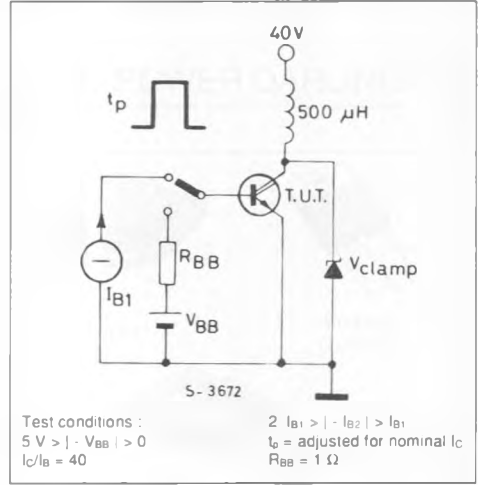


Figure 4 : Clamped E<sub>s</sub>b Test Circuit.



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

**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 ;  
 $Z_{th} < R_{thJ-C}$
2. for an intermediate power pulse of 5 ms to 50 ms ;  
 $Z_{th} = R_{thJ-C}$
3. for long power pulses of the order of 500 ms or greater :

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

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

Figure 5

