SGS-THOMSON
MICROELECTRONICS

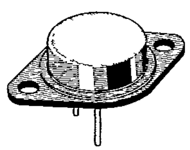
BUX47/V47/V47FI
BUX47A/V47A/47AFI

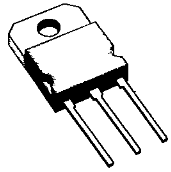
HIGH VOLTAGE POWER SWITCH

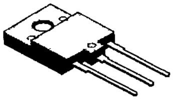
DESCRIPTION

The BUX47/A, BUV47/A, BUV47FI/AFI are silicon multiepitaxial mesa NPN transistors mounted respectively in TO-3 metal case, TO-218 plastic package and ISOWATT218 fully isolated package.

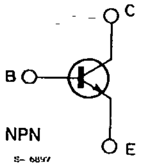
They are intended for high voltage, fast switching applications.


TO-3


TO-218


ISOWATT 218

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

<table>
<tr><th rowspan="2">Symbol</th><th rowspan="2">Parameter</th><th colspan="3">Value</th><th rowspan="2">Unit</th></tr>
<tr><th>BUX47
BUV47
BUV47FI</th><th colspan="2">BUX47A
BUV47A
BUV47AFI</th></tr>
<tr><td>V_{CER}</td><td>Collector-emitter Voltage ($R_{BE} = 10\ \Omega$)</td><td>850</td><td colspan="2">1000</td><td>V</td></tr>
<tr><td>V_{CES}</td><td>Collector-emitter Voltage ($V_{BE} = 0$)</td><td>850</td><td colspan="2">900</td><td>V</td></tr>
<tr><td>V_{CEO}</td><td>Collector-emitter Voltage ($I_B = 0$)</td><td>400</td><td colspan="2">450</td><td>V</td></tr>
<tr><td>V_{EBO}</td><td>Emitter-base Voltage ($I_C = 0$)</td><td colspan="3">7</td><td>V</td></tr>
<tr><td>I_C</td><td>Collector Current</td><td colspan="3">9</td><td>A</td></tr>
<tr><td>I_{CM}</td><td>Collector Peak Current ($t_p < 5$ ms)</td><td colspan="3">15</td><td>A</td></tr>
<tr><td>I_B</td><td>Base Current</td><td colspan="3">8</td><td>A</td></tr>
<tr><td>I_{BM}</td><td>Base Peak Current ($t_p < 5$ ms)</td><td colspan="3">10</td><td>A</td></tr>
<tr><td></td><td></td><th>TO-3</th><th>TO-218</th><th>ISOWATT218</th><td></td></tr>
<tr><td>P_{tot}</td><td>Total Dissipation at $T_c < 25$ °C</td><td>125</td><td>100</td><td>55</td><td>W</td></tr>
<tr><td>T_{stg}</td><td>Storage Temperature</td><td>– 65 to 175</td><td>– 65 to 150</td><td>– 65 to 150</td><td>°C</td></tr>
<tr><td>T_j</td><td>Max. Operating Junction Temperature</td><td>175</td><td>150</td><td>150</td><td>°C</td></tr>
</table>

T-33-13

THERMAL DATA

		TO-3	TO-218	ISOWATT218	
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case max	1.2	1.25	2.27	°C/W

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CER}	Collector Cutoff Current (R_{BE} = 10 Ω)	V_{CE} = 850 V V_{CE} = 850 V T_{case} = 125 °C			0.4 3	mA mA
I_{CEV}	Collector Cutoff Current (V_{BE} = – 2.5 V)	V_{CE} = 850 V V_{CE} = 850 V T_{case} = 125 °C			0.15 1.5	mA mA
I_{EBO}	Emitter Cutoff Current (I_C = 0)	V_{EB} = 5 V			1	mA
$V_{CEO(sus)}$*	Collector-emitter Sustaining Voltage (I_B = 0)	I_C = 0.2 A L = 25 mH for **BUX47/BUV47/BUV47FI** for **BUX47A/BUV47A/BUV47AFI**	 400 450			 V V
V_{EBO}	Emitter-base Voltage (I_C = 0)	I_E = 50 mA	7		30	V
$V_{CE(sat)}$*	Collector-emitter Saturation Voltage	for **BUX47A/BUV47A/BUV47AFI** I_C = 5 A I_B = 1 A I_C = 8 A I_B = 2.5 A for **BUX47/BUV47/BUV47FI** I_C = 6 A I_B = 1.2 A I_C = 9 A I_B = 3 A			 1.5 3 1.5 3	 V V V V
$V_{BE(sat)}$*	Base-emitter Saturation Voltage	for **BUX47A/BUV47A/BUV47AFI** I_C = 5 A I_B = 1 A for **BUX47/BUV47/BUV47FI** I_C = 6 A I_B = 1.2 A			 1.6 1.6	 V V

RESISTIVE SWITCHING TIMES (see fig. 1)

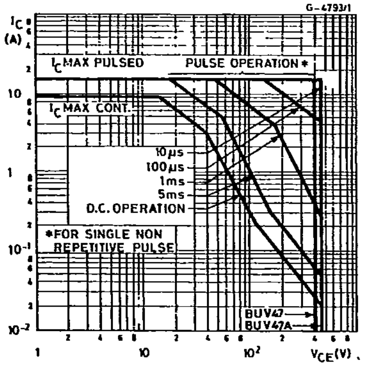
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_{on}	Turn-on Time	for **BUX47A/BUV47A/BUV47AFI**			0.7	µs
t_s	Storage Time	I_C = 5 A V_{CC} = 150 V			3	µs
t_f	Fall Time	I_{B1} = – I_{B2} = 1 A			0.8	µs
t_{on}	Turn-on Time	for **BUX47/BUV47/BUV47FI**			0.8	µs
t_s	Storage Time	I_C = 6 A V_{CC} = 150 V			2.5	µs
t_f	Fall Time	I_{B1} = – I_{B2} = 1.2 A			0.8	µs

INDUCTIVE SWITCHING TIMES (see fig. 2)

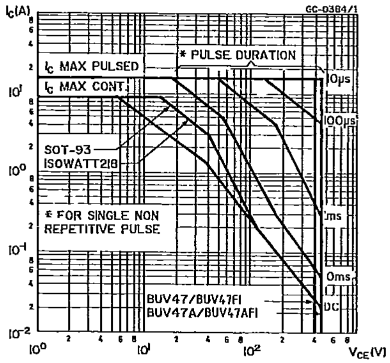
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_f	Fall Time	I_C = 5 A I_{B1} = 1 A V_{BE} = 5 V V_{CC} = 300 V L = 3 µH T_j = 100 °C			0.5	µs

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

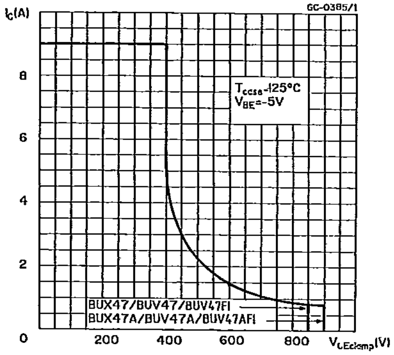
Safe Operating Areas (TO-3).



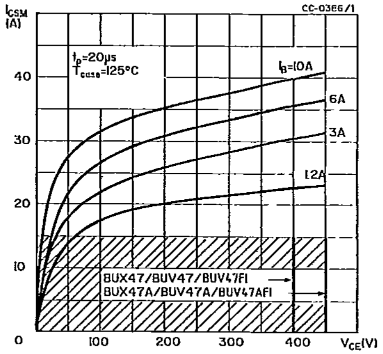
Safe Operating Areas (TO-218, ISOWATT218).



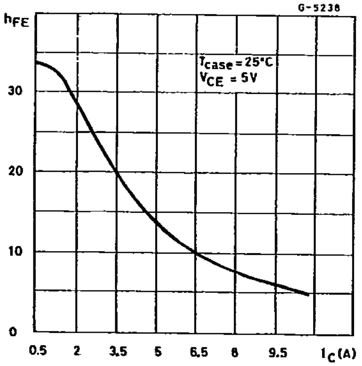
Clamped Reverse Bias Safe Operating Areas.



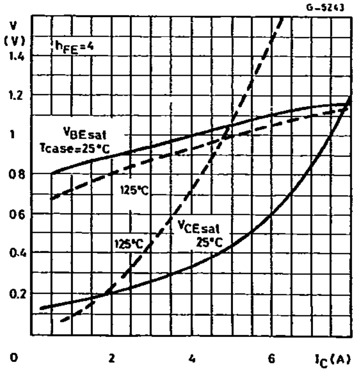
Forward Biased Accidental Overload Area (see fig. 3).



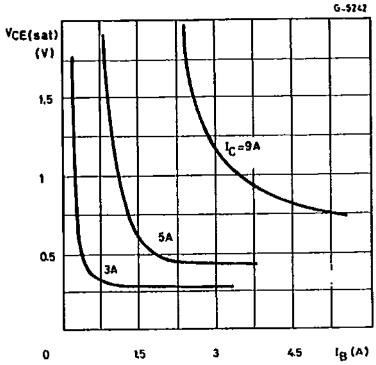
DC Current Gain.



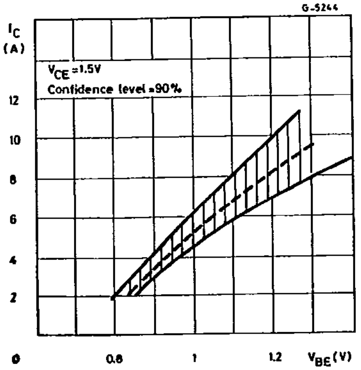
Saturation Voltage.



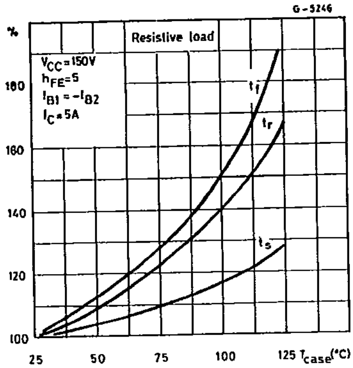
Collector-emitter Saturation Voltage.



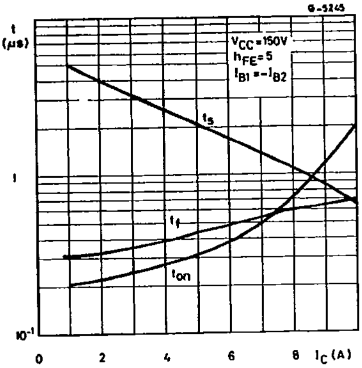
Collector Current Spread vs. Base Emitter Voltage.



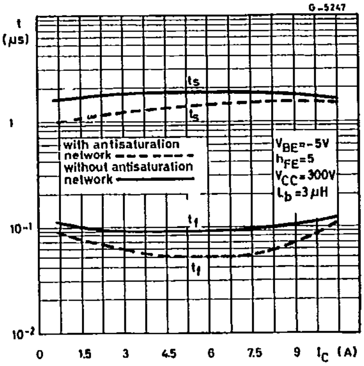
Switching Times Percentage Variation vs. Case Temperature.



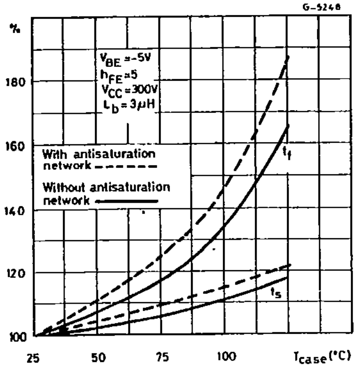
Switching Times Resistive Load (see fig. 1).



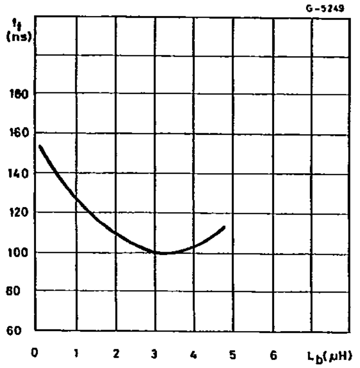
Switching Times Inductive Load (see fig. 2).



Switching Times Inductive Load vs. Case Temperature.



Fall Times vs. L_b (see fig. 2).



Dynamic Collector-emitter Saturation Voltage (see fig. 4).

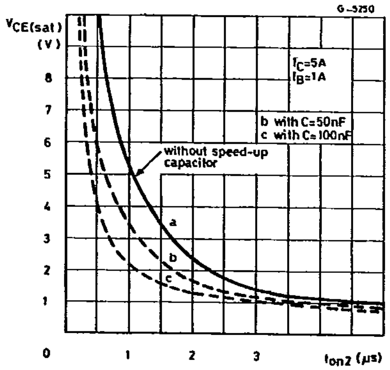


Figure 1 : Switching Times Test Circuit on Resistive Load.

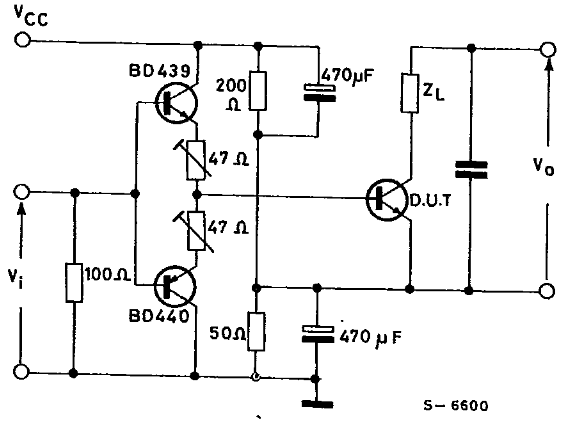
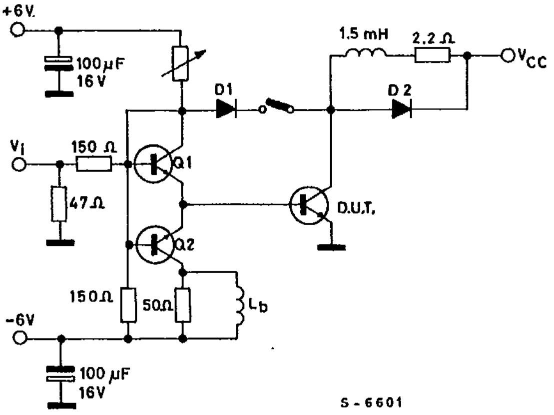


Figure 2 : Switching Times Test Circuit on Inductive Load. With and without Antisaturation Network.



D1, D2 : Fast recovery diodes
Q1, Q2 : Transistors SGS 2N5191, 2N5195.

Figure 3 : Forward Biased Accidental Overload Area Test Circuit.

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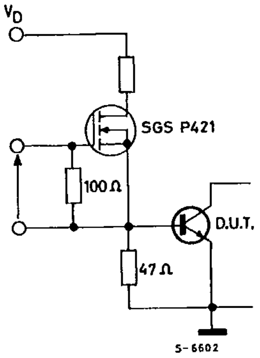
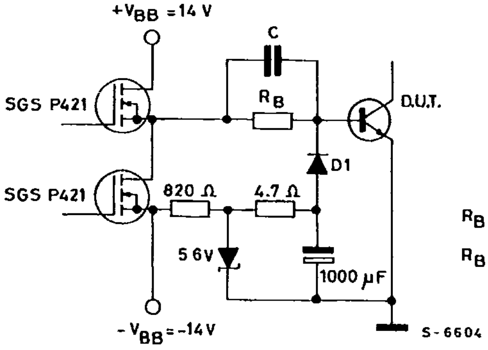


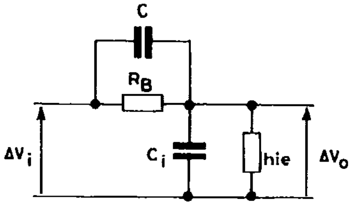
Figure 4 : $V_{CE\ (sat)}$ Dyn. Test Circuit.



$$R_B = \frac{V_{BB} - V_{BE}}{I_B}$$

$$R_B = 6.8\ \Omega$$

Figure 5 : Equivalent Input Schematic Circuit at Turn-on.



$$\Delta V_o = \Delta V_i \frac{C}{C_i + C}$$

$$\text{if } C \gg C_i \quad \Delta V_o = \Delta V_i$$

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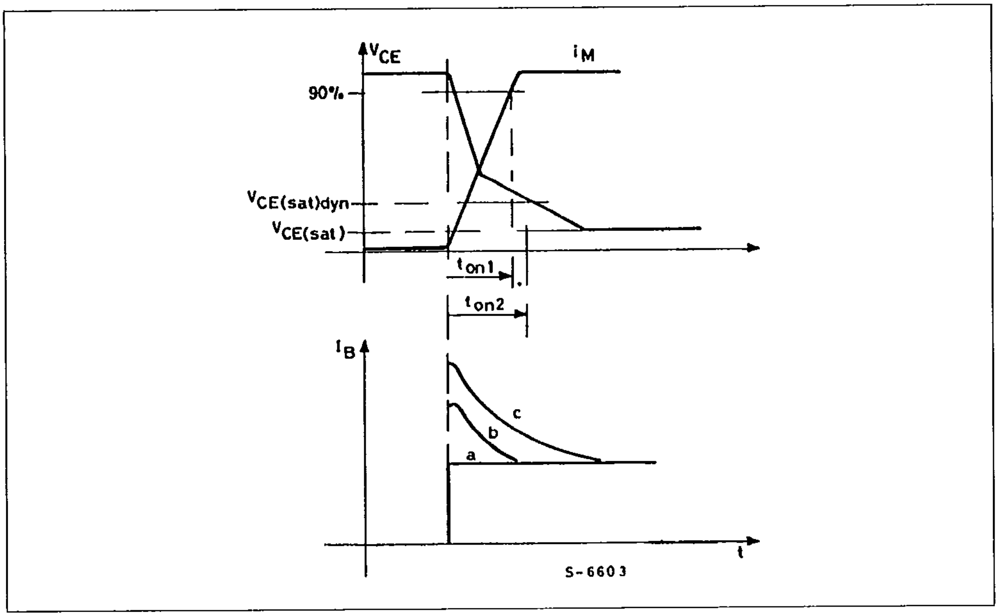
Figure 6 : Remarks to $V_{CE\ (sat)}$ Dyn. Test Circuit (fig. 4).



The speed-up capacitor decreases the $V_{CE\ (sat)}$ dyn. as shown in diagram (figure 6). The 50 nF capacitor modifies the shape of base current with a overshoot.

ISOWATT218 PACKAGE CHARACTERISTICS AND APPLICATION

ISOWATT218 is fully isolated to 4000V 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 equivalent to that of the standard part, mounted with a 0.1mm 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 ISOWATT218 PACKAGE

Fig. 7 illustrates the elements contributing to the thermmal resistance of a 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 of less than 1ms :

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

2 - For an intermediate power pulse of 5ms to 50ms seconds :

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

3 - For long power pulses of the order of 500ms seconds 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 7.