

## FASTSWITCH EASY-TO-DRIVE (ETD) NPN TRANSISTORS

### PRELIMINARY DATA

- HIGH SWITCHING SPEED NPN POWER TRANSISTOR
- EASY TO DRIVE
- HIGH VOLTAGE FOR OFF-LINE APPLICATIONS
- 100KHz SWITCHING SPEED
- LOW COST DRIVE CIRCUITS
- LOW DYNAMIC SATURATION

industrial and professional power driving applications such as motor drives and off-line switching power supplies. ETD transistors will operate using easy drive circuits at up to 100KHz ; this helps to simplify designs and improve reliability. The superior switching performance and low crossover losses reduce dissipation and consequently lower the equipment operating temperature. These ETD transistors are suitable for applications in high reliability medium power motors drives and half bridge and full bridge converters.

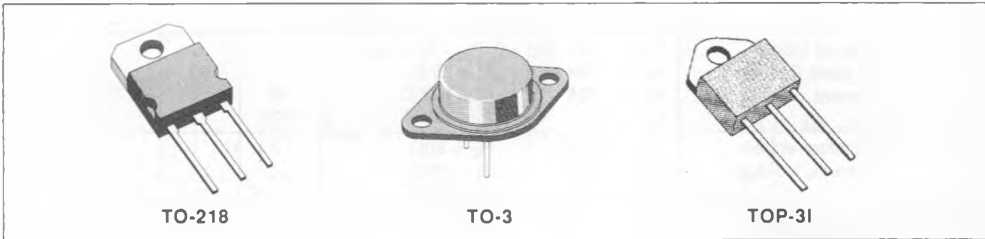
### APPLICATIONS

- SMPS
- MOTOR DRIVES

### DESCRIPTION

These Easy-to-Drive FASTSWITCH NPN power transistors are specially designed for high reliability

These Easy-to-Drive FASTSWITCH transistors are available in TO-218 and TO-3 packages. Additionally, the alumina isolated version is available in the TOP-3I package.



### ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	TO-218 TOP-3I	Value		Unit
			BUF410 BUF410I	BUF410A BUF410AI	
$V_{CEV}$	Collector-emitter Voltage ( $V_{BE} = -1.5V$ )		850	1000	V
$V_{CEO}$	Collector-emitter Voltage ( $I_B = 0$ )		450		V
$V_{EBO}$	Emitter-base Voltage ( $I_C = 0$ )		7		V
$I_C$	Collector Current		15		A
$I_{CM}$	Collector Peak Current		30		A
$I_B$	Base Current		3		A
$I_{BM}$	Base Peak Current		4.5		A
			<b>TO-218</b>	<b>TOP-3I</b>	
$P_{Tot}$	Total Dissipation at $T_c < 25^\circ C$		125	85	W
$T_{stg}$	Storage Temperature		- 65 to 150		$^\circ C$
$T_j$	Max. Operating Junction Temperature		150		$^\circ C$

**THERMAL DATA**

			<b>TO-218</b>	<b>TOP-3I</b>	
$R_{th(j-case)}$	Thermal Resistance Junction-case	Max	1	1.47	°C/W

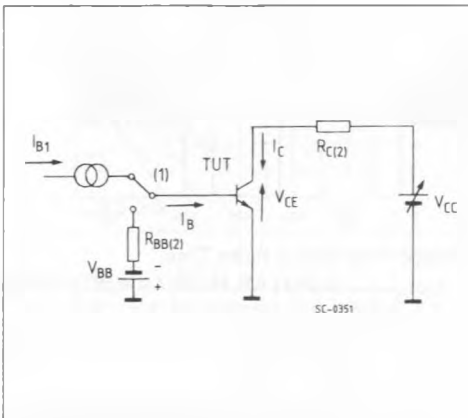
**ELECTRICAL CHARACTERISTICS** ( $T_j = 25^\circ\text{C}$  unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$I_{CER}$	Collector Cutoff Current ( $R_{BE} = 10\Omega$ )	$V_{CE} = V_{CEV}$ $V_{CE} = V_{CEV}$ $T_c = 100^\circ\text{C}$			0.2 1	mA mA
$I_{CEV}$	Collector Cutoff Current	$V_{CE} = V_{CEV}$ $V_{BE} = -1.5\text{V}$ $V_{CE} = V_{CEV}$ $V_{BE} = -1.5\text{V}$ $T_c = 100^\circ\text{C}$			0.2 1	mA mA
$I_{EBO}$	Emitter Cutoff Current ( $I_C = 0$ )	$V_{EB} = 5\text{V}$			1	mA
$V_{CEO(sus)}^*$	Collector Emitter Sustaining Voltage	$I_C = 0.2\text{A}$ $L = 25\text{mH}$	450			V
$V_{EBO}$	Emitter-base Voltage ( $I_C = 0$ )	$I_E = 50\text{mA}$	7			V
$V_{CE(sat)}^*$	Collector-emitter Saturation Voltage	$I_C = 5\text{A}$ $I_B = 0.5\text{A}$ $I_C = 5\text{A}$ $I_B = 0.5\text{A}$ $T_c = 100^\circ\text{C}$ $I_C = 10\text{A}$ $I_B = 2\text{A}$ $I_C = 10\text{A}$ $I_B = 2\text{A}$ $T_c = 100^\circ\text{C}$		0.8 0.5	2.8 2	V V V V
$V_{BE(sat)}^*$	Base-emitter Saturation Voltage	$I_C = 5\text{A}$ $I_B = 0.5\text{A}$ $I_C = 5\text{A}$ $I_B = 0.5\text{A}$ $T_c = 100^\circ\text{C}$ $I_C = 10\text{A}$ $I_B = 2\text{A}$ $I_C = 10\text{A}$ $I_B = 2\text{A}$ $T_c = 100^\circ\text{C}$		0.9 1.1	1.5 1.5	V V V V
$di_c/dt$	Rate of Rise of on-state Collector Current	$V_{CC} = 300\text{V}$ $R_C = 0$ $t_p = 3\mu\text{s}$ $I_{B1} = 0.75\text{A}$ $T_j = 25^\circ\text{C}$ $I_{B1} = 0.75\text{A}$ $T_j = 100^\circ\text{C}$ $I_{B1} = 3\text{A}$ $T_j = 100^\circ\text{C}$	45 100	60		A/ $\mu\text{s}$ A/ $\mu\text{s}$ A/ $\mu\text{s}$
$V_{CE(3\mu\text{s})}$	Collector-emitter Dynamic Voltage	$V_{CC} = 300\text{V}$ $R_C = 60\Omega$ $I_{B1} = 0.75\text{A}$ $T_j = 25^\circ\text{C}$ $T_j = 100^\circ\text{C}$		2.1	8	V V
$V_{CE(5\mu\text{s})}$	Collector-emitter Dynamic Voltage	$V_{CC} = 300\text{V}$ $R_C = 60\Omega$ $I_{B1} = 0.75\text{A}$ $T_j = 25^\circ\text{C}$ $T_j = 100^\circ\text{C}$		1.1	4	V V
$t_s$ $t_f$ $t_c$	Storage Time Fall Time Cross Over Time	$I_C = 5\text{A}$ $V_{CC} = 50\text{V}$ $V_{BB} = -5\text{V}$ $R_{BB} = 1.2\Omega$ $V_{clamp} = 400\text{V}$ $I_{B1} = 0.5\text{A}$ $L = 0.5\text{mH}$		0.8 0.05 0.08		$\mu\text{s}$ $\mu\text{s}$ $\mu\text{s}$
$t_s$ $t_f$ $t_c$	Storage Time Fall Time Cross Over Time	$I_C = 5\text{A}$ $V_{CC} = 50\text{V}$ $V_{BB} = -5\text{V}$ $R_{BB} = 1.2\Omega$ $V_{clamp} = 400\text{V}$ $I_{B1} = 0.5\text{A}$ $L = 0.5\text{mH}$ $T_j = 100^\circ\text{C}$			1.8 0.1 0.18	$\mu\text{s}$ $\mu\text{s}$ $\mu\text{s}$
$V_{CEW}$	Maximum Collector Emitter Voltage without Snubber	$I_C = 5\text{A}$ $V_{CC} = 50\text{V}$ $V_{BB} = -5\text{V}$ $R_{BB} = 1.2\Omega$ $V_{clamp} = 400\text{V}$ $I_{B1} = 0.5\text{A}$ $L = 0.5\text{mH}$ $T_j = 125^\circ\text{C}$	500			V
$t_s$ $t_f$ $t_c$	Storage Time Fall Time Cross Over Time	$I_C = 5\text{A}$ $V_{CC} = 50\text{V}$ $V_{BB} = 0$ $R_{BB} = 0.3\Omega$ $V_{clamp} = 400\text{V}$ $I_{B1} = 0.5\text{A}$ $L = 0.5\text{mH}$		1.5 0.04 0.07		$\mu\text{s}$ $\mu\text{s}$ $\mu\text{s}$

**ELECTRICAL CHARACTERISTICS** (continued)

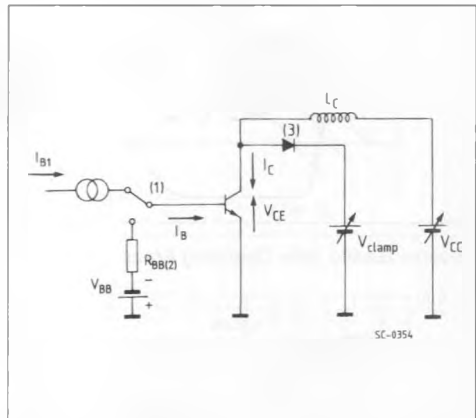
Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
$t_s$	Storage Time	$I_C = 5A$	$V_{CC} = 50V$			3	$\mu s$
$t_f$	Fall Time	$V_{BB} = 0$	$R_{BB} = 0.3\Omega$			0.15	$\mu s$
$t_c$	Cross Over Time	$V_{clamp} = 400V$ $L = 0.5mH$	$I_{B1} = 0.5A$ $T_J = 100^\circ C$			0.25	$\mu s$
$V_{CEW}$	Maximum Collector Emitter Voltage without Snubber	$I_C = 5A$ $V_{BB} = 0$ $V_{clamp} = 400V$ $L = 0.5mH$	$V_{CC} = 50V$ $R_{BB} = 0.3\Omega$ $I_{B1} = 0.5A$ $T_J = 125^\circ C$	500			V
$t_s$	Storage Time	$I_C = 10A$	$V_{CC} = 50V$		1.9		$\mu s$
$t_f$	Fall Time	$V_{BB} = -5V$	$R_{BB} = 1.2\Omega$		0.06		$\mu s$
$t_c$	Cross Over Time	$V_{clamp} = 400V$ $L = 0.25mH$	$I_{B1} = 2A$		0.12		$\mu s$
$t_s$	Storage Time	$I_C = 10A$	$V_{CC} = 50V$			3.2	$\mu s$
$t_f$	Fall Time	$V_{BB} = -5V$	$R_{BB} = 1.2\Omega$			0.12	$\mu s$
$t_c$	Cross Over Time	$V_{clamp} = 400V$ $L = 0.25mH$	$I_{B1} = 2A$ $T_J = 100^\circ C$			0.3	$\mu s$
$V_{CEW}$	Maximum Collector Emitter Voltage without Snubber	$I_{Cwoff} = 15A$ $V_{BB} = -5V$ $L = 0.17mH$ $T_J = 125^\circ C$	$I_{B1} = 3A$ $V_{CC} = 50V$ $R_{BB} = 1.2\Omega$	400			V

Turn-on Switching Test Circuit.



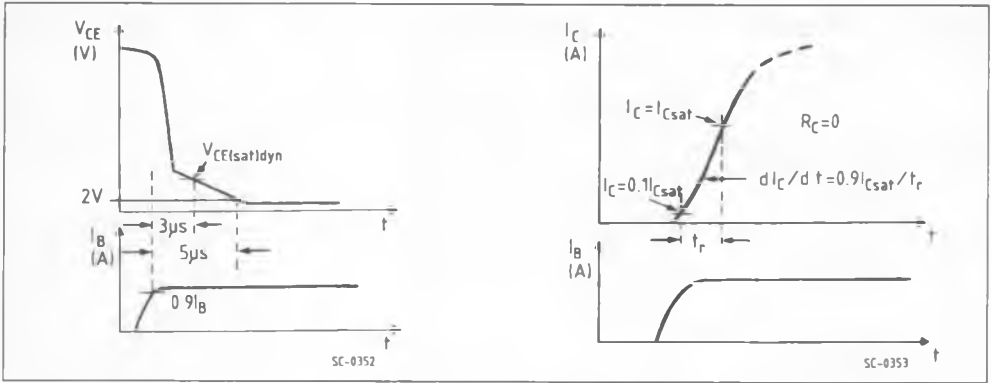
- (1) Fast electronic switch
- (2) Non-inductive Resistor

Turn-off Switching Test Circuit.

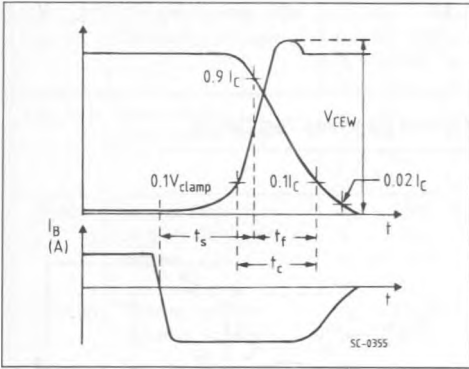


- (1) Fast electronic switch
- (2) Non-inductive Resistor
- (3) Fast recovery rectifier

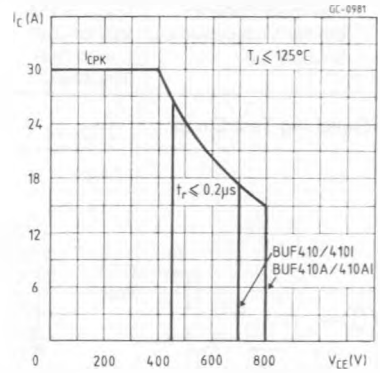
Turn-on Switching Test Waveforms.



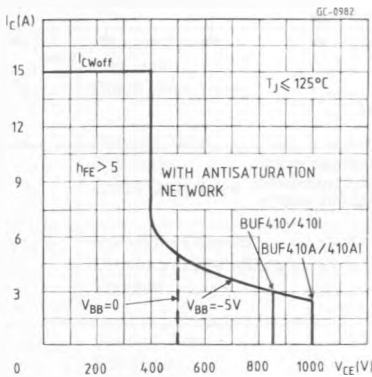
Turn-off Switching Waveforms (inductive load).



Forward Biased Safe Operating Areas.



Reverse Biased Safe Operating Areas.



Storage Time Versus Pulse Time.

