



# BUF405A BUF405AFP

## HIGH VOLTAGE FAST-SWITCHING NPN POWER TRANSISTORS

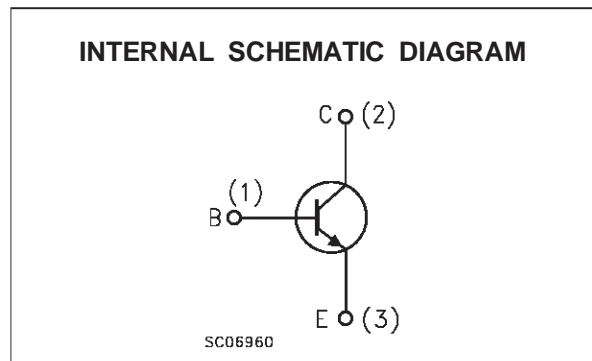
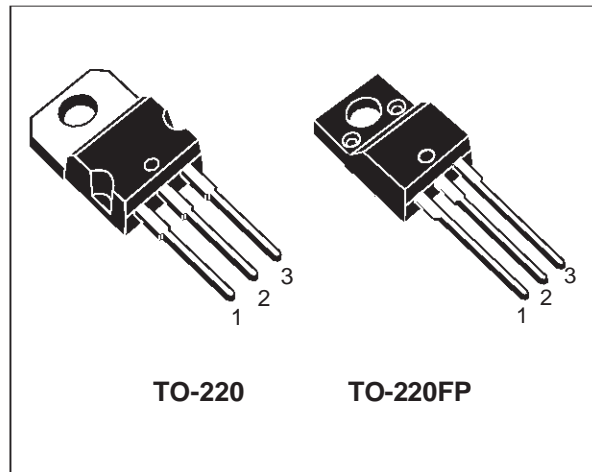
- HIGH SWITCHING SPEED NPN POWER TRANSISTORS
- EASY TO DRIVE
- HIGH VOLTAGE FOR OFF-LINE APPLICATIONS
- 100 KHz SWITCHING SPEED
- LOW COST DRIVE CIRCUITS
- LOW DYNAMIC SATURATION

### APPLICATIONS:

- SWITCH MODE POWER SUPPLIES
- MOTOR DRIVERS

### DESCRIPTION

These Easy-to-Drive FASTSWITCH NPN power transistors are specially designed for high reliability 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 lowers the equipment operating temperature.



### ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value		Unit
		BUF405A	BUF405AFP	
$V_{CEV}$	Collector-Emitter Voltage ( $V_{BE} = -1.5 V$ )	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	7.5		A
$I_{CM}$	Collector Peak Current ( $t_p < 5 ms$ )	15		A
$I_B$	Base Current	3		A
$I_{BM}$	Base Peak Current ( $t_p < 5 ms$ )	4.5		A
$P_{tot}$	Total Dissipation at $T_c = 25^\circ C$	80	39	W
$T_{stg}$	Storage Temperature	-65 to 150		$^\circ C$
$T_j$	Max Operation Junction Temperature	150		$^\circ C$

# BUF405A / BUF405AFP

## THERMAL DATA

			TO-220	TO-220FP	
R <sub>thj-case</sub>	Thermal Resistance Junction-Case	Max	1.56	3.2	°C/W

## ELECTRICAL CHARACTERISTICS (T<sub>case</sub> = 25 °C unless otherwise specified)

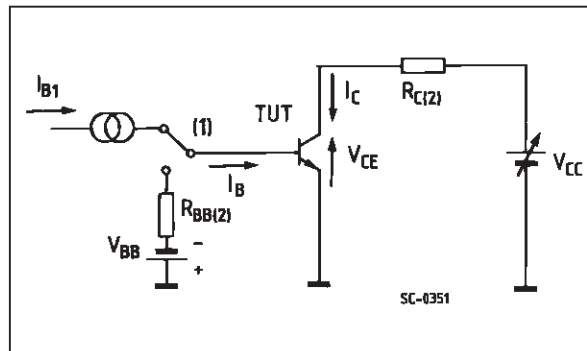
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I <sub>CEr</sub>	Collector Cut-off Current (R <sub>BE</sub> = 5 Ω)	V <sub>CE</sub> = V <sub>CEV</sub> V <sub>CE</sub> = V <sub>CEV</sub> T <sub>c</sub> = 100 °C			0.1 0.5	mA mA
I <sub>CEV</sub>	Collector Cut-off Current (I <sub>B</sub> = 0)	V <sub>CE</sub> = V <sub>CEV</sub> V <sub>BE</sub> = -1.5 V V <sub>CE</sub> = V <sub>CEV</sub> V <sub>BE</sub> = -1.5 V T <sub>c</sub> = 100°C			0.1 0.5	mA mA
I <sub>EBO</sub>	Emitter Cut-off Current (I <sub>C</sub> = 0)	V <sub>BE</sub> = 5 V			1	mA
V <sub>CEO(sus)*</sub>	Collector-Emitter Sustaining Voltage	I <sub>C</sub> = 200 mA L = 25 mH	450			V
V <sub>EBO</sub>	Emitter Base Voltage (I <sub>C</sub> = 0)	I <sub>E</sub> = 50 mA	7			V
V <sub>CE(sat)*</sub>	Collector-Emitter Saturation Voltage	I <sub>C</sub> = 2.5 A I <sub>B</sub> = 0.25 A I <sub>C</sub> = 2.5 A I <sub>B</sub> = 0.25 A T <sub>c</sub> = 100°C I <sub>C</sub> = 5 A I <sub>B</sub> = 1 A I <sub>C</sub> = 5 A I <sub>B</sub> = 1 A T <sub>c</sub> = 100°C		0.8 0.5	2.8 2	V V V V
V <sub>BE(sat)*</sub>	Base-Emitter Saturation Voltage	I <sub>C</sub> = 2.5 A I <sub>B</sub> = 0.25 A I <sub>C</sub> = 2.5 A I <sub>B</sub> = 0.25 A T <sub>c</sub> = 100°C I <sub>C</sub> = 5 A I <sub>B</sub> = 1 A I <sub>C</sub> = 5 A I <sub>B</sub> = 1 A T <sub>c</sub> = 100°C		0.9 1.1	1.5 1.5	V V V V
di <sub>c</sub> /dt	Rate of rise on-state Collector Current	V <sub>CC</sub> = 300 V R <sub>C</sub> = 0 t <sub>p</sub> = 3 μs I <sub>B1</sub> = 0.375 A T <sub>j</sub> = 25°C I <sub>B1</sub> = 0.375 A T <sub>j</sub> = 100°C I <sub>B1</sub> = 1.5 A T <sub>j</sub> = 100°C	30 60	40		A/μs A/μs A/μs
V <sub>CE(3μs)</sub>	Collector-Emitter Dynamic Voltage	V <sub>CC</sub> = 300 V R <sub>C</sub> = 120 Ω I <sub>B1</sub> = 0.375 A T <sub>j</sub> = 25°C T <sub>j</sub> = 100°C		2.1	8	V V
V <sub>CE(5μs)</sub>	Collector-Emitter Dynamic Voltage	V <sub>CC</sub> = 300 V R <sub>C</sub> = 120 Ω I <sub>B1</sub> = 0.375 A T <sub>j</sub> = 25°C T <sub>j</sub> = 100°C		1.1	4	V V
t <sub>s</sub> t <sub>f</sub> t <sub>c</sub>	INDUCTIVE LOAD Storage Time Fall Time Cross Over Time	I <sub>C</sub> = 2.5 A V <sub>CC</sub> = 50 V V <sub>BB</sub> = -5 V R <sub>BB</sub> = 2.4 Ω V <sub>clamp</sub> = 400 V I <sub>B1</sub> = 0.25 A L = 1 mH		0.8 0.05 0.08		μs μs μs
t <sub>s</sub> t <sub>f</sub> t <sub>c</sub>	INDUCTIVE LOAD Storage Time Fall Time Cross Over Time	I <sub>C</sub> = 2.5 A V <sub>CC</sub> = 50 V V <sub>BB</sub> = -5 V R <sub>BB</sub> = 2.4 Ω V <sub>clamp</sub> = 400 V I <sub>B1</sub> = 0.25 A L = 1 mH T <sub>j</sub> = 100°C			1.8 0.1 0.18	μs μs μs
V <sub>CEW</sub>	Maximum Collector Emitter Voltage without Snubber	I <sub>C</sub> = 2.5 A V <sub>CC</sub> = 50 V V <sub>BB</sub> = -5 V R <sub>BB</sub> = 2.4 Ω V <sub>clamp</sub> = 400 V I <sub>B1</sub> = 0.25 A L = 1 mH T <sub>j</sub> = 125°C	500			V
t <sub>s</sub> t <sub>f</sub> t <sub>c</sub>	INDUCTIVE LOAD Storage Time Fall Time Cross Over Time	I <sub>C</sub> = 2.5 A V <sub>CC</sub> = 50 V V <sub>BB</sub> = 0 R <sub>BB</sub> = 0.6 Ω V <sub>clamp</sub> = 400 V I <sub>B1</sub> = 0.25 A L = 1 mH		1.5 0.04 0.07		μs μs μs

**ELECTRICAL CHARACTERISTICS** (continued)

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
$t_s$ $t_f$ $t_c$	INDUCTIVE LOAD Storage Time Fall Time Cross Over Time	$I_C = 2.5\text{ A}$ $V_{BB} = 0$ $V_{clamp} = 400\text{ V}$ $L = 1\text{ mH}$	$V_{CC} = 50\text{ V}$ $R_{BB} = 0.6\ \Omega$ $I_{B1} = 0.25\text{ A}$ $T_j = 100^\circ\text{C}$			3 0.15 0.25	$\mu\text{s}$ $\mu\text{s}$ $\mu\text{s}$
$V_{CEW}$	Maximum Collector Emitter Voltage without Snubber	$I_C = 2.5\text{ A}$ $V_{BB} = 0$ $V_{clamp} = 400\text{ V}$ $L = 1\text{ mH}$	$V_{CC} = 50\text{ V}$ $R_{BB} = 0.6\ \Omega$ $I_{B1} = 0.25\text{ A}$ $T_j = 125^\circ\text{C}$	500			V
$t_s$ $t_f$ $t_c$	INDUCTIVE LOAD Storage Time Fall Time Cross Over Time	$I_C = 5\text{ A}$ $V_{BB} = -5\text{ V}$ $V_{clamp} = 400\text{ V}$ $L = 0.5\text{ mH}$	$V_{CC} = 50\text{ V}$ $R_{BB} = 2.4\ \Omega$ $I_{B1} = 1\text{ A}$		1.9 0.06 0.12		$\mu\text{s}$ $\mu\text{s}$ $\mu\text{s}$
$t_s$ $t_f$ $t_c$	INDUCTIVE LOAD Storage Time Fall Time Cross Over Time	$I_C = 5\text{ A}$ $V_{BB} = -5\text{ V}$ $V_{clamp} = 400\text{ V}$ $L = 0.5\text{ mH}$	$V_{CC} = 50\text{ V}$ $R_{BB} = 2.4\ \Omega$ $I_{B1} = 1\text{ A}$ $T_j = 100^\circ\text{C}$			3.2 0.12 0.3	$\mu\text{s}$ $\mu\text{s}$ $\mu\text{s}$
$V_{CEW}$	Maximum Collector Emitter Voltage without Snubber	$I_{Coff} = 7.5\text{ A}$ $V_{BB} = -5\text{ V}$ $L = 0.33\text{ mH}$ $T_j = 125^\circ\text{C}$	$V_{CC} = 50\text{ V}$ $R_{BB} = 2.4\ \Omega$ $I_{B1} = 1.5\text{ A}$	400			V

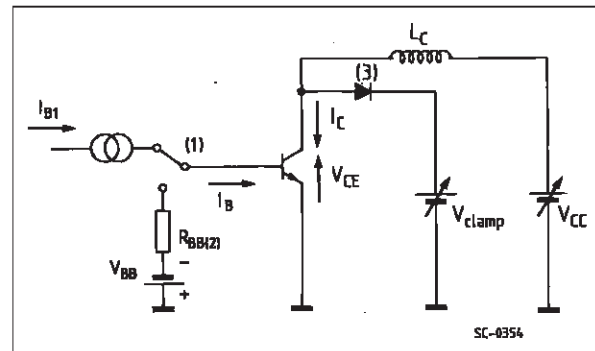
\* Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle < 1.5 %

Turn-on Switching Test Circuit



- 1 Fast electronic switch
- 2 Non-inductive Resistor

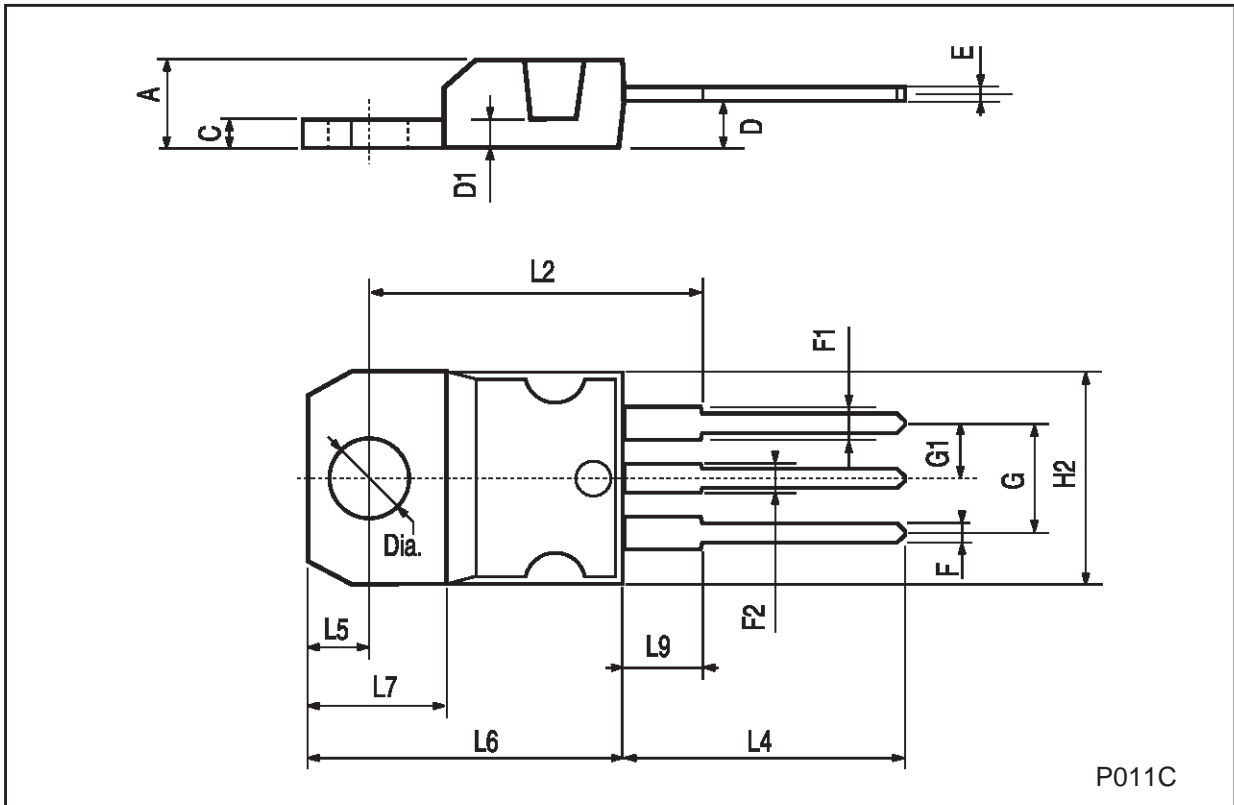
Turn-off Switching Test Circuit



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

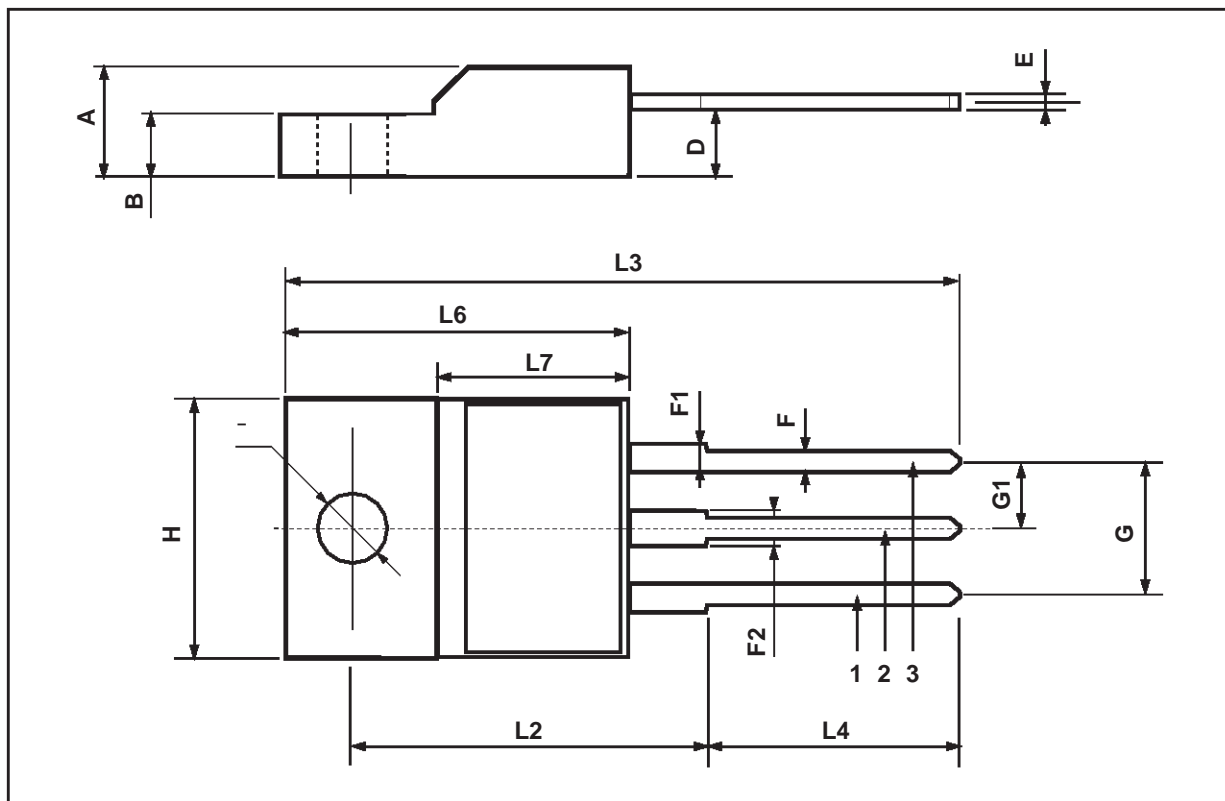
**TO-220 MECHANICAL DATA**

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	4.40		4.60	0.173		0.181
C	1.23		1.32	0.048		0.051
D	2.40		2.72	0.094		0.107
D1		1.27			0.050	
E	0.49		0.70	0.019		0.027
F	0.61		0.88	0.024		0.034
F1	1.14		1.70	0.044		0.067
F2	1.14		1.70	0.044		0.067
G	4.95		5.15	0.194		0.203
G1	2.4		2.7	0.094		0.106
H2	10.0		10.40	0.393		0.409
L2		16.4			0.645	
L4	13.0		14.0	0.511		0.551
L5	2.65		2.95	0.104		0.116
L6	15.25		15.75	0.600		0.620
L7	6.2		6.6	0.244		0.260
L9	3.5		3.93	0.137		0.154
DIA.	3.75		3.85	0.147		0.151



TO-220FP 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	1.15		1.7	0.045		0.067
F2	1.15		1.7	0.045		0.067
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
L6	15.9		16.4	0.626		0.645
L7	9		9.3	0.354		0.366
Ø	3		3.2	0.118		0.126



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