

High voltage fast-switching NPN power transistor

Features

- High voltage capability
- Minimum lot-to-lot spread for reliable operation
- Very high switching speed

Applications

- Electronic ballast for fluorescent lighting
- Switch mode power supplies

Description

The device is manufactured using high voltage multi-epitaxial planar technology for high switching speeds and medium voltage capability.

It uses a cellular emitter structure with planar edge termination to enhance switching speeds while maintaining a satisfactory RBSOA.

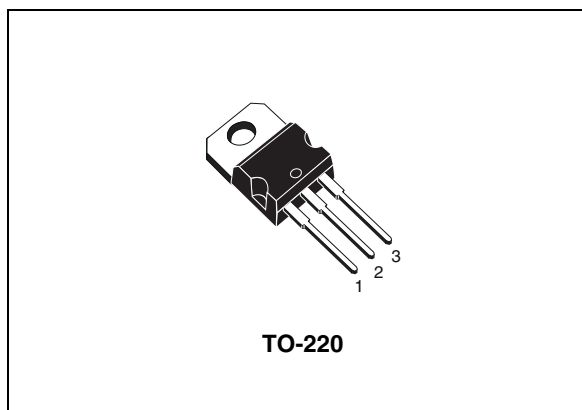


Figure 1. Internal schematic diagram

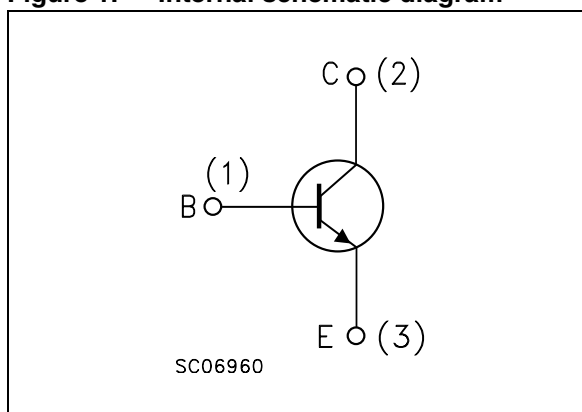


Table 1. Device summary

Order code	Marking	Package	Packaging
ST13005N	13005N	TO-220	Tube

1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CES}	Collector-emitter voltage ($V_{BE} = 0$)	700	V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	400	V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	9	V
I_C	Collector current	4	A
I_{CM}	Collector peak current ($t_P < 5$ ms)	8	A
I_B	Base current	2	A
I_{BM}	Base peak current ($t_P < 5$ ms)	4	A
P_{tot}	Total dissipation at $T_C = 25$ °C	60	W
T_{stg}	Storage temperature	-65 to 150	°C
T_J	Max. operating junction temperature	150	°C

Table 3. Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance junction-case max	2.08	°C/W

2 Electrical characteristics

$T_{\text{case}} = 25\text{ °C}$ unless otherwise specified

Table 4. Electrical characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector cut-off current ($V_{\text{BE}} = 0$)	$V_{\text{CE}} = 700\text{ V}$			0.1	mA
		$V_{\text{CE}} = 700\text{ V}$ $T_{\text{C}} = 125\text{ °C}$			0.5	mA
I_{EBO}	Emitter cut-off current ($I_{\text{C}} = 0$)	$V_{\text{EB}} = 9\text{ V}$			1	mA
$V_{\text{CEO(sus)}}^{(1)}$	Collector-emitter sustaining voltage ($I_{\text{B}} = 0$)	$I_{\text{C}} = 10\text{ mA}$	400			V
$V_{\text{CE(sat)}}^{(1)}$	Collector-emitter saturation voltage	$I_{\text{C}} = 1\text{ A}$ $I_{\text{B}} = 0.2\text{ A}$			0.5	V
		$I_{\text{C}} = 2\text{ A}$ $I_{\text{B}} = 0.5\text{ A}$			0.6	V
		$I_{\text{C}} = 3\text{ A}$ $I_{\text{B}} = 0.75\text{ A}$			5	V
$V_{\text{BE(sat)}}^{(1)}$	Base-emitter saturation voltage	$I_{\text{C}} = 1\text{ A}$ $I_{\text{B}} = 0.2\text{ A}$			1.2	V
		$I_{\text{C}} = 2\text{ A}$ $I_{\text{B}} = 0.5\text{ A}$			1.6	V
$h_{\text{FE}}^{(1)}$	DC current gain	$I_{\text{C}} = 1\text{ A}$ $V_{\text{CE}} = 5\text{ V}$	10		30	
		$I_{\text{C}} = 2\text{ A}$ $V_{\text{CE}} = 5\text{ V}$	8		24	
t_{s} t_{f}	Resistive load Storage time	$I_{\text{C}} = 2\text{ A}$ $I_{\text{B1}} = -I_{\text{B2}} = 0.4\text{ A}$		1.65		μs
	Fall time	$V_{\text{CC}} = 125\text{ V}$ $t_{\text{p}} = 30\text{ }\mu\text{s}$		260		ns

1. Pulse test: pulse duration $\leq 300\text{ }\mu\text{s}$, duty cycle $\leq 2\%$

2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

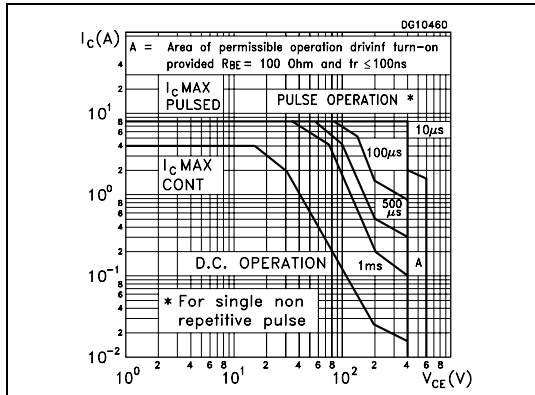


Figure 3. Derating curve

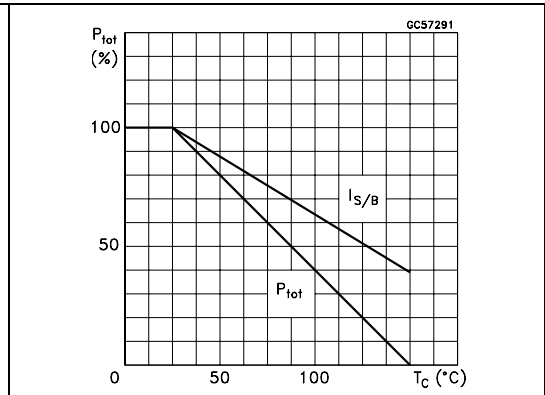


Figure 4. DC current gain ($V_{CE} = 1 \text{ V}$)

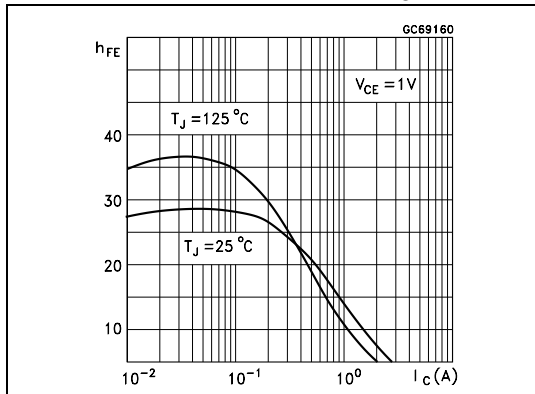


Figure 5. DC current gain ($V_{CE} = 5 \text{ V}$)

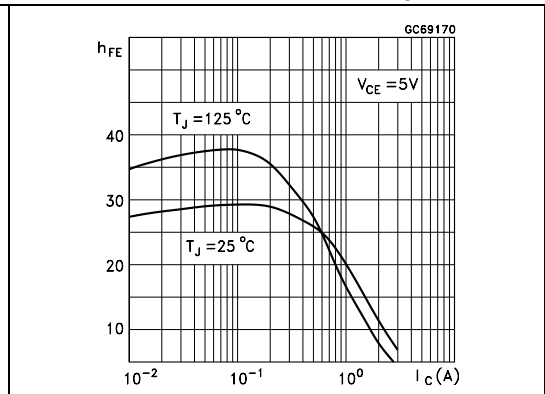


Figure 6. Collector-emitter saturation voltage

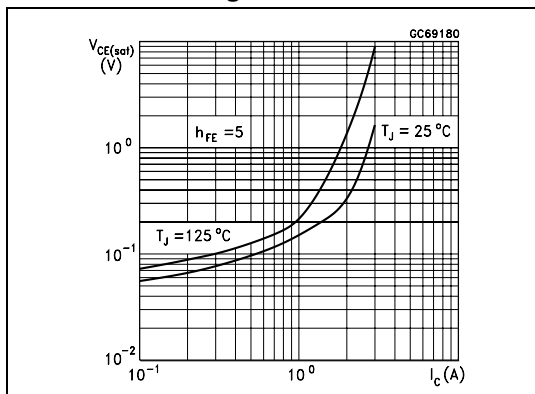


Figure 7. Base-emitter saturation voltage

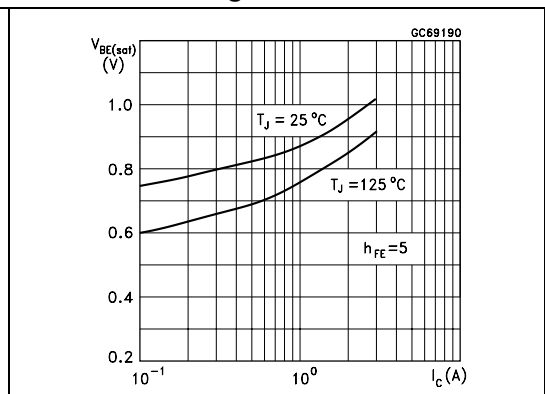


Figure 8. Inductive load fall time

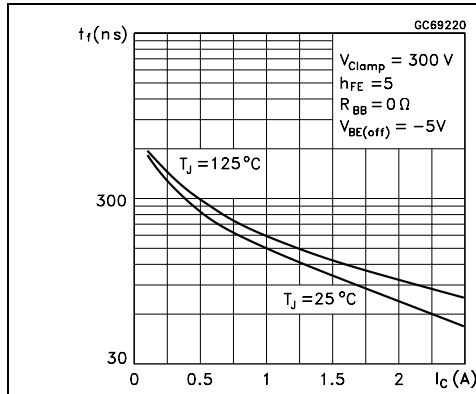


Figure 9. Inductive load storage time

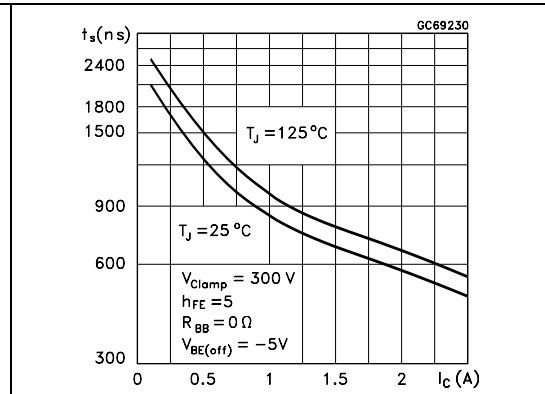


Figure 10. Resistive load fall time

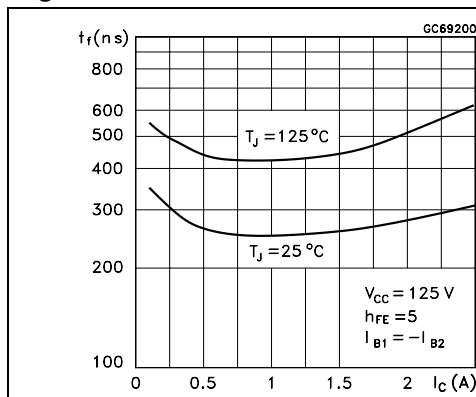


Figure 11. Resistive load storage time

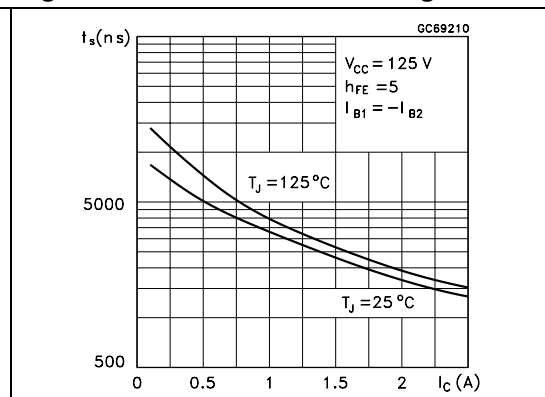
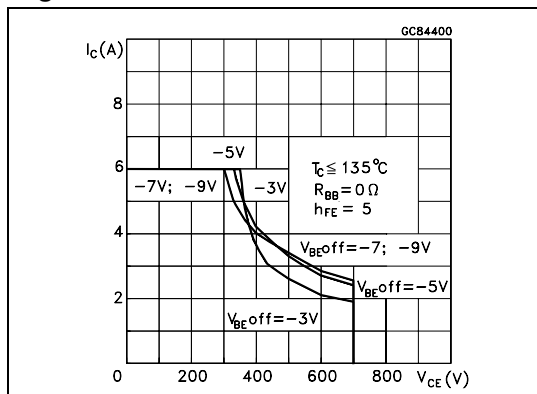
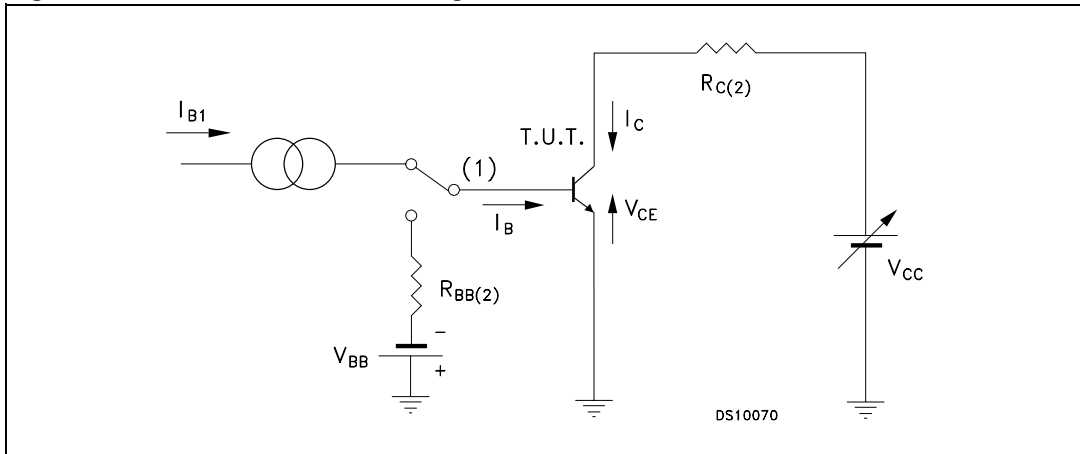


Figure 12. Reverse biased SOA



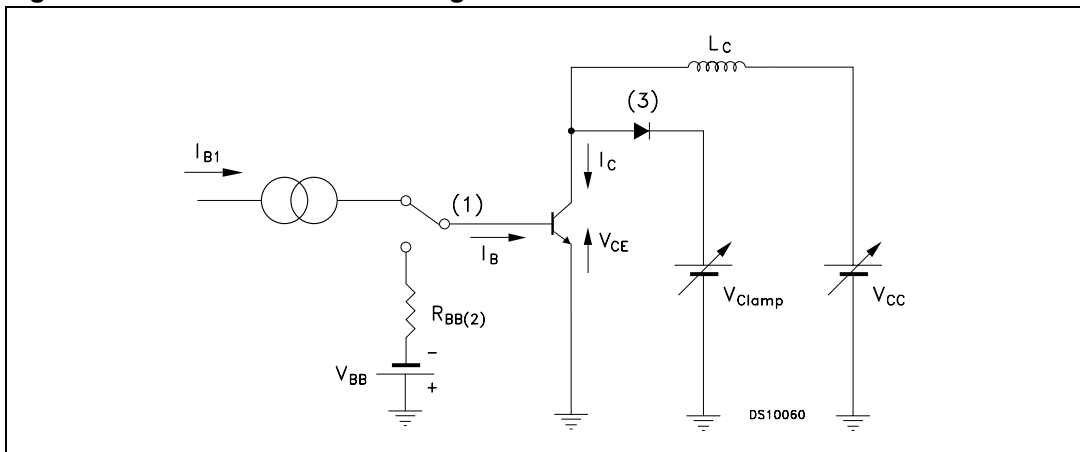
2.2 Test circuits

Figure 13. Resistive load switching test circuit



1. Fast electronic switch
2. Non-inductive resistor

Figure 14. Inductive load switching test circuit



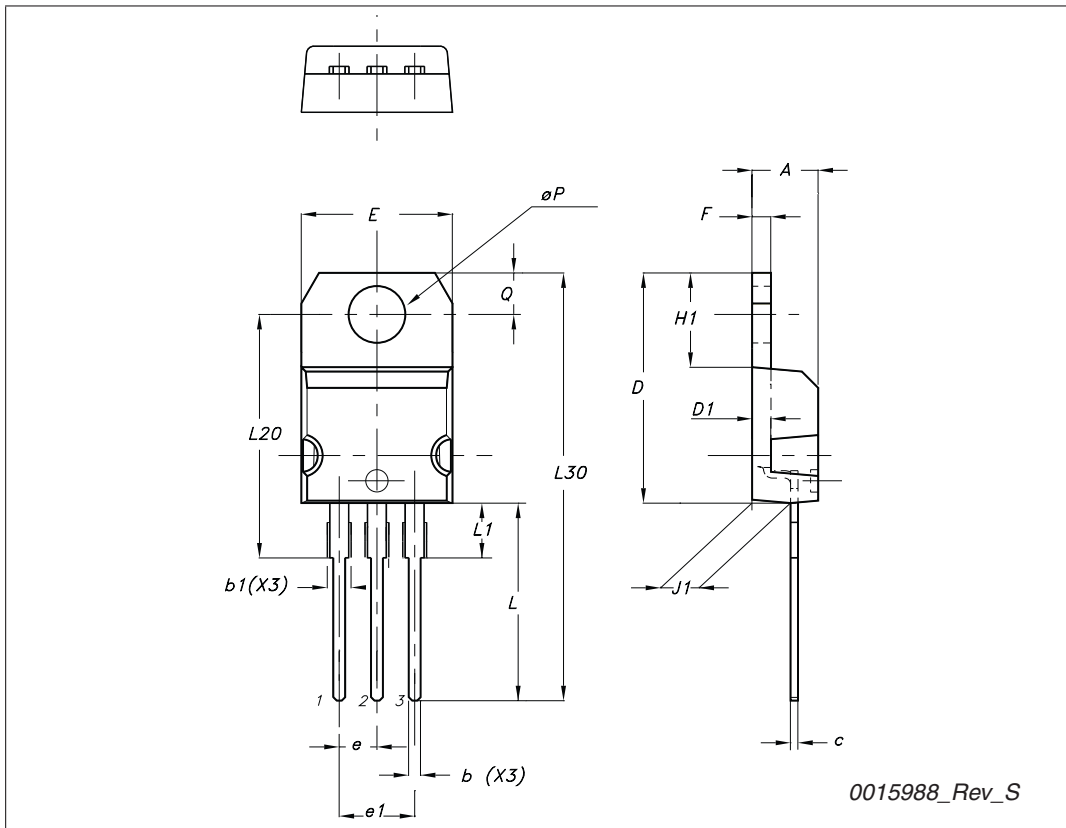
1. Fast electronic switch
2. Non-inductive resistor
3. Fast recovery rectifier

3 Package mechanical data

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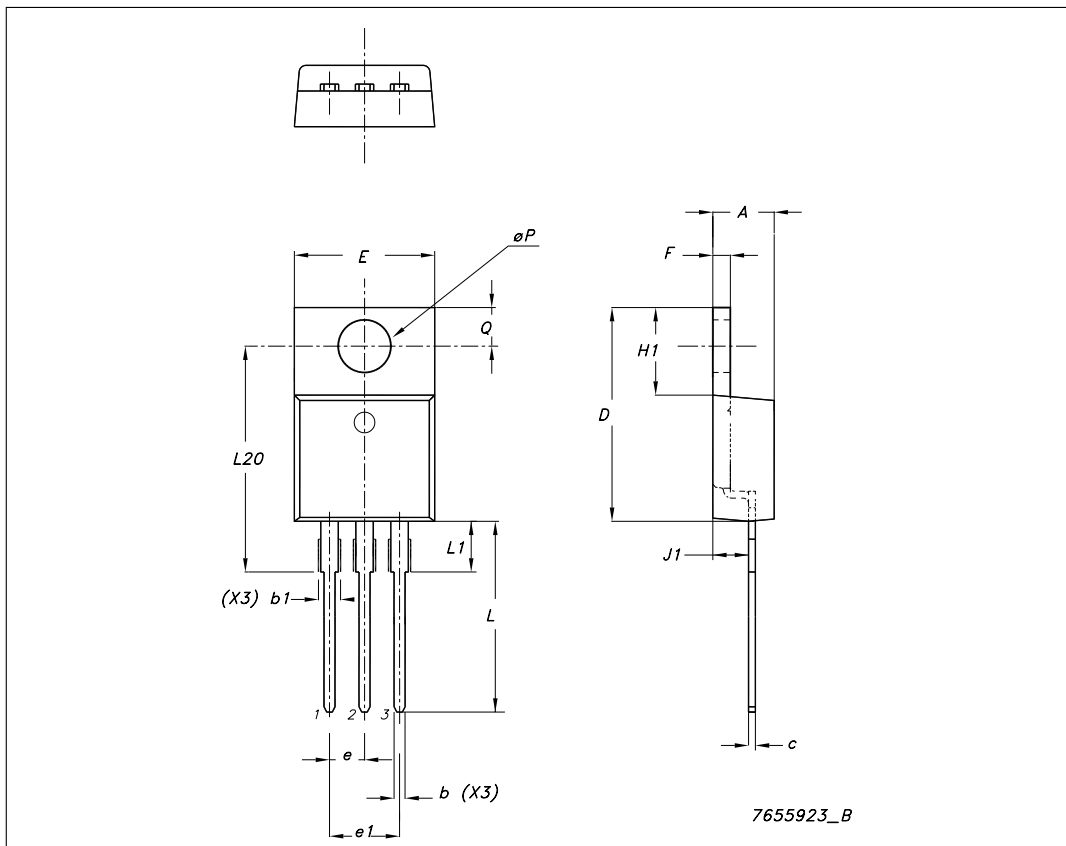
TO-220 type A mechanical data

Dim	mm		
	Min	Typ	Max
A	4.40		4.60
b	0.61		0.88
b1	1.14		1.70
c	0.48		0.70
D	15.25		15.75
D1		1.27	
E	10		10.40
e	2.40		2.70
e1	4.95		5.15
F	1.23		1.32
H1	6.20		6.60
J1	2.40		2.72
L	13		14
L1	3.50		3.93
L20		16.40	
L30		28.90	
∅P	3.75		3.85
Q	2.65		2.95



TO-220 type E mechanical data

Dim	mm		
	Min	Typ	Max
A	4.47		4.67
b	0.70		0.91
b1	1.17		1.37
c	0.31		0.53
D	14.60		15.70
E	9.96		10.36
e		2.54	
e1	4.98	5.08	5.18
F	1.17		1.37
H1	6.10		6.80
J1	2.52		2.82
L	12.70		13.80
L1	3.20		3.96
L20	15.21		16.77
øP	3.73		3.94
Q	2.59		2.89



4 Revision history

Table 5. Document revision history

Date	Revision	Changes
21-Jun-2004	2	Document migration, no content change.
10-Sep-2009	3	Updated TO-220 package mechanical data.

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