

High voltage fast-switching NPN power transistor

Features

- High voltage capability
- Low spread of dynamic parameters
- Minimum lot-to-lot spread for reliable operation
- Very high switching speed

Application

- SMPS for battery charger

Description

The device is manufactured using high voltage multi epitaxial planar technology for high switching speeds and high voltage capability. It uses a cellular emitter structure with planar edge termination to enhance switching speeds while maintaining the wide RBSOA.

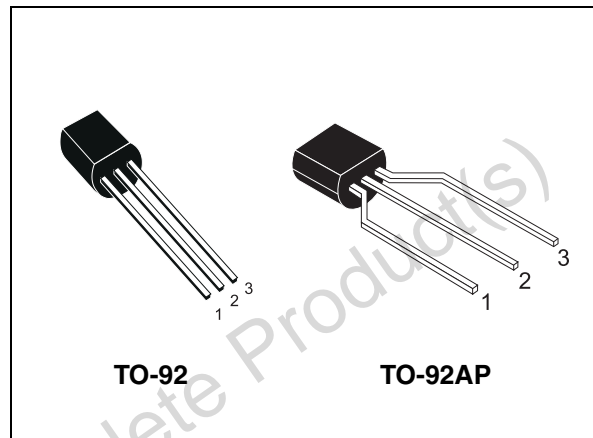


Figure 1. Internal schematic diagram

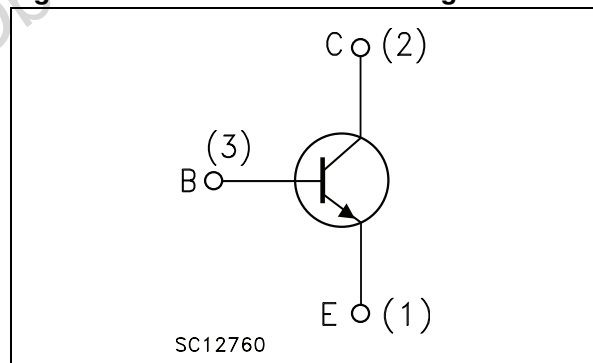


Table 1. Device summary

Order codes	Marking	Package	Packaging
STX13004	X13004	TO-92	Bulk
STX13004G ⁽¹⁾	X13004G	TO-92	Bulk
STX13004-AP	X13004	TO-92AP	Ammopack
STX13004G-AP ⁽¹⁾	X13004G	TO-92AP	Ammopack

1. The letter "G" in the order code identifies the product as ECOPACK@2 grade. Please see [Section 3](#) for details.

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}	Collector-base voltage ($I_C = 0, I_B = 1\text{ A}, t_P < 10\text{ ms}$)	$V_{(BR)EBO}$	V
I_C	Collector current	2	A
I_{CM}	Collector peak current ($t_P < 5\text{ ms}$)	4	A
I_B	Base current	1	A
I_{BM}	Base peak current ($t_P < 5\text{ ms}$)	2	A
P_{TOT}	Total dissipation at $T_C = 25\text{ °C}$	2.5	W
T_{STG}	Storage temperature	-65 to 150	°C
T_J	Max. operating junction temperature	150	

Table 3. Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance junction-case max	50	°C/W
R_{thJA}	Thermal resistance junction-ambient max	150	°C/W

2 Electrical characteristics

$T_{\text{case}} = 25\text{ }^{\circ}\text{C}$; unless otherwise specified.

Table 4. Electrical characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector cut-off current ($V_{\text{BE}} = 0$)	$V_{\text{CE}} = 700\text{ V}$			10	μA
I_{CEO}	Collector cut-off current ($I_{\text{B}} = 0$)	$V_{\text{CE}} = 400\text{ V}$			1	mA
$V_{(\text{BR})\text{EBO}}$	Emitter-base breakdown voltage ($I_{\text{C}} = 0$)	$I_{\text{E}} = 10\text{ mA}$	9		18	V
$V_{\text{CEO(sus)}}^{(1)}$	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	$I_{\text{C}} = 1\text{ A}$ $I_{\text{B}} = 200\text{ mA}$ $I_{\text{C}} = 2\text{ A}$ $I_{\text{B}} = 500\text{ mA}$			0.5 1	V V
$V_{\text{BE(sat)}}^{(1)}$	Base-emitter saturation voltage	$I_{\text{C}} = 1\text{ A}$ $I_{\text{B}} = 200\text{ mA}$ $I_{\text{C}} = 2\text{ A}$ $I_{\text{B}} = 500\text{ mA}$			1.2 1.6	V V
h_{FE}	DC current gain	$I_{\text{C}} = 0.5\text{ mA}$ $V_{\text{CE}} = 2\text{ V}$ $I_{\text{C}} = 400\text{ mA}$ $V_{\text{CE}} = 2\text{ V}$ $I_{\text{C}} = 1\text{ A}$ $V_{\text{CE}} = 5\text{ V}$ $I_{\text{C}} = 2\text{ A}$ $V_{\text{CE}} = 5\text{ V}$	15 26 10 6	35		
t_{s} t_{f}	Resistive load Storage time Fall time	$I_{\text{C}} = 2\text{ A}$ $t_{\text{p}} = 30\text{ }\mu\text{s}$ $I_{\text{B(on)}} = -I_{\text{B(off)}} = 400\text{ mA}$ $V_{\text{CC}} = 125\text{ V}$ $V_{\text{BB(off)}} = -5\text{ V}$ (see Figure 12)		1.1 300		μs ns
t_{s} t_{f}	Inductive load Storage time Fall time	$I_{\text{C}} = 1\text{ A}$ $V_{\text{clamp}} = 300\text{ V}$ $I_{\text{B(on)}} = 250\text{ mA}$ $V_{\text{BB(off)}} = -5\text{ V}$ $C_{\text{snuubber}} = 1\text{ nF}$ $R_{\text{BB(off)}} = 0$ (see Figure 13)		2.4 200		μs 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

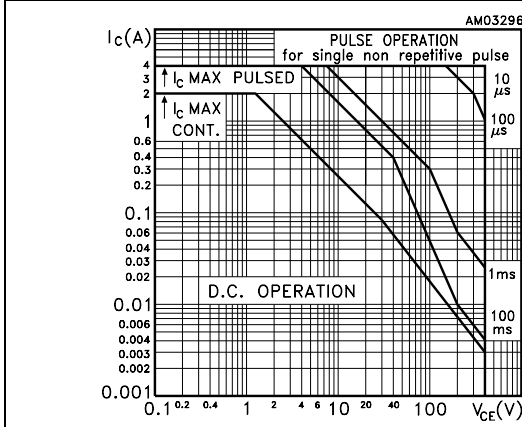


Figure 3. Derating curve

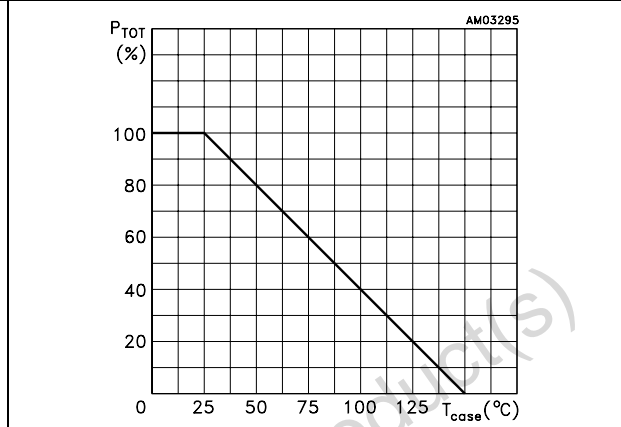


Figure 4. DC current gain @ V_{CE} = 2 V

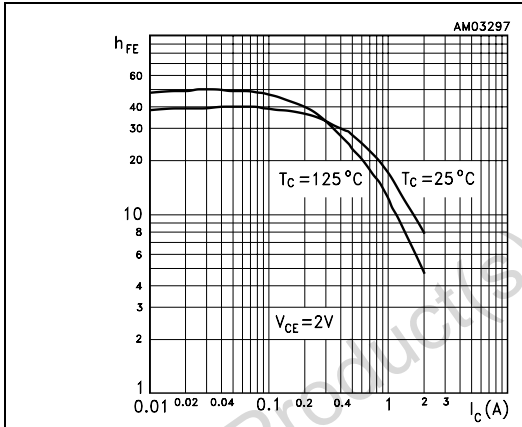


Figure 5. DC current gain @ V_{CE} = 5 V

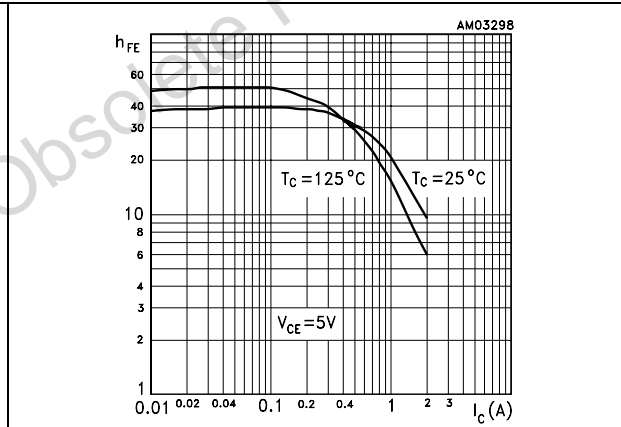


Figure 6. Collector-emitter saturation voltage

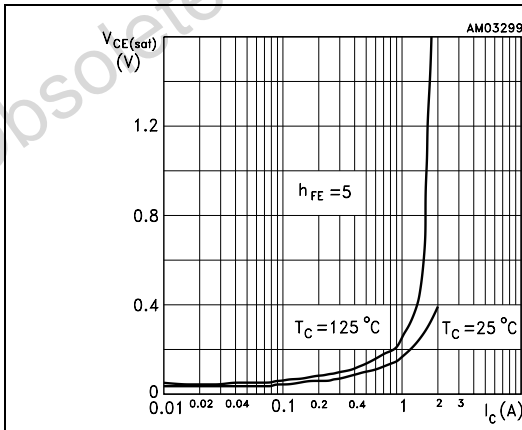


Figure 7. Base-emitter saturation voltage

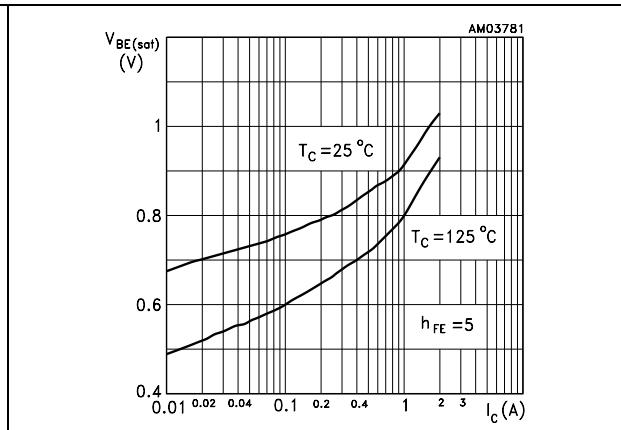


Figure 8. Output characteristics

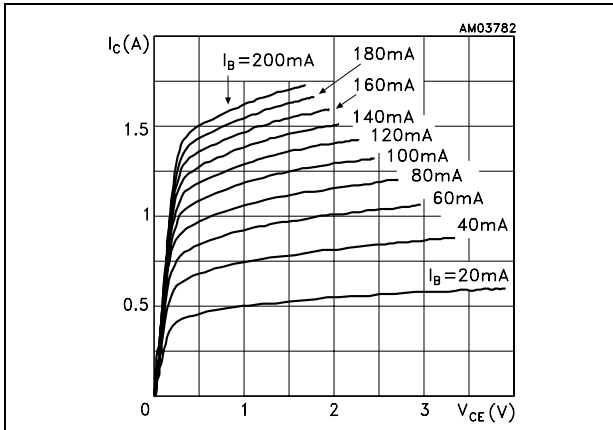


Figure 9. Reverse biased SOA

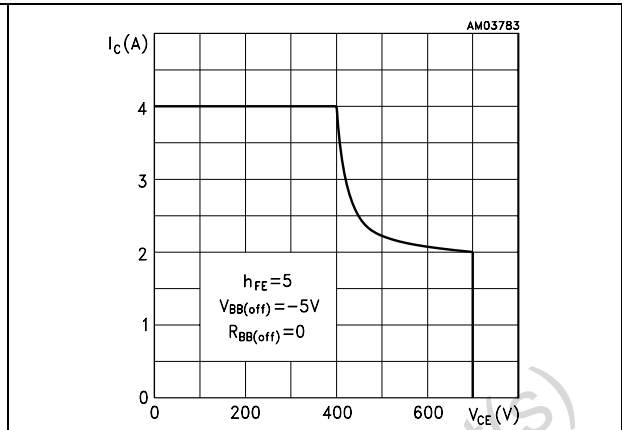


Figure 10. Resistive load switching times

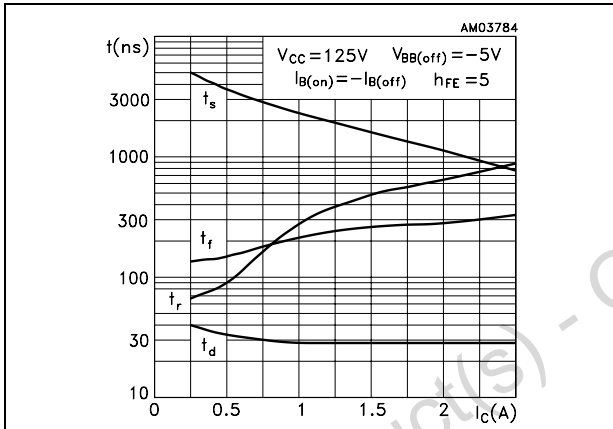
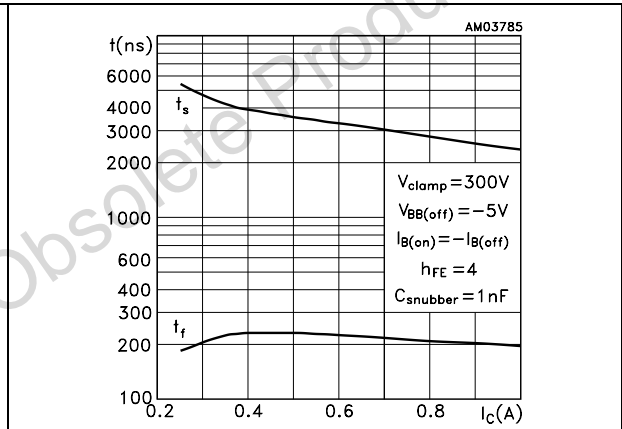
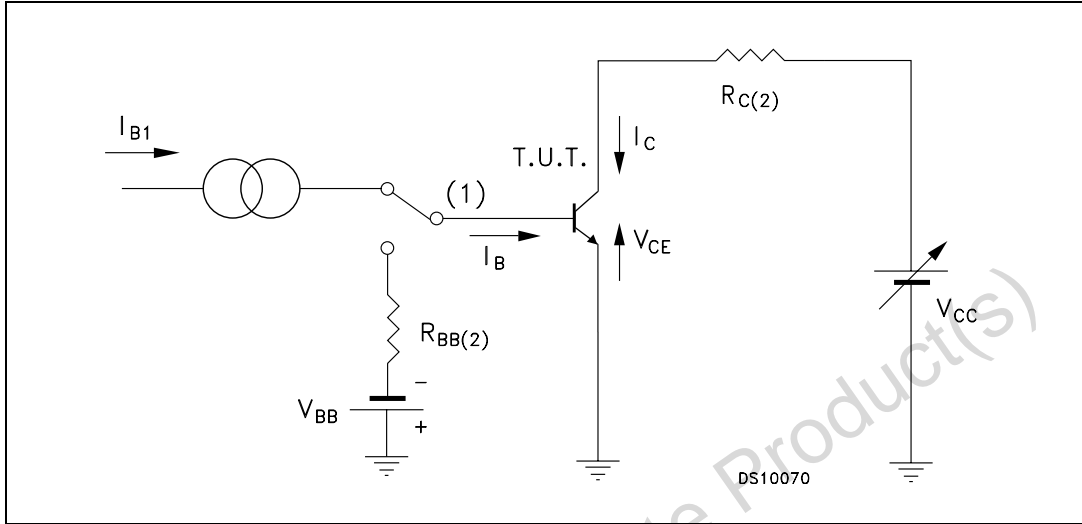


Figure 11. Inductive load switching times



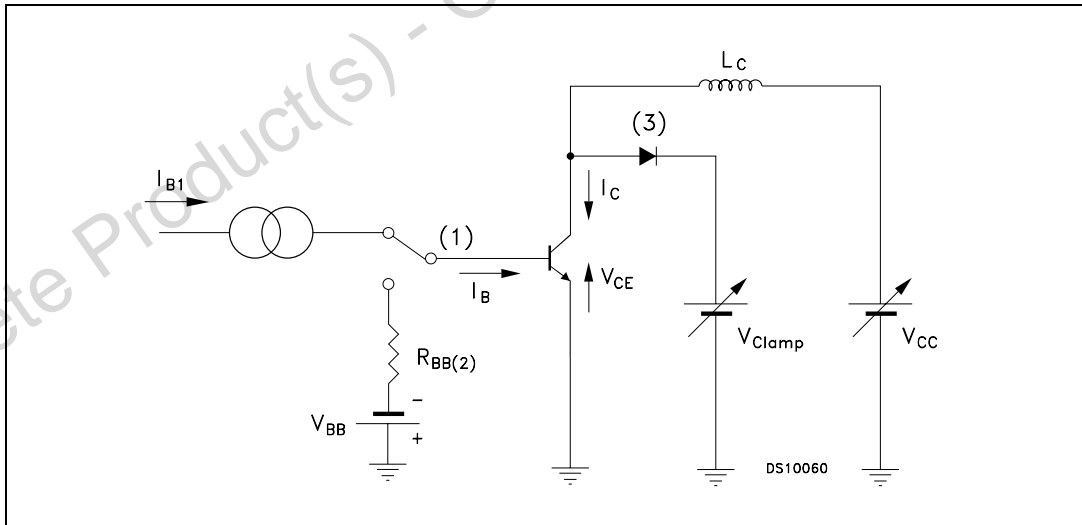
2.2 Test circuits

Figure 12. Resistive load switching test circuit



- 1. Fast electronic switch
- 2. Non-inductive resistor

Figure 13. Inductive load switching test circuit



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

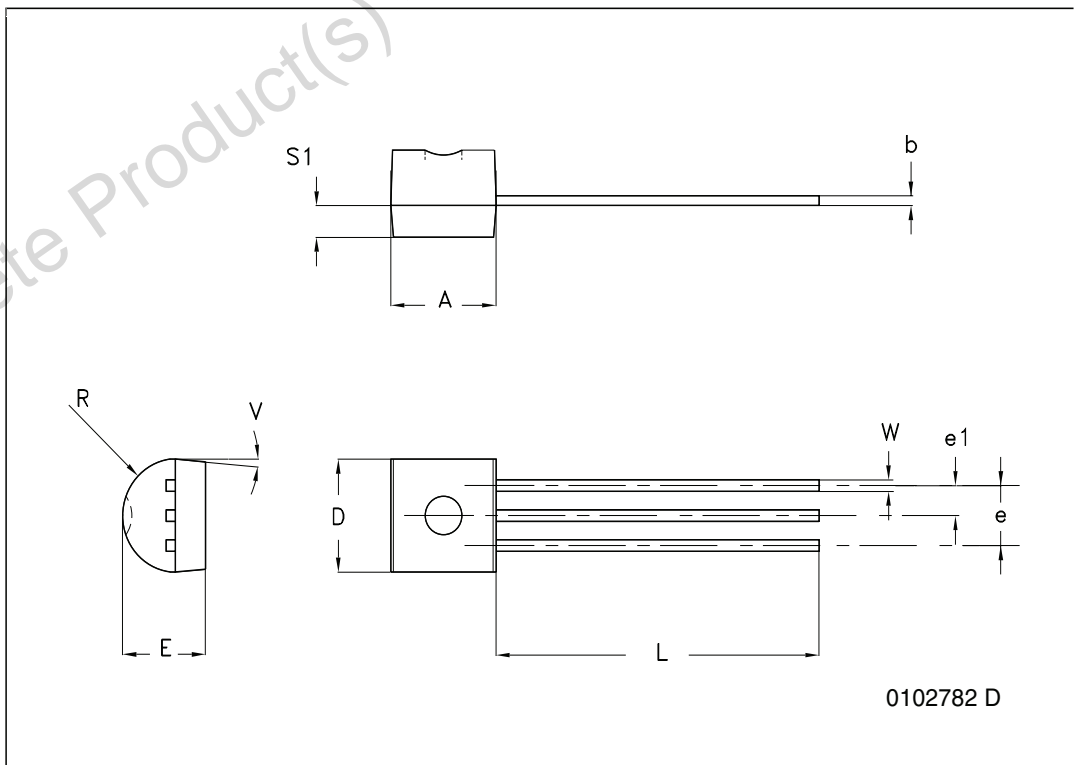
3 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: www.st.com. ECOPACK® is an ST trademark.

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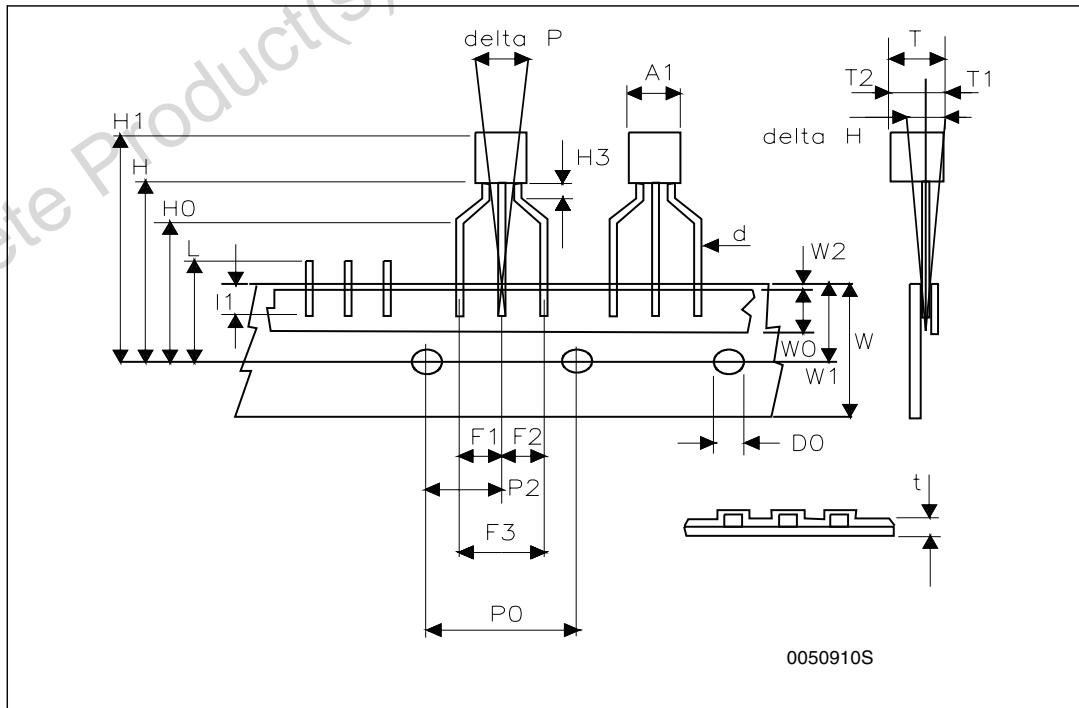
TO-92 bulk shipment mechanical data

DIM.	mm.		
	MIN.	TYP	MAX.
A	4.32		4.95
b	0.36		0.51
D	4.45		4.95
E	3.30		3.94
e	2.41		2.67
e1	1.14		1.40
L	12.70		15.49
R	2.16		2.41
S1	0.92		1.52
W	0.41		0.56
V		5°	



TO-92 ammopack shipment (suffix"-AP") mechanical data

Dim.	mm		
	Min	Typ	Max
A1			4.80
T			3.80
T1			1.60
T2			2.30
d			0.48
P0	12.50	12.70	12.90
P2	5.65	6.35	7.05
F1,F2	2.44	2.54	2.94
F3	4.98	5.08	5.48
delta H	-2.00		2.00
W	17.50	18.00	19.00
W0	5.70	6.00	6.30
W1	8.50	9.00	9.25
W2			0.50
H	18.50		20.50
H3	0.5	1	1.5
H0	15.50	16.00	16.50
H1			25.00
D0	3.80	4.00	4.20
t			0.90
L			11.00
I1	3.00		
delta P	-1.00		1.00



4 Revision history

Table 5. Document revision history

Date	Revision	Changes
01-Apr-2009	1	First release.
21-Apr-2010	2	Updated h_{FE} specification Table 4 on page 3 .
06-Jul-2010	3	Added R_{thJA} value Table 3 on page 2 and updated I_{CES} maximum value Table 4 on page 3 .

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