

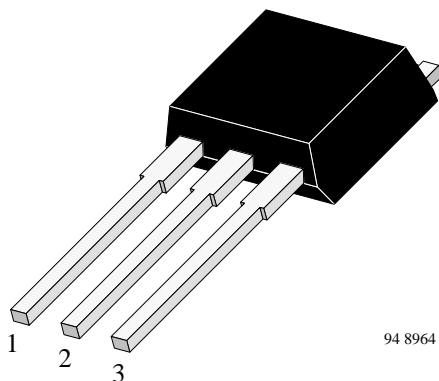
### Silicon NPN High Voltage Switching Transistor

#### Features

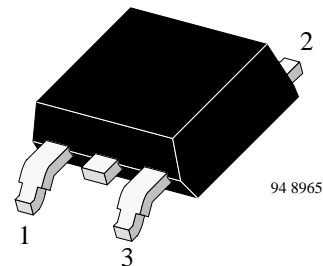
- Monolithic integrated C-E-free-wheel diode
- HIGH SPEED technology
- Planarpassivation
- Very short switching times
- Very low switching losses
- Very low dynamic saturation
- Very low operating temperature
- High reverse voltage

#### Applications

Electronic lamp ballast circuits  
Switch-mode power supplies



TD13004D • TD13005D  
1 Base 2 Collector 3 Emitter



TD13004D • TD13005D –SMD  
1 Base 2 Collector 3 Emitter

#### Absolute Maximum Ratings

$T_{case} = 25^{\circ}C$ , unless otherwise specified

Parameter	Test Conditions	Type	Symbol	Value	Unit
Collector-emitter voltage		TD13004D	$V_{CEO}$	300	V
		TD13005D	$V_{CEO}$	400	V
		TD13004D	$V_{CES}$	600	V
		TD13005D	$V_{CES}$	700	V
Emitter-base voltage			$V_{EBO}$	9	V
Collector current			$I_C$	4	A
Collector peak current			$I_{CM}$	6	A
Base current			$I_B$	2	A
Base peak current			$I_{BM}$	4	A
Total power dissipation	$T_{case} \leq 60^{\circ}C$		$P_{tot}$	30	W
Junction temperature			$T_j$	150	$^{\circ}C$
Storage temperature range			$T_{stg}$	-65 to +150	$^{\circ}C$

## Maximum Thermal Resistance

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

Parameter	Test Conditions	Symbol	Value	Unit
Junction case		$R_{\text{thJC}}$	3	K/W

## Electrical Characteristics

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

Parameter	Test Conditions	Type	Symbol	Min	Typ	Max	Unit
<b>Transistor</b>							
Collector cut-off current	$V_{\text{CE}} = 600 \text{ V}$	TD13004D	$I_{\text{CES}}$			50	$\mu\text{A}$
	$V_{\text{CE}} = 700 \text{ V}$	TD13005D	$I_{\text{CES}}$			50	$\mu\text{A}$
	$V_{\text{CE}} = 600 \text{ V}; T_{\text{case}} = 150^{\circ}\text{C}$	TD13004D	$I_{\text{CES}}$			0.5	mA
	$V_{\text{CE}} = 700 \text{ V}; T_{\text{case}} = 150^{\circ}\text{C}$	TD13005D	$I_{\text{CES}}$			0.5	mA
Collector-emitter breakdown voltage (figure 1)	$I_{\text{C}} = 300 \text{ mA}; L = 125 \text{ mH}; I_{\text{measure}} = 100 \text{ mA}$	TD13004D	$V_{(\text{BR})\text{CEO}}$	300			V
		TD13005D	$V_{(\text{BR})\text{CEO}}$	400			V
Emitter-base breakdown voltage	$I_{\text{E}} = 1 \text{ mA}$		$V_{(\text{BR})\text{EBO}}$	9			V
Collector-emitter saturation voltage	$I_{\text{C}} = 2 \text{ A}; I_{\text{B}} = 0.5 \text{ A}$		$V_{\text{CEsat}}$			0.6	V
Base-emitter saturation voltage	$I_{\text{C}} = 2 \text{ A}; I_{\text{B}} = 0.5 \text{ A}$		$V_{\text{BEsat}}$			1.6	V
DC forward current transfer ratio	$V_{\text{CE}} = 5 \text{ V}; I_{\text{C}} = 10 \text{ mA}$		$h_{\text{FE}}$	10			
	$V_{\text{CE}} = 5 \text{ V}; I_{\text{C}} = 1 \text{ A}$		$h_{\text{FE}}$	10			
	$V_{\text{CE}} = 5 \text{ V}; I_{\text{C}} = 4 \text{ A}$		$h_{\text{FE}}$	4			
Dynamic saturation voltage	$I_{\text{C}} = 2 \text{ A}; I_{\text{B}} = 0.4 \text{ A}, t = 1 \mu\text{s}$		$V_{\text{CEsatdyn}}$		3		V
	$I_{\text{C}} = 2 \text{ A}; I_{\text{B}} = 0.4 \text{ A}, t = 3 \mu\text{s}$		$V_{\text{CEsatdyn}}$		1		V
Gain bandwidth product	$V_{\text{CE}} = 10 \text{ V}; I_{\text{C}} = 500 \text{ mA}; f = 1 \text{ MHz}$		$f_{\text{T}}$	4			MHz
<b>Free-wheel diode</b>							
Forward voltage	$I_{\text{F}} = 2.5 \text{ A}$		$V_{\text{F}}$		1.3	1.5	V
Turn-on transient peak voltage	$I_{\text{F}} = 2.5 \text{ A}; di_{\text{F}}/dt = 10 \text{ A}/\mu\text{s}$		$V_{\text{FP}}$		4	5	V
Reverse recovery current	$I_{\text{F}} = 2.5 \text{ A}; -di_{\text{F}}/dt = 5 \text{ A}/\mu\text{s}; V_{\text{S}} = 200 \text{ V}$		$I_{\text{RM}}$		5		A

### Switching Characteristics

$T_{case} = 25^{\circ}C$ , unless otherwise specified

Parameter	Test Conditions	Type	Symbol	Min	Typ	Max	Unit
Resistive load (figure 2)							
Turn on time	$I_C = 2\text{ A}; I_{B1} = -I_{B2} = 0.4\text{ A};$ $V_S = 125\text{ V}$		$t_{on}$		0.25	0.4	$\mu s$
Storage time			$t_s$		1.5	2.5	$\mu s$
Fall time			$t_f$		0.15	0.3	$\mu s$
Inductive load (figure 3)							
Storage time	$I_C = 2\text{ A}; I_{B1} = 0.4\text{ A};$ $L = 200\text{ }\mu H; V_{clamp} = 300\text{ V};$ $-V_{BE} = 5\text{ V}; T_{case} = 100^{\circ}C$		$t_s$		1.2	2	$\mu s$
Cross over time			$t_c$		0.4	0.7	$\mu s$
Free-wheel diode							
Reverse recovery time	$I_F = 0.5\text{ A}; I_R = 1\text{ A};$ $i_R = 0.25\text{ A}$		$t_{rr}$		0.7	1	$\mu s$
Forward recovery time	$I_F = 2\text{ A}; di_F/dt = 10\text{ A}/\mu s$		$t_{fr}$		0.4		$\mu s$
Reverse recovery time	$I_F = 2\text{ A}; -di_F/dt = 5\text{ A}/\mu s$		$t_{rr}$		1.1		$\mu s$
			$t_{IRM}$		0.9		$\mu s$

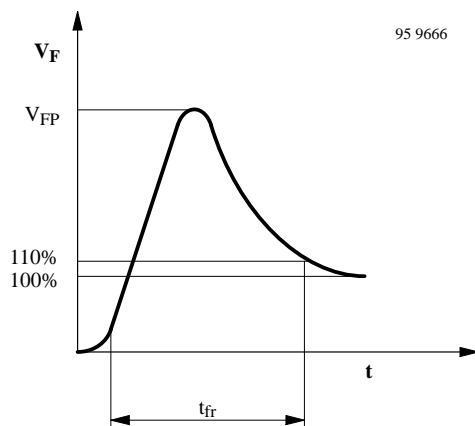


Figure 1. Turn on transient peak voltage

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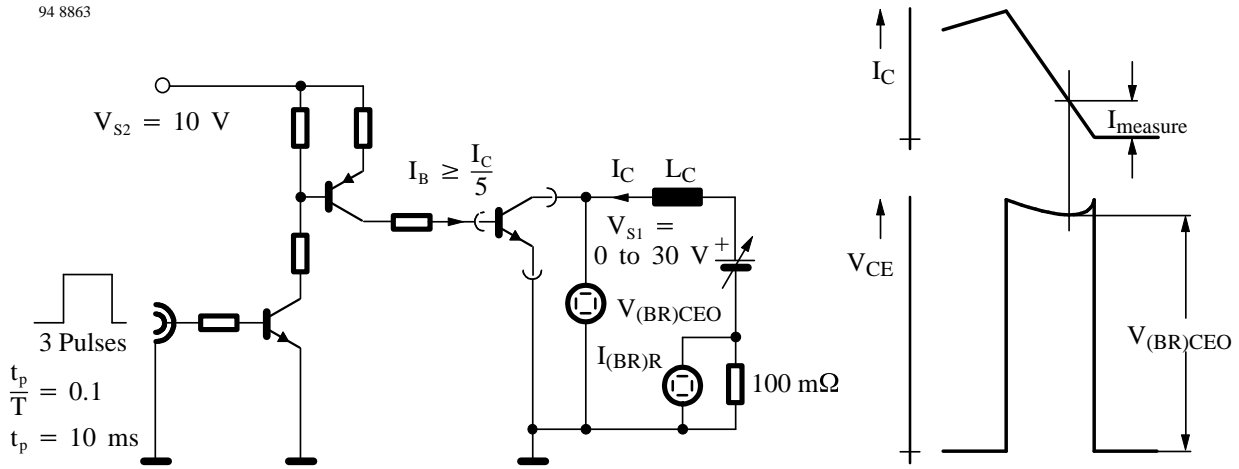
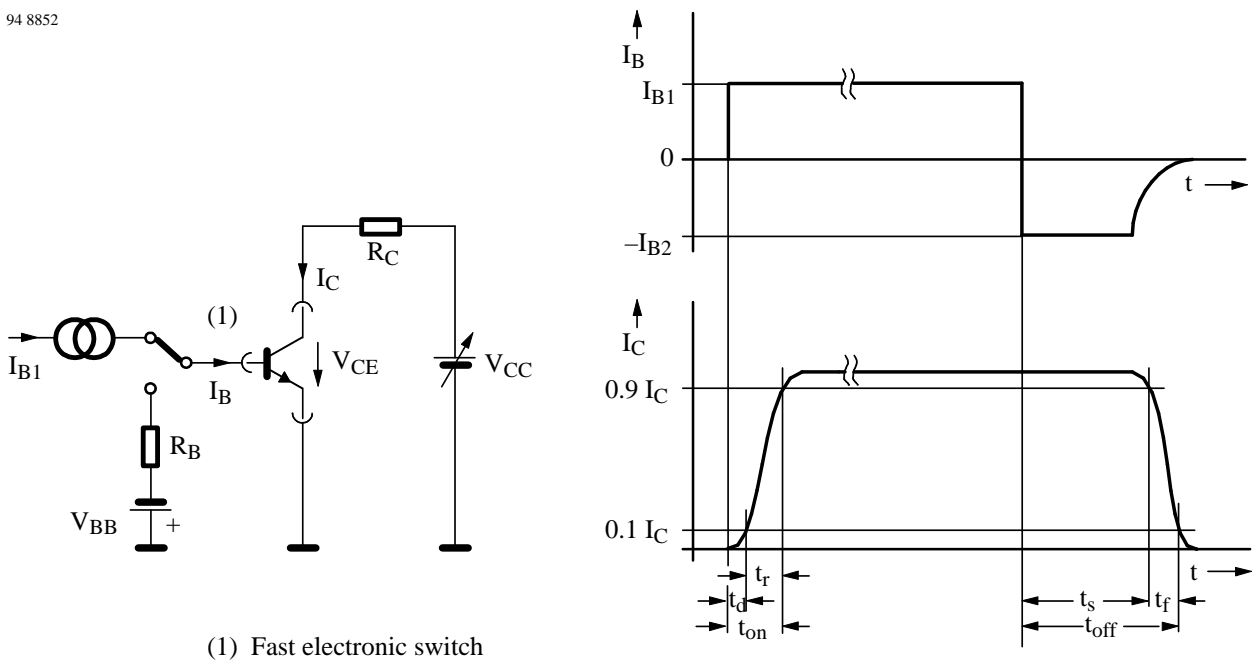


Figure 2. Test circuit for  $V_{(BR)CEO}$

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(1) Fast electronic switch

Figure 3. Test circuit for switching characteristics – resistive load

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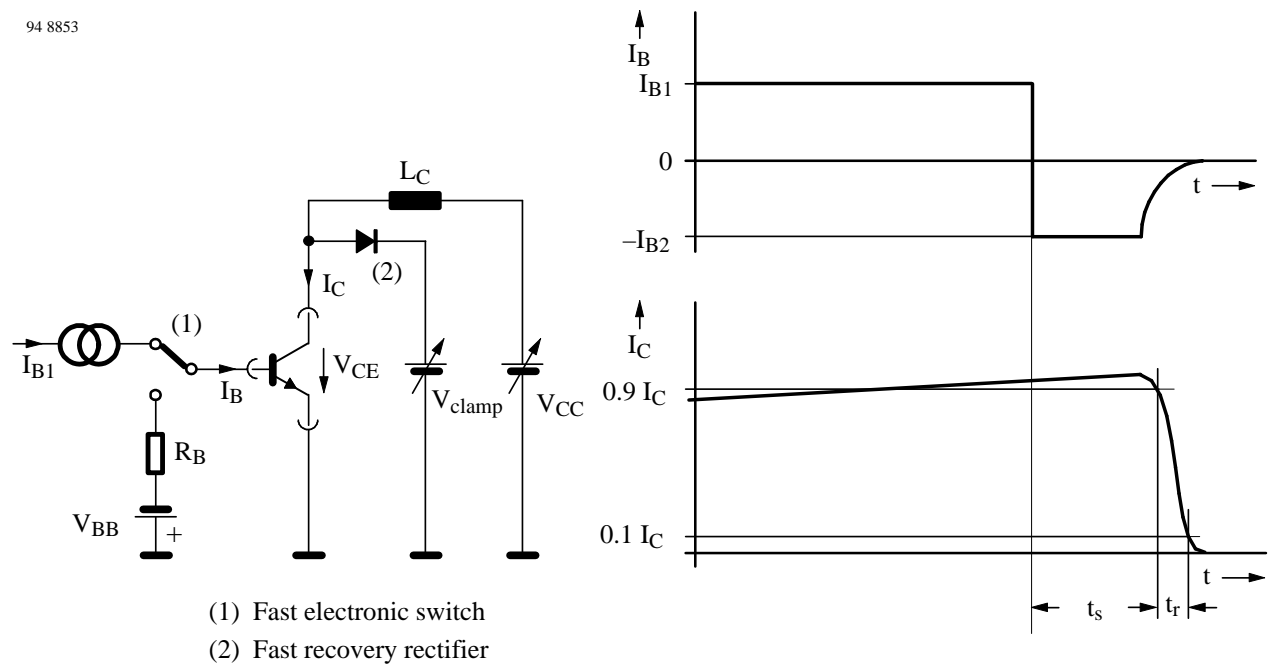
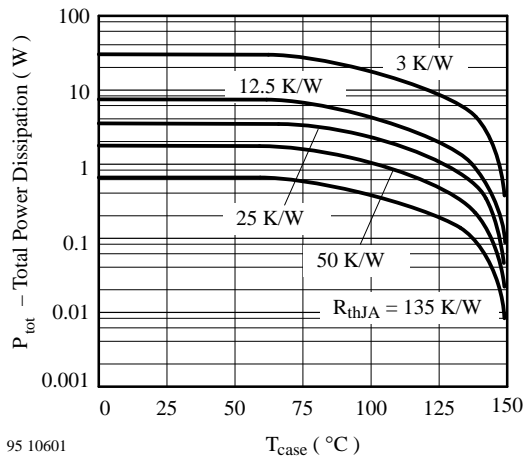


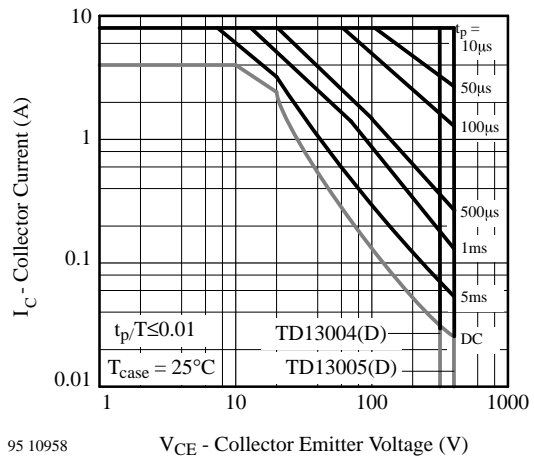
Figure 4. Test circuit for switching characteristics – inductive load

## Typical Characteristics ( $T_{case} = 25^{\circ}C$ unless otherwise specified)



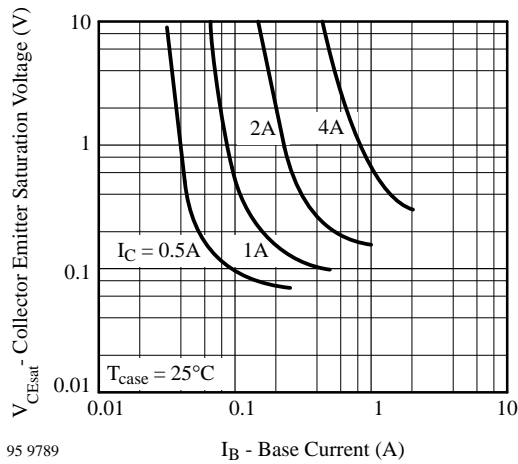
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Figure 5.  $P_{tot}$  vs.  $T_{case}$



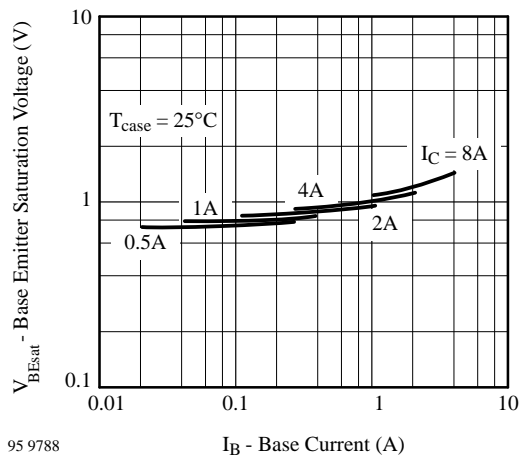
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Figure 8.  $I_C$  vs.  $V_{CE}$



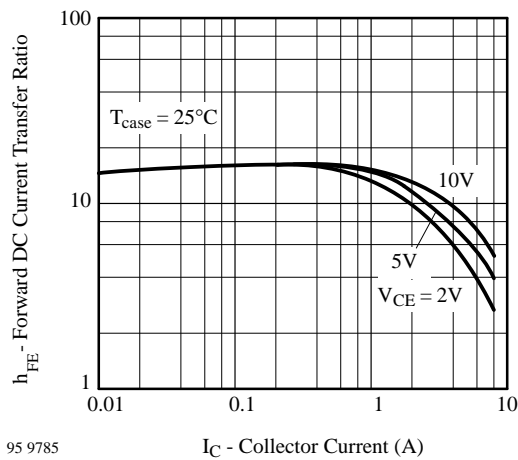
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Figure 6.  $V_{CE(sat)}$  vs.  $I_B$



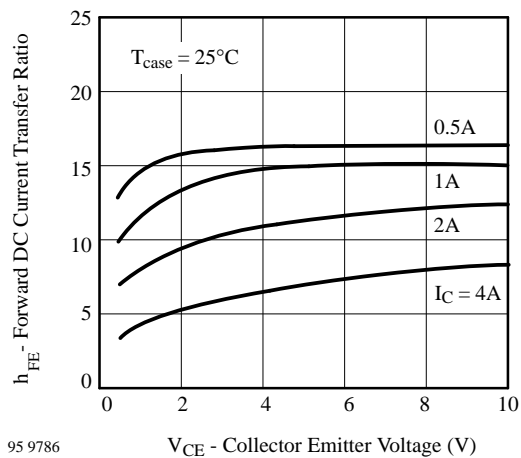
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Figure 9.  $V_{BE(sat)}$  vs.  $I_B$



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Figure 7.  $h_{FE}$  vs.  $I_C$



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Figure 10.  $h_{FE}$  vs.  $V_{CE}$

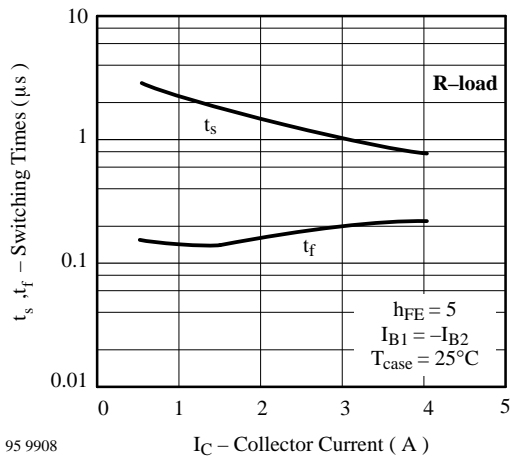


Figure 11.  $t_s, t_f$  vs.  $I_C$

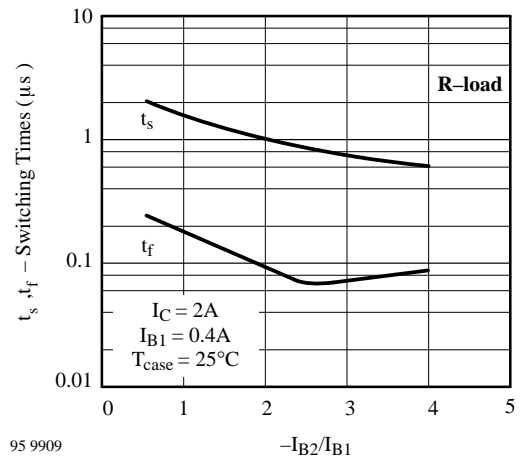


Figure 14.  $t_s, t_f$  vs.  $-I_{B2}/I_{B1}$

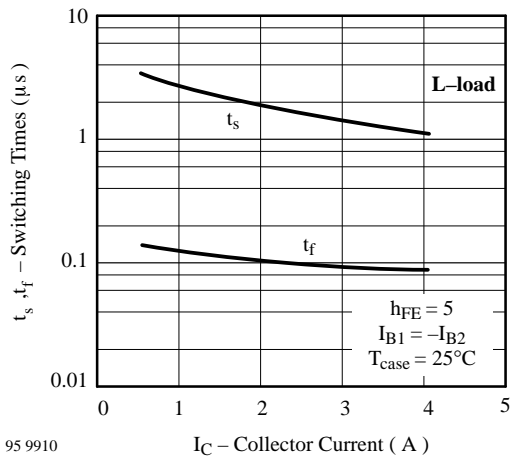


Figure 12.  $t_s, t_f$  vs.  $I_C$

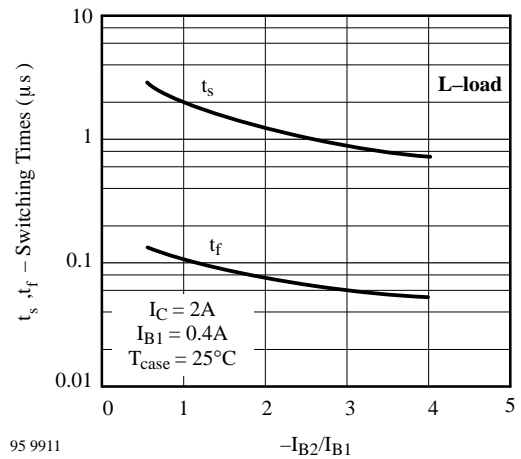


Figure 15.  $t_s, t_f$  vs.  $-I_{B2}/I_{B1}$

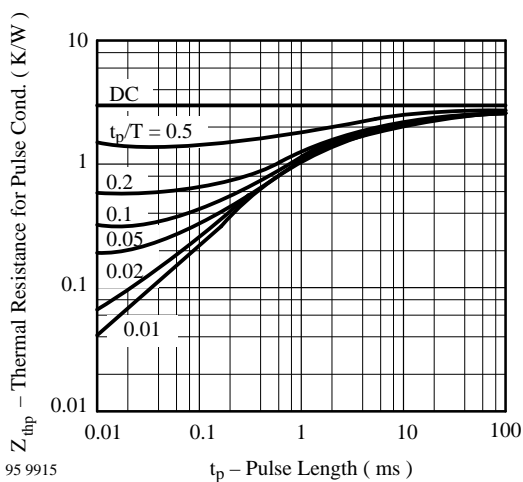


Figure 13.  $Z_{thp}$  vs.  $t_p$

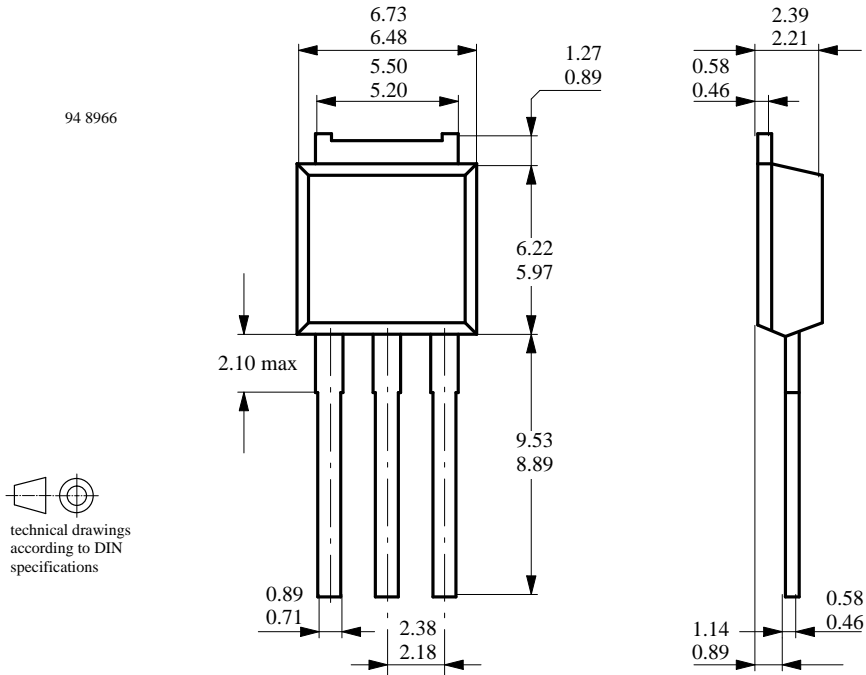
# TD13004D • TD13005D

# TEMIC

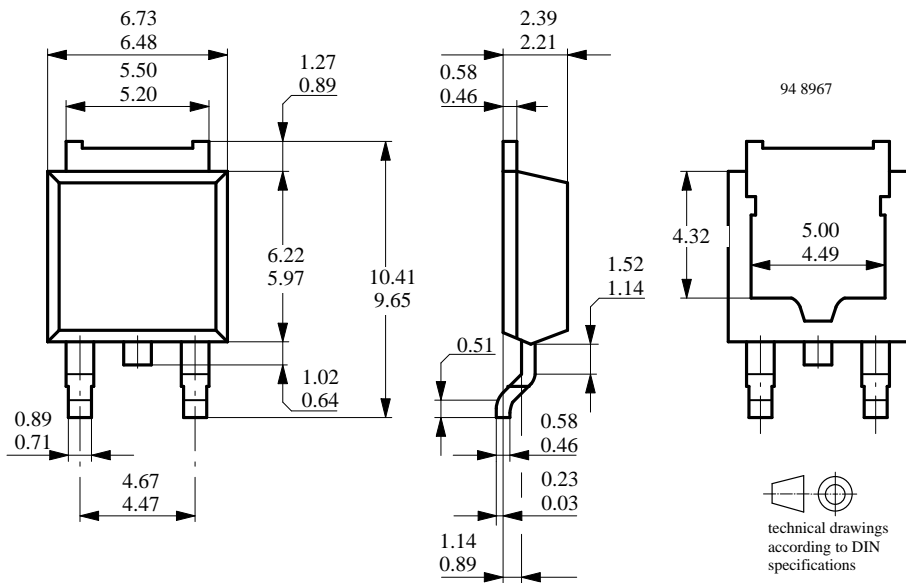
TELEFUNKEN Semiconductors

## Dimensions in mm

TO251



TO252



For ordering TO 252 add SMD to the type number (i.e. TD13005D -SMD)



### Ozone Depleting Substances Policy Statement

It is the policy of **TEMIC TELEFUNKEN microelectronic GmbH** to

1. Meet all present and future national and international statutory requirements.
2. Regularly and continuously improve the performance of our products, processes, distribution and operating systems with respect to their impact on the health and safety of our employees and the public, as well as their impact on the environment.

It is particular concern to control or eliminate releases of those substances into the atmosphere which are known as ozone depleting substances (ODSs).

The Montreal Protocol (1987) and its London Amendments (1990) intend to severely restrict the use of ODSs and forbid their use within the next ten years. Various national and international initiatives are pressing for an earlier ban on these substances.

**TEMIC TELEFUNKEN microelectronic GmbH** semiconductor division has been able to use its policy of continuous improvements to eliminate the use of ODSs listed in the following documents.

1. Annex A, B and list of transitional substances of the Montreal Protocol and the London Amendments respectively
2. Class I and II ozone depleting substances in the Clean Air Act Amendments of 1990 by the Environmental Protection Agency (EPA) in the USA
3. Council Decision 88/540/EEC and 91/690/EEC Annex A, B and C (transitional substances) respectively.

**TEMIC** can certify that our semiconductors are not manufactured with ozone depleting substances and do not contain such substances.

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