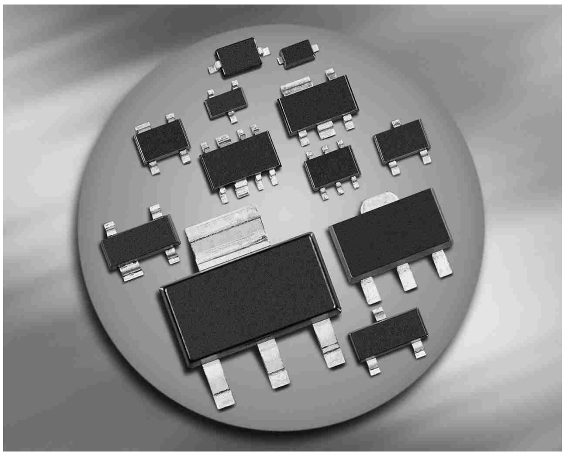
NPN Silicon Switching Transistors

- High DC current gain: 0.1 mA to 100 mA
- Low collector-emitter saturation voltage
- For SMBT3904S:
  Two (galvanic) internal isolated transistors
  with good matching in one package
- Complementary types: SMBT3906... MMBT3906
- SMBT3904S: For orientation in reel
  see package information below
- Pb-free (RoHS compliant) package
- Qualified according AEC Q101



AEC Qualified RoHS

Type	Marking	Pin Configuration						Package
SMBT3904/MMBT3904	s1A	1=B	2=E	3=C	-	-	-	SOT23
SMBT3904S	s1A	1=E1	2=B1	3=C2	4=E2	5=B2	6=C1	SOT363

Maximum Ratings

Parameter	Symbol	Value	Unit
Collector-emitter voltage	V_{CEO}	40	V
Collector-base voltage	V_{CBO}	60	
Emitter-base voltage	V_{EBO}	6	
Collector current	I_C	200	mA
Total power dissipation- $T_S \le 71$°C, SOT23, SMBT3904 $T_S \le 115$°C, SOT363, SMBT3904S	P_{tot}	 330 250	mV
Junction temperature	T_j	150	°C
Storage temperature	T_{stg}	-65 ... 150	

Thermal Resistance

Parameter	Symbol	Value	Unit
Junction - soldering point[1)] SMBT3904/MMBT3904 SMBT3904S	R_{thJS}	 $\le$ 240 $\le$ 140	K/W

[1]For calculation of R_{thJA} please refer to Application Note AN077 (Thermal Resistance Calculation)

Electrical Characteristics at T_A = 25°C, unless otherwise specified

Parameter	Symbol	Values			Unit
		min.	typ.	max.	
DC Characteristics					
Collector-emitter breakdown voltage I_C = 1 mA, I_B = 0	$V_{(BR)CEO}$	40	-	-	V
Collector-base breakdown voltage I_C = 10 µA, I_E = 0	$V_{(BR)CBO}$	60	-	-	
Emitter-base breakdown voltage I_E = 10 µA, I_C = 0	$V_{(BR)EBO}$	6	-	-	
Collector-base cutoff current V_{CB} = 30 V, I_E = 0	I_{CBO}	-	-	50	nA
DC current gain[1)] I_C = 100 µA, V_{CE} = 1 V I_C = 1 mA, V_{CE} = 1 V I_C = 10 mA, V_{CE} = 1 V I_C = 50 mA, V_{CE} = 1 V I_C = 100 mA, V_{CE} = 1 V	h_{FE}	 40 70 100 60 30	 - - - - -	 - - 300 - -	-
Collector-emitter saturation voltage[1)] I_C = 10 mA, I_B = 1 mA I_C = 50 mA, I_B = 5 mA	V_{CEsat}	 - -	 - -	 0.2 0.3	V
Base emitter saturation voltage[1)] I_C = 10 mA, I_B = 1 mA I_C = 50 mA, I_B = 5 mA	V_{BEsat}	 0.65 -	 - -	 0.85 0.95	

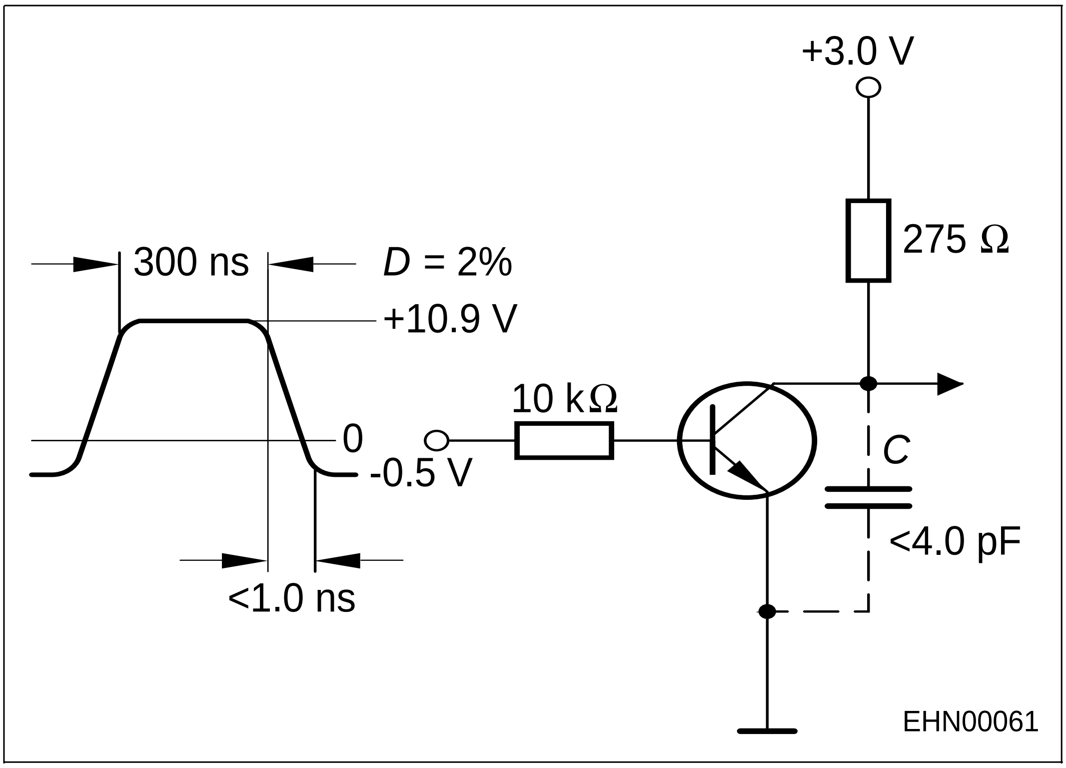
[1]Pulse test: t < 300µs; D < 2%

Electrical Characteristics at T_A = 25°C, unless otherwise specified

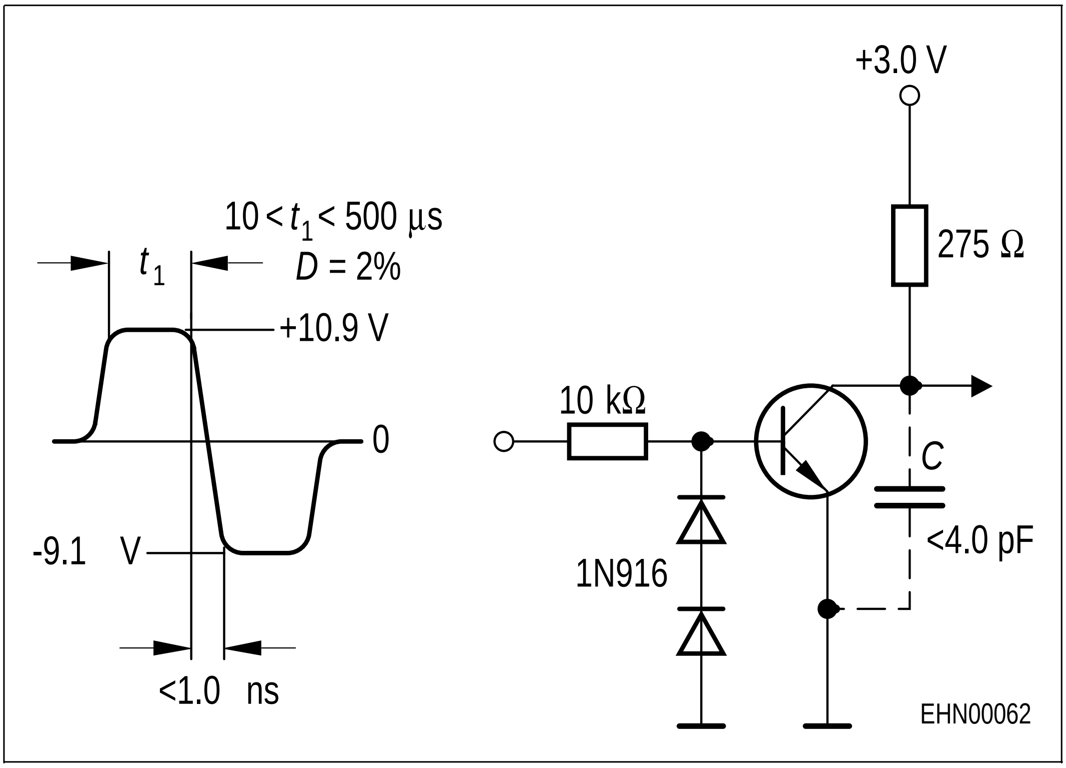
Parameter	Symbol	Values			Unit
		min.	typ.	max.	
AC Characteristics					
Transition frequency I_C = 10 mA, V_{CE} = 20 V, f = 100 MHz	f_T	300	-	-	MHz
Collector-base capacitance V_{CB} = 5 V, f = 1 MHz	C_{cb}	-	-	3.5	pF
Emitter-base capacitance V_{EB} = 0.5 V, f = 1 MHz	C_{eb}	-	-	8	
Delay time V_{CC} = 3 V, I_C = 10 mA, I_{B1} = 1 mA, $V_{BE(off)}$ = 0.5 V	t_d	-	-	35	ns
Rise time V_{CC} = 3 V, I_C = 10 mA, I_{B1} = 1 mA, $V_{BE(off)}$ = 0.5 V	t_r	-	-	35	
Storage time V_{CC} = 3 V, I_C = 10 mA, I_{B1} = I_{B2} = 1 mA	t_{stg}	-	-	200	
Fall time V_{CC} = 3 V, I_C = 10 mA, I_{B1} = I_{B2} = 1 mA	t_f	-	-	50	
Noise figure I_C = 100 µA, V_{CE} = 5 V, f = 1 kHz, Δf = 200 Hz, R_S = 1 kΩ	F	-	-	5	dB

Test circuits

Delay and rise time

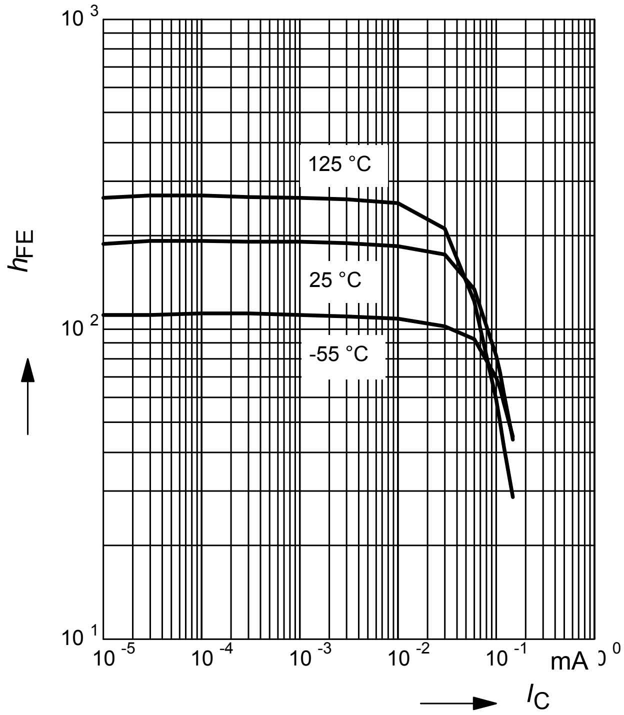


Storage and fall time



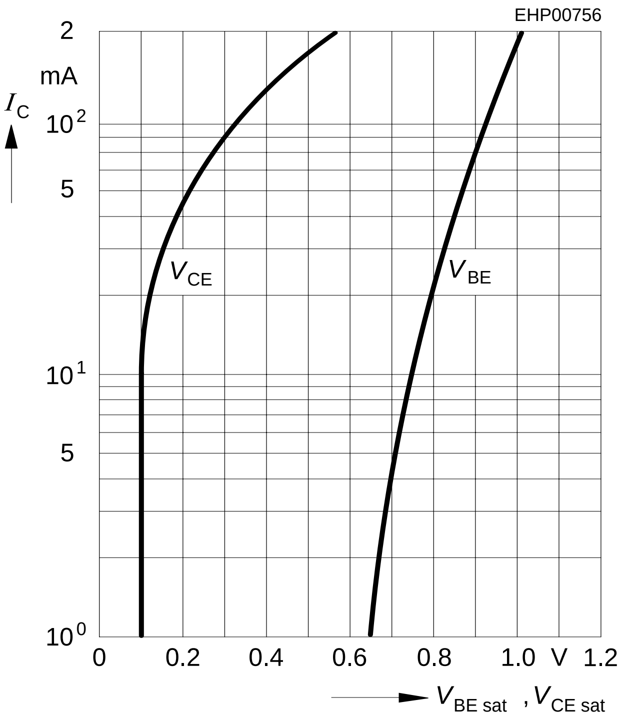
DC current gain $h_{FE} = f(I_C)$

V_{CE} = 1 V, normalized



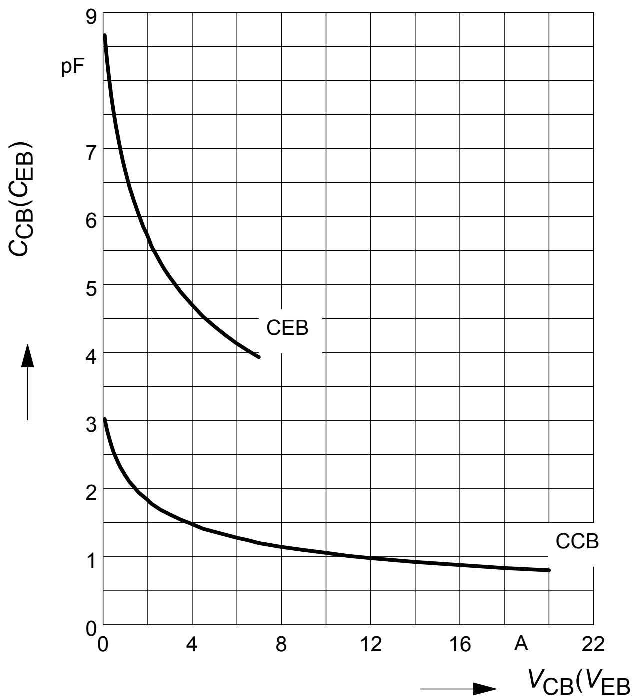
Saturation voltage $I_C = f(V_{BEsat}; V_{CEsat})$

h_{FE} = 10



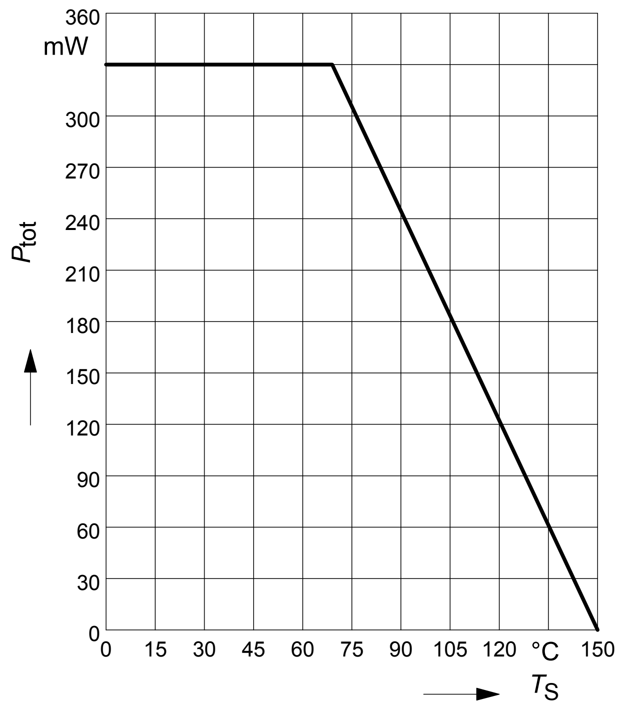
Collector-base capacitance $C_{cb} = f(V_{CB})$

Emitter-base capacitance $C_{eb} = f(V_{EB})$



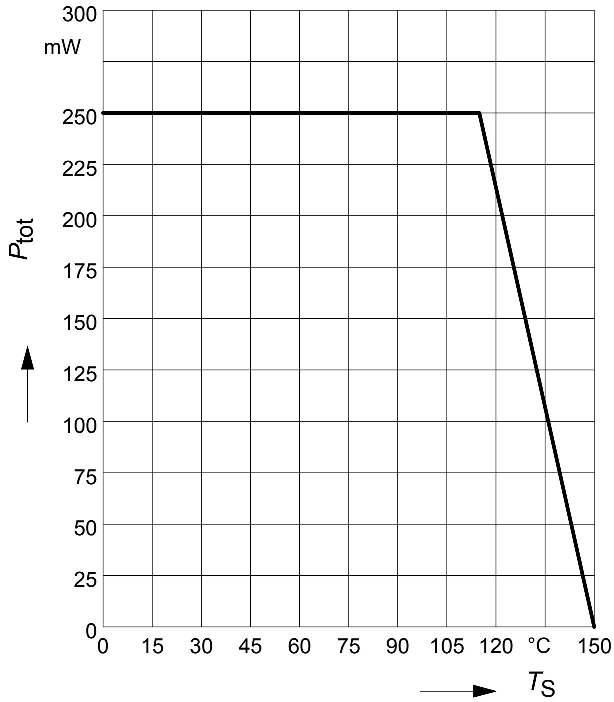
Total power dissipation $P_{tot} = f(T_S)$

SMBT3904/MMBT3904



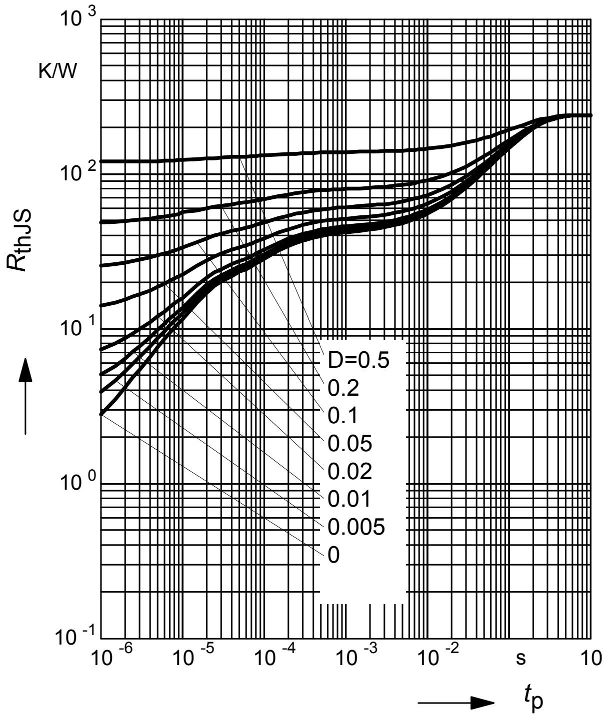
Total power dissipation $P_{tot} = f(T_S)$

SMBT3904S



Permissible Pulse Load $R_{thJS} = f(t_p)$

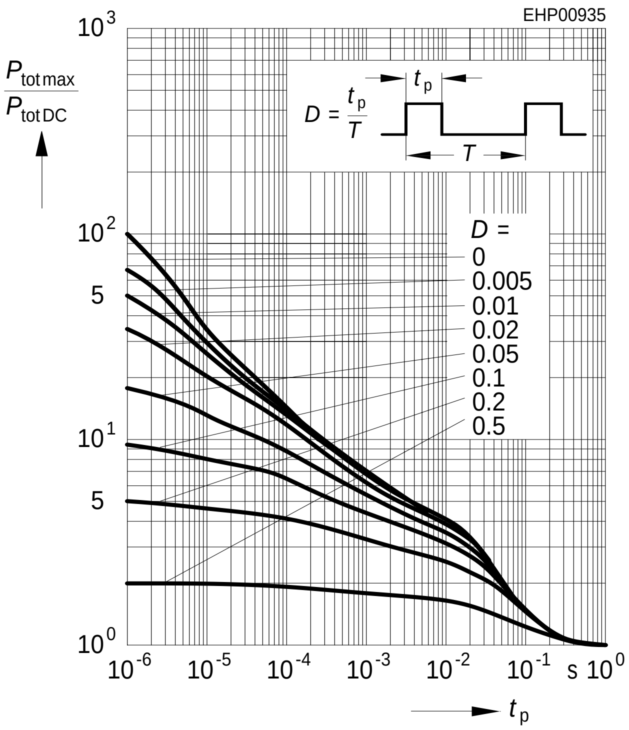
SMBT3904/ MMBT3904



Permissible Pulse Load

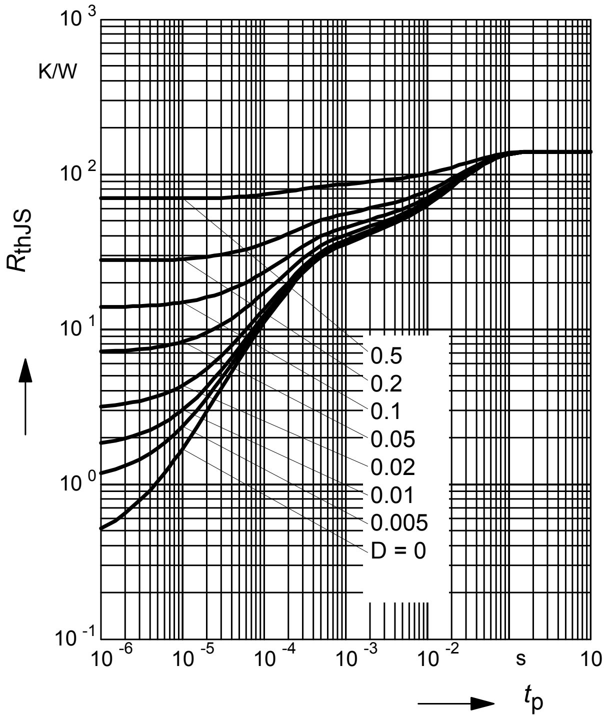
$P_{totmax}/P_{totDC} = f(t_p)$

SMBT3904/MMBT3904



Permissible Puls Load $R_{thJS} = f(t_p)$

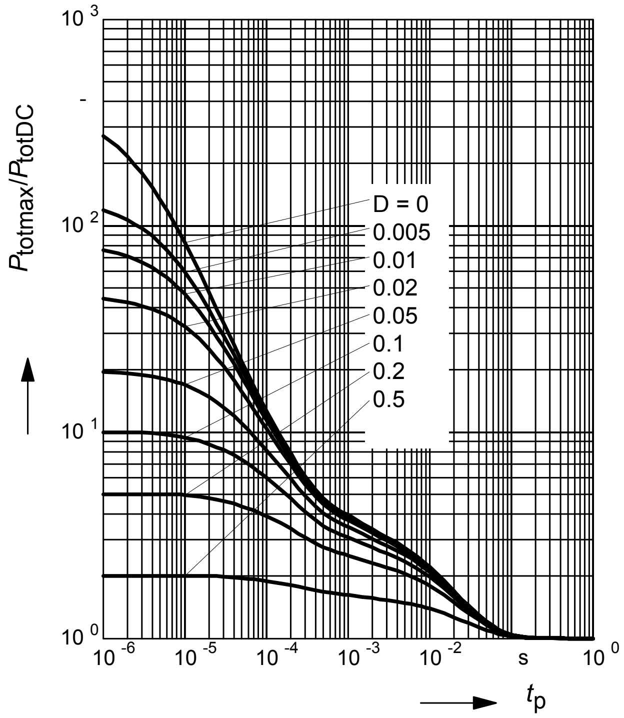
SMBT3904S



Permissible Pulse Load

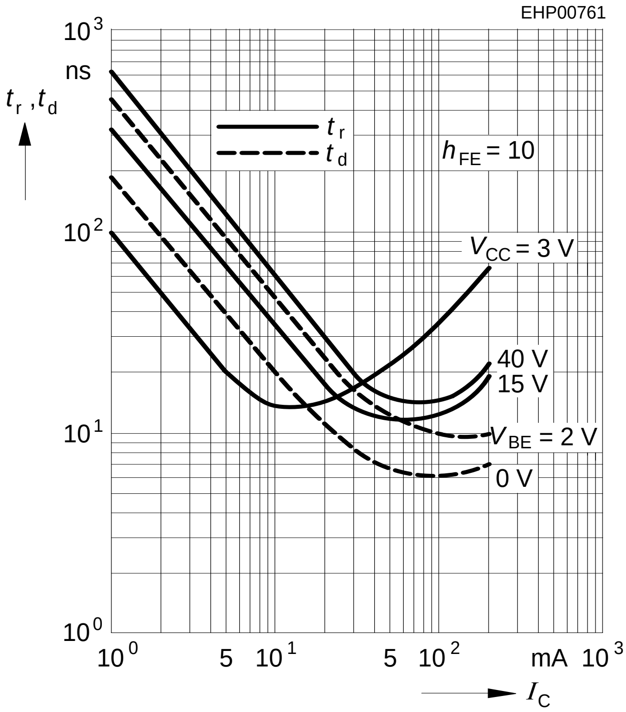
$P_{totmax}/P_{totDC} = f(t_p)$

SMBT3904S

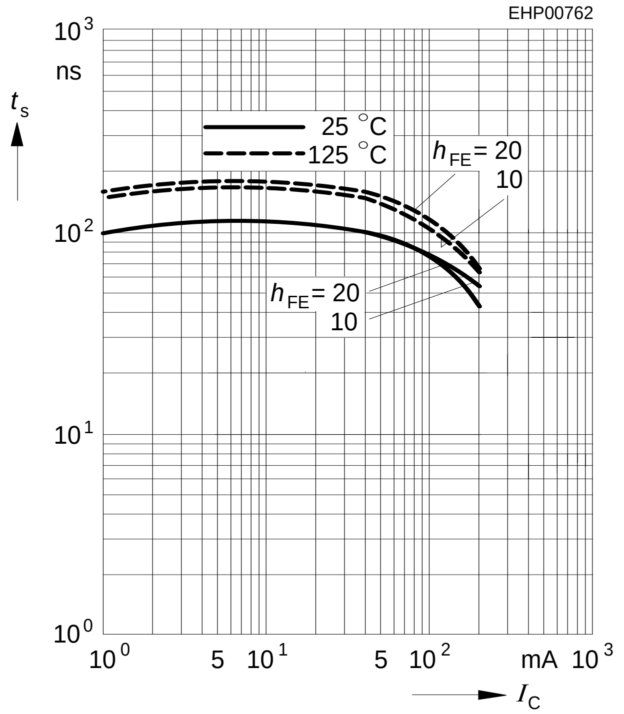


Delay time $t_d = f(I_C)$

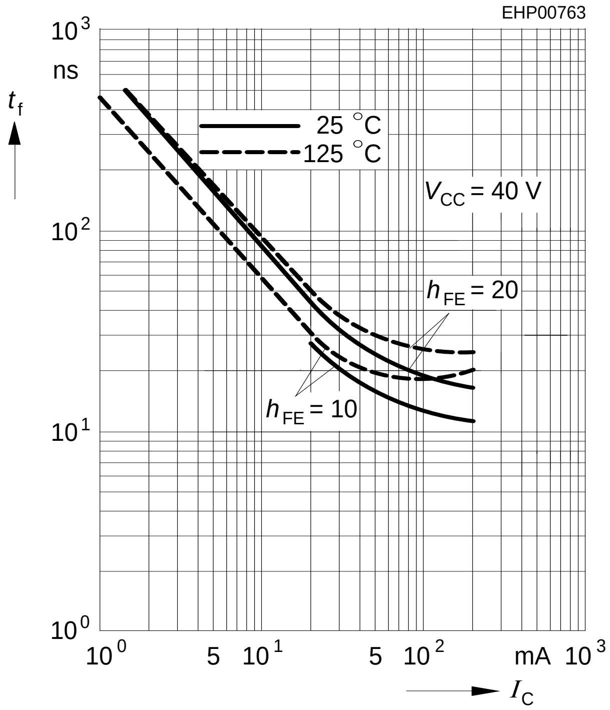
Rise time $t_r = f(I_C)$



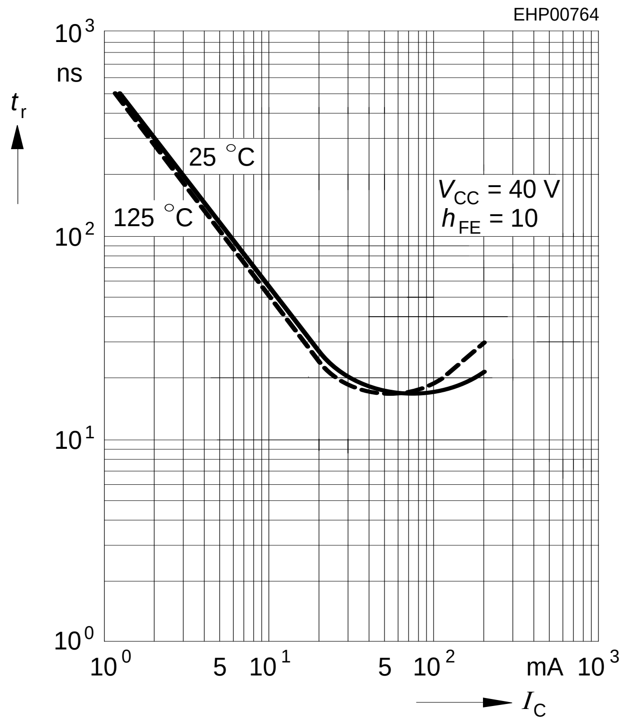
Storage time $t_{stg} = f(I_C)$



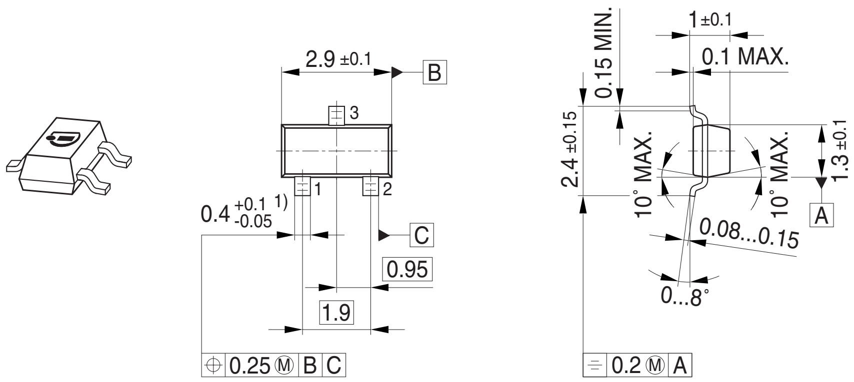
Fall time $t_f = f(I_C)$



Rise time $t_r = f(I_C)$

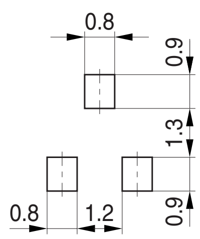


Package Outline

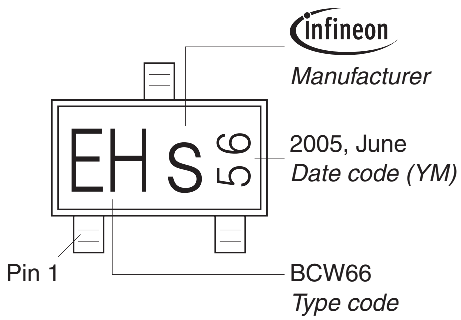


1) Lead width can be 0.6 max. in dambar area

Foot Print

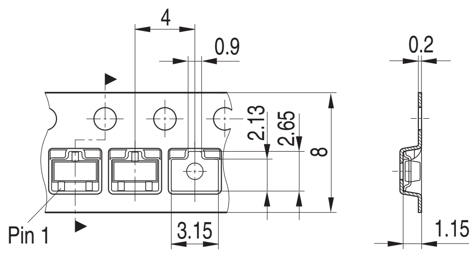


Marking Layout (Example)

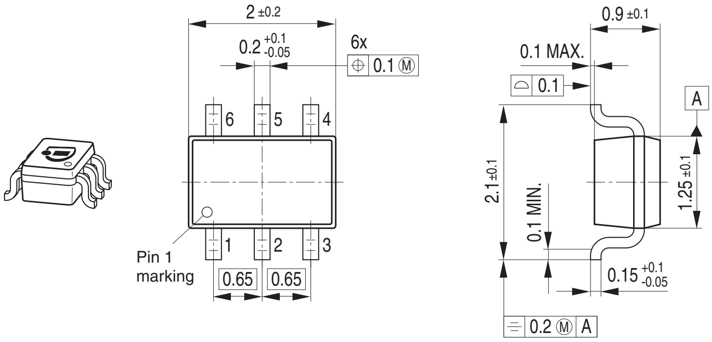


Standard Packing

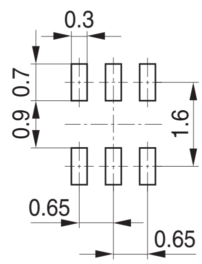
Reel ø180 mm = 3.000 Pieces/Reel
Reel ø330 mm = 10.000 Pieces/Reel



Package Outline

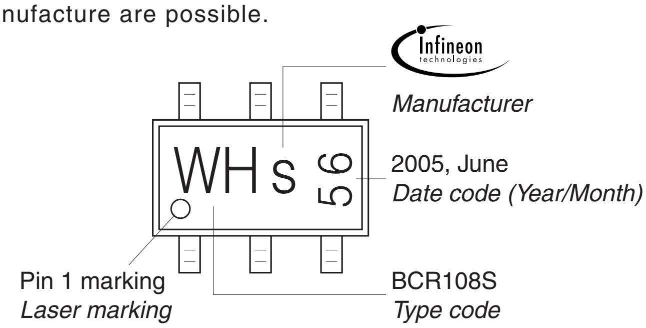


Foot Print



Marking Layout (Example)

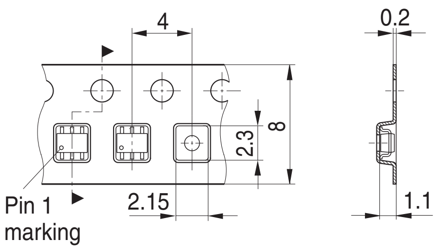
Small variations in positioning of
Date code, Type code and Manufacture are possible.



Standard Packing

Reel ø180 mm = 3.000 Pieces/Reel
Reel ø330 mm = 10.000 Pieces/Reel

For symmetric types no defined Pin 1 orientation in reel.



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