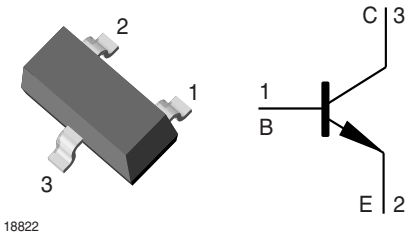
Small Signal Transistor (NPN)

Features

- NPN Silicon Epitaxial Planar Transistor for switching and amplifier applications.
- As complementary type, the PNP transistor MMBT3906 is recommended.
- This transistor is also available in the TO-92 case with the type designation 2N3904.



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Mechanical Data

Case: SOT-23 Plastic Package
Weight: approx. 8.8 mg

Packaging Codes/Options:
GS18 / 10 k per 13" reel (8 mm tape), 10 k/box
GS08 / 3 k per 7" reel (8 mm tape), 15 k/box

Parts Table

Part	Type differentiation	Ordering code	Marking	Remarks
MMBT3904	h_{FE}, 100 to 300 @ 10 mA	MMBT3904-GS18 or MMBT3904-GS08	1AM	Tape and Reel

Absolute Maximum Ratings

T_{amb} = 25 °C, unless otherwise specified

Parameter	Test condition	Symbol	Value	Unit
Collector - base voltage		V_{CBO}	60	V
Collector - emitter voltage		V_{CEO}	40	V
Emitter - base voltage		V_{EBO}	6	V
Collector current		I_C	200	mA
Power dissipation	T_A = 25 °C	P_{tot}	225[1)]	mW
		P_{tot}	300[2)]	mW

[1)] Device on fiberglass substrate, see layout.

[2)] Device on alumina substrate.

Maximum Thermal Resistance

Parameter	Test condition	Symbol	Value	Unit
Thermal resistance junction to substrate backside		R_{thSB}	320[1)]	°C/W
Thermal resistance junction to ambient air		R_{thJA}	450[1)]	°C/W
Junction temperature		T_j	150	°C
Storage temperature range		T_S	- 65 to + 150	°C

[1)] Device on fiberglass substrate, see layout.

Electrical DC Characteristics

Parameter	Test condition	Symbol	Min	Typ	Max	Unit
DC Current gain	V_{CE} = 1 V, I_C = 0.1 mA	h_{FE}	40			
	V_{CE} = 1 V, I_C = 1 mA	h_{FE}	70			
	V_{CE} = 1 V, I_C = 10 mA	h_{FE}	100		300	
	V_{CE} = 1 V, I_C = 50 mA	h_{FE}	60			
	V_{CE} = 1 V, I_C = 100 mA	h_{FE}	30			
Collector - base breakdown voltage	I_C = 10 µA, I_E = 0	$V_{(BR)CBO}$	60			V
Collector - emitter breakdown voltage	I_C = 10 mA, I_B = 0	$V_{(BR)CEO}$	40			V
Emitter - base breakdown voltage	I_E = 10 µA, I_C = 0	$V_{(BR)EBO}$	6.0			V
Collector saturation voltage	I_C = 10 mA, I_B = 1 mA	V_{CEsat}			0.2	V
	I_C = 50 mA, I_B = 5 mA	V_{CEsat}			0.3	V
Base saturation voltage	I_C = 10 mA, I_B = 1 mA	V_{BEsat}			0.85	V
	I_C = 50 mA, I_B = 5 mA	V_{BEsat}			0.95	V
Collector-emitter cut-off current	V_{EB} = 3 V, V_{CE} = 30 V	I_{CEV}			50	nA
Emitter-base cut-off current	V_{EB} = 3 V, V_{CE} = 30 V	I_{EBV}			50	nA

Electrical AC Characteristics

Parameter	Test condition	Symbol	Min	Typ	Max	Unit
Gain - bandwidth product	V_{CE} = 20 V, I_C = 10 mA, f = 100 MHz	f_T	300			MHz
Collector - base capacitance	V_{CB} = 5 V, f = 100 kHz	C_{CBO}			4	pF
Emitter - base capacitance	V_{EB} = 0.5 V, f = 100 kHz	C_{EBO}			8	pF
Noise figure	V_{CE} = 5 V, I_C = 100 µA, R_G = 1 KΩ, f = 10 to15000 HZ	NF			5	dB
Input impedance	V_{CE} = 10 V, I_C = 1 mA, f = 1 kHz	h_{ie}	1		10	kΩ
Small signal current gain	V_{CE} = 10 V, I_C = 1 mA, f = 1 kHz	h_{fe}	100		400	
Voltage feedback ratio	V_{CE} = 10 V, I_C = 1 mA, f = 1 kHz	h_{re}	0.5×10^{-4}		8×10^{-4}	
Output admittance	V_{CE} = 1 V, I_C = 1 mA, f = 1 kHz	h_{oe}	1		40	µS
Delay time (see fig. 1)	I_B = 1 mA, I_C = 10 mA	t_d			35	ns
Rise time (see fig. 1)	I_B = 1 mA, I_C= 10 mA	t_r			35	ns
Storage time (see fig. 2)	- I_{B1} = I_{B2} = 1 mA, I_C = 10 mA	t_s			200	ns
Fall time (see fig. 2)	- I_{B1} = I_{B2} = 1 mA, I_C = 10 mA	t_f			50	ns

Test Circuit

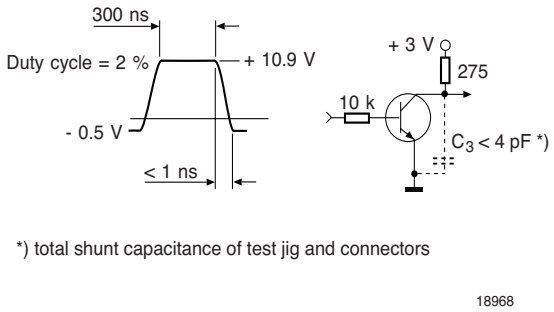


Fig. 1 Test Circuit for Delay and Rise Time

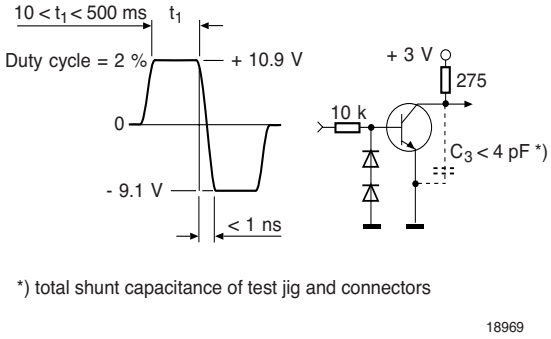
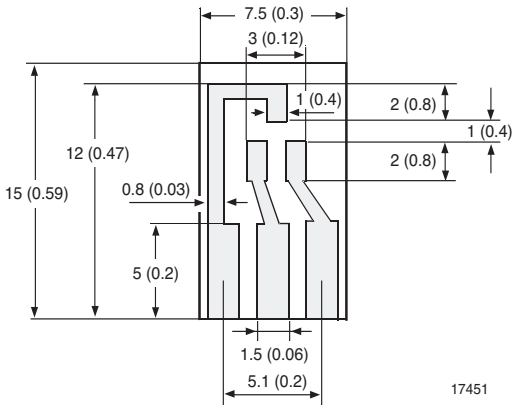


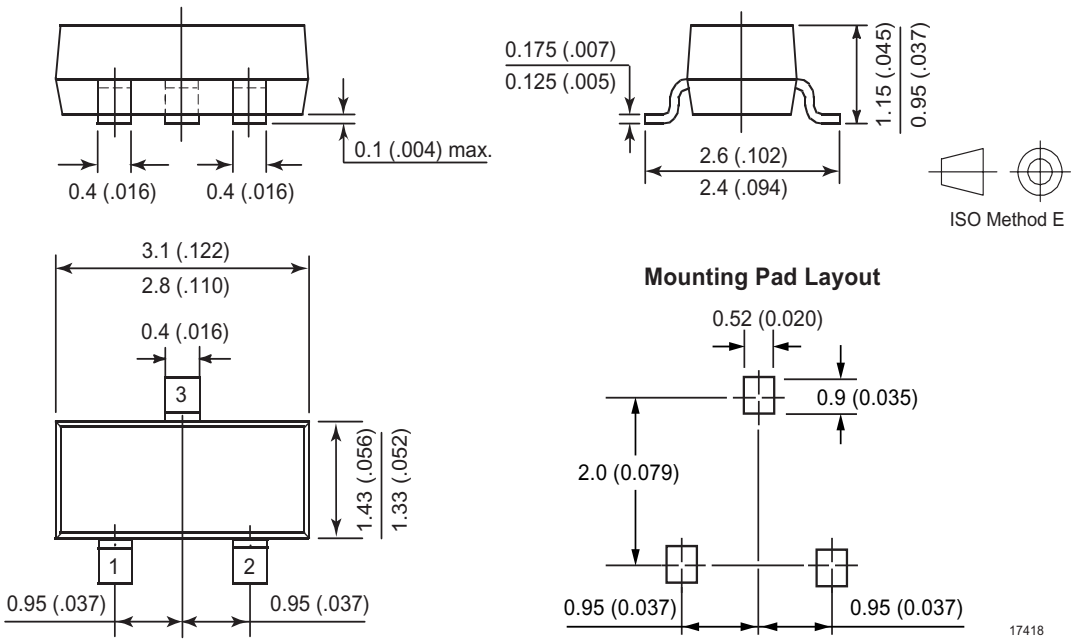
Fig. 2 Test Circuit for Storage and Fall Time

Layout for R_{thJA} test

Thickness: Fiberglass 1.5 mm (0.059 in.)
Copper leads 0.3 mm (0.012 in.)



Package Dimensions in mm (Inches)



Ozone Depleting Substances Policy Statement

It is the policy of **Vishay Semiconductor 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 operatingsystems 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.

Vishay Semiconductor GmbH 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.

Vishay Semiconductor GmbH can certify that our semiconductors are not manufactured with ozone depleting substances and do not contain such substances.

Vishay Semiconductor GmbH, P.O.B. 3535, D-74025 Heilbronn, Germany
Telephone: 49 (0)7131 67 2831, Fax number: 49 (0)7131 67 2423