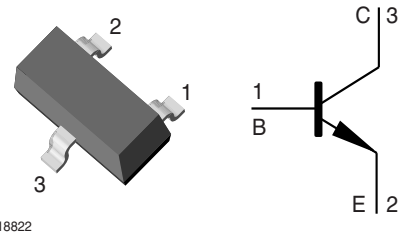
Small Signal Transistor (NPN)

Features

- NPN Silicon Epitaxial Planar Transistor for switching and amplifier applications.
- As complementary type, the PNP transistor MMBT4403 is recommended.
- This transistor is also available in the TO-92 case with the type designation 2N4401.



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
MMBT4401	h_{FE}, 100 to 300 @ 150 mA	MMBT4401-GS18 or MMBT4401-GS08	2X	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 (continuous)		I_C	200	mA
Power dissipation	FR-5 board [1], T_A = 25 °C	P_{tot}	225	mW
	Derate above 25 °C	P_{tot}	1.8	mW/°C
	Alumina substrate [2], T_A = 25 °C	P_{tot}	300	mW
	Derate above 25 °C	P_{tot}	2.4	mW/°C

[1] FR-5 Board = 1.0 x 0.75 x 0.062 in.

[2] Alumina Substrate = 0.4 x 0.3 x 0.024 in. 99.5 % alumina

Maximum Thermal Resistance

Parameter	Test condition	Symbol	Value	Unit
Thermal resistance junction to ambient air	FR-5 board	R_{thJA}	556	°C/W
	Alumina substrate	R_{thJA}	417	°C/W
Junction temperature		T_j	150	°C
Storage temperature range		T_S	- 55 to + 150	°C

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}	20			
	V_{CE} = 1 V, I_C = 1 mA	h_{FE}	40			
	V_{CE} = 1 V, I_C = 10 mA	h_{FE}	80			
	V_{CE} = 1 V, I_C = 150 mA	h_{FE}	100		300	
	V_{CE} = 2 V, I_C = 500 mA	h_{FE}	40			
Collector - base breakdown voltage	I_C = 0.1 mA, I_E = 0	$V_{(BR)CBO}$	60			V
Collector - emitter breakdown voltage [1]	I_C = 1 mA, I_B = 0	$V_{(BR)CEO}$	40			V
Emitter - base breakdown voltage	I_E = 0.1 mA, I_C = 0	$V_{(BR)EBO}$	6.0			V
Collector - emitter saturation voltage	I_C = 150 mA, I_B = 15 mA	V_{CEsat}			0.40	V
	I_C = 500 mA, I_B = 50 mA	V_{CEsat}			0.75	V
Base - emitter saturation voltage	I_C = 150 mA, I_B = 15 mA	V_{BEsat}	0.75		0.95	V
	I_C = 500 mA, I_B = 50 mA	V_{BEsat}			1.20	V
Collector-emitter cut-off current	V_{EB} = 0.4 V, V_{CE} = 35 V	I_{CEX}			100	nA
Base cut - off current	V_{EB} = 0.4 V, V_{CE} = 35 V	I_{BL}			100	nA
Input impedance	V_{CE} = 10 V, I_C = 1 mA, f = 1 kHz	h_{ie}	1		15	kΩ
Voltage feedback ratio	V_{CE} = 10 V, I_C = 1 mA, f = 1 kHz	h_{re}	0.1×10^{-4}		8×10^{-4}	
Output admittance	V_{CE} = 10 V, I_C = 1 mA, f = 1 kHz	h_{oe}	1.0		30	µS
Small signal current gain	V_{CE} = 10 V, I_C = 1 mA, f = 1 kHz	h_{fe}	40		500	

[1] Pulse test: pulse width ≤ 300 µs, duty cycle ≤ 2 %

Electrical AC Characteristics

Parameter	Test condition	Symbol	Min	Typ	Max	Unit
Current gain - bandwidth product	V_{CE} = 10 V, I_C = 20 mA, f = 100 MHz	f_T	250			MHz
Collector - base capacitance	V_{CB} = 5 V, f = 1 MHz, I_E = 0	C_{CBO}			6.5	pF
Emitter - base capacitance	V_{CB} = 0.5 V, f = 1 MHz, I_C = 0	C_{EBO}			30	pF
Delay time (see fig.1)	I_{B1} = 15 mA, I_C = 150 mA, V_{CC} = 30 V, V_{BE} = 40 V	t_d			15	ns
Rise time (see fig.1)	I_{B1} = 15 mA, I_C = 150 mA, V_{CC} = 30 V, V_{BE} = 40 V	t_r			20	ns
Storage time (see fig.2)	I_{B1} = I_{B2} = 15 mA, I_C = 150 mA, V_{CC} = 30 V	t_s			225	ns
Fall time (see fig.2)	I_{B1} = I_{B2} = 1 mA, I_C = 150 mA, V_{CC} = 30 V	t_s			30	ns

Switching Time Equivalent Test Circuit

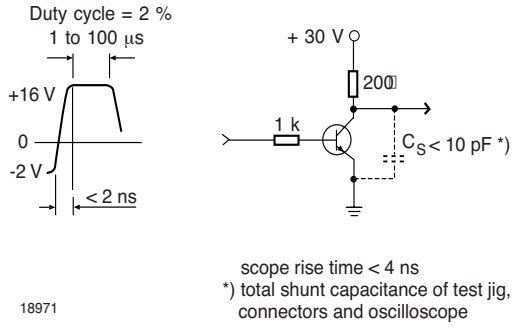


Fig. 1 Turn-On Time

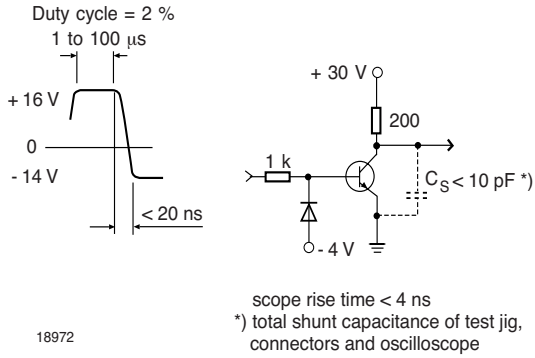
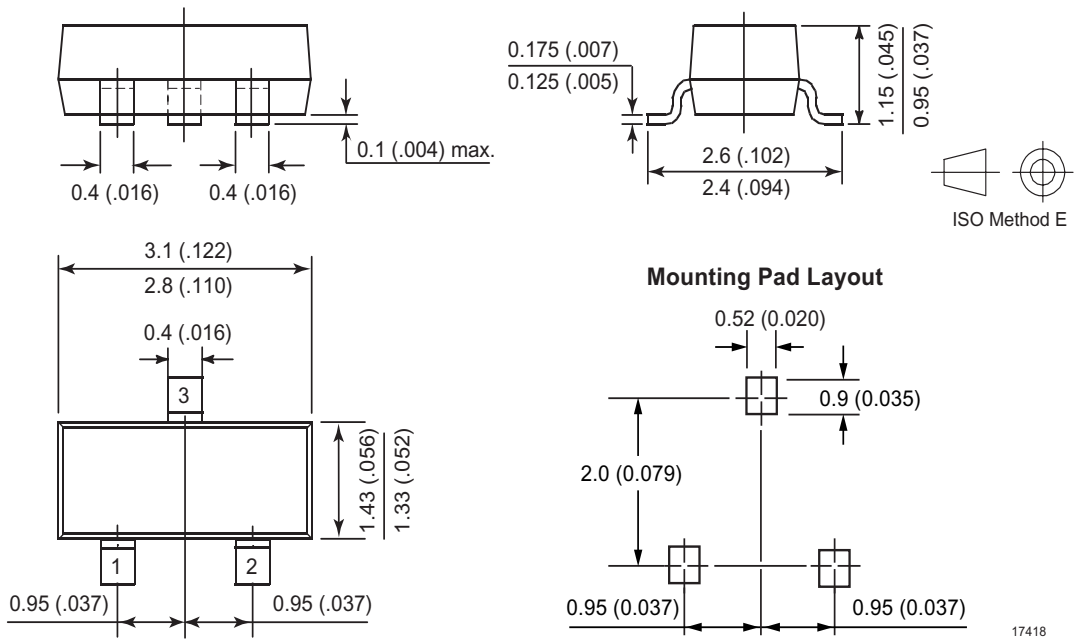


Fig. 2 Turn-Off Time

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.

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