SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N silicon transistors, in a microminiature plastic envelope intended for switching and linear applications in thick and thin-film circuits.

QUICK REFERENCE DATA

			PMBT2222	PMBT2222A	
Collector-base voltage (open emitter)	V_{CBO}	max.	60	75	V
Collector-emitter voltage (open base)	V_{CEO}	max.	30	40	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5,0	6,0	V
Collector current (d.c.)	I_C	max.	600		mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250		mW
D.C. current gain					
I_C = 150 mA; V_{CE} = 10 V	h_{FE}		100 to 300		
I_C = 500 mA; V_{CE} = 10 V	h_{FE}	>	30	40	
Transition frequency at f = 100 MHz					
I_C = 20 mA; V_{CE} = 20 V	f_T	>	250	300	MHz

MECHANICAL DATA

Dimensions in mm

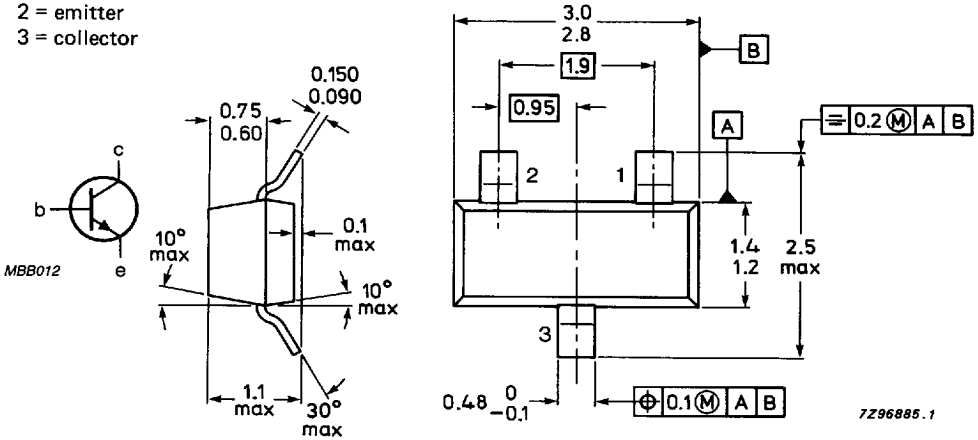
Fig. 1 SOT-23.

Pinning:

1 = base
2 = emitter
3 = collector

Marking code

PMBT2222 = p1B
PMBT2222A = p1P



TOP VIEW

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

			PMBT2222	PMBT2222A	
Collector-base voltage (open emitter)	V_{CBO}	max.	60	75	V
Collector-emitter voltage (open base)	V_{CEO}	max.	30	40	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5,0	6,0	V
Collector current (d.c.)	I_C	max	600		mA
Total power dissipation* up to T_{amb} = 25 °C	P_{tot}	max.	250		mW
Storage temperature range	T_{stg}		−65 to 150		°C
Junction temperature	T_j	max.	150		°C

THERMAL RESISTANCE *

From junction to ambient	$R_{th\ j\text{-}a}$	=	500	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

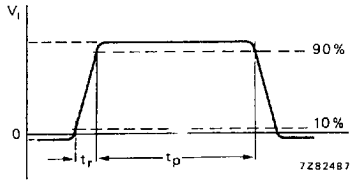
			PMBT2222	PMBT2222A	
Collector cut-off current					
I_E = 0; V_{CB} = 50 V	I_{CBO}	<	0,01	–	μA
I_E = 0; V_{CB} = 60 V	I_{CBO}	<	–	0,01	μA
I_E = 0; V_{CB} = 50 V; T_j = 125 °C	I_{CBO}	<	10	–	μA
I_E = 0; V_{CB} = 60 V; T_j = 125 °C	I_{CBO}	<	–	10	μA
V_{EB} = 3 V; V_{CE} = 60 V	I_{CEX}	<	–	10	nA
Base current with reverse biased emitter junction					
V_{EB} = 3 V; V_{CE} = 60 V	I_{BEX}	<	–	20	nA
Emitter cut-off current					
I_C = 0; V_{EB} = 3 V	I_{EBO}	<		10	nA
Saturation voltages**					
I_C = 150 mA; I_B = 15 mA	V_{CEsat}	<	400	300	mV
	V_{BEsat}	<	1300	–	mV
	V_{BEsat}		–	0,6 to 1,2	V
I_C = 500 mA; I_B = 50 mA	V_{CEsat}	<	1600	1000	mV
	V_{BEsat}	<	2600	2000	mV
Breakdown voltages					
I_C = 1,0 mA; I_B = 0	$V_{(BR)CEO}$	>	30	40	V
I_C = 100 μA; I_E = 0	$V_{(BR)CBO}$	>	60	75	V
I_C = 0; I_E = 10 μA	$V_{(BR)EBO}$	>	5,0	6,0	V

* Device mounted on a ceramic substrate of 8 mm x 10 mm x 0.7 mm.

** Measured under pulsed conditions to avoid excessive dissipation; $t_p \leqslant 300\ \mu s$; $\delta \leqslant 0{,}02$.

			PMBT2222	PMBT2222A	
D.C. current gain					
I_C = 0,1 mA; V_{CE} = 10 V	h_{FE}	>	35		
I_C = 1 mA; V_{CE} = 10 V	h_{FE}	>	50		
I_C = 10 mA; V_{CE} = 10 V	h_{FE}	>	75		
I_C = 10 mA; V_{CE} = 10 V; T_{amb} = −55 °C	h_{FE}	>	35		
I_C = 150 mA; V_{CE} = 10 V	h_{FE}		100 to 300		
I_C = 150 mA; V_{CE} = 1 V	h_{FE}	>	50		
I_C = 500 mA; V_{CE} = 10 V	h_{FE}	>	30	40	
Transition frequency at f = 100 MHz*					
I_C = 20 mA; V_{CE} = 20 V	f_T	>	250	300	MHz
Output capacitance at f = 1 MHz					
I_E = 0; V_{CB} = 10 V	C_o	<	8,0		pF
Input capacitance at f = 1 MHz					
I_C = 0; V_{EB} = 0,5 V	C_i	<	30	25	
h-parameters (common emitter) at f = 1 kHz					
I_C = 1 mA; V_{CE} = 10 V					
input impedance	h_{ie}		2,0 to 8,0		kΩ
reverse voltage transfer ratio	h_{re}		$< 8,0 \times 10^{-4}$		
small signal current gain	h_{fe}		50 to 300		
output admittance	h_{oe}		5,0 to 35		μS
I_C = 10 mA; V_{CE} = 10 V					
input impedance	h_{ie}		0,25 to 1,25		kΩ
reverse voltage transfer ratio	h_{re}		$< 4,0 \times 10^{-4}$		
small signal current gain	h_{fe}		75 to 375		
output admittance	h_{oe}		25 to 200		μS
Noise figure at R_S = 1 kΩ					
I_C = 100 μA; V_{CE} = 10 V; f = 1 kHz	F	<	4,0		dB
Switching times (between 10% and 90% levels)					
Turn-on time switched to I_C = 150 mA					
delay time	t_d	<	10		ns
rise time	t_r	<	25		ns
Turn-off time switched from I_C = 150 mA					
storage time	t_s	<	225		ns
fall time	t_f	<	60		ns

* f_T is defined as the frequency at which h_{fe} extrapolates to unity.



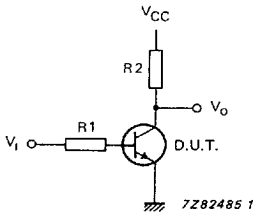
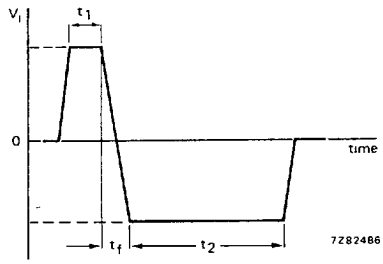


Fig. 2 Waveform and test circuit delay and rise time.

V_i = −0,5 to + 9,9 V; V_{CC} = 30 V; R1 = 619 Ω; R2 = 200 Ω.

Pulse generator:				Oscilloscope:			
pulse duration	t_p	⩽	200 ns	input impedance	Z_i	>	100 kΩ
rise time	t_r	⩽	2 ns	input capacitance	C_i	<	12 pF
duty factor	δ	=	2 %	rise time	t_r	<	5 ns



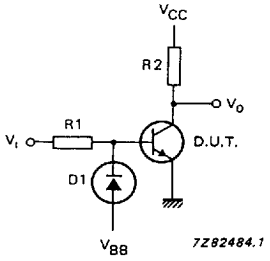


Fig. 3 Waveform and test circuit storage and fall time.

V_i = −13,8 to + 16,2 V; V_{CC} = 30 V; $-V_{BB}$ = 3 V; R1 = 1 kΩ; R2 = 200 Ω.

Pulse generator:				Oscilloscope:			
fall time	t_f	<	5 ns	input impedance	Z_i	>	100 kΩ
pulse time	t_1	=	100 μs	input capacitance	C_i	<	12 pF
	t_2	=	500 μs	rise time	t_r	<	5 ns

SILICON PLANAR EPITAXIAL SWITCHING TRANSISTOR

N-P-N transistor in a plastic SOT-23 envelope intended for high-speed switching applications.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V_{CBO}	max.	40	V
Collector-emitter voltage (V_{BE} = 0)	V_{CES}	max.	40	V
Collector-emitter voltage (open base)	V_{CEO}	max.	15	V
Collector current (d.c. value)	I_C	max.	500	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250	mW
D.C. current gain				
I_C = 10 mA; V_{CE} = 1 V	h_{FE}		40 to 120	
I_C = 100 mA; V_{CE} = 2 V	h_{FE}	>	20	
Storage time				
$I_{Con} = I_{Bon} = I_{Boff}$ = 10 mA	t_s	<	13	ns

MECHANICAL DATA

Dimensions in mm

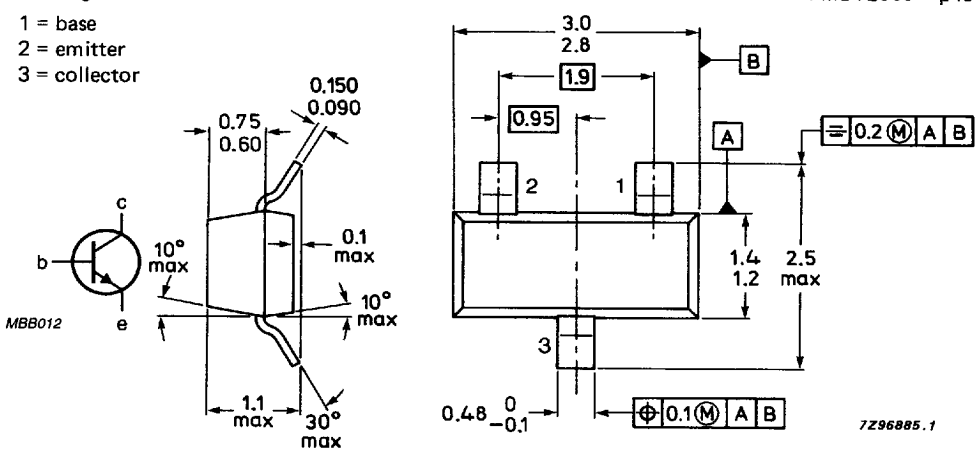
Fig. 1 SOT-23.

Marking code

PMBT2369 = p1J

Pinning:

1 = base
2 = emitter
3 = collector



TOP VIEW

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage (open emitter)	V_{CBO}	max.	40	V
Collector-emitter voltage (V_{BE} = 0)	V_{CES}	max.	40	V
Collector-emitter voltage (open base)	V_{CEO}	max.	15	V
Emitter-base voltage (open collector)	V_{EBO}	max.	4,5	V
Collector current (d.c. value)	I_C	max.	500	mA
Total power dissipation up to T_{amb} = 25 °C *	P_{tot}	max.	250	mW
Storage temperature	T_{stg}		−65 to 150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient in free air*	$R_{th\ j\text{-}a}$	=	500	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current				
I_E = 0; V_{CB} = 20 V	I_{CBO}	<	400	nA
I_E = 0; V_{CB} = 20 V; T_j = 125 °C	I_{CBO}	<	30	μA
Saturation voltages				
I_C = 10 mA; I_B = 1 mA	V_{CEsat}	<	0,25	V
	V_{BEsat}		0,70 to 0,85	V
D.C. current gain				
I_C = 10 mA; V_{CE} = 1 V	h_{FE}		40 to 120	
I_C = 10 mA; V_{CE} = 1 V; T_{amb} = −55 °C	h_{FE}	>	20	
I_C = 100 mA; V_{CE} = 2 V	h_{FE}	>	20	
Output capacitance at f = 1 MHz				
I_E = 0; V_{CB} = 5 V	C_o	<	4,0	pF
Small-signal current gain				
I_C = 1,0 mA; V_{CE} = 10 V; f = 100 MHz; T_{amb} = 25 °C	h_{fe}	>	5,0	pF
Breakdown voltages				
I_C = 10 mA; I_B = 0	$V_{(BR)CEO}$	min.	15	V
I_C = 10 μA; I_E = 0	$V_{(BR)CBO}$	min.	40	V
I_C = 0; I_E = 10 μA	$V_{(BR)EBO}$	min.	4,5	V
I_C = 10 μA; V_{BE} = 0	$V_{(BR)CES}$	min.	40	V

Switching times at T_{amb} = 25 °C

Storage time (see Fig. 2)		typ.	5,0	ns
$I_{Con} = I_{Bon} = -I_{Boff}$ = 10 mA	t_s	<	13	ns
Turn-on time (see Fig. 3)	t_{on}	typ.	8,0	ns
I_C = 10 mA; I_{Bon} = 3 mA; V_{CC} = 3 V	t_{on}	<	12	ns
Turn-off time (see Fig. 3)	t_{off}	typ.	10	ns
I_C = 10 mA; I_{Bon} = 3 mA; I_{Boff} = 1,5 mA; V_{CC} = 3 V	t_{off}	<	18	ns

* Device mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm .