

## NPN Silicon Switching Transistors

## SMBT 2222 SMBT 2222 A

- High DC current gain: 0.1 mA to 500 mA
- Low collector-emitter saturation voltage
- Complementary types: SMBT 2907,  
SMBT 2907 A (PNP)



Type	Marking	Ordering Code (tape and reel)	Pin Configuration			Package <sup>1)</sup>
			1	2	3	
SMBT 2222	s1B	Q68000-A6481	B	E	C	SOT-23
SMBT 2222 A	s1P	Q68000-A6473				

### Maximum Ratings

Parameter	Symbol	Values		Unit
		SMBT 2222	SMBT 2222 A	
Collector-emitter voltage	$V_{CE0}$	30	40	V
Collector-base voltage	$V_{CB0}$	60	75	
Emitter-base voltage	$V_{EB0}$	5	6	
Collector current	$I_C$	600		mA
Total power dissipation, $T_s = 77\text{ °C}$	$P_{tot}$	330		mW
Junction temperature	$T_j$	150		°C
Storage temperature range	$T_{stg}$	- 65 ... + 150		

### Thermal Resistance

Junction - ambient <sup>2)</sup>	$R_{th\ JA}$	≤ 290	K/W
Junction - soldering point	$R_{th\ JS}$	≤ 220	

<sup>1)</sup> For detailed information see chapter Package Outlines.

<sup>2)</sup> Package mounted on epoxy pcb 40 mm × 40 mm × 1.5 mm/6 cm<sup>2</sup> Cu.

## Electrical Characteristics

at  $T_A = 25\text{ °C}$ , unless otherwise specified.

Parameter	Symbol	Values			Unit
		min.	typ.	max.	
Collector-emitter breakdown voltage $I_C = 10\text{ mA}$	$V_{(BR)CE0}$	30	–	–	V
SMBT 2222 SMBT 2222 A		40	–	–	
Collector-base breakdown voltage $I_C = 10\text{ }\mu\text{A}$	$V_{(BR)CB0}$	60	–	–	
SMBT 2222 SMBT 2222 A		75	–	–	
Emitter-base breakdown voltage $I_E = 10\text{ }\mu\text{A}$	$V_{(BR)EB0}$	5	–	–	
SMBT 2222 SMBT 2222 A		6	–	–	
Collector cutoff current $V_{CB} = 50\text{ V}$	$I_{CB0}$	–	–	10	nA
$V_{CB} = 60\text{ V}$		–	–	10	nA
$V_{CB} = 50\text{ V}, T_A = 150\text{ °C}$		–	–	10	$\mu\text{A}$
$V_{CB} = 60\text{ V}, T_A = 150\text{ °C}$		–	–	10	$\mu\text{A}$
Emitter cutoff current $V_{EB} = 3\text{ V}$	$I_{EB0}$	–	–	10	nA
DC current gain $I_C = 100\text{ }\mu\text{A}, V_{CE} = 10\text{ V}$	$h_{FE}$	35	–	–	–
$I_C = 1\text{ mA}, V_{CE} = 10\text{ V}$		50	–	–	
$I_C = 10\text{ mA}, V_{CE} = 10\text{ V}^{1)}$		75	–	–	
$I_C = 150\text{ mA}, V_{CE} = 1\text{ V}^{1)}$		50	–	–	
$I_C = 150\text{ mA}, V_{CE} = 10\text{ V}^{1)}$		100	–	300	
$I_C = 500\text{ mA}, V_{CE} = 10\text{ V}^{1)}$		30	–	–	
SMBT 2222 SMBT 2222 A		40	–	–	
$I_C = 10\text{ mA}, V_{CE} = 10\text{ V},$ $T_A = 55\text{ °C}$	SMBT 2222 A	35	–	–	
Collector-emitter saturation voltage <sup>1)</sup> $I_C = 150\text{ mA}, I_B = 15\text{ mA}$	$V_{CEsat}$	–	–	0.4	V
SMBT 2222 SMBT 2222 A		–	–	0.3	
$I_C = 500\text{ mA}, I_B = 50\text{ mA}$	SMBT 2222	–	–	1.6	
SMBT 2222 A	–	–	1.0		
Base-emitter saturation voltage <sup>1)</sup> $I_C = 150\text{ mA}, I_B = 15\text{ mA}$	$V_{BEsat}$	–	–	1.3	
SMBT 2222 SMBT 2222 A		0.6	–	1.2	
$I_C = 500\text{ mA}, I_B = 50\text{ mA}$		–	–	2.6	
SMBT 2222 SMBT 2222 A		–	–	2.0	

<sup>1)</sup> Pulse test conditions:  $t \leq 300\text{ }\mu\text{s}, D = 2\%$ .

**Electrical Characteristics**

at  $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise specified.

Parameter	Symbol	Values			Unit
		min.	typ.	max.	

**AC characteristics**

Transition frequency $I_C = 20\text{ mA}$ , $V_{CE} = 20\text{ V}$ , $f = 100\text{ MHz}$	$f_T$				MHz
SMBT 2222		250	–	–	
SMBT 2222 A		300	–	–	
Output capacitance $V_{CB} = 10\text{ V}$ , $f = 1\text{ MHz}$	$C_{obo}$	–	–	8	pF
Input capacitance $V_{EB} = 0.5\text{ V}$ , $f = 1\text{ MHz}$	$C_{ibo}$				
SMBT 2222		–	–	30	
SMBT 2222 A		–	–	25	
Short-circuit input impedance $I_C = 1\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 1\text{ kHz}$	$h_{11e}$				k $\Omega$
SMBT 2222 A		2	–	8	
$I_C = 10\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 1\text{ kHz}$					
SMBT 2222 A		0.25	–	1.25	
Open-circuit reverse voltage transfer ratio $I_C = 1\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 1\text{ kHz}$	$h_{12e}$				$10^{-4}$
SMBT 2222 A		–	–	8.0	
$I_C = 10\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 1\text{ kHz}$					
SMBT 2222 A		–	–	4.0	
Short-circuit forward current transfer ratio $I_C = 1\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 1\text{ kHz}$	$h_{21e}$				–
SMBT 2222 A		50	–	300	
$I_C = 10\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 1\text{ kHz}$					
SMBT 2222 A		75	–	375	
Open-circuit output admittance $I_C = 1\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 1\text{ kHz}$	$h_{22e}$				$\mu\text{S}$
SMBT 2222		5	–	35	
$I_C = 10\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 1\text{ kHz}$					
SMBT 2222 A		25	–	200	
Collector-base time constant $I_E = 20\text{ mA}$ , $V_{CB} = 10\text{ V}$ , $f = 31.8\text{ MHz}$	$r_b'C_c$	–	–	150	ps
SMBT 2222 A					
Noise figure $I_C = 100\text{ }\mu\text{A}$ , $V_{CE} = 10\text{ V}$ , $R_s = 1\text{ k}\Omega$	$F$	–	–	4.0	dB
SMBT 2222 A					

## Electrical Characteristics

at  $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise specified.

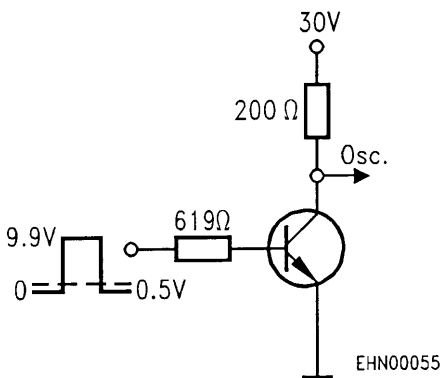
Parameter	Symbol	Values			Unit
		min.	typ.	max.	

## AC characteristics (continued)

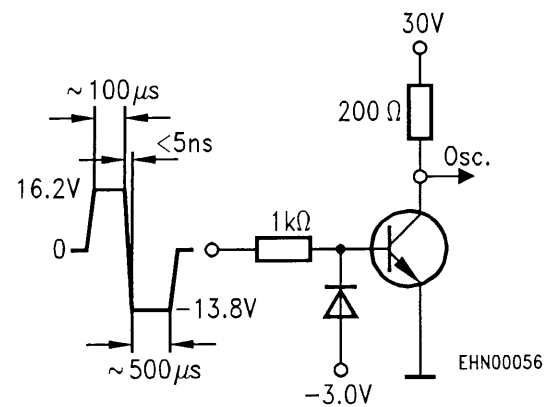
$V_{CC} = 30\text{ V}$ , $I_C = 150\text{ mA}$ , $I_{B1} = 15\text{ mA}$ $V_{BE(off)} = 0.5\text{ V}$					
Delay time	$t_d$	—	—	10	ns
Rise time	$t_r$	—	—	25	ns
$V_{CC} = 30\text{ V}$ , $I_C = 150\text{ mA}$ , $I_{B1} = I_{B2} = 15\text{ mA}$					
Storage time	$t_{stg}$	—	—	225	ns
Fall time	$t_f$	—	—	60	ns

## Test circuits

### Delay and rise time



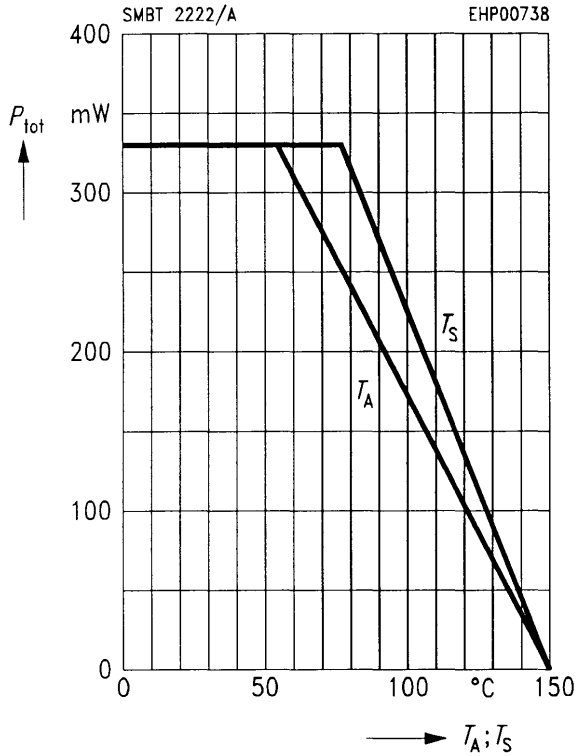
### Storage and fall time



Oscilloscope:  $R > 100\text{ }\Omega$   
 $C < 12\text{ pF}$   
 $t_r < 5\text{ ns}$

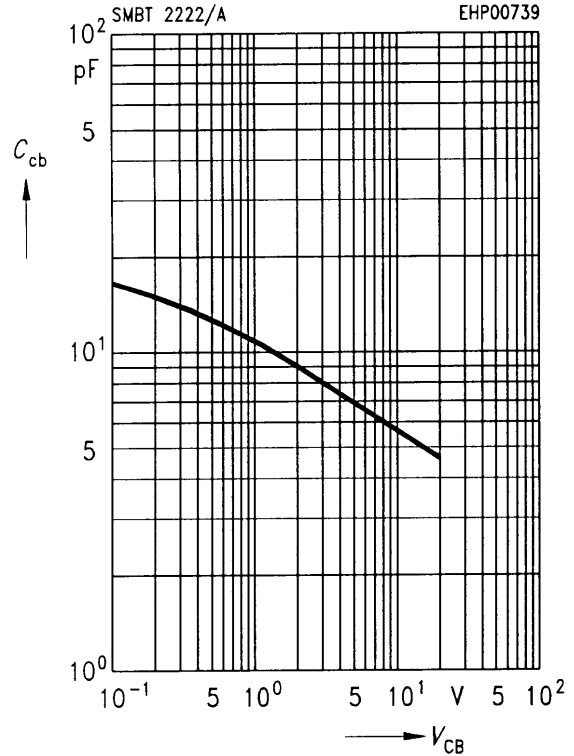
### Total power dissipation $P_{tot} = f(T_A^*; T_S)$

\* Package mounted on epoxy

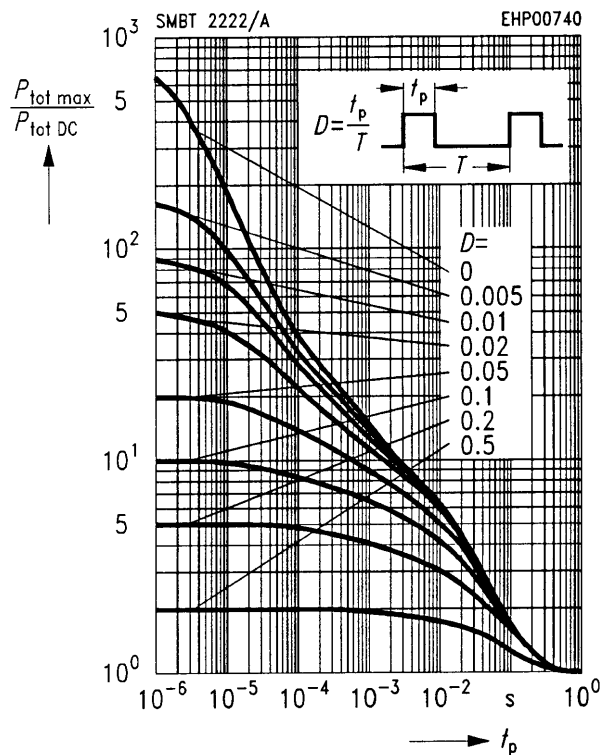


### Collector-base capacitance $C_{cb} = f(V_{CB})$

$f = 1 \text{ MHz}$

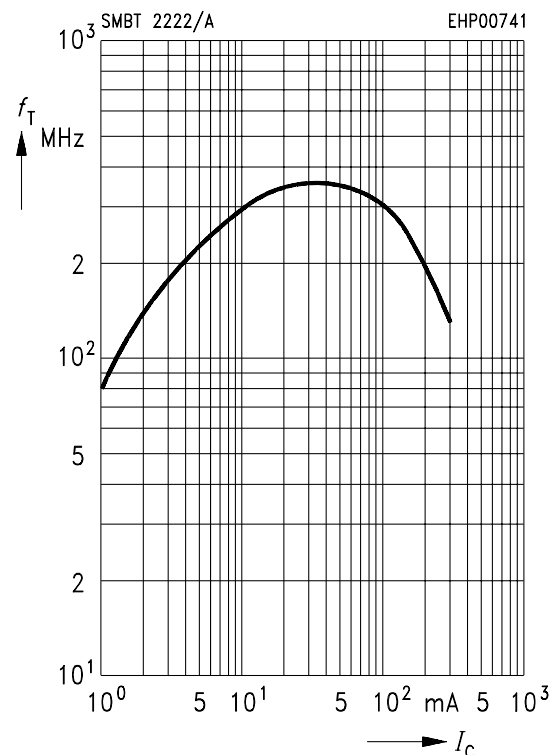


### Permissible pulse load $P_{tot \text{ max}}/P_{tot \text{ DC}} = f(t_p)$

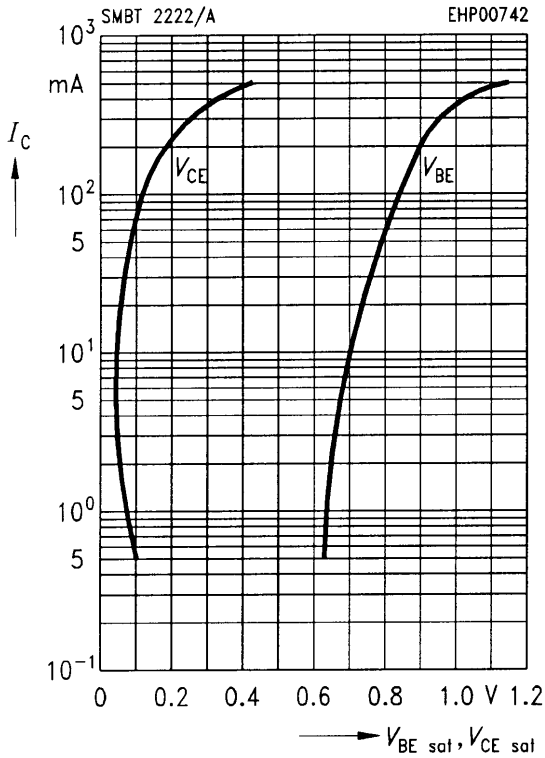


### Transition frequency $f_T = f(I_C)$

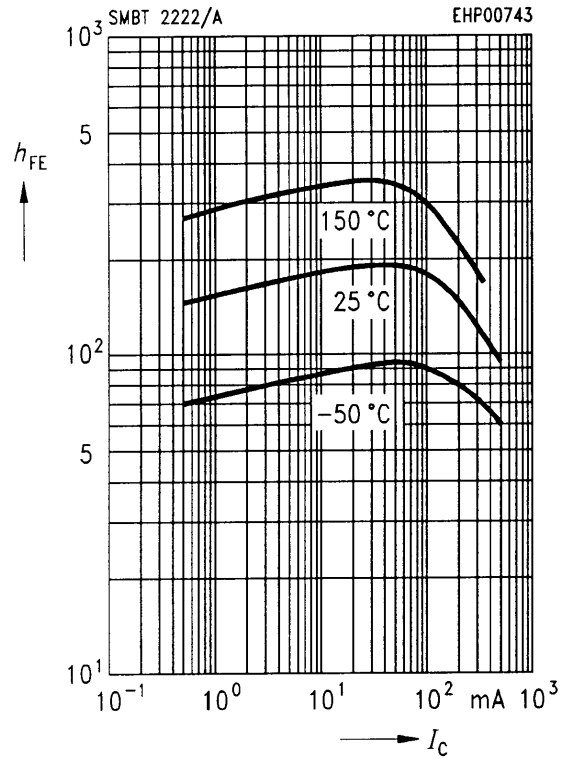
$V_{CE} = 20 \text{ V}$



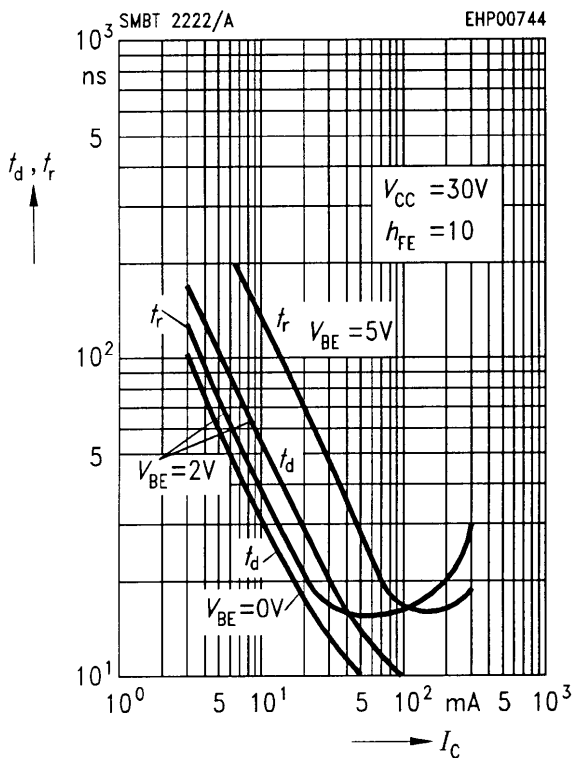
**Saturation voltage**  $I_C = f(V_{BEsat}, V_{CEsat})$   
 $h_{FE} = 10$



**DC current gain**  $h_{FE} = f(I_C)$   
 $V_{CE} = 10\text{ V}$



**Delay time**  $t_d = f(I_C)$   
**Rise time**  $t_r = f(I_C)$



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

