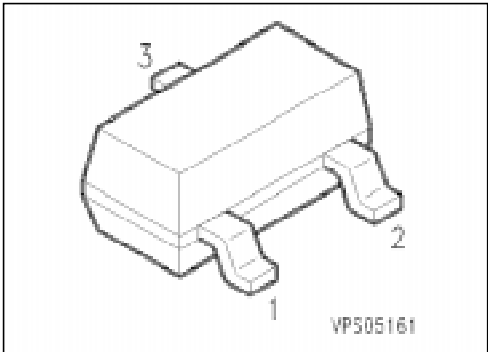


## PNP Silicon Switching Transistor

**SMBT 3906**

- High DC current gain: 0.1 mA to 100 mA
- Low collector-emitter saturation voltage
- Complementary type: SMBT 3904 (NPN)



| Type      | Marking | Ordering Code<br>(tape and reel) | Pin Configuration |   |   | Package <sup>1)</sup> |
|-----------|---------|----------------------------------|-------------------|---|---|-----------------------|
|           |         |                                  | 1                 | 2 | 3 |                       |
| SMBT 3906 | s2A     | Q68000-A4417                     | B                 | E | C | SOT-23                |

### Maximum Ratings

| Parameter                                         | Symbol    | Values         | Unit             |
|---------------------------------------------------|-----------|----------------|------------------|
| Collector-emitter voltage                         | $V_{CE0}$ | 40             | V                |
| Collector-base voltage                            | $V_{CB0}$ | 40             |                  |
| Emitter-base voltage                              | $V_{EB0}$ | 5              |                  |
| Collector current                                 | $I_C$     | 200            | mA               |
| Total power dissipation, $T_s = 71^\circ\text{C}$ | $P_{tot}$ | 330            | mW               |
| Junction temperature                              | $T_j$     | 150            | $^\circ\text{C}$ |
| Storage temperature range                         | $T_{stg}$ | - 65 ... + 150 |                  |

### Thermal Resistance

|                                  |             |            |     |
|----------------------------------|-------------|------------|-----|
| Junction - ambient <sup>2)</sup> | $R_{th JA}$ | $\leq 310$ | K/W |
| Junction - soldering point       | $R_{th JS}$ | $\leq 240$ |     |

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

| Parameter | Symbol | Values |      |      | Unit |
|-----------|--------|--------|------|------|------|
|           |        | min.   | typ. | max. |      |

## DC characteristics

|                                                                                                                                                                                                                                                                                          |               |                             |                       |                         |    |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-----------------------------|-----------------------|-------------------------|----|
| Collector-emitter breakdown voltage<br>$I_C = 1\text{ mA}$                                                                                                                                                                                                                               | $V_{(BR)CE0}$ | 40                          | —                     | —                       | V  |
| Collector-base breakdown voltage<br>$I_C = 10\text{ }\mu\text{A}$                                                                                                                                                                                                                        | $V_{(BR)CB0}$ | 40                          | —                     | —                       |    |
| Emitter-base breakdown voltage<br>$I_E = 10\text{ }\mu\text{A}$                                                                                                                                                                                                                          | $V_{(BR)EB0}$ | 5                           | —                     | —                       |    |
| Collector cutoff current<br>$V_{CB} = 30\text{ V}$                                                                                                                                                                                                                                       | $I_{CB0}$     | —                           | —                     | 50                      | nA |
| DC current gain<br>$I_C = 100\text{ }\mu\text{A}$ , $V_{CE} = 1\text{ V}$<br>$I_C = 1\text{ mA}$ , $V_{CE} = 1\text{ V}$<br>$I_C = 10\text{ mA}$ , $V_{CE} = 1\text{ V}^{1)}$<br>$I_C = 50\text{ mA}$ , $V_{CE} = 1\text{ V}^{1)}$<br>$I_C = 100\text{ mA}$ , $V_{CE} = 1\text{ V}^{1)}$ | $h_{FE}$      | 60<br>80<br>100<br>60<br>30 | —<br>—<br>—<br>—<br>— | —<br>—<br>300<br>—<br>— | —  |
| Collector-emitter saturation voltage <sup>1)</sup><br>$I_C = 10\text{ mA}$ , $I_B = 1\text{ mA}$<br>$I_C = 50\text{ mA}$ , $I_B = 5\text{ mA}$                                                                                                                                           | $V_{CEsat}$   | —<br>—                      | —<br>—                | 0.25<br>0.4             | V  |
| Base-emitter saturation voltage <sup>1)</sup><br>$I_C = 10\text{ mA}$ , $I_B = 1\text{ mA}$<br>$I_C = 50\text{ mA}$ , $I_B = 5\text{ mA}$                                                                                                                                                | $V_{BEsat}$   | 0.65<br>—                   | —<br>—                | 0.85<br>0.95            |    |

<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.

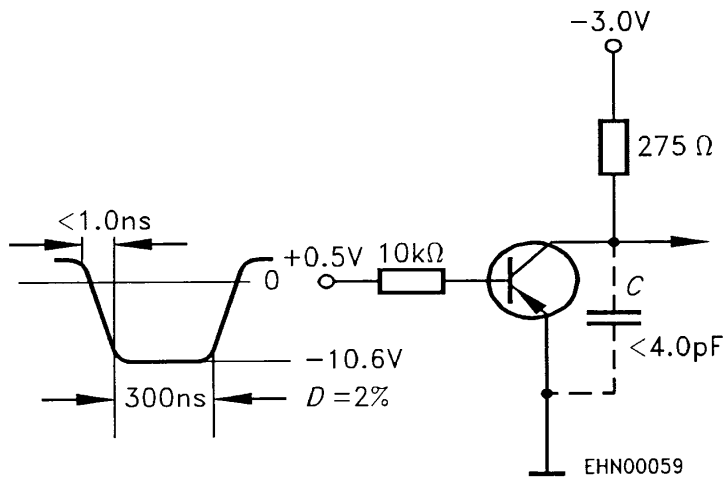
| Parameter | Symbol | Values |      |      | Unit |
|-----------|--------|--------|------|------|------|
|           |        | min.   | typ. | max. |      |

## AC characteristics

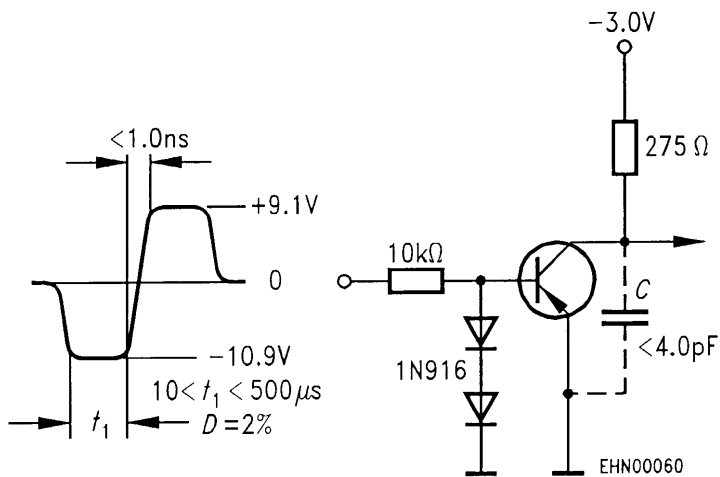
|                                                                                                                        |           |     |   |     |               |
|------------------------------------------------------------------------------------------------------------------------|-----------|-----|---|-----|---------------|
| Transition frequency<br>$I_C = 10\text{ mA}$ , $V_{CE} = 20\text{ V}$ , $f = 100\text{ MHz}$                           | $f_T$     | 250 | — | —   | MHz           |
| Output capacitance<br>$V_{CB} = 5\text{ V}$ , $f = 1\text{ MHz}$                                                       | $C_{obo}$ | —   | — | 4.5 | pF            |
| Input capacitance<br>$V_{EB} = 0.5\text{ V}$ , $f = 1\text{ MHz}$                                                      | $C_{ibo}$ | —   | — | 10  |               |
| Short-circuit input impedance<br>$I_C = 1\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 1\text{ kHz}$                     | $h_{11e}$ | 2   | — | 12  | k $\Omega$    |
| Open-circuit reverse voltage transfer ratio<br>$I_C = 1\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 1\text{ kHz}$       | $h_{12e}$ | 0.1 | — | 10  | $10^{-4}$     |
| Short-circuit forward current transfer ratio<br>$I_C = 1\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 1\text{ kHz}$      | $h_{21e}$ | 100 | — | 400 | —             |
| Open-circuit output admittance<br>$I_C = 1\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 1\text{ kHz}$                    | $h_{22e}$ | 3   | — | 60  | $\mu\text{S}$ |
| Noise figure<br>$I_C = 100\text{ }\mu\text{A}$ , $V_{CE} = 5\text{ V}$ , $R_S = 1\text{ k}\Omega$ , $f = 1\text{ kHz}$ | $F$       | —   | — | 4   | dB            |
| $V_{CC} = 3\text{ V}$ , $I_C = 10\text{ mA}$ , $I_{B1} = 1\text{ mA}$<br>$V_{BE(off)} = 0.5\text{ Vdc}$<br>Delay time  | $t_d$     | —   | — | 35  | ns            |
| Rise time                                                                                                              | $t_r$     | —   | — | 35  | ns            |
| $V_{CC} = 3\text{ V}$ , $I_C = 10\text{ mA}$ , $I_{B1} = I_{B2} = 1\text{ mA}$<br>Storage time                         | $t_{stg}$ | —   | — | 225 | ns            |
| Fall time<br>(see diagrams)                                                                                            | $t_f$     | —   | — | 75  | ns            |

## Test circuits

### Delay and rise time

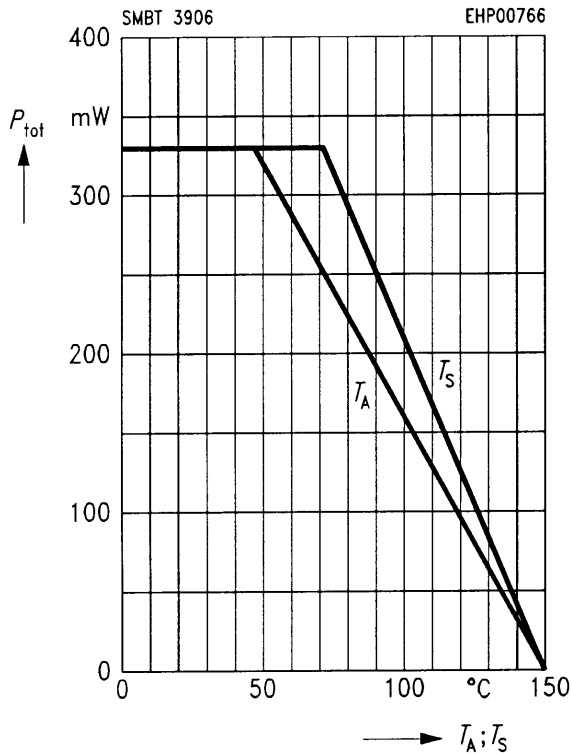


### Storage and fall time

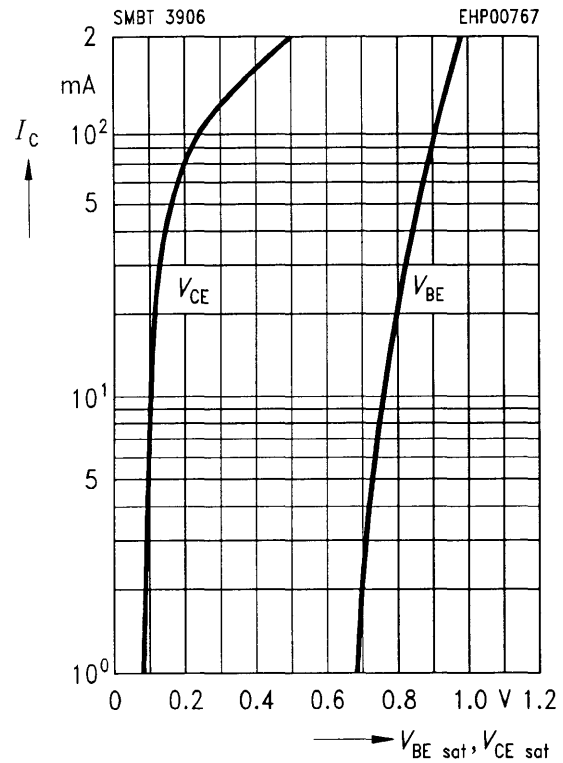


## Total power dissipation $P_{\text{tot}} = f(T_A^*; T_S)$

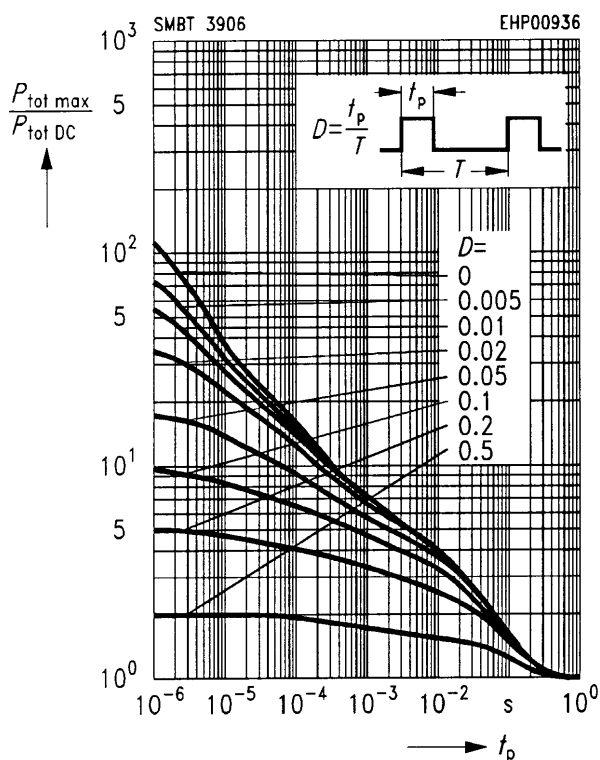
\* Package mounted on epoxy



## Saturation voltage $I_C = f(V_{\text{BE sat}}, V_{\text{CE sat}})$

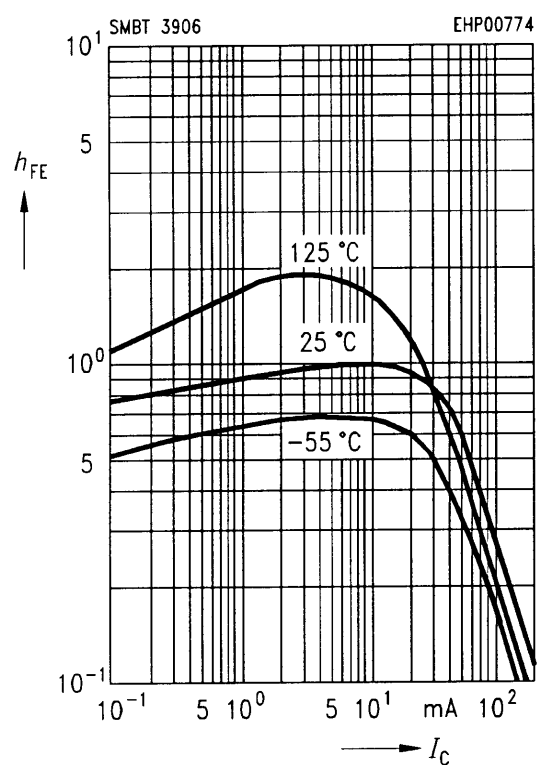


## Permissible pulse load $P_{\text{tot max}} / P_{\text{tot DC}} = f(t_p)$



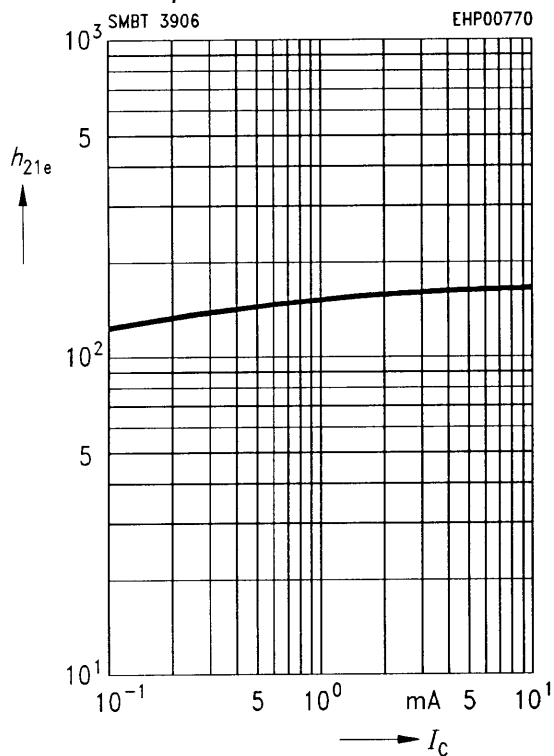
## DC current gain $h_{\text{FE}} = f(I_C)$

$V_{\text{CE}} = 1 \text{ V}$ , normalized



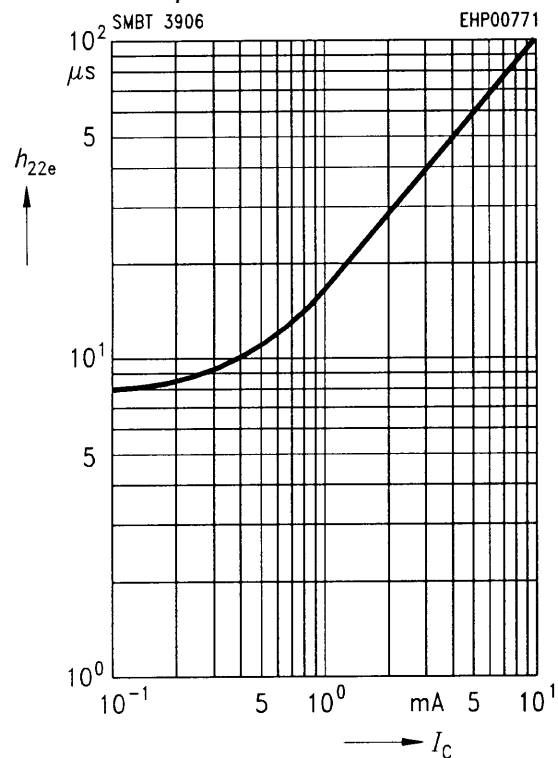
**Short-circuit forward current transfer ratio  $h_{21e} = f(I_C)$**

$V_{CE} = 10 \text{ V}, f = 1 \text{ MHz}$



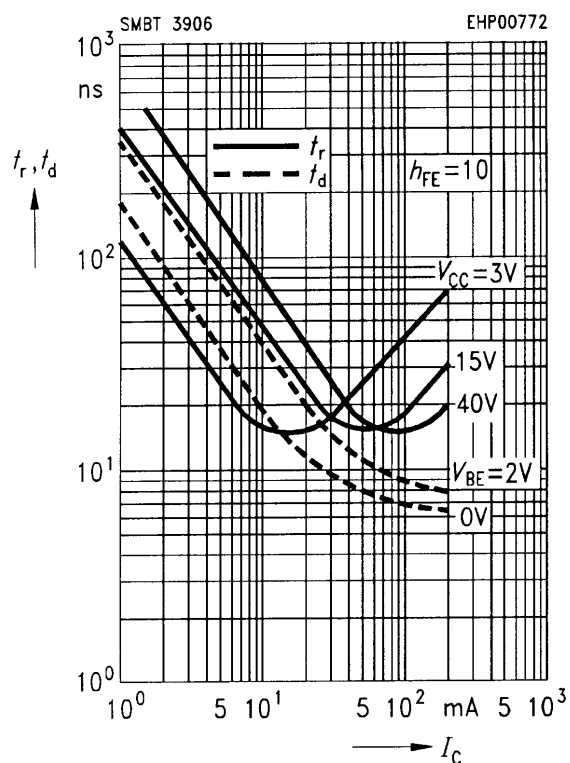
**Open-circuit output admittance  $h_{22e} = f(I_C)$**

$V_{CE} = 10 \text{ V}, f = 1 \text{ MHz}$

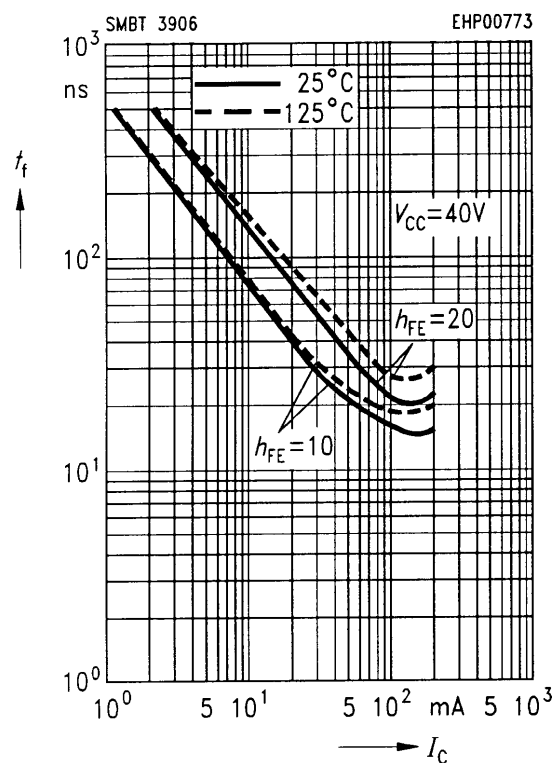


**Delay time  $t_d = f(I_C)$**

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



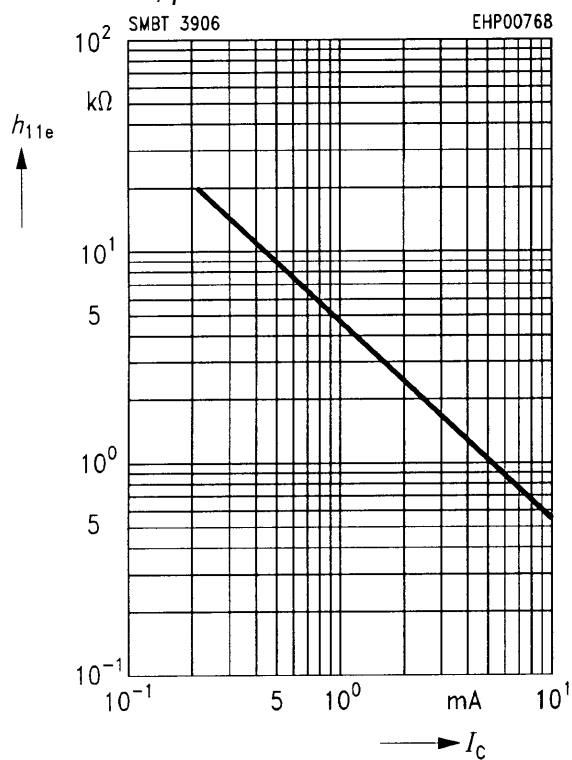
**Fall time  $t_f = f(I_C)$**



### Short-circuit input impedance

$$h_{11e} = f(I_C)$$

$V_{CE} = 10 \text{ V}$ ,  $f = 1 \text{ kHz}$



### Open-circuit reverse voltage transfer ratio $h_{12e} = f(I_C)$

