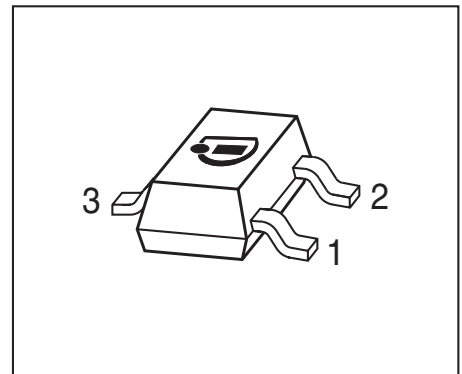


## NPN Silicon Switching Transistor

- Low collector-emitter saturation voltage
- Complementary type:  
SMBT2907A / MMBT2907A (PNP)
- Pb-free (RoHS compliant) package
- Qualified according AEC Q101



| Type                | Marking | Pin Configuration |       |       | Package |
|---------------------|---------|-------------------|-------|-------|---------|
| SMBT2222A/MMBT2222A | s1P     | 1 = B             | 2 = E | 3 = C | SOT23   |

### Maximum Ratings

| Parameter                                               | Symbol    | Value       | Unit             |
|---------------------------------------------------------|-----------|-------------|------------------|
| Collector-emitter voltage                               | $V_{CEO}$ | 40          | V                |
| Collector-base voltage                                  | $V_{CBO}$ | 75          |                  |
| Emitter-base voltage                                    | $V_{EBO}$ | 6           |                  |
| Collector current                                       | $I_C$     | 600         | mA               |
| Total power dissipation-<br>$T_S \leq 77^\circ\text{C}$ | $P_{tot}$ | 330         | mW               |
| Junction temperature                                    | $T_j$     | 150         | $^\circ\text{C}$ |
| Storage temperature                                     | $T_{stg}$ | -65 ... 150 |                  |

### Thermal Resistance

| Parameter                                | Symbol     | Value      | Unit |
|------------------------------------------|------------|------------|------|
| Junction - soldering point <sup>1)</sup> | $R_{thJS}$ | $\leq 220$ | K/W  |

<sup>1)</sup>For calculation of  $R_{thJA}$  please refer to Application Note AN077 (Thermal Resistance Calculation)

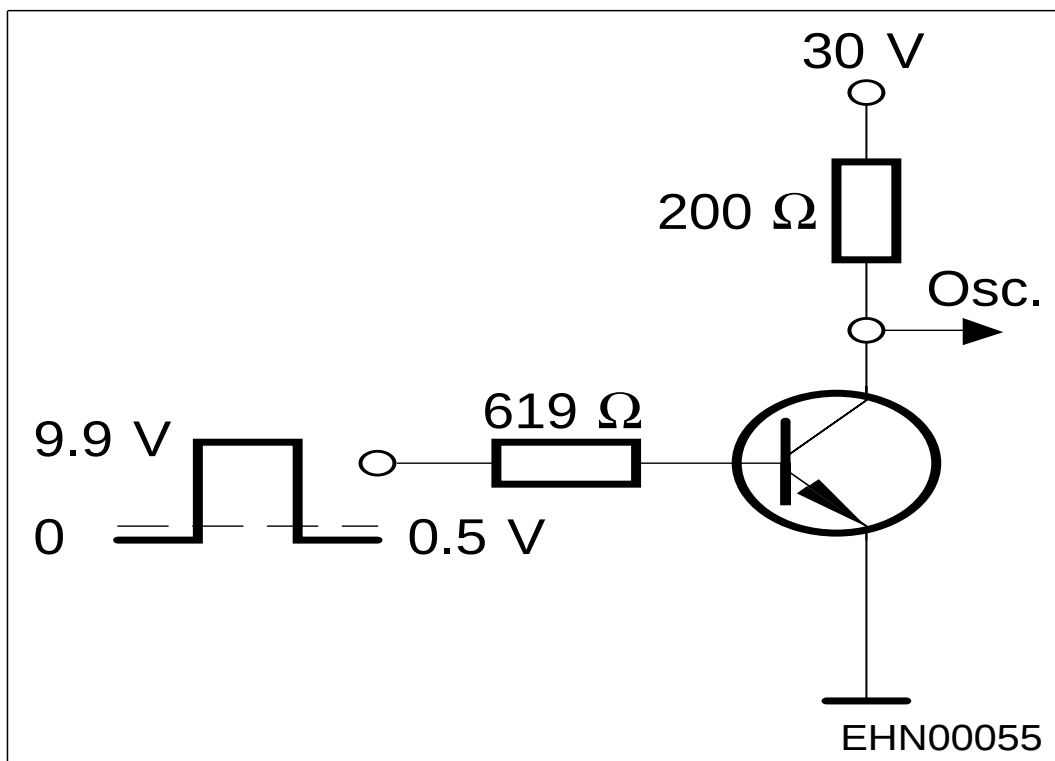
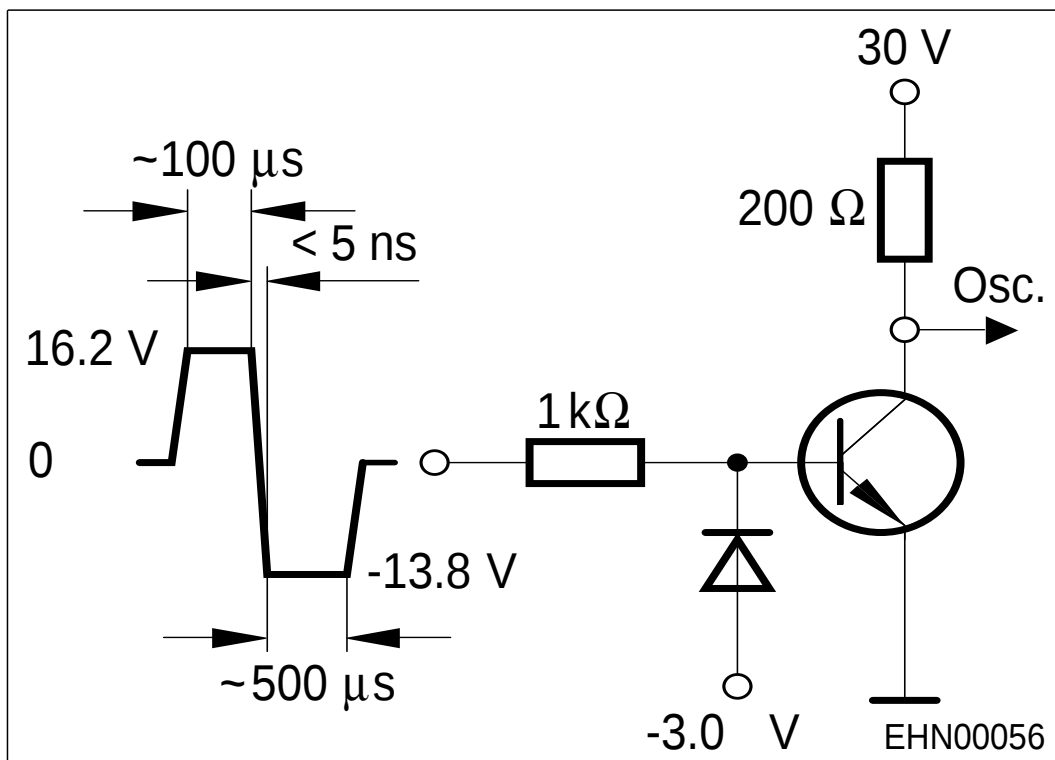
**Electrical Characteristics** at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

| Parameter                                                                                                                                                                                                                                                                                                                    | Symbol        | Values                            |                            |                              | Unit          |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-----------------------------------|----------------------------|------------------------------|---------------|
|                                                                                                                                                                                                                                                                                                                              |               | min.                              | typ.                       | max.                         |               |
| DC Characteristics                                                                                                                                                                                                                                                                                                           |               |                                   |                            |                              |               |
| Collector-emitter breakdown voltage<br>$I_C = 10\text{ mA}, I_B = 0$                                                                                                                                                                                                                                                         | $V_{(BR)CEO}$ | 40                                | -                          | -                            | V             |
| Collector-base breakdown voltage<br>$I_C = 10\text{ }\mu\text{A}, I_E = 0$                                                                                                                                                                                                                                                   | $V_{(BR)CBO}$ | 75                                | -                          | -                            |               |
| Emitter-base breakdown voltage<br>$I_E = 10\text{ }\mu\text{A}, I_C = 0$                                                                                                                                                                                                                                                     | $V_{(BR)EBO}$ | 6                                 | -                          | -                            |               |
| Collector-base cutoff current<br>$V_{CB} = 60\text{ V}, I_E = 0$<br>$V_{CB} = 60\text{ V}, I_E = 0, T_A = 150\text{ }^\circ\text{C}$                                                                                                                                                                                         | $I_{CBO}$     | -<br>-                            | -<br>-                     | 0.01<br>10                   | $\mu\text{A}$ |
| Emitter-base cutoff current<br>$V_{EB} = 3\text{ V}, I_C = 0$                                                                                                                                                                                                                                                                | $I_{EBO}$     | -                                 | -                          | 10                           | nA            |
| DC current gain <sup>1)</sup><br>$I_C = 100\text{ }\mu\text{A}, V_{CE} = 10\text{ V}$<br>$I_C = 1\text{ mA}, V_{CE} = 10\text{ V}$<br>$I_C = 10\text{ mA}, V_{CE} = 10\text{ V}$<br>$I_C = 150\text{ mA}, V_{CE} = 1\text{ V}$<br>$I_C = 150\text{ mA}, V_{CE} = 10\text{ V}$<br>$I_C = 500\text{ mA}, V_{CE} = 10\text{ V}$ | $h_{FE}$      | 35<br>50<br>75<br>50<br>100<br>40 | -<br>-<br>-<br>-<br>-<br>- | -<br>-<br>-<br>-<br>300<br>- | -             |
| Collector-emitter saturation voltage <sup>1)</sup><br>$I_C = 150\text{ mA}, I_B = 15\text{ mA}$<br>$I_C = 500\text{ mA}, I_B = 50\text{ mA}$                                                                                                                                                                                 | $V_{CEsat}$   | -<br>-                            | -<br>-                     | 0.3<br>1                     | V             |
| Base emitter saturation voltage <sup>1)</sup><br>$I_C = 150\text{ mA}, I_B = 15\text{ mA}$<br>$I_C = 500\text{ mA}, I_B = 50\text{ mA}$                                                                                                                                                                                      | $V_{BEsat}$   | 0.6<br>-                          | -<br>-                     | 1.2<br>2                     |               |

<sup>1)</sup>Pulse test:  $t < 300\mu\text{s}$ ;  $D < 2\%$

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

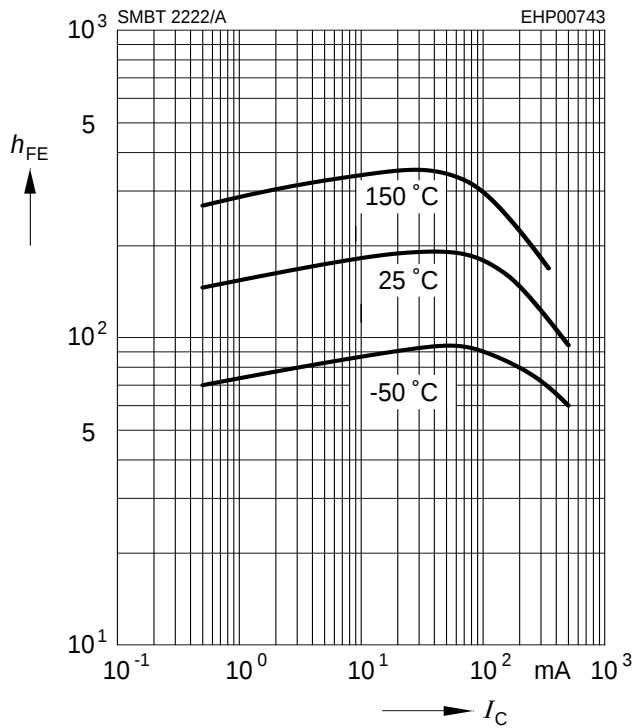
| Parameter                                                                                                                                                                              | Symbol    | Values    |        |            | Unit             |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|-----------|--------|------------|------------------|
|                                                                                                                                                                                        |           | min.      | typ.   | max.       |                  |
| AC Characteristics                                                                                                                                                                     |           |           |        |            |                  |
| Transition frequency<br>$I_C = 20\text{ mA}$ , $V_{CE} = 20\text{ V}$ , $f = 100\text{ MHz}$                                                                                           | $f_T$     | 300       | -      | -          | MHz              |
| Collector-base capacitance<br>$V_{CB} = 10\text{ V}$ , $f = 1\text{ MHz}$                                                                                                              | $C_{cb}$  | -         | 2.5    | 5          | pF               |
| Emitter-base capacitance<br>$V_{EB} = 0.5\text{ V}$ , $f = 1\text{ MHz}$                                                                                                               | $C_{eb}$  | -         | -      | 35         |                  |
| Short-circuit input impedance<br>$I_C = 1\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 1\text{ kHz}$<br>$I_C = 10\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 1\text{ kHz}$               | $h_{11e}$ | 2<br>0.25 | -<br>- | 8<br>1.25  | kΩ               |
| Open-circuit reverse voltage transf. ratio<br>$I_C = 1\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 1\text{ kHz}$<br>$I_C = 10\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 1\text{ kHz}$  | $h_{12e}$ | -<br>-    | -<br>- | 8<br>4     | 10 <sup>-4</sup> |
| Short-circuit forward current transf. ratio<br>$I_C = 1\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 1\text{ kHz}$<br>$I_C = 10\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 1\text{ kHz}$ | $h_{21e}$ | 50<br>75  | -<br>- | 300<br>375 | -                |
| Open-circuit output admittance<br>$I_C = 1\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 1\text{ kHz}$<br>$I_C = 10\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 1\text{ kHz}$              | $h_{22e}$ | 5<br>25   | -<br>- | 35<br>200  | μS               |
| Delay time<br>$V_{CC} = 30\text{ V}$ , $I_C = 150\text{ mA}$ , $I_{B1} = 15\text{ mA}$ ,<br>$V_{BE(off)} = 0.5\text{ V}$                                                               | $t_d$     | -         | -      | 10         | ns               |
| Rise time<br>$V_{CC} = 30\text{ V}$ , $I_C = 150\text{ mA}$ , $I_{B1} = 15\text{ mA}$ ,<br>$V_{BE(off)} = 0.5\text{ V}$                                                                | $t_r$     | -         | -      | 25         |                  |
| Storage time<br>$V_{CC} = 30\text{ V}$ , $I_C = 150\text{ mA}$ , $I_{B1} = I_{B2} = 15\text{mA}$                                                                                       | $t_{stg}$ | -         | -      | 225        |                  |
| Fall time<br>$V_{CC} = 30\text{ V}$ , $I_C = 150\text{ mA}$ , $I_{B1} = I_{B2} = 15\text{mA}$                                                                                          | $t_f$     | -         | -      | 60         |                  |
| Noise figure<br>$I_C = 100\text{ }\mu\text{A}$ , $V_{CE} = 10\text{ V}$ , $f = 1\text{ kHz}$ ,<br>$\Delta f = 200\text{ Hz}$ , $R_S = 1\text{ k}\Omega$                                | $F$       | -         | -      | 4          | dB               |

**Test circuit**
**Delay and rise time**

**Storage and fall time**


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

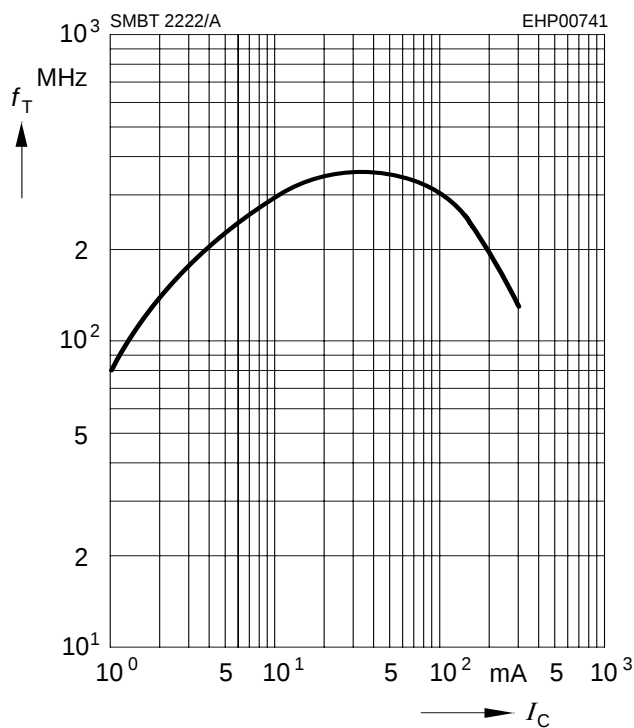
**DC current gain  $h_{FE} = f(I_C)$**

$V_{CE} = 10 \text{ V}$



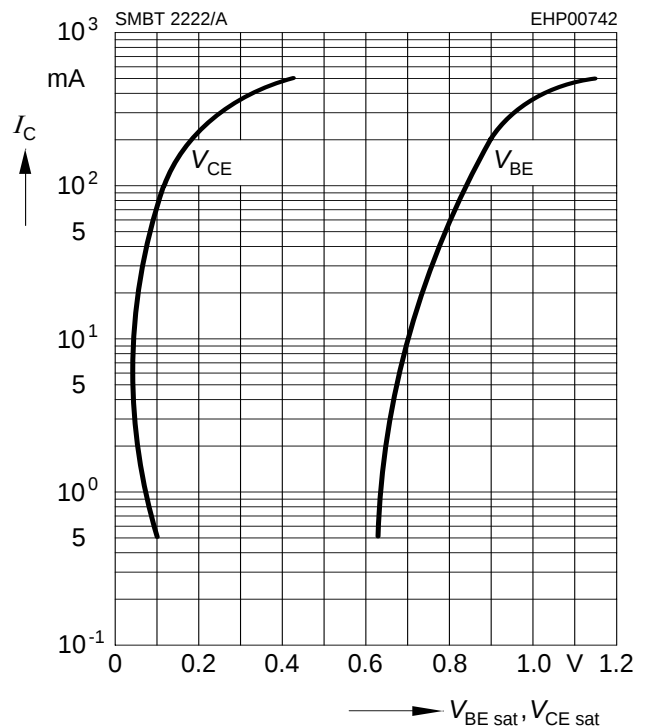
**Transition frequency  $f_T = f(I_C)$**

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



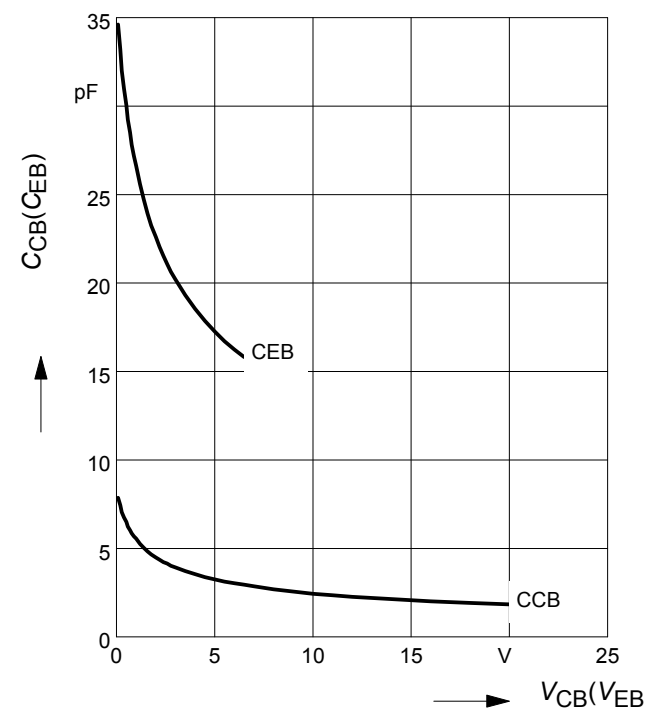
**Saturation voltage  $I_C = f(V_{BEsat}; V_{CEsat})$**

$h_{FE} = 10$

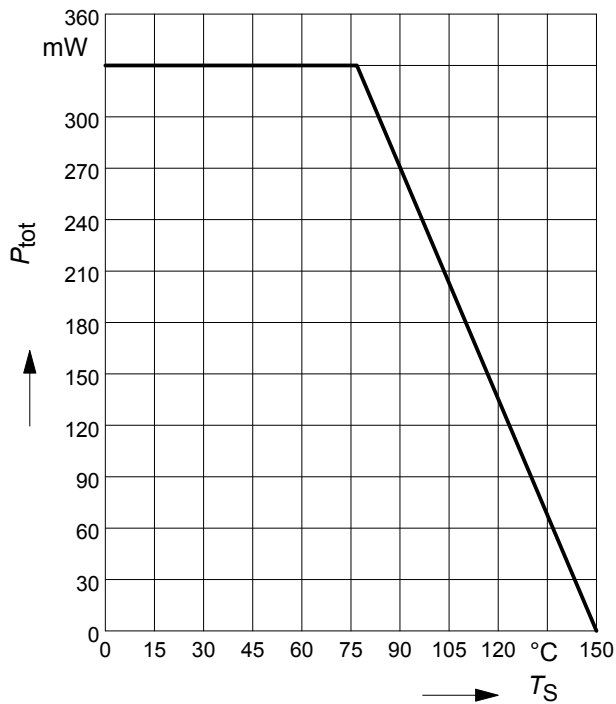


**Collector-base capacitance  $C_{cb} = f(V_{CB})$**

**Emitter-base capacitance  $C_{eb} = f(V_{EB})$**

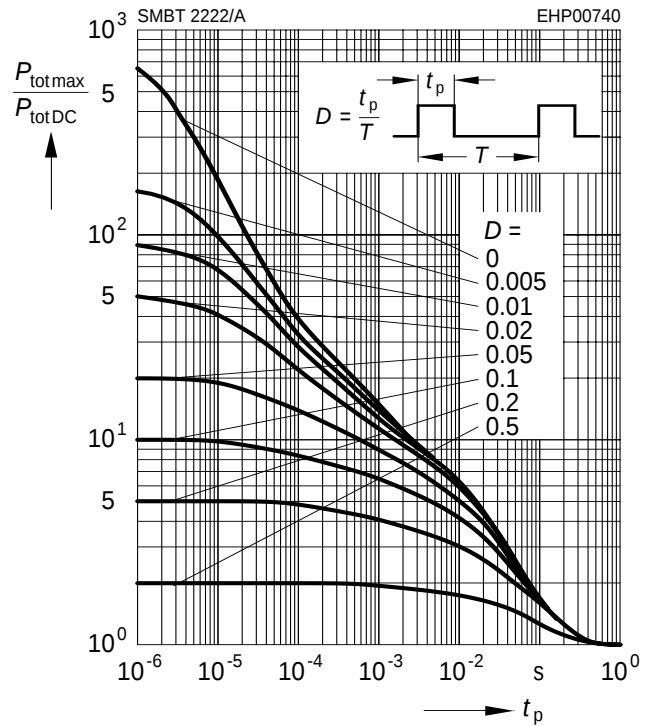


**Total power dissipation  $P_{\text{tot}} = f(T_S)$**



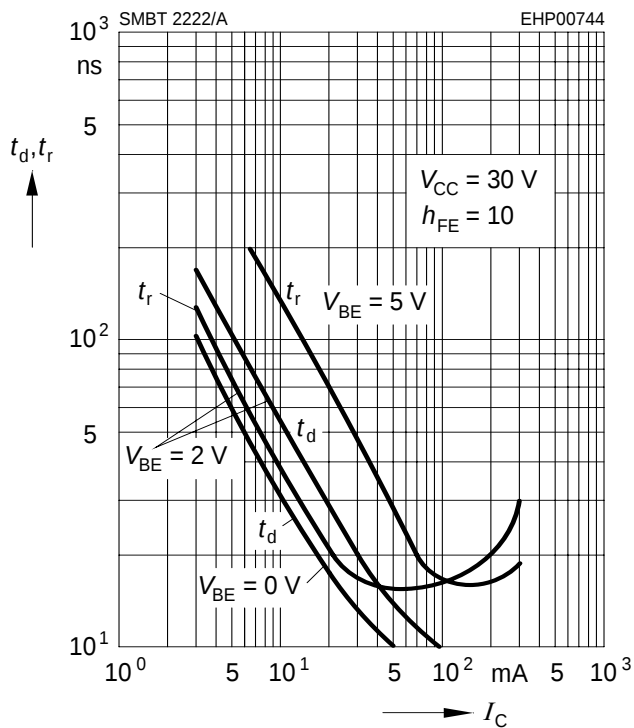
**Permissible Pulse Load**

$$P_{\text{totmax}}/P_{\text{totDC}} = f(t_p)$$



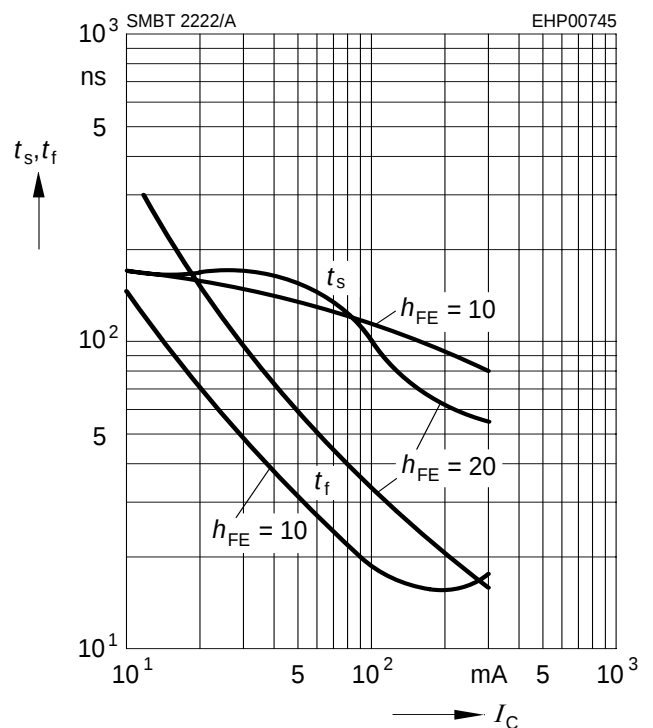
**Delay time  $t_d = f(I_C)$**

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



**Storage time  $t_{\text{stg}} = f(I_C)$**

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

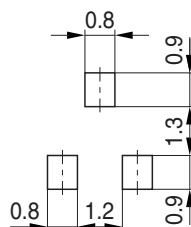


## Package Outline

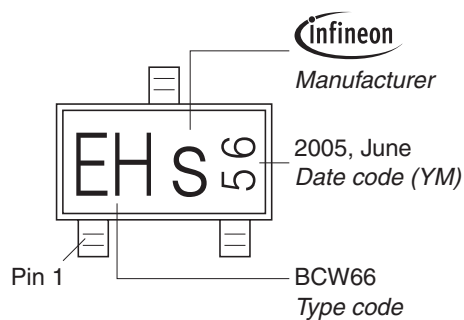


1) Lead width can be 0.6 max. in dambar area

## Foot Print

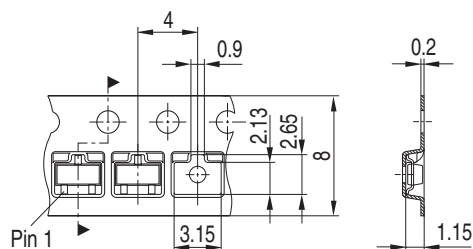


## Marking Layout (Example)



## Standard Packing

Reel ø180 mm = 3.000 Pieces/Reel  
Reel ø330 mm = 10.000 Pieces/Reel



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