

Bipolar Transistors Silicon NPN Epitaxial Type

## TTC502

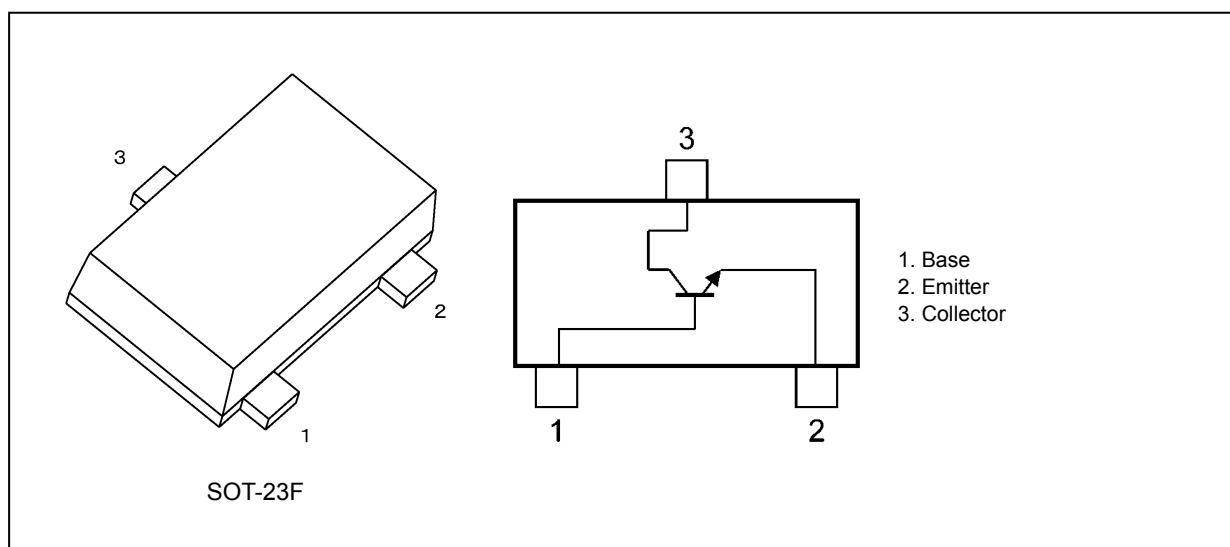
### 1. Applications

- High-Speed Switching
- DC-DC Converters

### 2. Features

- (1) High DC current gain:  $h_{FE} = 120$  to  $300$  ( $I_C = 0.1$  A)
- (2) Low collector-emitter saturation voltage:  $V_{CE(sat)} = 0.14$  V (max)
- (3) High-speed switching:  $t_f = 200$  ns (typ.)

### 3. Packaging and Internal Circuit



Start of commercial production  
2021-03

## 4. Absolute Maximum Ratings (Note) (Unless otherwise specified, $T_a = 25\text{ }^\circ\text{C}$ )

| Characteristics                                | Symbol    | Rating      | Unit             |
|--|-----------|-------------|------------------|
| Collector-base voltage                         | $V_{CBO}$ | 180         | V                |
| Collector-emitter voltage                      | $V_{CEO}$ | 120         | V                |
| Emitter-base voltage                           | $V_{EBO}$ | 7           | V                |
| Collector current (DC) (Note 1)                | $I_C$     | 1.0         | A                |
| Collector current (pulsed) (Note 1)            | $I_{CP}$  | 2.0         | A                |
| Base current                                   | $I_B$     | 100         | mA               |
| Collector power dissipation DC (Note 2)        | $P_C$     | 1           | W                |
| Collector power dissipation (t = 1 s) (Note 2) | $P_C$     | 1.8         | W                |
| Junction temperature                           | $T_j$     | 150         | $^\circ\text{C}$ |
| Storage temperature                            | $T_{stg}$ | - 55 to 150 | $^\circ\text{C}$ |

Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings.

Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

Note 1: Ensure that the channel temperature does not exceed  $150\text{ }^\circ\text{C}$ .

Note 2: Device mounted on an FR4 board. (25.4 mm × 25.4 mm × 1.6 mm ,Cu pad: 645 mm<sup>2</sup>)

## 5. Electrical Characteristics

### 5.1. Electrical Characteristics (Unless otherwise specified, $T_a = 25\text{ }^\circ\text{C}$ )

| Characteristics                      | Symbol        | Test Condition                                | Min | Typ. | Max  | Unit |
|--------------------------------------|---------------|---|-----|------|------|------|
| Collector cut-off current            | $I_{CBO}$     | $V_{CB} = 180\text{ V}$ , $I_E = 0\text{ mA}$ | —   | —    | 100  | nA   |
| Emitter cut-off current              | $I_{EBO}$     | $V_{EB} = 7\text{ V}$ , $I_C = 0\text{ mA}$   | —   | —    | 100  | nA   |
| Collector-base breakdown voltage     | $V_{(BR)CBO}$ | $I_C = 1\text{ mA}$ , $I_B = 0\text{ mA}$     | 180 | —    | —    | V    |
| Collector-emitter breakdown voltage  | $V_{(BR)CEO}$ | $I_C = 10\text{ mA}$ , $I_B = 0\text{ mA}$    | 120 | —    | —    | V    |
| DC current gain                      | $h_{FE(1)}$   | $V_{CE} = 2\text{ V}$ , $I_C = 1\text{ mA}$   | 100 | —    | —    | —    |
|                                      | $h_{FE(2)}$   | $V_{CE} = 2\text{ V}$ , $I_C = 0.1\text{ A}$  | 120 | —    | 300  | —    |
|                                      | $h_{FE(3)}$   | $V_{CE} = 2\text{ V}$ , $I_C = 0.3\text{ A}$  | 60  | —    | —    | —    |
| Collector-emitter saturation voltage | $V_{CE(sat)}$ | $I_C = 0.3\text{ A}$ , $I_B = 10\text{ mA}$   | —   | —    | 0.14 | V    |
| Base-emitter saturation voltage      | $V_{BE(sat)}$ | $I_C = 0.3\text{ A}$ , $I_B = 10\text{ mA}$   | —   | —    | 1.10 | V    |

### 5.2. Dynamic Characteristics (Unless otherwise specified, $T_a = 25\text{ }^\circ\text{C}$ )

| Characteristics               | Symbol    | Test Condition  | Min | Typ. | Max | Unit |
|-------------------------------|-----------|---|-----|------|-----|------|
| Switching time (rise time)    | $t_r$     | See Figure 5.2.1<br>$V_{CC} \approx 72\text{ V}$ , $R_L = 240\text{ }\Omega$ ,<br>$I_{B1} = 10\text{ mA}$ , $I_{B2} = 10\text{ mA}$ | —   | 100  | —   | ns   |
| Switching time (storage time) | $t_{stg}$ |   | —   | 1500 | —   | ns   |
| Switching time (fall time)    | $t_f$     |   | —   | 200  | —   | ns   |

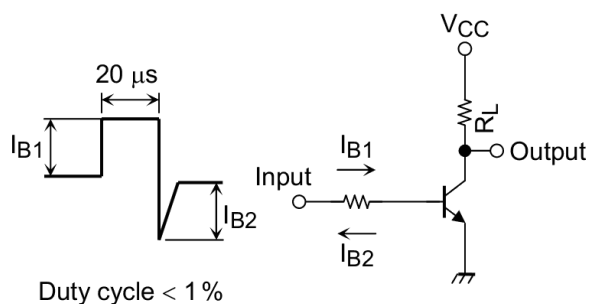


Fig. 5.2.1 Switching Time Test Circuit

## 6. Marking

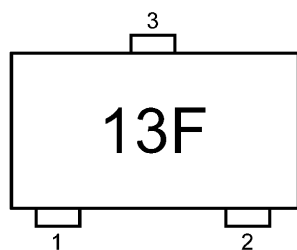
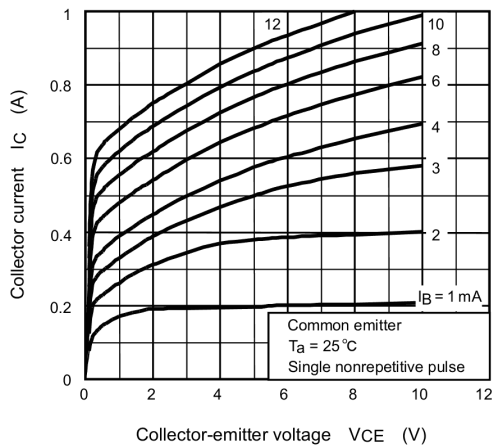
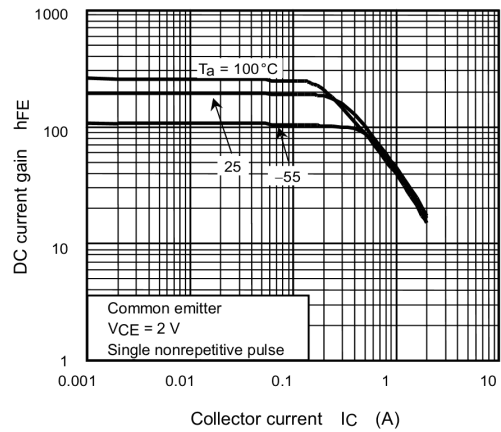


Fig. 6.1 Marking

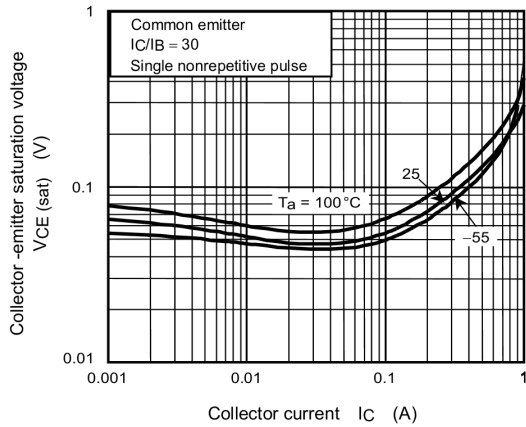
## 7. Characteristics Curves (Note)



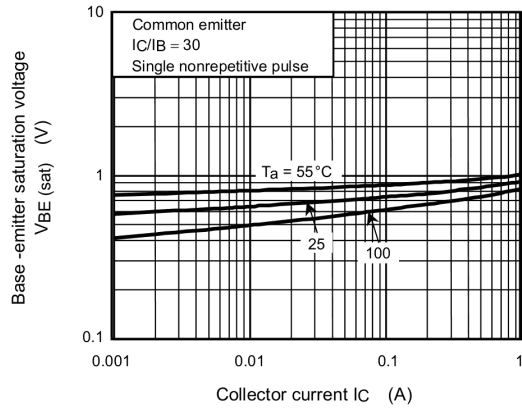
**Fig. 7.1**  $I_C - V_{CE}$



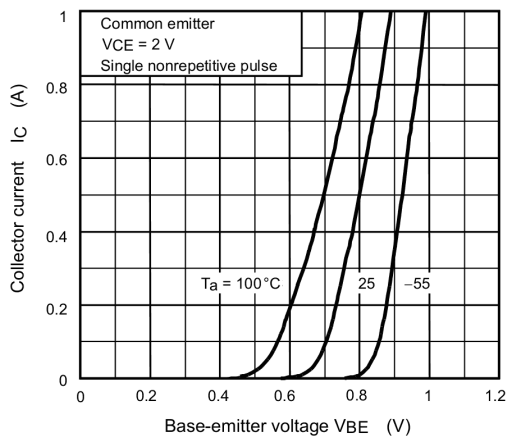
**Fig. 7.2**  $h_{FE} - I_C$



**Fig. 7.3**  $V_{CE(sat)} - I_C$



**Fig. 7.4**  $V_{BE(sat)} - I_C$



**Fig. 7.5**  $I_C - V_{BE}$

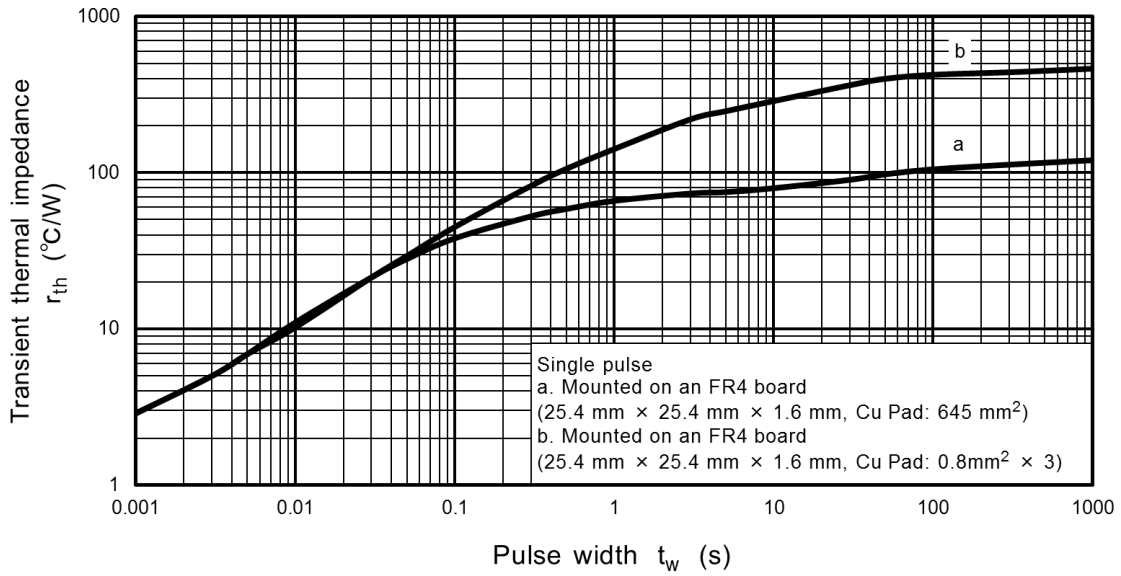


Fig. 7.6  $r_{th} - t_w$

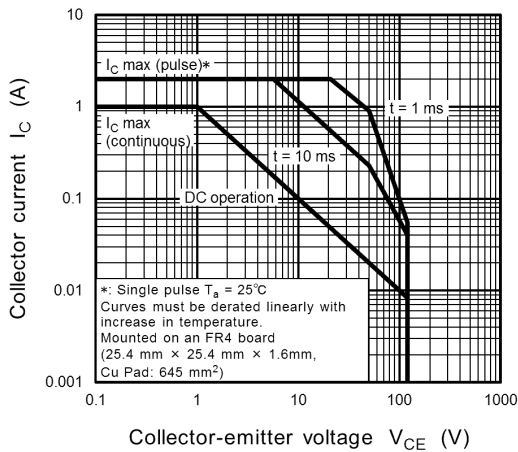
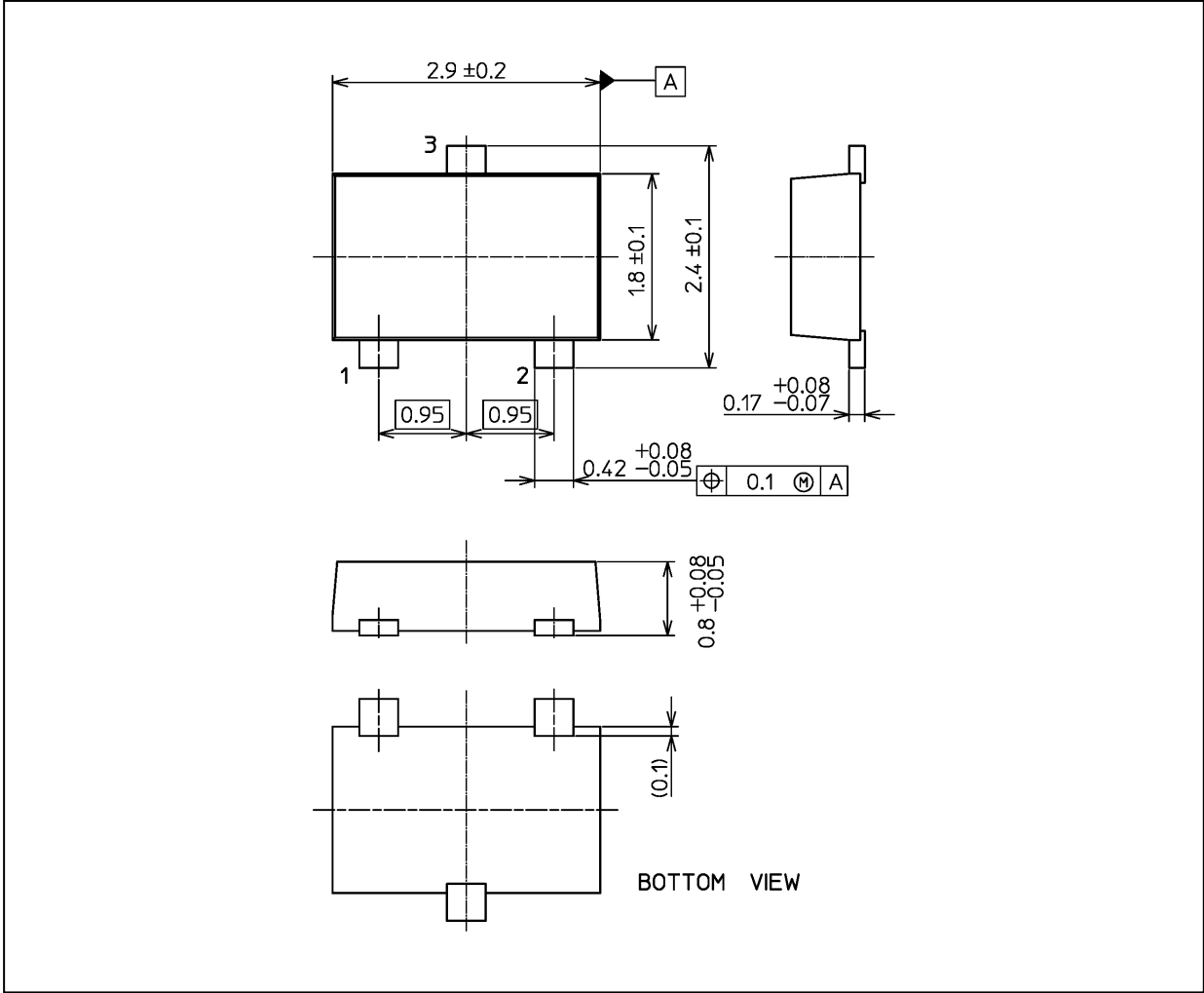


Fig. 7.7 Safe Operating Area

Note: The above characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.

Package Dimensions

Unit: mm



Weight: 0.011 g (typ.)

|                   |
|-------------------|
| Package Name(s)   |
| Nickname: SOT-23F |

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