

## TTC021

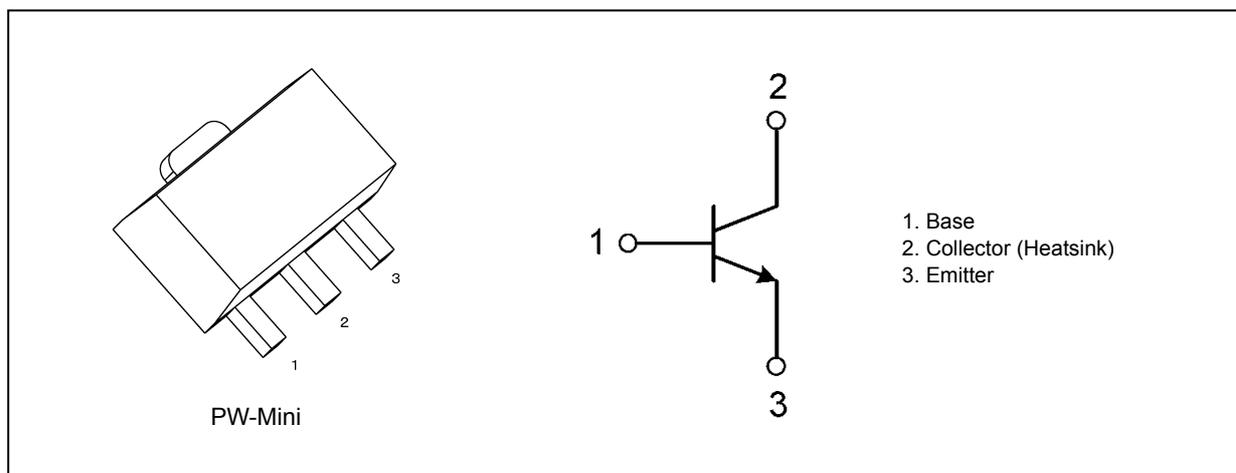
### 1. Applications

- High-Speed Switching
- DC-DC Converters

### 2. Features

- (1) High DC current gain:  $h_{FE} = 120$  to  $240$  ( $V_{CE} = 2$  V,  $I_C = 0.3$  A)
- (2) Low collector-emitter saturation voltage:  $V_{CE(sat)} = 0.15$  V (max) ( $I_C = 1.0$  A,  $I_B = 0.1$  A)
- (3) High-speed switching:  $t_f = 170$  ns (typ.) ( $I_C = 1.0$  A)

### 3. Packaging and Internal Circuit



Start of commercial production

2022-10

## 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	$V_{CEX}$	160	V
	$V_{CEO}$	120	
Emitter-base voltage	$V_{EBO}$	7	V
Collector current (DC) (Note 1)	$I_C$	3	A
Collector current (pulsed) (Note 1)	$I_{CP}$	6	
Base current	$I_B$	0.3	A
Collector power dissipation (Note 2)	$P_C$	1.0	W
Collector power dissipation (Note 3)		2.5	
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 junction temperature does not exceed  $150\text{ }^\circ\text{C}$ .

Note 2: Device mounted on a  $25.4\text{ mm} \times 25.4\text{ mm} \times 1.6\text{ mm}$  FR-4 glass epoxy board (with a dissipating copper surface of  $645\text{ mm}^2$ )

Note 3: Device mounted on a  $40.0\text{ mm} \times 40.0\text{ mm} \times 0.8\text{ mm}$  ceramic board (with a dissipating copper surface of  $1600\text{ mm}^2$ )

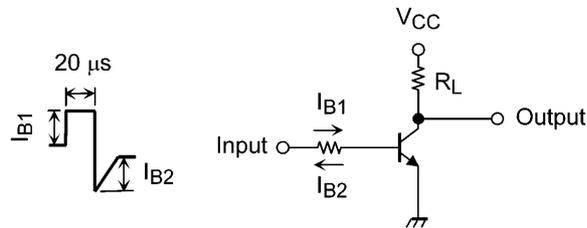
## 5. Electrical Characteristics

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

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Collector cut-off current	$I_{CBO}$	$V_{CB} = 180\text{ V}, I_E = 0\text{ A}$	—	—	100	nA
Emitter cut-off current	$I_{EBO}$	$V_{EB} = 7\text{ V}, I_C = 0\text{ A}$	—	—	100	nA
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	$I_C = 10\text{ mA}, I_B = 0\text{ A}$	120	—	—	V
DC current gain	$h_{FE(1)}$	$V_{CE} = 2\text{ V}, I_C = 0.3\text{ A}$	120	—	240	—
	$h_{FE(2)}$	$V_{CE} = 2\text{ V}, I_C = 1.0\text{ A}$	80	—	—	
Collector-emitter saturation voltage	$V_{CE(sat)(1)}$	$I_C = 0.3\text{ A}, I_B = 30\text{ mA}$	—	0.04	0.08	V
	$V_{CE(sat)(2)}$	$I_C = 1.0\text{ A}, I_B = 0.1\text{ A}$	—	0.08	0.15	
Base-emitter saturation voltage	$V_{BE(sat)}$	$I_C = 1.0\text{ A}, I_B = 0.1\text{ A}$	—	0.88	1.10	V

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

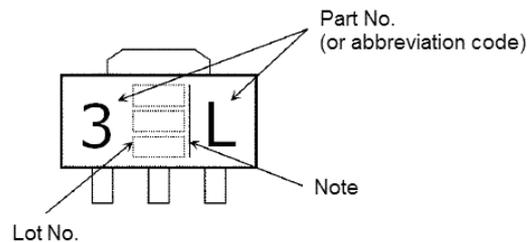
Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Collector output capacitance	$C_{ob}$	$V_{CB} = 10\text{ V}$ , $I_E = 0\text{ A}$ , $f = 1\text{ MHz}$	—	17	—	pF
Switching time (rise time)	$t_r$	See Figure 5.2.1	—	25	—	ns
Switching time (storage time)	$t_{stg}$	$V_{CC} \approx 30\text{ V}$ , $R_L = 30\ \Omega$ , $I_{B1} = 0.1\text{ A}$ , $I_{B2} = -0.1\text{ A}$	—	1100	—	
Switching time (fall time)	$t_f$		—	170	—	



Duty cycle  $\leq 1\%$

**Fig. 5.2.1 Switching Time Test Circuit**

## 6. Marking (Note)



**Fig. 6.1 Marking**

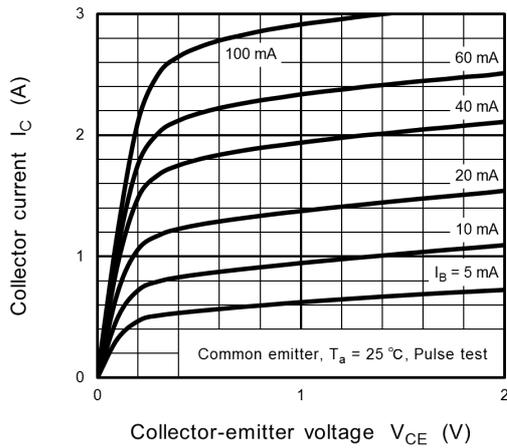
Note: A line beside a Lot No. identifies the indication of product Labels.

[[G]]/RoHS COMPATIBLE or [[G]]/RoHS [[Pb]]

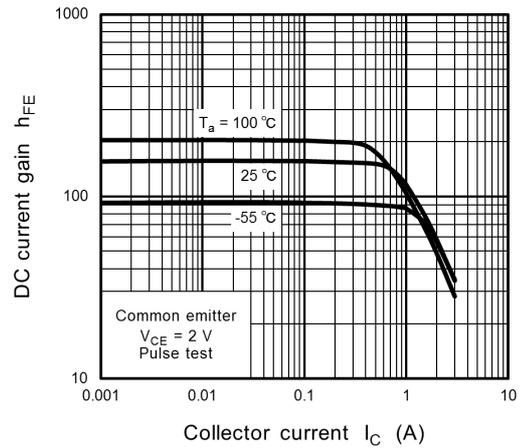
Please contact your TOSHIBA sales representative for details as to environmental matters such as the RoHS compatibility of Product.

The RoHS is the Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

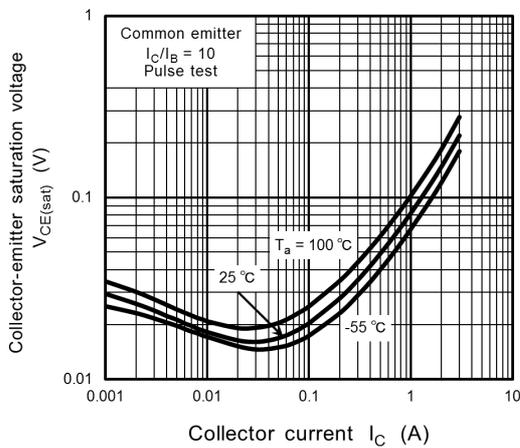
## 7. Characteristics Curves (Note)



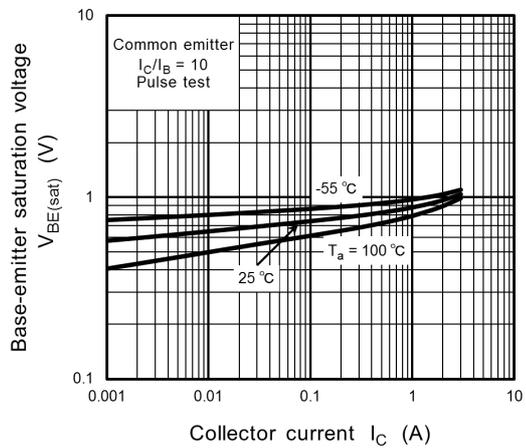
**Fig. 7.1  $I_C - V_{CE}$**



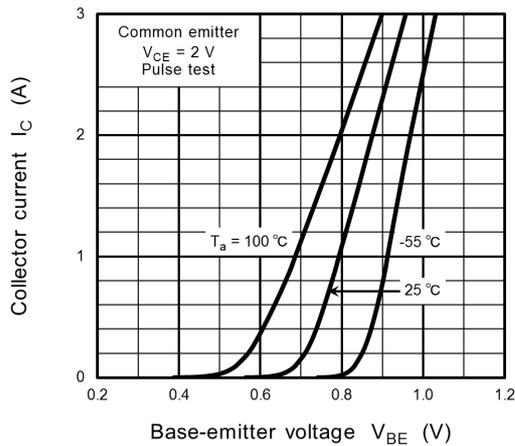
**Fig. 7.2  $h_{FE} - I_C$**



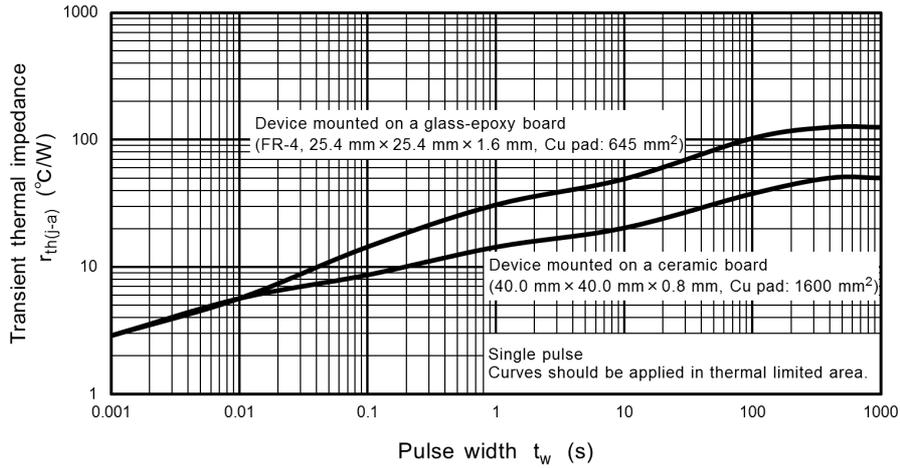
**Fig. 7.3  $V_{CE(sat)} - I_C$**



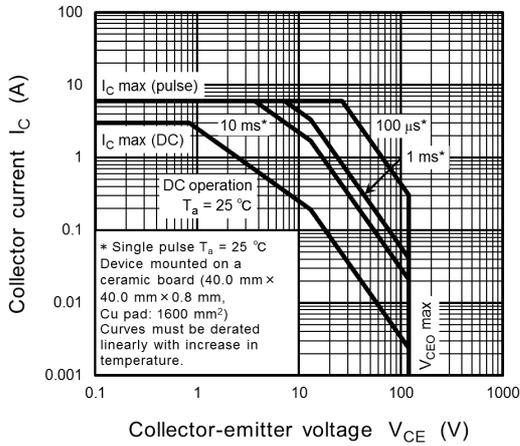
**Fig. 7.4  $V_{BE(sat)} - I_C$**



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



**Fig. 7.6  $r_{th} - t_w$**   
(Guaranteed Maximum)

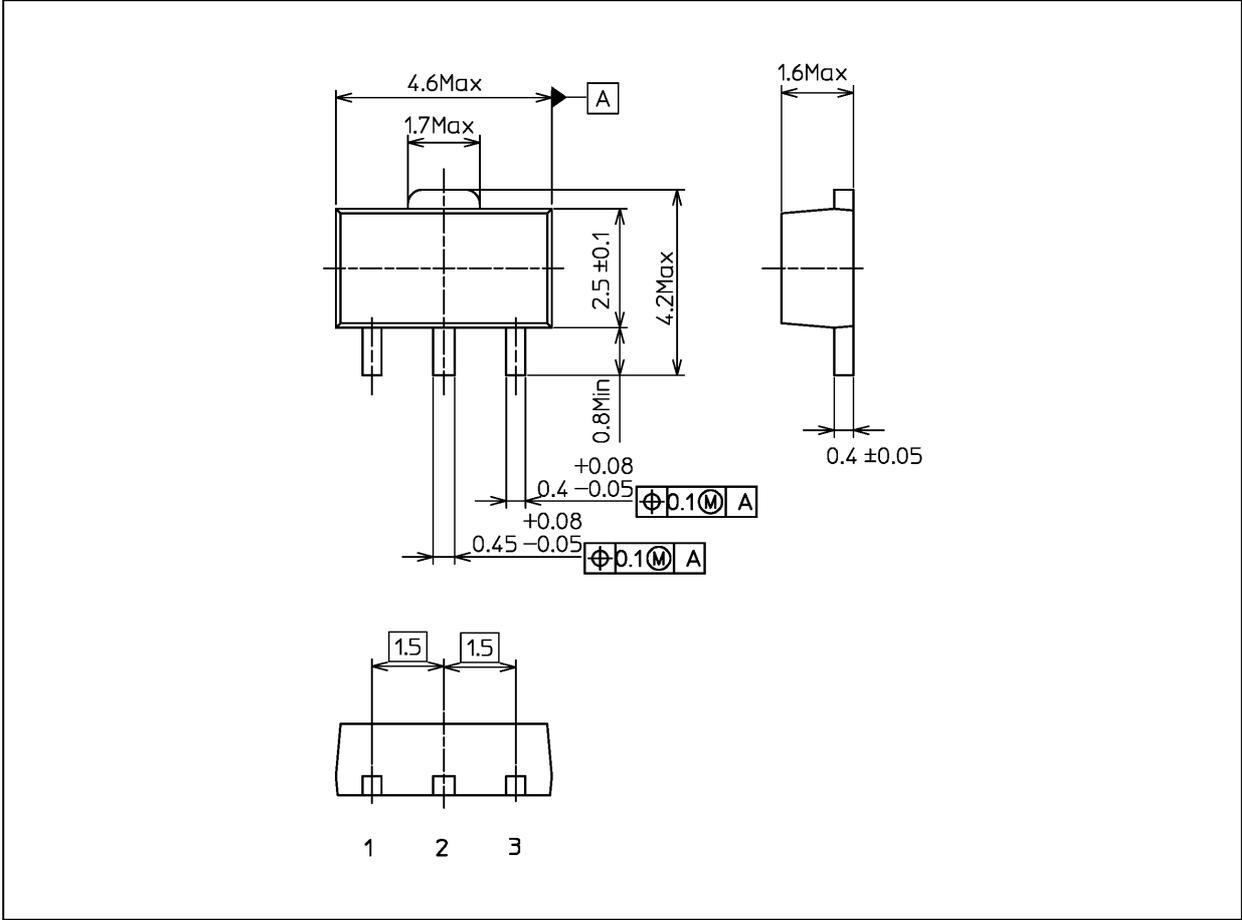


**Fig. 7.7 Safe Operating Area**  
(Guaranteed Maximum)

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

Package Dimensions

Unit: mm



Weight: 0.05 g (typ.)

Package Name(s)
TOSHIBA: 2-5K1S
Nickname: PW-Mini

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