

Bipolar Transistors Silicon NPN Epitaxial Type

TTC022

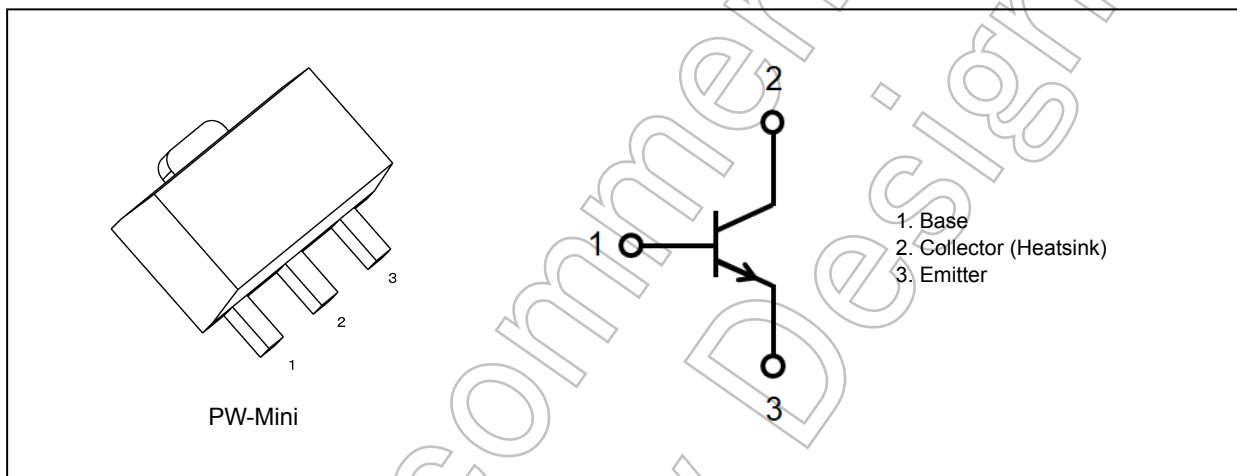
1. Applications

- High-Speed Switching
- DC-DC Converters

2. Features

- (1) High DC current gain: $h_{FE} = 250$ to 500 ($V_{CE} = 2$ V, $I_C = 0.5$ A)
- (2) Low collector-emitter saturation voltage: $V_{CE(sat)} = 0.14$ V (max) ($I_C = 2.0$ A, $I_B = 67$ mA)
- (3) High-speed switching: $t_f = 50$ ns (typ.) ($I_C = 2.0$ A)

3. Packaging and Internal Circuit



Start of commercial production

2024-03

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

Characteristics	Symbol	Rating	Unit
Collector-base voltage	V_{CBO}	12	V
Collector-emitter voltage	V_{CEO}	12	V
Emitter-base voltage	V_{EBO}	6	V
Collector current (DC) (Note 1)	I_C	5	A
Collector current (pulsed) $t \leq 1\text{ms}$ (Note 1)	I_{CP}	12	A
Base current	I_B	0.5	A
Collector power dissipation (Note 2)	P_C	1.0	W
Collector power dissipation (Note 3)	P_C	2.5	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 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 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 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}	$V_{CB} = 12\text{ V}, I_E = 0\text{ A}$	—	—	100	nA
Emitter cut-off current	I_{EBO}	$V_{EB} = 6\text{ V}, I_C = 0\text{ A}$	—	—	100	nA
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	$I_C = 10\text{ mA}, I_B = 0\text{ A}$	12	—	—	V
DC current gain	$h_{FE(1)}$	$V_{CE} = 2\text{ V}, I_C = 0.5\text{ A}$	250	—	500	—
	$h_{FE(2)}$	$V_{CE} = 2\text{ V}, I_C = 2.0\text{ A}$	180	—	—	
Collector-emitter saturation voltage	$V_{CE(sat)(1)}$	$I_C = 0.5\text{ A}, I_B = 17\text{ mA}$	—	0.03	0.06	V
	$V_{CE(sat)(2)}$	$I_C = 2.0\text{ A}, I_B = 67\text{ mA}$	—	0.10	0.14	
	$V_{CE(sat)(3)}$	$I_C = 2.0\text{ A}, I_B = 200\text{ mA}$	—	0.095	0.13	
Base-emitter saturation voltage	$V_{BE(sat)}$	$I_C = 2.0\text{ A}, I_B = 67\text{ mA}$	—	0.89	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}	$V_{CB} = 10\text{ V}$, $I_E = 0\text{ A}$, $f = 1\text{ MHz}$	—	61	—	pF
Switching time (rise time)	t_r	See Figure 5.2.1	—	170	—	ns
Switching time (storage time)	t_{stg}	$V_{CC} \approx 10\text{ V}$, $R_L = 5\ \Omega$, $I_{B1} = 67\text{ mA}$, $I_{B2} = -67\text{ mA}$	—	270	—	
Switching time (fall time)	t_f		—	50	—	

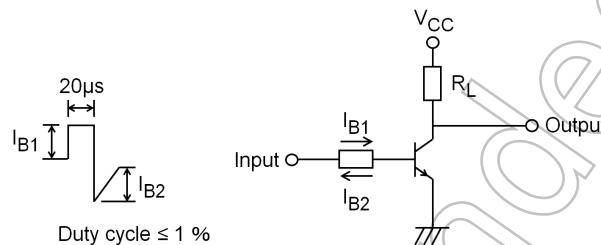


Fig. 5.2.1 Switching Time Test Circuit

6. Marking (Note)

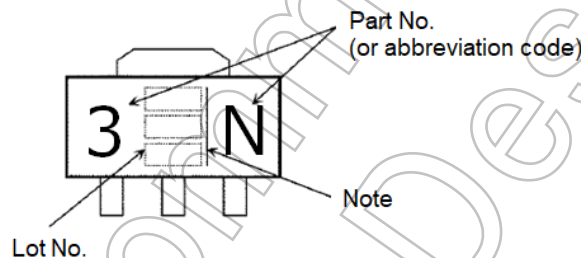


Fig. 6.1 Marking

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)

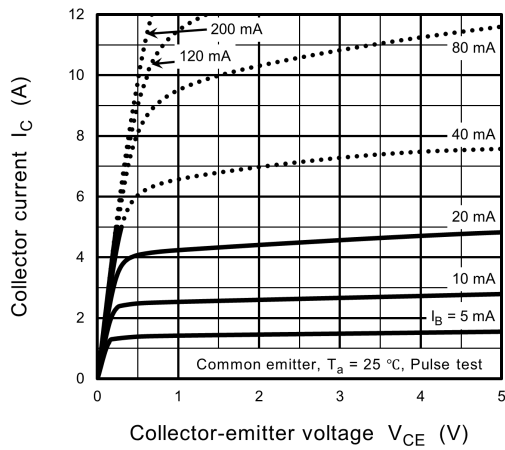


Fig. 7.1 $I_C - V_{CE}$

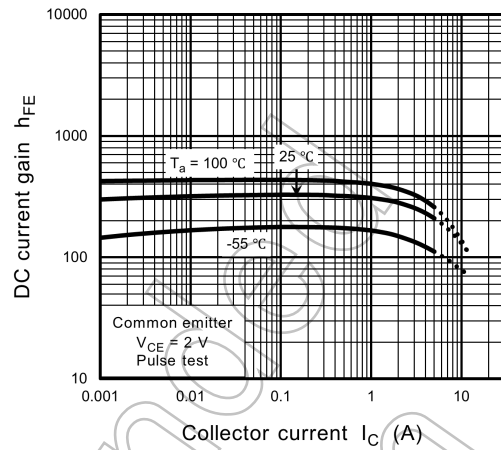


Fig. 7.2 $h_{FE} - I_C$

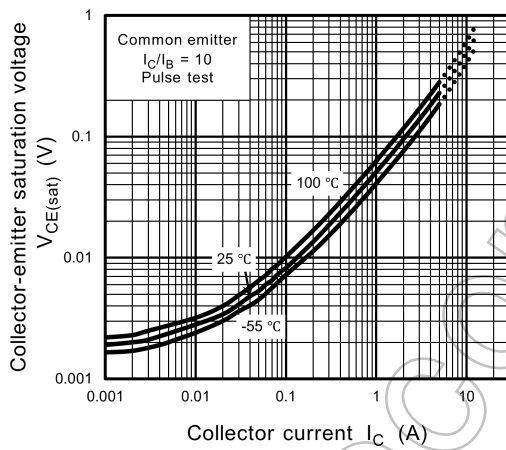


Fig. 7.3 $V_{CE(sat)} - I_C$

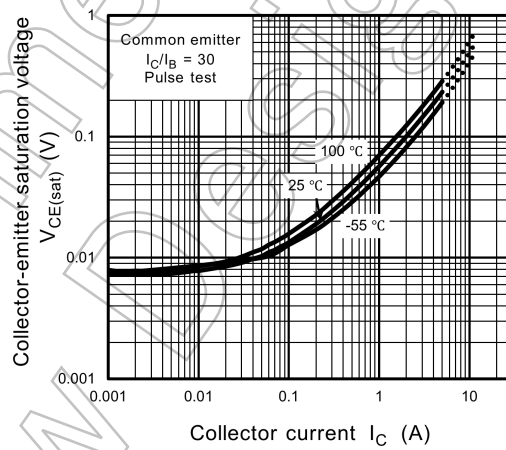


Fig. 7.4 $V_{CE(sat)} - I_C$

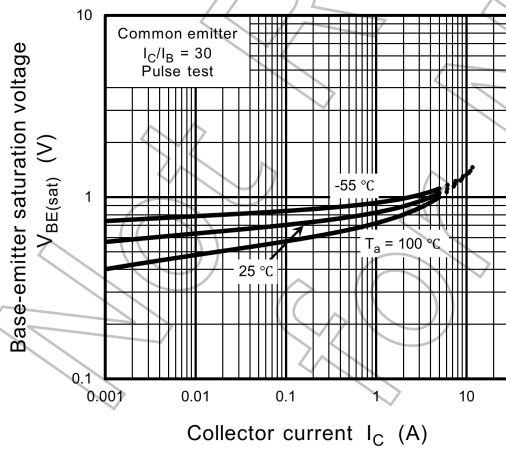


Fig. 7.5 $V_{BE(sat)} - I_C$

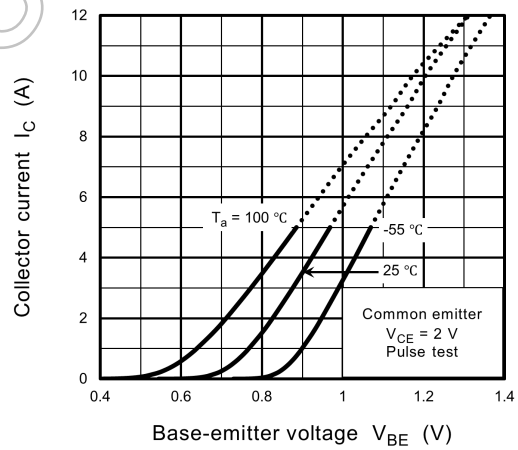


Fig. 7.6 $I_C - V_{BE}$

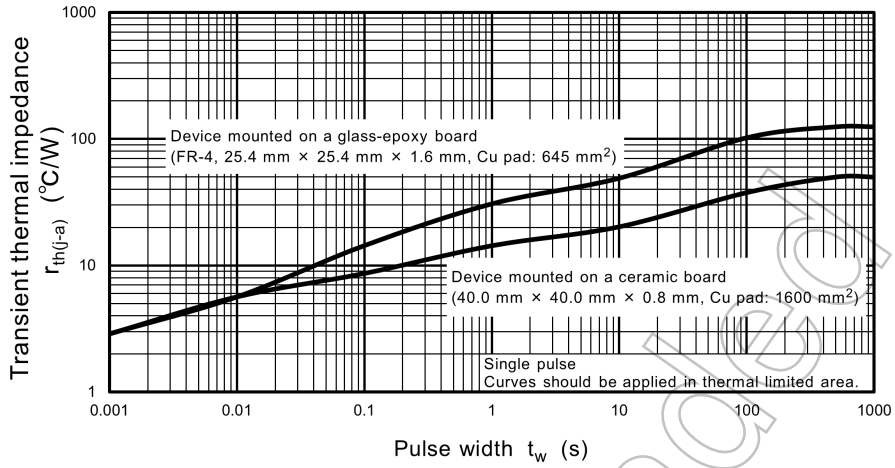


Fig. 7.7 $r_{th} - t_w$
(Guaranteed Maximum)

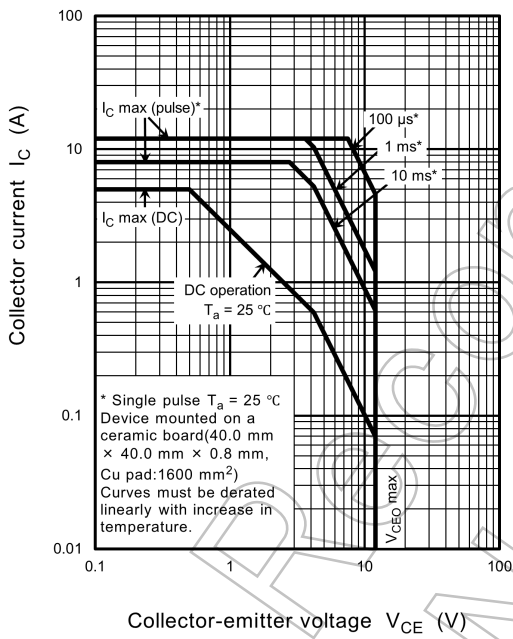
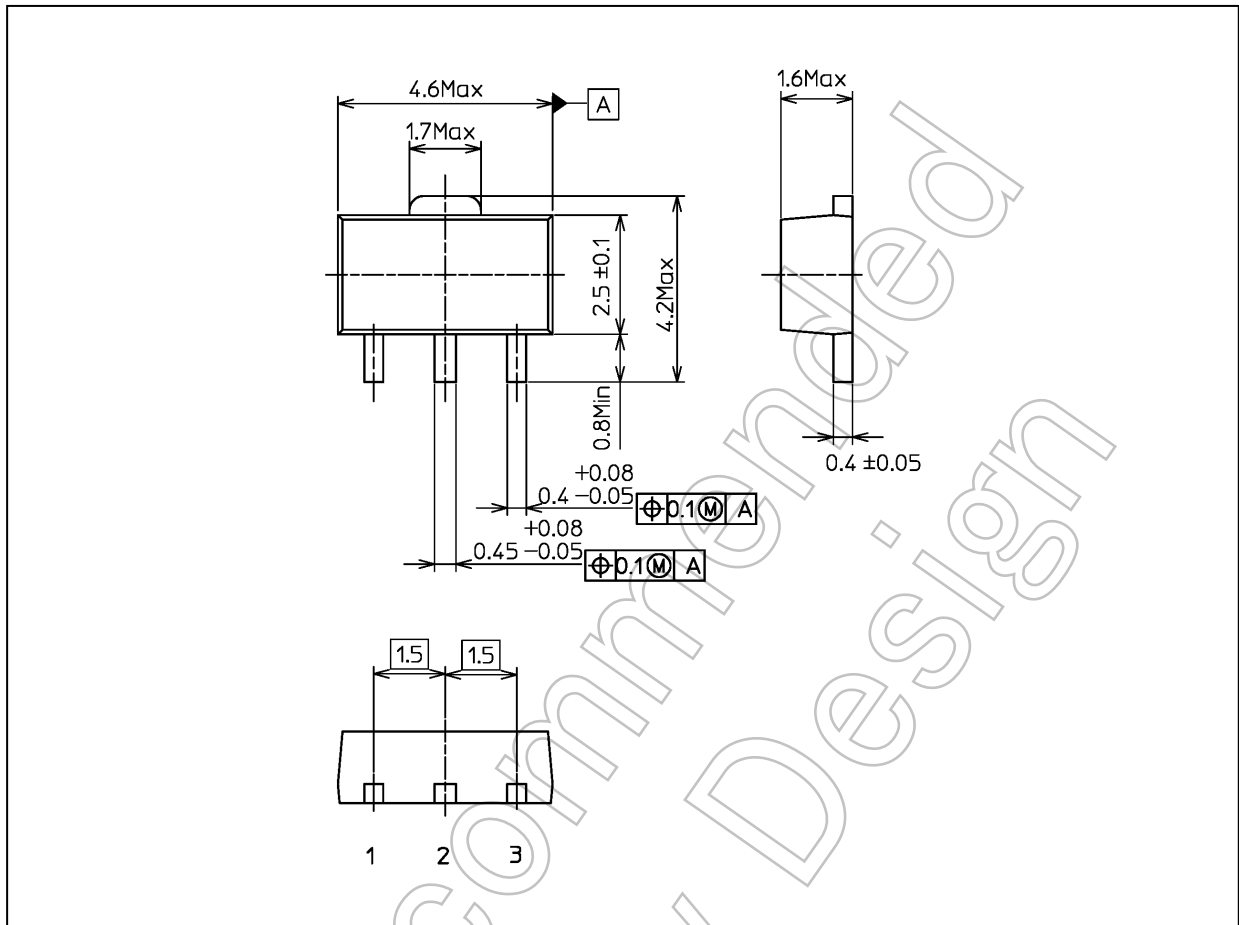


Fig. 7.8 Safe Operating Area
(Guaranteed Maximum)

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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