

TOSHIBA Transistor Silicon NPN Epitaxial Type (Darlington Power)

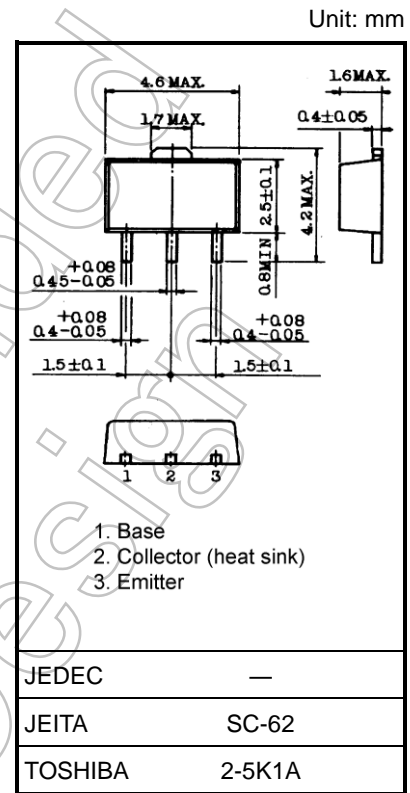
# 2SD2686

Solenoid Drive Applications  
 Motor Drive Applications

- High DC current gain:  $h_{FE} = 2000$  (min) ( $V_{CE} = 2\text{ V}$ ,  $I_C = 1.0\text{ A}$ )
- Zener diode included between collector and base

### Absolute Maximum Ratings ( $T_a = 25^\circ\text{C}$ )

Characteristic	Symbol	Rating	Unit	
Collector-base voltage	$V_{CBO}$	50	V	
Collector-emitter voltage	$V_{CEO}$	$60 \pm 10$	V	
Emitter-base voltage	$V_{EBO}$	8	V	
Collector current	DC	$I_C$	1	A
	Pulse	$I_{CP}$	3	
Base current	$I_B$	0.5	A	
Collector power dissipation	DC	$P_C$ (Note 1)	1.0	W
	$t = 10\text{ s}$		2.5	
Junction temperature	$T_j$	150	$^\circ\text{C}$	
Storage temperature range	$T_{stg}$	-55 to 150	$^\circ\text{C}$	



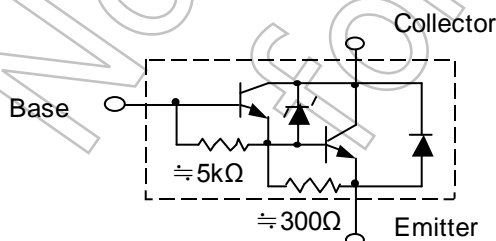
Note 1: Mounted on an FR4 board (glass-epoxy; 1.6 mm thick; Cu area, 645 mm<sup>2</sup>)

Weight: 0.05 g (typ.)

Note 2: 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).

### Equivalent Circuit

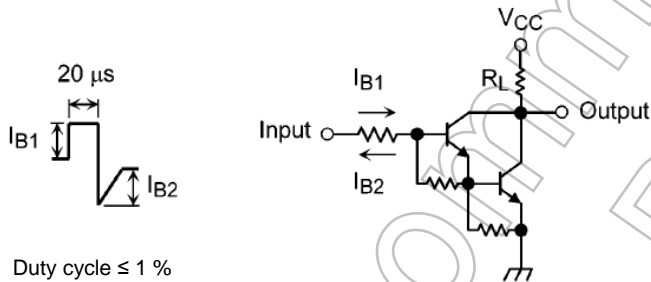


Start of commercial production  
 2002-09

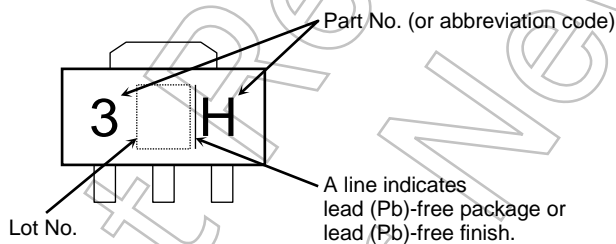
**Electrical Characteristics (Ta = 25°C)**

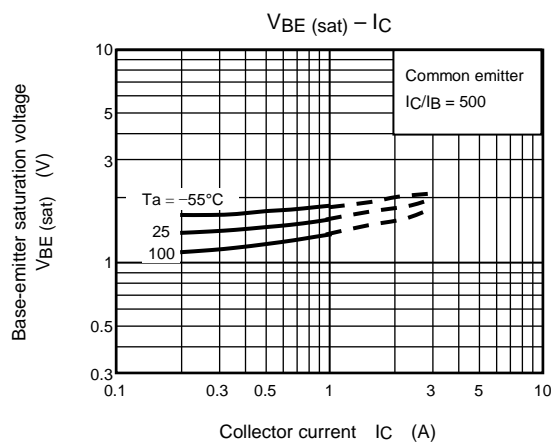
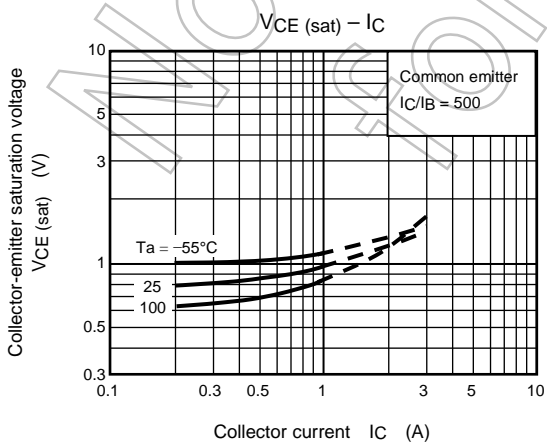
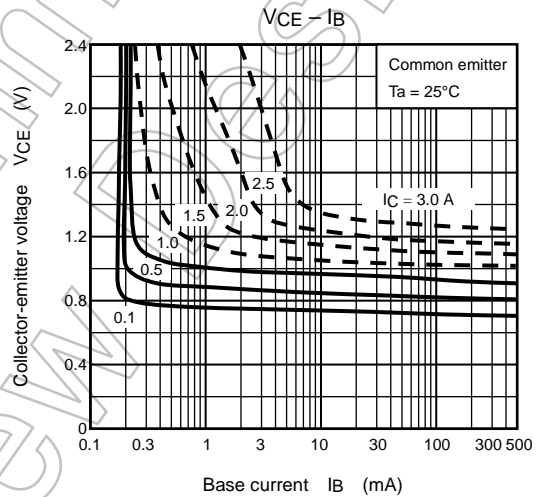
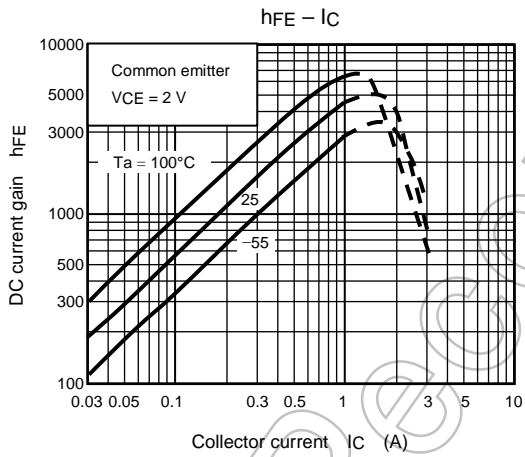
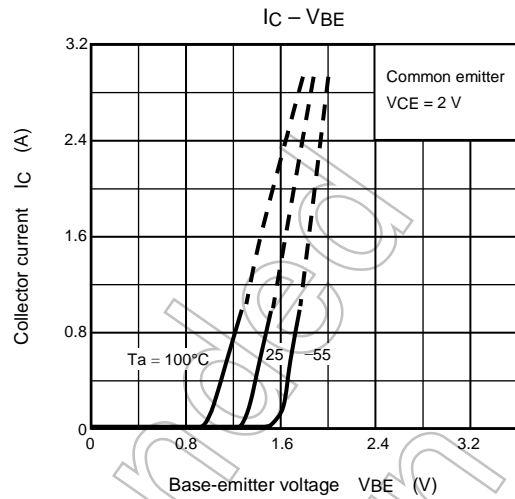
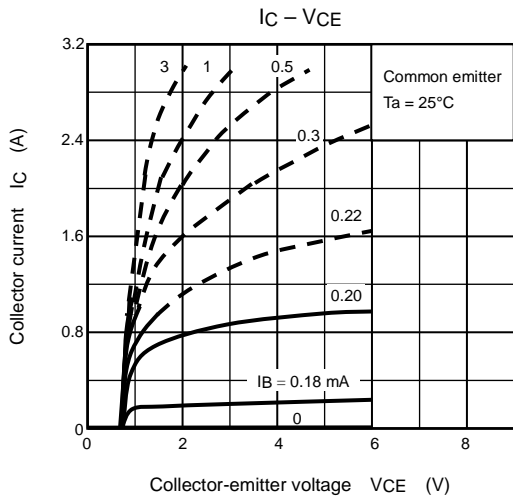
Characteristic		Symbol	Test Condition	Min	Typ.	Max	Unit
Collector cutoff current		ICBO	V <sub>CB</sub> = 45 V, I <sub>E</sub> = 0 A	—	—	10	μA
		ICEO	V <sub>CE</sub> = 45 V, I <sub>E</sub> = 0 A	—	—	10	μA
Emitter cutoff current		I <sub>EBO</sub>	V <sub>EB</sub> = 8 V, I <sub>C</sub> = 0 A	0.80	—	4.0	mA
Collector-emitter breakdown voltage		V (BR) CEO	I <sub>C</sub> = 10 mA, I <sub>B</sub> = 0 A	50	60	70	V
DC current gain		hFE	V <sub>CE</sub> = 2 V, I <sub>C</sub> = 1.0 A	2000	—	—	—
Collector-emitter saturation voltage		V <sub>CE</sub> (sat) (1)	I <sub>C</sub> = 0.5 A, I <sub>B</sub> = 1 mA	—	—	1.2	V
		V <sub>CE</sub> (sat) (2)	I <sub>C</sub> = 1.0 A, I <sub>B</sub> = 1 mA	—	—	1.5	V
Base-emitter saturation voltage		V <sub>BE</sub> (sat)	I <sub>C</sub> = 1.0 A, I <sub>B</sub> = 1 mA	—	—	2.0	V
Switching time	Rise time	t <sub>on</sub>	See Figure 1	—	0.4	—	μs
	Storage time	t <sub>stg</sub>	V <sub>CC</sub> ≈ 30 V, R <sub>L</sub> = 30 Ω	—	4.0	—	
	Fall time	t <sub>f</sub>	I <sub>B1</sub> = 1 mA, I <sub>B2</sub> = 1 mA	—	0.6	—	

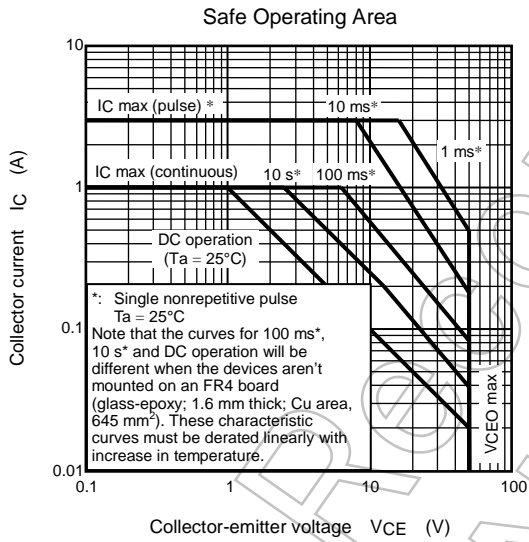
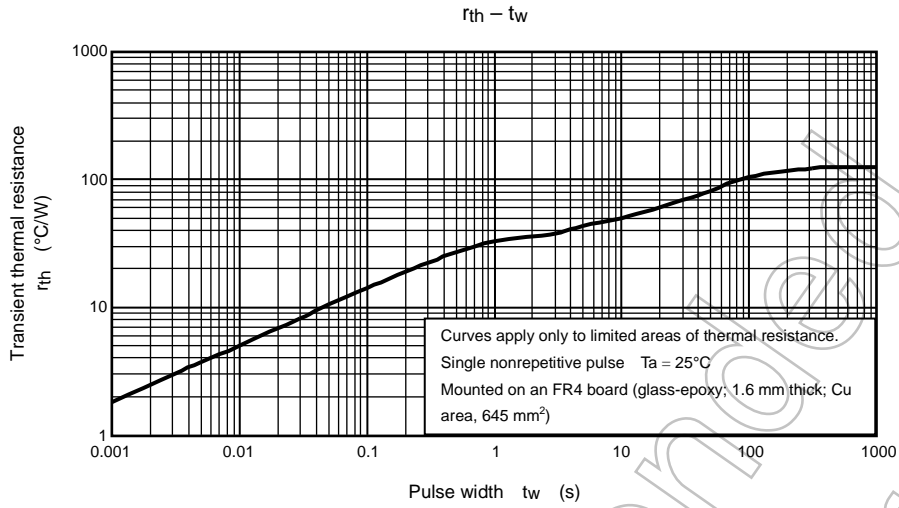
**Figure 1. Switching Time Test Circuit**



**Marking**







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