TOSHIBA Multi-Chip Device Silicon PNP Epitaxial Type, Schottky Barrier Diode

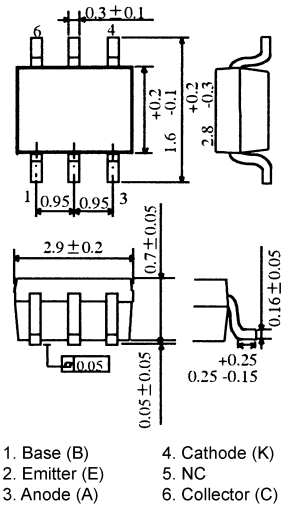
TPC6D03

High-Speed Switching Applications

DC-DC Converter Applications

- A PNP transistor and a Schottky barrier diode are mounted on a compact and slim package.

Unit: mm



1. Base (B)
2. Emitter (E)
3. Anode (A)
4. Cathode (K)
5. NC
6. Collector (C)

JEDEC	—
JEITA	—
TOSHIBA	2-3T1F

Weight: 0.011 g (typ.)

Maximum Ratings

Transistor (Ta = 25°C)

Characteristics		Symbol	Rating	Unit
Collector-base voltage		V_{CBO}	−20	V
Collector-emitter voltage		V_{CEO}	−20	V
Emitter-collector voltage		V_{ECO}	−9.5	V
Emitter-base voltage		V_{EBO}	−9.5	V
Collector current	DC	I_C	−1.2	A
	Pulse	I_{CP}	−2.0	A
Base current		I_B	−120	mA
Collector power dissipation (Q1 single-device operation)		P_C (Note 1)	400	mW
Junction temperature		T_j	150	°C

Diode (Ta = 25°C)

Characteristics	Symbol	Rating	Unit
Repetitive peak reverse voltage	V_{RRM}	30	V
Average forward current	$I_{F\ (AV)}$	0.7	A
Peak one cycle surge forward current (sine wave)	I_{FSM}	7.0	A
Power dissipation (D1 single-device operation)	P_D (Note 1)	320	mW
Junction temperature	T_j	125	°C

Maximum Ratings for Transistor and Diode (Ta = 25°C)

Characteristics	Symbol	Rating	Unit
Total power dissipation (simultaneous operation)	P_T (Note 2)	600	mW
Storage temperature range	T_{stg}	−55~150	°C

Thermal Resistance Characteristics (for transistor and diode)

Characteristics	Symbol	Max	Unit
Thermal resistance, junction to ambient (single-device operation)	$R_{th\ (j\text{-}a)}$ (Note 1)	312	°C/W

Note 1: Mounted on an FR4 board (glass epoxy, 1.6 mm thick, Cu area: 645 mm^2)

Note 2: Mounted on an FR4 board (glass epoxy, 1.6 mm thick, Cu area: 645 mm^2)
Total power dissipation value when two devices are operated at the same time

Note 3: 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).

Electrical Characteristics (Ta = 25°C)

Transistor

Characteristics		Symbol	Test Condition	Min	Typ.	Max	Unit
Collector cut-off current		I_{CBO}	V_{CB} = −20 V, I_E = 0	—	—	−100	nA
Emitter cut-off current		I_{EBO}	V_{EB} = −9.5 V, I_C = 0	—	—	−100	nA
Collector-emitter breakdown voltage		$V_{(BR)\ CEO}$	I_C = −10 mA, I_B = 0	−20	—	—	V
DC current gain		h_{FE} (1)	V_{CE} = −2 V, I_C = −0.15 A	140	—	350	
		h_{FE} (2)	V_{CE} = −2 V, I_C = −0.5 A	85	—	—	
Collector-emitter saturation voltage		$V_{CE\ (sat)}$	I_C = −0.5 A, I_B = −16.7 mA	—	—	−0.17	V
Base-emitter saturation voltage		$V_{BE\ (sat)}$	I_C = −0.5 A, I_B = −16.7 mA	—	—	−1.10	V
Switching time	Rise time	t_r	See Figure 1 circuit diagram.	—	40	—	ns
	Storage time	t_{stg}	V_{CC} ≃ −12 V, R_L = 24 Ω	—	135	—	
	Fall time	t_f	I_{B1} = −I_{B2} = −16.7 mA	—	37	—	

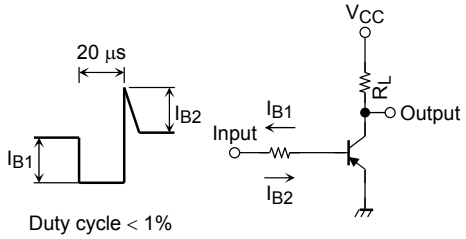
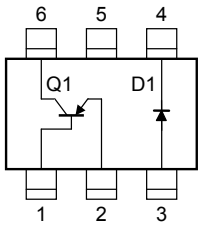
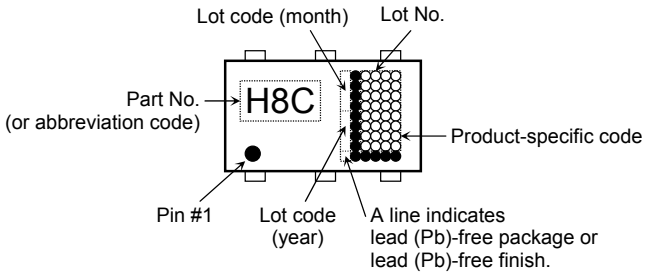


Figure 1 Switching Time Test Circuit & Timing Chart

Circuit Configuration



Marking



Diode

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Peak forward voltage	$V_{FM\ (1)}$	I_F = 0.5 A	—	0.35	0.4	V
Peak forward voltage	$V_{FM\ (2)}$	I_F = 0.7 A	—	0.38	0.43	V
Repetitive peak reverse voltage	V_{RRM}	I_R = 3 mA	30	40	—	V
Repetitive peak reverse current	I_{RRM}	V_R = 10 V	—	25	100	μA
Junction capacitance	C_j	V_R = 10 V, f = 1 MHz	—	19	—	pF

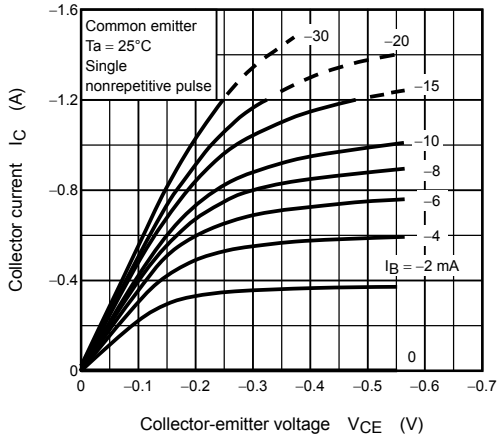
Handling Precaution

Schottky barrier diodes have large-reverse-current-leakage characteristic compared to other rectifier products. This current leakage and not proper operating temperature or voltage may cause thermal runaway.

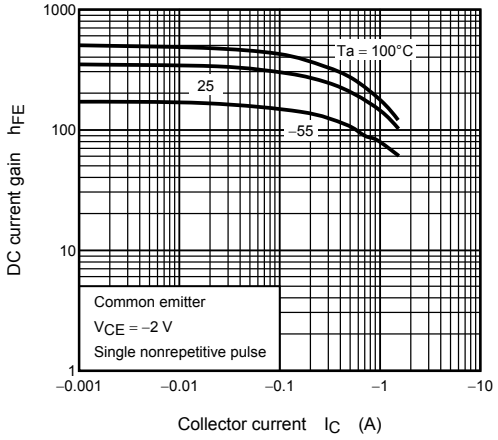
Please take forward and reverse loss into consideration during design.

Transistor

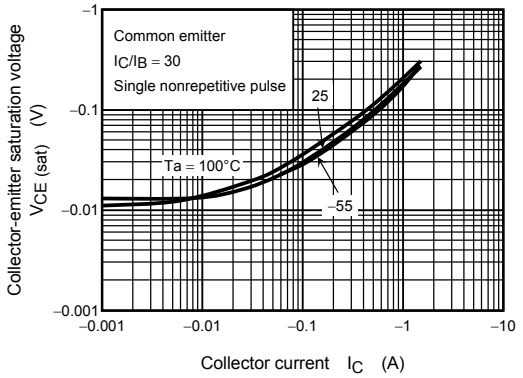
$I_C - V_{CE}$



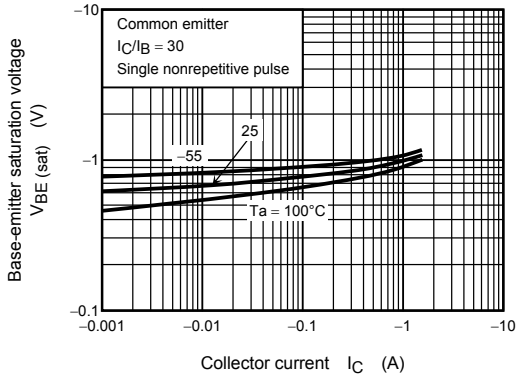
$h_{FE} - I_C$



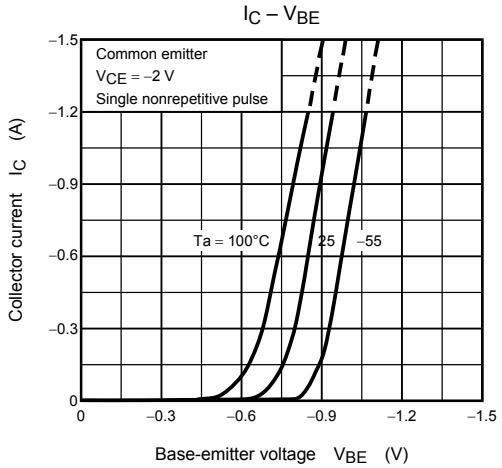
$V_{CE\ (sat)} - I_C$



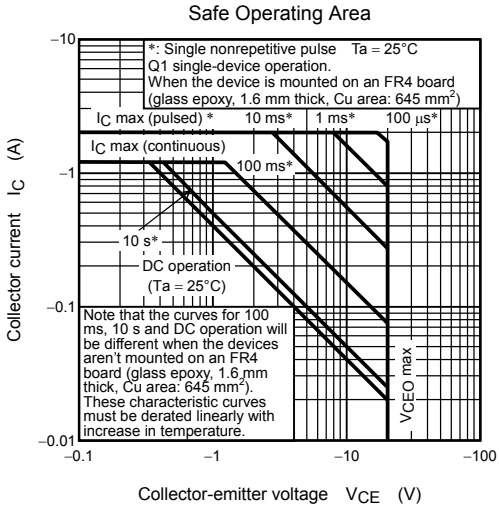
$V_{BE\ (sat)} - I_C$



$I_C - V_{BE}$

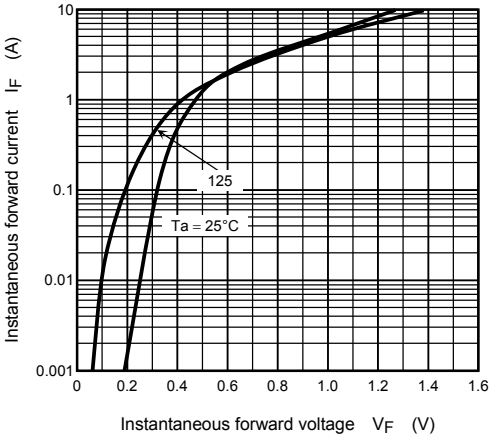


Safe Operating Area

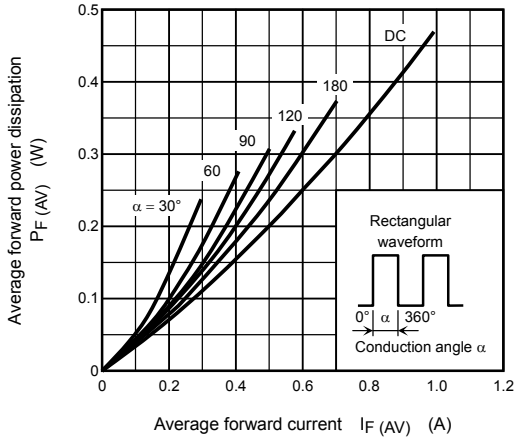


Diode

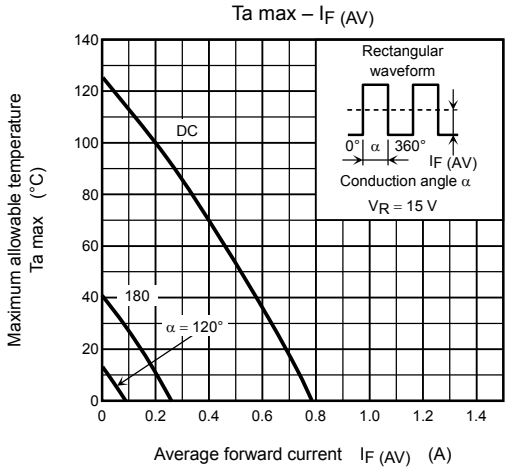
$I_F - V_F$



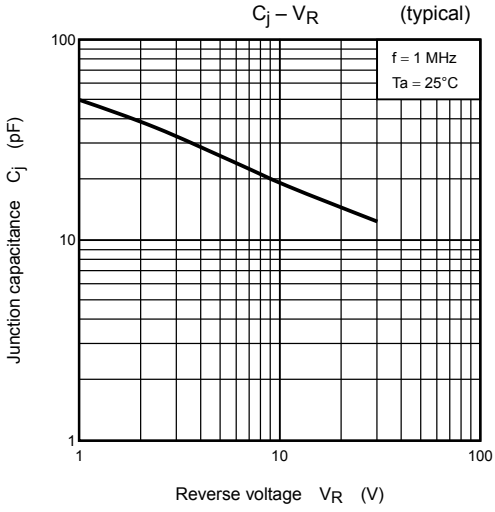
$P_{F\ (AV)} - I_{F\ (AV)}$



Ta max – $I_{F\ (AV)}$

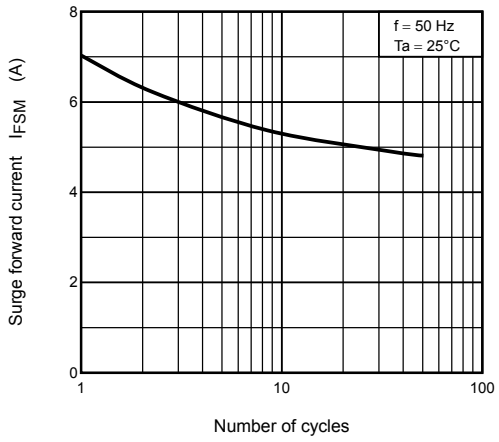


$C_j - V_R$ (typical)

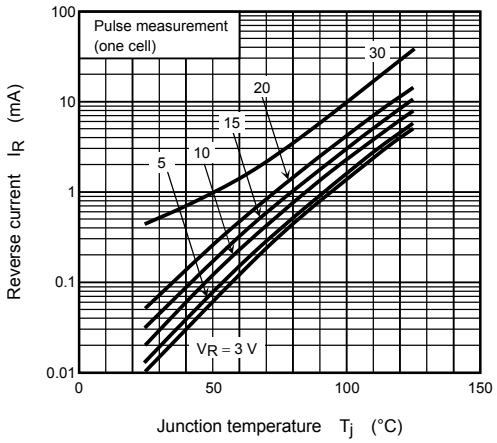


Diode

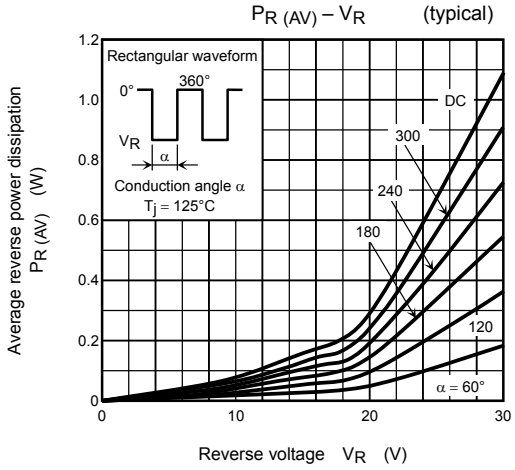
Surge forward current (non-repetitive)



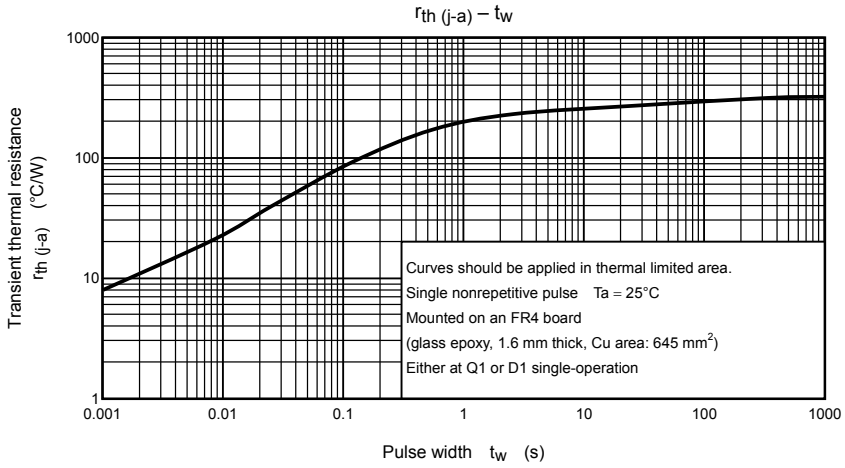
$I_R - T_j$ (typical)

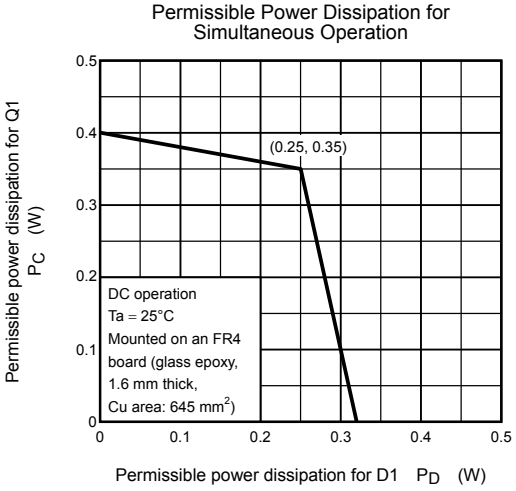


$P_{R\ (AV)} - V_R$ (typical)



Transistor and Diode





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