Bipolar Transistors Silicon NPN/PNP Epitaxial Type (PCT Process)(Bias Resistor built-in Transistor)

RN4988FE

1. Applications

- Switching
- Inverter Circuits
- Interfacing
- Driver Circuits

2. Features

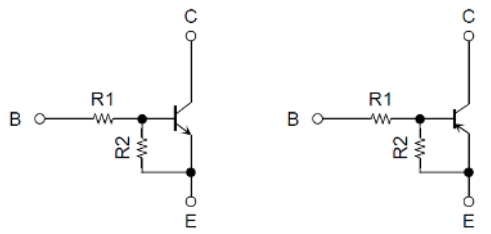
(1) AEC-Q101 qualified (Please see the orderable part number list)

(2) Small package (Dual type)

(3) The integrated bias resistor reduces the number of external parts required, making it possible to reduce system size and assembly time.

3. Equivalent Circuit

Q1 **Q2**

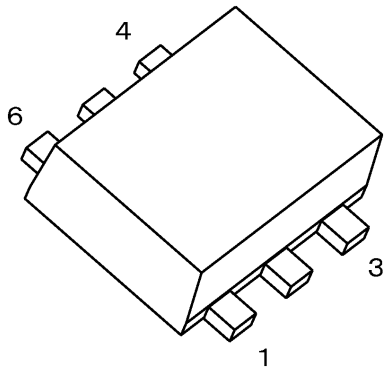


R1: 22 kΩ

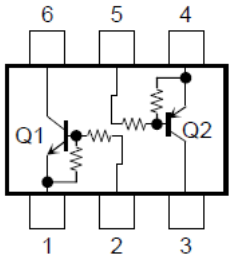
R2: 47 kΩ

(Q1, Q2 common)

4. Packaging and Pin Assignment



ES6



1: Emitter1
2: Base1
3: Collector2
4: Emitter2
5: Base2
6: Collector1

Start of commercial production
2000-05

5. Orderable part number

Orderable part number	AEC-Q101	Note
RN4988FE,LF	—	General Use
RN4988FE,LXGF	YES (Note 1)	Unintended Use (Note 1)
RN4988FE,LXHF	YES	Automotive Use

Note 1: For more information, please contact our sales or use the inquiry form on our website.

6. Q1 Absolute Maximum Ratings (Note) (Unless otherwise specified, T_a = 25 °C)

Characteristics	Symbol	Rating	Unit
Collector-base voltage	V_{CBO}	50	V
Collector-emitter voltage	V_{CEO}	50	
Emitter-base voltage	V_{EBO}	7	
Collector current	I_C	100	mA

7. Q2 Absolute Maximum Ratings (Note) (Unless otherwise specified, T_a = 25 °C)

Characteristics	Symbol	Rating	Unit
Collector-base voltage	V_{CBO}	-50	V
Collector-emitter voltage	V_{CEO}	-50	
Emitter-base voltage	V_{EBO}	-7	
Collector current	I_C	-100	mA

8. Q1, Q2 Common Absolute Maximum Ratings (Note) (Unless otherwise specified, T_a = 25 °C)

Characteristics	Symbol	Rating	Unit
Collector power dissipation (Note 1)	P_C	100	mW
Junction temperature	T_j	150	°C
Storage temperature	T_{stg}	-55 to 150	

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: Total rating

9. Q1 Electrical Characteristics (Unless otherwise specified, T_a = 25 °C)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Collector cut-off current	I_{CBO}	V_{CB} = 50 V, I_E = 0 mA	—	—	100	nA
Collector cut-off current	I_{CEO}	V_{CE} = 50 V, I_B = 0 mA	—	—	500	
Emitter cut-off current	I_{EBO}	V_{EB} = 7 V, I_C = 0 mA	0.078	—	0.145	mA
DC current gain	h_{FE}	V_{CE} = 5 V, I_C = 10 mA	80	—	—	—
Collector-emitter saturation voltage	$V_{CE(sat)}$	I_C = 5 mA, I_B = 0.25 mA	—	0.1	0.3	V
Input voltage (ON)	$V_{I(ON)}$	V_{CE} = 0.2 V, I_C = 5 mA	1.0	—	2.6	
Input voltage (off)	$V_{I(off)}$	V_{CE} = 5 V, I_C = 0.1 mA	0.6	—	1.16	
Transition frequency	f_T	V_{CE} = 10 V, I_C = 5 mA	—	250	—	MHz
Collector output capacitance	C_{ob}	V_{CB} = 10 V, I_E = 0 mA, f = 1 MHz	—	3	6	pF

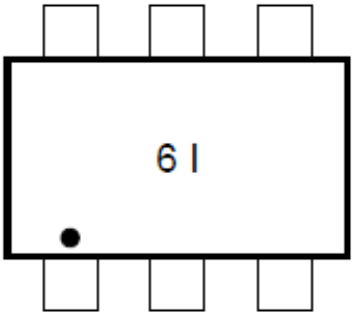
10. Q2 Electrical Characteristics (Unless otherwise specified, T_a = 25 °C)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Collector cut-off current	I_{CBO}	V_{CB} = -50 V, I_E = 0 mA	—	—	-100	nA
Collector cut-off current	I_{CEO}	V_{CE} = -50 V, I_B = 0 mA	—	—	-500	
Emitter cut-off current	I_{EBO}	V_{EB} = -7 V, I_C = 0 mA	-0.078	—	-0.145	mA
DC current gain	h_{FE}	V_{CE} = -5 V, I_C = -10 mA	80	—	—	—
Collector-emitter saturation voltage	$V_{CE(sat)}$	I_C = -5 mA, I_B = -0.25 mA	—	-0.1	-0.3	V
Input voltage (ON)	$V_{I(ON)}$	V_{CE} = -0.2 V, I_C = -5 mA	-1.0	—	-2.6	
Input voltage (off)	$V_{I(off)}$	V_{CE} = -5 V, I_C = -0.1 mA	-0.6	—	-1.16	
Transition frequency	f_T	V_{CE} = -10 V, I_C = -5 mA	—	200	—	MHz
Collector output capacitance	C_{ob}	V_{CB} = -10 V, I_E = 0 mA, f = 1 MHz	—	3	6	pF

11. Q1, Q2 Common Electrical Characteristics (Unless otherwise specified, T_a = 25 °C)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Input resistance	R_1	-	15.4	22	28.6	kΩ
Resistor ratio	R1/R2	-	0.421	0.468	0.515	—

12. Marking



13. Characteristics Curves (Note)

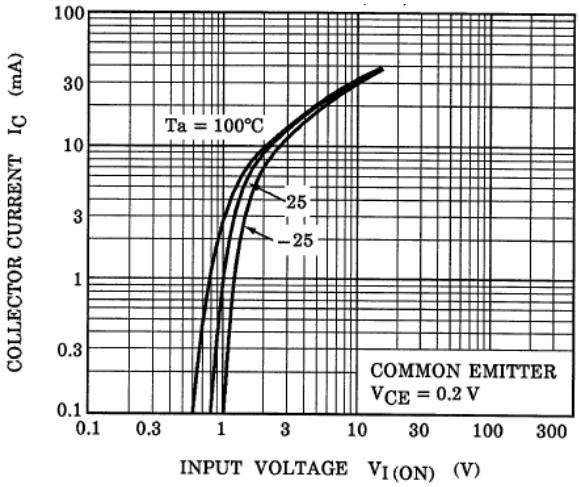


Fig. 13.1 Q1 I_C-$V_{I(ON)}$

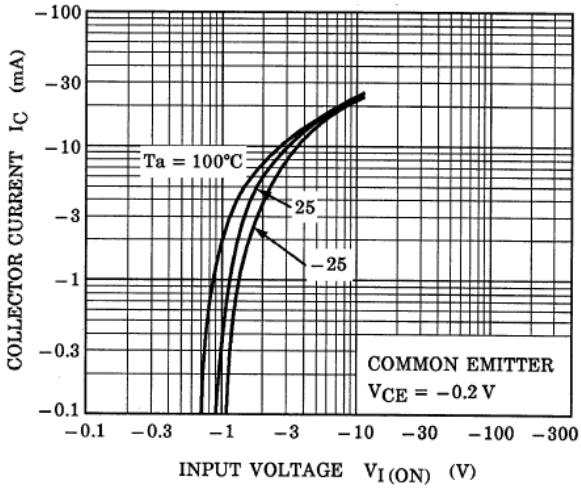


Fig. 13.2 Q2 I_C-$V_{I(ON)}$

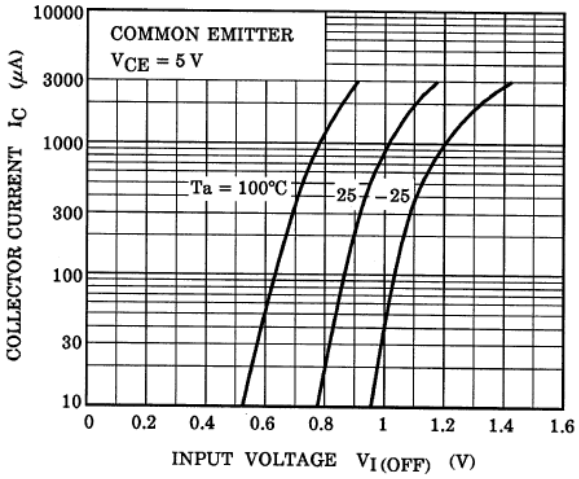


Fig. 13.3 Q1 I_C-$V_{I(OFF)}$

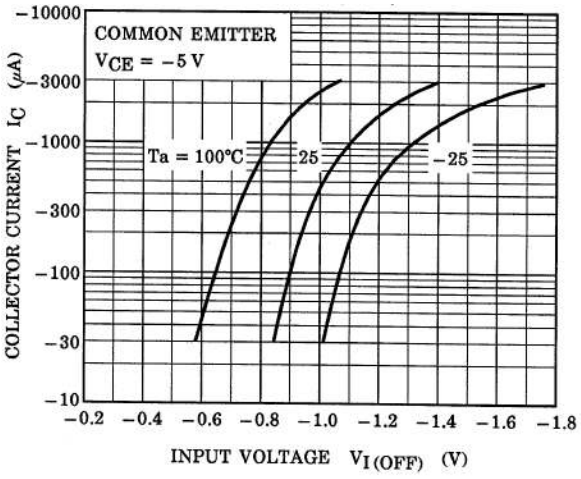


Fig. 13.4 Q2 I_C-$V_{I(OFF)}$

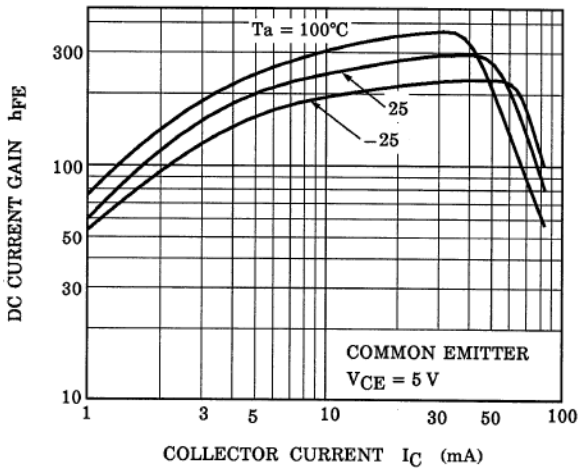


Fig. 13.5 Q1 h_{FE}-I_C

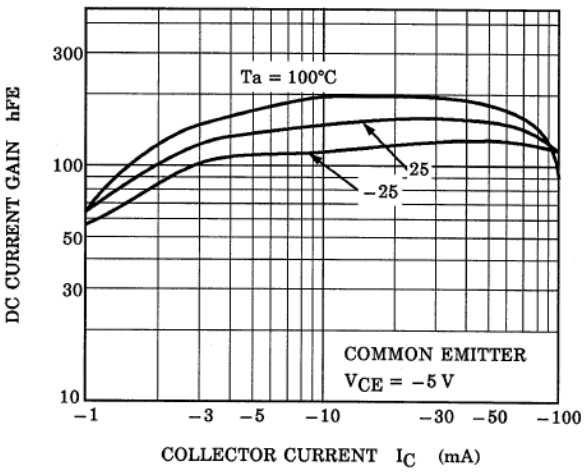


Fig. 13.6 Q2 h_{FE}-I_C

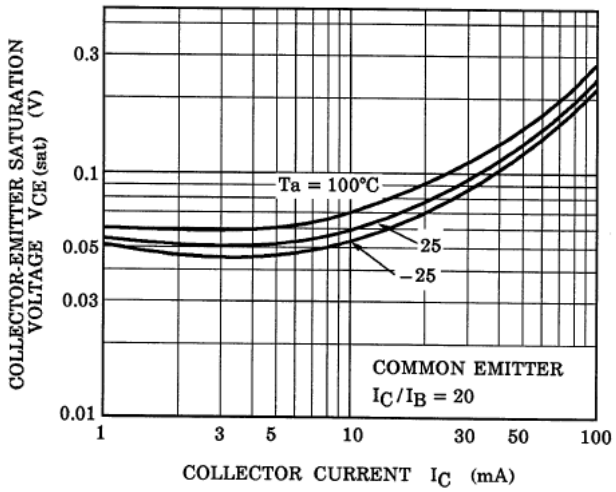


Fig. 13.7 Q1 $V_{CE(sat)}$-I_C

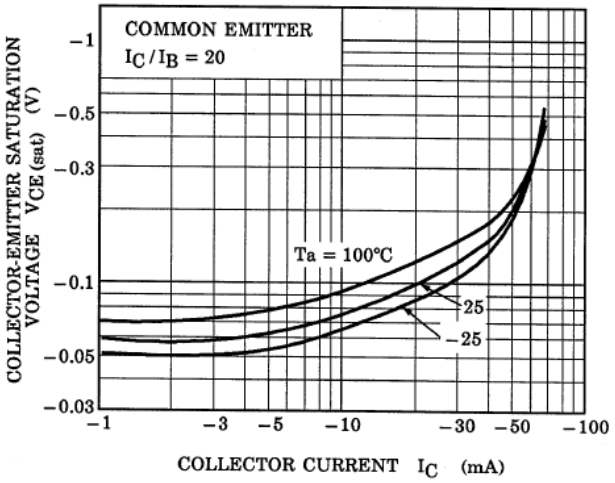
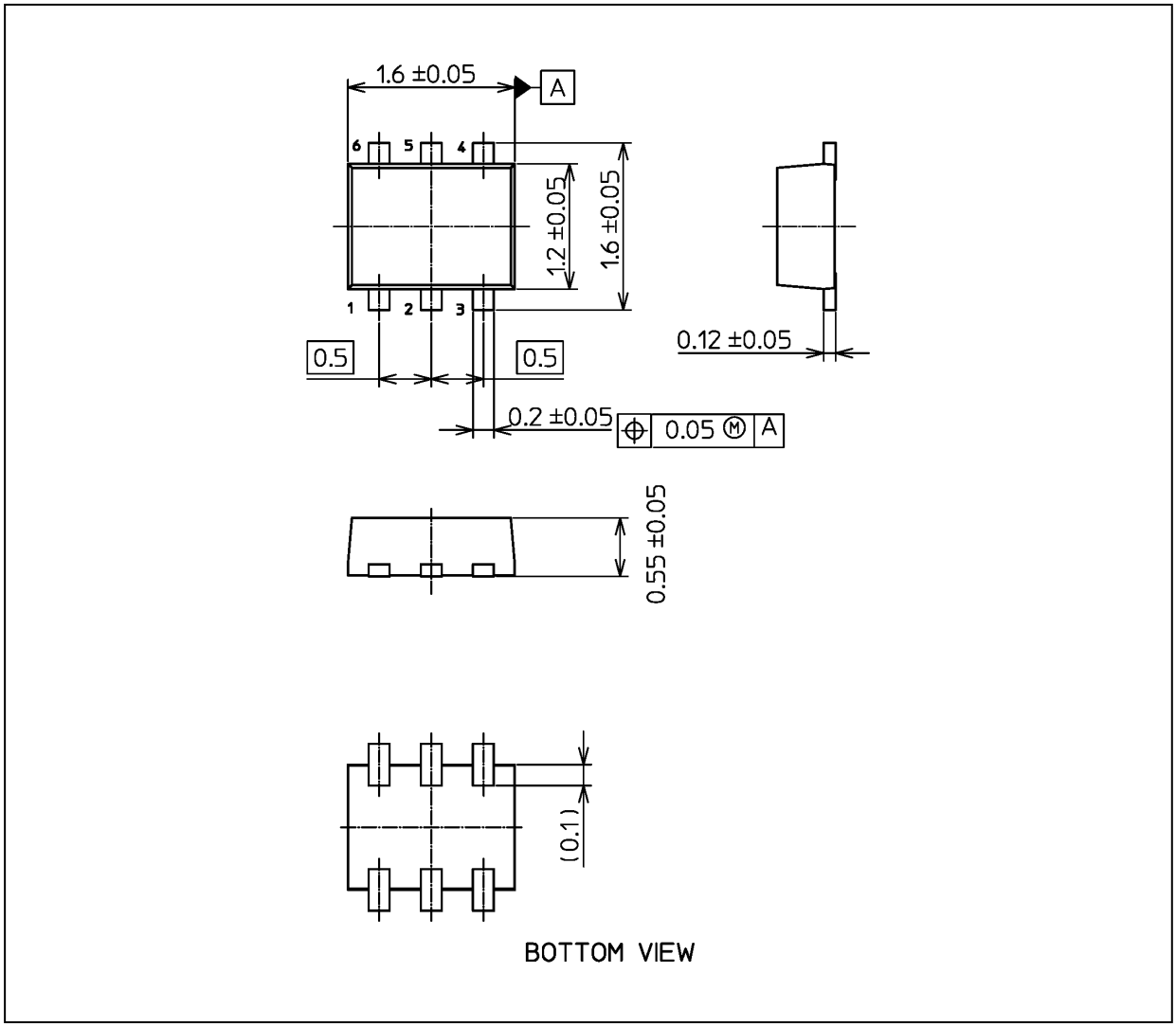


Fig. 13.8 Q2 $V_{CE(sat)}$-I_C

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

Package Dimensions

Unit: mm



Weight: 3.0 mg (typ.)

Package Name(s)
TOSHIBA: 1-2X1S
Nickname: ES6

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