

# HN2E04F

Super High Speed Switching Application  
 Audio Frequency Amplifier Application  
 Audio Low Noise Amplifier Application

**Q1**

- High Voltage :  $V_{CEO} = -120V$
- High DC Current Gain :  $h_{FE} = 200$  to  $700$
- Good  $h_{FE}$  Linearity :  $h_{FE}(I_C = -0.1mA) / h_{FE}(I_C = -2mA) = 0.95$

**Q2**

- Low Forward Voltage Drop :  $V_{F(3)} = 0.98V$  (typ.)
- Fast Reverse Recovery Time :  $t_{rr} = 1.6ns$  (typ.)
- Low Total Capacitance :  $C_T = 0.5pF$  (typ.)

Q1 (Transistor) : 2SA1587 equivalent

Q2 (Diode) : 1SS352 equivalent

**Q1 (Transistor) Absolute Maximum Ratings (Ta = 25°C)**

Characteristic	Symbol	Rating	Unit
Collector-base voltage	$V_{CBO}$	-120	V
Collector-emitter voltage	$V_{CEO}$	-120	V
Emitter-base voltage	$V_{EBO}$	-5	V
Collector current	$I_C$	-100	mA
Base current	$I_B$	-20	mA

**Q2 (Diode) Absolute Maximum Ratings (Ta = 25°C)**

Characteristic	Symbol	Rating	Unit
Maximum (peak) reverse voltage	$V_{RM}$	85	V
Reverse voltage	$V_R$	80	V
Maximum (peak) forward current	$I_{FM}$	300	mA
Average forward current	$I_O$	100	mA
Surge current (10ms)	$I_{FSM}$	1	A

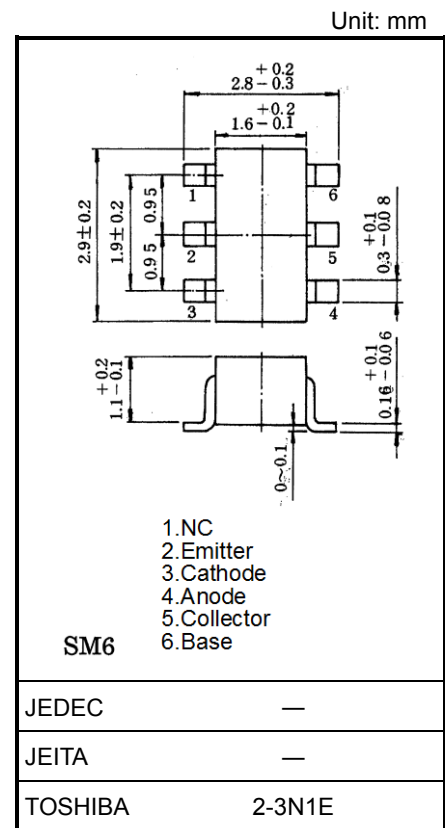
**Absolute Maximum Ratings (Ta = 25°C) (Q1, Q2 Common)**

Characteristic	Symbol	Rating	Unit
Collector power dissipation	$P_C^*$	300	mW
Junction temperature	$T_j$	125	°C
Storage temperature range	$T_{stg}$	-55 to 125	°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).

\*Total rating: Power dissipation per element should not exceed 200mW per element.



Weight: 0.015g (typ.)

Start of commercial production  
 2000-02

## Q1 (Transistor) Electrical Characteristics (Ta = 25°C)

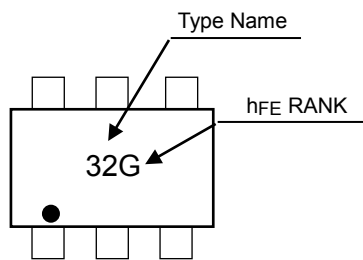
Characteristic	Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Collector cut-off current	ICBO	—	V <sub>CB</sub> = -120V, I <sub>E</sub> = 0A	—	—	-100	nA
Emitter cut-off current	IEBO	—	V <sub>EB</sub> = -5V, I <sub>C</sub> = 0A	—	—	-100	nA
DC current gain	h <sub>FE</sub> *	—	V <sub>CE</sub> = -6V, I <sub>C</sub> = -2mA	200	—	700	
Collector-emitter saturation voltage	V <sub>CE(sat)</sub>	—	I <sub>C</sub> = -10mA, I <sub>B</sub> = -1mA	—	—	-0.3	V
Transition Frequency	f <sub>T</sub>	—	V <sub>CE</sub> = -6V, I <sub>C</sub> = -1mA	—	100	—	MHz
Collector Output Capacitance	C <sub>ob</sub>	—	V <sub>CB</sub> = -10V, I <sub>E</sub> = 0A, f=1MHz	—	4	—	pF
Noise figure	NF	—	V <sub>CE</sub> = -6 V, I <sub>C</sub> = -0.1 mA f = 1 kHz, R <sub>g</sub> = 10 kΩ	—	1.0	—	dB

\*: h<sub>FE</sub> Classifications GR(G): 200 to 400, BL(L): 350 to 700 ( ) Marking Symbol

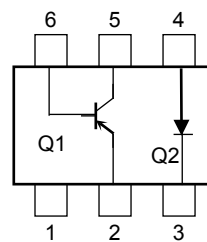
## Q2 (Diode) Electrical Characteristics (Ta = 25°C)

Characteristic	Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Forward voltage	V <sub>F</sub> (1)	—	I <sub>F</sub> = 1mA	—	0.62	—	V
	V <sub>F</sub> (2)	—	I <sub>F</sub> = 10mA	—	0.75	—	
	V <sub>F</sub> (3)	—	I <sub>F</sub> = 100mA	—	0.98	1.20	
Reverse current	I <sub>R</sub> (1)	—	V <sub>R</sub> = 30V	—	—	0.1	μA
	I <sub>R</sub> (2)	—	V <sub>R</sub> = 80V	—	—	0.5	
Total capacitance	C <sub>T</sub>	—	V <sub>R</sub> = 0V, f = 1MHz	—	0.5	—	pF
Reverse recovery time	t <sub>rr</sub>	—	I <sub>F</sub> = 10mA (fig.1)	—	1.6	—	ns

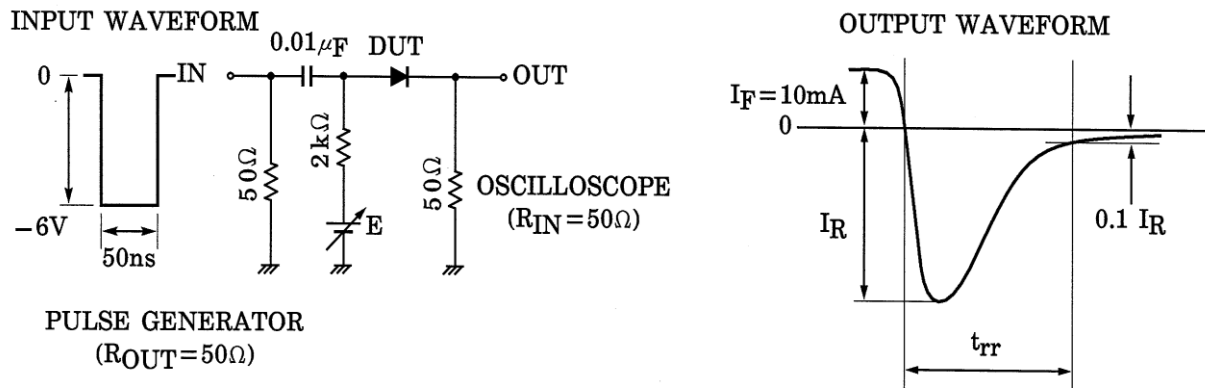
## Marking



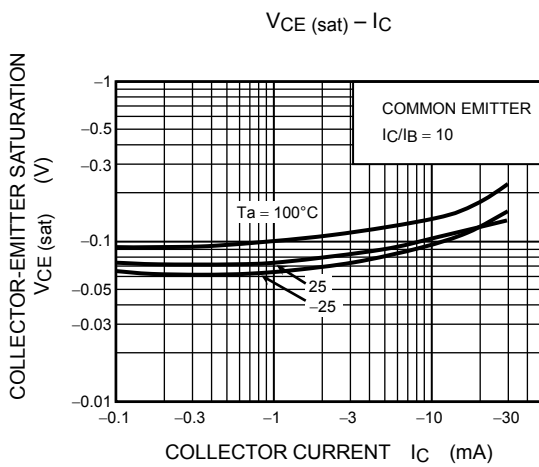
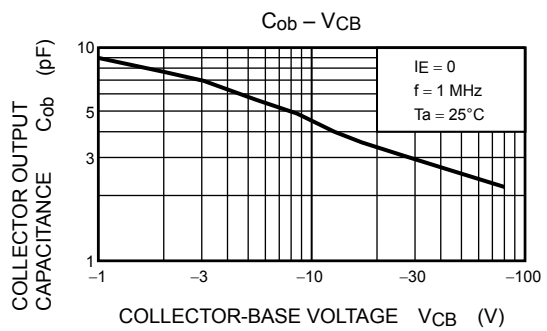
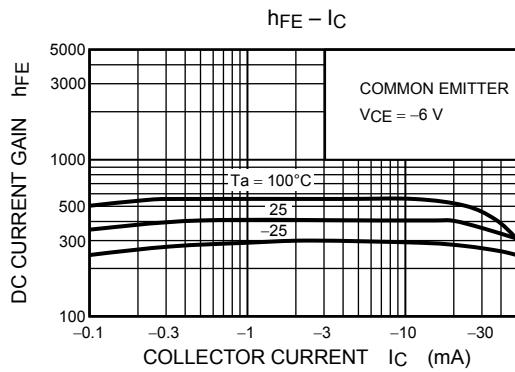
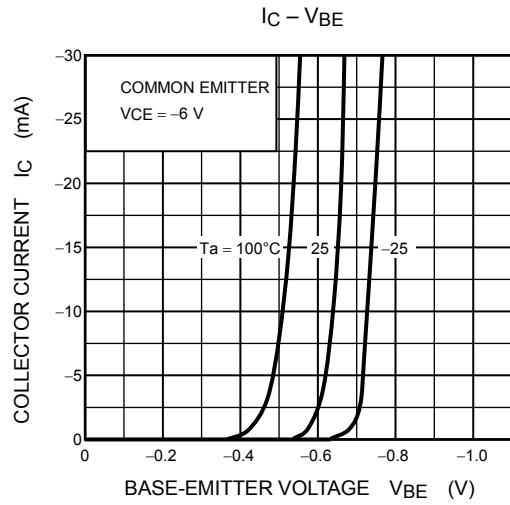
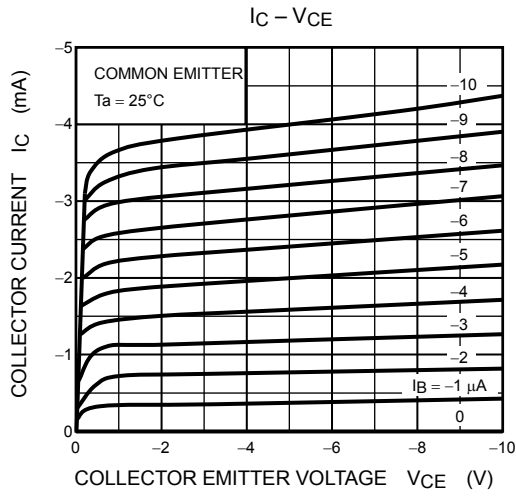
## Equivalent Circuit (Top View)

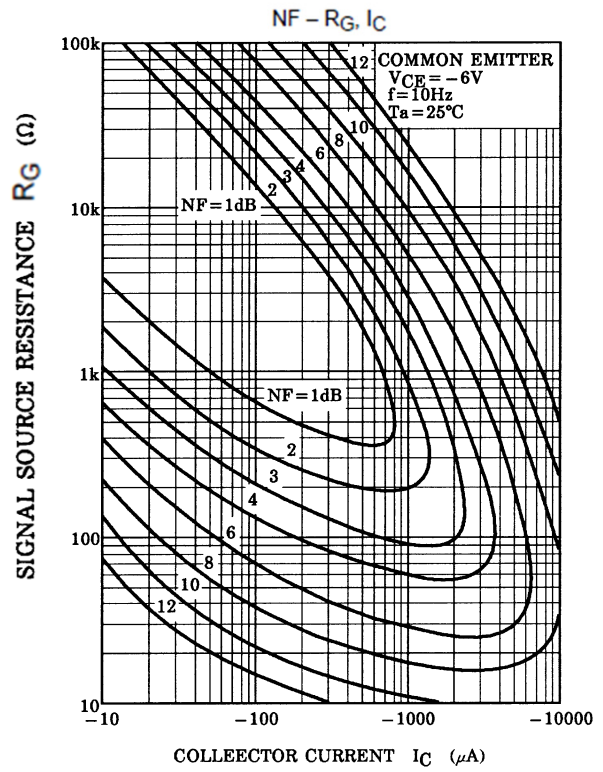
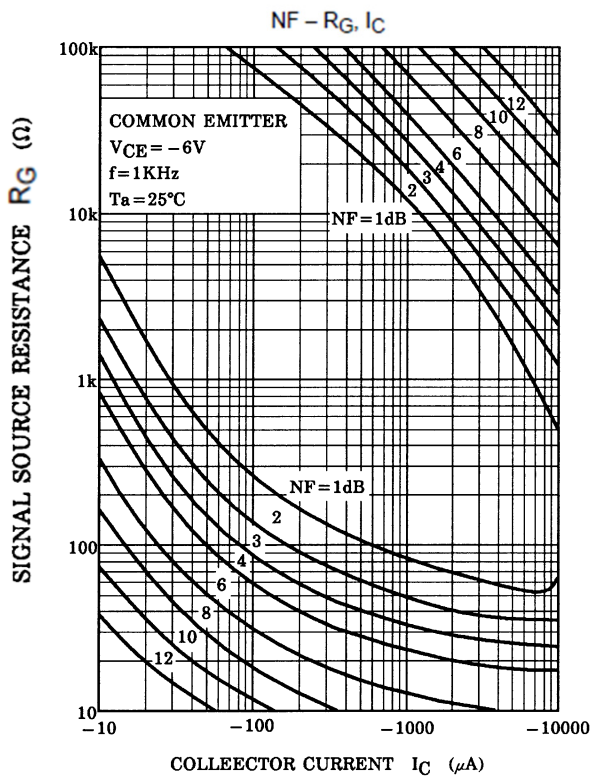
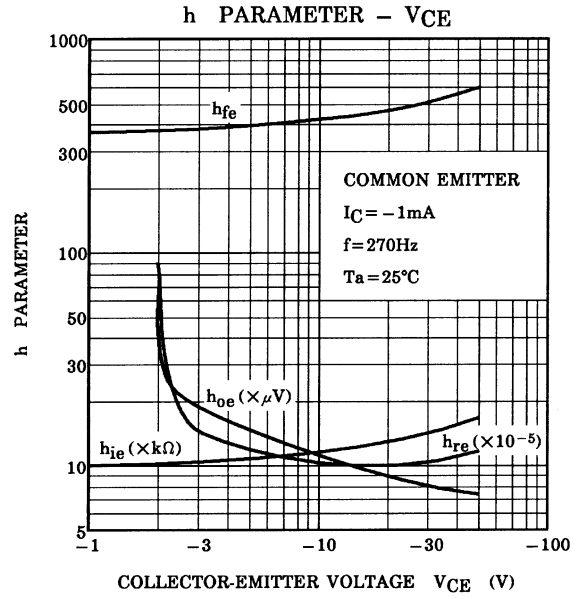
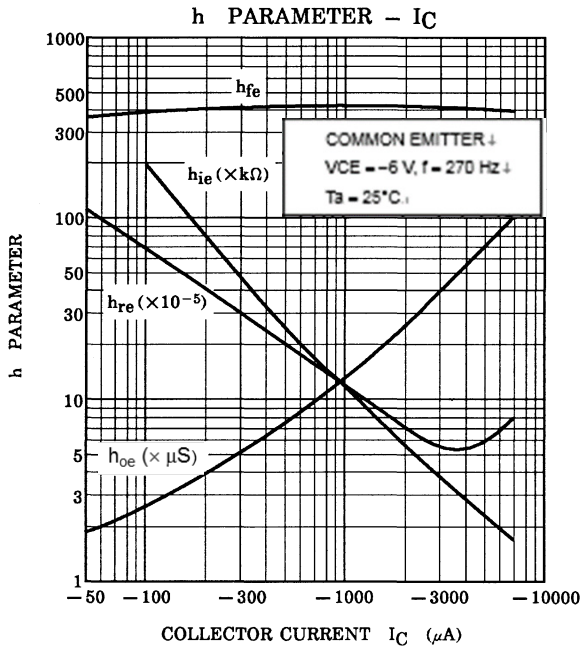


**Fig. 1: Reverse Recovery Time ( $t_{rr}$ ) Test Circuit**

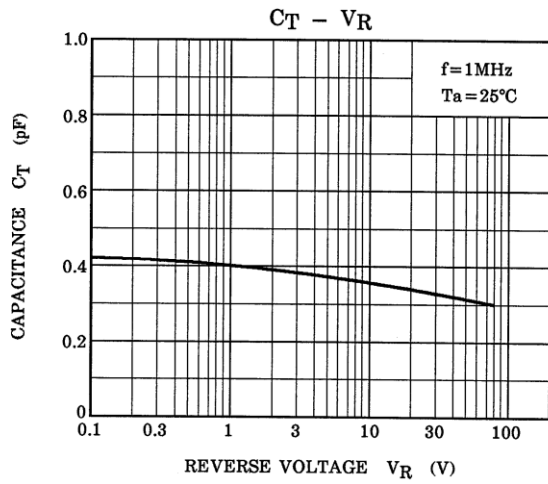
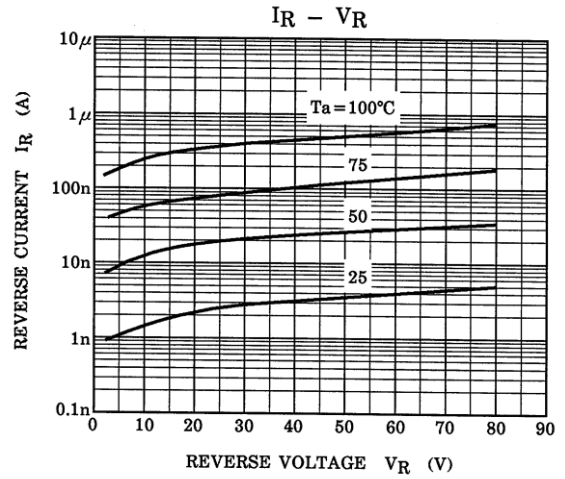
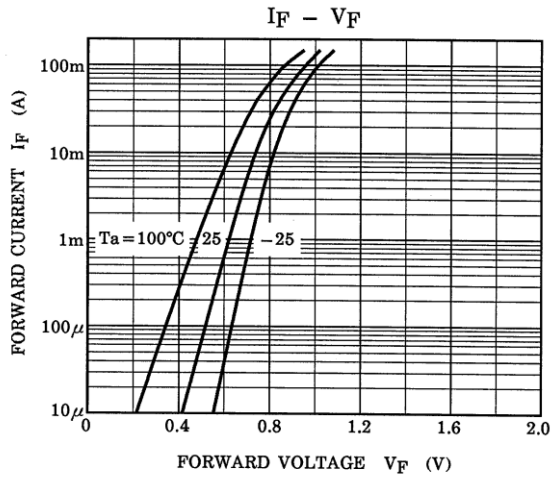


**Q1**

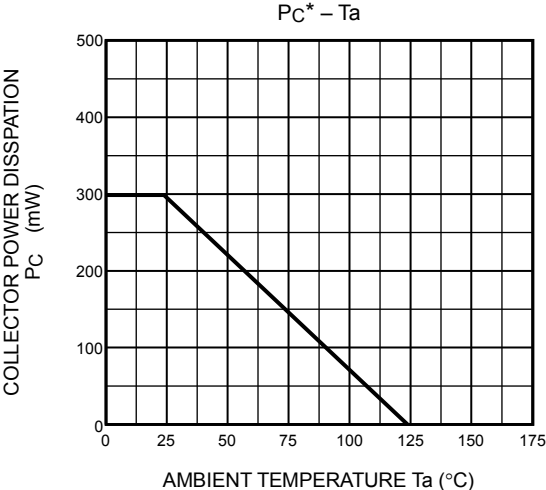




Q2



**Q1, Q2 Common**



\*Total Rating.

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