

TOSHIBA MULTI CHIP DISCRETE DEVICE

# 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 :  $h_{FE} = 200 \sim 700$   
 Good  $h_{FE}$  Linearity :  $h_{FE}(I_C = -0.1mA) / h_{FE}(I_C = -2mA) = 0.95$

**Q2**

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

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

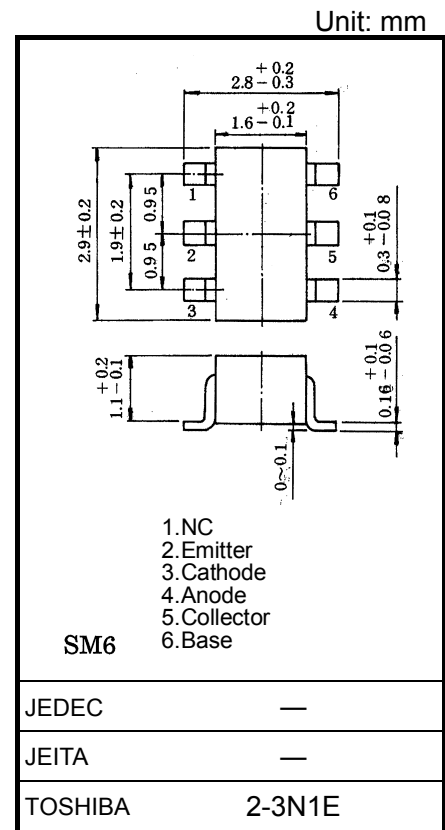
**Absolute Maximum Ratings (Ta = 25°C) (Q1, Q2 Common)**

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

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

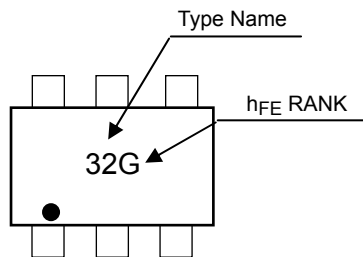
Characteristic	Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Collector cut-off current	$I_{CBO}$	—	$V_{CB} = -120V, I_E = 0$	—	—	-100	nA
Emitter cut-off current	$I_{EBO}$	—	$V_{EB} = -5V, I_C = 0$	—	—	-100	nA
DC current gain	$h_{FE}^*$	—	$V_{CE} = -6V, I_C = -2mA$	200	—	700	
Collector-emitter saturation voltage	$V_{CE(sat)}$	—	$I_C = -10mA, I_B = -1mA$	—	—	-0.3	V
Transition Frequency	$f_T$	—	$V_{CE} = -6V, I_C = -1mA$	—	100	—	MHz
Collector Output Capacitance	$C_{ob}$	—	$V_{CB} = -10V, I_E = 0, f=1MHz$	—	4	—	pF
Noise figure	NF	—	$V_{CE} = -6V, I_C = -0.1mA$ $f = 1kHz, R_g = 10k\Omega$	—	1.0	—	dB

\*:  $h_{FE}$  Classifications GR(G):200~400, BL(L):350~700 ( )Marking Symbol

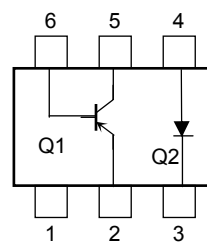
## Q2 (Diode) Electrical Characteristics (Ta = 25°C)

Characteristic	Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Forward voltage	$V_F (1)$	—	$I_F = 1mA$	—	0.62	—	V
	$V_F (2)$	—	$I_F = 10mA$	—	0.75	—	
	$V_F (3)$	—	$I_F = 100mA$	—	0.98	1.20	
Reverse current	$I_R (1)$	—	$V_R = 30V$	—	—	0.1	$\mu A$
	$I_R (2)$	—	$V_R = 80V$	—	—	0.5	
Total capacitance	$C_T$	—	$V_R = 0, f = 1MHz$	—	0.5	—	pF
Reverse recovery time	$t_{rr}$	—	$I_F = 10mA$ (fig.1)	—	1.6	—	ns

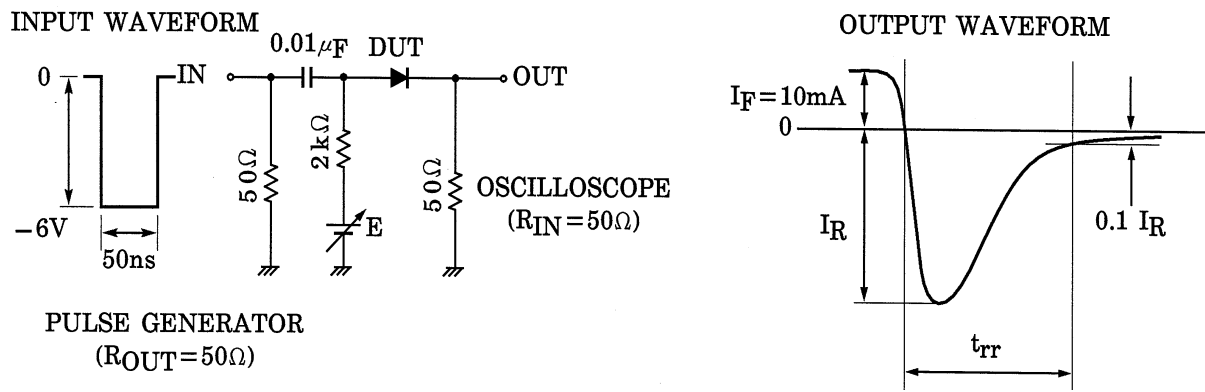
## Marking



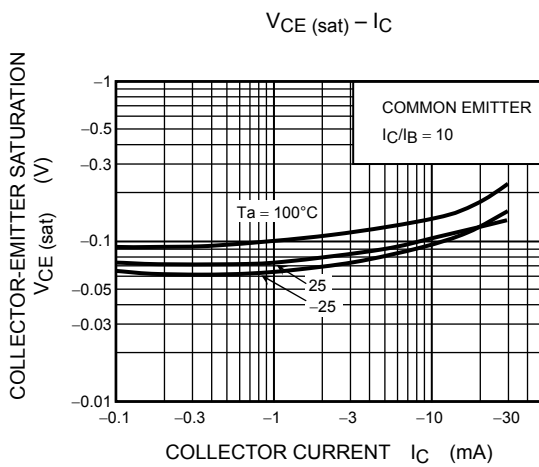
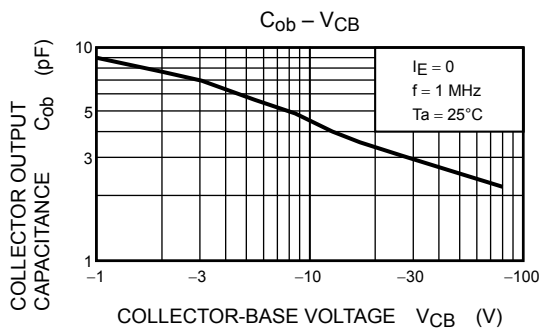
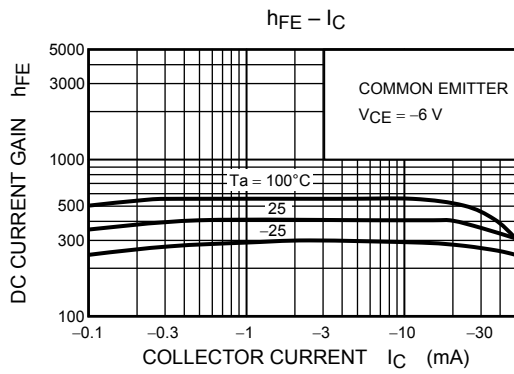
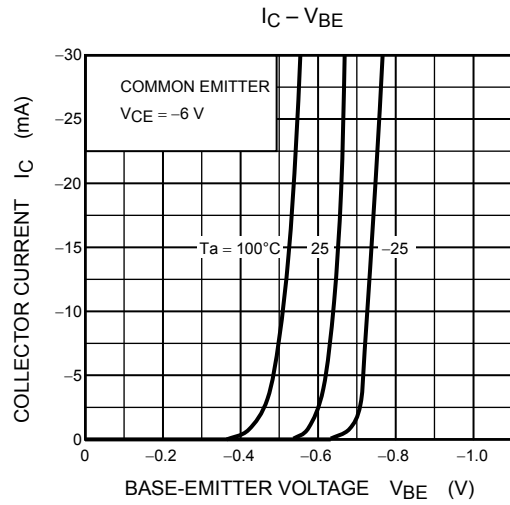
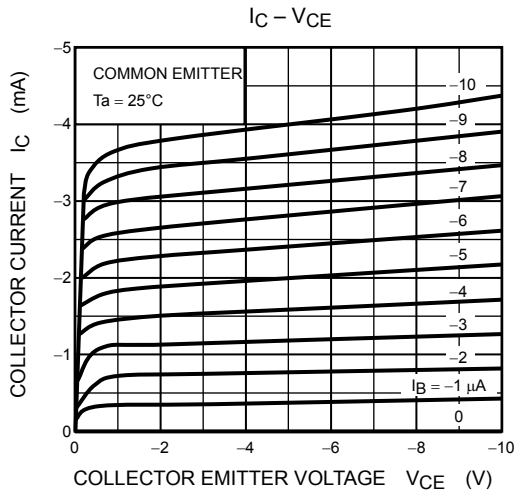
## Equivalent Circuit (Top View)

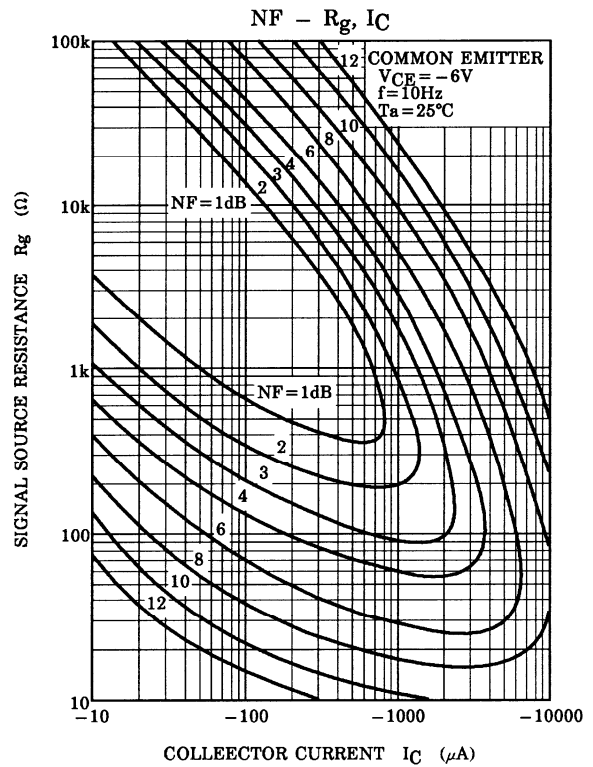
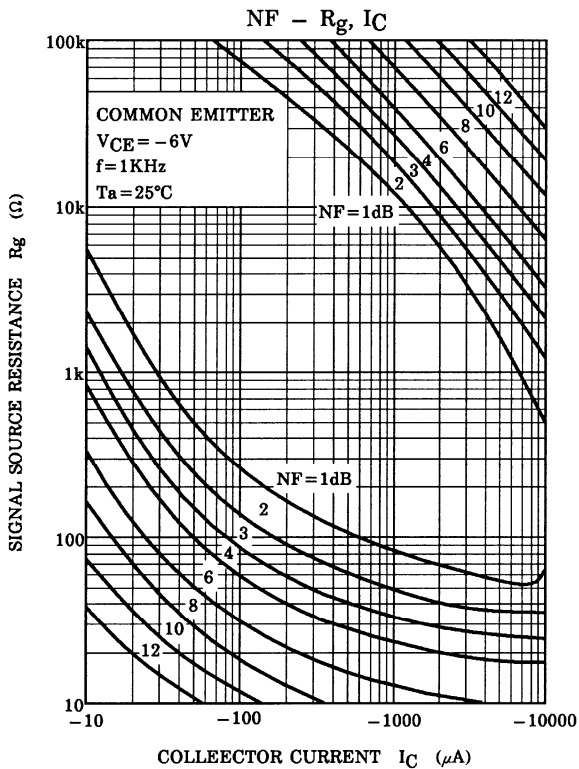
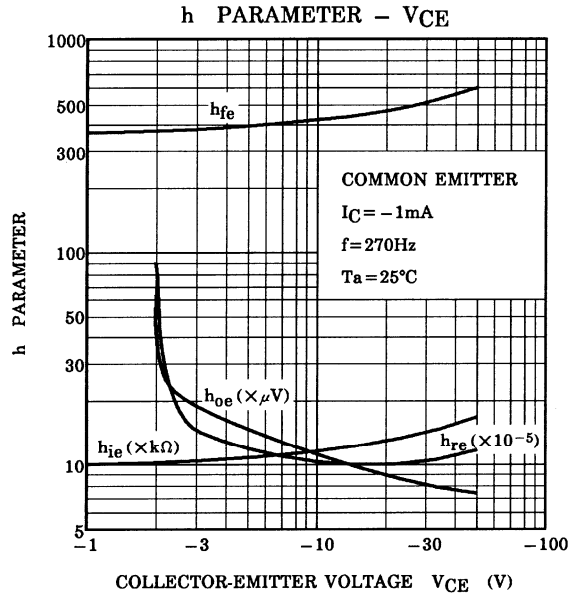
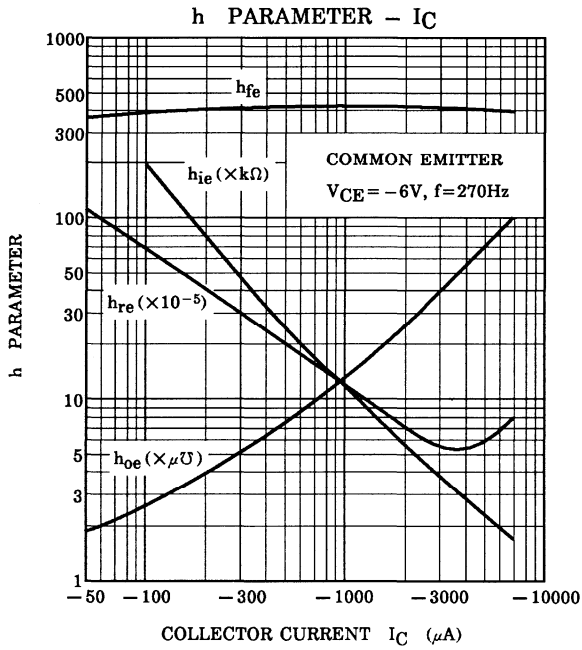


**Fig. 1: Reverse Recovery Time ( $t_{rr}$ ) Test Circuit**

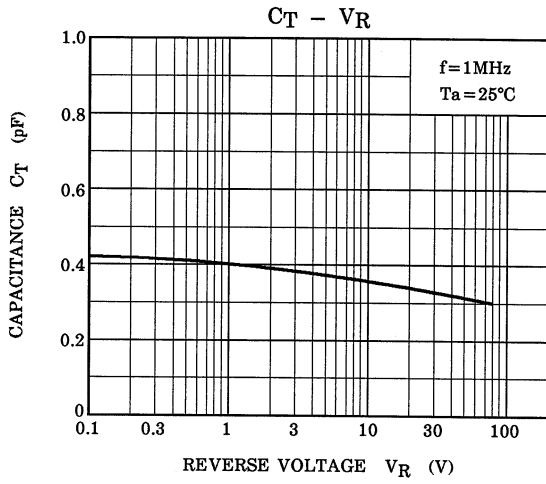
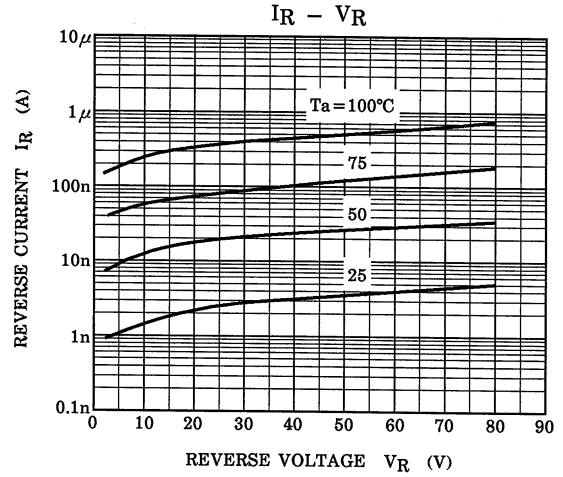
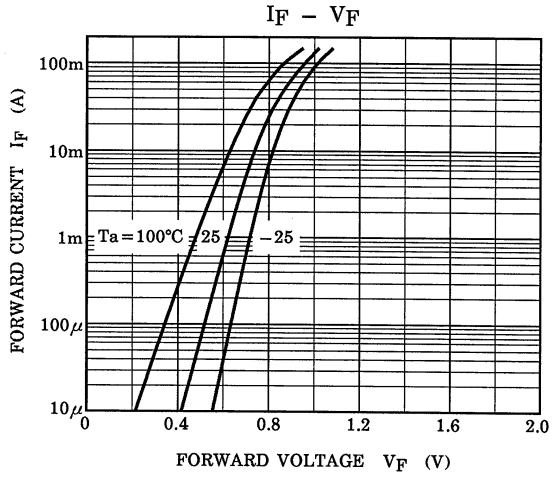


**Q1**

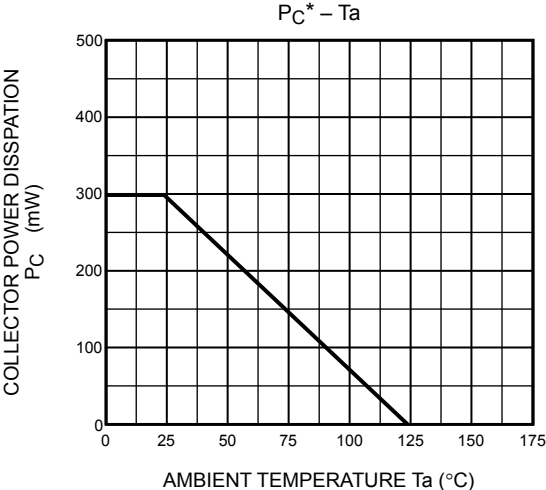




Q2



**Q1, Q2 Common**



\*Total Rating.

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