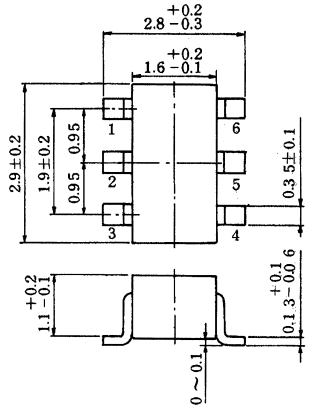
TOSHIBA MULTI CHIP DISCRETE DEVICE

HN2E04F

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

Unit: mm



JEDEC	—
JEITA	—
TOSHIBA	2-3N1E

Weight:0.015g (typ.)

Q1

High Voltage :V_{CEO}= −120V
High DC Current Gain : h_{FE} =200~700
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 (Transistor) : 1SS352 equivalent

Q1 (Transistor) 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

Q1 (Diode) 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

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

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

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

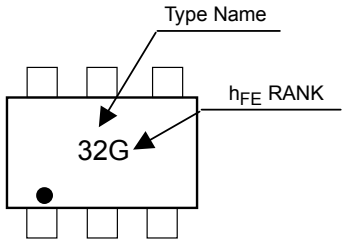
Characteristic	Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Collector cut-off current	I_{CBO}	—	V_{CB} = −120V, I_E = 0	—	—	−100	nA
Emitter cut-off current	I_{EBO}	—	V_{EB} = −5V, I_C = 0	—	—	−100	nA
DC current gain	h_{FE}*	—	V_{CE} = − 6V, I_C = −2mA	200	—	700	
Collector-emitter saturation voltage	$V_{CE(sat)}$	—	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} = −6 V, I_C = −0.1 mA f = 1 kHz,R_g = 10 kΩ	—	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	μA
	$I_{R\ (2)}$	—	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)

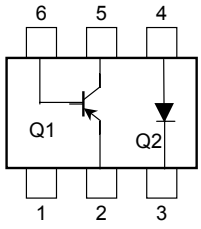
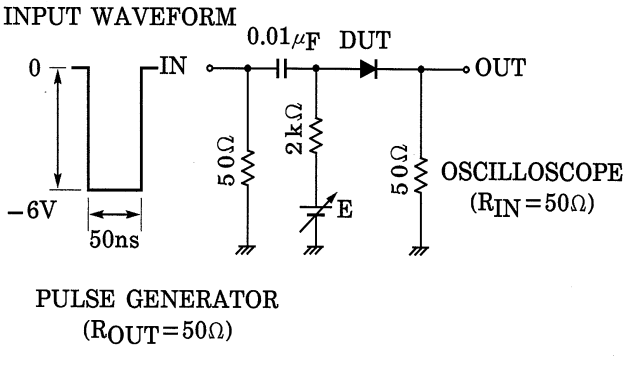
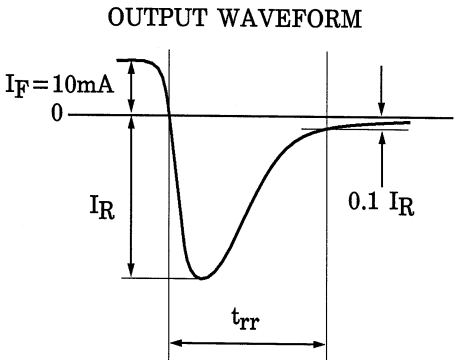


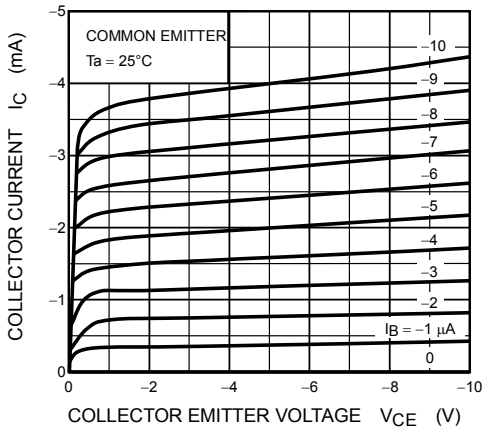
Fig. 1: Reverse Recovery Time (t_{rr}) Test Circuit


INPUT WAVEFORM
0
IN
−6V
50ns
0.01μF
DUT
OUT
50Ω
2kΩ
E
50Ω
OSCILLOSCOPE
(RIN=50Ω)
PULSE GENERATOR
(ROUT=50Ω)

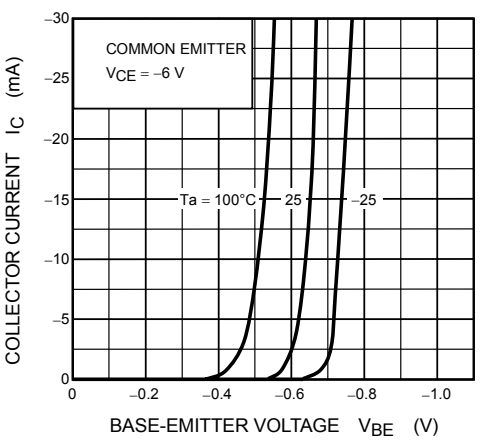

OUTPUT WAVEFORM
IF=10mA
0
IR
0.1 IR
trr

Q1

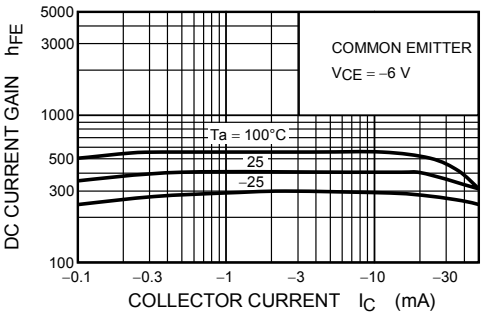
$I_C - V_{CE}$



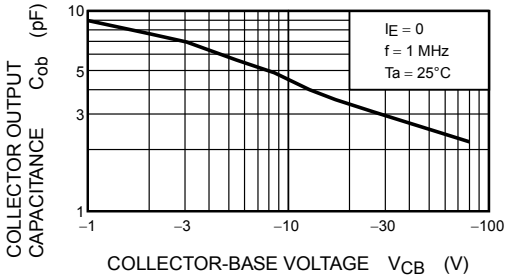
$I_C - V_{BE}$



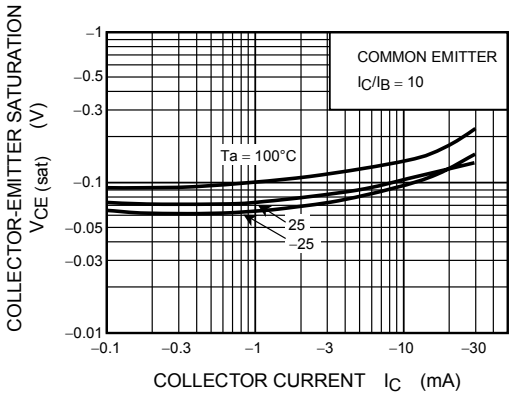
$h_{FE} - I_C$



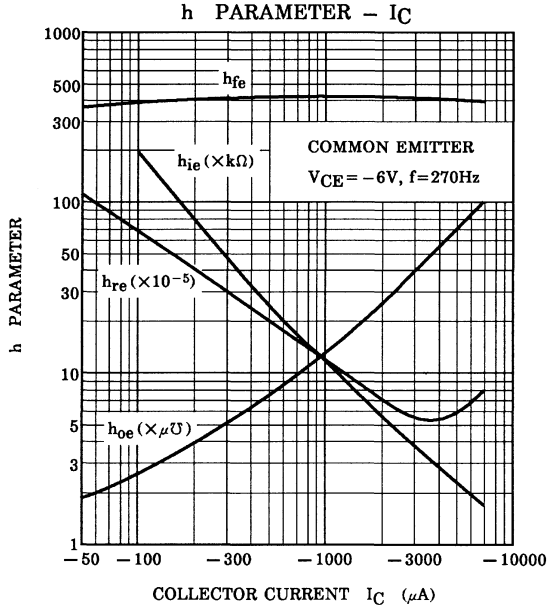
$C_{ob} - V_{CB}$



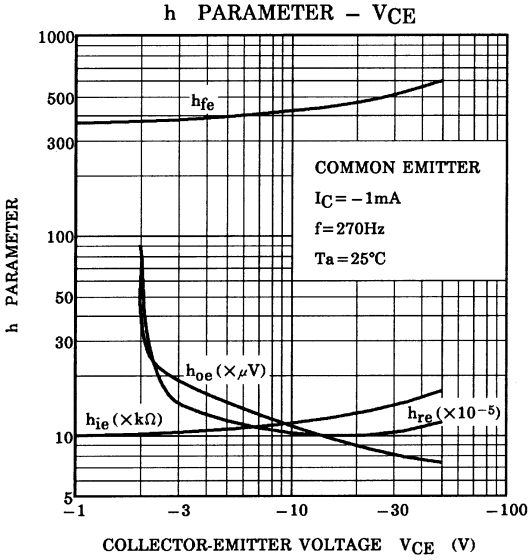
$V_{CE\ (sat)} - I_C$



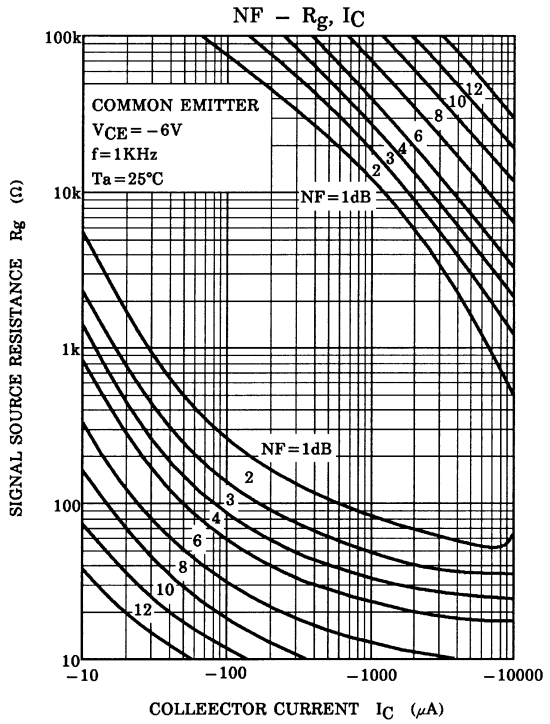
h PARAMETER – I_C



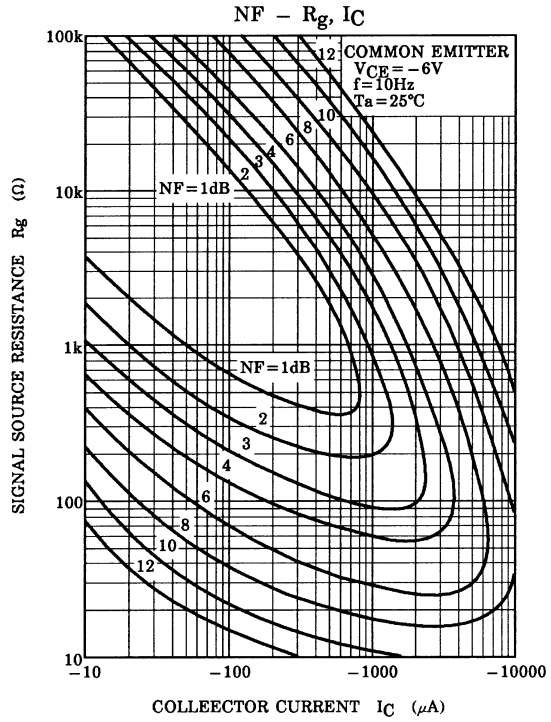
h PARAMETER – V_{CE}



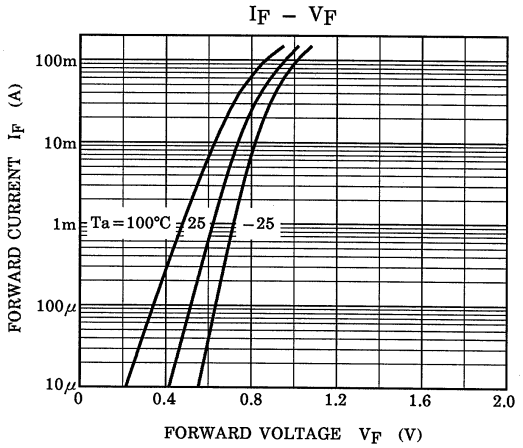
NF – R_g, I_C

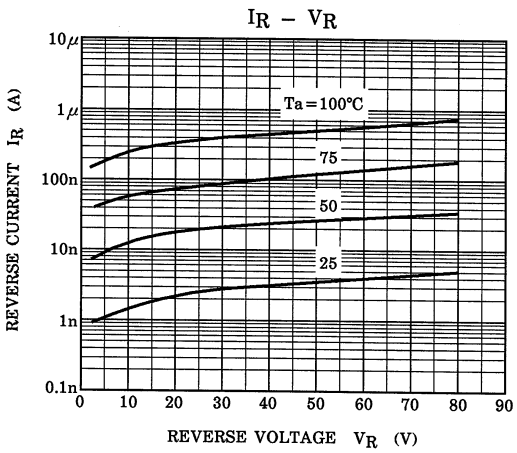


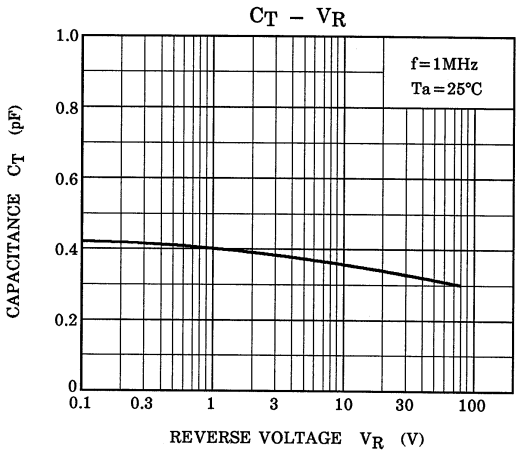
NF – R_g, I_C



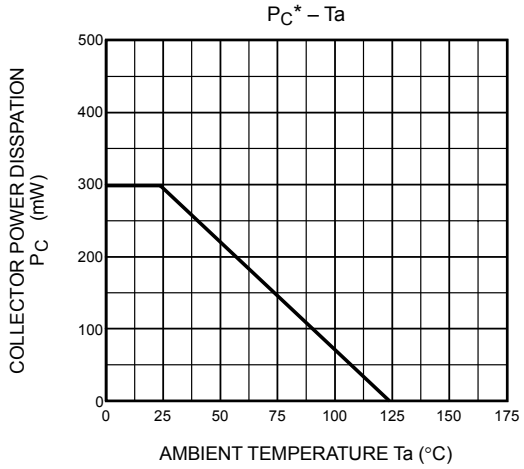
Q2


I_F – V_F
FORWARD CURRENT I_F (A)
100m
10m
1m
100μ
10μ
Ta = 100°C
25
−25
0
0.4
0.8
1.2
1.6
2.0
FORWARD VOLTAGE V_F (V)


I_R – V_R
REVERSE CURRENT I_R (A)
10μ
1μ
100n
10n
1n
0.1n
Ta = 100°C
75
50
25
0
10
20
30
40
50
60
70
80
90
REVERSE VOLTAGE V_R (V)


C_T – V_R
CAPACITANCE C_T (pF)
1.0
0.8
0.6
0.4
0.2
0
f = 1MHz
Ta = 25°C
0.1
0.3
1
3
10
30
100
REVERSE VOLTAGE V_R (V)

Q1, Q2 Common



*Total Rating.

RESTRICTIONS ON PRODUCT USE 030619EAA

- The information contained herein is subject to change without notice.
- The information contained herein is presented only as a guide for the applications of our products. No responsibility is assumed by TOSHIBA for any infringements of patents or other rights of the third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of TOSHIBA or others.
- TOSHIBA is continually working to improve the quality and reliability of its products. Nevertheless, semiconductor devices in general can malfunction or fail due to their inherent electrical sensitivity and vulnerability to physical stress. It is the responsibility of the buyer, when utilizing TOSHIBA products, to comply with the standards of safety in making a safe design for the entire system, and to avoid situations in which a malfunction or failure of such TOSHIBA products could cause loss of human life, bodily injury or damage to property.
  In developing your designs, please ensure that TOSHIBA products are used within specified operating ranges as set forth in the most recent TOSHIBA products specifications. Also, please keep in mind the precautions and conditions set forth in the “Handling Guide for Semiconductor Devices,” or “TOSHIBA Semiconductor Reliability Handbook” etc..
- The TOSHIBA products listed in this document are intended for usage in general electronics applications (computer, personal equipment, office equipment, measuring equipment, industrial robotics, domestic appliances, etc.). These TOSHIBA products are neither intended nor warranted for usage in equipment that requires extraordinarily high quality and/or reliability or a malfunction or failure of which may cause loss of human life or bodily injury (“Unintended Usage”). Unintended Usage include atomic energy control instruments, airplane or spaceship instruments, transportation instruments, traffic signal instruments, combustion control instruments, medical instruments, all types of safety devices, etc.. Unintended Usage of TOSHIBA products listed in this document shall be made at the customer’s own risk.
- TOSHIBA products should not be embedded to the downstream products which are prohibited to be produced and sold, under any law and regulations.