

# Boca Semiconductor Corp.

## BSC

<http://www.bocasemi.com>

### MAXIMUM RATINGS

Rating	Symbol	2N3250 2N3251	2N3251A	Unit
Collector-Emitter Voltage	$V_{CE0}$	-40	-60	Vdc
Collector-Base Voltage	$V_{CB0}$	-50	-60	Vdc
Emitter-Base Voltage	$V_{EB0}$	-5.0		Vdc
Collector Current	$I_C$	-200		mAdc
Total Device Dissipation @ $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	0.36 2.06		Watt mW/ $^\circ\text{C}$
Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	1.2 6.9		Watts mW/ $^\circ\text{C}$
Operating and Storage Temperature Temperature Range	$T_J, T_{stg}$	-65 to +200		$^\circ\text{C}$

### THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	486	$^\circ\text{C}/\text{W}$
Thermal Resistance, Junction to Case	$R_{\theta JC}$	146	$^\circ\text{C}/\text{W}$

### ELECTRICAL CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ unless otherwise noted.)

Characteristic	Symbol	Min	Max	Unit
<b>OFF CHARACTERISTICS</b>				
Collector-Emitter Breakdown Voltage(1) ( $I_C = -10$ mAdc)	$V_{(BR)CEO}$	-40 -60	—	Vdc
Collector-Base Breakdown Voltage ( $I_C = -10$ $\mu\text{Adc}$ )	$V_{(BR)CBO}$	-50 -60	—	Vdc
Emitter-Base Breakdown Voltage ( $I_E = -10$ $\mu\text{Adc}$ )	$V_{(BR)EBO}$	-5.0	—	Vdc
Collector Cutoff Current ( $V_{CE} = -40$ Vdc, $V_{EB} = -3.0$ Vdc)	$I_{CEX}$	—	-20	nA
Base Cutoff Current ( $V_{CE} = -40$ Vdc, $V_{EB} = -3.0$ Vdc)	$I_{BL}$	—	-50	nAdc

### ON CHARACTERISTICS

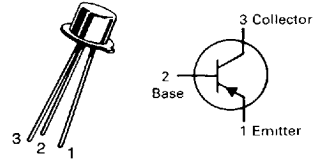
DC Forward Current Transfer Ratio ( $I_C = -0.1$ mAdc, $V_{CE} = -10$ Vdc)	$h_{FE}$	40 80	— —	—
( $I_C = -1.0$ mAdc, $V_{CE} = -1.0$ Vdc)		45 90	— —	
( $I_C = -10$ mAdc, $V_{CE} = -1.0$ Vdc)(1)		50 100	150 300	
( $I_C = -50$ mAdc, $V_{CE} = -1.0$ Vdc)(1)		15 30	— —	
Collector-Emitter Saturation Voltage (1) ( $I_C = -10$ mAdc, $I_B = -1.0$ mAdc) ( $I_C = -50$ mAdc, $I_B = -5.0$ mAdc)	$V_{CE(sat)}$	— —	-0.25 -0.5	Vdc
Base-Emitter Saturation Voltage (1) ( $I_C = -10$ mAdc, $I_B = -1.0$ mAdc) ( $I_C = -50$ mAdc, $I_B = -5.0$ mAdc)	$V_{BE(sat)}$	-0.6 —	-0.9 -1.2	Vdc

### SMALL-SIGNAL CHARACTERISTICS

Current-Gain — Bandwidth Product ( $I_C = -10$ mAdc, $V_{CE} = -20$ Vdc, $f = 100$ MHz)	$f_T$	250 300	— —	MHz
Output Capacitance ( $V_{CB} = -10$ Vdc, $I_E = 0$ , $f = 1.0$ MHz)	$C_{obo}$	—	6.0	pF
Input Capacitance ( $V_{EB} = -1.0$ Vdc, $I_C = 0$ , $f = 1.0$ MHz)	$C_{ibo}$	—	8.0	pF

# 2N3250 2N3251A★

CASE 22-03, STYLE 1  
TO-18 (TO-206AA)



## GENERAL PURPOSE TRANSISTORS

PNP SILICON

★2N3251A is a Motorola  
designated preferred device.

**2N3250 2N3251,A**

**ELECTRICAL CHARACTERISTICS** (continued) ( $T_A = 25^\circ\text{C}$  unless otherwise noted.)

Characteristic		Symbol	Min	Max	Unit
Input Impedance ( $I_C = -1.0\text{ mA}$ , $V_{CE} = -10\text{ V}$ , $f = 1.0\text{ kHz}$ )	2N3250 2N3251, 2N3251A	$h_{ie}$	1.0 2.0	6.0 12	kohms
Voltage Feedback Ratio ( $I_C = -1.0\text{ mA}$ , $V_{CE} = -10\text{ V}$ , $f = 1.0\text{ kHz}$ )	2N3250 2N3251, 2N3251A	$h_{re}$	—	10 20	$\times 10^{-4}$
Small-Signal Current Gain ( $I_C = -1.0\text{ mA}$ , $V_{CE} = -10\text{ V}$ , $f = 1.0\text{ kHz}$ )	2N3250 2N3251, 2N3251A	$h_{fe}$	50 100	200 400	—
Output Admittance ( $I_C = -1.0\text{ mA}$ , $V_{CE} = -10\text{ V}$ , $f = 1.0\text{ kHz}$ )	2N3250 2N3251, 2N3251A	$h_{oe}$	4.0 10	40 60	$\mu\text{mhos}$
Collector Base Time Constant ( $I_C = -10\text{ mA}$ , $V_{CE} = -20\text{ V}$ , $f = 31.8\text{ MHz}$ )		$r_b' C_C$	—	250	ps
Noise Figure ( $I_C = -100\text{ }\mu\text{A}$ , $V_{CE} = -5.0\text{ V}$ , $R_S = 1.0\text{ k}\Omega$ , $f = 100\text{ Hz}$ )		NF	—	6.0	dB

**SWITCHING CHARACTERISTICS**

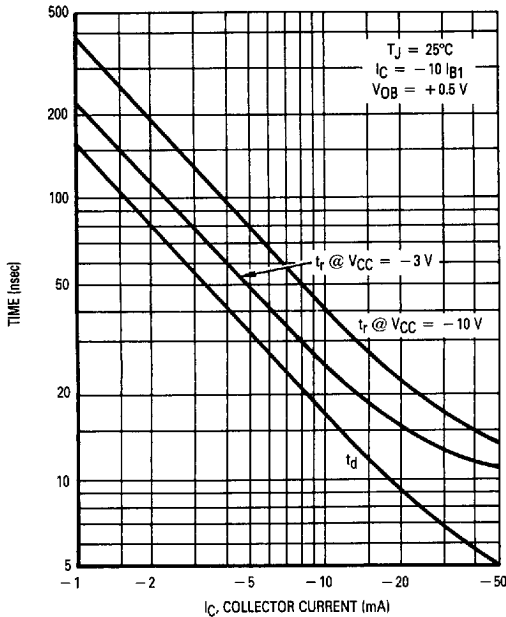
Characteristic		Symbol	Max	Unit
Delay Time	( $V_{CC} = -3.0\text{ Vdc}$ , $V_{BE} = +0.5\text{ Vdc}$ $I_C = -10\text{ mAdc}$ , $I_{B1} = -1.0\text{ mA}$ )	$t_d$	35	ns
Rise Time		$t_r$	35	ns
Storage Time	$I_C = -10\text{ mAdc}$ , $I_{B1} = I_{B2} = -1.0\text{ mAdc}$ ( $V_{CC} = -3.0\text{ V}$ )	$t_s$	175 200	ns
Fall Time			$t_f$	50

(1) Pulse Test:  $PW = 300\text{ }\mu\text{s}$ , Duty Cycle = 2.0%.

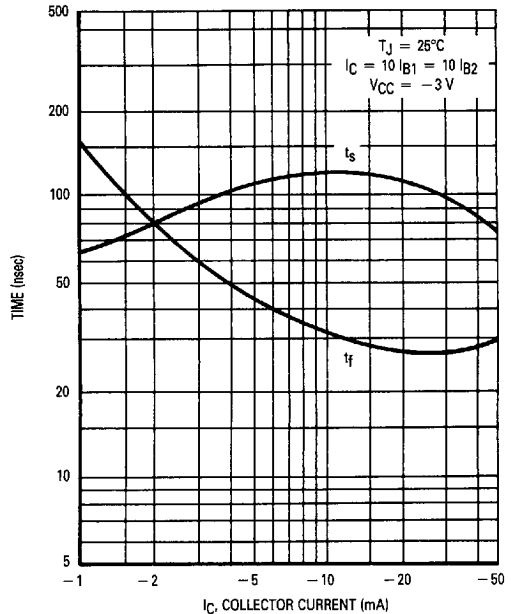
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**SWITCHING TIME CHARACTERISTICS**

**FIGURE 1 — DELAY AND RISE TIME**

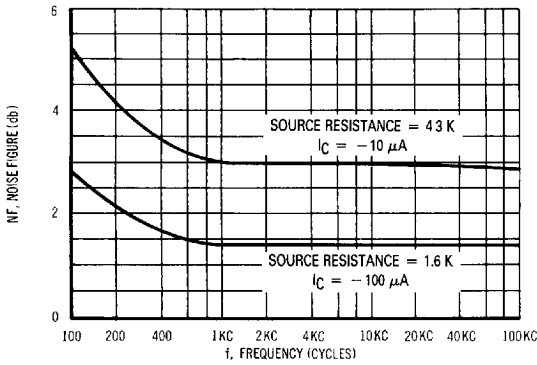


**FIGURE 2 — STORAGE AND FALL TIME**

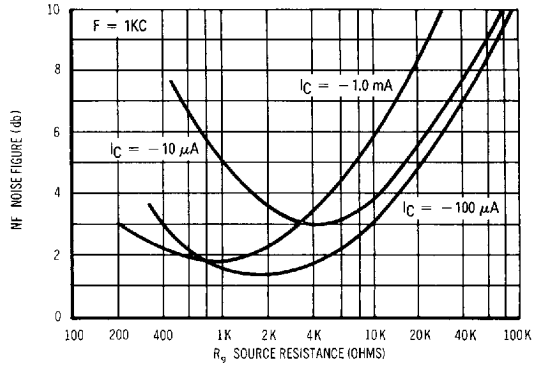


**AUDIO SMALL-SIGNAL CHARACTERISTICS**  
**NOISE FIGURE VARIATIONS**  
( $V_{CE} = 6.0 \text{ V}$ ,  $T_A = 25^\circ\text{C}$ )

**FIGURE 3 — FREQUENCY**



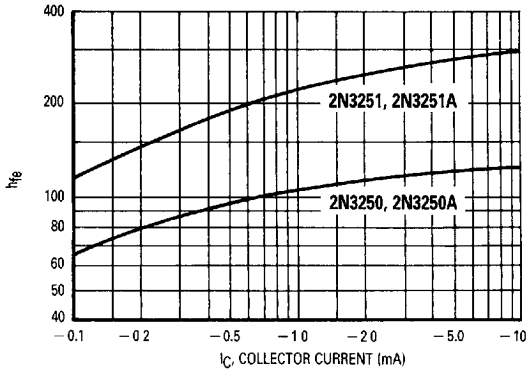
**FIGURE 4 — SOURCE RESISTANCE**



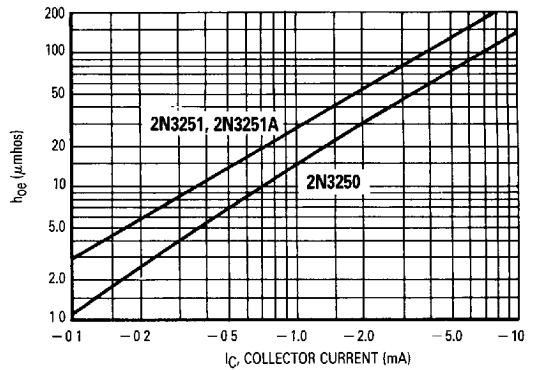
**h PARAMETERS**

$V_{CE} = 10 \text{ V}$ ,  $f = 1.0 \text{ kc}$ ,  $T_A = 25^\circ\text{C}$

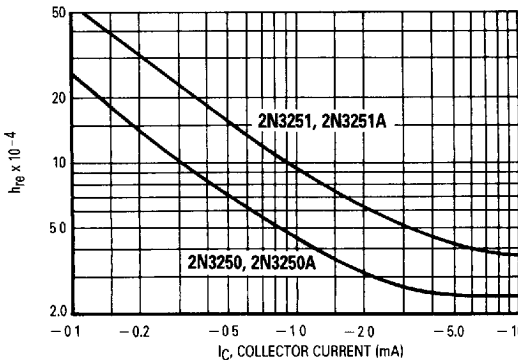
**FIGURE 5 — CURRENT GAIN**



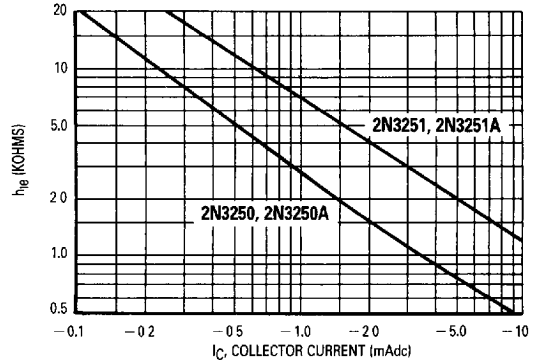
**FIGURE 6 — OUTPUT ADMITTANCE**



**FIGURE 7 — VOLTAGE FEEDBACK RATIO**

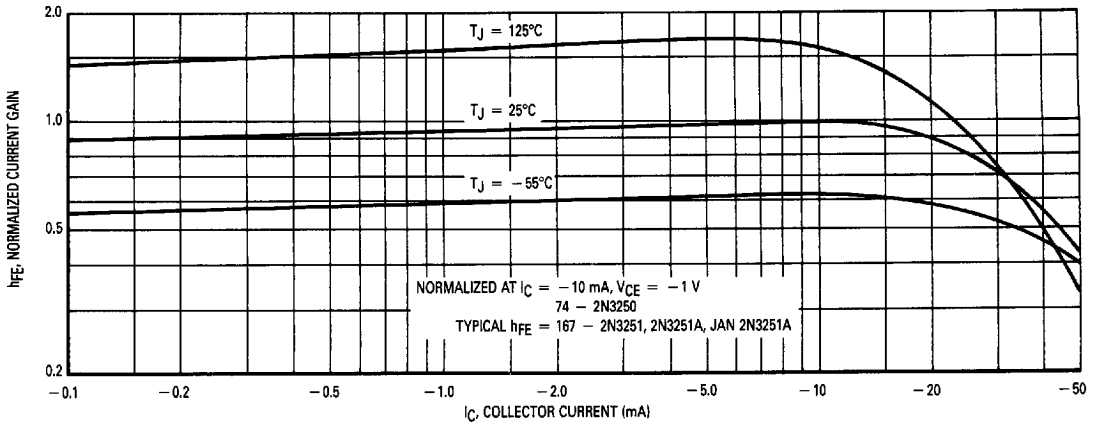


**FIGURE 8 — INPUT IMPEDANCE**

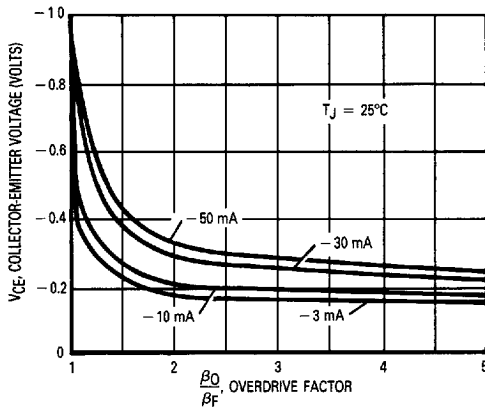


**2N3250 2N3251,A**

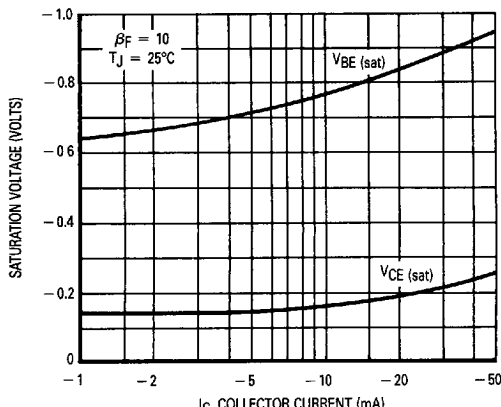
**FIGURE 9 — NORMALIZED CURRENT GAIN CHARACTERISTICS**



**FIGURE 10 — COLLECTOR SATURATION REGION**



**FIGURE 11 — SATURATION VOLTAGES**



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This graph shows the effect of base current on collector current  $\beta_O$  is the current gain of the transistor at 1 volt, and  $\beta_F$  (forced gain) is the ratio of  $I_C/I_{BF}$  in a circuit. EXAMPLE: For type 2N3251, estimate a base current ( $I_{BF}$ ) to insure saturation at a temperature of  $25^\circ\text{C}$  and a collector current of 10 mA.

Observe that at  $I_C = 10\text{ mA}$  an overdrive factor of at least 2.5 is required to drive the transistor well into the saturation region. From Figure 1, it is seen that  $h_{FE} @ 1\text{ volt}$  is typically 167 (guaranteed limits from the Table of Characteristics can be used for "worst case" design).

$$\frac{\beta_O}{\beta_F} = \frac{h_{FE} @ 1\text{ Volt}}{I_C/I_{BF}} \quad 2.5 = \frac{167}{10\text{ mA}/I_{BF}} \quad I_{BF} \approx -6.68\text{ mA}$$

**FIGURE 12 — TEMPERATURE COEFFICIENTS**

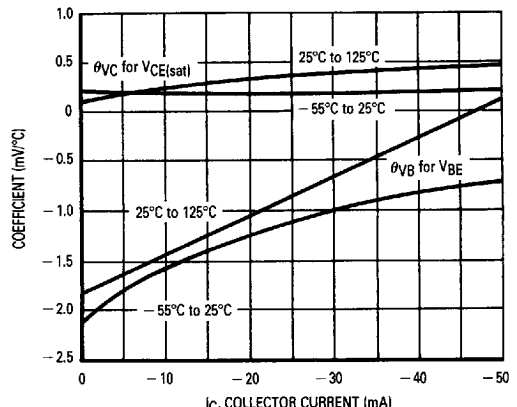


FIGURE 13 —  $f_T$  AND  $r_b'C_c$  versus  $I_C$

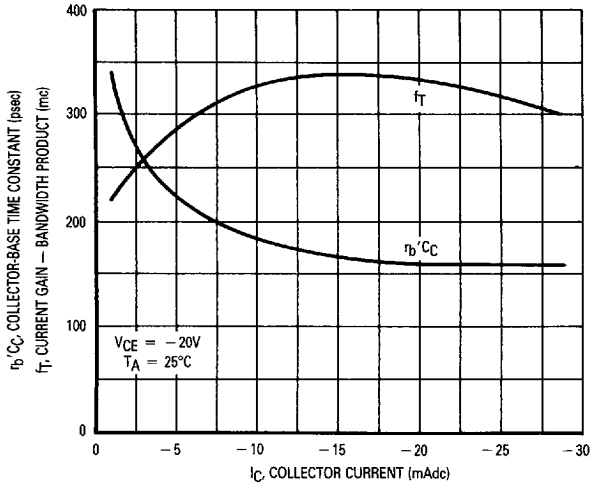
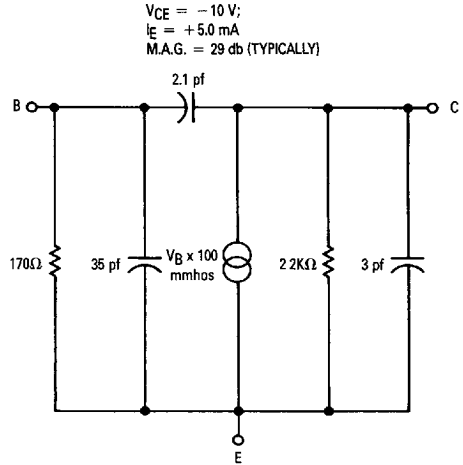


FIGURE 14 — 30 MC EQUIVALENT CIRCUIT



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FIGURE 15 — JUNCTION CAPACITANCE

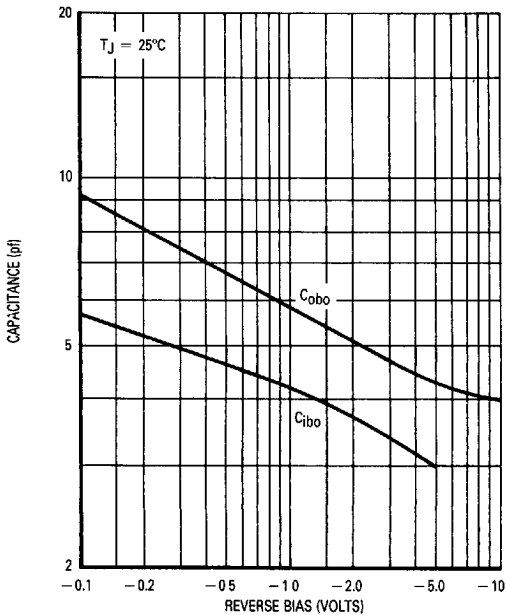


FIGURE 16 — CHARGE DATA

