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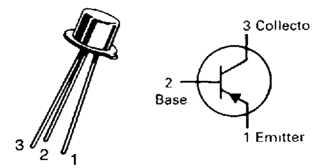
2N3250
2N3251,A★

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



GENERAL PURPOSE TRANSISTORS

PNP SILICON

★2N3251A is a Motorola designated preferred device.

MAXIMUM RATINGS

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

THERMAL CHARACTERISTICS

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

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage(1) (I_C = −10 mAdc)	2N3250, 2N3251 2N3251A	$V_{(BR)CEO}$	−40 −60	—	Vdc
Collector-Base Breakdown Voltage (I_C = −10 μAdc)	2N3250, 2N3251 2N3251A	$V_{(BR)CBO}$	−50 −60	—	Vdc
Emitter-Base Breakdown Voltage (I_E = −10 μAdc)		$V_{(BR)EBO}$	−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		h_{FE}			—
(I_C = −0.1 mAdc, V_{CE} = −10 Vdc)	2N3250 2N3251, 2N3251A		40 80	— —	
(I_C = −1.0 mAdc, V_{CE} = −1.0 Vdc)	2N3250 2N3251, 2N3251A		45 90	— —	
(I_C = −10 mAdc, V_{CE} = −1.0 Vdc)(1)	2N3250 2N3251, 2N3251A		50 100	150 300	
(I_C = −50 mAdc, V_{CE} = −1.0 Vdc)(1)	2N3250 2N3251, 2N3251A		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)	2N3250 2N3251, 2N3251A	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

ELECTRICAL CHARACTERISTICS (continued) (T_A = 25°C unless otherwise noted.)

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

SWITCHING CHARACTERISTICS

Characteristic			Symbol	Max	Unit
Delay Time	(V_{CC} = −3.0 Vdc, V_{BE} = +0.5 Vdc I_C = −10 mAdc, I_{B1} = −1.0 mA)		t_d	35	ns
Rise Time			t_r	35	ns
Storage Time	I_C = −10 mAdc, I_{B1} = I_{B1} = −1.0 mAdc) (V_{CC} = −3.0 V)	2N3250 2N3251, 2N3251A	t_s	175 200	ns
Fall Time			t_f	50	ns

(1) Pulse Test: PW = 300 μs, Duty Cycle = 2.0%.

SWITCHING TIME CHARACTERISTICS

FIGURE 1 — DELAY AND RISE TIME

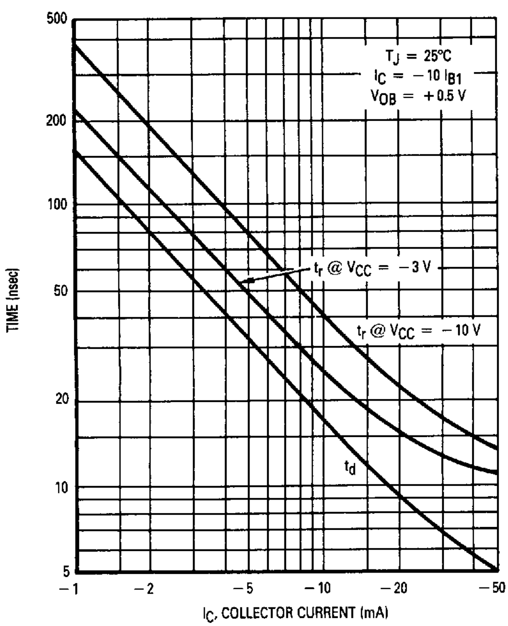
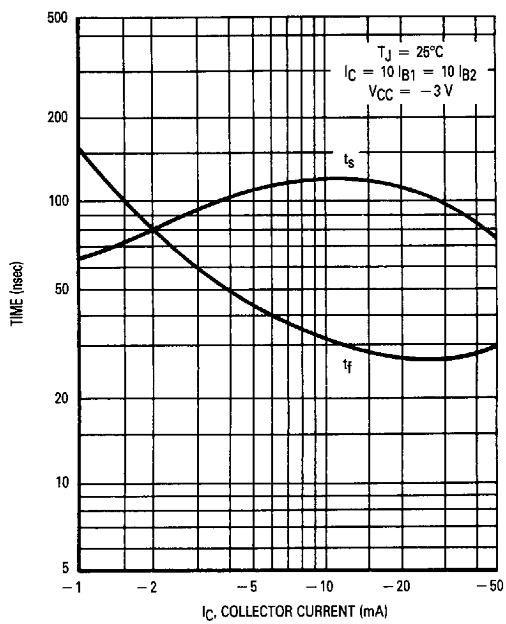


FIGURE 2 — STORAGE AND FALL TIME



AUDIO SMALL-SIGNAL CHARACTERISTICS
NOISE FIGURE VARIATIONS
(V_{CE} = 6.0 V, T_A = 25°C)

FIGURE 3 — FREQUENCY

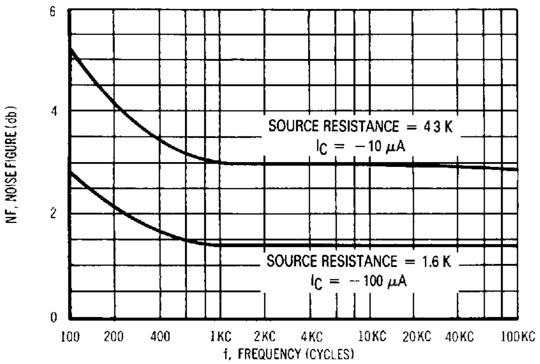
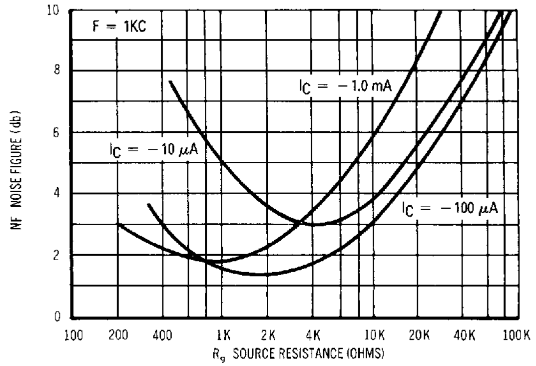


FIGURE 4 — SOURCE RESISTANCE



h PARAMETERS
V_{CE} = 10 V, f = 1.0 kc, T_A = 25°C

FIGURE 5 — CURRENT GAIN

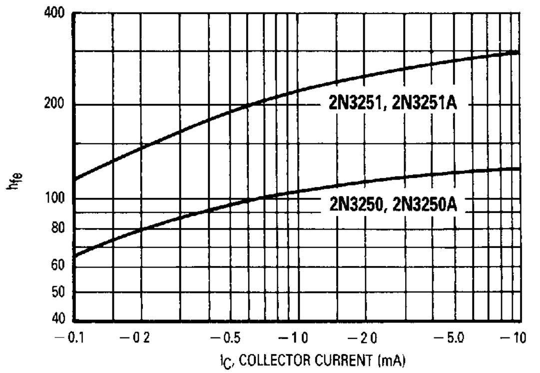


FIGURE 6 — OUTPUT ADMITTANCE

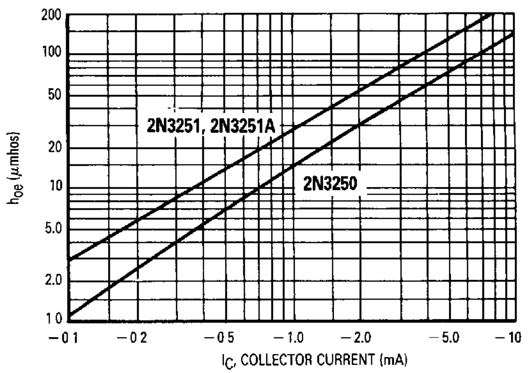


FIGURE 7 — VOLTAGE FEEDBACK RATIO

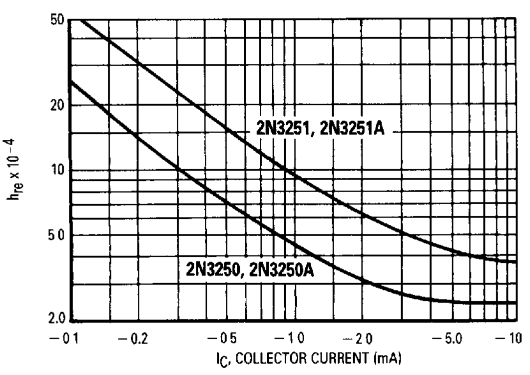


FIGURE 8 — INPUT IMPEDANCE

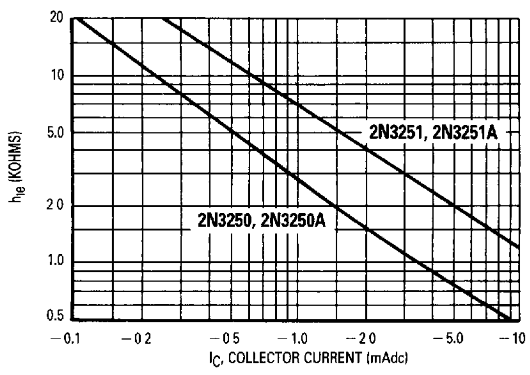


FIGURE 9 — NORMALIZED CURRENT GAIN CHARACTERISTICS

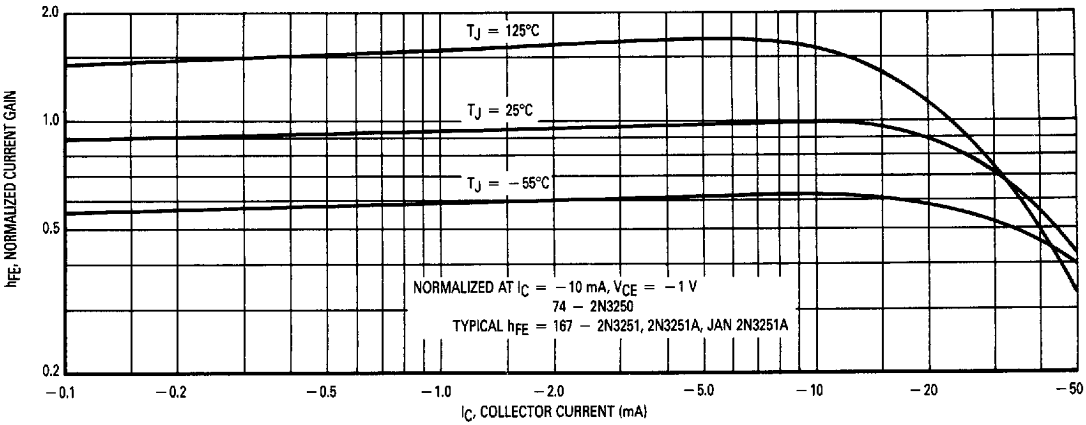
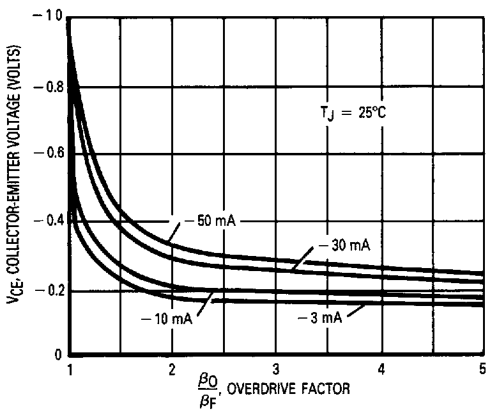


FIGURE 10 — COLLECTOR SATURATION REGION



This graph shows the effect of base current on collector current β_O is the current gain of the transistor at 1 volt, and β_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°C and a collector current of 10 mA

Observe that at I_C = 10 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 volt is typically 167 (guaranteed limits from the Table of Characteristics can be used for "worst case" design) .

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

FIGURE 11 — SATURATION VOLTAGES

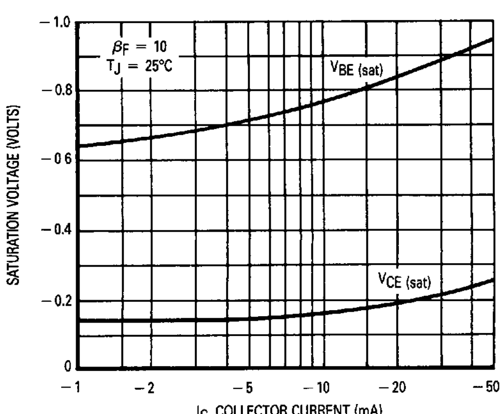


FIGURE 12 — TEMPERATURE COEFFICIENTS

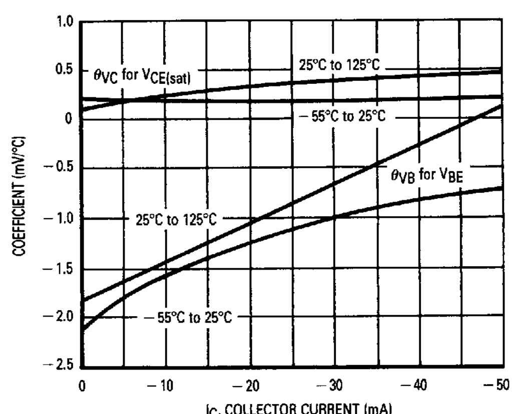


FIGURE 13 — f_T AND $r_b'C_c$ versus I_C

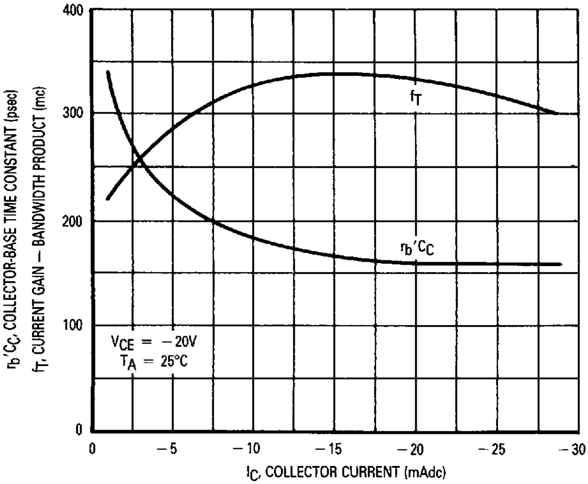


FIGURE 14 — 30 MC EQUIVALENT CIRCUIT

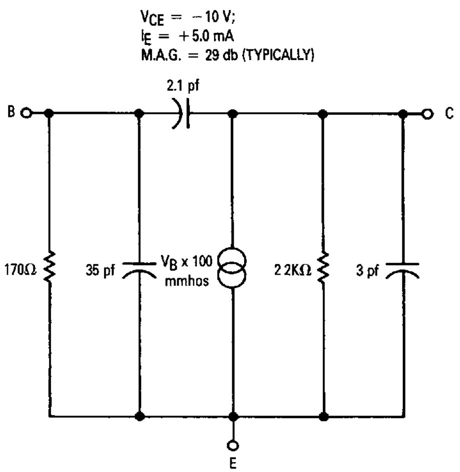


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FIGURE 15 — JUNCTION CAPACITANCE

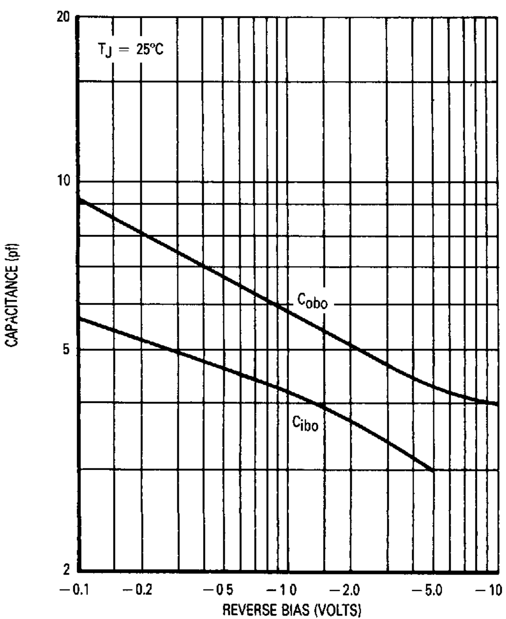

FIGURE 16 — CHARGE DATA