2N3250,A
2N3251,A

**2N3250A,2N3251A
JAN, JTX, JTXV AVAILABLE**

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

**GENERAL PURPOSE TRANSISTOR
PNP SILICON**

4

MAXIMUM RATINGS

Rating	Symbol	2N3250 2N3251	2N3250A 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 Case	$R_{\theta JC}$	0.15	mW/°C
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	0.49	mW/°C

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 2N3250A, 2N3251A	$V_{(BR)CEO}$	40 60	—	Vdc
Collector-Base Breakdown Voltage (I_C = 10 μAdc)	2N3250, 2N3251 2N3250A, 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_{BE} = 3.0 Vdc)		I_{CEX}	—	20	Adc
Base Cutoff Current (V_{CE} = 40 Vdc, V_{BE} = 3.0 Vdc)		I_{BL}	—	50	nAdc
ON CHARACTERISTICS					
DC Forward Current Transfer Radio (1)		h_{FE}			—
(I_C = 0.1 mAdc, V_{CE} = 1.0 Vdc)	2N3250, 2N3250A 2N3251, 2N3251A		40 80	— —	
(I_C = 1.0 mAdc, V_{CE} = 1.0 Vdc)	2N3250, 2N3250A 2N3251, 2N3251A		45 90	— —	
(I_C = 10 mAdc, V_{CE} = 1.0 Vdc)	2N3250, 2N3250A 2N3251, 2N3251A		50 100	150 300	
(I_C = 50 mAdc, V_{CE} = 1.0 Vdc)	2N3250, 2N3250A 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, 2N3250A 2N3251, 2N3251A	f_T	250 300	— —	MHz
Output Capacitance (V_{CB} = 10 Vdc, I_E = 0, f = 100 kHz)		C_{obo}	—	6.0	pF
Input Capacitance (V_{CB} = 1.0 Vdc, I_C = 0, f = 100 kHz)		C_{ibo}	—	8.0	pF

2N3250,A, 2N3251,A

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, 2N3250A 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, 2N3250A 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, 2N3250A 2N3251, 2N3251A	h_{fe}	50 100	200 400	—
Output Admittance (I_C = 1.0 mA, V_{CE} = 10 V, f = 1.0 kHz)	2N3250, 2N3250A 2N3251, 2N3251A	h_{oe}	4.0 10	40 60	μmhos
Collector Base Time Constant (I_C = 10 mA, V_{CE} = 20 V)		$rb'C_C$	—	250	ps
Noise Figure (I_C = 100 μA, V_{CE} = 5.0 V, R_S = 1.0 k Ω, 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		t_d	35	ns
Rise Time	I_C = 10 mAdc, I_{B1} = 1.0 mA)		t_r	35	ns
Storage Time	(I_C = 10 mAdc, I_{B1} = I_{B2} = 1.0 mAdc V_{CC} = 3.0 V)	2N3250, 2N3250A 2N3251, 2N3251A	t_S	175 200	ns
Fall Time			t_f	50	ns

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

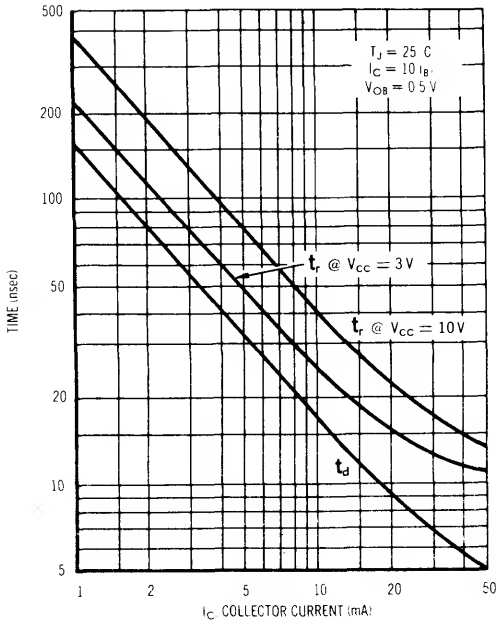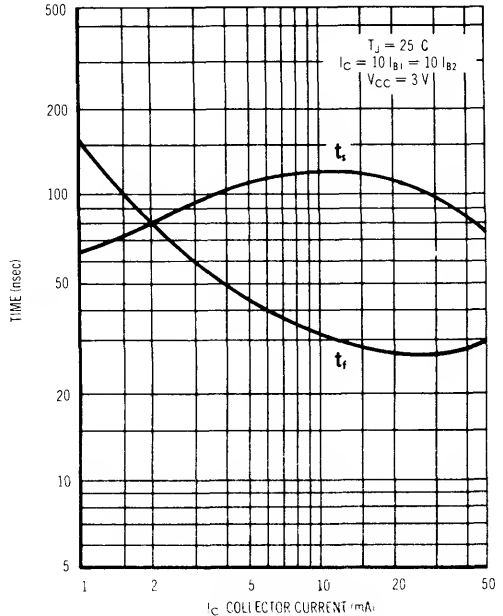## SWITCHING TIME CHARACTERISTICS

FIGURE 1 — DELAY AND RISE TIME

FIGURE 2 — STORAGE AND FALL TIME

AUDIO SMALL SIGNAL CHARACTERISTICS
NOISE FIGURE VARIATIONS
($V_{CE} = 6V$, $T_A = 25°C$)

FIGURE 3 — FREQUENCY

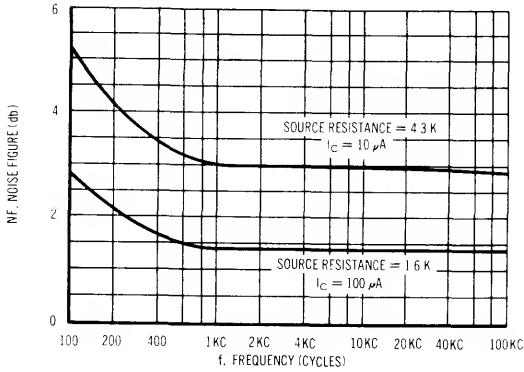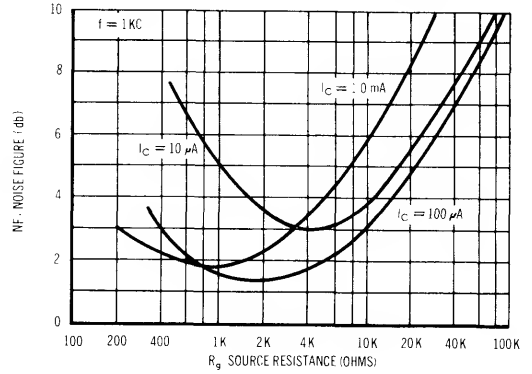### FIGURE 4 — SOURCE RESISTANCE

h PARAMETERS
$V_{CE} = 10V$, $f = 1$ kc, $T_A = 25°C$

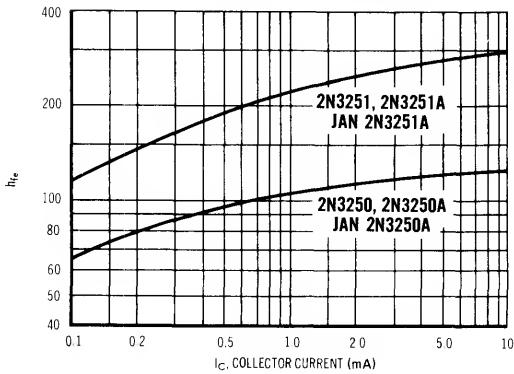### FIGURE 5 — CURRENT GAIN

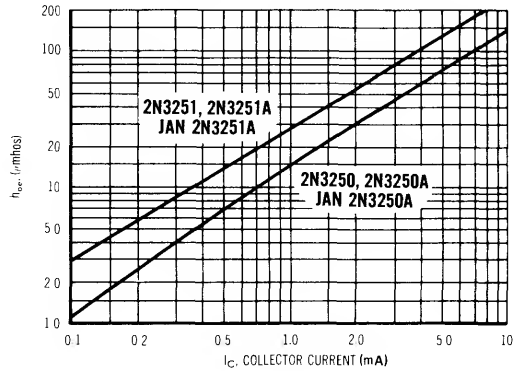### FIGURE 6 — OUTPUT ADMITTANCE
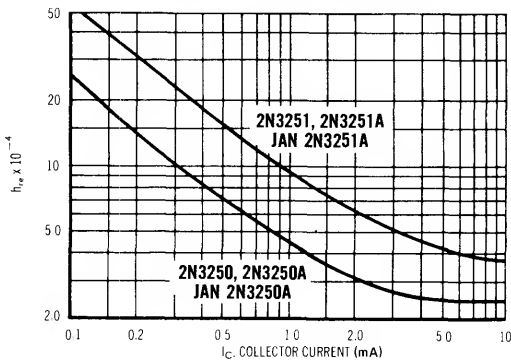

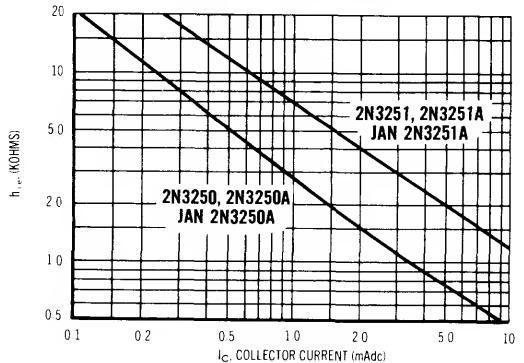### FIGURE 7 — VOLTAGE FEEDBACK RATIO

FIGURE 8 — INPUT IMPEDANCE
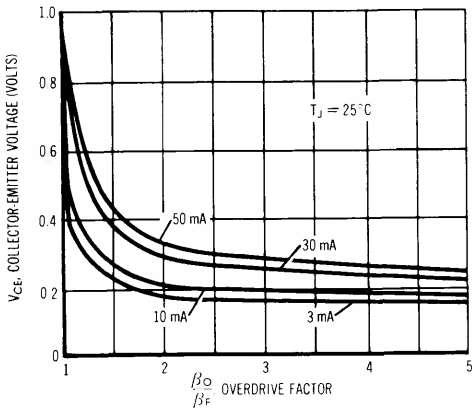
FIGURE 9 — NORMALIZED CURRENT GAIN CHARACTERISTICS

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)

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

FIGURE 11 — SATURATION VOLTAGES

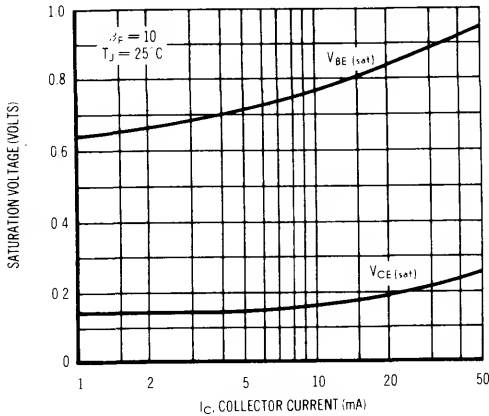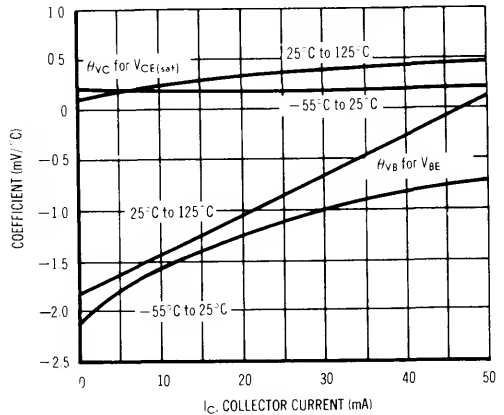**FIGURE 12 — TEMPERATURE COEFFICIENTS**
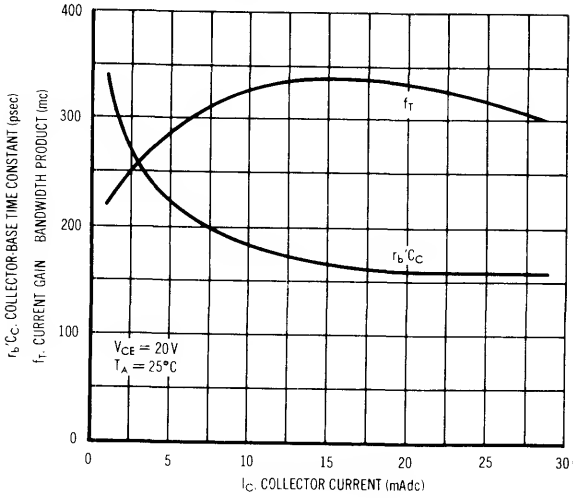
FIGURE 13 — f_T AND $r_b'C_C$ versus I_C

FIGURE 14 — 30 MC EQUIVALENT CIRCUIT

$V_{CE} = 10 V,$
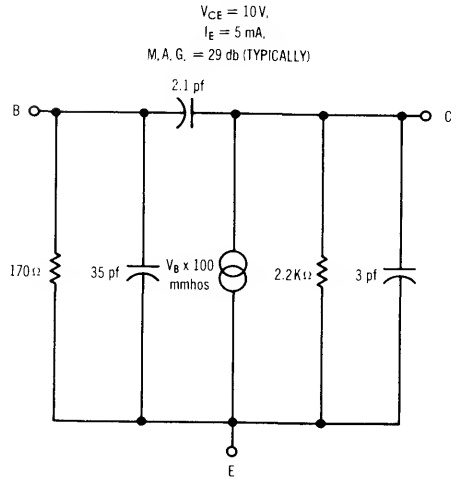$I_E = 5 mA,$
M. A. G. = 29 db (TYPICALLY)

FIGURE 15 — JUNCTION CAPACITANCE

FIGURE 16 — CHARGE DATA