TYPE	MATERIAL	POLARITY	REPLACEMENT	PAGE NUMBER	USE	MAXIMUM RATINGS						ELECTRICAL CHARACTERISTICS								
						P_D @ 25°C	Ref Point	T_J °C	V_{CB} (volts)	V_{CE-} (volts)	Subscript	h_{FE} @ I_C (min)	(max)	Units	$V_{CE(SAT)}$ @ I_C (volts)	Units	h_{f-}	Subscript	f_- Units	Subscript
2N3174	S	P	2N3790	7-147	HPA	75W	C	200	100	100	O	12	36	1.0A	0.75	1.0A	10	E	1.0M	T
2N3175	S	P	MJ2267	7-202	HPA	85W	C	200	40	40	O	10	30	2.0A	1.0	2.0A	10	E	1.0M	T
2N3176	S	P	2N3789	7-147	HPA	85W	C	200	60	60	O	10	30	2.0A	1.0	2.0A	10	E	1.0M	T
2N3177	S	P	2N3790	7-147	HPA	85W	C	200	80	80	O	10	30	2.0A	1.0	2.0A	10	E	1.0M	T
2N3178	S	P	2N3790	7-147	HPA	85W	C	200	100	100	O	10	30	2.0A	1.0	2.0A	10	E	1.0M	T
2N3179	S	P	MJ2267	7-202	HPA	85W	C	200	40	40	O	10	30	2.0A	1.0	2.0A	10	E	1.0M	T
2N3180	S	P	2N3789	7-147	HPA	85W	C	200	60	60	O	10	30	2.0A	1.0	2.0A	10	E	1.0M	T
2N3181	S	P	2N3790	7-147	HPA	85W	C	200	80	80	O	10	30	2.0A	1.0	2.0A	10	E	1.0M	T
2N3182	S	P	2N3790	7-147	HPA	85W	C	200	100	100	O	10	30	2.0A	1.0	2.0A	10	E	1.0M	T
2N3183	S	P	2N3789	7-147	HPA	75W	C	200	40	40	O	10	30	2.0A	1.0	2.0A	10	E	1.0M	T
2N3184	S	P	2N3789	7-147	HPA	75W	C	200	60	60	O	10	30	2.0A	1.0	2.0A	10	E	1.0M	T
2N3185	S	P	2N3790	7-147	HPA	75W	C	200	80	80	O	10	30	2.0A	1.0	2.0A	10	E	1.0M	T
2N3186	S	P	2N3790	7-147	HPA	75W	C	200	100	100	O	10	30	2.0A	1.0	2.0A	10	E	1.0M	T
2N3187	S	P	MJ2267	7-202	HPA	85W	C	200	40	40	O	10	30	3.0A	0.9	3.0A	10	E	1.0M	T
2N3188	S	P	2N3789	7-147	HPA	85W	C	200	60	60	O	10	30	3.0A	0.9	3.0A	10	E	1.0M	T
2N3189	S	P	2N3790	7-147	HPA	85W	C	200	80	80	O	10	30	3.0A	0.9	3.0A	10	E	1.0M	T
2N3190	S	P	2N3790	7-147	HPA	85W	C	200	100	100	O	10	30	3.0A	0.9	3.0A	10	E	1.0M	T
2N3191	S	P			HPA	85W	C	200	40	40	O	10	30	3.0A	0.9	3.0A	10	E	1.0M	T
2N3192	S	P	2N3789	7-147	HPA	85W	C	200	60	60	O	10	30	3.0A	0.9	3.0A	10	E	1.0M	T
2N3193	S	P	2N3790	7-147	HPA	85W	C	200	80	80	O	10	30	3.0A	0.9	3.0A	10	E	1.0M	T
2N3194	S	P	2N3790	7-147	HPA	85W	C	200	100	100	O	10	30	3.0A	0.9	3.0A	10	E	1.0M	T
2N3195	S	P			HPA	75W	C	200	40	40	O	10	30	3.0A	0.9	3.0A	10	E	1.0M	T
2N3196	S	P	2N3789	7-147	HPA	75W	C	200	60	60	O	10	30	3.0A	0.9	3.0A	10	E	1.0M	T
2N3197	S	P	2N3790	7-147	HPA	75W	C	200	80	80	O	10	30	3.0A	0.9	3.0A	10	E	1.0M	T
2N3198	S	P	2N3790	7-147	HPA	75W	C	200	100	100	O	10	30	3.0A	0.9	3.0A	10	E	1.0M	T
2N3199	S	P			HPA	40W	C	200	40	40	O	20	60	1.0A	0.3	1.0A	10	E	1.0M	T
2N3200	S	P	2N3740	7-137	HPA	40W	C	200	60	60	O	20	60	1.0A	0.3	1.0A	10	E	1.0M	T
2N3201	S	P	2N3741	7-137	HPA	40W	C	200	80	80	O	20	60	1.0A	0.3	1.0A	10	E	1.0M	T
2N3202	S	P			HPA	8.8W	C	200	40	40	O	20	60	1.0A	0.3	1.0A	10	E	1.0M	T
2N3203	S	P	2N3740	7-137	HPA	8.8W	C	200	60	60	O	20	60	1.0A	0.3	1.0A	10	E	1.0M	T
2N3204	S	P	2N3741	7-137	HPA	8.8W	C	200	80	80	O	20	60	1.0A	0.3	1.0A	10	E	1.0M	T
2N3205	S	P			HPA	40W	C	200	40	40	O	20	60	0.5A	0.4	0.5A	10	E	1.0M	T
2N3206	S	P	2N3740	7-137	HPA	40W	C	200	60	60	O	20	60	0.5A	0.4	0.5A	10	E	1.0M	T
2N3207	S	P	2N3741	7-137	HPA	40W	C	200	100	100	O	20	60	0.5A	0.4	0.5A	10	E	1.0M	T
2N3208	S	P	2N3740	7-137	HPA	8.8W	C	200	40	40	O	20	60	0.5A	0.4	0.5A	10	E	1.0M	T
2N3209	S	P	MM2894	8-328	MSS	0.36W	A	200	20	20	O	30	120	30M	0.2	30M			400M	T
2N3210	S	N		8-196	HSS	0.36W	A	200	40	15	O	30	120	10M	0.75	0.2A			300M	T
2N3211	S	N		8-198	HSS	0.36W	A	200	40	15	O	50	150	10M	0.2	10M			350M	T
2N3212	G	P			LPA	14W	C	110	100	80	O	30	90	3.0A	0.5	5.0A	3.0	E		
2N3213	G	P			LPA	14W	C	110	80	60	O	30	90	3.0A	0.5	5.0A	3.0	E		
2N3214	G	P			LPA	14W	C	110	60	40	O	30	90	3.0A	0.5	5.0A	3.0	E		
2N3215	G	P			LPA	14W	C	110	40	30	O	25	100	3.0A	0.5	5.0A	3.0	E		
2N3216	G	P			MSS	150M	A	100	20	10	O	60		200M	0.22	200M			10M	T
2N3217	S	P			CHP	400M	A	200	15	10	O								1.0M	T
2N3218	S	P			CHP	400M	A	200	25	20	O								1.0M	T
2N3219	S	P			CHP	400M	A	200	40	35	O								1.0M	T
2N3220	S	N			HFA	6.0W	C	175	100	80	O	20	60	1.0A	1.25	1.0A	20	E	10M	T
2N3221	S	N			HPA	6.0W	C	175	100	80	O	40	120	1.0A	1.25	1.0A	40	E	10M	T
2N3222	S	N			HPA	6.0W	C	175	80	60	O	20	60	1.0A	1.25	1.0A	20	E	10M	T
2N3223	S	N			HPA	6.0W	C	175	80	60	O	40	120	1.0A	1.25	1.0A	40	E	10M	T
2N3224	S	P	2N3498	8-232	VID	0.7W	A	200	100	100	O	20	60	50M			20	E	60M	T
2N3225	S	P	2N3498	8-232	VID	0.7W	A	200	100	100	O	40	120	50M			40	E	80M	T
2N3226	S	N			LPA	75W	C	200	35	35	O	20	50	2.0A	1.2	2.7A	20	E	30K	E
2N3227	S	N		8-130	HSS	0.36W	A	200	40	20	O	100	300	10M	0.25	10M			500M	T
2N3228	Thyristor, see Table on Page 1-154																			
2N3229	S	N			HPA	17.5W	C	200	105	60	O	5.0		2.5A	1.0	2.5A			150M	T
2N3230	S	N			PHS	25W	C	200	80	60	O	2K	20K	2.0A	1.4	2.0A			40M	T
2N3231	S	N			PHS	25W	C	200	100	80	O	2K	20K	2.0A	1.4	2.0A			40M	T
2N3232	S	N		7-106	HPA	117W	C	200	80	60	O	18	55	3.0A	2.5	3.0A	10	E	1.0M	E
2N3233	S	N			HPA	117W	C	200	110	100	O	18	55	3.0A	2.5	3.0A	10	E	1.0M	E
2N3234	S	N			HPA	117W	C	200	160	160	O	18	55	3.0A	2.5	3.0A	10	E	1.0M	E
2N3235	S	N		7-106	HPA	117W	C	200	65	55	O	20	70	4.0A	1.1	4.0A	10	E	1.0M	E
2N3236	S	N			HPA	150W	C	200	90	90	O	17	60	5.0A	1.1	5.0A	10	E	1.0M	E
2N3237	S	N			HPA	200W	C	200	90	75	O	12	36	10A	2.0	10A	10	E	1.0M	E
2N3238	S	N			HPA	150W	C	200	80	80	O	8.5	25	10A	3.0	10A	10	E	1.0M	E
2N3239	S	N			HPA	150W	C	200	80	80	O	8.5	25	10A	1.0	10A	10	E	1.0M	E
2N3240	S	N			HPA	150W	C	200	160	160	O	8.5	25	10A	1.0	10A	10	E	1.0M	E
2N3241	S	N			LNA	0.5W	A	175	30	25	O	50	300	10M			70	E	50M	T
2N3241A	S	N			AFA	500M	A	175	30	25	O						175	E	100M	T
2N3242	S	N			LNA	0.5W	A	175	30	25	O	75		10M			100	E	50M	T
2N3242A	S	N			AFA	500M	A	175	40	40	O						200	E	100M	T
2N3244	S	P		8-200	HSS	1.0W	A	200	40	40	O	50	150	0.5A	0.3	0.15A			175M	T
2N3245	S	P		8-200	HSS	1.0W	A	200	50	50	O	30	90	0.5A	0.35	0.15A			150M	T
2N3246	S	N			LNA	0.35W	A	200	60	45	O	200	600	10*	0.5	5.0M	200	E	60M	T
2N3247	S	N			LNA	0.15W	A	150	60	45	O	200	600	10*	0.5	5.0M	200	E	60M	T
2N3248	S	P		8-204	HSS	0.36W	A	200	15	12	O	50	150	0.1M	0.125	10M			250M	T
2N3249	S	P		8-204	HSS	0.36W	A	200	15	12	O	100	300	0.1M	0.125	10M			300M	T
2N3250	S	P		8-208	HSS	0.36W	A	200	50	40	O	50	150	10M	0.25	10M	50	E	250M	T
2N3250A	S	P		8-208	HSS	0.36W	A	200	60	60	O	50	150	10M	0.25	10M	50	E	250M	T
2N3251	S	P		8-208	HSS	0.36W	A	200	50	40	O	100	300	10M	0.25	10M	100	E	300M	T
2N3251A	S	P		8-208	HSS	0.36W	A	200	60	60	O	100	300	10M	0.25	10M	100	E	300M	T
2N3252	S	N		8-214	HSS	1.0W	A	200	60	30	O	30	90	0.5A	0.3	0.15A			200M	T
2N3253	S	N		8-214	HSS	1.0W	A	200	75	40	O	25	75	375M	0.35	0.15A			175M	T
2N3254 thru 2N3259	Thyristors, see Table on Page 1-154																			
2N3260	S	N			PMS	200W	C	200	200	200	O	10	40	20A	1.5	20A			0.6M	T
2N3261	S	N			HSS	0.3W	A	175	40	15	O	40	150	10M	0.35	0.1A			600M	T

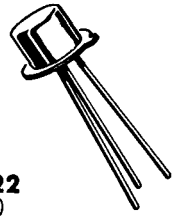
GENERAL PURPOSE SWITCHING AND AMPLIFIER TRANSISTORS (SILICON)

Current versus Voltage

BV_{CEO} Min Volts	OPTIMUM COLLECTOR CURRENT									
	0 to 10 mA		10 mA to 100 mA		100 mA to 500 mA		500 mA to 1.0 A		1.0 A to 3.0 A	
	NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP
15 ↓ 29	2N916 2N2330 2N2331		2N916 2N1983 2N1984		2N696 2N697 2N718 2N1420 2N2195	2N1991				
30 ↓ 39			2N2218 2N2219 2N2221 2N2222	2N3133 2N3134 2N3135 2N3136	2N2218 2N2219 2N2221 2N2222 2N3299 2N3300 2N3301 2N3302	2N2800 2N2801 2N2837 2N2838 2N3133 2N3134 2N3135 2N3136				
49 ↓ 59	2N758 2N795 2N760 2N915 2N929 2N930 2N3946 2N3947	2N3250 2N3251 MM4048	2N2218A 2N2219A 2N2221A 2N2222A 2N2224 2N3946 2N3947	2N3250 2N3251	2N2194 2N2218A 2N2219A 2N2221A 2N2222A	2N2904 2N2905 2N2906 2N2907 2N3485 2N3486 2N4890	2N2192 2N2193	2N3244 2N3245	2N3506 2N3507	
60 ↓ 79	2N758A 2N759A 2N760A 2N929A 2N930A MM2483 MM2484	2N3798 2N3799 2N3250A 2N3251A	2N910 2N911 2N1990	2N3250A 2N3251A	2N656 2N699	2N2904A 2N2905A 2N2906A 2N2907A 2N3485A 2N3486A				
80 ↓ 99	2N739 2N740	2N3494 2N3496	2N720A 2N1893 2N2405	2N3494 2N3496	2N720A 2N3019 2N3020		2N3019 2N3020			
100 ↓ 149	2N4924	2N3495 2N3497 2N4928	2N3498 2N3499 2N4924	2N3495 2N3497 2N3634 2N3635 2N4928	2N3498 2N3499 2N4924	2N3634 2N3635				
150 ↓ 249	2N3114 2N4925 2N4926	2N4929 2N4930	2N3500 2N3501 2N4925 2N4926	2N3635 2N3637 2N4929 2N4930	2N3500 2N3501 2N4925	2N3636 2N3637				
250 UP	2N3742 2N4927	2N3743 2N4931	2N3742 2N4927	2N3743 2N4931						

2N3250, A (SILICON)
2N3251, A
2N3250A, 2N3251A JAN
2N3250,A, 2N3251,A HI-REL

$V_{CEO} = 40\text{-}60$ V
$I_C = 200$ mA
$f_T = 250\text{-}300$ MHz



CASE 22
(TO-18)

PNP silicon annular transistors for high-speed switching and amplifier applications.

Collector connected to case

MAXIMUM RATINGS

Rating	Symbol	2N3250 2N3251	2N3250A 2N3251A	Unit
Collector-Base Voltage	V_{CB}	50	60	Vdc
Collector-Emitter Voltage	V_{CEO}	40	60	Vdc
Emitter-Base Voltage	V_{EB}	5		Vdc
Collector Current	I_C	200		mAdc
Total Device Dissipation @ 25°C Case Temperature Derating Factor Above 25°C	P_D	1.2 6.9		Watts mW/°C
Total Device Dissipation @ 25°C Ambient Temperature Derating Factor Above 25°C	P_D	0.36 2.06		Watts mW/°C
Junction Operating Temperature	T_J	200		°C
Storage Temperature Range	T_{stg}	−65 to +200		°C
Thermal Resistance	θ_{JA} θ_{JC}	0.49 0.15		°C/mW °C/mW

2N3250, A, 2N3251, A (Continued)

ELECTRICAL CHARACTERISTICS (At 25°C unless otherwise noted)

Characteristic		Symbol	Min	Max	Unit
Collector Cutoff Current (V_{CE} = 40 Vdc, $V_{BE(off)}$ = 3 Vdc)		I_{CEX}	--	20	nAdc
Base Cutoff Current (V_{CE} = 40 Vdc, $V_{BE(off)}$ = 3 Vdc)		I_{BL}	--	50	nAdc
Collector-Base Breakdown Voltage (I_C = 10 μAdc)	2N3250, 2N3251 2N3250A, 2N3251A	BV_{CBO}	50 60	--	Vdc
Collector-Emitter Breakdown Voltage * (I_C = 10 mAdc)	2N3250, 2N3251 2N3250A, 2N3251A	BV_{CEO} *	40 60	--	Vdc
Emitter-Base Breakdown Voltage (I_E = 10 μAdc)		BV_{EBO}	5	--	Vdc
Collector Saturation Voltage * (I_C = 10 mAdc, I_B = 1 mAdc) (I_C = 50 mAdc, I_B = 5 mAdc)		$V_{CE(sat)}$ *	-- --	0.25 0.5	Vdc
Base-Emitter Saturation Voltage * (I_C = 10 mAdc, I_B = 1 mAdc) (I_C = 50 mAdc, I_B = 5 mAdc)		$V_{BE(sat)}$ *	0.6 --	0.9 1.2	Vdc
DC Forward Current Transfer Ratio * (I_C = 0.1 mAdc, V_{CE} = 1 Vdc)	2N3250, 2N3250A 2N3251, 2N3251A	h_{FE} *	40 80	-- --	--
(I_C = 1 mAdc, V_{CE} = 1 Vdc)	2N3250, 2N3250A 2N3251, 2N3251A		45 90	-- --	
(I_C = 10 mAdc, V_{CE} = 1 Vdc)	2N3250, 2N3250A 2N3251, 2N3251A		50 100	150 300	
(I_C = 50 mAdc, V_{CE} = 1 Vdc)	2N3250, 2N3250A 2N3251, 2N3251A		15 30	-- --	
Output Capacitance (V_{CB} = 10 Vdc, I_E = 0, f = 100 kHz)		C_{ob}	--	6	pF
Input Capacitance (V_{CB} = 1 Vdc, I_C = 0, f = 100 kHz)		C_{ib}	--	8	pF
Current-Gain - Bandwidth Product (I_C = 10 mAdc, V_{CE} = 20 Vdc, f = 100 MHz)	2N3250, 2N3250A 2N3251, 2N3251A	f_T	250 300	-- --	MHz

SMALL SIGNAL CHARACTERISTICS

Characteristic		Symbol	Min	Max	Unit
Small Signal Current Gain (I_C = 1.0 mA, V_{CE} = 10 V, f = 1 kHz)	2N3250, 2N3250A 2N3251, 2N3251A	h_{fe}	50 100	200 400	--
Voltage Feedback Ratio (I_C = 1.0 mA, V_{CE} = 10 V, f = 1 kHz)	2N3250, 2N3250A 2N3251, 2N3251A	h_{re}	-- --	10 20	$X10^{-4}$
Input Impedance (I_C = 1.0 mA, V_{CE} = 10 V, f = 1 kHz)	2N3250, 2N3250A 2N3251, 2N3251A	h_{ie}	1 2	6 12	kohms
Output Admittance (I_C = 1.0 mA, V_{CE} = 10 V, f = 1 kHz)	2N3250, 2N3250A 2N3251, 2N3251A	h_{oe}	4 10	40 60	μ mhos
Collector-Base Time Constant (I_C = 10 mA, V_{CE} = 20 V)		$r'_b C_C$	--	250	ps
Noise Figure (I_C = 100 μA, V_{CE} = 5 V, R_S = 1 kΩ, f = 100 Hz)		NF	--	6	dB

*Pulse Test: PW = 300 μs, Duty Cycle = 2%

2N3250, A, 2N3251, A (Continued)

SWITCHING CHARACTERISTICS (At 25°C unless otherwise noted)

Characteristic			Symbol	Max	Unit
Delay Time	(V_{CC} = 3 Vdc, V_{BE} = 0.5 Vdc I_C = 10 mAdc, I_{B1} = 1 mA)		t_d	35	ns
Rise Time			t_r	35	ns
Storage Time	(I_{B1} = I_{B2} = 1 mAdc V_{CC} = 3V)	2N3250, 2N3250A	t_s	175	ns
		2N3251, 2N3251A		200	
Fall Time			t_f	50	ns

SWITCHING TIME CHARACTERISTICS

FIGURE 1 — DELAY AND RISE TIME

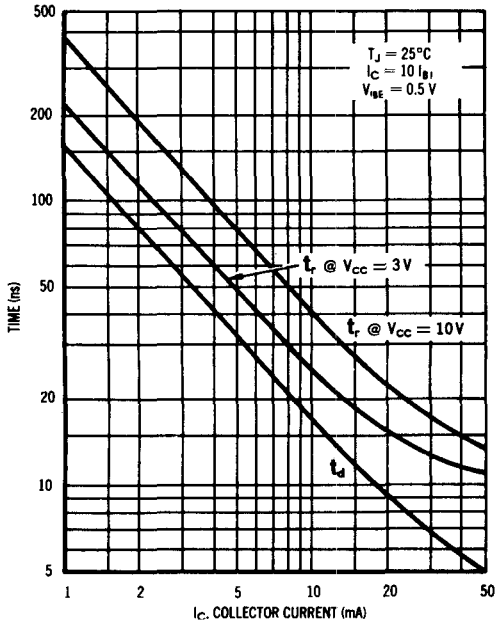
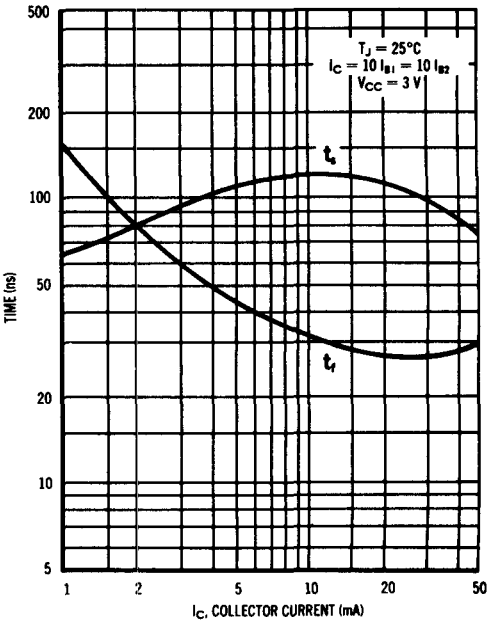


FIGURE 2 — STORAGE AND FALL TIME



2N3250, A, 2N3251, A (Continued)

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

FIGURE 3 — FREQUENCY

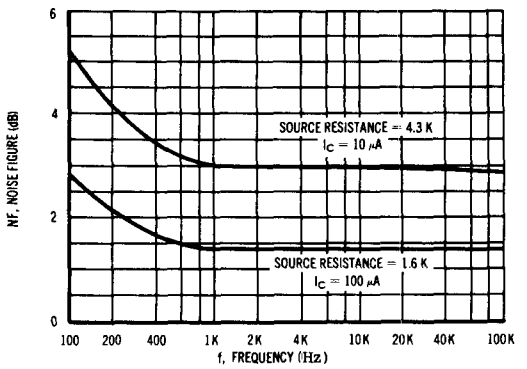
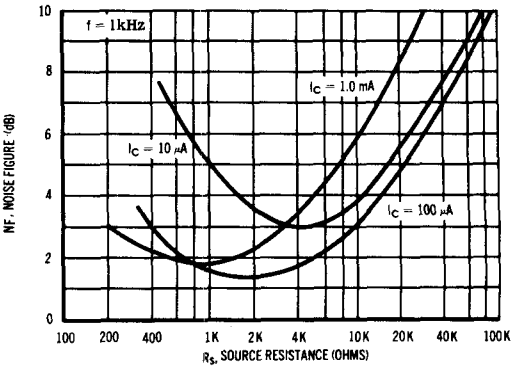


FIGURE 4 — SOURCE RESISTANCE



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

FIGURE 5 — CURRENT GAIN

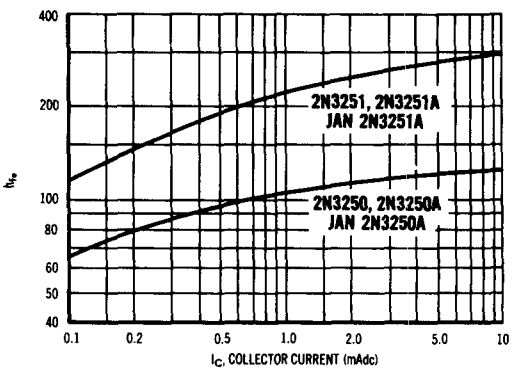


FIGURE 6 — OUTPUT ADMITTANCE

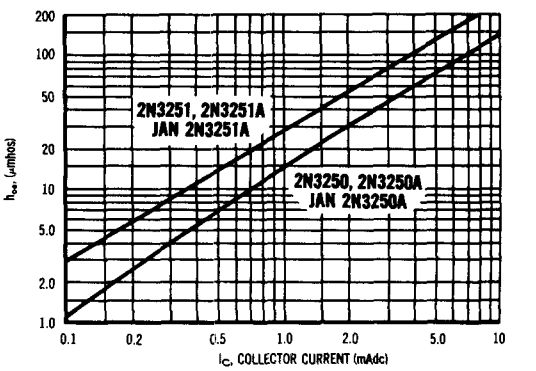


FIGURE 7 — VOLTAGE FEEDBACK RATIO

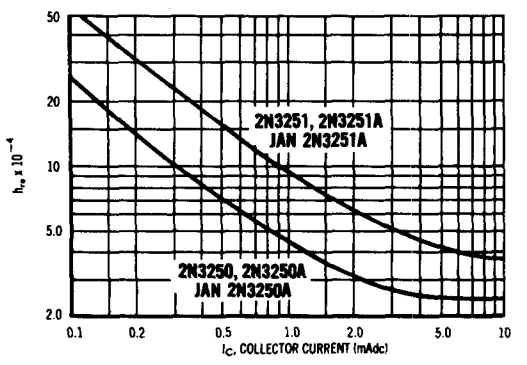
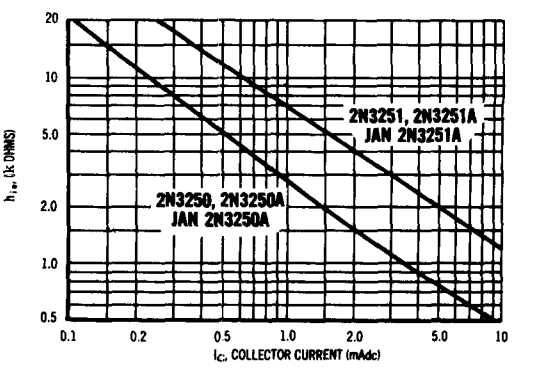


FIGURE 8 — INPUT IMPEDANCE



2N3250, A, 2N3251, A (Continued)

FIGURE 9 — NORMALIZED CURRENT GAIN CHARACTERISTICS

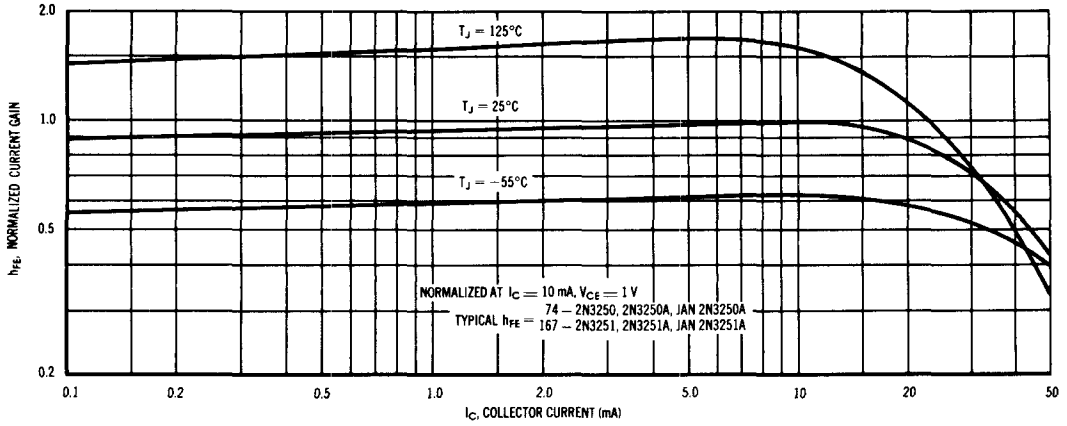
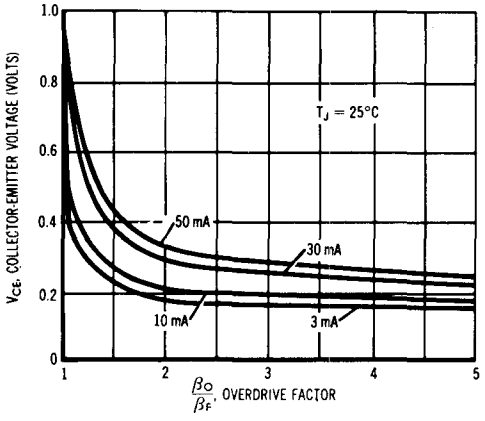


FIGURE 10 — COLLECTOR SATURATION REGION



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 9, 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) . . .

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

FIGURE 11 — SATURATION VOLTAGES

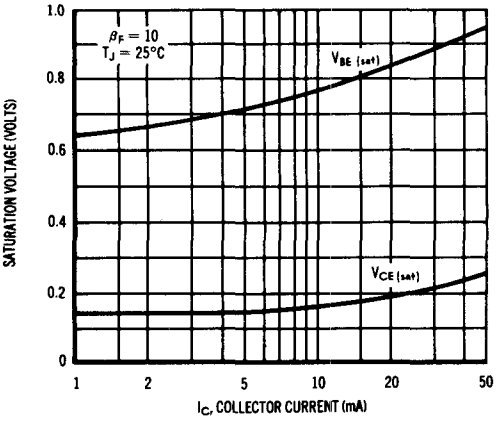
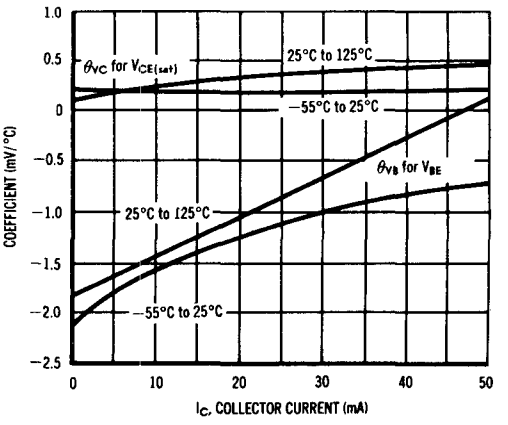


FIGURE 12 — TEMPERATURE COEFFICIENTS



2N3250, A, 2N3251, A (Continued)

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

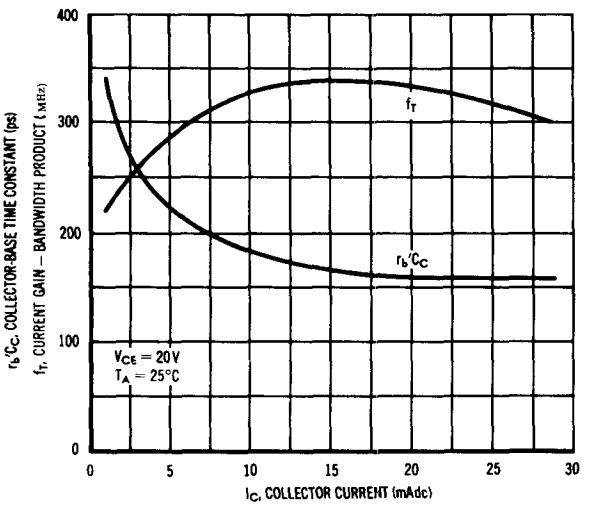


FIGURE 14 — 30 MC EQUIVALENT CIRCUIT

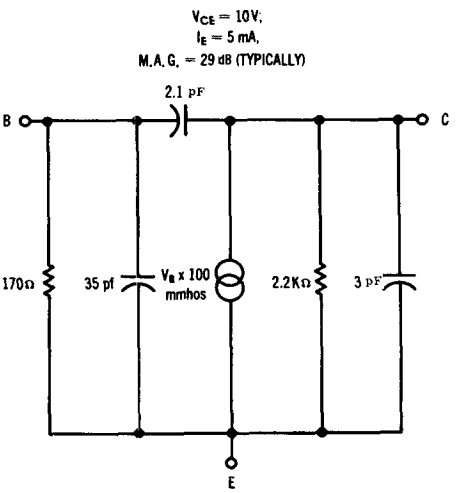


FIGURE 15 — JUNCTION CAPACITANCE

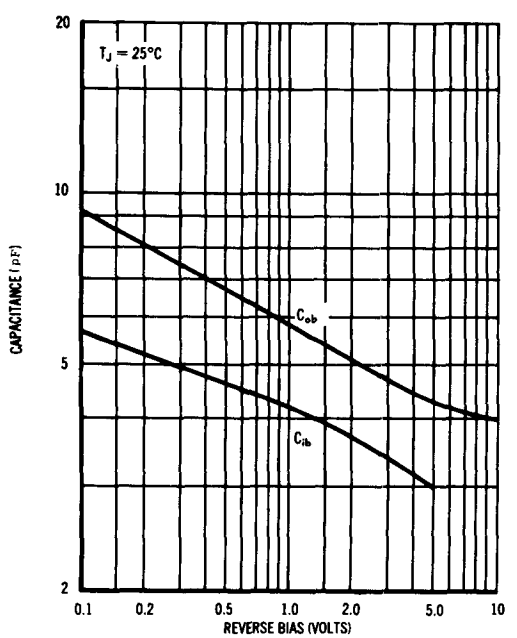


FIGURE 16 — CHARGE DATA