2N3946
2N3947

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

GENERAL PURPOSE TRANSISTOR

NPN SILICON

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MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	40	Vdc
Collector-Base Voltage	V_{CBO}	60	Vdc
Emitter-Base Voltage	V_{EBO}	6.0	Vdc
Collector Current — Continuous	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 Junction 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	°C/mW
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	0.49	°C/mW

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)		$V_{(BR)CEO}$	40	—	Vdc
Collector-Base Breakdown Voltage (I_C = 10 μAdc, I_E = 0)		$V_{(BR)CBO}$	60	—	Vdc
Emitter-Base Breakdown Voltage (I_E = 10 μAdc, I_C = 0)		$V_{(BR)EBO}$	6.0	—	Vdc
Collector Cutoff Current (V_{CE} = 40 Vdc, V_{OB} = 3.0 Vdc) (V_{CE} = 40 Vdc, V_{OB} = 3.0 Vdc, T_A = 150°C)		I_{CEX}	— —	0.010 15	μAdc
Base Cutoff Current (V_{CE} = 40 Vdc, V_{OB} = 3.0 Vdc)		I_{BL}	—	.025	μAdc
ON CHARACTERISTICS					
DC Current Gain(1) (I_C = 0.1 mAdc, V_{CE} = 1.0 Vdc)	2N3946 2N3947	h_{FE}	30 60	— —	—
(I_C = 1.0 mAdc, V_{CE} = 1.0 Vdc)	2N3946 2N3947		45 90	— —	
(I_C = 10 mAdc, V_{CE} = 1.0 Vdc)	2N3946 2N3947		50 100	150 300	
(I_C = 50 mAdc, V_{CE} = 1.0 Vdc)	2N3946 2N3947		20 40	— —	
Collector-Emitter Saturation Voltage(1) (I_C = 10 mAdc, I_B = 1.0 mAdc) (I_C = 50 mAdc, I_B = 5.0 mAdc)		$V_{CE(sat)}$	— —	0.2 0.3	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 1.0	Vdc
SMALL-SIGNAL CHARACTERISTICS					
Current-Gain — Bandwidth Product (I_C = 10 mAdc, V_{CE} = 20 Vdc, f = 100 MHz)	2N3946 2N3947	f_T	250 300	— —	MHz
Output Capacitance (V_{CB} = 10 Vdc, I_E = 0, f = 100 kHz)		C_{obo}	—	4.0	pF

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

Characteristic		Symbol	Min	Max	Unit
Input Capacitance (V_{BE} = 1.0 Vdc, I_C = 0, f = 100 kHz)		C_{ibo}	—	8.0	pF
Input Impedance (I_C = 1.0 mA, V_{CE} = 10 V, f = 1.0 kHz)	2N3946 2N3947	h_{ie}	 0.5 2.0	 6.0 12	kohms
Voltage Feedback Ratio (I_C = 1.0 mA, V_{CE} = 10 V, f = 1.0 kHz)	2N3946 2N3947	h_{re}	 — —	 10 20	X 10^{-4}
Small Signal Current Gain (I_C = 1.0 mA, V_{CE} = 10 V, f = 1.0 kHz)	2N3946 2N3947	h_{fe}	 50 100	 250 700	—
Output Admittance (I_C = 1.0 mA, V_{CE} = 10 V, f = 1.0 kHz)	2N3946 2N3947	h_{oe}	 1.0 5.0	 30 50	μmhos
Collector Base Time Constant (I_C = 10 mA, V_{CE} = 20 V, f = 31.8 MHz)		$rb'C_c$	—	200	ps
Noise Figure (I_C = 100 μA, V_{CE} = 5.0 V, R_g = 1.0 kΩ, f = 10 Hz to 15.7 kHz)		NF	—	5.0	dB

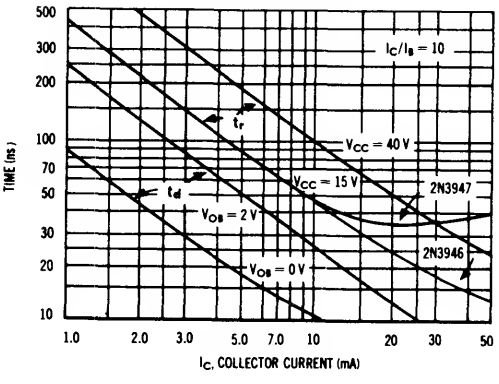
SWITCHING CHARACTERISTICS

Delay Time	V_{CC} = 3.0 Vdc, V_{OB} = 0.5 Vdc,		t_d	—	35	ns
Rise Time	I_C = 10 mAdc, I_{B1} = 1.0 mA		t_r	—	35	ns
Storage Time	V_{CC} = 3.0 V, I_C = 10 mA,	2N3946 2N3947	t_s	— —	300 375	ns
Fall Time	I_{B1} = I_{B2} = 1.0 mAdc		t_f	—	75	ns

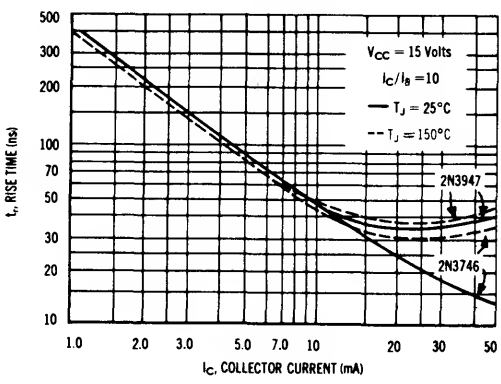
(1) Pulse Test: PW ≤ 300 μs, Duty Cycle ≤ 2%.

TYPICAL SWITCHING CHARACTERISTICS
(T_A = 25°C unless otherwise noted)

DELAY AND RISE TIME

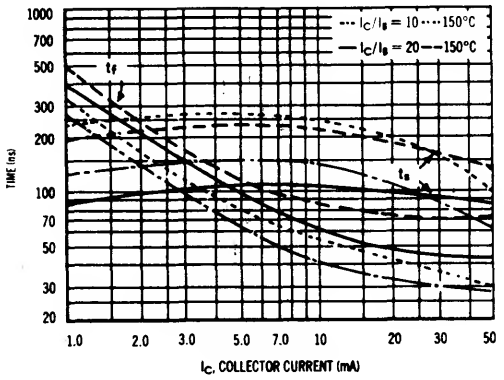


RISE TIME

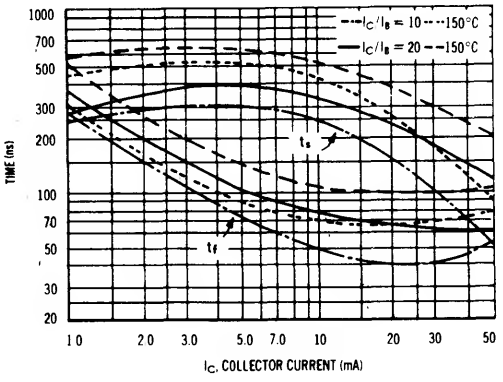


STORAGE AND FALL TIMES

2N3946



2N3947



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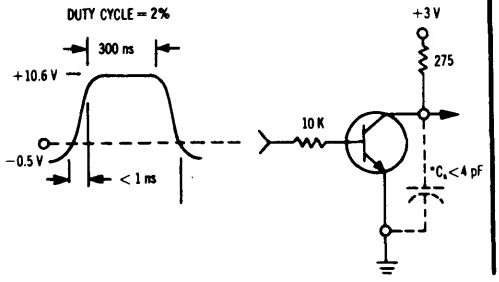
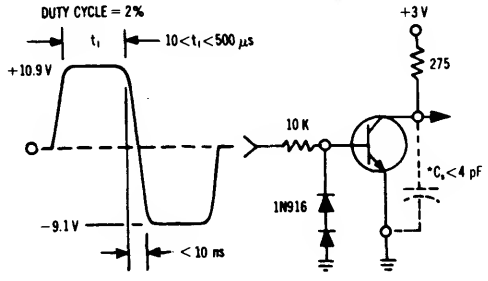
TURN-ON TIME EQUIVALENT TEST CIRCUIT



TURN-OFF TIME EQUIVALENT TEST CIRCUIT

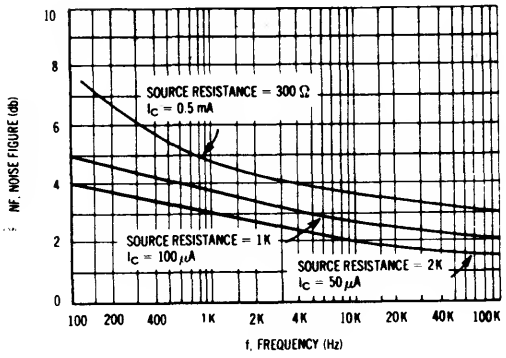


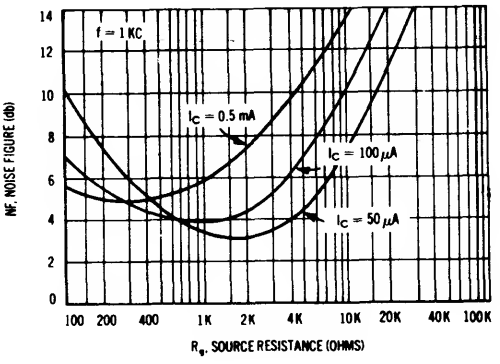
*TOTAL SHUNT CAPACITANCE OF TEST JIG AND CONNECTORS

AUDIO SMALL-SIGNAL CHARACTERISTICS

NOISE FIGURE VARIATIONS

V_{CE} = 5 V, T_A = 25°C





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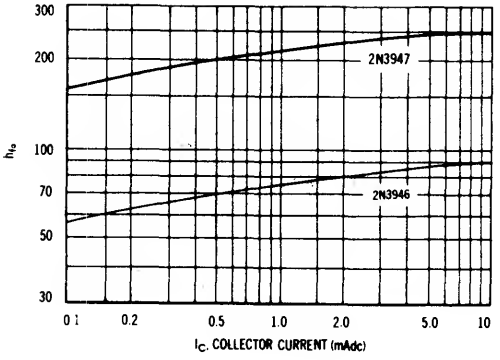
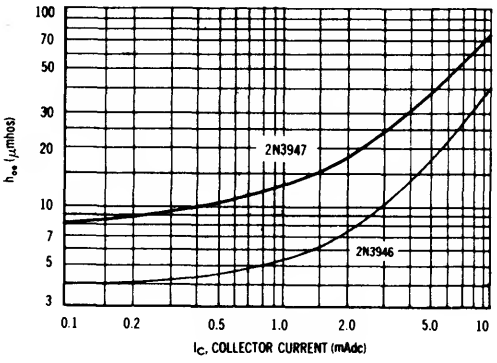
h PARAMETERS

V_{CE} = 10 V, T_A = 25°C, f = 1 Kc

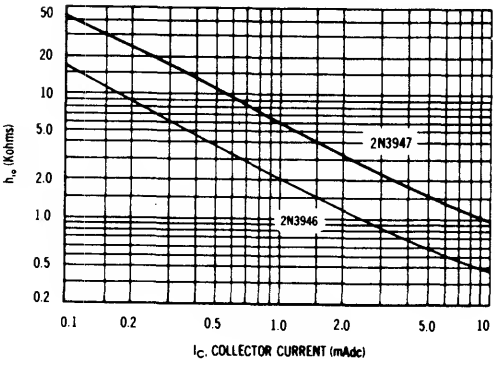
CURRENT GAIN



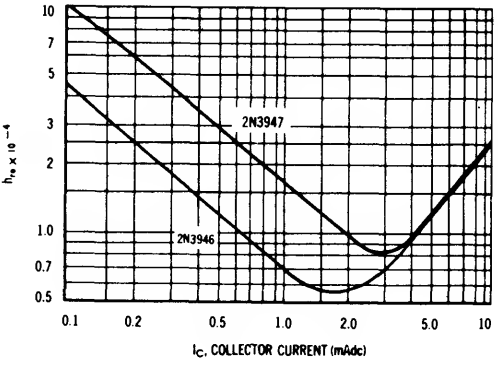
OUTPUT ADMITTANCE



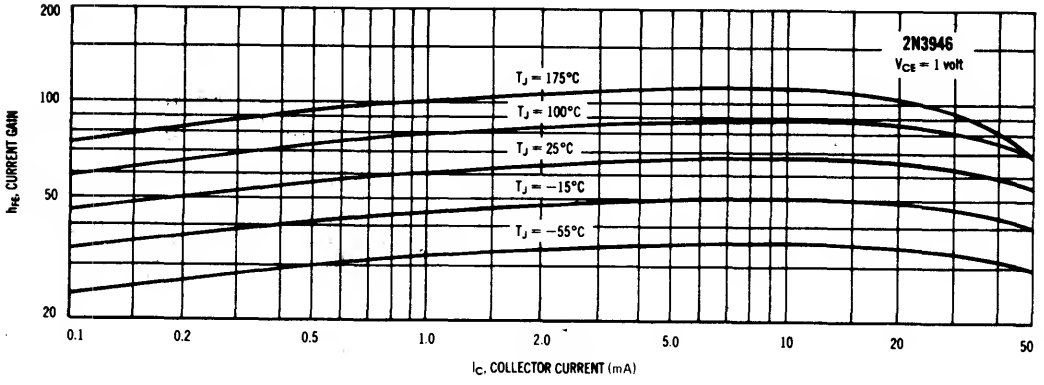
INPUT IMPEDANCE

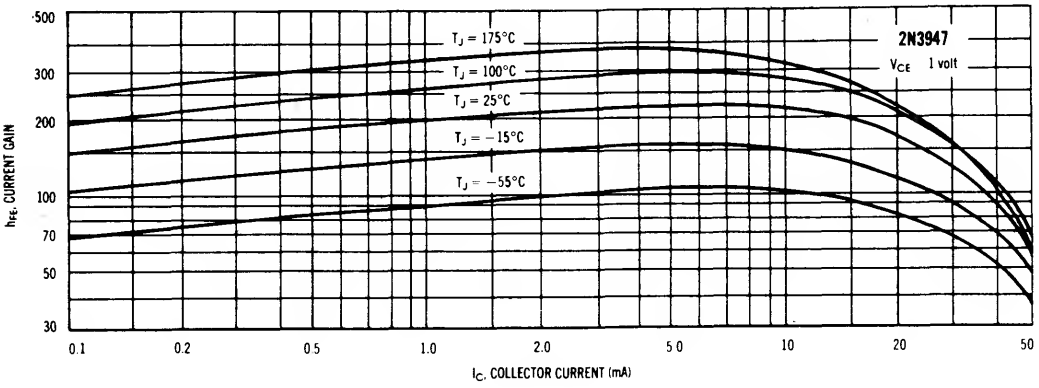


VOLTAGE FEEDBACK RATIO

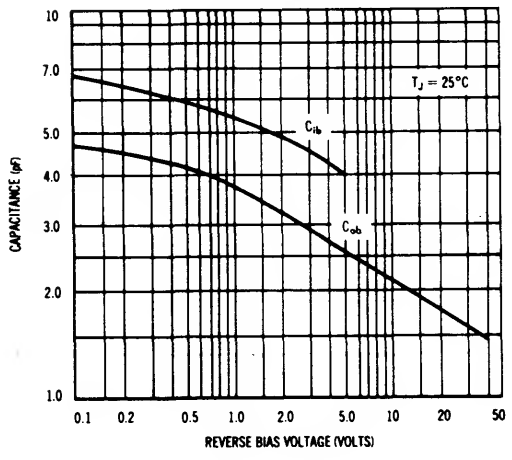


CURRENT GAIN CHARACTERISTICS

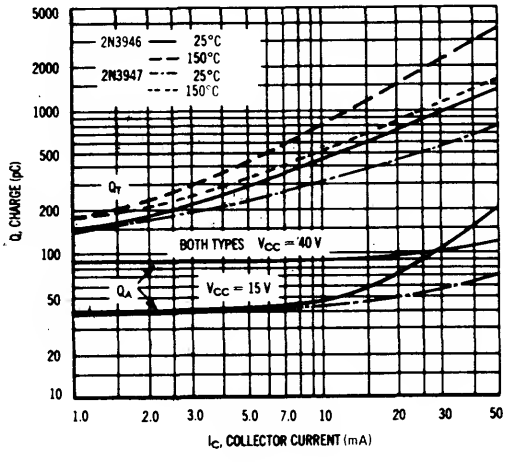




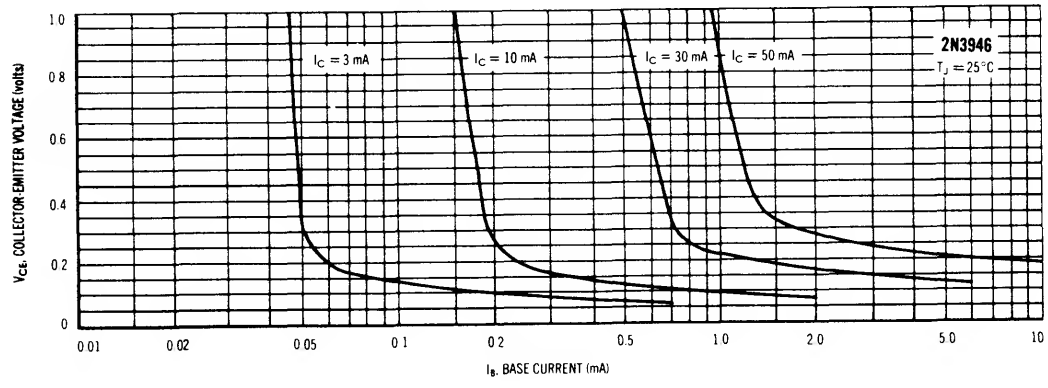
CAPACITANCE

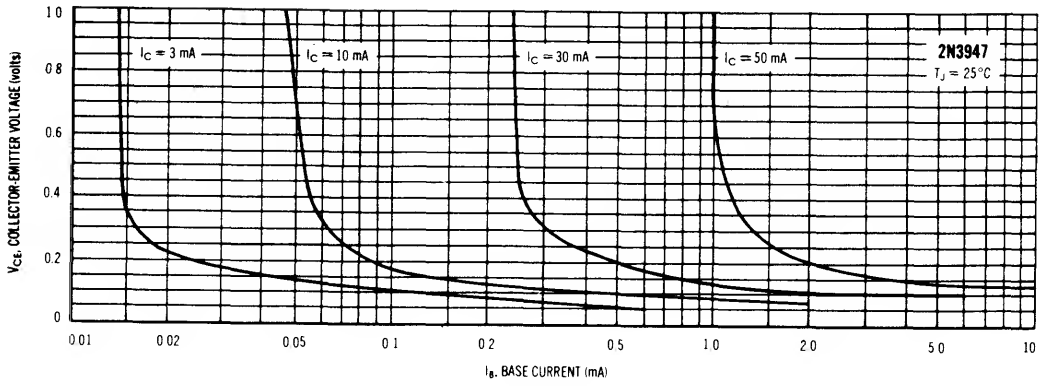


CHARGE DATA



COLLECTOR SATURATION REGION





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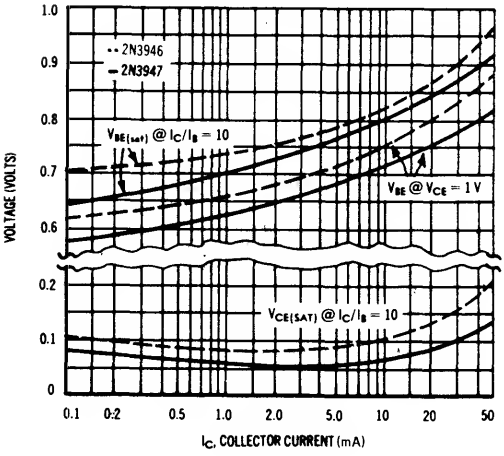
"ON" VOLTAGES



TEMPERATURE COEFFICIENTS