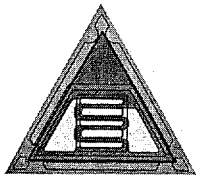
MOTOROLA
Semiconductors
BOX 955 • PHOENIX 1, ARIZONA

2N3905
2N3906

PNP SILICON ANNULAR* TRANSISTORS

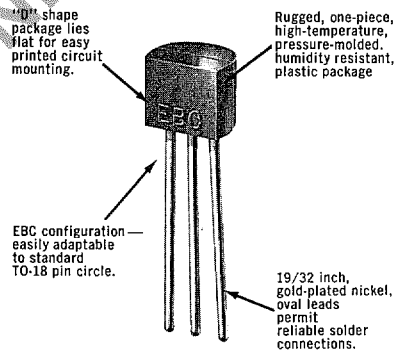


. . . designed for general purpose switching and amplifier applications and for complementary circuitry with types 2N3903 and 2N3904.

- One-Piece, Injection-Molded Unibloc† Package for High Reliability
- High Voltage Ratings — $BV_{CEO} = 40$ Volts minimum
- Current Gain Specified from 100 μA to 100 mA
- Complete Switching and Amplifier Specifications
- Low Capacitance — $C_{ob} = 4.5$ pF maximum

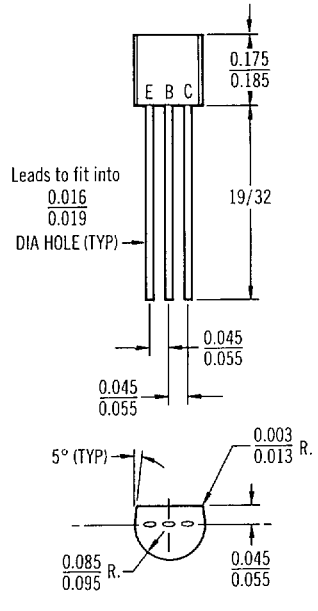
PNP SILICON SWITCHING & AMPLIFIER TRANSISTORS

AUGUST 1967 — DS 5128 R1
(Replaces DS 5128)



MAXIMUM RATINGS

Characteristic	Symbol	Rating	Unit
Collector-Base Voltage	V_{CB}	40	Vdc
Collector-Emitter Voltage	V_{CEO}	40	Vdc
Emitter-Base Voltage	V_{EB}	5	Vdc
Collector Current	I_C	200	mAdc
Total Device Dissipation @ $T_A = 60^oC$	P_D	210	mW
Total Device Dissipation @ $T_A = 25^oC$ Derate above 25^oC	P_D	310 2.81	mW $mW/^oC$
Thermal Resistance, Junction to Ambient	θ_{JA}	0.357	$^oC/mW$
Junction Operating Temperature	T_J	135	^oC
Storage Temperature Range	T_{stg}	-55 to +135	^oC



CASE 29 (1)
(TO-92)

*Annular semiconductors patented by Motorola Inc.
†Trademark of Motorola Inc.

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

Characteristic		Fig. No.	Symbol	Min	Max	Unit
OFF CHARACTERISTICS						
Collector-Base Breakdown Voltage (I_C = 10 μAdc, I_E = 0)			BV_{CBO}	40	-	Vdc
Collector-Emitter Breakdown Voltage* (I_C = 1.0 mAdc, I_B = 0)			BV_{CEO}*	40	-	Vdc
Emitter-Base Breakdown Voltage (I_E = 10 μAdc, I_C = 0)			BV_{EBO}	5.0	-	Vdc
Collector Cutoff Current (V_{CE} = 30 Vdc, $V_{BE(off)}$ = 3.0 Vdc)			I_{CEX}	-	50	nAdc
Base Cutoff Current (V_{CE} = 30 Vdc, $V_{BE(off)}$ = 3.0 Vdc)			I_{BL}	-	50	nAdc
ON CHARACTERISTICS						
DC Current Gain*			h_{FE}*			-
(I_C = 0.1 mAdc, V_{CE} = 1.0 Vdc)	2N3905	15		30	-	
	2N3906			60	-	
(I_C = 1.0 mAdc, V_{CE} = 1.0 Vdc)	2N3905			40	-	
	2N3906			80	-	
(I_C = 10 mAdc, V_{CE} = 1.0 Vdc)	2N3905			50	150	
	2N3906			100	300	
(I_C = 50 mAdc, V_{CE} = 1.0 Vdc)	2N3905			30	-	
	2N3906			60	-	
(I_C = 100 mAdc, V_{CE} = 1.0 Vdc)	2N3905			15	-	
	2N3906			30	-	
Collector-Emitter Saturation Voltage*		16, 17	$V_{CE(sat)}$*			Vdc
(I_C = 10 mAdc, I_B = 1.0 mAdc)				-	0.25	
(I_C = 50 mAdc, I_B = 5.0 mAdc)				-	0.4	
Base-Emitter Saturation Voltage*		17	$V_{BE(sat)}$*			Vdc
(I_C = 10 mAdc, I_B = 1.0 mAdc)				0.65	0.85	
(I_C = 50 mAdc, I_B = 5.0 mAdc)				-	0.95	
SMALL-SIGNAL CHARACTERISTICS						
Current-Gain—Bandwidth Product (I_C = 10 mAdc, V_{CE} = 20 Vdc, f = 100 MHz)	2N3905		f_T	200	-	MHz
	2N3906			250	-	
Output Capacitance (V_{CB} = 5.0 Vdc, I_E = 0, f = 100 kHz)		3	C_{ob}	-	4.5	pF
Input Capacitance (V_{BE} = 0.5 Vdc, I_C = 0, f = 100 kHz)		3	C_{ib}	-	10	pF
Input Impedance (I_C = 1.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	2N3905	13	h_{ie}	0.5	8.0	k ohms
	2N3906			2.0	12	
Voltage Feedback Ratio (I_C = 1.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	2N3905	14	h_{re}	0.1	5.0	X 10^{-4}
	2N3906			1.0	10	
Small-Signal Current Gain (I_C = 1.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	2N3905	11	h_{fe}	50	200	-
	2N3906			100	400	
Output Admittance (I_C = 1.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	2N3905	12	h_{oe}	1.0	40	μmhos
	2N3906			3.0	60	
Noise Figure (I_C = 100 μAdc, V_{CE} = 5.0 Vdc, R_S = 1.0 k ohm, f = 10 Hz to 15.7 kHz)	2N3905	9, 10	NF	-	5.0	dB
	2N3906			-	4.0	
SWITCHING CHARACTERISTICS						
Delay Time	(V_{CC} = 3.0 Vdc, $V_{BE(off)}$ = 0.5 Vdc, I_C = 10 mAdc, I_{B1} = 1.0 mAdc)	1, 5	t_d	-	35	ns
Rise Time		1, 5, 6	t_r	-	35	ns
Storage Time	(V_{CC} = 3.0 Vdc, I_C = 10 mAdc, I_{B1} = I_{B2} = 1.0 mAdc) 2N3905	2, 7	t_s	-	200	ns
	2N3906			-	225	
Fall Time	2N3905	2, 8	t_f	-	60	ns
	2N3906			-	75	

* Pulse Test: Pulse Width = 300 μs, Duty Cycle = 2.0%.

FIGURE 1 — DELAY AND RISE TIME EQUIVALENT TEST CIRCUIT

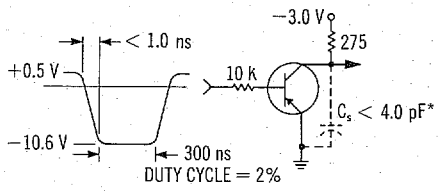
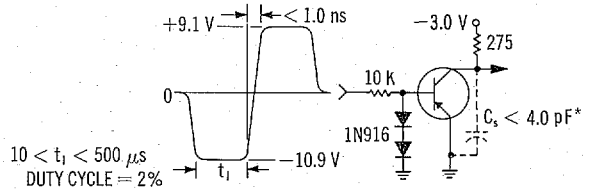


FIGURE 2 — STORAGE AND FALL TIME EQUIVALENT TEST CIRCUIT



*Total shunt capacitance of test jig and connectors

TRANSIENT CHARACTERISTICS

— $T_J = 25°C$ — $T_J = 125°C$

FIGURE 3 — CAPACITANCE

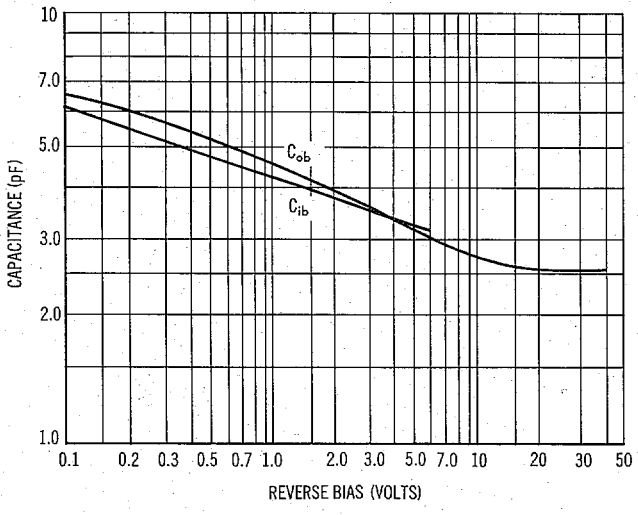


FIGURE 4 — CHARGE DATA

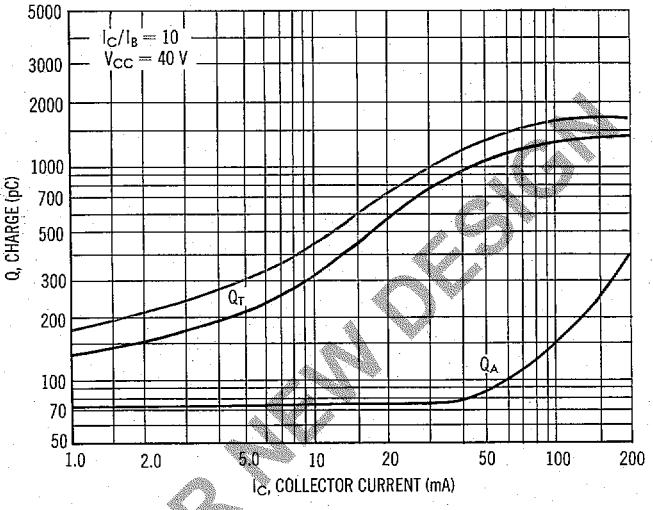


FIGURE 5 — TURN-ON TIME

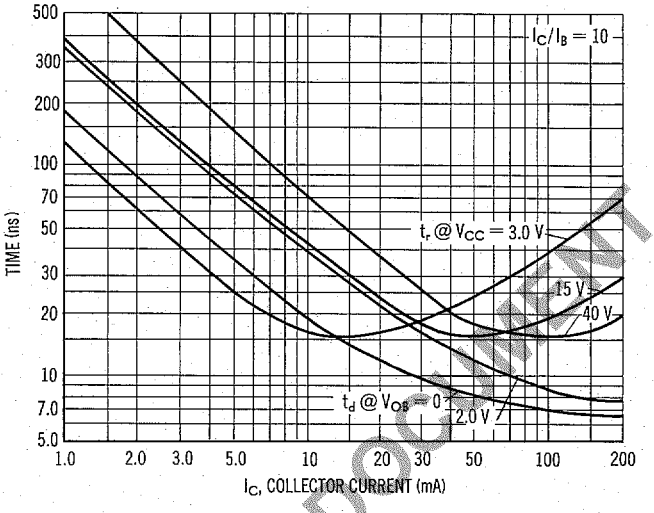


FIGURE 6 — RISE TIME

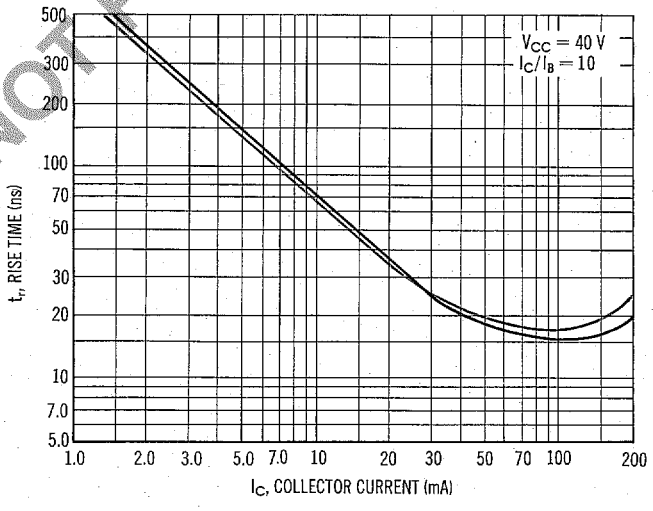


FIGURE 7 — STORAGE TIME

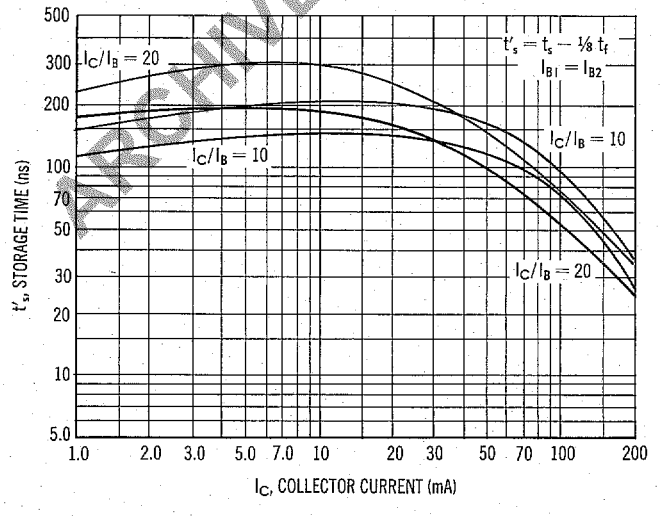
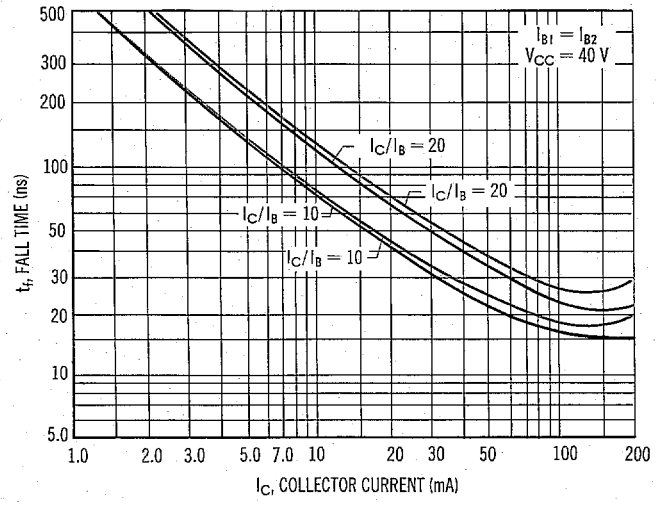


FIGURE 8 — FALL TIME



AUDIO SMALL SIGNAL CHARACTERISTICS

NOISE FIGURE VARIATIONS
$V_{CE} = 5.0$ Vdc, $T_A = 25°C$

FIGURE 9

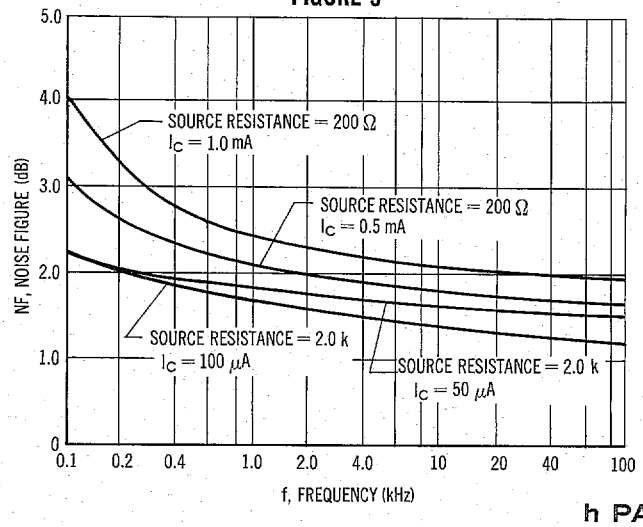
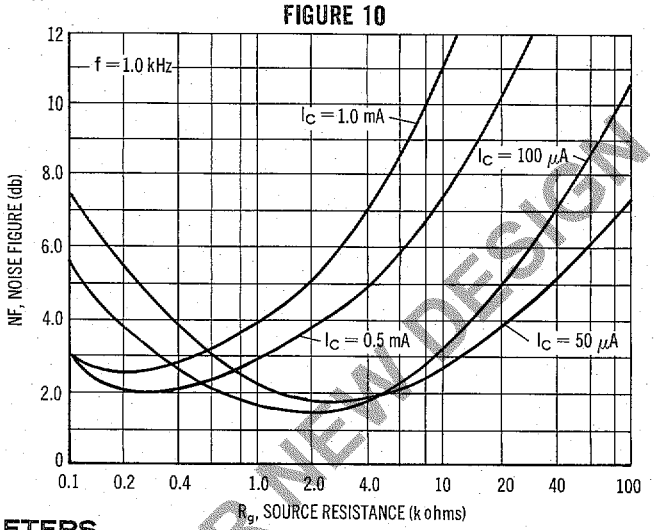


FIGURE 10



h PARAMETERS
(V_{CE} = 10 Vdc, f = 1.0 kHz, T_A = 25°C)

FIGURE 11 — CURRENT GAIN

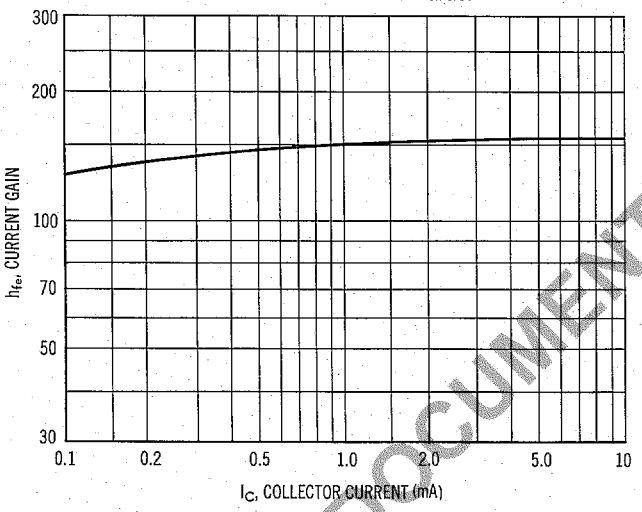


FIGURE 12 — OUTPUT ADMITTANCE

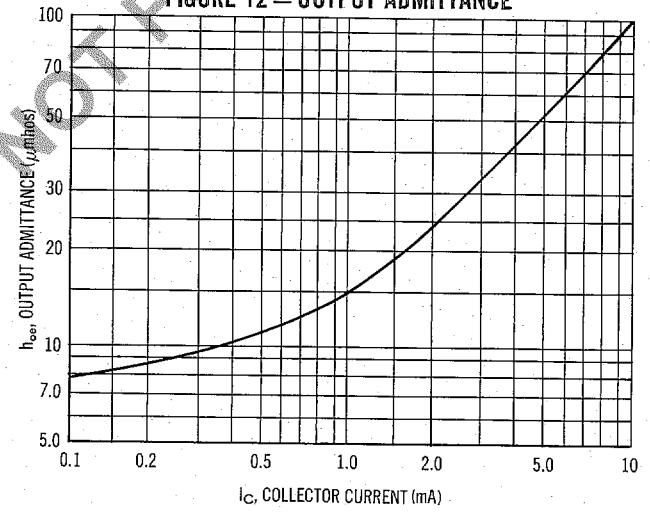


FIGURE 13 — INPUT IMPEDANCE

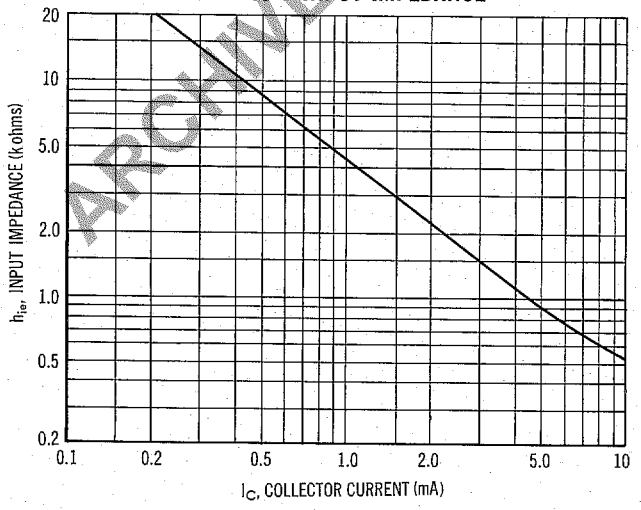
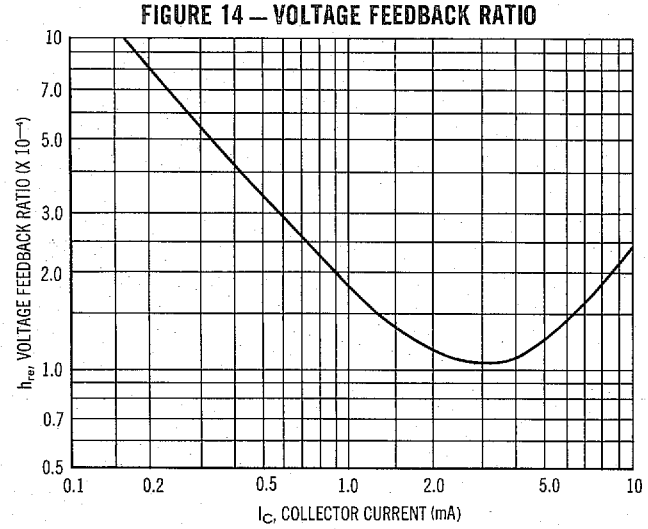


FIGURE 14 — VOLTAGE FEEDBACK RATIO



STATIC CHARACTERISTICS

FIGURE 15 — NORMALIZED CURRENT GAIN

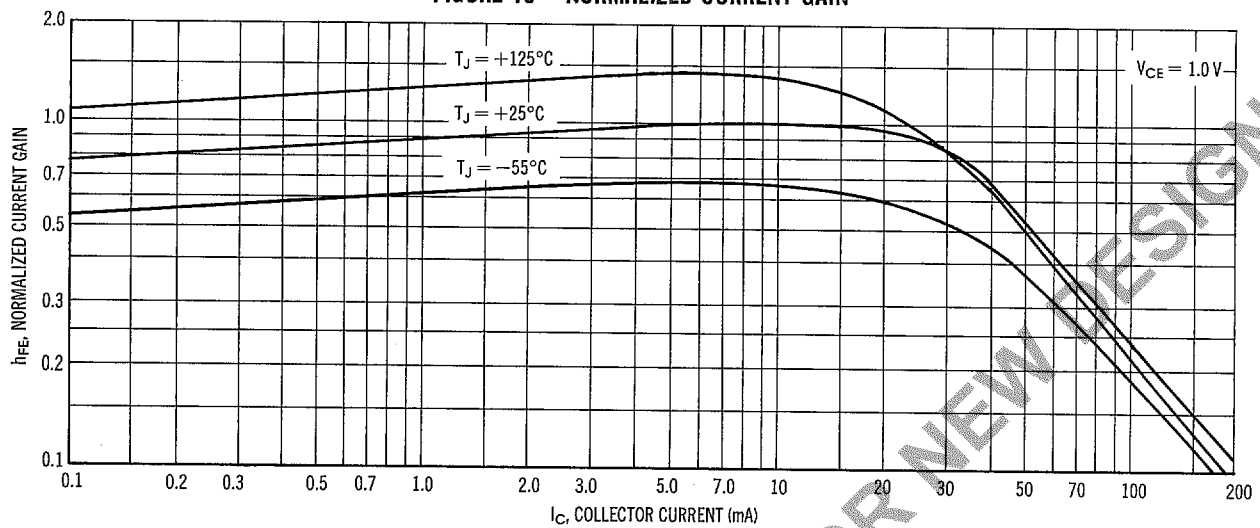


FIGURE 16 — COLLECTOR SATURATION REGION

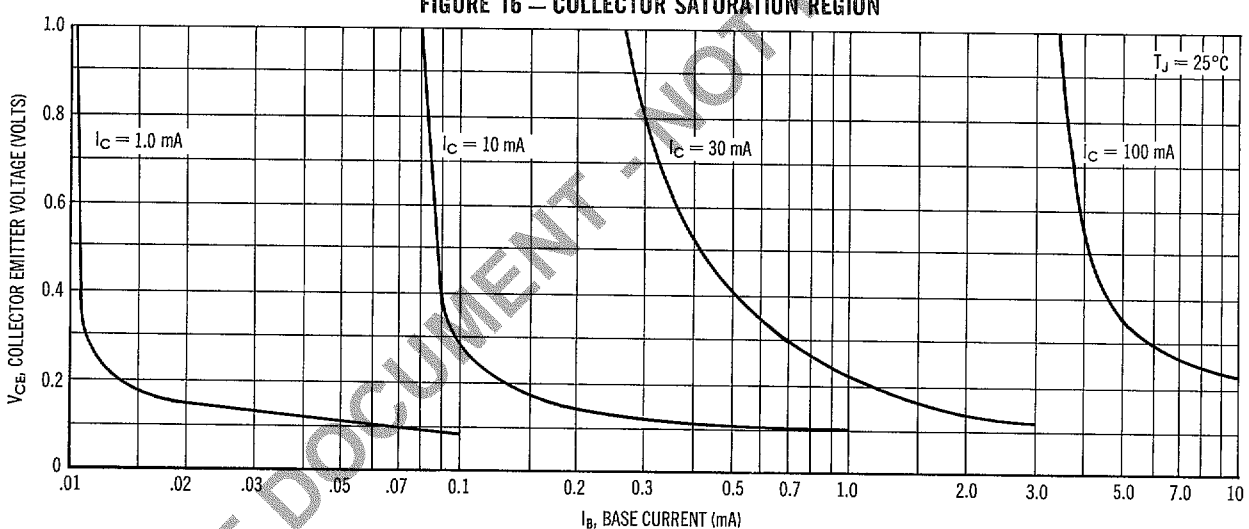


FIGURE 17 — "ON" VOLTAGES

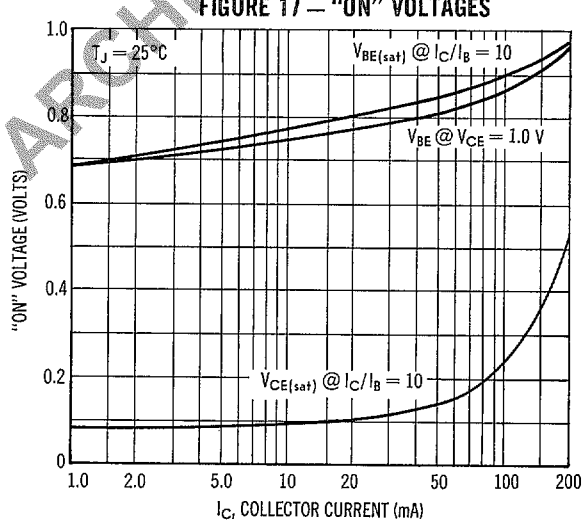
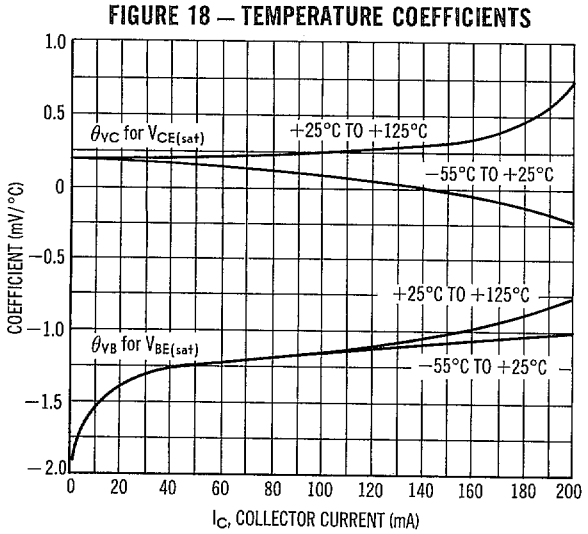


FIGURE 18 — TEMPERATURE COEFFICIENTS



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