

CA3118, CA3146, CA3183 Types High-Voltage Transistor Arrays

RCA-CA3118AT, CA3118T, CA3146AE, CA3146E, CA3183AE, and CA3183E are general-purpose high-voltage silicon n-p-n transistor arrays on a common monolithic substrate.

Types CA3118AT and CA3118T consist of four transistors with two of the transistors connected in a Darlington configuration. These types are well suited for a wide variety of applications in low-power systems in the DC through VHF range. Both types are supplied in a hermetically sealed 12-lead TO-5 type package and operate over the full military temperature range. (CA3118AT and CA3118T are high-voltage versions of the popular predecessor type CA3018.

Types CA3146AE and CA3146E consist of five transistors with two of the transistors connected to form a differentially-connected pair. These types are recommended for low-power applications in the DC through VHF range.

Types CA3183AE and CA3183E consist of five high-current transistors with independent connections for each transistor. In addition two of these transistors (Q1 and Q2) are matched at low-current (i.e. 1mA) for applications where offset parameters are of special importance. A special substrate terminal is also included for greater flexibility in circuit design.

The types with an "A" suffix are premium versions of their non-"A" counterparts and feature tighter control of breakdown voltages making them more suitable for higher voltage applications.

For detailed application information, see companion Application Note, ICAN-5296 "Application of the RCA CA3018 Integrated Circuit Transistor Array."

TYPE	P _T [•]	I _C	V _{CEO}	V _{CBO}	V _{CE sat.} at 10 mA	h _{FE} at 1 mA, & V _{CE} =5V	V _{IO}	I _{IO}	T _A Range (Operating) °C
	max. mW	max. mA	max. V	max. V	typ. V	typ.	Diff. Pair at 1 mA	max.	
							mV	μA	
VALUES APPLY FOR EACH TRANSISTOR									
CA3118AT	300	50	40	50	0.33	95	±5	2	-55 - +125
CA3118T	300	50	30	40	0.33	95	±5	2	
CA3146AE	300	50	40	50	0.33	95	±5	2	
CA3146E	300	50	30	40	0.33	95	±5	2	
CA3183AE	500	75	40	50	0.16	75	±5	2.5	
CA3183E	500	75	30	40	0.16	75	±5	2.5	

• Caution on Total Package Power Dissipation: The maximum total package dissipation rating for the CA3118 Series circuits is 450 mW at temperatures up to +85°C, then derate linearly at 5 mW/°C. The maximum total package dissipation rating for the CA3146 and CA3183 Series circuits is 750 mW at temperatures up to +55°C, then derate linearly at 6.67 mW/°C.

MAXIMUM RATINGS, Absolute-Maximum Values at T_A = 25°C

Power Dissipation:

Any one transistor —

CA3118AT, CA3118T, CA3146AE, CA3146E	300	mW
CA3183AE, CA3183E	500	mW

Total package —

Up to 85°C (CA3118AT, CA3118T)	450	mW
Up to 55°C (CA3146AE, CA3146E, CA3183AE, CA3183E)	750	mW
Above 85°C (CA3118AT, CA3118T)	derate linearly 5	mW/°C
Above 55°C (CA3146AE, CA3146E, CA3183AE, CA3183E)	derate linearly 6.67	mW/°C

Ambient Temperature Range:

Operating —	-55 to +125	°C
Storage (all types)	-65 to +150	°C

Lead Temperature (During Soldering):

At distance 1/16 ± 1/32 inch (1.59 ± 0.79mm) from case for 10 seconds max.	+265	°C
---	------	----

The following ratings apply for each transistor in the device:

Collector-to-Emitter Voltage (V _{CEO}):		
CA3118AT, CA3146AE, CA3183AE	40	V
CA3118T, CA3146E, CA3183E	30	V
Collector-to-Base Voltage (V _{CBO}):		
CA3118AT, CA3146AE, CA3183AE	50	V
CA3118T, CA3146E, CA3183E	40	V
Collector-to-Substrate Voltage (V _{CIO}): [■]		
CA3118AT, CA3146AE, CA3183AE	50	V
CA3118T, CA3146E, CA3183E	40	V
Emitter-to-Base Voltage (V _{EBO}) all types	5	V
Collector Current —		
CA3118AT, CA3118T, CA3146AE, CA3146E	50	mA
CA3183AE, CA3183E	75	mA
Base Current (I _B) — CA3183AE, CA3183E	20	mA

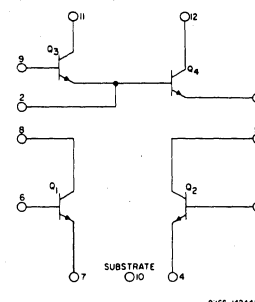
■ The collector of each transistor is isolated from the substrate by an integral diode. The substrate must be connected to a voltage which is more negative than any collector voltage. In order to maintain isolation between transistors and provide normal transistor action. To avoid undesired coupling between transistors, the substrate terminal should be maintained at either DC or signal (AC) ground. A suitable bypass capacitor can be used to establish a signal ground.

Features

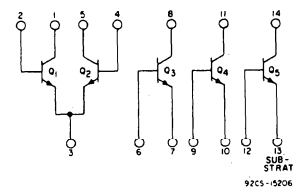
- Matched general-purpose transistors
- V_{BE} matched ±5mV max.
- Operation from DC to 120 MHz (CA3118AT, T; CA3146AE, E)
- Low-noise figure: 3.2dB typ. at 1kHz (CA3118AT, T; CA3146AE, E)
- High I_C: 75mA max. (CA3183AE, E)

Applications

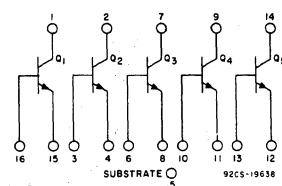
- General use in signal processing systems in DC through VHF range
- Custom designed differential amplifiers
- Temperature compensated amplifiers
- Lamp and relay drivers (CA3183AE, E)
- Thyristor firing (CA3183AE, E)



CA3118AT, CA3118T



CA3146AE, CA3146E



CA3183AE, CA3183E

Fig. 1 — Schematic diagrams of high-voltage arrays.

The CA3146AE and CA3146E are supplied in the 14-lead dual-in-line plastic package; the CA3183AE and CA3183E are supplied in the 16-lead dual-in-line plastic package.

CA3118, CA3146, CA3183 Types

COMPARISON OF RELATED PREDECESSOR TYPE WITH TYPES IN THIS DATA BULLETIN

	DATA FILE NO.	V _{CEO} min.	V _{CBO} min.	V _{CE sat.} typ. V I _C =10 mA	V _{BE} typ. V I _C =1 mA	I _C max. mA	C _{CB} typ. pF	C _{CI} typ. pF	C _{EB} typ. pF
CA3018	338	15	20	0.23	0.715	50	0.58	2.8	0.6
CA3018A	338	15	20	0.23	0.715	50	0.58	2.8	0.6
CA3118AT		40	50	0.33	0.730	50	0.37	2.2	0.7
CA3118T		30	40	0.33	0.730	50	0.37	2.2	0.7
CA3046	341	15	20	0.23	0.715	50	0.58	2.8	0.6
CA3146AE		40	50	0.33	0.730	50	0.37	2.2	0.7
CA3146E		30	40	0.33	0.730	50	0.37	2.2	0.7
CA3083	481	15	20	0.4	0.74	100	—	—	—
CA3183AE		40	50	1.7	0.75	75	—	—	—
CA3183E		30	40	1.7	0.75	75	—	—	—

TYPICAL STATIC CHARACTERISTICS CURVES—CA3118 and CA3146 SERIES (cont'd Fig.2 to 12)

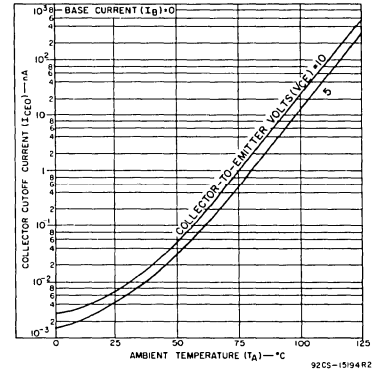


Fig. 2 — I_{CEO} vs. T_A for any transistor.

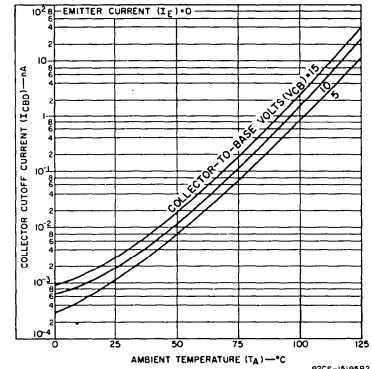


Fig. 3 — I_{CBO} vs. T_A for any transistor.

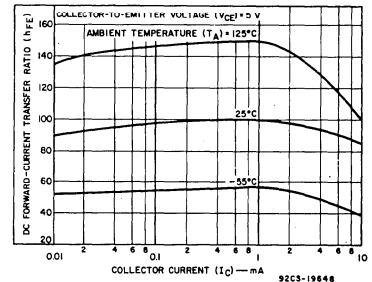


Fig. 4 — h_{FE} vs. I_C for any transistor.

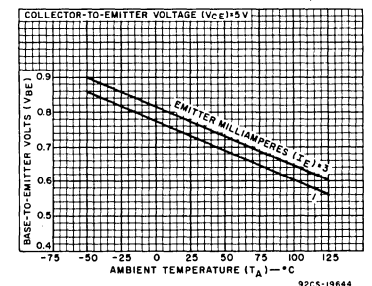


Fig. 5 — V_{BE} vs. T_A for any transistor.

STATIC ELECTRICAL CHARACTERISTICS — CA3118 and CA3146 Series

CHARACTERISTICS	SYMBOL	TEST CONDITIONS		LIMITS						UNITS
		T _A = 25°C	CA3118AT, CA3146AE			CA3118T, CA3146E				
			Min.	Typ.	Max.	Min.	Typ.	Max.		
For Each Transistor:										
Collector-to-Base Breakdown Voltage	V _{(BR)CBO}	I _C = 10 μA, I _E = 0	50	72	—	40	72	—	V	
Collector-to-Emitter Breakdown Voltage	V _{(BR)CEO}	I _C = 1 mA, I _B = 0	40	56	—	30	56	—	V	
Collector-to-Substrate Breakdown Voltage	V _{(BR)CIS}	I _{C1} = 10 μA, I _B = 0, I _E = 0	50	72	—	40	72	—	V	
Emitter-to-Base Breakdown Voltage	V _{(BR)EBO}	I _E = 10 μA, I _C = 0	5	7	—	5	7	—	V	
Collector-Cutoff Current	I _{CEO}	V _{CE} = 10V, I _B = 0	—	see curve	5	—	see curve	5	μA	
Collector-Cutoff Current	I _{CBO}	V _{CB} = 10V, I _E = 0	—	0.002	100	—	0.002	100	nA	
DC Forward-Current Transfer Ratio	h _{FE}	V _{CE} = 5V, I _C = 10 mA	—	85	—	—	85	—	—	
		V _{CE} = 5V, I _C = 1 mA	30	100	—	30	100	—	—	
		V _{CE} = 5V, I _C = 10 μA	—	90	—	—	90	—	—	
Base-to-Emitter Voltage	V _{BE}	V _{CE} = 3V, I _C = 1 mA	0.63	0.73	0.83	0.63	0.73	0.83	V	
Collector-to-Emitter Saturation Voltage	V _{CEsat}	I _C = 10 mA, I _B = 1 mA	—	0.33	—	—	0.33	—	V	
For transistors Q3 and Q4 (Darlington Configuration):										
Collector-Cutoff Current	CA3118AT and CA3118T only	I _{CEO}	V _{CE} = 10V, I _B = 0	—	—	5	—	—	μA	
DC Forward-Current Transfer Ratio	CA3118AT and CA3118T only	h _{FE}	V _{CE} = 5V, I _C = 1 mA	1500	9000	—	1500	9000	—	
Base-to-Emitter (Q3 to Q4)	V _{BE}	V _{CE} = 5V, I _E = 10 mA	—	1.46	—	—	1.46	—	V	
		V _{CE} = 5V, I _E = 1 mA	—	1.32	—	—	1.32	—	V	
Magnitude of Base-to-Emitter Temperature Coefficient	$\frac{\Delta V_{BE}}{\Delta T}$	V _{CE} = 5V, I _E = 1 mA	—	4.4	—	—	4.4	—	mV/°C	
For transistors Q1 and Q2 (AS a Differential Amplifier):										
Magnitude of Input Offset Voltage	V _{IO}	V _{CE} = 5V, I _E = 1 mA	—	0.48	5	—	0.48	5	mV	
Magnitude of h _{FE} Ratio	CA3118AT and CA3118T only	V _{CE} = 5V, I _{C1} = I _{C2} = 1 mA	0.9	1.0	1.1	0.9	1.0	1.1	—	
Magnitude of Base-to-Emitter Temperature Coefficient	$\frac{\Delta V_{BE}}{\Delta T}$	V _{CE} = 5V, I _E = 1 mA	—	1.9	—	—	1.9	—	mV/°C	
Magnitude of V _{IO} (V _{BE1} - V _{BE2}) Temperature Coefficient	$\frac{\Delta V_{IO}}{\Delta T}$	V _{CE} = 5V, I _{C1} = I _{C2} = 1 mA	—	1.1	—	—	1.1	—	μV/°C	
Magnitude of Input Offset Current	CA3146AE and CA3146E only	I _{IO}	V _{CE} = 5V, I _{C1} = I _{C2} = 1 mA	—	0.3	2	—	0.3	2	μA

CA3118, CA3146, CA3183 Types

DYNAMIC ELECTRICAL CHARACTERISTICS — CA3118 and CA3146 Series

CHARACTERISTICS	SYM-BOL	TEST CONDITIONS $T_A = 25^\circ\text{C}$	CA3118AT CA3146AE			CA3118T CA3146E			UNITS
			Min.	Typ.	Max.	Min.	Typ.	Max.	
Low Frequency Noise Figure	NF	$f = 1\text{kHz}$, $V_{CE} = 5\text{V}$, $I_C = 100\mu\text{A}$, Source resistance = $1\text{ k}\Omega$	—	3.25	—	—	3.25	—	dB
Low-Frequency, Small-Signal Equivalent-Circuit Characteristics:									
Forward-Current Transfer Ratio	h_{fe}	$f = 1\text{kHz}$, $V_{CE} = 5\text{V}$, $I_C = 1\text{mA}$	—	100	—	—	100	—	—
Short-Circuit Input Impedance	h_{ie}		—	2.7	—	—	3.5	—	$\text{k}\Omega$
Open-Circuit Output Impedance	h_{oe}		—	15.6	—	—	15.6	—	μmho
Open-Circuit Reverse Voltage Transfer Ratio	h_{re}		—	1.8×10^{-4}	—	—	1.8×10^{-4}	—	—
Admittance Characteristics:									
Forward Transfer Admittance	Y_{fe}	$f = 1\text{MHz}$, $V_{CE} = 5\text{V}$, $I_C = 1\text{mA}$	—	$31-j1.5$	—	—	$31-j1.5$	—	mmho
Input Admittance	Y_{ie}		—	$0.35+j0.04$	—	—	$0.3+j0.04$	—	mmho
Output Admittance	Y_{oe}		—	$0.001+j0.03$	—	—	$0.001+j0.03$	—	mmho
Reverse Transfer Admittance	Y_{re}		—	See curve	—	—	See curve	—	mmho
Gain-Bandwidth Product	f_T	$V_{CE} = 5\text{V}$, $I_C = 3\text{mA}$	300	500	—	300	500	—	MHz
Emitter-to-Base Capacitance	C_{EB}	$V_{EB} = 5\text{V}$, $I_E = 0$	—	0.70	—	—	0.70	—	pF
Collector-to-Base Capacitance	C_{CB}	$V_{CB} = 5\text{V}$, $I_C = 0$	—	0.37	—	—	0.37	—	pF
Collector-to-Substrate Capacitance	C_{CI}	$V_{CI} = 5\text{V}$, $I_C = 0$	—	2.2	—	—	2.2	—	pF

STATIC ELECTRICAL CHARACTERISTICS — CA3183 Series

CHARACTERISTICS	SYMBOL	TEST CONDITIONS	LIMITS						UNITS
		$T_A = 25^{\circ}\text{C}$	CA3183AE			CA3183E			
			Min.	Typ.	Max.	Min.	Typ.	Max.	
For Each Transistor:									
Collector-to-Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C = 100\mu\text{A}$, $I_E = 0$	50	—	—	40	—	—	V
Collector-to-Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C = 1\text{mA}$, $I_B = 0$	40	—	—	30	—	—	V
Collector-to-Substrate Breakdown Voltage	$V_{(BR)CIO}$	$I_{C1} = 100\mu\text{A}$, $I_B = 0$, $I_E = 0$	50	—	—	40	—	—	V
Emitter-to-Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E = 500\mu\text{A}$, $I_C = 0$	5	—	—	5	—	—	V
Collector-Cutoff Current	I_{CEO}	$V_{CE} = 10\text{V}$, $I_B = 0$	—	—	10	—	—	10	μA
Collector-Cutoff Current	I_{CBO}	$V_{CB} = 10\text{V}$, $I_E = 0$	—	—	1	—	—	1	μA
DC Forward-Current Transfer Ratio	h_{FE}	$V_{CE} = 3\text{V}$, $I_C = 10\text{mA}$ $V_{CE} = 5\text{V}$, $I_C = 50\text{mA}$	40	—	—	40	—	—	—
Base-to-Emitter Voltage	V_{BE}	$V_{CE} = 3\text{V}$, $I_C = 10\text{mA}$	0.65	0.75	0.85	0.65	0.75	0.85	V
Collector-to-Emitter Saturation Voltage	V_{CEsat}	$I_C = 50\text{mA}$, $I_B = 5\text{mA}$	—	1.7	3.0	—	1.7	3.0	V
For Transistors Q1 and Q2 (As a Differential Amplifier):									
Absolute Input Offset Voltage	$ V_{IO} $	$V_{CE} = 3\text{V}$, $I_C = 1\text{mA}$	—	0.47	5	—	0.47	5	mV
Absolute Input Offset Current	$ I_{IO} $		—	0.78	2.5	—	0.78	2.5	μA

* A maximum dissipation of 5 transistors $\times$ $150\text{mW} = 750\text{mW}$ is possible for a particular application.

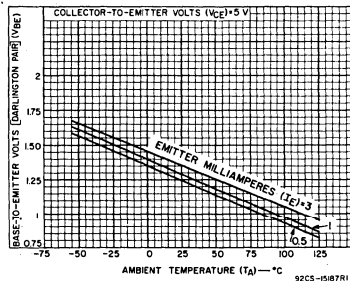


Fig. 9 — V_{BE} vs. T_A for Darlington pair (Q3 and Q4).

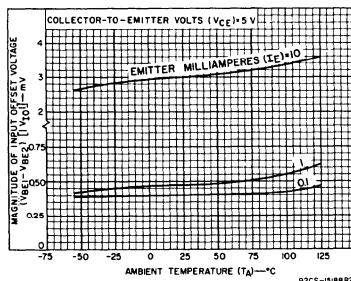


Fig. 10 — V_{IO} vs. T_A for Q1 and Q2.

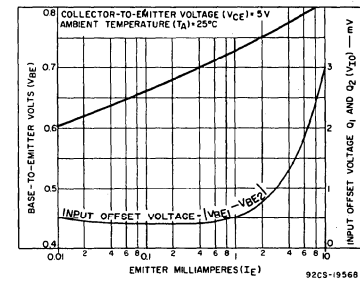


Fig. 11 — V_{BE} and V_{IO} vs. I_E for Q1 and Q2.

TYPICAL STATIC CHARACTERISTICS CURVES—
CA3118 and CA3146 SERIES (cont'd Fig.2 to 12)

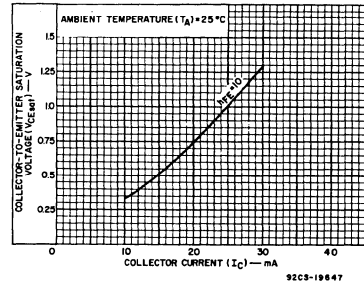


Fig. 6 — V_{CEsat} vs. I_C for any transistor.

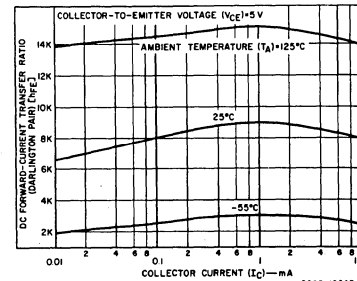


Fig. 7 — h_{FE} vs. I_C for Darlington pair (Q3 and Q4) for types CA3118AT and CA3118T.

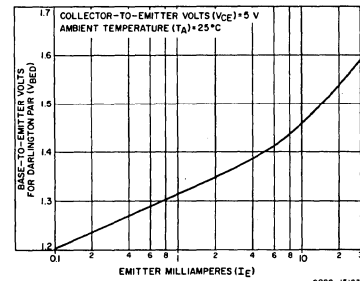


Fig. 8 — V_{BE} vs. I_E for Darlington pair (Q3 and Q4).

CA3118, CA3146, CA3183 Types

TYPICAL STATIC CHARACTERISTICS CURVES—
CA3118 and CA3146 SERIES (Fig. 2 to 12)

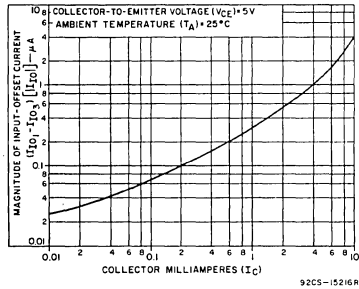


Fig. 12 — I_O vs. I_C (Q1 and Q2) for types CA3146AE and CA3146E.

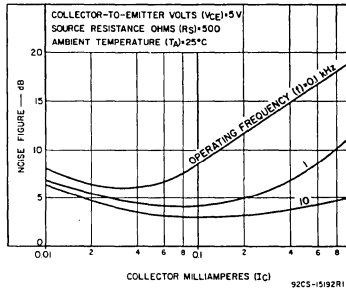


Fig. 13 — NF vs. I_C @ $R_S = 500\Omega$.

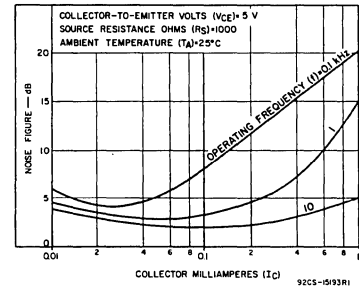


Fig. 14 — NF vs. I_C @ $R_S = 1k\Omega$.

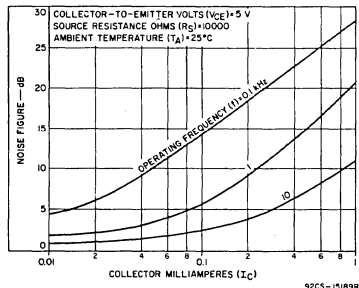


Fig. 15 — NF vs. I_C @ $R_S = 10k\Omega$.

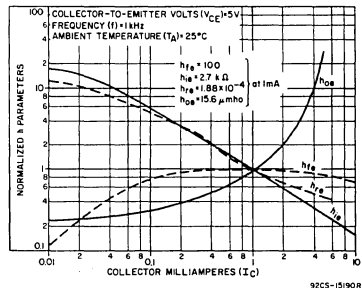


Fig. 16 — h_{fe} , h_{ie} , h_{oe} , h_{re} vs. I_C .

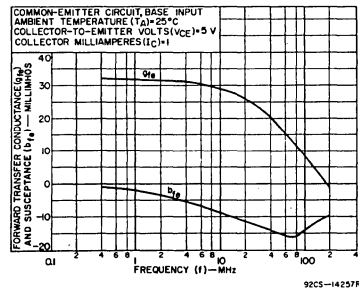


Fig. 17 — y_{fe} vs. f .

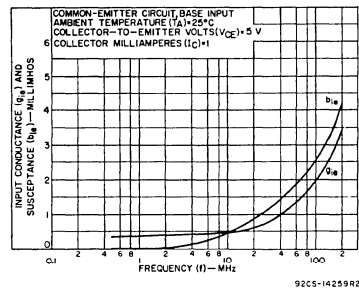


Fig. 18 — y_{ie} vs. f .

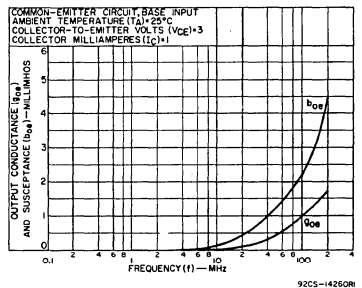


Fig. 19 — y_{oe} vs. f .

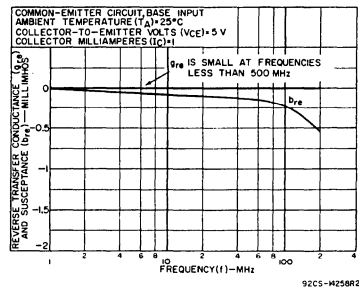


Fig. 20 — y_{re} vs. f .

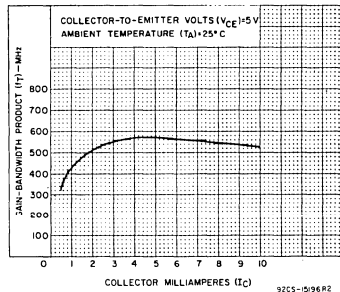


Fig. 21 — f_T vs. I_C .

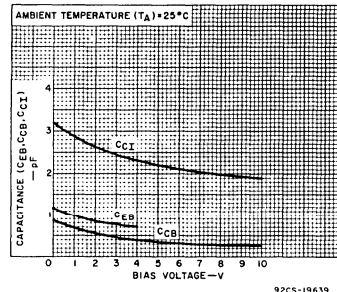


Fig. 22 — C_{EB} , C_{CB} , C_{CI} vs. bias voltage

CA3118, CA3146, CA3183 Types

TYPICAL STATIC CHARACTERISTICS CURVES—CA3183 SERIES (Fig. 23 to 30)

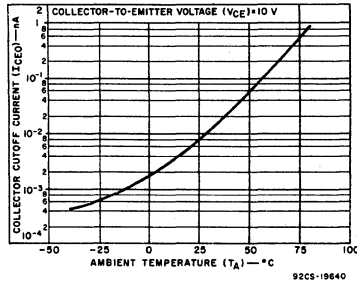


Fig. 23 — I_{CEO} vs. T_A for any transistor.

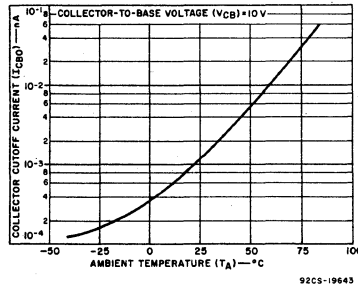


Fig. 24 — I_{CBO} vs. T_A for any transistor.

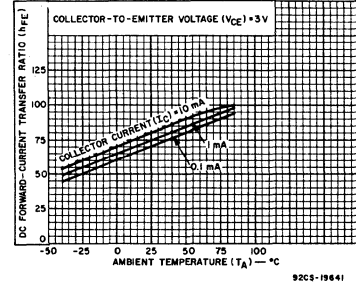


Fig. 25 — h_{FE} vs. T_A for any transistor.

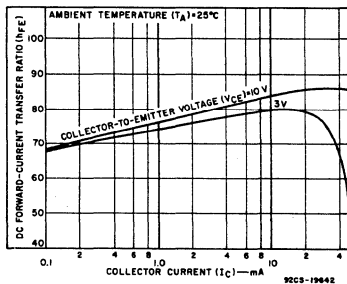


Fig. 26 — h_{FE} vs. I_C for any transistor.

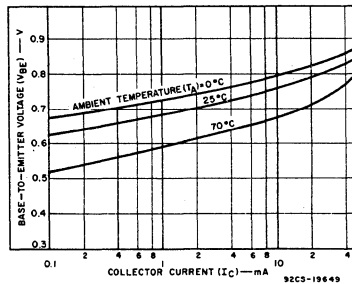


Fig. 27 — V_{BE} vs. I_C for any transistor.

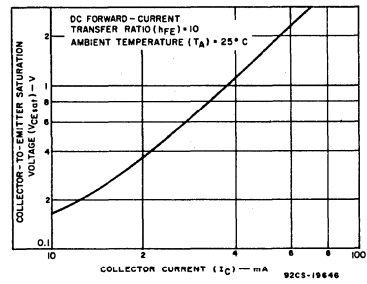


Fig. 28 — $V_{CE sat}$ vs. I_C for any transistor.

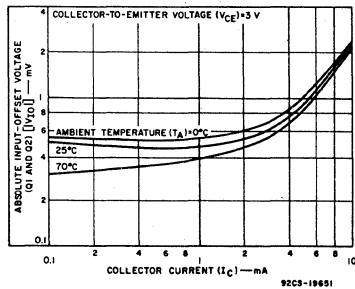


Fig. 29 — $|V_{IO}|$ vs. I_C for differential amplifier (Q1 and Q2).

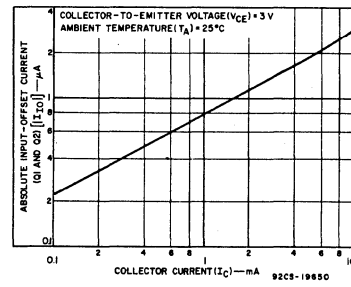


Fig. 30 — $|I_{IO}|$ vs. I_C for differential amplifier (Q1 and Q2).