CA3118, CA3146, CA3183

High-Voltage Transistor Arrays

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)**

RCA-CA3118AT, CA3118T, CA3146AE, CA3146E, CA-3183AE, 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 di ferentially-connected pair. These types are recommended for low-power applications in the DC through VHF range. Both types are supplied in a 14-lead dual-in-line plastic package and operate over the ambient temperature range of −40°C to +85°C. (CA3146AE and CA3146E are high-voltage versions of the popular predecessor type CA3046.)

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. Both types are supplied in a 16-lead dual-in-line plastic package and operate over the ambient temperature range of −40°C to +85°C. (CA3183AE and CA3183E are high-voltage versions of the popular predecessor type CA3083.)

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."

*Formerly Developmental Types Nos.

CA3118AT	– TA6091	CA3146E	– TA6181
CA3118T	– TA6182	CA3183AE	– TA6094
CA3146AE	– TA6084	CA3183E	– TA6183

TYPE	P_T● max. mW	I_C max. mA	V_{CEO} max. V	V_{CBO} max. V	V_{CE} sat. at 10 mA typ. V	h_{FE} at 1 mA, & V_{CE}=5V typ.	V_{IO} Diff. Pair at 1 mA max. mV	I_{IO} Diff. Pair at 1 mA max. µA	T_A Range (Operating) °C
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	−55 – +125
CA3146AE	300	50	40	50	0.33	95	±5	2	−40 – +85
CA3146E	300	50	30	40	0.33	95	±5	2	−40 – +85
CA3183AE	500	75	40	50	0.16	75	±5	2.5	−40 – +85
CA3183E	500	75	30	40	0.16	75	±5	2.5	−40 – +85

●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.

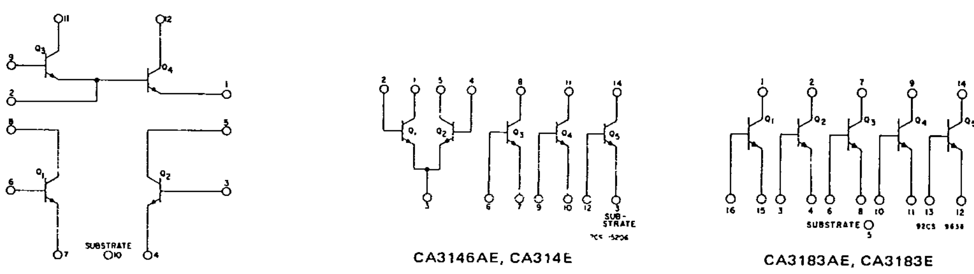
File Number **532**

CA3118, CA3146, CA3183

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 —		
CA3118AT, CA3118T	−55 to +125	°C
CA3146AE, CA3146E, CA3183AE, CA3183E	−40 to +85	°C
Storage (all types)	−65 to +150	°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.



CA3118AT, CA3118T   CA3146AE, CA314E   CA3183AE, CA3183E

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

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	V_{BE} typ. V	I_C max. mA	C_{CB} typ. pF	C_{CI} typ. pF	C_{EB} typ. pF
				I_C=10 mA	I_C=1 mA				
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
				I_C=10 mA	I_C=1 mA				
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
				I_C=50 mA	I_C=10 mA				
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	–	–	–

NOTE: Related predecessor types are shown in shaded areas.

CA3118, CA3146, CA3183

STATIC ELECTRICAL CHARACTERISTICS – CA3118 and CA3146 Series

CHARACTERISTICS	SYMBOL	TEST CONDITIONS $T_A = 25^oC$	Typ. Char. Curve Fig. No.	CA3118AT, CA3146AE Min.	CA3118AT, CA3146AE Typ.	CA3118AT, CA3146AE Max.	CA3118T, CA3146E Min.	CA3118T, CA3146E Typ.	CA3118T, CA3146E Max.	UNITS
For Each Transistor:										
Collector-to-Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C = 10\mu A, I_E = 0$	–	50	72	–	40	72	–	V
Collector-to-Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C = 1mA, I_B = 0$	–	40	56	–	30	56	–	V
Collector-to-Substrate Breakdown Voltage	$V_{(BR)CIO}$	$I_{CI} = 10\mu A, I_B = 0$, $I_E = 0$	–	50	72	–	40	72	–	V
Emitter-to-Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E = 10\mu A, I_C = 0$	–	5	7	–	5	7	–	V
Collector-Cutoff Current	I_{CEO}	$V_{CE} = 10V, I_B = 0$	2	–	see curve	5	–	see curve	5	µA
Collector-Cutoff Current	I_{CBO}	$V_{CB} = 10V, I_E = 0$	3	–	0.002	100	–	0.002	100	nA
DC Forward-Current Transfer Ratio	h_{FE}	$V_{CE}=5V$, $I_C=10mA$	4	–	85	–	–	85	–	–
		$V_{CE}=5V$, $I_C=1mA$	4	30	100	–	30	100	–	
		$V_{CE}=5V$, $I_C=10\mu A$	4	–	90	–	–	90	–	
Base-to-Emitter Voltage	V_{BE}	$V_{CE} = 3V, I_C = 1mA$	5	0.63	0.73	0.83	0.63	0.73	0.83	V
Collector-to-Emitter Saturation Voltage	V_{CEsat}	$I_C = 10mA, I_B = 1mA$	6	–	0.33	–	–	0.33	–	V
For transistors Q3 and Q4 (Darlington Configeration):										
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}	$V_{CE} = 5V, I_C = 1mA$	7	1500	9000	–	1500	9000	–	–
Base-to-Emitter (Q3 to Q4)	V_{BE}	$V_{CE}=5V$, $I_E = 10mA$	8	–	1.46	–	–	1.46	–	V
		$V_{CE}=5V$, $I_E = 1mA$	8,9	–	1.32	–	–	1.32	–	
Magnitude of Base-to-Emitter Temperature Coefficient	$\left\lvert\frac{\Delta V_{BE}}{\Delta T}\right\rvert$	$V_{CE} = 5V, I_E = 1mA$	–	–	4.4	–	–	4.4	–	mV/°C
For transistors Q1 and Q2 (AS a Differential Amplifier):										
Magnitude of Input Offset Voltage $\lvert V_{BE1} - V_{BE2}\rvert$	$\lvert V_{IO}\rvert$	$V_{CE} = 5V, I_E = 1mA$	10,11	–	0.48	5	–	0.48	5	mV
Magnitude of h_{FE} Ratio (CA3118AT and CA3118T only)		$V_{CE} = 5V$, $I_{C1} = I_{C2} = 1mA$	–	0.9	1.0	1.1	0.9	1.0	1.1	–
Magnitude of Base-to-Emitter Temperature Coefficient	$\left\lvert\frac{\Delta V_{BE}}{\Delta T}\right\rvert$	$V_{CE} = 5V$, $I_E = 1mA$	–	–	1 9	–	–	1.9	–	mV/°C
Magnitude of V_{IO} ($V_{BE1} - V_{BE2}$) Temperature Coefficient	$\left\lvert\frac{\Delta V_{IO}}{\Delta T}\right\rvert$	$V_{CE} = 5V$, $I_{C1} = I_{C2} = 1mA$	–	–	1.1	–	–	1.1	–	µV/°C
Magnitude of Input Offset Current $\lvert I_{IO1} - I_{IO2}\rvert$ (CA3146AE and CA3146E only)	I_{IO}	$V_{CE} = 5V$, $I_{C1} = I_{C2} = 1mA$	12	–	0.3	2	–	0.3	2	µA

CA3118, CA3146, CA3183

DYNAMIC ELECTRICAL CHARACTERISTICS – CA3118 and CA3146 Series

CHARACTERISTICS	SYM-BOL	TEST CONDITIONS $T_A = 25^oC$	Typ. Char. Curve Fig.No.	CA3118AT CA3146AE Min.	Typ.	Max.	CA3118T CA3146E Min.	Typ.	Max.	UNITS
Low Frequency Noise Figure	NF	f = 1kHz, V_{CE} = 5V, I_C = 100μA, Source resistance = 1 kΩ	14	–	3 25	–	–	3.25	–	dB
Low-Frequency, Small-Signal Equivalent-Circuit Characteristics:										
Foward-Current Transfer Ratio	h_{fe}	f = 1kHz, V_{CE} = 5V, I_C = 1mA	16	–	100	–	–	100	–	–
Short-Circuit Input Impedance	h_{ie}		16	–	2.7	–	–	3 5	–	kΩ
Open-Circuit Output Impedance	h_{oe}		16	–	15 6	–	–	15.6	–	μmho
Open-Circuit Reverse-Voltage Transfer Ratio	h_{re}		16	–	1.8x10^{-4}	–	–	1.8x10 ^{4}	–	–
Admittance Characteristics:										
Foward Transfer Admittance	Y_{fe}	f = 1MHz, V_{CE} = 5V, I_C = 1mA	17	–	31-j1.5	–	–	31 j1.5	–	mmho
Input Admittance	Y_{ie}		18	–	0.35+j0 04	–	–	0.3+j0.04	–	mmho
Output Admittance	Y_{oe}		19	–	0 001+j0.03	–	–	0.001+j0.03	–	mmho
Reverse Transfer Admittance	Y_{re}		20		See curve			See curve		mmho
Gain-Bandwidth Product	f_T	V_{CE} = 5V, I_C = 3mA	21	300	500	–	300	500	–	MHz
Emitter-to-Base Capacitance	C_{EB}	V_{EB} = 5V, I_E = 0	22	–	0 70	–	–	0.70	–	pF
Collector-to-Base Capacitance	C_{CB}	V_{CB} = 5V, I_C = 0	22	–	0.37	–	–	0.37	–	pF
Collector-to-Substrate Capacitance	C_{CI}	V_{CI} = 5V, I_C = 0	22	–	2 2	–	–	2 2	–	pF

STATIC ELECTRICAL CHARACTERISTICS – CA3183 Series

CHARACTERISTICS	SYMBOL	TEST CONDITIONS $T_A = 25^oC$	Typ. Char Curve Fig. No.	LIMITS CA3183AE Min.	Typ.	Max.	CA3183E Min.	Typ.	Max.	UNITS
For Each Transistor:										
Collector-to-Base Breakdown Voltage	$V_{(BR)CBO}$	I_C=100μA, I_E=0	–	50	–	–	40	–	–	V
Collector-to-Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C=1mA, I_B=0	–	40	–	–	30	–	–	V
Collector-to-Substrate Breakdown Voltage	$V_{(BR)CIO}$	I_{CI}=100μA, I_B=0, I_E = 0	–	50	–	–	40	–	–	V
Emitter-to-Base Breakdown Voltage	$V_{(BR)EBO}$	I_E = 500μA, I_C = 0	–	5	–	–	5	–	–	V
Collector-Cutoff Current	I_{CEO}	V_{CE} = 10V, I_B = 0	23	–	–	10	–	–	10	μA
Collector Cutoff Current	I_{CBO}	V_{CB} = 10V, I_E = 0	24	–	–	1	–	–	1	μA
DC Forward-Current Transfer Ratio	h_{FE}	V_{CE}= 3 V, I_C = 10mA	25,26	40	–	–	40	–	–	–
		V_{CE} = 5V, I_C = 50mA	–	40	–	–	40	–	–	
Base-to-Emitter Voltage	V_{BE}	V_{CE} = 3V, I_C = 10mA	27	0.65	0 75	0.85	0.65	0 75	0 85	V
Collector-to-Emitter Saturation Voltage	•V_{CEsat}	I_C = 50mA, I_B = 5mA	28	–	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} = 3V, I_C = 1mA	29	–	0.47	5	–	0 47	5	mV
Absolute Input Offset Current	$\|I_{IO}\|$		30	–	0.78	2.5	–	0.78	2.5	μA

• A maximum dissipation of 5 transistors x 150mW = 750mW is possible for a particular application.

CA3118, CA3146, CA3183

TYPICAL STATIC CHARACTERISTICS CURVES – CA3118 and CA3146 SERIES

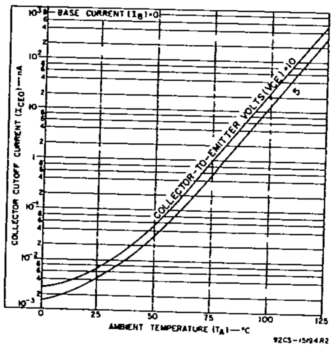


Fig. 2 – I_{CEO} vs. T_A for any transistor.

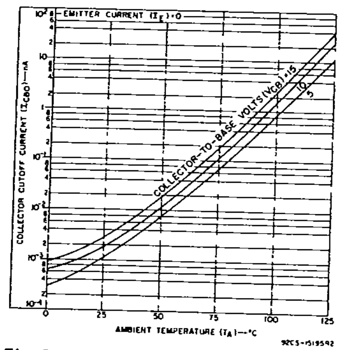


Fig. 3 – I_{CBO} vs. T_A for any transistor.

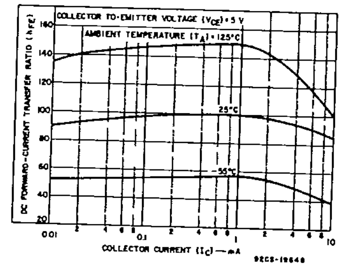


Fig. 4 – h_{FE} vs. I_C for any transistor.

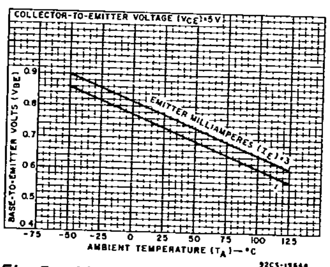


Fig. 5 – V_{BE} vs. T_A for any transistor.

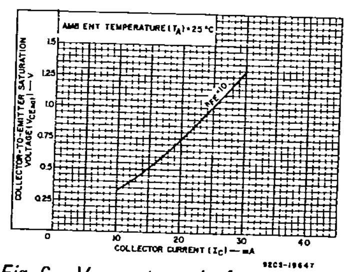


Fig. 6 – V_{CE} sat vs. I_C for any transistor.

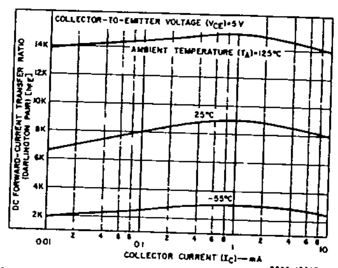


Fig. 7 – h_{FE} vs. I_C for Darlington pair (Q3 and Q4) for types CA3118AT and CA3118T.

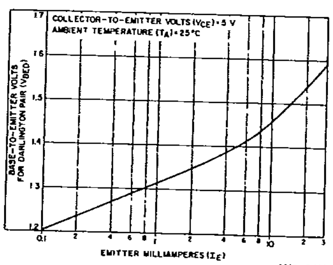


Fig. 8 – V_{BE} vs. I_E for Darlington pair (Q3 and Q4).

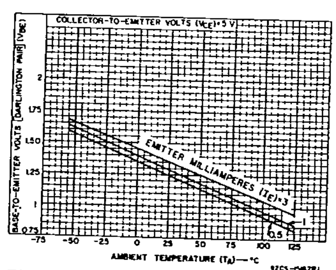


Fig. 9 – V_{BE} vs. T_A for Darlington pair (Q3 and Q4).

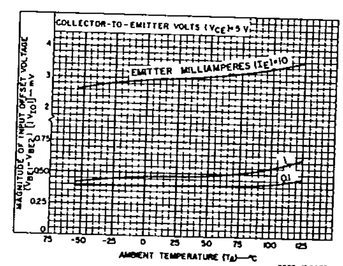


Fig. 10 – V_{IO} vs. T_A for Q1 and Q2.

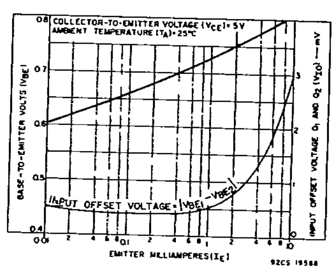


Fig. 11 – V_{BE} and V_{IO} vs. I_E for Q1 and Q2.

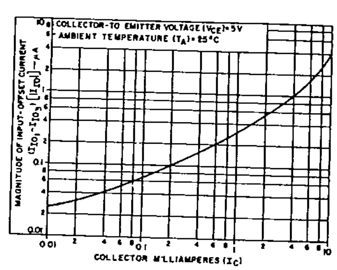


Fig. 12 – I_{IO} vs. I_C (Q1 and Q2) for types CA3146AE and CA3146E.

CA3118, CA3146, CA3183

TYPICAL DYNAMIC CHARACTERISTICS CURVES (FOR ANY TRANSISTOR) – CA3118, CA3146 SERIES

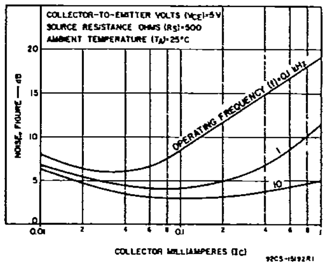


Fig. 13 – NF vs. I_C @ $R_S = 500\Omega$.

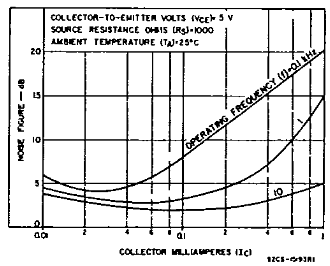


Fig. 14 – NF vs. I_C @ $R_S = 1k\Omega$.

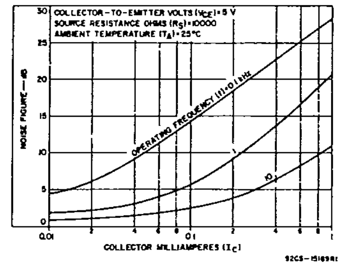


Fig. 15 – NF vs. I_C @ $R_S = 10k\Omega$.

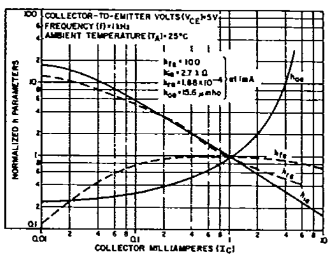


Fig. 16 – h_{fe}, h_{ie}, h_{oe}, h_{re} vs. I_C.

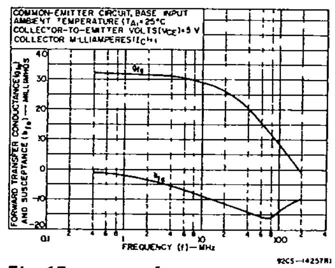


Fig. 17 – y_{fe} vs. f.

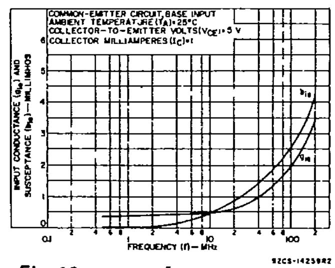


Fig. 18 – y_{ie} vs. f.

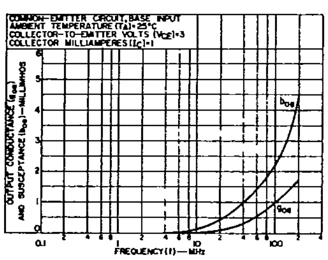


Fig. 19 – y_{oe} vs. f.

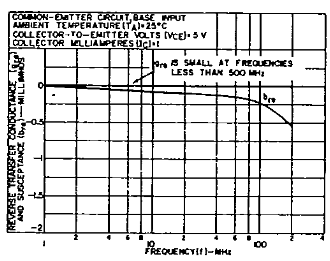


Fig. 20 – y_{re} vs. f.

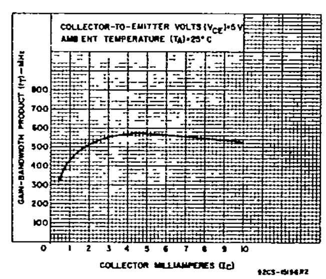


Fig. 21 – f_T vs. I_C.

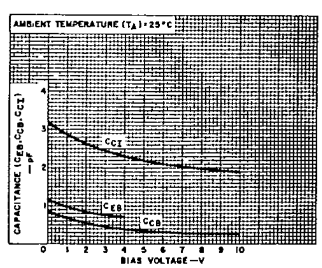


Fig. 22 – C_{EB}, C_{CB}, C_{CI} vs. bias voltage

CA3118, CA3146, CA3183

TYPICAL STATIC CHARACTERISTICS CURVES – CA3183 SERIES

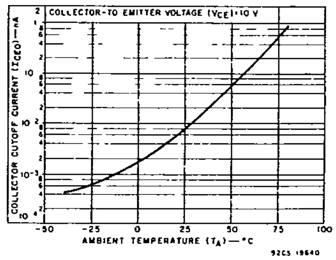


Fig. 23 – I_{CEO} vs. T_A for any transistor.

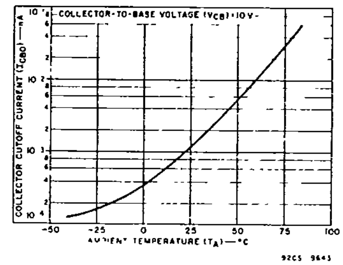


Fig. 24 – I_{CBO} vs. T_A for any transistor.

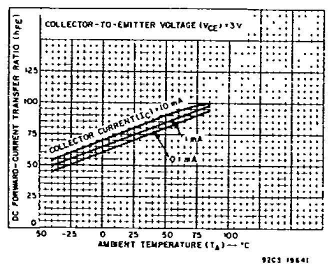


Fig. 25 – h_{FE} vs. T_A for any transistor.

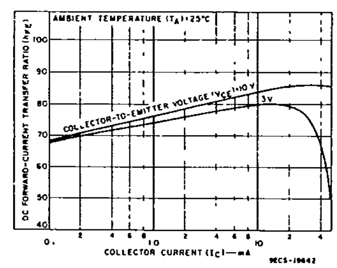


Fig. 26 – h_{FE} vs. I_C for any transistor.

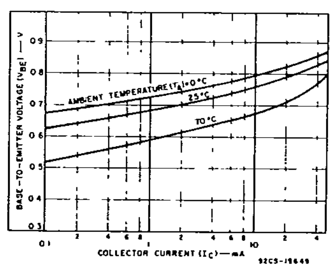


Fig. 27 – V_{BE} vs. I_C for any transistor.

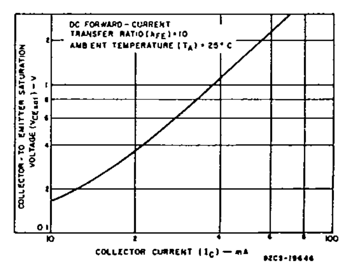


Fig. 28 – $V_{CE\ sat}$ vs. I_C for any transistor.

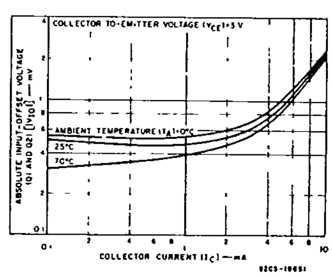


Fig. 29 – $|V_{IO}|$ vs. I_C for differential amplifier (Q1 and Q2).

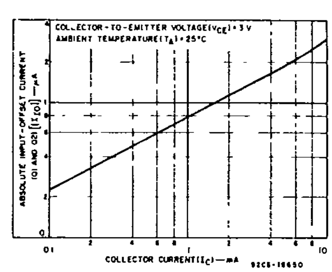


Fig. 30 – $|I_{IO}|$ vs. I_C for differential amplifier (Q1 and Q2).