

Arrays

T-43-25

# CA3118, CA3146, CA3183

## High-Voltage Transistor Arrays

**Features**

- Matched general-purpose transistors
- $V_{BE}$  matched  $\pm 5\text{mV}$  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)

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. Both types are supplied in a 14-lead dual-in-line plastic package and operate over the ambient temperature range of  $-40^\circ\text{C}$  to  $+85^\circ\text{C}$ . (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 para-

**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)

meters 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  $-40^\circ\text{C}$  to  $+85^\circ\text{C}$ . (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	$P_T$ <sup>●</sup> 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.	$I_{IO}$ Diff. Pair at 1 mA		$T_A$ Range (Operating)  $^\circ\text{C}$
							max. mV	max. $\mu\text{A}$	
<b>VALUES APPLY FOR EACH TRANSISTOR</b>									
CA3118AT	300	50	40	50	0.33	95	$\pm 5$	2	$-55 - +125$
CA3118T	300	50	30	40	0.33	95	$\pm 5$	2	$-55 - +125$
CA3146AE	300	50	40	50	0.33	95	$\pm 5$	2	$-40 - +85$
CA3146E	300	50	30	40	0.33	95	$\pm 5$	2	$-40 - +85$
CA3183AE	500	75	40	50	0.16	75	$\pm 5$	2.5	$-40 - +85$
CA3183E	500	75	30	40	0.16	75	$\pm 5$	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  $+85^\circ\text{C}$ , then derate linearly at  $5\text{ mW}/^\circ\text{C}$ . The maximum total package dissipation rating for the CA3146 and CA3183 Series circuits is 750 mW at temperatures up to  $+55^\circ\text{C}$ , then derate linearly at  $6.67\text{ mW}/^\circ\text{C}$ .

File Number 532

## CA3118, CA3146, CA3183

### MAXIMUM RATINGS, Absolute-Maximum Values at $T_A = 25^\circ\text{C}$

**Power Dissipation:**

Any one transistor —		
CA3118AT, CA3118T, CA3146AE, CA3146E	300	mW
CA3183AE, CA3183E	500	mW
Total package —		
Up to $85^\circ\text{C}$ (CA3118AT, CA3118T)	450	mW
Up to $55^\circ\text{C}$ (CA3146AE, CA3146E, CA3183AE, CA3183E)	750	mW
Above $85^\circ\text{C}$ (CA3118AT, CA3118T)	derate linearly 5	mW/ $^\circ\text{C}$
Above $55^\circ\text{C}$ (CA3146AE, CA3146E, CA3183AE, CA3183E)	derate linearly 6.67	mW/ $^\circ\text{C}$

**Ambient Temperature Range:**

Operating —		
CA3118AT, CA3118T	-55 to +125	$^\circ\text{C}$
CA3146AE, CA3146E, CA3183AE, CA3183E	-40 to +85	$^\circ\text{C}$
Storage (all types)	-65 to +150	$^\circ\text{C}$

The following ratings apply for each transistor in the device:

<b>Collector-to-Emitter Voltage (<math>V_{CE0}</math>):</b>		
CA3118AT, CA3146AE, CA3183AE	40	V
CA3118T, CA3146E, CA3183E	30	V
<b>Collector-to-Base Voltage (<math>V_{CB0}</math>):</b>		
CA3118AT, CA3146AE, CA3183AE	50	V
CA3118T, CA3146E, CA3183E	40	V
<b>Collector-to-Substrate Voltage (<math>V_{CS0}</math>):</b>		
CA3118AT, CA3146AE, CA3183AE	50	V
CA3118T, CA3146E, CA3183E	40	V
<b>Emitter-to-Base Voltage (<math>V_{EB0}</math>) all types</b>		
	5	V
<b>Collector Current —</b>		
CA3118AT, CA3118T, CA3146AE, CA3146E	50	mA
CA3183AE, CA3183E	75	mA
<b>Base Current (<math>I_B</math>) — CA3183AE, CA3183E</b>		
	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.

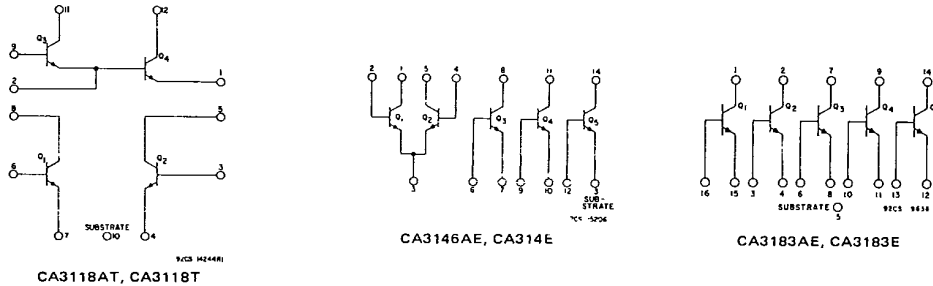


Fig. 1 — Schematic diagrams of high-voltage arrays.

### COMPARISON OF RELATED PREDECESSOR TYPE WITH TYPES IN THIS DATA BULLETIN

	DATA FILE NO.	$V_{CE0}$ min.	$V_{CB0}$ 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
				$I_C=10\text{ mA}$	$I_C=1\text{ mA}$				
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
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	—	—	—

NOTE: Related predecessor types are shown in shaded areas.

CA3118, CA3146, CA3183

STATIC ELECTRICAL CHARACTERISTICS – CA3118 and CA3146 Series

CHARACTERISTICS	SYMBOL	TEST CONDITIONS		LIMITS						UNITS	
		$T_A = 25^\circ\text{C}$	Typ. Char. Curve Fig. No.	CA3118AT, CA3146AE			CA3118T, CA3146E				
				Min.	Typ.	Max.	Min.	Typ.	Max.		
For Each Transistor:											
Collector-to-Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C = 10\mu\text{A}, I_E = 0$	–	50	72	–	40	72	–	V	
Collector-to-Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C = 1\text{mA}, I_B = 0$	–	40	56	–	30	56	–	V	
Collector-to-Substrate Breakdown Voltage	$V_{(BR)CIO}$	$I_C = 10\mu\text{A}, I_B = 0, I_E = 0$	–	50	72	–	40	72	–	V	
Emitter-to-Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E = 10\mu\text{A}, I_C = 0$	–	5	7	–	5	7	–	V	
Collector-Cutoff Current	$I_{CEO}$	$V_{CE} = 10\text{V}, I_B = 0$	2	–	see curve	5	–	see curve	5	$\mu\text{A}$	
Collector-Cutoff Current	$I_{CBO}$	$V_{CB} = 10\text{V}, I_E = 0$	3	–	0.002	100	–	0.002	100	nA	
DC Forward-Current Transfer Ratio	$h_{FE}$	$V_{CE} = 5\text{V}$	$I_C = 10\text{mA}$	4	–	85	–	85	–	–	
			$I_C = 1\text{mA}$	4	30	100	–	30	100	–	–
			$I_C = 10\mu\text{A}$	4	–	90	–	–	90	–	–
Base-to-Emitter Voltage	$V_{BE}$	$V_{CE} = 3\text{V}, I_C = 1\text{mA}$	5	0.63	0.73	0.83	0.63	0.73	0.83	V	
Collector-to-Emitter Saturation Voltage	$V_{CEsat}$	$I_C = 10\text{mA}, I_B = 1\text{mA}$	6	–	0.33	–	–	0.33	–	V	
For transistors Q3 and Q4 (Darlington Configuration):											
Collector-Cutoff Current	CA3118AT and CA3118T only	$I_{CEO}$	$V_{CE} = 10\text{V}, I_B = 0$	–	–	–	5	–	–	–	$\mu\text{A}$
DC Forward-Current Transfer Ratio			$h_{FE}$	$V_{CE} = 5\text{V}, I_C = 1\text{mA}$	7	1500	9000	–	1500	9000	–
Base-to-Emitter (Q3 to Q4)	$V_{BE}$	$V_{CE} = 5\text{V}$	$I_E = 10\text{mA}$	8	–	1.46	–	–	1.46	–	V
			$I_E = 1\text{mA}$	8,9	–	1.32	–	–	1.32	–	–
Magnitude of Base-to-Emitter Temperature Coefficient	$\frac{\Delta V_{BE}}{\Delta T}$	$V_{CE} = 5\text{V}, I_E = 1\text{mA}$	–	–	4.4	–	–	4.4	–	mV/ $^\circ\text{C}$	
For transistors Q1 and Q2 (AS a Differential Amplifier):											
Magnitude of Input Offset Voltage $ V_{BE1} = V_{BE2} $	$ V_{IO} $	$V_{CE} = 5\text{V}, I_E = 1\text{mA}$	10, 11	–	0.48	5	–	0.48	5	mV	
Magnitude of $h_{FE}$ Ratio	CA3118AT and CA3118T only	$V_{CE} = 5\text{V}, I_{C1} = I_{C2} = 1\text{mA}$	–	0.9	1.0	1.1	0.9	1.0	1.1	–	
Magnitude of Base-to-Emitter Temperature Coefficient	$\frac{\Delta V_{BE}}{\Delta T}$	$V_{CE} = 5\text{V}, I_E = 1\text{mA}$	–	–	1.9	–	–	1.9	–	mV/ $^\circ\text{C}$	
Magnitude of $V_{IO}$ ( $V_{BE1} - V_{BE2}$ ) Temperature Coefficient	$\frac{\Delta V_{IO}}{\Delta T}$	$V_{CE} = 5\text{V}, I_{C1} = I_{C2} = 1\text{mA}$	–	–	1.1	–	–	1.1	–	$\mu\text{V}/^\circ\text{C}$	
Magnitude of Input Offset Current $ I_{O1} - I_{O2} $	CA3146AE and CA3146E only	$I_{IO}$	$V_{CE} = 5\text{V}, I_{C1} = I_{C2} = 1\text{mA}$	12	–	0.3	2	–	0.3	2	$\mu\text{A}$

CA3118, CA3146, CA3183

DYNAMIC ELECTRICAL CHARACTERISTICS – CA3118 and CA3146 Series

CHARACTERISTICS	SYM-BOL	TEST CONDITIONS			LIMITS			UNITS		
		T <sub>A</sub> = 25°C	Typ. Char. Curve Fig.No.	CA3118AT CA3146AE			CA3118T CA3146E			
				Min.	Typ.	Max.	Min.		Typ.	Max.
Low Frequency Noise Figure	NF	f = 1kHz, V <sub>CE</sub> = 5V, I <sub>C</sub> = 100µA, Source resistance = 1 kΩ	14	–	3.25	–	–	3.25	–	dB
Low-Frequency, Small-Signal Equivalent-Circuit Characteristics:										
Forward-Current Transfer Ratio	h <sub>FE</sub>	f = 1kHz, V <sub>CE</sub> = 5V, I <sub>C</sub> = 1mA	16	–	100	–	–	100	–	–
Short-Circuit Input Impedance	h <sub>ie</sub>		16	–	2.7	–	–	3.5	–	kΩ
Open-Circuit Output Impedance	h <sub>oe</sub>		16	–	15.6	–	–	15.6	–	µmho
Open-Circuit Reverse Voltage Transfer Ratio	h <sub>re</sub>		16	–	1.8x10 <sup>-4</sup>	–	–	1.8x10 <sup>-4</sup>	–	–
Admittance Characteristics:										
Forward Transfer Admittance	Y <sub>fe</sub>	f = 1MHz, V <sub>CE</sub> = 5V, I <sub>C</sub> = 1mA	17	–	31 ± 1.5	–	–	31 ± 1.5	–	mmho
Input Admittance	Y <sub>ie</sub>		18	–	0.35 ± 0.04	–	–	0.3 ± 0.04	–	mmho
Output Admittance	Y <sub>oe</sub>		19	–	0.001 ± 0.03	–	–	0.001 ± 0.03	–	mmho
Reverse Transfer Admittance	Y <sub>re</sub>		20	–	See curve	–	–	See curve	–	mmho
Gain-Bandwidth Product	f <sub>T</sub>	V <sub>CE</sub> = 5V, I <sub>C</sub> = 3mA	21	300	500	–	300	500	–	MHz
Emitter-to-Base Capacitance	C <sub>EB</sub>	V <sub>EB</sub> = 5V, I <sub>E</sub> = 0	22	–	0.70	–	–	0.70	–	pF
Collector-to-Base Capacitance	C <sub>CB</sub>	V <sub>CB</sub> = 5V, I <sub>C</sub> = 0	22	–	0.37	–	–	0.37	–	pF
Collector-to-Substrate Capacitance	C <sub>CI</sub>	V <sub>CI</sub> = 5V, I <sub>C</sub> = 0	22	–	2.2	–	–	2.2	–	pF

STATIC ELECTRICAL CHARACTERISTICS – CA3183 Series

CHARACTERISTICS	SYMBOL	TEST CONDITIONS		LIMITS						UNITS
		T <sub>A</sub> = 25°C	Typ. Char. Curve Fig. No.	CA3183AE			CA3183E			
				Min.	Typ.	Max.	Min.	Typ.	Max.	
For Each Transistor:										
Collector-to-Base Breakdown Voltage	V <sub>(BR)CBO</sub>	I <sub>C</sub> = 100µA, I <sub>E</sub> = 0	–	50	–	–	40	–	–	V
Collector-to-Emitter Breakdown Voltage	V <sub>(BR)CEO</sub>	I <sub>C</sub> = 1mA, I <sub>B</sub> = 0	–	40	–	–	30	–	–	V
Collector-to-Substrate Breakdown Voltage	V <sub>(BR)CIC</sub>	I <sub>C</sub> = 100µA, I <sub>B</sub> = 0, I <sub>E</sub> = 0	–	50	–	–	40	–	–	V
Emitter-to-Base Breakdown Voltage	V <sub>(BR)EBO</sub>	I <sub>E</sub> = 500µA, I <sub>C</sub> = 0	–	5	–	–	5	–	–	V
Collector-Cutoff Current	I <sub>CEO</sub>	V <sub>CE</sub> = 10V, I <sub>B</sub> = 0	23	–	–	10	–	–	10	µA
Collector Cutoff Current	I <sub>CBO</sub>	V <sub>CB</sub> = 10V, I <sub>E</sub> = 0	24	–	–	1	–	–	1	µA
DC Forward-Current Transfer Ratio	h <sub>FE</sub>	V <sub>CE</sub> = 3V, I <sub>C</sub> = 10mA	25,26	40	–	–	40	–	–	–
		V <sub>CE</sub> = 5V, I <sub>C</sub> = 50mA	–	40	–	–	40	–	–	–
Base-to-Emitter Voltage	V <sub>BE</sub>	V <sub>CE</sub> = 3V, I <sub>C</sub> = 10mA	27	0.65	0.75	0.85	0.65	0.75	0.85	V
Collector-to-Emitter Saturation Voltage	*V <sub>CEsat</sub>	I <sub>C</sub> = 50mA, I <sub>B</sub> = 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 <sub>IO</sub>	V <sub>CE</sub> = 3V, I <sub>C</sub> = 1mA	29	–	0.47	5	–	0.47	5	mV
Absolute Input Offset Current	I <sub>IO</sub>		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

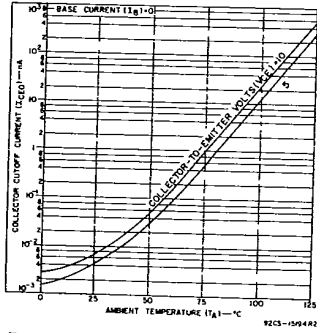


Fig. 2 -  $I_{CEO}$  vs.  $T_A$  for any transistor.

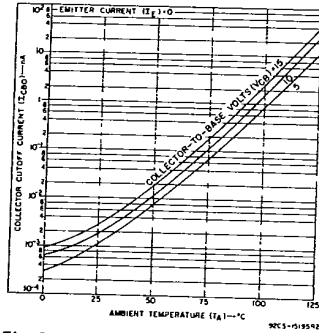


Fig. 3 -  $I_{CBO}$  vs.  $T_A$  for any transistor.

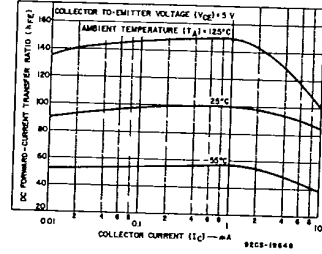


Fig. 4 -  $h_{FE}$  vs.  $I_C$  for any transistor.

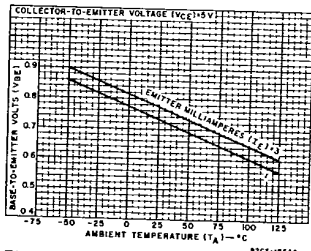


Fig. 5 -  $V_{BE}$  vs.  $T_A$  for any transistor.

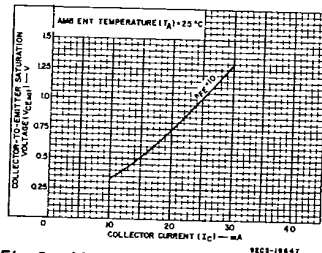


Fig. 6 -  $V_{CE sat}$  vs.  $I_C$  for any transistor.

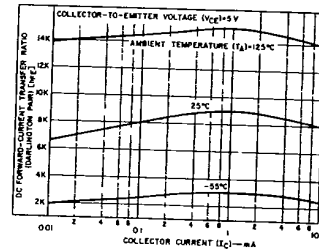


Fig. 7 -  $h_{FE}$  vs.  $I_C$  for Darlington pair (Q3 and Q4) for types CA3118AT and CA3118T.

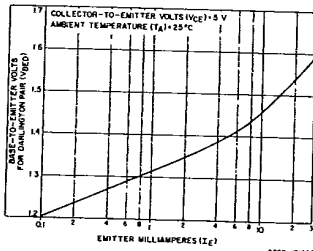


Fig. 8 -  $V_{BE}$  vs.  $I_E$  for Darlington pair (Q3 and Q4).

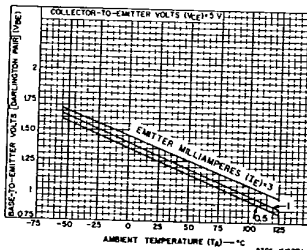


Fig. 9 -  $V_{BE}$  vs.  $T_A$  for Darlington pair (Q3 and Q4).

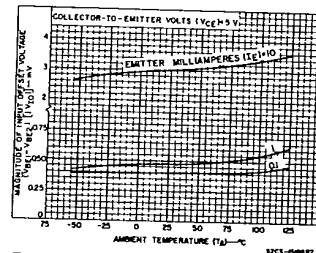


Fig. 10 -  $V_{IQ}$  vs.  $T_A$  for Q1 and Q2.

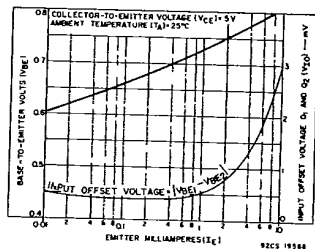


Fig. 11 -  $V_{BE}$  and  $V_{IQ}$  vs.  $I_E$  for Q1 and Q2.

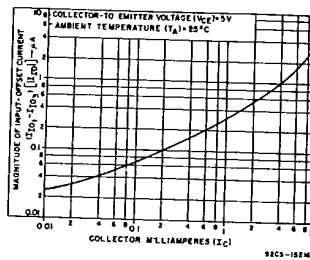


Fig. 12 -  $I_{IO}$  vs.  $I_C$  (Q1 and Q2) for types CA3146AE and CA3146E.

CA3118, CA3146, CA3183

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

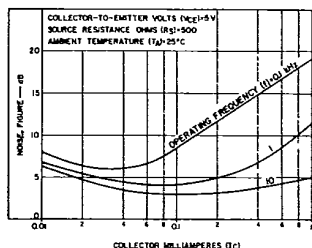


Fig. 13 – NF vs.  $I_C$  @  $R_S = 500 \Omega$ .

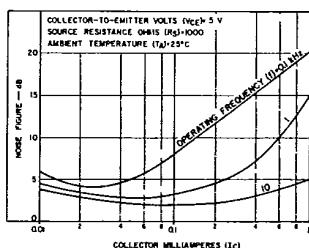


Fig. 14 – NF vs.  $I_C$  @  $R_S = 1k \Omega$ .

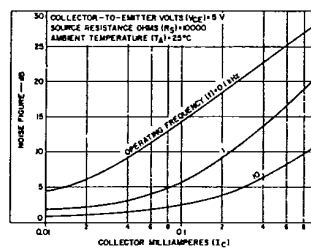


Fig. 15 – NF vs.  $I_C$  @  $R_S = 10k \Omega$ .

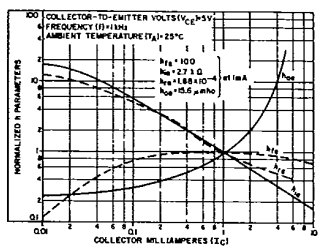


Fig. 16 –  $h_{fe}$ ,  $h_{ie}$ ,  $h_{oe}$ ,  $h_{re}$  vs.  $I_C$

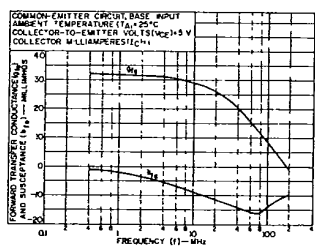


Fig. 17 –  $y_{fe}$  vs.  $f$ .

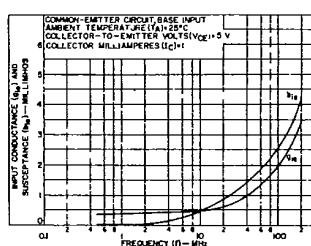


Fig. 18 –  $y_{ie}$  vs.  $f$ .

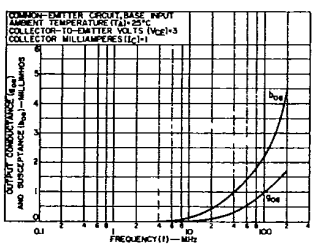


Fig. 19 –  $y_{oe}$  vs.  $f$ .

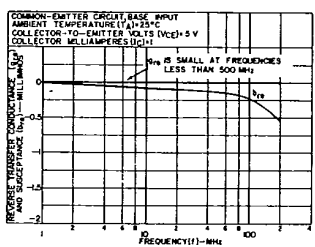


Fig. 20 –  $y_{re}$  vs.  $f$ .

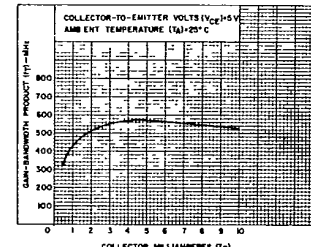


Fig. 21 –  $f_T$  vs.  $I_C$

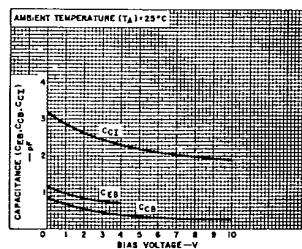


Fig. 22 –  $C_{EB}$ ,  $C_{CB}$ ,  $C_{CI}$  vs. bias voltage

CA3118, CA3146, CA3183

TYPICAL STATIC CHARACTERISTICS CURVES - CA3183 SERIES

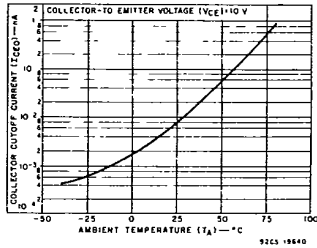


Fig. 23 -  $I_{CEO}$  vs.  $T_A$  for any transistor.

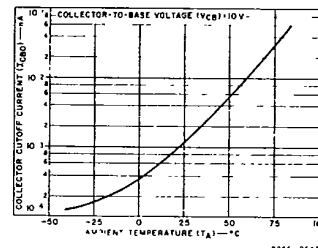


Fig. 24 -  $I_{CBO}$  vs.  $T_A$  for any transistor.

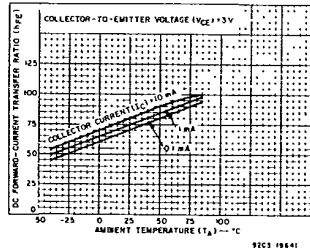


Fig. 25 -  $h_{FE}$  vs.  $T_A$  for any transistor.

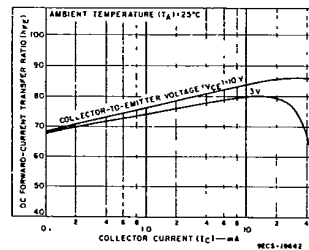


Fig. 26 -  $h_{FE}$  vs.  $I_C$  for any transistor.

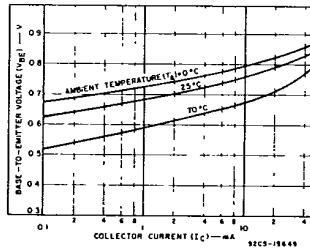


Fig. 27 -  $V_{BE}$  vs.  $I_C$  for any transistor.

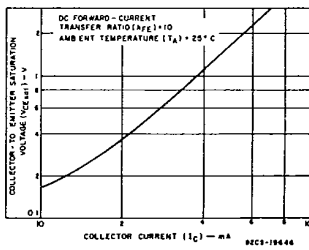


Fig. 28 -  $V_{CE sat}$  vs.  $I_C$  for any transistor.

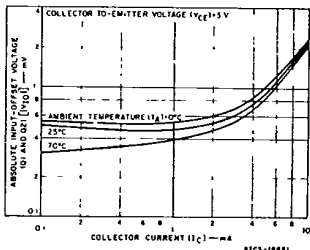


Fig. 29 -  $|V_{IO}|$  vs.  $I_C$  for differential amplifier (Q1 and Q2).

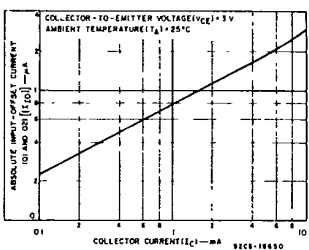


Fig. 30 -  $|I_{IO}|$  vs.  $I_C$  for differential amplifier (Q1 and Q2).