CA3146, CA3183

March 1993

High-Voltage Transistor Arrays

Features

- **Matched General Purpose Transistors**
- **V_{BE} Matched ±5mV Max**
- **Operation from DC to 120MHz (CA3146, A)**
- **Low Noise Figure: 3.2dB Typ at 1kHz (CA3146, A)**
- **High I_C: 75mA Max (CA3183, A)**

Applications

- **General Use in Signal Processing Systems in DC through VHF Range**
- **Custom Designed Differential Amplifiers**
- **Temperature Compensated Amplifiers**
- **Lamp and Relay Drivers (CA3183, A)**
- **Thyristor Firing (CA3183, A)**

Ordering Information

PART NUMBER	TEMPERATURE RANGE	PACKAGE
CA3146AE	-40°C to +85°C	14 Lead Plastic DIP
CA3146AM	-40°C to +85°C	14 Lead SOIC
CA3146AM96	-40°C to +85°C	14 Lead SOIC*
CA3146E	-40°C to +85°C	14 Lead Plastic DIP
CA3146M	-40°C to +85°C	14 Lead SOIC
CA3146M96	-40°C to +85°C	14 Lead SOIC*
CA3183AE	-40°C to +85°C	16 Lead Plastic DIP
CA3183AM	-40°C to +85°C	16 Lead Narrow Body SOIC
CA3183AM96	-40°C to +85°C	16 Lead Narrow Body SOIC*
CA3183E	-40°C to +85°C	16 Lead Plastic DIP
CA3183M	-40°C to +85°C	16 Lead Narrow Body SOIC
CA3183M96	-40°C to +85°C	16 Lead Narrow Body SOIC*

*Denotes Tape and Reel

Description

The CA3146A, CA3146, CA3183A, and CA3183* are general purpose high voltage silicon n-p-n transistor arrays on a common monolithic substrate.

Types CA3146A and CA3146 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. (CA3146A and CA3146 are high voltage versions of the popular predecessor type CA3046.)

Types CA3183A and CA3183 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. (CA3183A and CA3183 are high voltage versions of the popular predecessor type CA3083.)

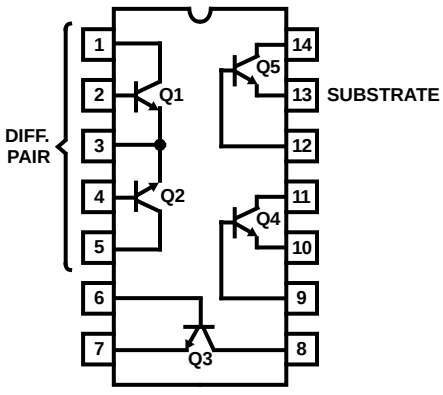
The types with an “A” suffix are premium versions of their non-”A” counterparts and feature tighter control of breakdown voltages making them more suitable for higher voltage applications.

For detailed application information, see companion Application Note AN5296 “Application of the CA3018 Integrated Circuit Transistor Array.”

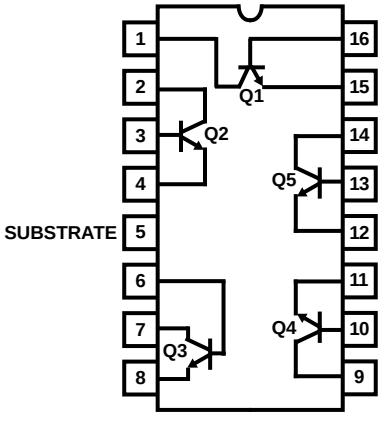
* Formerly Developmental Types Nos.
CA3146A - TA6084 CA3183A - TA6094
CA3146 - TA6181 CA3183 - TA6183

Pinouts

CA3146, A (PDIP, SOIC)
TOP VIEW



CA3183, A (PDIP, 150MIL SOIC)
TOP VIEW



CAUTION: These devices are sensitive to electrostatic discharge. Users should follow proper I.C. Handling Procedures.

File Number **532.2**

Absolute Maximum Ratings

Power Dissipation: (any one transistor)
- CA3146A, CA3146 . . . . . .300mW
- CA3183A, CA3183 . . . . . .500mW

Total Package
- Up to +55°C (CA3146A, CA3146, CA3183A, CA3183) 750mW
- Above +55°C . . . . . Derate Linearly 6.67mW/°C (CA3146, A, CA3183, A)

The following ratings apply for each transistor in the device:

Collector-to-Emitter Voltage (V_{CEO}):
- CA3146A, CA3183A 40V
- CA3146, CA3183 . . . . . .30V

Collector-to-Base Voltage (V_{CBO}):
- CA3146A, CA3183A 50V
- CA3146, CA3183 . . . . . .40V

Collector-to-Substrate Voltage (V_{CIO}): (Note 1)
- CA3146A, CA3183A 50V
- CA3146, CA3183 . . . . . .40V

Emitter-to-Base Voltage (V_{EBO}) all types 5V

Collector Current
- CA3146A, CA3146 . . . . . 50mA
- CA3183 . . . . . 75mA

Base Current (I_B) - CA3183A, CA3183. . . . . 20mA

Junction Temperature . . . . . .+175°C

Junction Temperature (Plastic Package) . . . . . +150°C

Lead Temperature (Soldering 10 Sec.). . . . . +300°C

Operating Conditions

Operating Temperature Range
- CA3146A, CA3146, CA3183A, CA3183 . . . . . -40°C to +85°C

Storage Temperature Range (all types) . . . . . -65°C to +150°C

CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

Values Apply For Each Transistor

TYPE	(NOTE 2) P_T MAX. (mW)	I_C MAX. (mA)	V_{CEO} (MAX) (V)	V_{CBO} (MAX) (V)	$V_{CE\ SAT}$ AT 10mA TYP (V)	h_{FE} AT 1mA, & V_{CE} = 5V (TYP)	DIFF. PAIR AT 1mA		T_A RANGE (OPERATING)
							V_{IO} MAX (mV)	I_{IO} MAX (μA)	
VALUES APPLY FOR EACH TRANSISTOR									
CA3146A	300	50	40	50	0.33	100	±5	2	-40°C to +85°C
CA3146	300	50	30	40	0.33	100	±5	2	-40°C to +85°C
CA3183A	500	75	40	50	0.16	75	±5	2.5	-40°C to +85°C
CA3183	500	75	30	40	0.16	75	±5	2.5	-40°C to +85°C

Comparison Of Related Predecessor Type with Types in this Data Sheet

TYPE	V_{CEO} MIN (V)	V_{CBO} MIN (V)	$V_{CE\ SAT}$ TYP (V)	V_{BE} TYP (V)	I_C MAX (mA)	C_{CB} TYP (pF)	C_{CI} TYP (pF)	C_{EB} TYP (pF)
			I_C = 10mA	I_C = 1mA				
CA3046	15	20	0.23	0.715	50	0.58	2.8	0.6
CA3146A	40	50	0.33	0.730	50	0.37	2.2	0.7
CA3146	30	40	0.33	0.730	50	0.37	2.2	0.7

Comparison Of Related Predecessor Type with Types in this Data Sheet (Continued)

TYPE	V_{CEO} MIN (V)	V_{CBO} MIN (V)	$V_{CE\ SAT}$ TYP (V)	V_{BE} TYP (V)	I_C MAX (mA)	C_{CB} TYP (pF)	C_{CI} TYP (pF)	C_{EB} TYP (pF)
			I_C = 50mA	I_C = 10mA				
CA3083	15	20	0.4	0.74	100	-	-	-
CA3183A	40	50	1.7	0.75	75	-	-	-
CA3183	30	40	1.7	0.75	75	-	-	-

NOTES:

1. 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 transisters, and to provide for 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.
2. Caution on Total Package Power Dissipation: The maximum total package dissipation rating for the CA3146 and CA3183 Series circuits is 750mW at temperatures up to +55^{o}C, then derate linearly at 6.67mW/^{o}C.

Static Electrical Characteristics CA3146 Series

PARAMETERS	SYMBOL	TEST CONDITIONS T_A = +25^{o}C		TYP. CHAR. CURVE FIG. NO.	LIMITS CA3146A MIN	CA3146A TYP	CA3146A MAX	CA3146 MN	CA3146 TYP	CA3146 MAX	UNITS
For Each Transistor											
Collector-to-Base Breakdown Voltage	$V_{(BR)CBO}$	I_C = 10µA, 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} = 10µA, I_B = 0, I_E = 0		-	50	72	-	40	72	-	V
Emitter-to-Base Breakdown Voltage	$V_{(BR)EBO}$	I_E = 10µA, 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 = 10µA	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	$V_{CE\ SAT}$	I_C = 10mA, I_B = 1mA		6	-	0.33	-	-	0.33	-	V
For transistors Q3 and Q4 (Darlington Configuration):											
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	-	V
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/^{o}C

Static Electrical Characteristics CA3146 Series (Continued)

PARAMETERS	SYMBOL	TEST CONDITIONS T_A = +25°C	TYP. CHAR. CURVE FIG. NO.	LIMITS CA3146A MIN	CA3146A TYP	CA3146A MAX	CA3146 MN	CA3146 TYP	CA3146 MAX	UNITS
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 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

Dynamic Electrical Characteristics CA3146 Series

PARAMETERS	SYMBOL	TEST CONDITIONS T_A = +25°C	TYP. CHAR. CURVE FIG. NO.	LIMITS CA3146A MIN	CA3146A TYP	CA3146A MAX	CA3146 MIN	CA3146 TYP	CA3146 MAX	UNITS
Low Frequency Noise Figure	NF	f = 1kHz, V_{CE} = 5V, I_C = 100µA, Source resistance = 1kΩ	14	-	3.25	-	-	3.25	-	dB
Low-Frequency, Small-Signal Equivalent-Circuit Characteristics:										
Forward-Current Transfer Ratio	h_{FE}	f = 1kHz, V_{CE} = 5V, I_C = 1mA	16	-	100	-	-	100	-	-
Short-Circuit Input Impedance	h_{IE}	f = 1kHz, V_{CE} = 5V, I_C = 1mA	16	-	2.7	-	-	3.5	-	kΩ
Open-Circuit Output Impedance	h_{OE}	f = 1kHz, V_{CE} = 5V, I_C = 1mA	16	-	15.6	-	-	15.6	-	µmho
Open-Circuit Reverse Voltage Transfer Ratio	h_{RE}	f = 1kHz, V_{CE} = 5V, I_C = 1mA	16	-	1.8×10^{-4}	-	-	1.8×10^{-4}	-	-
Admittance Characteristics:										
Forward Transfer Admittance	Y_{FE}	f = 1MHz, V_{CE} = 5V, I_C = 1 mA	17	-	31-j1.5	-	-	31-j1.5	-	mmho
Input Admittance	Y_{IE}	f = 1MHz, V_{CE} = 5V, I_C = 1 mA	18	-	0.35 + j0.04	-	-	0.3 + j0.04	-	mmho
Output Admittance	Y_{OE}	f = 1MHz, V_{CE} = 5V, I_C = 1 mA	19	-	0.001 + j0.03	-	-	0.001 + j0.03	-	mmho
Reverse Transfer Admittance	Y_{RE}	f = 1MHz, V_{CE} = 5V, I_C = 1 mA	20		See Curve			See Curve		mmho

Dynamic Electrical Characteristics CA3146 Series **(Continued)**

PARAMETERS	SYMBOL	TEST CONDITIONS		LIMITS						UNITS
				CA3146A			CA3146			
		T_A = +25°C	TYP. CHAR. CURVE FIG. NO.	MIN	TYP	MAX	MIN	TYP	MAX	
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

PARAMETERS	SYMBOL	TEST CONDITIONS		LIMITS						UNITS
				CA3183A			CA3183			
		T_A = +25°C	TYP. CHAR CURVE FIG. NO.	MIN	TYP	MAX	MIN	TYP	MAX	
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} = 3V, 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	$V_{CE\ SAT}$ (Note 1)	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	$\|I_{IO}\|$	V_{CE} = 3V, I_C = 1mA	30	-	0.78	2.5	-	0.78	2.5	µA

NOTE:

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

Typical Performance Curves Static Characteristics - CA3146 Series

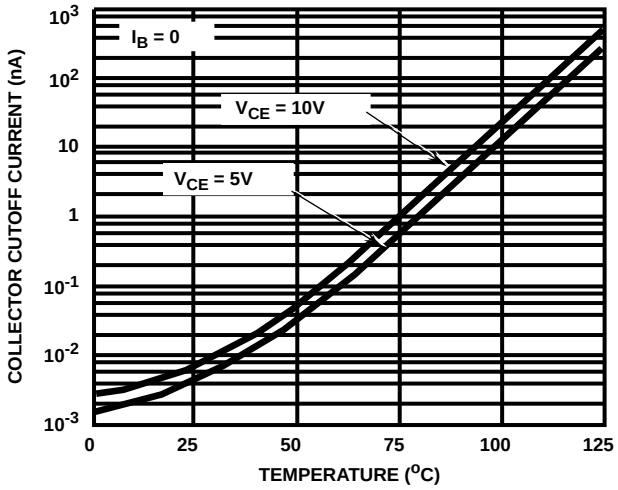


FIGURE 1. I_{CEO} vs TEMPERATURE FOR ANY TRANSISTOR

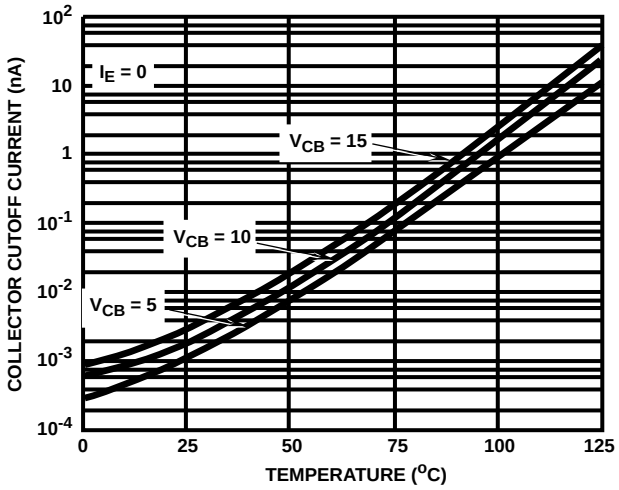


FIGURE 2. I_{CBO} vs TEMPERATURE FOR ANY TRANSISTOR

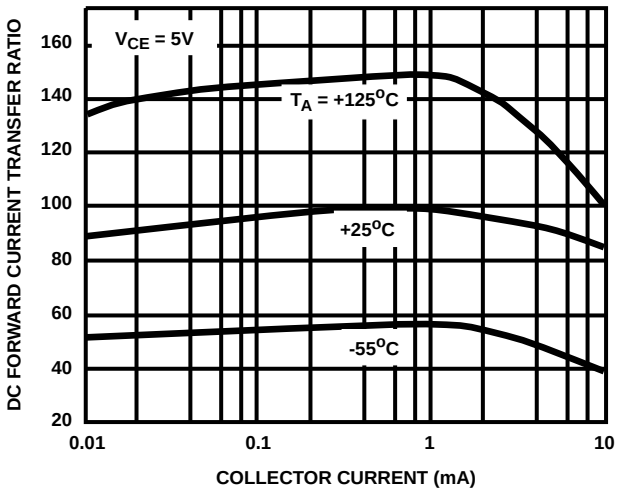


FIGURE 3. h_{FE} vs I_C FOR ANY TRANSISTOR

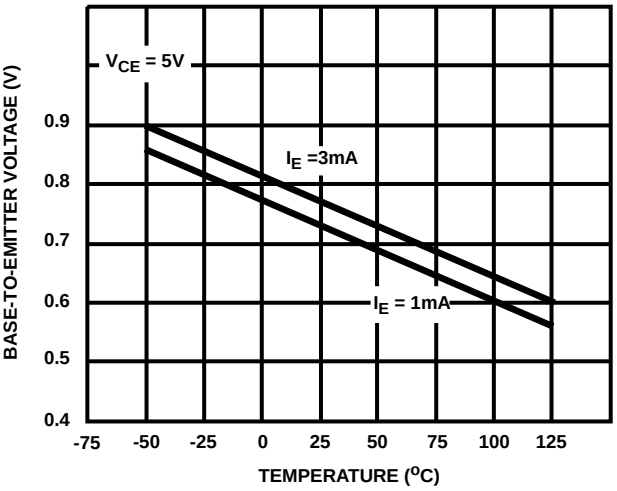


FIGURE 4. V_{BE} vs TEMPERATURE FOR ANY TRANSISTOR

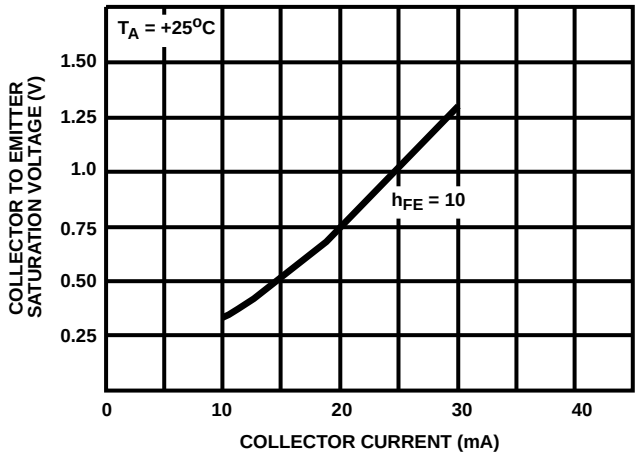


FIGURE 5. $V_{CE\ SAT}$ vs I_C FOR ANY TRANSISTOR

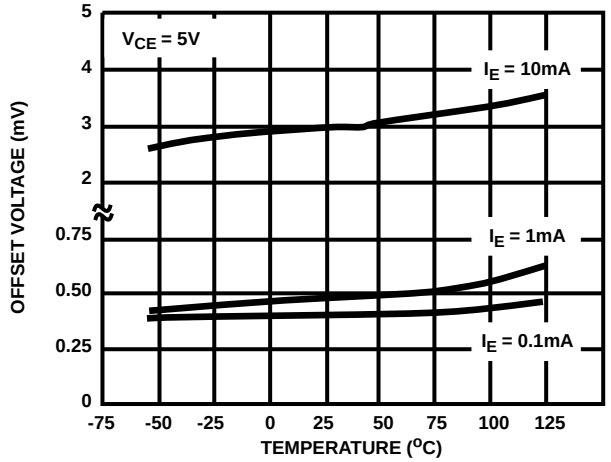


FIGURE 6. V_{IO} vs TEMPERATURE FOR Q1 AND Q2

Typical Performance Curves Static Characteristics - CA3146 Series (Continued)

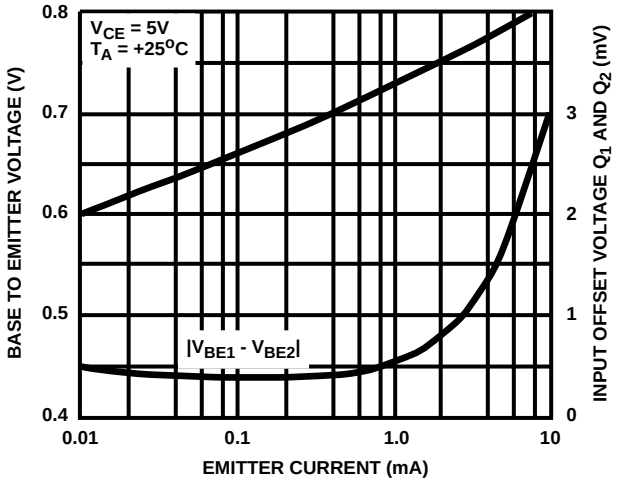


FIGURE 7. V_{BE} AND V_{IO} vs I_E FOR Q1 AND Q2

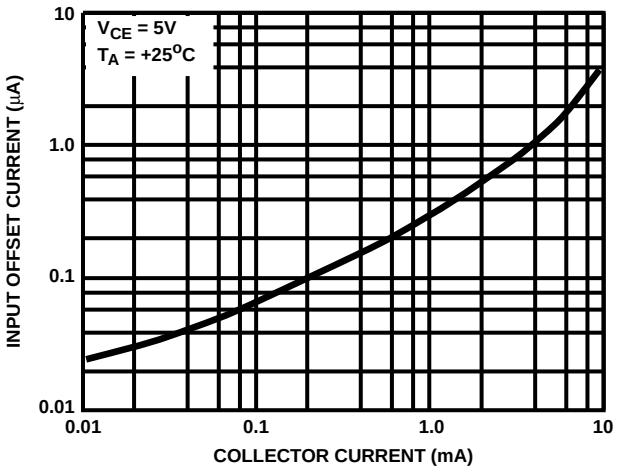


FIGURE 8. I_{IO} vs I_C (Q1 AND Q2) FOR TYPES CA3146A AND CA3146

Typical Performance Curves Dynamic Characteristics (for any transistor) - CA3146 Series

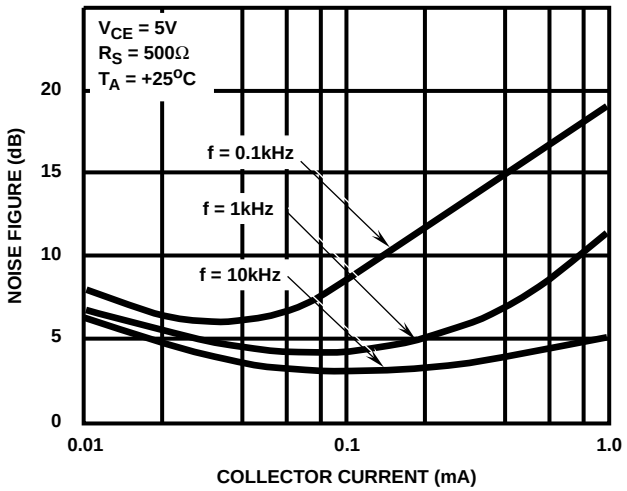


FIGURE 9. NF vs I_C AT R_S = 500Ω

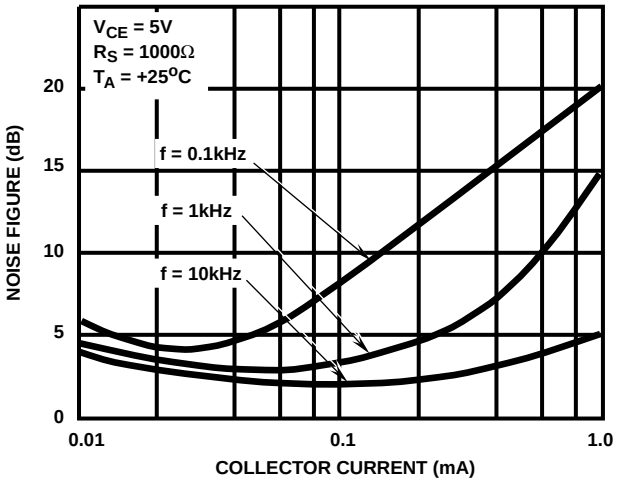


FIGURE 10. NF vs I_C AT R_S = 1kΩ

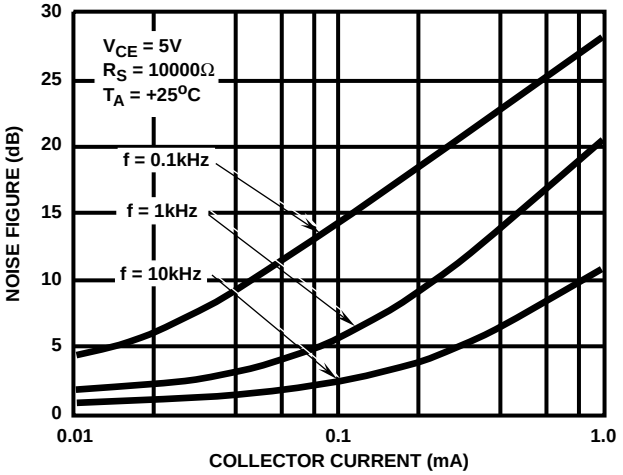


FIGURE 11. NF vs I_C AT R_S = 10kΩ

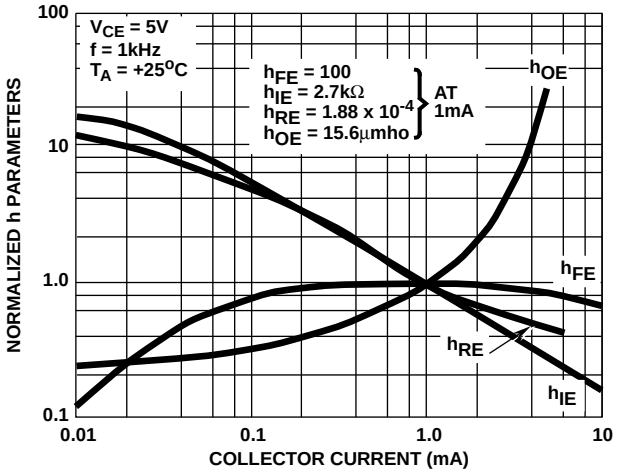


FIGURE 12. h_{FE}, h_{IE}, h_{OE}, h_{RE} vs I_C

Typical Performance Curves Dynamic Characteristics (for any transistor) - CA3146 Series (Continued)

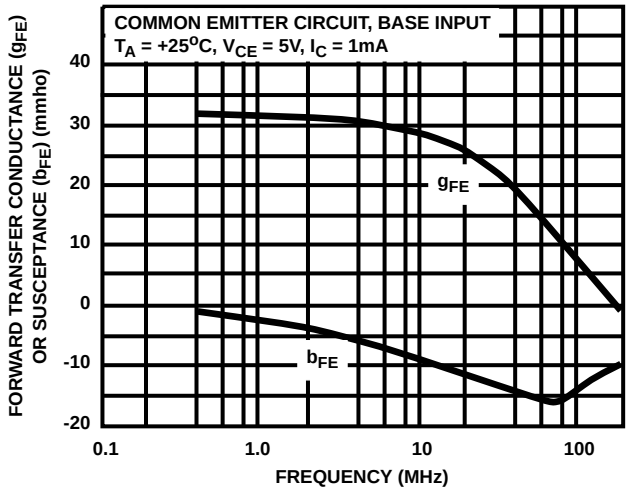


FIGURE 13. y_{FE} vs FREQUENCY

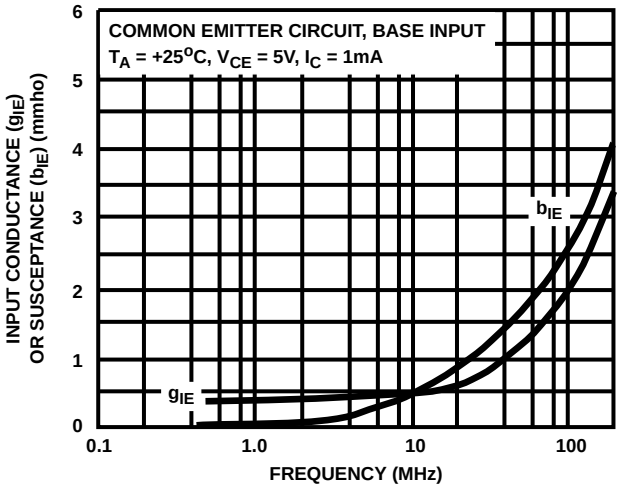


FIGURE 14. y_{IE} vs FREQUENCY

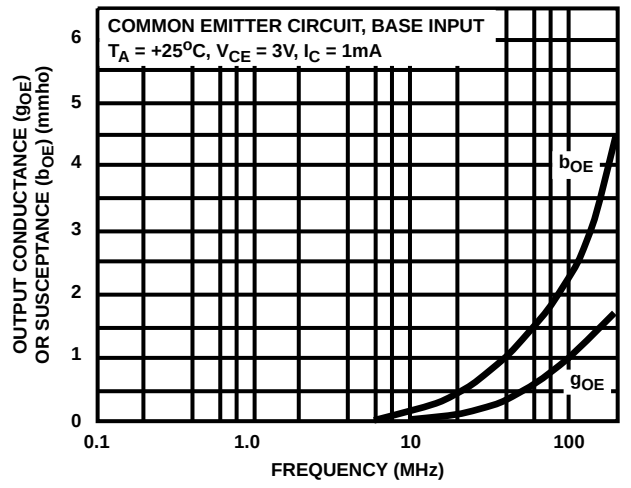


FIGURE 15. y_{OE} vs FREQUENCY

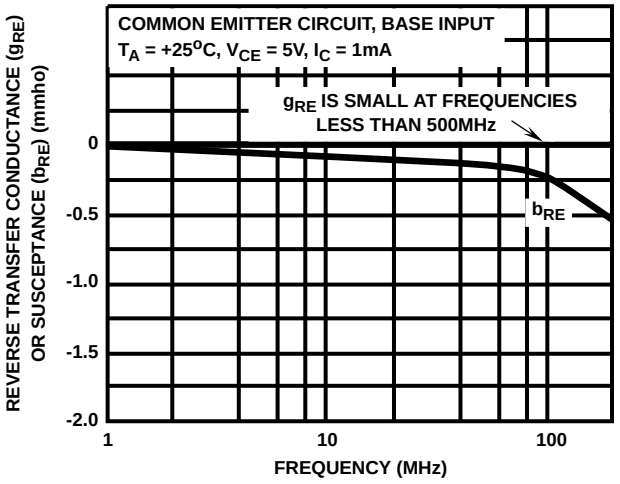


FIGURE 16. y_{RE} vs FREQUENCY

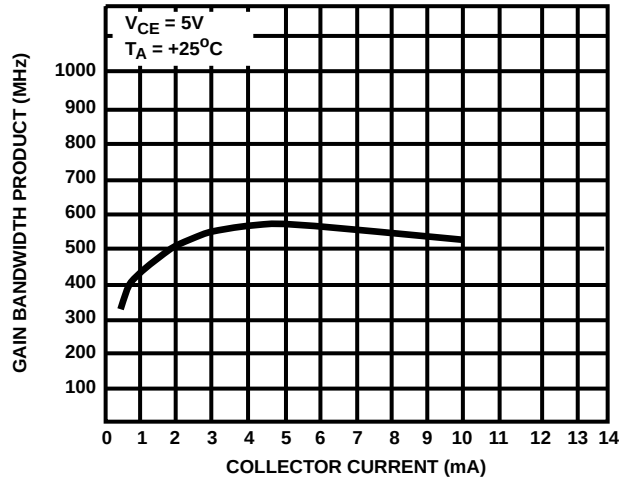


FIGURE 17. f_T vs I_C

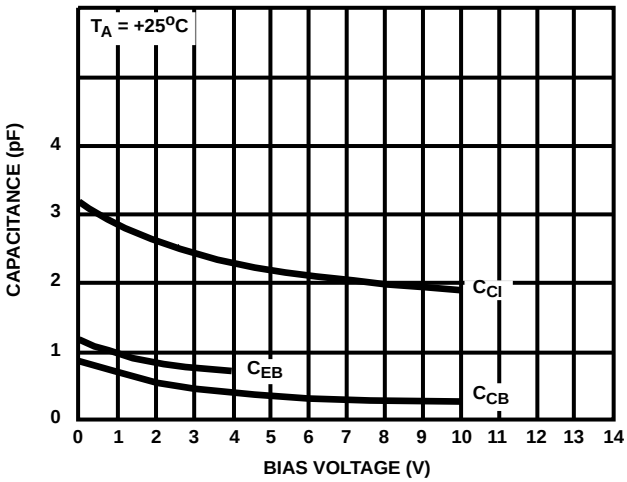


FIGURE 18. C_{EB}, C_{CB}, C_{CI} vs BIAS VOLTAGE

Typical Performance Curves Static Characteristics - CA3183 Series

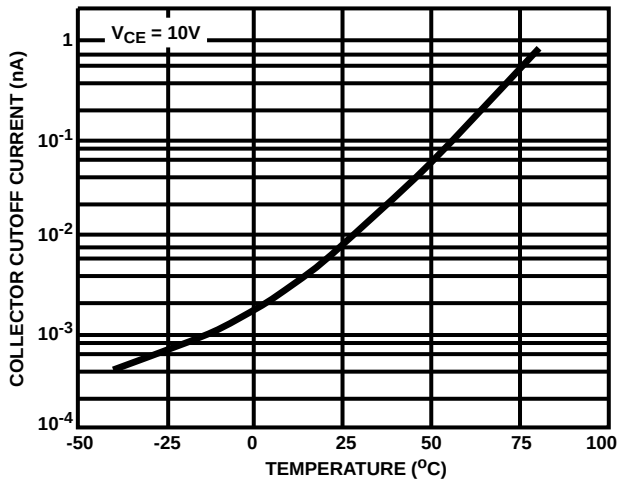


FIGURE 19. I_{CEO} vs TEMPERATURE FOR ANY TRANSISTOR

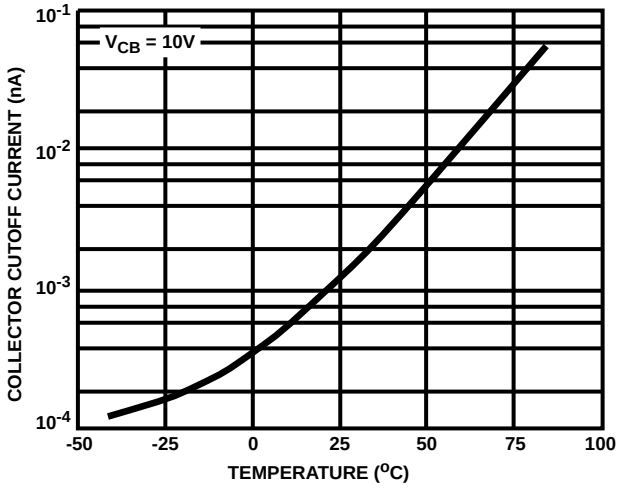


FIGURE 20. I_{CBO} vs TEMPERATURE FOR ANY TRANSISTOR

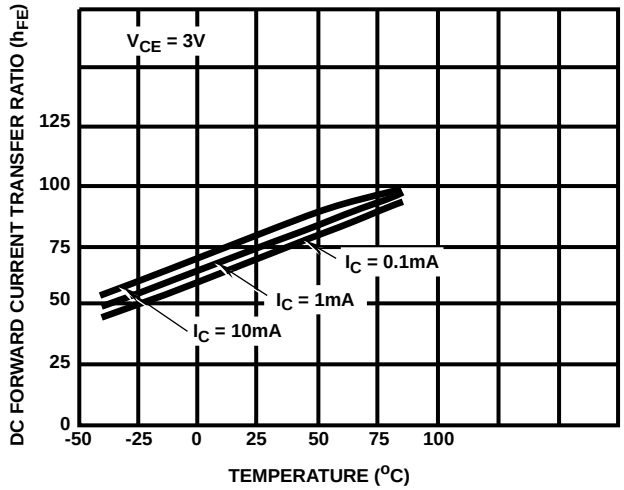


FIGURE 21. h_{FE} vs TEMPERATURE FOR ANY TRANSISTOR

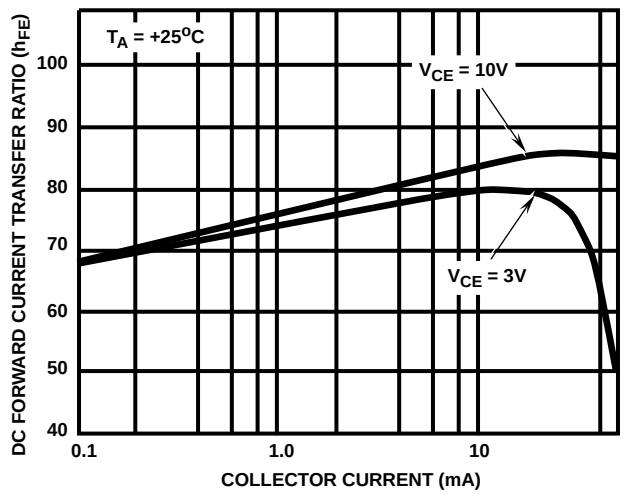


FIGURE 22. h_{FE} vs I_C FOR ANY TRANSISTOR

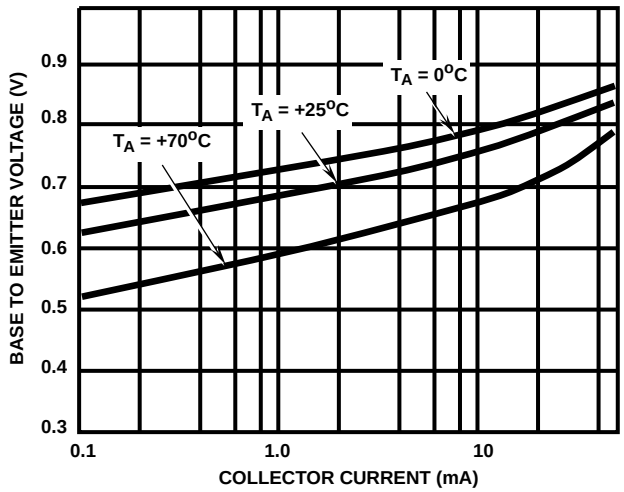


FIGURE 23. V_{BE} vs I_C FOR ANY TRANSISTOR

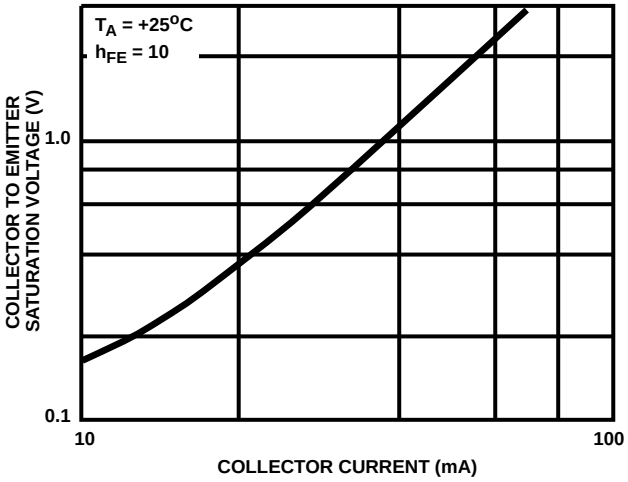


FIGURE 24. $V_{CE\ SAT}$ vs I_C FOR ANY TRANSISTOR

Typical Performance Curves Static Characteristics - CA3183 Series (Continued)

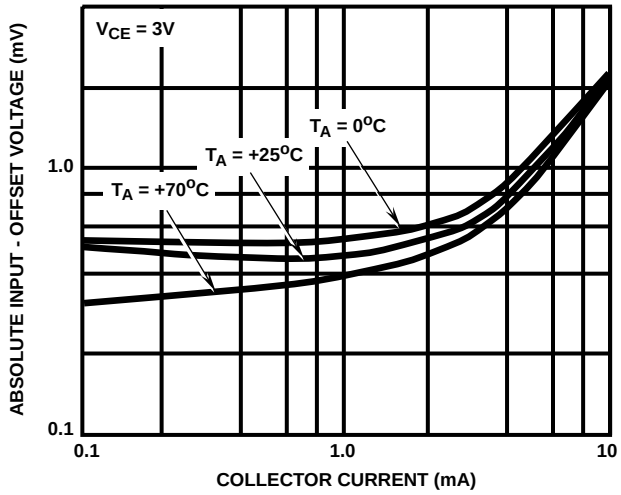


FIGURE 25. $|V_{IO}|$ vs I_C FOR DIFFERENTIAL AMPLIFIER (Q1 AND Q2)

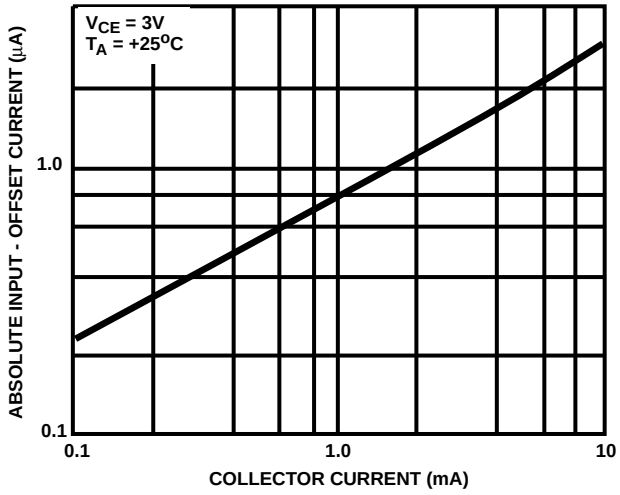


FIGURE 26. $|I_{IO}|$ vs I_C FOR DIFFERENTIAL AMPLIFIER (Q1 AND Q2)