

August 1996

## High-Voltage Transistor Arrays

### Features

- Matched General Purpose Transistors
  - $V_{BE}$  Match .....  $\pm 5\text{mV}$  (Max)
- Operation from DC to 120MHz (CA3146, CA3146A)
- Low Noise Figure ..... 3.2dB (CA3146, CA3146A)
- High  $I_C$  ..... 75mA (Max) (CA3183, CA3183A)

### Applications

- General Use in Signal Processing Systems in DC through VHF Range
- Custom Designed Differential Amplifiers
- Temperature Compensated Amplifiers
- Lamp and Relay Drivers (CA3183, CA3183A)
- Thyristor Firing (CA3183, CA3183A)

### Ordering Information

PART NUMBER (BRAND)	TEMP. RANGE (°C)	PACKAGE	PKG. NO.
CA3146AE	-40 to 85	14 Ld PDIP	E14.3
CA3146AM (3146A)	-40 to 85	14 Ld SOIC	M14.15
CA3146AM96 (3146A)	-40 to 85	14 Ld SOIC Tape and Reel	M14.15
CA3146E	-40 to 85	14 Ld PDIP	E14.3
CA3146M (3146)	-40 to 85	14 Ld SOIC	M14.15
CA3146M96 (3146)	-40 to 85	14 Ld SOIC Tape and Reel	M14.15
CA3183AE	-40 to 85	16 Ld PDIP	E16.3
CA3183AM (3183A)	-40 to 85	16 Ld SOIC	M16.15
CA3183AM96 (3183A)	-40 to 85	16 Ld SOIC Tape and Reel	M16.15
CA3183E	-40 to 85	16 Ld PDIP	E16.3
CA3183M (3183)	-40 to 85	16 Ld SOIC	M16.15
CA3183M96 (3183)	-40 to 85	16 Ld SOIC Tape and Reel	M16.15

### Description

The CA3146A, CA3146, CA3183A, and CA3183 are general purpose high voltage silicon NPN 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.)

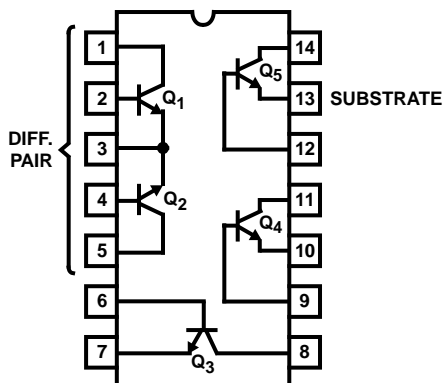
Types CA3183A and CA3183 consist of five high current transistors with independent connections for each transistor. In addition two of these transistors ( $Q_1$  and  $Q_2$ ) are matched at low current (i.e., 1mA) for applications where offset parameters are of special importance. A special substrate 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.

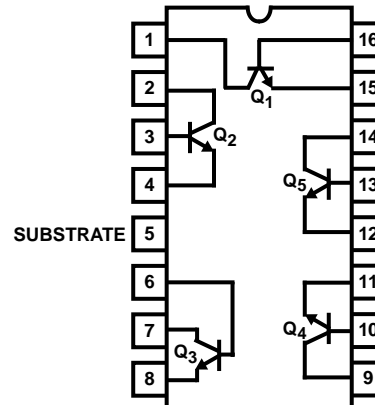
For detailed application information, see companion Application Note AN5296 "Application of the CA3018 Integrated Circuit Transistor Array."

### Pinouts

CA3146, CA3146A (PDIP, SOIC)  
TOP VIEW



CA3183, CA3183A (PDIP, SOIC)  
TOP VIEW



# CA3146, CA3146A, CA3183, CA3183A

## Absolute Maximum Ratings

Collector-to-Emitter Voltage ( $V_{CE0}$ ):	
CA3146A, CA3183A .....	40V
CA3146, CA3183 .....	30V
Collector-to-Base Voltage ( $V_{CB0}$ ):	
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
CA3183A, CA3183 .....	75mA
Base Current ( $I_B$ ) - CA3183A, CA3183 .....	20mA

## Thermal Information

Thermal Resistance (Typical, Note 2)	$\theta_{JA}$ ( $^{\circ}C/W$ )
14 Ld PDIP Package .....	100
14 Ld SOIC Package .....	185
16 Ld PDIP Package .....	90
16 Ld SOIC Package .....	175
Maximum Power Dissipation (Any One Transistor, Note 3)	
CA3146A, CA3146 .....	300mW
CA3183A, CA3183 .....	500mW
Maximum Junction Temperature (Die) .....	175 $^{\circ}C$
Maximum Junction Temperature (Plastic Package) .....	150 $^{\circ}C$
Maximum Storage Temperature Range (all types) ..	-65 $^{\circ}C$ to 150 $^{\circ}C$
Maximum Lead Temperature (Soldering 10s) .....	300 $^{\circ}C$ (SOIC - Lead Tips Only)

## Operating Conditions

Temperature Range .....

*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.*

### NOTES:

- 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 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.
- $\theta_{JA}$  is measured with the component mounted on an evaluation PC board in free air.
- Care must be taken to avoid exceeding the maximum junction temperature. Use the total power dissipation (all transistors) and thermal resistances to calculate the junction temperature.

## Electrical Specifications CA3146 Series

PARAMETER	SYMBOL	TEST CONDITIONS $T_A = 25^{\circ}C$	TYP. PERF. CURVE FIG. NO.	CA3146			CA3146A			UNITS
				MN	TYP	MAX	MIN	TYP	MAX	
<b>DC CHARACTERISTICS FOR EACH TRANSISTOR</b>										
Collector-to-Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C = 10\mu A, I_E = 0$	-	40	72	-	50	72	-	V
Collector-to-Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C = 1mA, I_B = 0$	-	30	56	-	40	56	-	V
Collector-to-Substrate Breakdown Voltage	$V_{(BR)CIO}$	$I_{CI} = 10\mu A, I_B = 0, I_E = 0$	-	40	72	-	50	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	$I_{CEO}$	$V_{CE} = 10V, I_B = 0$	1	-	See Curve	5	-	See Curve	5	$\mu A$
Collector-Cutoff Current	$I_{CBO}$	$V_{CB} = 10V, I_E = 0$	2	-	0.002	100	-	0.002	100	nA
DC Forward-Current Transfer Ratio	$h_{FE}$	$V_{CE} = 5V, I_C = 10mA$	3	-	85	-	-	85	-	-
		$V_{CE} = 5V, I_C = 1mA$	3	30	100	-	30	100	-	-
		$V_{CE} = 5V, I_C = 10\mu A$	3	-	90	-	-	90	-	-
Base-to-Emitter Voltage	$V_{BE}$	$V_{CE} = 3V, I_C = 1mA$	4	0.63	0.73	0.83	0.63	0.73	0.83	V
Collector-to-Emitter Saturation Voltage	$V_{CE SAT}$	$I_C = 10mA, I_B = 1mA$	5	-	0.33	-	-	0.33	-	V

**CA3146, CA3146A, CA3183, CA3183A**

**Electrical Specifications** CA3146 Series (Continued)

PARAMETER	SYMBOL	TEST CONDITIONS	TYP. PERF. CURVE FIG. NO.	CA3146			CA3146A			UNITS
		T <sub>A</sub> = 25°C		MN	TYP	MAX	MIN	TYP	MAX	
<b>DC CHARACTERISTICS FOR TRANSISTORS Q<sub>1</sub> AND Q<sub>2</sub> (AS A DIFFERENTIAL AMPLIFIER)</b>										
Magnitude of Input Offset Voltage  V <sub>BE1</sub> - V <sub>BE2</sub>	V <sub>IO</sub>	V <sub>CE</sub> = 5V, I <sub>E</sub> = 1mA	6, 7	-	0.48	5	-	0.48	5	mV
Magnitude of Base-to-Emitter Temperature Coefficient	$\left  \frac{\Delta V_{BE}}{\Delta T} \right $	V <sub>CE</sub> = 5V, I <sub>E</sub> = 1mA	-	-	1.9	-	-	1.9	-	mV/°C
Magnitude of V <sub>IO</sub> (V <sub>BE1</sub> - V <sub>BE2</sub> ) Temperature Coefficient	$\left  \frac{\Delta V_{IO}}{\Delta T} \right $	V <sub>CE</sub> = 5V, I <sub>C1</sub> = I <sub>C2</sub> = 1mA	-	-	1.1	-	-	1.1	-	μV/°C
Magnitude of Input Offset Current  I <sub>O1</sub> - I <sub>O2</sub>   (CA3146AE and CA3146E Only)	I <sub>IO</sub>	V <sub>CE</sub> = 5V, I <sub>C1</sub> = I <sub>C2</sub> = 1mA	8	-	0.3	2	-	0.3	2	μA
<b>DYNAMIC CHARACTERISTICS</b>										
Low Frequency Noise Figure	NF	f = 1kHz, V <sub>CE</sub> = 5V, I <sub>C</sub> = 100μA, Source Resistance = 1kΩ	10	-	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	12	-	100	-	-	100	-	-
Short-Circuit Input Impedance	h <sub>IE</sub>	f = 1kHz, V <sub>CE</sub> = 5V, I <sub>C</sub> = 1mA	12	-	3.5	-	-	2.7	-	kΩ
Open-Circuit Output Impedance	h <sub>OE</sub>	f = 1kHz, V <sub>CE</sub> = 5V, I <sub>C</sub> = 1mA	12	-	15.6	-	-	15.6	-	μS
Open-Circuit Reverse Voltage Transfer Ratio	h <sub>RE</sub>	f = 1kHz, V <sub>CE</sub> = 5V, I <sub>C</sub> = 1mA	12	-	1.8 x 10 <sup>-4</sup>	-	-	1.8 x 10 <sup>-4</sup>	-	-
Admittance Characteristics:										
Forward Transfer Admittance	Y <sub>FE</sub>	f = 1MHz, V <sub>CE</sub> = 5V, I <sub>C</sub> = 1 mA	13	-	31-j1.5	-	-	31-j1.5	-	mS
Input Admittance	Y <sub>IE</sub>	f = 1MHz, V <sub>CE</sub> = 5V, I <sub>C</sub> = 1 mA	14	-	0.3 + j0.04	-	-	0.35 + j0.04	-	mS
Output Admittance	Y <sub>OE</sub>	f = 1MHz, V <sub>CE</sub> = 5V, I <sub>C</sub> = 1 mA	15	-	0.001+ j0.03	-	-	0.001+ j0.03	-	mS
Reverse Transfer Admittance	Y <sub>RE</sub>	f = 1MHz, V <sub>CE</sub> = 5V, I <sub>C</sub> = 1 mA	16		See Curve			See Curve		mS
Gain-Bandwidth Product	f <sub>T</sub>	V <sub>CE</sub> = 5V, I <sub>C</sub> = 3mA	17	300	500	-	300	500	-	MHz
Emitter-to-Base Capacitance	C <sub>EB</sub>	V <sub>EB</sub> = 5V, I <sub>E</sub> = 0	18	-	0.70	-	-	0.70	-	pF
Collector-to-Base Capacitance	C <sub>CB</sub>	V <sub>CB</sub> = 5V, I <sub>C</sub> = 0	18	-	0.37	-	-	0.37	-	pF
Collector-to-Substrate Capacitance	C <sub>CI</sub>	V <sub>CI</sub> = 5V, I <sub>C</sub> = 0	18	-	2.2	-	-	2.2	-	pF

# CA3146, CA3146A, CA3183, CA3183A

## Electrical Specifications CA3183 Series

PARAMETER	SYMBOL	TEST CONDITIONS		CA3183			CA3183A			UNITS
		$T_A = 25^\circ\text{C}$	TYP. PERF. CURVE FIG. NO.	MIN	TYP	MAX	MIN	TYP	MAX	
<b>DC CHARACTERISTICS FOR EACH TRANSISTOR</b>										
Collector-to-Base Breakdown Voltage	$V_{(BR)CB}$ O	$I_C = 100\mu\text{A}, I_E = 0$	-	40	-	-	50	-	-	V
Collector-to-Emitter Breakdown Voltage	$V_{(BR)CE}$ O	$I_C = 1\text{mA}, I_B = 0$	-	30	-	-	40	-	-	V
Collector-to-Substrate Breakdown Voltage	$V_{(BR)CIO}$	$I_{CI} = 100\mu\text{A}, I_B = 0, I_E = 0$	-	40	-	-	50	-	-	V
Emitter-to-Base Breakdown Voltage	$V_{(BR)EB}$ O	$I_E = 500\mu\text{A}, I_C = 0$	-	5	-	-	5	-	-	V
Collector-Cutoff Current	$I_{CEO}$	$V_{CE} = 10\text{V}, I_B = 0$	19	-	-	10	-	-	10	$\mu\text{A}$
Collector-Cutoff Current	$I_{CBO}$	$V_{CB} = 10\text{V}, I_E = 0$	20	-	-	1	-	-	1	$\mu\text{A}$
DC Forward-Current Transfer Ratio	$h_{FE}$	$V_{CE} = 3\text{V}, I_C = 10\text{mA}$	21, 22	40	-	-	40	-	-	-
		$V_{CE} = 5\text{V}, I_C = 50\text{mA}$	-	40	-	-	40	-	-	-
Base-to-Emitter Voltage	$V_{BE}$	$V_{CE} = 3\text{V}, I_C = 10\text{mA}$	23	0.65	0.75	0.85	0.65	0.75	0.85	V
Collector-to-Emitter Saturation Voltage	$V_{CE\text{ SAT}}$ (Note 3)	$I_C = 50\text{mA}, I_B = 5\text{mA}$	24	-	1.7	3.0	-	1.7	3.0	V
<b>FOR TRANSISTORS Q<sub>1</sub> AND Q<sub>2</sub> (AS A DIFFERENTIAL AMPLIFIER)</b>										
Absolute Input Offset Voltage	$ V_{IO} $	$V_{CE} = 3\text{V}, I_C = 1\text{mA}$	25	-	0.47	5	-	0.47	5	mV
Absolute Input Offset Current	$ I_{IO} $	$V_{CE} = 3\text{V}, I_C = 1\text{mA}$	26	-	0.78	2.5	-	0.78	2.5	$\mu\text{A}$

## Typical Performance Curves DC Characteristics - CA3146 Series

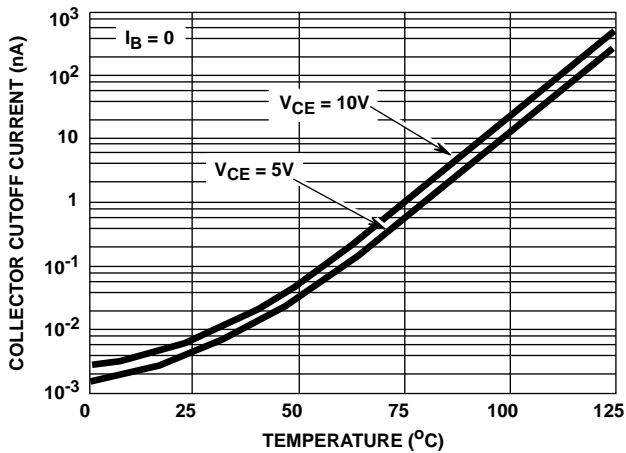


FIGURE 1.  $I_{CEO}$  vs TEMPERATURE FOR ANY TRANSISTOR

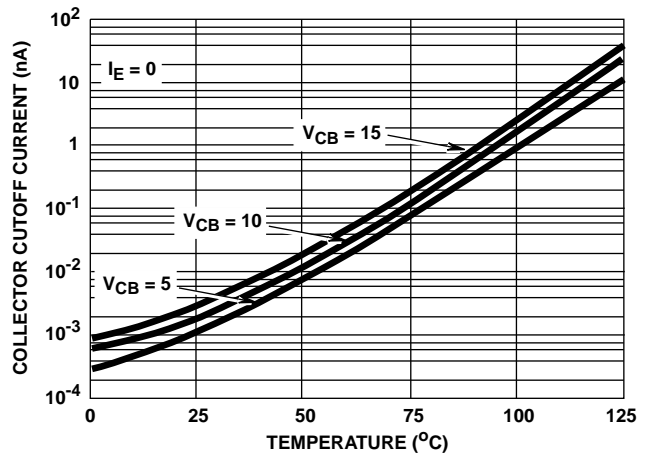


FIGURE 2.  $I_{CBO}$  vs TEMPERATURE FOR ANY TRANSISTOR

Typical Performance Curves DC Characteristics - CA3146 Series (Continued)

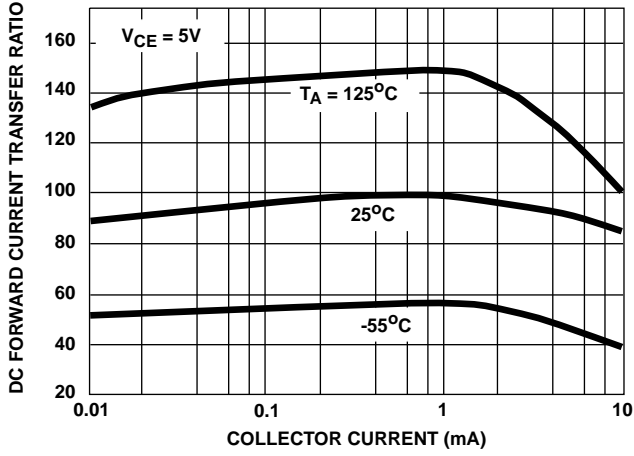


FIGURE 3.  $h_{FE}$  vs  $I_C$  FOR ANY TRANSISTOR

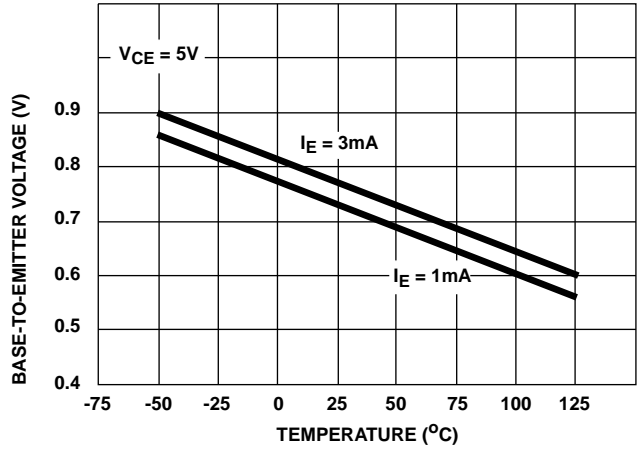


FIGURE 4.  $V_{BE}$  vs TEMPERATURE FOR ANY TRANSISTOR

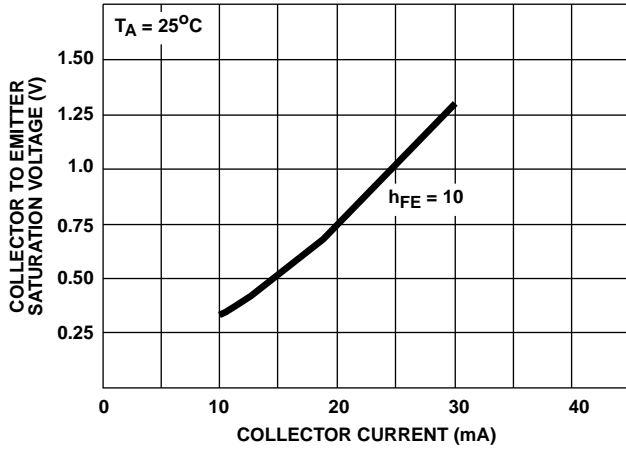


FIGURE 5.  $V_{CE SAT}$  vs  $I_C$  FOR ANY TRANSISTOR

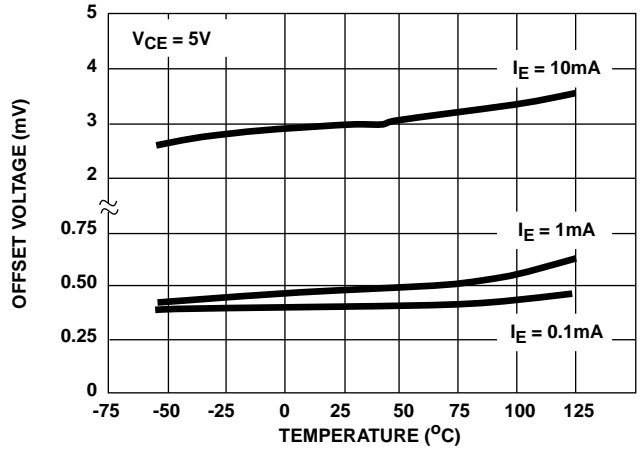


FIGURE 6.  $V_{IO}$  vs TEMPERATURE FOR  $Q_1$  AND  $Q_2$

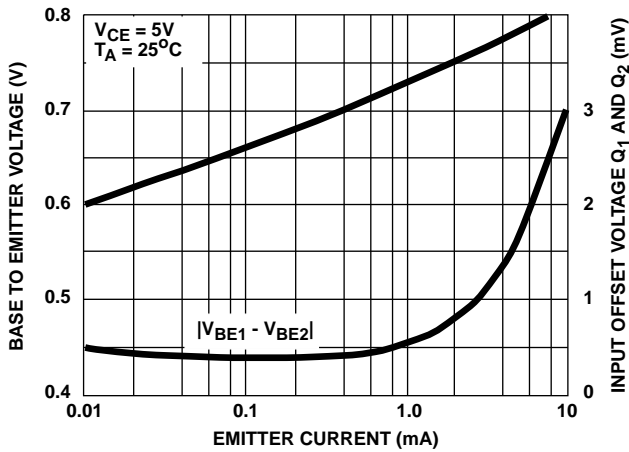


FIGURE 7.  $V_{BE}$  AND  $V_{IO}$  vs  $I_E$  FOR  $Q_1$  AND  $Q_2$

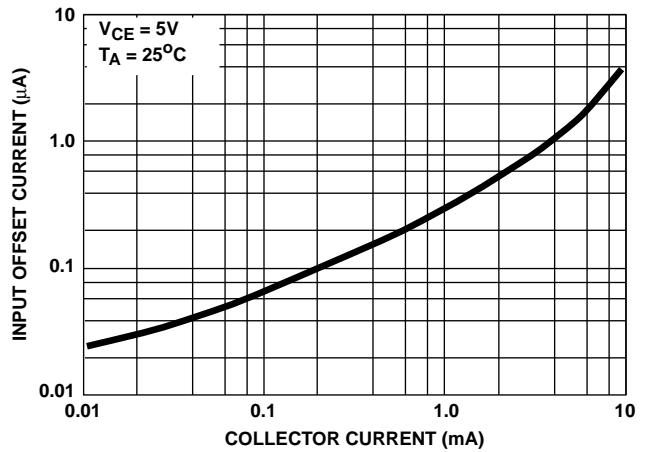


FIGURE 8.  $I_{IO}$  vs  $I_C$  FOR  $Q_1$  AND  $Q_2$

Typical Performance Curves Dynamic Characteristics (For Any Transistor) - CA3146 Series

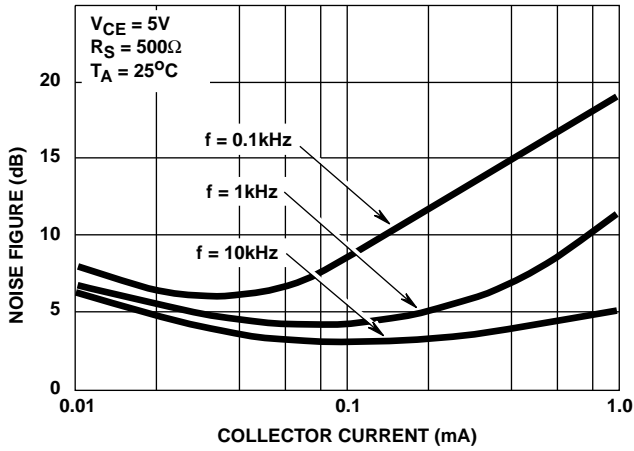


FIGURE 9. NF vs  $I_C$  AT  $R_S = 500\Omega$

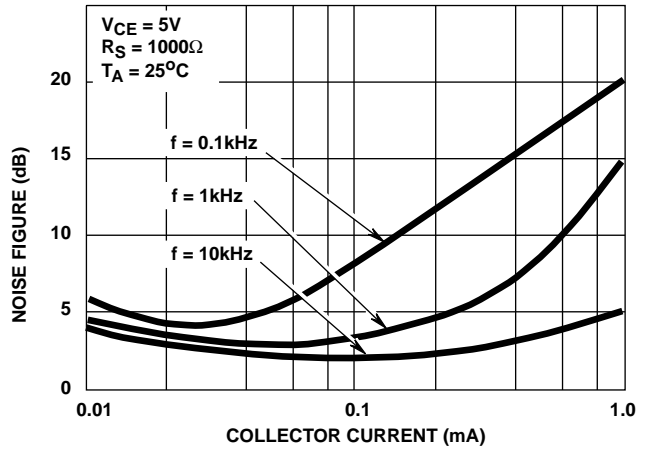


FIGURE 10. NF vs  $I_C$  AT  $R_S = 1k\Omega$

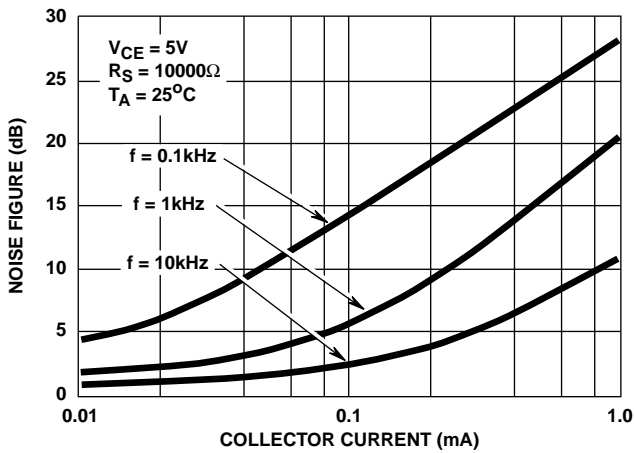


FIGURE 11. NF vs  $I_C$  AT  $R_S = 10k\Omega$

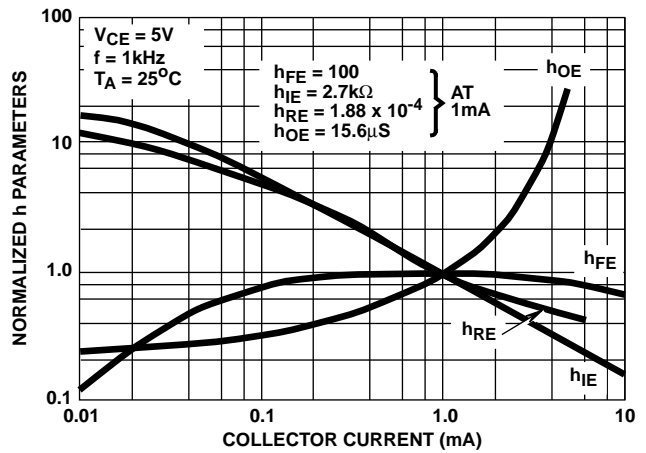


FIGURE 12.  $h_{FE}$ ,  $h_{IE}$ ,  $h_{OE}$ ,  $h_{RE}$  vs  $I_C$

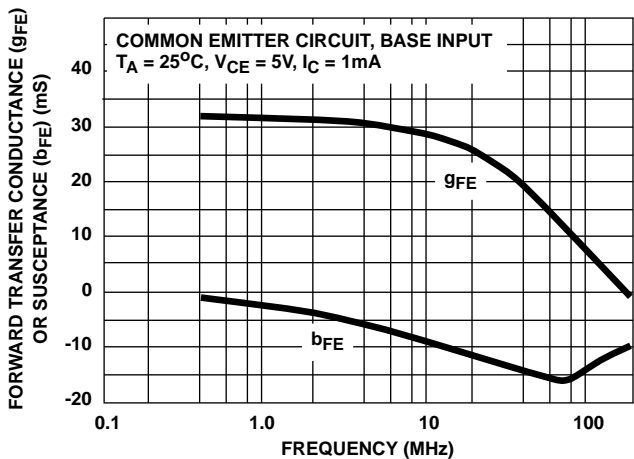


FIGURE 13.  $y_{FE}$  vs FREQUENCY

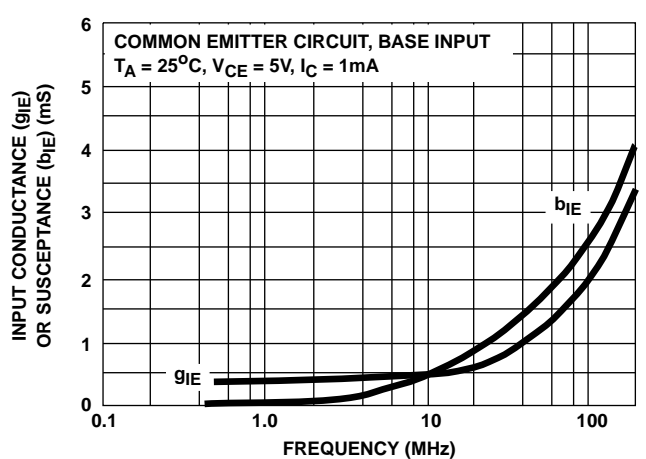


FIGURE 14.  $y_{IE}$  vs FREQUENCY

**Typical Performance Curves** Dynamic Characteristics (For Any Transistor) - CA3146 Series (Continued)

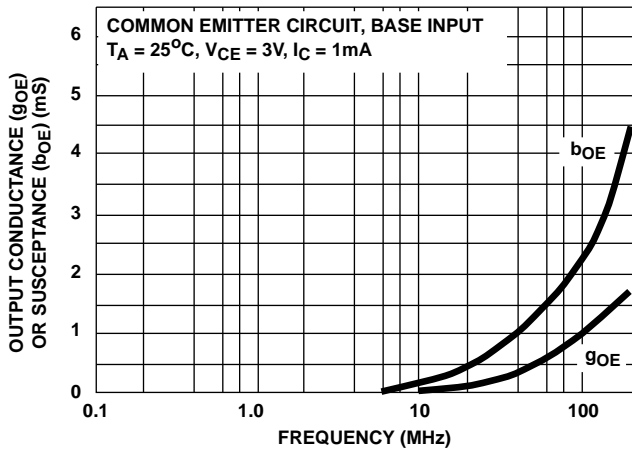


FIGURE 15. FIGURE 15.  $y_{OE}$  vs FREQUENCY

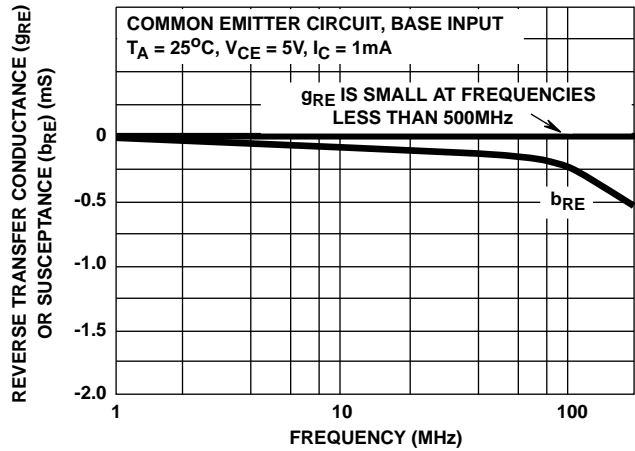


FIGURE 16. FIGURE 16.  $y_{RE}$  vs FREQUENCY

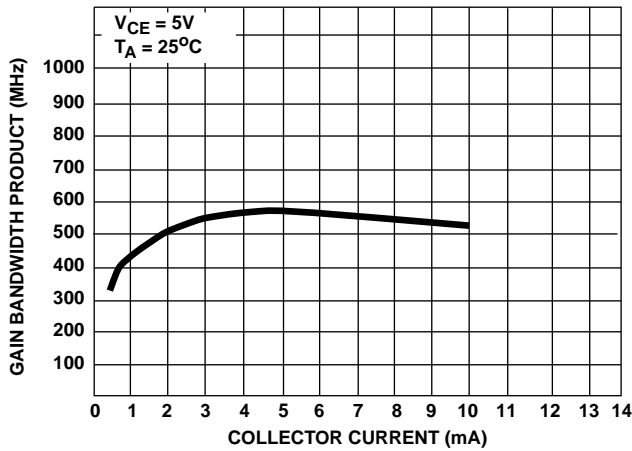


FIGURE 17.  $f_T$  vs  $I_C$

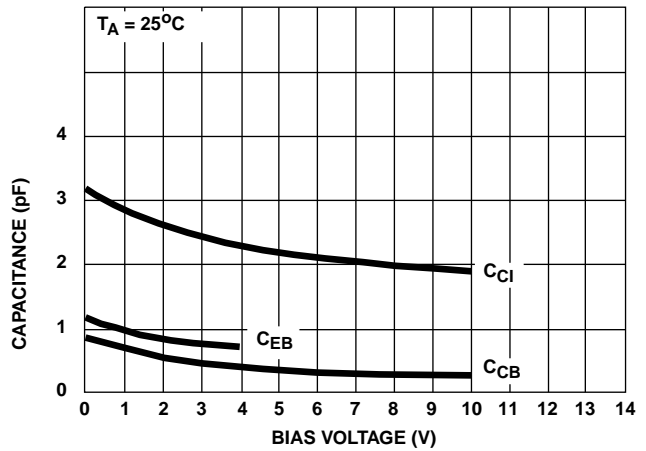


FIGURE 18.  $C_{EB}$ ,  $C_{CB}$ ,  $C_{CI}$  vs BIAS VOLTAGE

**Typical Performance Curves** DC Characteristics - CA3183 Series

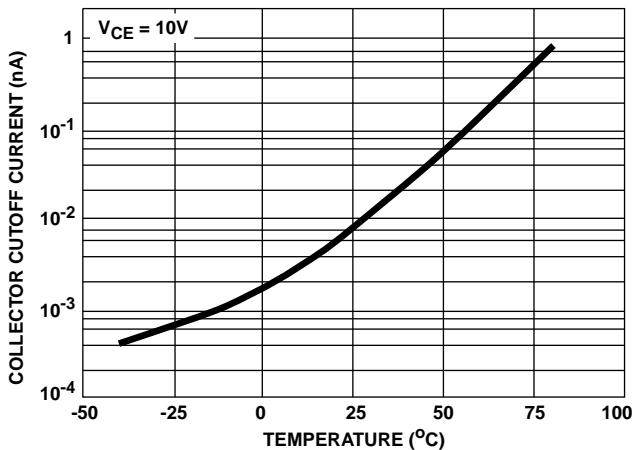


FIGURE 19.  $I_{CEO}$  vs TEMPERATURE FOR ANY TRANSISTOR

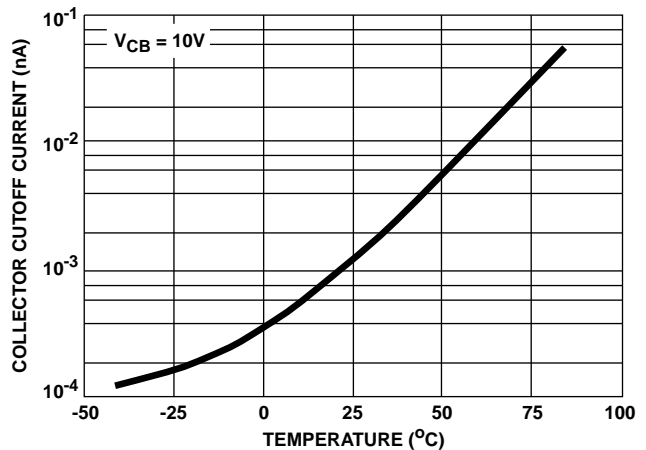


FIGURE 20.  $I_{CBO}$  vs TEMPERATURE FOR ANY TRANSISTOR

Typical Performance Curves DC Characteristics - CA3183 Series (Continued)

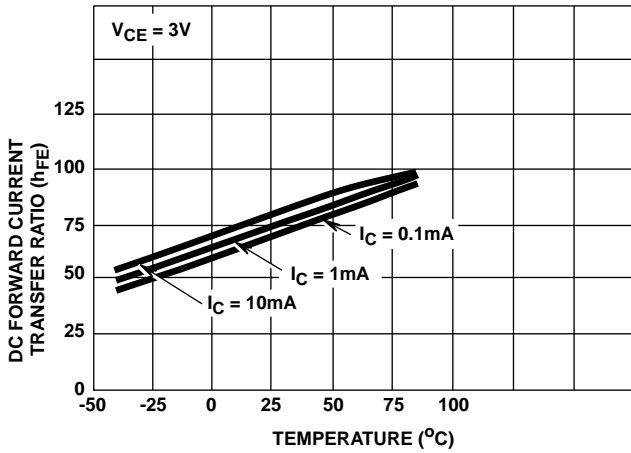


FIGURE 21.  $h_{FE}$  vs TEMPERATURE FOR ANY TRANSISTOR

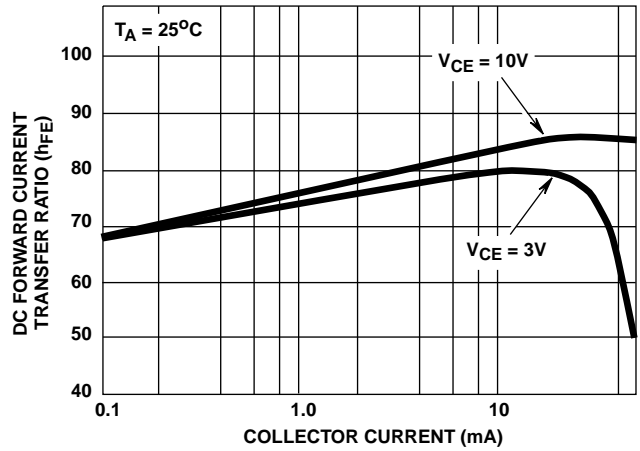


FIGURE 22.  $h_{FE}$  vs  $I_C$  FOR ANY TRANSISTOR

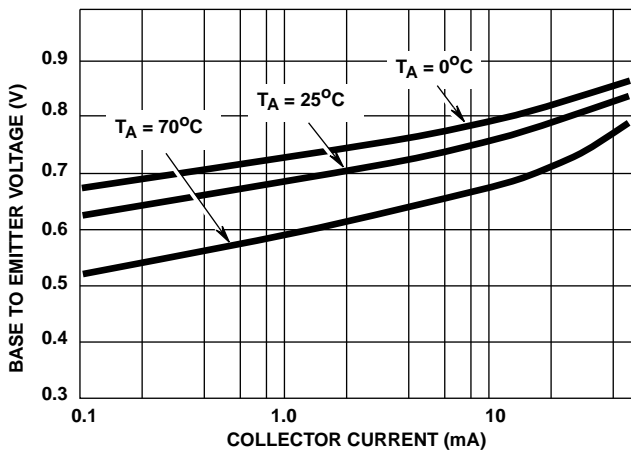


FIGURE 23.  $V_{BE}$  vs  $I_C$  FOR ANY TRANSISTOR

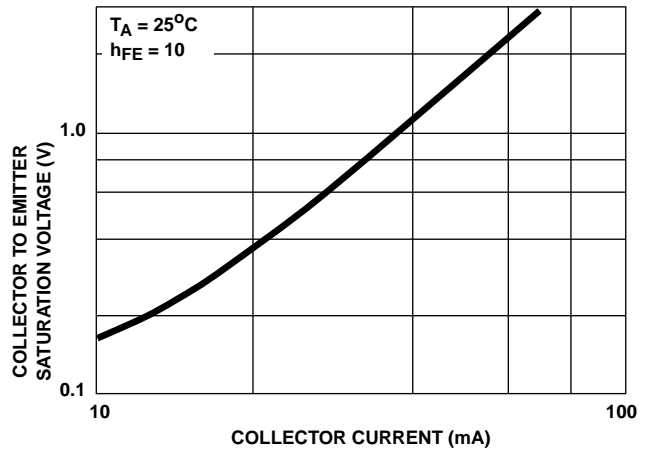


FIGURE 24.  $V_{CE SAT}$  vs  $I_C$  FOR ANY TRANSISTOR

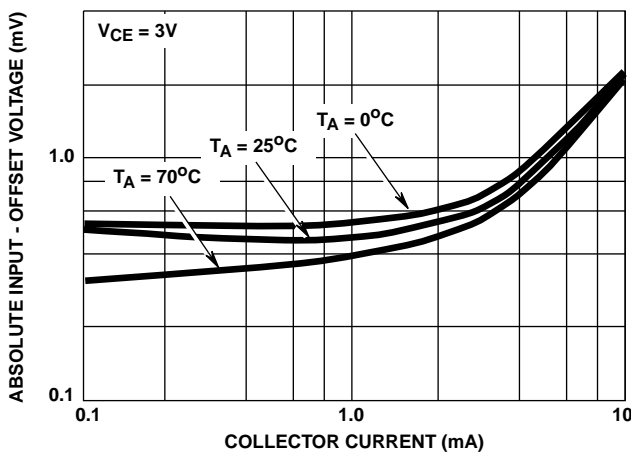


FIGURE 25.  $|V_{IO}|$  vs  $I_C$  FOR DIFFERENTIAL AMPLIFIER ( $Q_1$  AND  $Q_2$ )

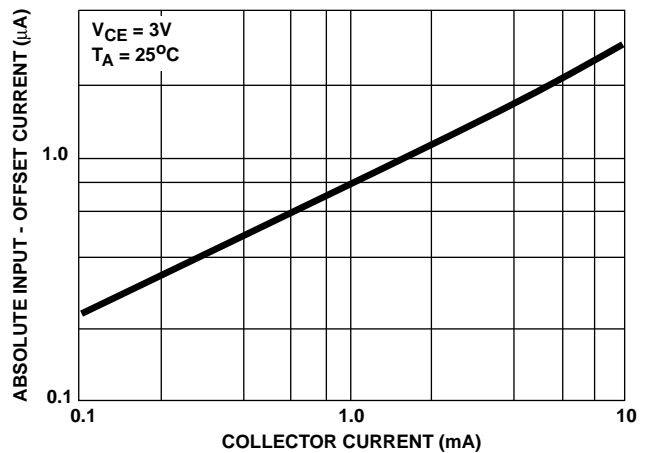


FIGURE 26.  $|I_{IO}|$  vs  $I_C$  FOR DIFFERENTIAL AMPLIFIER ( $Q_1$  AND  $Q_2$ )