HARRIS SEMICONDUCTOR

CA3146, CA3146A, CA3183, CA3183A

August 1996

High-Voltage Transistor Arrays

Features

- **Matched General Purpose Transistors**
  - **V_{BE} Match . . . . . ±5mV (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 (^oC)	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.)

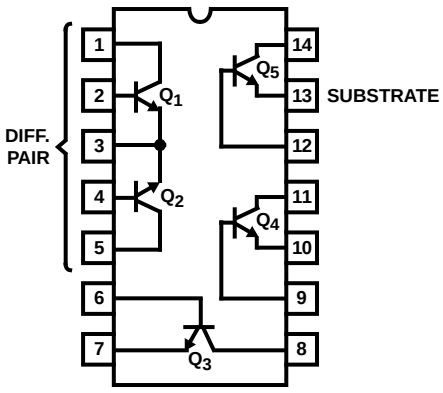
Types CA3183A and CA3183 consist of five high current transistors with independent connections for each transistor. In addition two of these transistors (Q_1 and Q_2) are matched at low current (i.e., 1mA) for applications where offset parameters are of special importance. A special substrate terminal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

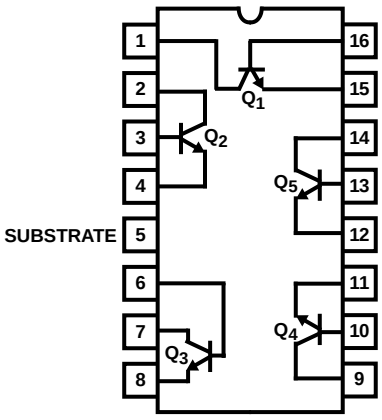
For detailed application information, see companion Application Note AN5296 “Application of the CA3018 Integrated Circuit Transistor Array.”

Pinouts

CA3146, CA3146A (PDIP, SOIC)
TOP VIEW



CA3183, CA3183A (PDIP, SOIC)
TOP VIEW



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

File Number **532.3**

Absolute Maximum Ratings

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
- CA3183A, CA3183 . . . . . 75mA

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

Thermal Information

Thermal Resistance (Typical, Note 2)	θ_{JA} ($^oC/W$)
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^oC

Maximum Junction Temperature (Plastic Package) . . . . . 150^oC

Maximum Storage Temperature Range (all types) . . -65^oC to 150^oC

Maximum Lead Temperature (Soldering 10s) . . . . . 300^oC
(SOIC - Lead Tips Only)

Operating Conditions

Temperature Range . . . . . -40^oC to 85^oC

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:

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. θ_{JA} is measured with the component mounted on an evaluation PC board in free air.
3. 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 $T_A = 25^oC$	TYP. PERF. CURVE FIG. NO.	CA3146 MN	CA3146 TYP	CA3146 MAX	CA3146A MIN	CA3146A TYP	CA3146A MAX	UNITS
DC CHARACTERISTICS FOR EACH TRANSISTOR										
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	μA
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

Electrical Specifications CA3146 Series **(Continued)**

PARAMETER	SYMBOL	TEST CONDITIONS $T_A = 25^oC$	TYP. PERF. CURVE FIG. NO.	CA3146 MN	CA3146 TYP	CA3146 MAX	CA3146A MIN	CA3146A TYP	CA3146A MAX	UNITS
DC CHARACTERISTICS FOR TRANSISTORS Q_1 AND Q_2 (AS A DIFFERENTIAL AMPLIFIER)										
Magnitude of Input Offset Voltage $\|V_{BE1} - V_{BE2}\|$	$\|V_{IO}\|$	V_{CE} = 5V, I_E = 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_{CE} = 5V, I_E = 1mA	-	-	1.9	-	-	1.9	-	$mV/^oC$
Magnitude of V_{IO} ($V_{BE1} - V_{BE2}$) Temperature Coefficient	$\left\|\frac{\Delta V_{IO}}{\Delta T}\right\|$	V_{CE} = 5V, $I_{C1} = I_{C2}$ = 1mA	-	-	1.1	-	-	1.1	-	$\mu V/^oC$
Magnitude of Input Offset Current $\|I_{IO1} - I_{IO2}\|$ (CA3146AE and CA3146E Only)	I_{IO}	V_{CE} = 5V, $I_{C1} = I_{C2}$ = 1mA	8	-	0.3	2	-	0.3	2	µA
DYNAMIC CHARACTERISTICS										
Low Frequency Noise Figure	NF	f = 1kHz, V_{CE} = 5V, I_C = 100µA, Source Resistance = 1kΩ	10	-	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	12	-	100	-	-	100	-	-
Short-Circuit Input Impedance	h_{IE}	f = 1kHz, V_{CE} = 5V, I_C = 1mA	12	-	3.5	-	-	2.7	-	kΩ
Open-Circuit Output Impedance	h_{OE}	f = 1kHz, V_{CE} = 5V, I_C = 1mA	12	-	15.6	-	-	15.6	-	µS
Open-Circuit Reverse Voltage Transfer Ratio	h_{RE}	f = 1kHz, V_{CE} = 5V, I_C = 1mA	12	-	1.8×10^{-4}	-	-	1.8×10^{-4}	-	-
Admittance Characteristics:										
Forward Transfer Admittance	Y_{FE}	f = 1MHz, V_{CE} = 5V, I_C = 1 mA	13	-	31-j1.5	-	-	31-j1.5	-	mS
Input Admittance	Y_{IE}	f = 1MHz, V_{CE} = 5V, I_C = 1 mA	14	-	0.3 + j0.04	-	-	0.35 + j0.04	-	mS
Output Admittance	Y_{OE}	f = 1MHz, V_{CE} = 5V, I_C = 1 mA	15	-	0.001+ j0.03	-	-	0.001+ j0.03	-	mS
Reverse Transfer Admittance	Y_{RE}	f = 1MHz, V_{CE} = 5V, I_C = 1 mA	16		See Curve			See Curve		mS
Gain-Bandwidth Product	f_T	V_{CE} = 5V, I_C = 3mA	17	300	500	-	300	500	-	MHz
Emitter-to-Base Capacitance	C_{EB}	V_{EB} = 5V, I_E = 0	18	-	0.70	-	-	0.70	-	pF
Collector-to-Base Capacitance	C_{CB}	V_{CB} = 5V, I_C = 0	18	-	0.37	-	-	0.37	-	pF
Collector-to-Substrate Capacitance	C_{CI}	V_{CI} = 5V, I_C = 0	18	-	2.2	-	-	2.2	-	pF

Electrical Specifications CA3183 Series

PARAMETER	SYMBOL	TEST CONDITIONS		CA3183			CA3183A			UNITS
		$T_A = 25^oC$	TYP. PERF. CURVE FIG. NO.	MIN	TYP	MAX	MIN	TYP	MAX	
DC CHARACTERISTICS FOR EACH TRANSISTOR										
Collector-to-Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C = 100\mu A$, $I_E = 0$	-	40	-	-	50	-	-	V
Collector-to-Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C = 1mA$, $I_B = 0$	-	30	-	-	40	-	-	V
Collector-to-Substrate Breakdown Voltage	$V_{(BR)CIO}$	$I_{CI} = 100\mu A$, $I_B = 0$, $I_E = 0$	-	40	-	-	50	-	-	V
Emitter-to-Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E = 500\mu A$, $I_C = 0$	-	5	-	-	5	-	-	V
Collector-Cutoff Current	I_{CEO}	$V_{CE} = 10V$, $I_B = 0$	19	-	-	10	-	-	10	µA
Collector-Cutoff Current	I_{CBO}	$V_{CB} = 10V$, $I_E = 0$	20	-	-	1	-	-	1	µA
DC Forward-Current Transfer Ratio	h_{FE}	$V_{CE} = 3V$, $I_C = 10mA$	21, 22	40	-	-	40	-	-	-
		$V_{CE} = 5V$, $I_C = 50mA$	-	40	-	-	40	-	-	-
Base-to-Emitter Voltage	V_{BE}	$V_{CE} = 3V$, $I_C = 10mA$	23	0.65	0.75	0.85	0.65	0.75	0.85	V
Collector-to-Emitter Saturation Voltage	$V_{CE\ SAT}$ (Note 3)	$I_C = 50mA$, $I_B = 5mA$	24	-	1.7	3.0	-	1.7	3.0	V
FOR TRANSISTORS Q_1 AND Q_2 (AS A DIFFERENTIAL AMPLIFIER)										
Absolute Input Offset Voltage	$\|V_{IO}\|$	$V_{CE} = 3V$, $I_C = 1mA$	25	-	0.47	5	-	0.47	5	mV
Absolute Input Offset Current	$\|I_{IO}\|$	$V_{CE} = 3V$, $I_C = 1mA$	26	-	0.78	2.5	-	0.78	2.5	µA

Typical Performance Curves DC Characteristics - CA3146 Series

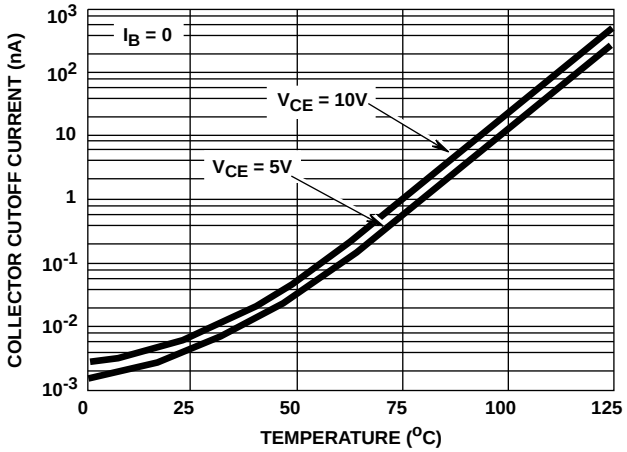


FIGURE 1. I_{CEO} vs TEMPERATURE FOR ANY TRANSISTOR

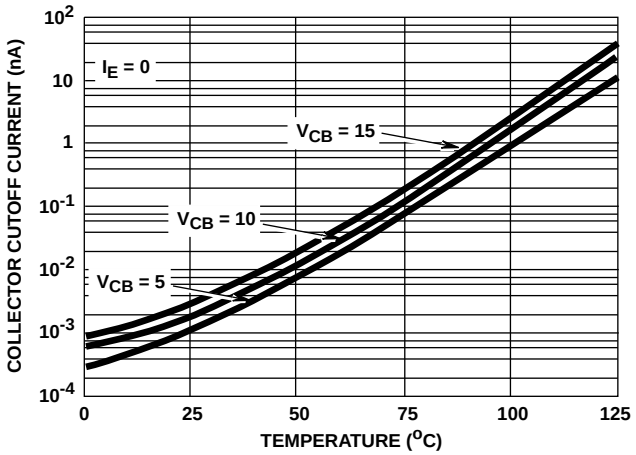


FIGURE 2. I_{CBO} vs TEMPERATURE FOR ANY TRANSISTOR

Typical Performance Curves DC Characteristics - CA3146 Series (Continued)

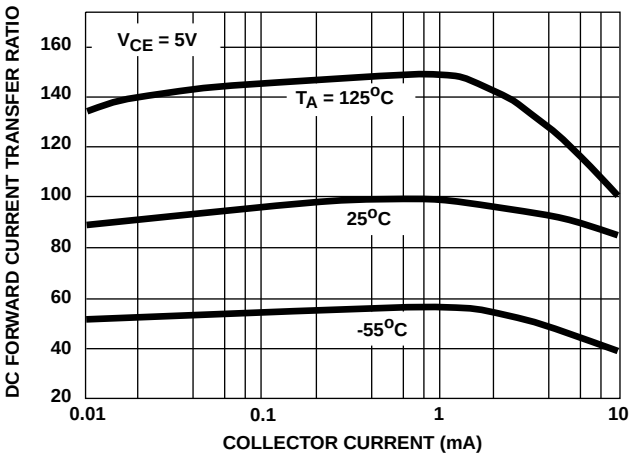


FIGURE 3. h_{FE} vs I_C FOR ANY TRANSISTOR

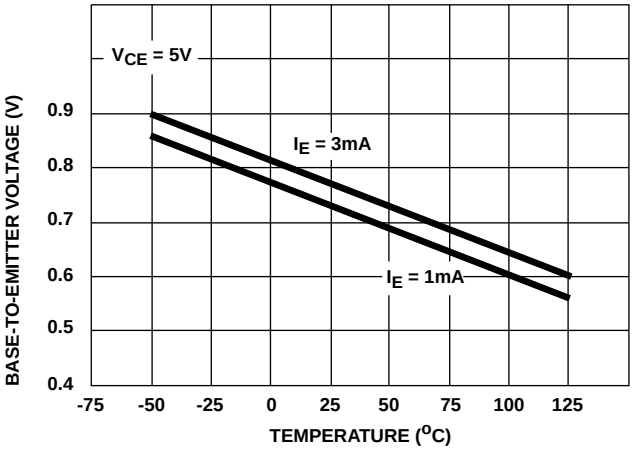


FIGURE 4. V_{BE} vs TEMPERATURE FOR ANY TRANSISTOR

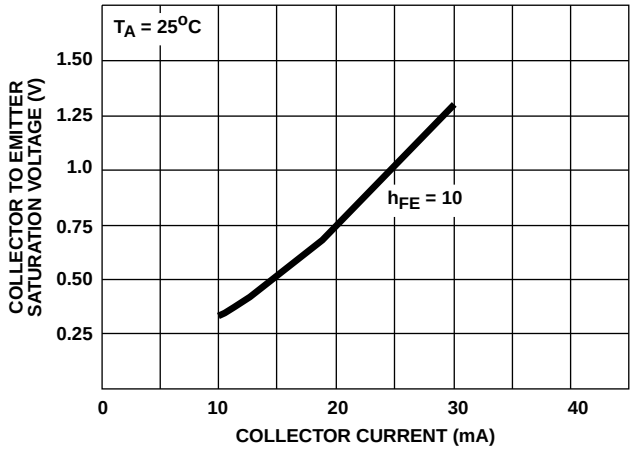


FIGURE 5. $V_{CE\ SAT}$ vs I_C FOR ANY TRANSISTOR

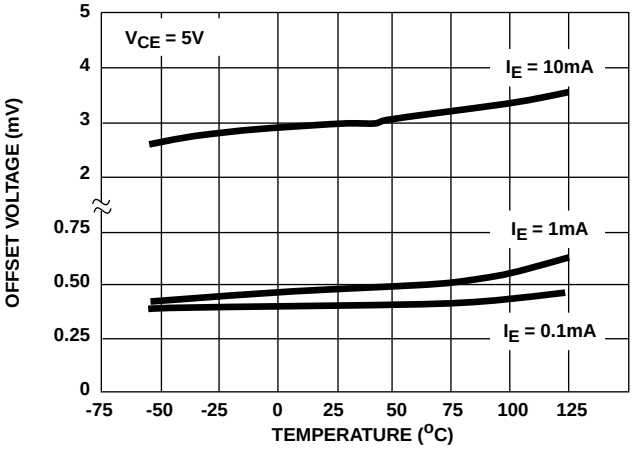


FIGURE 6. V_{IO} vs TEMPERATURE FOR Q_1 AND Q_2

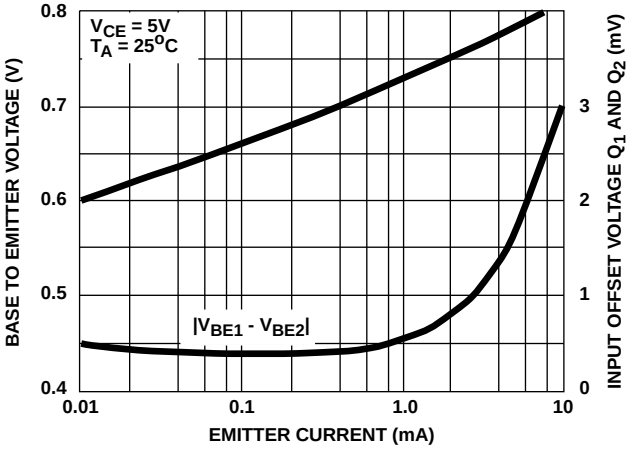


FIGURE 7. V_{BE} AND V_{IO} vs I_E FOR Q_1 AND Q_2

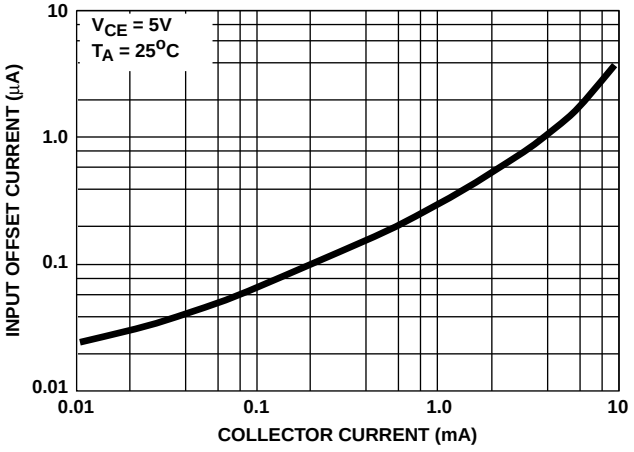


FIGURE 8. I_{IO} vs I_C FOR Q_1 AND Q_2

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

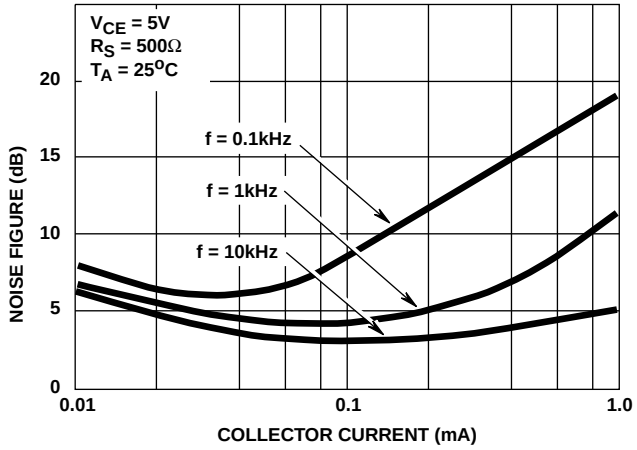


FIGURE 9. NF vs I_C AT R_S = 500Ω

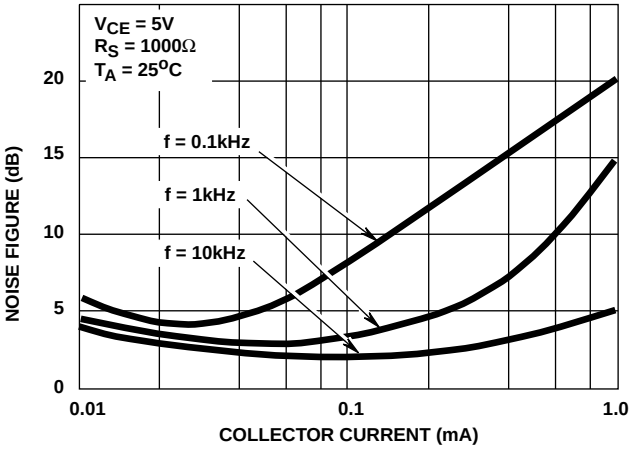


FIGURE 10. NF vs I_C AT R_S = 1kΩ

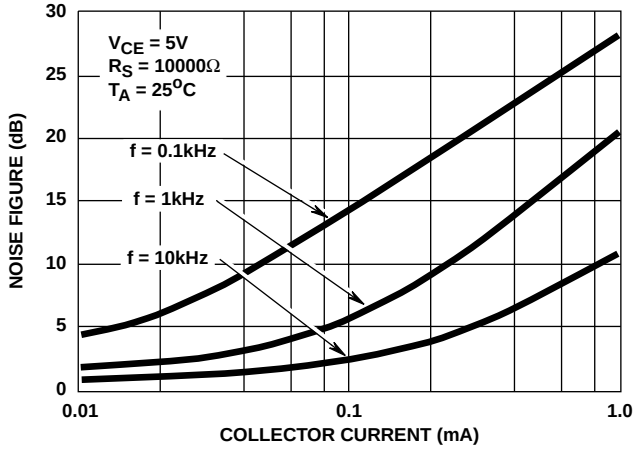


FIGURE 11. NF vs I_C AT R_S = 10kΩ

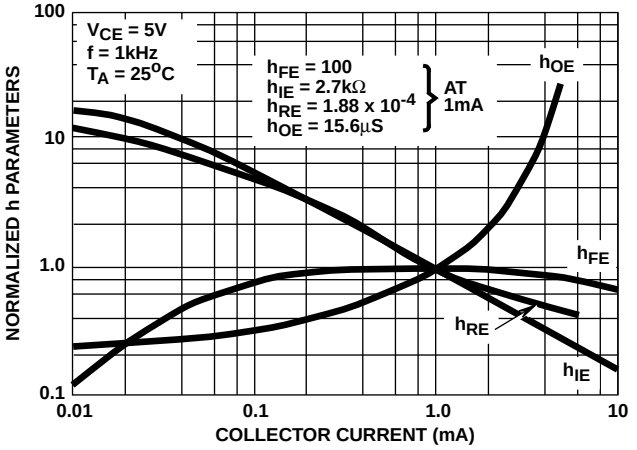


FIGURE 12. h_{FE}, h_{IE}, h_{OE}, h_{RE} vs I_C

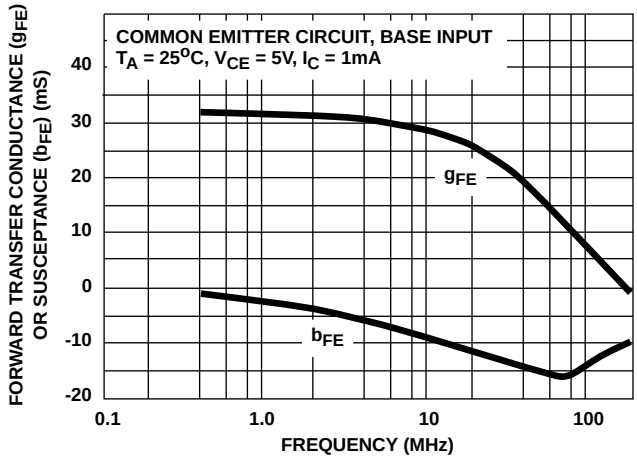


FIGURE 13. y_{FE} vs FREQUENCY

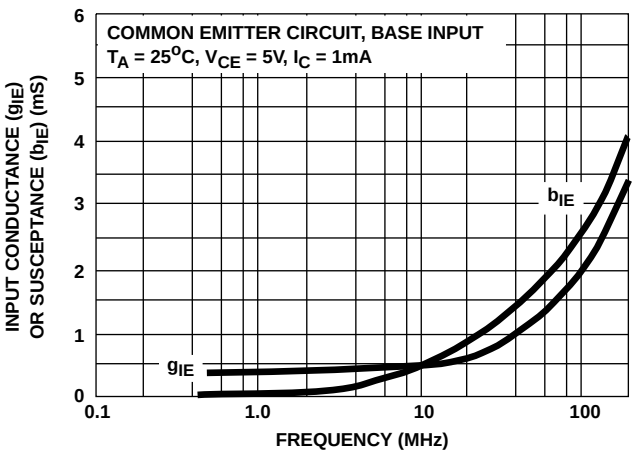


FIGURE 14. y_{IE} vs FREQUENCY

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

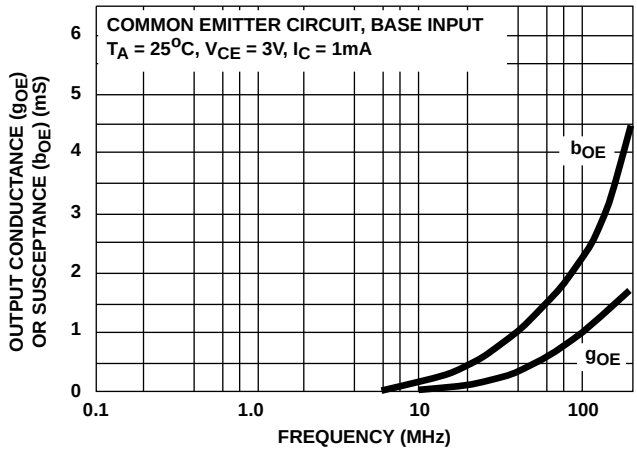


FIGURE 15. FIGURE 15. y_{OE} vs FREQUENCY

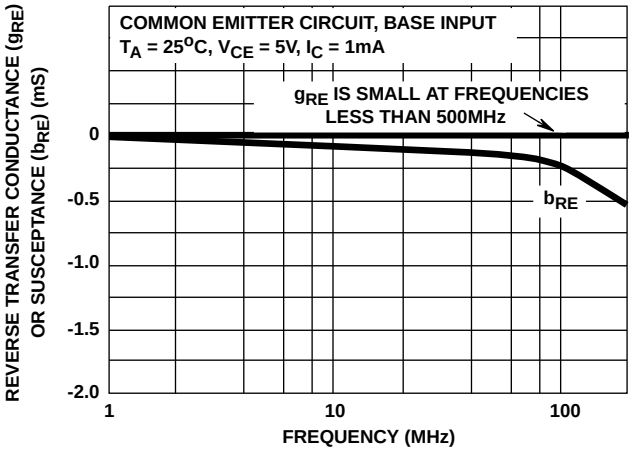


FIGURE 16. FIGURE 16. y_{RE} vs FREQUENCY

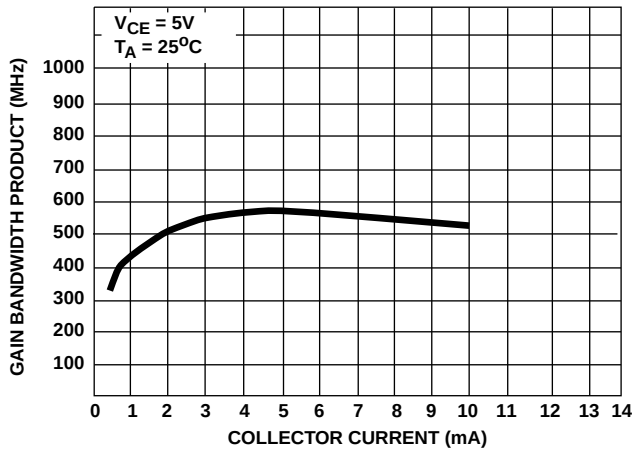


FIGURE 17. f_T vs I_C

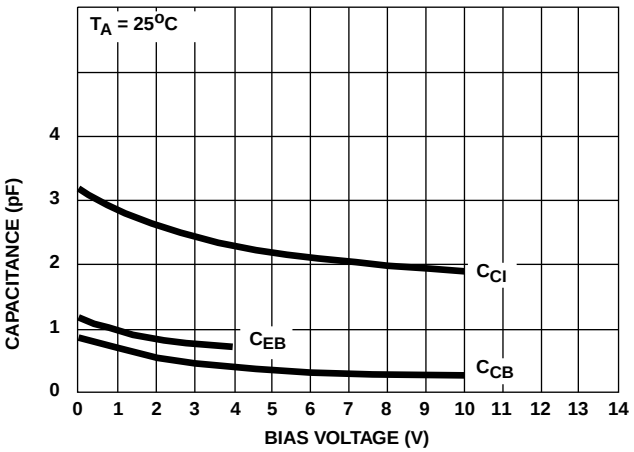


FIGURE 18. C_{EB}, C_{CB}, C_{CI} vs BIAS VOLTAGE

Typical Performance Curves DC Characteristics - CA3183 Series

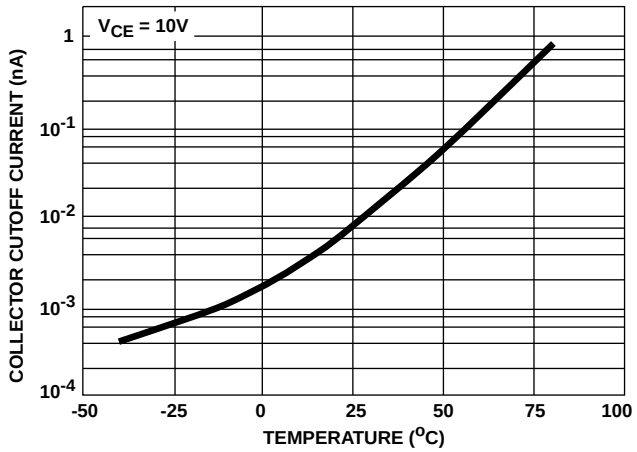


FIGURE 19. I_{CEO} vs TEMPERATURE FOR ANY TRANSISTOR

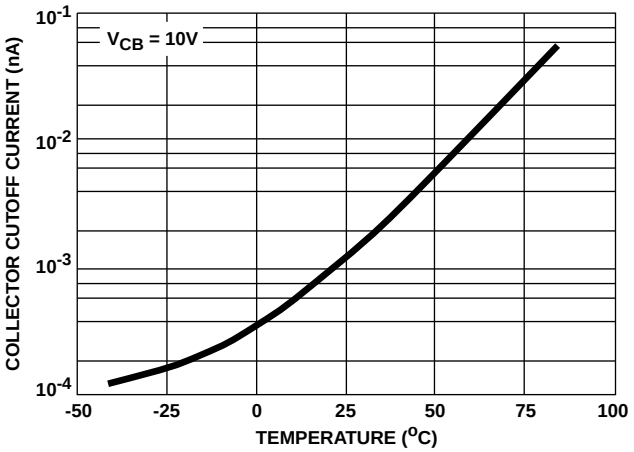


FIGURE 20. I_{CBO} vs TEMPERATURE FOR ANY TRANSISTOR

Typical Performance Curves DC Characteristics - CA3183 Series (Continued)

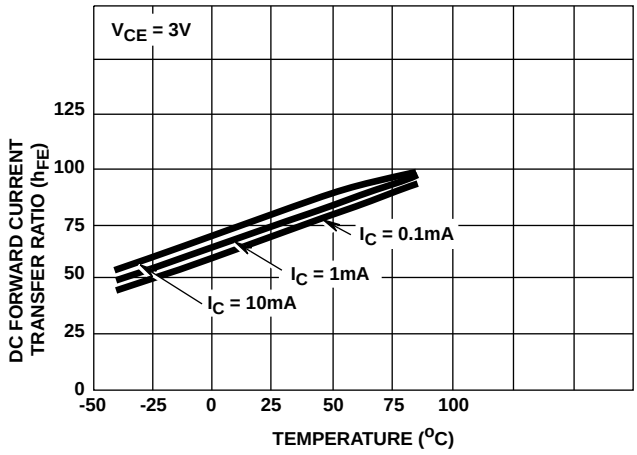


FIGURE 21. h_{FE} vs TEMPERATURE FOR ANY TRANSISTOR

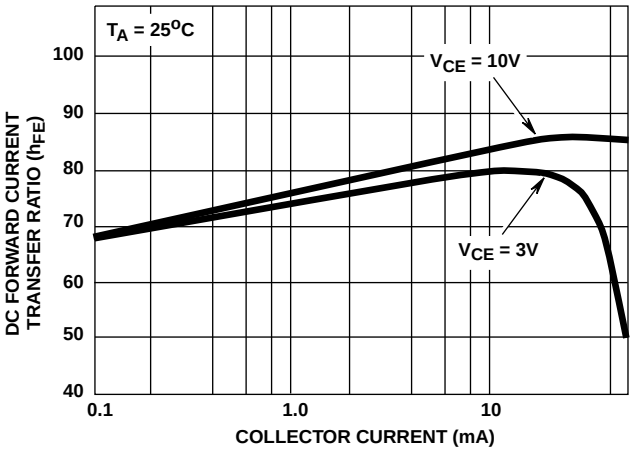


FIGURE 22. h_{FE} vs I_C FOR ANY TRANSISTOR

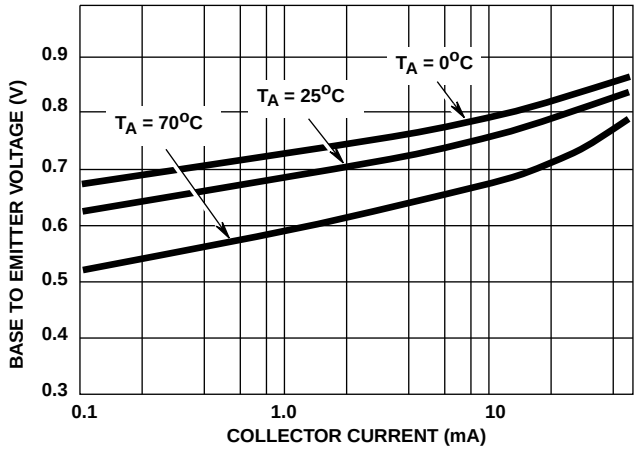


FIGURE 23. V_{BE} vs I_C FOR ANY TRANSISTOR

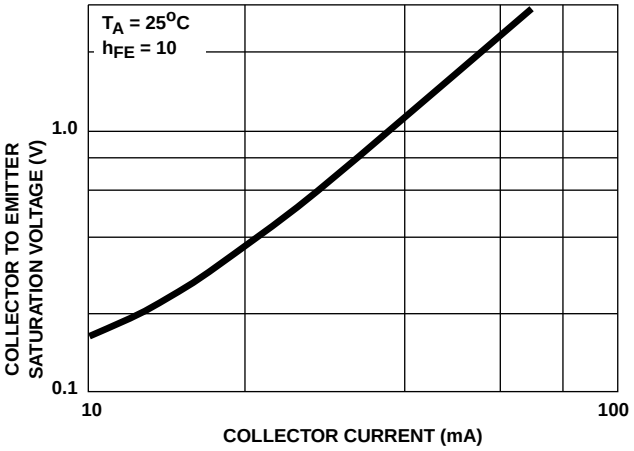


FIGURE 24. $V_{CE\ SAT}$ vs I_C FOR ANY TRANSISTOR

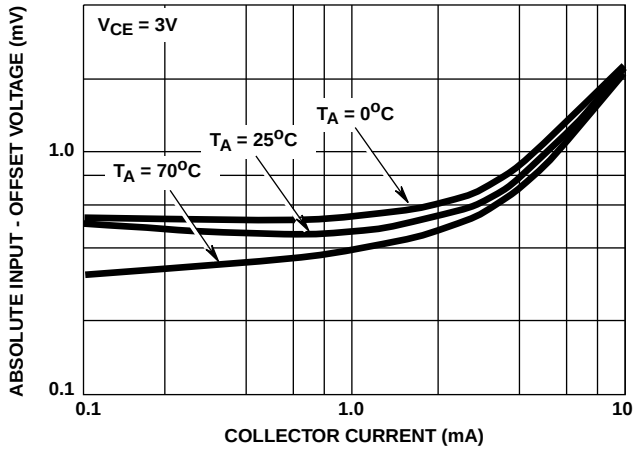


FIGURE 25. $|V_{IO}|$ vs I_C FOR DIFFERENTIAL AMPLIFIER (Q_1 AND Q_2)

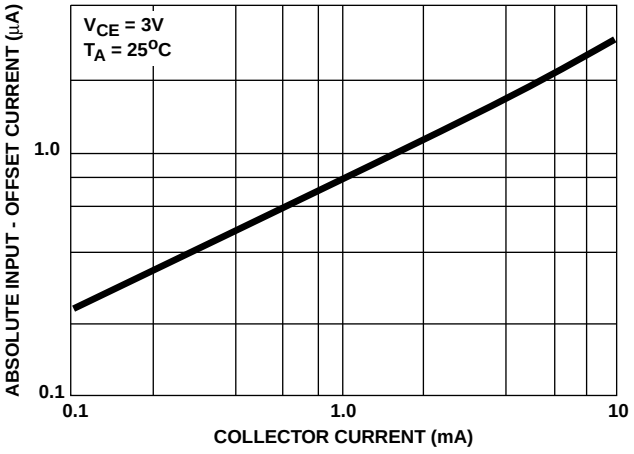


FIGURE 26. $|I_{IO}|$ vs I_C FOR DIFFERENTIAL AMPLIFIER (Q_1 AND Q_2)