

Data Sheet August 12, 2005 FN4445.2

# Ultra High Frequency Matched Pair Transistors

The HFA3134 and HFA3135 are Ultra High Frequency Transistor pairs that are fabricated with Intersil Corporation's complementary bipolar UHF-1X process. The NPN transistors exhibit an  $f_T$  of 8.5GHz, while the PNP transistors have an  $f_T$  of 7GHz. Both types exhibit low noise, making them ideal for high frequency amplifier and mixer applications.

Both arrays are matched high frequency transistor pairs. The matching simplifies DC bias problems and it minimizes imbalances in differential amplifier configurations. Their high  $f_T$  enables the design of UHF amplifiers which exhibit exceptional stability.

### **Ordering Information**

PART NUMBER (BRAND)	TEMP. RANGE (°C)	PACKAGE	PKG. DWG.#
HFA3134IH96 (04/†0)	-40 to 85	6 Ld SOT23 Tape and Reel	P6.064
HFA3134IHZ96 (4Z/Zt/) (Note)	-40 to 85	6 Ld SOT23 Tape and Reel (Pb-free)	P6.064
HFA3135IH96 (05/90)	-40 to 85	6 Ld SOT23 Tape and Reel	P6.064
HFA3135IHZ96 (5Z/9Z) (Note)	-40 to 85	6 Ld SOT23 Tape and Reel (Pb-free)	P6.064

NOTE: Intersil Pb-free plus anneal products employ special Pb-free material sets; molding compounds/die attach materials and 100% matte tin plate termination finish, which are RoHS compliant and compatible with both SnPb and Pb-free soldering operations. Intersil Pb-free products are MSL classified at Pb-free peak reflow temperatures that meet or exceed the Pb-free requirements of IPC/JEDEC J STD-020.

### Features

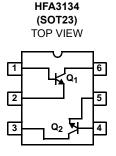
NPN Transistor (f <sub>T</sub> )	8.5GHz
NPN Current Gain (h <sub>FE</sub> )	100
• NPN Noise Figure (50 $\Omega$ ) at 1.0GHz	2.6dB
• PNP Transistor (f <sub>T</sub> )	7GHz
PNP Current Gain (h <sub>FE</sub> )	57
• PNP Noise Figure (50 $\Omega$ ) at 900MHz	4.6dB
• Small Package (EIAJ-SC74 Compliant)	SOT23-6

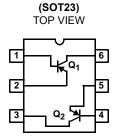
Pb-Free Plus Anneal Available (RoHS Compliant)

### **Applications**

- · VHF/UHF Amplifiers
- VHF/UHF Mixers
- · IF Converters
- · Synchronous Detectors

### **Pinouts**





HFA3135

### **Absolute Maximum Ratings**

Collector to Emitter Voltage ( $R_B \le 10 k\Omega$ to GND)
Collector to Base Voltage (Open Emitter)
Emitter to Base Voltage (Reverse Bias) 4.5V
Collector Current
26mA at T <sub>J</sub> = 125°C
Base Current (Note 2)
ESD Rating
Human Body Model
(Per MIL-STD-883 Method 3015.7)

### **Thermal Information**

Thermal Resistance (Typical, Note 1)	θ <sub>JA</sub> (°C/W)
SOT23-6 Package	350
Maximum Junction Temperature (Die)	175°C
Maximum Junction Temperature (Plastic Package)	150°C
Maximum Storage Temperature Range6	5°C to 150°C
Maximum Lead Temperature	300°C
(Soldering 10s, Lead Tips Only)	

### **Operating Conditions**

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.  $\theta_{\mbox{\scriptsize JA}}$  is measured with the component mounted on an evaluation PC board in free air.
- 2. If a transistor is used in a diode configuration, the collector must be connected to the base to avoid exceeding the maximum base current specification.

### Electrical Specifications T<sub>A</sub> = 25°C

PARAMETER	SYMBOL	TEST CONDITIONS	(NOTE 3) TEST LEVEL	MIN	TYP	MAX	UNITS
DC CHARACTERISTICS FOR HFA3134 (NPN)	•		•				
Collector to Base Breakdown Voltage	V <sub>(BR)CBO</sub>	$I_C = 10\mu A, I_E = 0$	Α	12	21	-	V
Collector to Emitter Breakdown Voltage	V <sub>(BR)CEO</sub>	I <sub>C</sub> = 100μA, I <sub>B</sub> = 0	Α	4	9	-	V
	V <sub>(BR)CER</sub>	$I_C$ = 100μA, $R_B$ = 10k $\Omega$	Α	11	17	-	V
Emitter to Base Breakdown Voltage (Note 4)	V <sub>(BR)EBO</sub>	$I_E = 10\mu A, I_C = 0$	В	-	6	-	V
Collector-Cutoff-Current	I <sub>CEO</sub>	V <sub>CE</sub> = 6V, I <sub>B</sub> = 0	Α	-5	-	5	nA
Collector-Cutoff-Current	I <sub>CBO</sub>	V <sub>CB</sub> = 8V, I <sub>E</sub> = 0	Α	-5	-	5	nA
Emitter-Cutoff-Current (Note 5)	I <sub>EBO</sub>	V <sub>EB</sub> = 1V, I <sub>C</sub> = 0	В	-	1	-	pА
Collector to Collector Leakage			С	-	1	-	nA
Collector to Emitter Saturation Voltage	V <sub>CE(SAT)</sub>	I <sub>C</sub> = 10mA, I <sub>B</sub> = 1mA	Α	-	95	250	mV
Base to Emitter Voltage (Note 5)	V <sub>BE</sub>	I <sub>C</sub> = 10mA, V <sub>CE</sub> = 2V	Α	-	780	1000	mV
Q <sub>1</sub> to Q <sub>2</sub> Base to Emitter Voltage Match	ΔV <sub>BE</sub>	I <sub>C</sub> = 10mA, V <sub>CE</sub> = 2V	Α	-	1.2	6	mV
(Note 5)		I <sub>C</sub> = 1mA, V <sub>CE</sub> = 2V	Α	-	1.0	6	mV
		I <sub>C</sub> = 0.1mA, V <sub>CE</sub> = 2V	Α	-	0.7	6	mV
Base to Emitter Voltage Drift		I <sub>C</sub> = 10mA	С	-	-1.5	-	mV/°C
DC Forward-Current Transfer Ratio	h <sub>FE</sub>	I <sub>C</sub> = 10mA, V <sub>CE</sub> = 2V	Α	48	80	200	
(Note 5)		I <sub>C</sub> = 1mA, V <sub>CE</sub> = 2V	Α	48	87	200	
		I <sub>C</sub> = 0.1mA, V <sub>CE</sub> = 2V	Α	48	90	200	
		I <sub>C</sub> = 10mA, V <sub>CE</sub> = 5V	Α	48	96	200	
		I <sub>C</sub> = 1mA, V <sub>CE</sub> = 5V	Α	48	96	200	
		I <sub>C</sub> = 0.1mA, V <sub>CE</sub> = 5V	Α	48	100	200	
Q <sub>1</sub> to Q <sub>2</sub> Current Transfer Ratio Match	Δh <sub>FE</sub>	$ 1mA \leq I_C \leq 10mA, \\ 1V \leq V_{CE} \leq 5V $	А	-	2	8	%
Early Voltage	V <sub>A</sub>	$I_C = 1mA$ , $\Delta V_{CE} = 3V$	Α	20	30	-	V

# **Electrical Specifications** $T_A = 25$ °C (Continued)

			(NOTE 3) TEST				
PARAMETER	SYMBOL	TEST CONDITIONS	LEVEL	MIN	TYP	MAX	UNITS
DYNAMIC CHARACTERISTICS FOR HFA3134	(NPN)						
Noise Figure N	NF	$ f = 1.0 GHz, I_C = 10 mA, $ $1V \le V_{CE} \le 5V, Z_S = 50 \Omega $	В	-	2.4	-	dB
		$ f = 1.0GHz, I_C = 1mA, \\ 1V \le V_{CE} \le 5V, Z_S = 50\Omega $	В	-	2.6	-	dB
Current Gain-Bandwidth Product	f <sub>T</sub>	$I_C$ = 10mA, $V_{CE}$ = 5V	В	-	8.5	-	GHz
(Note 5)		I <sub>C</sub> = 1mA, V <sub>CE</sub> = 5V	В	-	3	-	GHz
Power Gain-Bandwidth Product	f <sub>MAX</sub>	I <sub>C</sub> = 10mA, V <sub>CE</sub> = 5V	В	-	7.5	-	GHz
Base to Emitter Capacitance		V <sub>BE</sub> = -0.5V	В	-	600	-	fF
Collector to Base Capacitance		V <sub>CB</sub> = 3V	В	-	500	-	fF

# **Electrical Specifications** T<sub>A</sub> = 25°C

PARAMETER	SYMBOL	TEST CONDITIONS	(NOTE 3) TEST LEVEL	MIN	TYP	MAX	UNITS
DC CHARACTERISTICS FOR HFA3135 (PNP)		1		ı	ı		<u>I</u>
Collector to Base Breakdown Voltage	V <sub>(BR)CBO</sub>	$I_C = -10\mu A, I_E = 0$	Α	12	21	-	V
Collector to Emitter Breakdown Voltage	V <sub>(BR)CEO</sub>	I <sub>C</sub> = -100μA, I <sub>B</sub> = 0	Α	4	14	-	V
	V <sub>(BR)CER</sub>	$I_C$ = -100μA, $R_B$ = 10kΩ	А	11	23	-	V
Emitter to Base Breakdown Voltage (Note 4)	V <sub>(BR)EBO</sub>	$I_E = -10\mu A, I_C = 0$	В	-	5	-	V
Collector-Cutoff-Current	I <sub>CEO</sub>	V <sub>CE</sub> = -6V, I <sub>B</sub> = 0	Α	-5	-	5	nA
Collector-Cutoff-Current	I <sub>CBO</sub>	V <sub>CB</sub> = -8V, I <sub>E</sub> = 0	Α	-5	-	5	nA
Emitter-Cutoff-Current	I <sub>EBO</sub>	V <sub>EB</sub> = -1V, I <sub>C</sub> = 0	В	-	TBD	-	pA
Collector to Collector Leakage			В	-	1	-	nA
Collector to Emitter Saturation Voltage	V <sub>CE(SAT)</sub>	I <sub>C</sub> = -10mA, I <sub>B</sub> = -1mA	Α	-	150	250	mV
Base to Emitter Voltage	V <sub>BE</sub>	I <sub>C</sub> = -10mA, V <sub>CE</sub> = -2V	Α	-	850	1000	mV
Q <sub>1</sub> to Q <sub>2</sub> Base to Emitter Voltage Match	ΔV <sub>BE</sub>	I <sub>C</sub> = -10mA, V <sub>CE</sub> = -2V	Α	-	1	6	mV
		I <sub>C</sub> = -1mA, V <sub>CE</sub> = -2V	Α	-	1	6	mV
		I <sub>C</sub> = -0.1mA, V <sub>CE</sub> = -2V	Α	-	2	6	mV
DC Forward-Current Transfer Ratio	h <sub>FE</sub>	I <sub>C</sub> = -10mA, V <sub>CE</sub> = -2V	Α	15	40	125	
		I <sub>C</sub> = -1mA, V <sub>CE</sub> = -2V	Α	15	47	125	
		I <sub>C</sub> = -0.1mA, V <sub>CE</sub> = -2V	Α	15	52	125	
		I <sub>C</sub> = -10mA, V <sub>CE</sub> = -5V	Α	15	47	125	
		I <sub>C</sub> = -1mA, V <sub>CE</sub> = -5V	Α	15	53	125	
		I <sub>C</sub> = -0.1mA, V <sub>CE</sub> = -5V	Α	15	57	125	
Q <sub>1</sub> to Q <sub>2</sub> Current Gain Match	Δh <sub>FE</sub>	$-1mA \le I_C \le -10mA,$ $-1V \le V_{CE} \le -5V$	А	-	1	8	%
Early Voltage	V <sub>A</sub>	$I_C = -1mA$ , $\Delta V_{CE} = -3V$	Α	15	24	-	V
Base to Emitter Voltage Drift		I <sub>C</sub> = -10mA	С	-	-1.4	-	mV/°C

# **Electrical Specifications** $T_A = 25^{\circ}C$ (Continued)

PARAMETER	SYMBOL	TEST CONDITIONS	(NOTE 3) TEST LEVEL	MIN	TYP	MAX	UNITS	
DYNAMIC CHARACTERISTICS FOR HFA3135 (PNP)								
Noise Figure	NF	$ f = 900 MHz, I_C = -10 mA, $ $-1 V \le V_{CE} \le -5 V, Z_S = 50 \Omega $	В	-	5.2	-	dB	
		$ f = 900 MHz, I_C = -1 mA, $ $-1 V \le V_{CE} \le -5 V, Z_S = 50 \Omega $	В	-	4.6	-	dB	
Current Gain-Bandwidth Product	f <sub>T</sub>	I <sub>C</sub> = -10mA, V <sub>CE</sub> = -5V	В	-	7	-	GHz	
Power Gain-Bandwidth Product	f <sub>MAX</sub>	I <sub>C</sub> = -10mA, V <sub>CE</sub> = -5V	В	-	TBD	-	GHz	
Base to Emitter Capacitance		V <sub>BE</sub> = 0.5V	В	-	550	-	fF	
Collector to Base Capacitance		V <sub>CB</sub> = -3V	В	-	400	-	fF	

### NOTES:

- 3. Test Level: A. Production Tested; B. Typical or Guaranteed Limit Based on Characterization; C. Design Typical for Information Only.
- 4. Measuring  $V_{\mbox{\footnotesize{EBO}}}$  can degrade the transistor  $h_{\mbox{\footnotesize{FE}}}$  and  $h_{\mbox{\footnotesize{FE}}}$  match.
- 5. See Typical Performance Curves for more information.

# Typical Performance Curves T<sub>A</sub> = 25°C, Unless Otherwise Specified

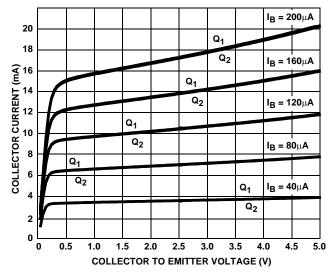


FIGURE 1. NPN COLLECTOR CURRENT vs COLLECTOR TO EMITTER VOLTAGE

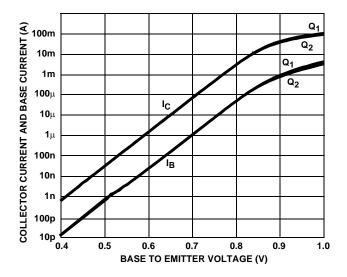
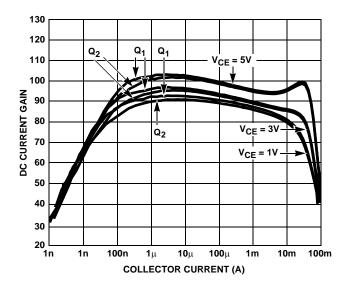


FIGURE 2. NPN COLLECTOR AND BASE CURRENTS vs BASE TO EMITTER VOLTAGE

# $\textit{Typical Performance Curves} \quad T_{A} = 25^{\circ}C, \ \text{Unless Otherwise Specified} \quad \textit{\textbf{(Continued)}}$



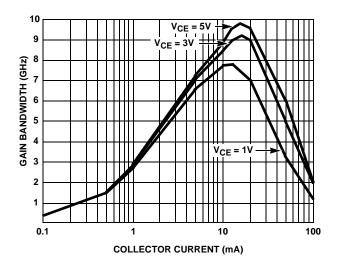


FIGURE 3. NPN DC CURRENT GAIN vs COLLECTOR CURRENT

FIGURE 4. NPN GAIN BANDWIDTH PRODUCT vs COLLECTOR CURRENT

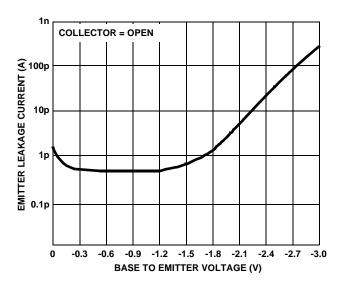


FIGURE 5. NPN EMITTER CUTOFF CURRENT VS BASE TO EMITTER VOLTAGE

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401 Building No.5, JiuGe Business Center, Lane 2301, Yishan Rd Minhang District, Shanghai , China

# > Sales:

Direct +86 (21) 6401-6692

Email amall@ameya360.com

QQ 800077892

Skype ameyasales1 ameyasales2

# Customer Service :

Email service@ameya360.com

# Partnership :

Tel +86 (21) 64016692-8333

Email mkt@ameya360.com