

HFA3134, HFA3135

Ultra High Frequency Matched Pair Transistors

FN4445  
Rev 2.00  
August 12, 2005

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/Z†) (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**

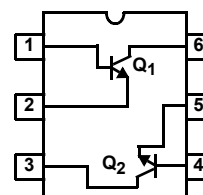
- NPN Transistor ( $f_T$ ) ..... 8.5GHz
- NPN Current Gain ( $h_{FE}$ )..... 100
- NPN Noise Figure (50Ω) at 1.0GHz..... 2.6dB
- PNP Transistor ( $f_T$ )..... 7GHz
- PNP Current Gain ( $h_{FE}$ )..... 57
- PNP Noise Figure (50Ω) at 900MHz ..... 4.6dB
- Small Package (EIAJ-SC74 Compliant).....SOT23-6
- Pb-Free Plus Anneal Available (RoHS Compliant)

**Applications**

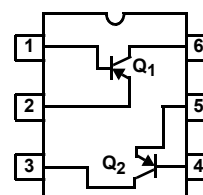
- VHF/UHF Amplifiers
- VHF/UHF Mixers
- IF Converters
- Synchronous Detectors

**Pinouts**

HFA3134 (SOT23) TOP VIEW



HFA3135 (SOT23) TOP VIEW



**Absolute Maximum Ratings**

Collector to Emitter Voltage ( $R_B \leq 10k\Omega$ to GND) . . . . .	11V
Collector to Base Voltage (Open Emitter) . . . . .	12V
Emitter to Base Voltage (Reverse Bias) . . . . .	4.5V
Collector Current . . . . .	14mA at $T_J = 150^\circ\text{C}$ 26mA at $T_J = 125^\circ\text{C}$
Base Current (Note 2) . . . . .	1.7mA
ESD Rating	
Human Body Model . . . . .	400V
(Per MIL-STD-883 Method 3015.7)	

**Thermal Information**

Thermal Resistance (Typical, Note 1)	$\theta_{JA}$ ( $^\circ\text{C}/\text{W}$ )
SOT23-6 Package . . . . .	350
Maximum Junction Temperature (Die) . . . . .	175 $^\circ\text{C}$
Maximum Junction Temperature (Plastic Package) . . . . .	150 $^\circ\text{C}$
Maximum Storage Temperature Range . . . . .	-65 $^\circ\text{C}$ to 150 $^\circ\text{C}$
Maximum Lead Temperature . . . . .	300 $^\circ\text{C}$
(Soldering 10s, Lead Tips Only)	

**Operating Conditions**

Temperature Range . . . . . -40 $^\circ\text{C}$  to 85 $^\circ\text{C}$

*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.*

## NOTES:

- $\theta_{JA}$  is measured with the component mounted on an evaluation PC board in free air.
- 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**  $T_A = 25^\circ\text{C}$ 

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

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

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

**Electrical Specifications**  $T_A = 25^\circ\text{C}$ 

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

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

PARAMETER	SYMBOL	TEST CONDITIONS	(NOTE 3) TEST LEVEL	MIN	TYP	MAX	UNITS
<b>DYNAMIC CHARACTERISTICS FOR HFA3135 (PNP)</b>							
Noise Figure	NF	$f = 900\text{MHz}, I_C = -10\text{mA}, -1\text{V} \leq V_{CE} \leq -5\text{V}, Z_S = 50\Omega$	B	-	5.2	-	dB
		$f = 900\text{MHz}, I_C = -1\text{mA}, -1\text{V} \leq V_{CE} \leq -5\text{V}, Z_S = 50\Omega$	B	-	4.6	-	dB
Current Gain-Bandwidth Product	$f_T$	$I_C = -10\text{mA}, V_{CE} = -5\text{V}$	B	-	7	-	GHz
Power Gain-Bandwidth Product	$f_{\text{MAX}}$	$I_C = -10\text{mA}, V_{CE} = -5\text{V}$	B	-	TBD	-	GHz
Base to Emitter Capacitance		$V_{BE} = 0.5\text{V}$	B	-	550	-	fF
Collector to Base Capacitance		$V_{CB} = -3\text{V}$	B	-	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  $V_{EBO}$  can degrade the transistor  $h_{FE}$  and  $h_{FE}$  match.
5. See Typical Performance Curves for more information.

**Typical Performance Curves**  $T_A = 25^\circ\text{C}$ , Unless Otherwise Specified

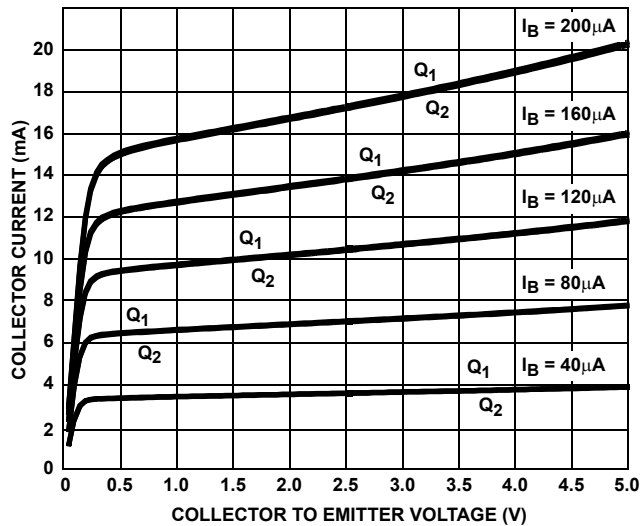


FIGURE 1. NPN COLLECTOR CURRENT vs COLLECTOR TO EMITTER VOLTAGE

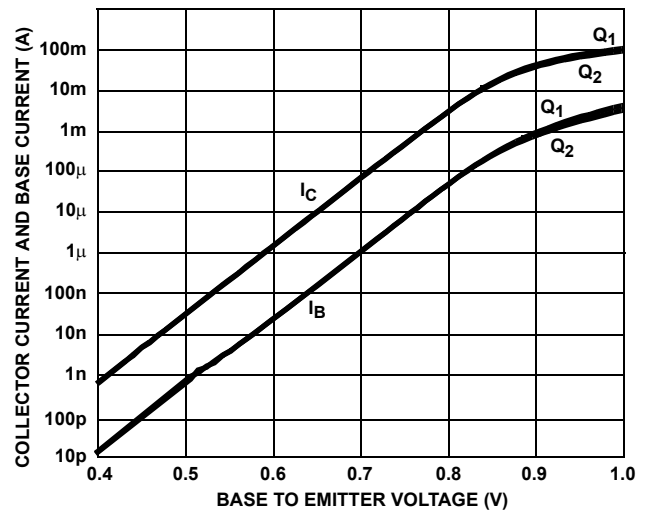


FIGURE 2. NPN COLLECTOR AND BASE CURRENTS vs BASE TO EMITTER VOLTAGE