

Introduction

This application note describes the SPICE transistor models for the bipolar devices that comprise the HFA3046, HFA3096, HFA3127, and HFA3128 Ultra High Frequency Transistor Arrays. These arrays are fabricated on Intersil's complementary bipolar UHF1 process and contain a combination of NPN and/or PNP transistors. These transistors exhibit peak f_T 's of 9 GHz and 5.5 GHz respectively, as illustrated by the included performance curves.

Model Description

While this model was developed for the PSpice simulator from MicroSim Corporation, it may be adaptable to other simulators. The performance curves included in this document were generated using PSpice. A cdsSpice compatible version of the model is available upon request.

The PSpice model contains parameters for UHF NPN and PNP transistors. Only transistor type determines model selection, since all transistors within a type have the same geometry.

The models emulate typical rather than worst case devices, at an ambient temperature of 25°C.

Package Models

Rudimentary models for the available packages are included at the back of this application note. These models are preliminary and are a best estimate of package parasitics based on measurements and industry literature. Because package parasitics can be the limiting factor in high frequency circuits, simulations with these package models should not be considered a substitute for breadboarding the design.

Parameters Not Modeled

Some effects haven't been included in this model. The major exclusions are listed below:

- Temperature Effects
- Breakdown Effects

Future releases of this model may include some of these effects.

PSpice Listing

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*
*HFA3046/3096/3127/3128 PSpice MODEL
*REV: 1-3-94
*
***** UHFN - LE = 3 WE = 50 *****
*
* — BJT MODELS —
*
.model NUHFARRY NPN
+      (IS = 1.840E - 16      XTI = 3.000E + 00      EG = 1.110E + 00      VAF = 7.200E + 01
+      VAR = 4.500E + 00      BF = 1.036E + 02      ISE = 1.686E - 19      NE = 1.400E + 00
+      IKF = 5.400E - 02      XTB = 0.000E + 00      BR = 1.000E + 01      ISC = 1.605E - 14
+      NC = 1.800E + 00      IKR = 5.400E - 02      RC = 1.140E + 01      CJC = 3.980E - 13
+      MJC = 2.400E - 01      VJC = 9.700E - 01      FC = 5.000E - 01      CJE = 2.400E - 13
+      MJE = 5.100E - 01      VJE = 8.690E - 01      TR = 4.000E - 09      TF = 10.51E - 12
+      ITF = 3.500E - 02      XTF = 2.300E + 00      VTF = 3.500E + 00      PTF = 0.000E + 00
+      XCJC = 9.000E - 01      CJS = 1.150E - 13      VJS = 7.500E - 01      MJS = 0.000E + 00
+      RE = 1.848E + 00      RB = 5.007E + 01      RBM = 1.974E + 00      KF = 0.000E + 00
+      AF = 1.000E + 00)
*
*
***** UHFP - LE = 3 WE = 50 *****
*
.model PUHFARRY PNP
+      (IS = 1.027E - 16      XTI = 3.000E + 00      EG = 1.110E + 00      VAF = 3.000E + 01
+      VAR = 4.500E + 00      BF = 5.228E + 01      ISE = 9.398E - 20      NE = 1.400E + 00
+      IKF = 5.412E - 02      XTB = 0.000E + 00      BR = 7.000E + 00      ISC = 1.027E - 14
+      NC = 1.800E + 00      IKR = 5.412E - 02      RC = 3.420E + 01      CJC = 4.951E - 13
+      MJC = 3.000E - 01      VJC = 1.230E + 00      FC = 5.000E - 01      CJE = 2.927E - 13
+      MJE = 5.700E - 01      VJE = 8.800E - 01      TR = 4.000E - 09      TF = 20.05E - 12
+      ITF = 2.001E - 02      XTF = 1.534E + 00      VTF = 1.800E + 00      PTF = 0.000E + 00
+      XCJC = 9.000E - 01      CJS = 1.150E - 13      VJS = 7.500E - 01      MJS = 0.000E + 00
+      RE = 1.848E + 00      RB = 3.271E + 01      RBM = 9.902E - 01      KF = 0.000E + 00
+      AF = 1.000E + 00)
    
```

Model Performance

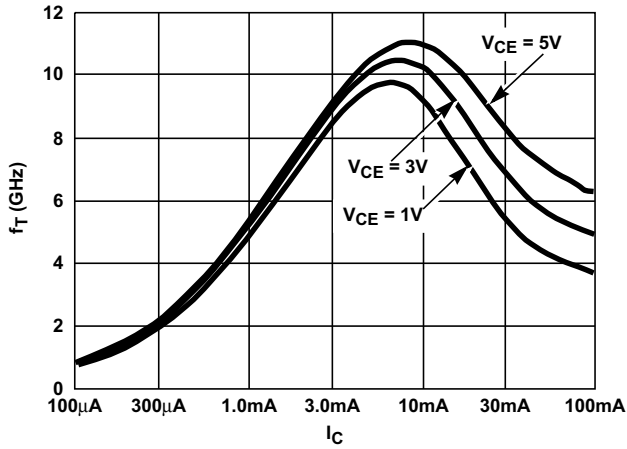


FIGURE 1. NPN f_T vs I_C

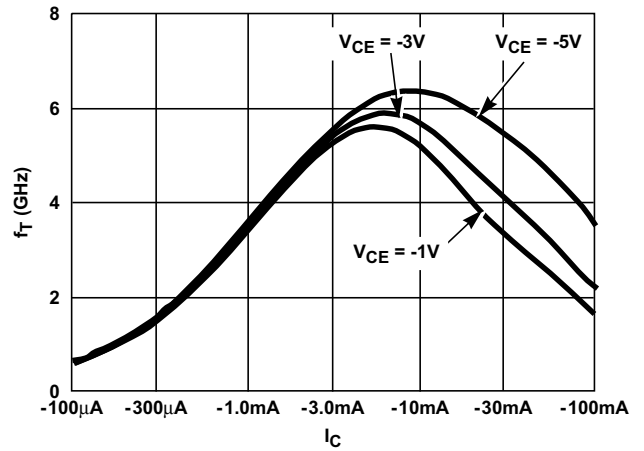


FIGURE 2. PNP f_T vs I_C

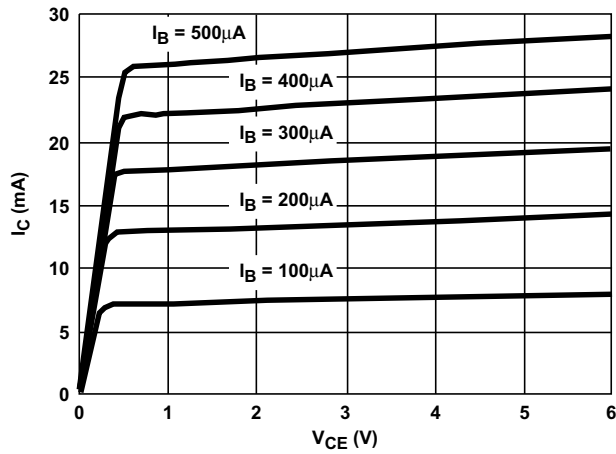


FIGURE 3. NPN I_C vs V_{CE}

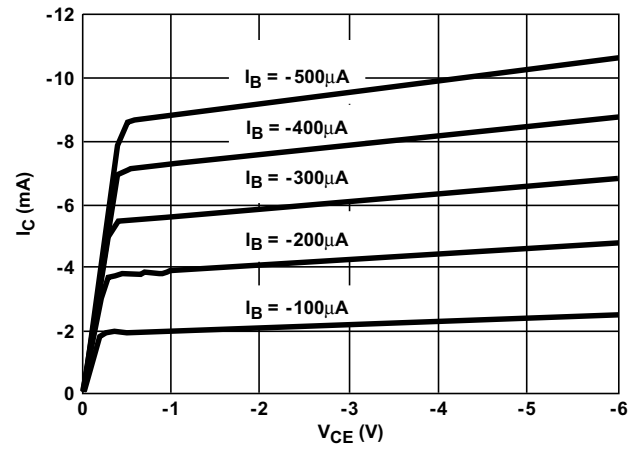


FIGURE 4. PNP I_C vs V_{CE}

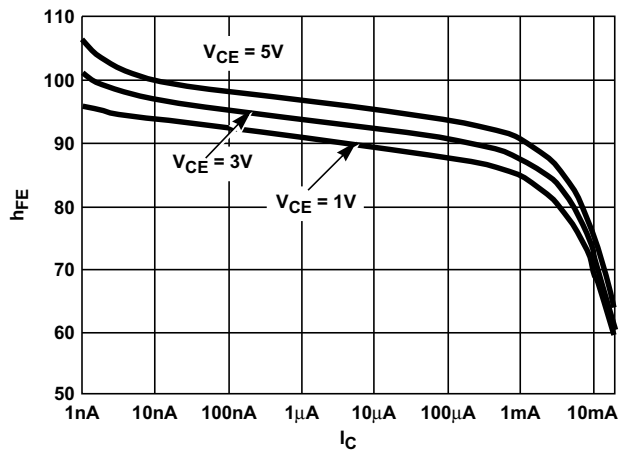


FIGURE 5. NPN h_{FE} vs I_C

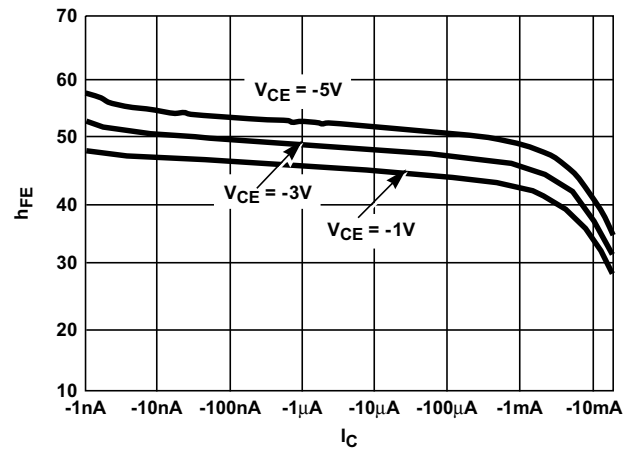


FIGURE 6. PNP h_{FE} vs I_C

Model Performance (Continued)

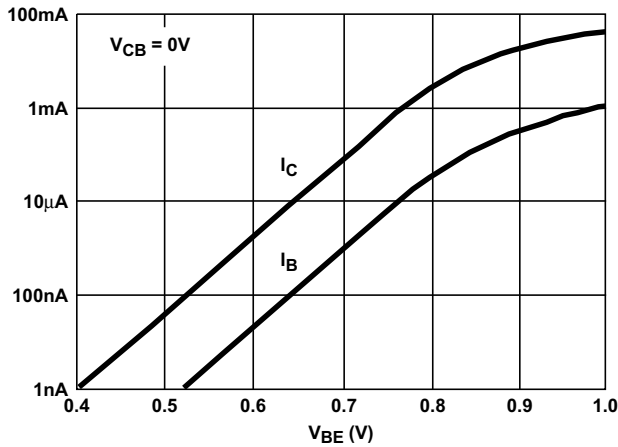


FIGURE 7. NPN I_C AND I_B vs V_{BE}

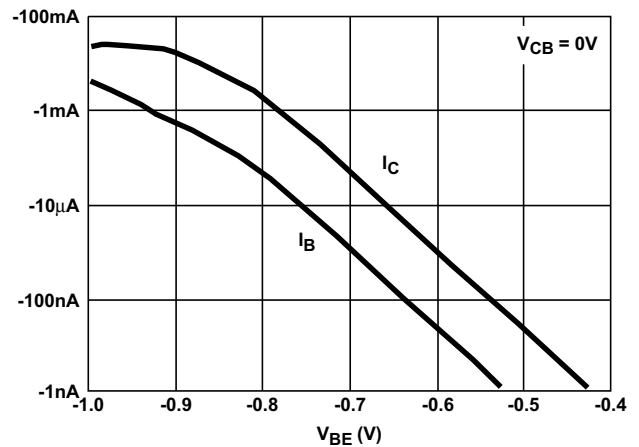


FIGURE 8. PNP I_C AND I_B vs V_{BE}

Package Models

Equivalent Circuit:

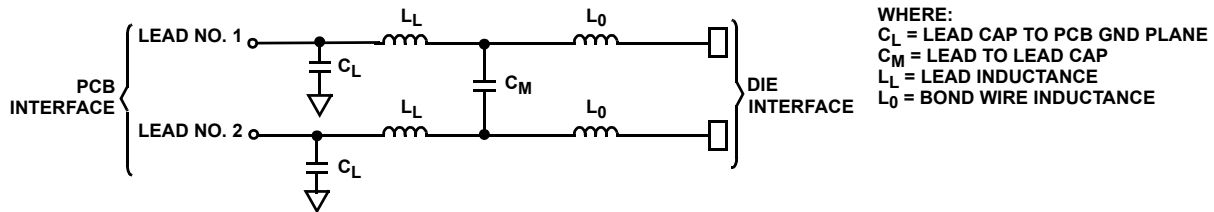


TABLE 1. ELEMENT VALUES

LEAD NO.	14 LEAD SOIC				16 LEAD SOIC			
	CL	CM	LL	LB	CL	CM	LL	LB
1	0.2pF	0.05pF	1.9nH	1.1nH	0.2pF	0.05pF	2.1nH	1.1nH
2	0.2pF	0.05pF	1.3nH	1.1nH	0.2pF	0.05pF	1.5nH	1.1nH
3	0.2pF	0.05pF	0.9nH	1.1nH	0.2pF	0.05pF	0.9nH	1.1nH
4	0.2pF	0.05pF	0.7nH	1.1nH	0.2pF	0.05pF	0.7nH	1.1nH
5	0.2pF	0.05pF	0.9nH	1.1nH	0.2pF	0.05pF	0.7nH	1.1nH
6	0.2pF	0.05pF	1.3nH	1.1nH	0.2pF	0.05pF	0.9nH	1.1nH
7	0.2pF	0.05pF	1.9nH	1.1nH	0.2pF	0.05pF	1.5nH	1.1nH
8	0.2pF	0.05pF	1.9nH	1.1nH	0.2pF	0.05pF	2.1nH	1.1nH
9	0.2pF	0.05pF	1.3nH	1.1nH	0.2pF	0.05pF	2.1nH	1.1nH
10	0.2pF	0.05pF	0.9nH	1.1nH	0.2pF	0.05pF	1.5nH	1.1nH
11	0.2pF	0.05pF	0.7nH	1.1nH	0.2pF	0.05pF	0.9nH	1.1nH
12	0.2pF	0.05pF	0.9nH	1.1nH	0.2pF	0.05pF	0.7nH	1.1nH
13	0.2pF	0.05pF	1.3nH	1.1nH	0.2pF	0.05pF	0.7nH	1.1nH
14	0.2pF	0.05pF	1.9nH	1.1nH	0.2pF	0.05pF	0.9nH	1.1nH
15	X	X	X	X	0.2pF	0.05pF	1.5nH	1.1nH
16	X	X	X	X	0.2pF	0.05pF	2.1nH	1.1nH

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Renesas Electronics America Inc.
1001 Murphy Ranch Road, Milpitas, CA 95035, U.S.A.
Tel: +1-408-432-8888, Fax: +1-408-434-5351

Renesas Electronics Canada Limited
9251 Yonge Street, Suite 8309 Richmond Hill, Ontario Canada L4C 9T3
Tel: +1-905-237-2004

Renesas Electronics Europe Limited
Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, U.K.
Tel: +44-1628-651-700, Fax: +44-1628-651-804

Renesas Electronics Europe GmbH
Arcadiastrasse 10, 40472 Düsseldorf, Germany
Tel: +49-211-6503-0, Fax: +49-211-6503-1327

Renesas Electronics (China) Co., Ltd.
Room 1709 Quantum Plaza, No.27 ZhichunLu, Haidian District, Beijing, 100191 P. R. China
Tel: +86-10-8235-1155, Fax: +86-10-8235-7679

Renesas Electronics (Shanghai) Co., Ltd.
Unit 301, Tower A, Central Towers, 555 Langao Road, Putuo District, Shanghai, 200333 P. R. China
Tel: +86-21-2226-0888, Fax: +86-21-2226-0999

Renesas Electronics Hong Kong Limited
Unit 1601-1611, 16/F., Tower 2, Grand Century Place, 193 Prince Edward Road West, Mongkok, Kowloon, Hong Kong
Tel: +852-2265-6688, Fax: +852-2886-9022

Renesas Electronics Taiwan Co., Ltd.
13F, No. 363, Fu Shing North Road, Taipei 10543, Taiwan
Tel: +886-2-8175-9600, Fax: +886-2-8175-9670

Renesas Electronics Singapore Pte. Ltd.
80 Bendemeer Road, Unit #06-02 Hyflux Innovation Centre, Singapore 339949
Tel: +65-6213-0200, Fax: +65-6213-0300

Renesas Electronics Malaysia Sdn.Bhd.
Unit 1207, Block B, Menara Amcorp, Amcorp Trade Centre, No. 18, Jln Persiaran Barat, 46050 Petaling Jaya, Selangor Darul Ehsan, Malaysia
Tel: +60-3-7955-9390, Fax: +60-3-7955-9510

Renesas Electronics India Pvt. Ltd.
No.777C, 100 Feet Road, HAL 2nd Stage, Indiranagar, Bangalore 560 038, India
Tel: +91-80-67208700, Fax: +91-80-67208777

Renesas Electronics Korea Co., Ltd.
17F, KAMCO Yangjae Tower, 262, Gangnam-daero, Gangnam-gu, Seoul, 06265 Korea
Tel: +82-2-558-3737, Fax: +82-2-558-5338