HFA3046/3096/3127/3128 Transistor Array SPICE Models

MM3046
Rev.1.00
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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 25oC.

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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*
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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

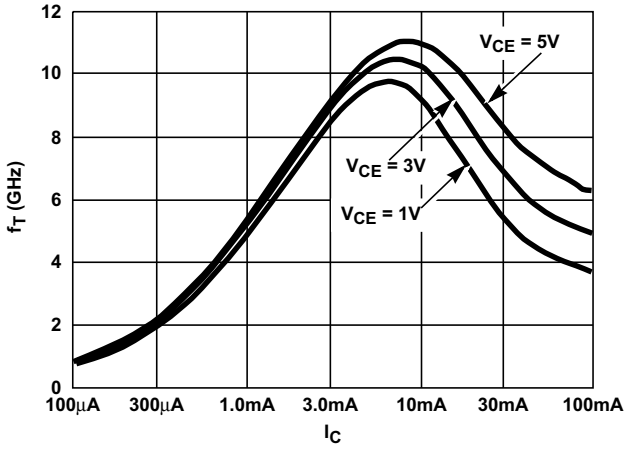


FIGURE 1. NPN f_T vs I_C

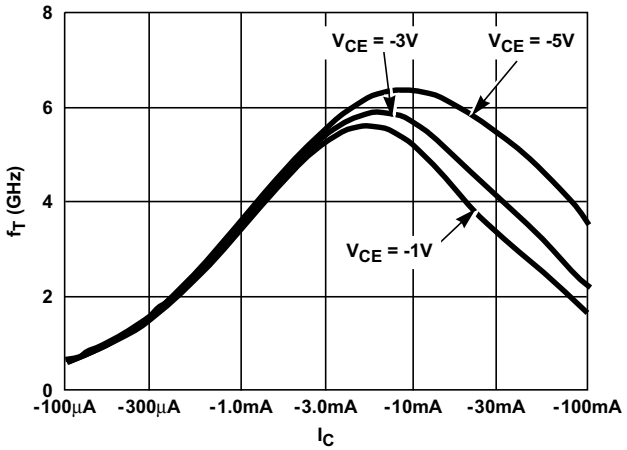


FIGURE 2. PNP f_T vs I_C

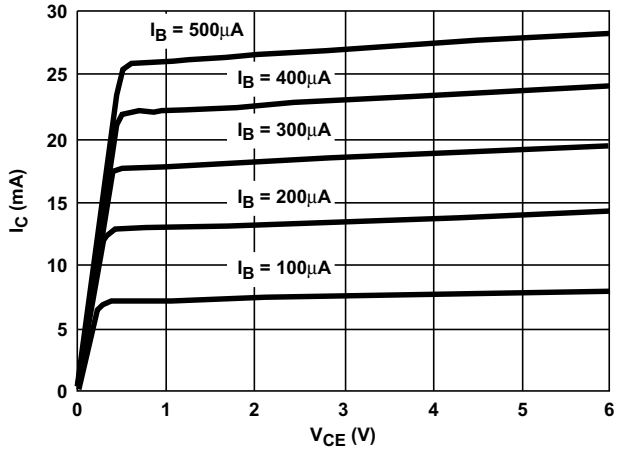


FIGURE 3. NPN I_C vs V_{CE}

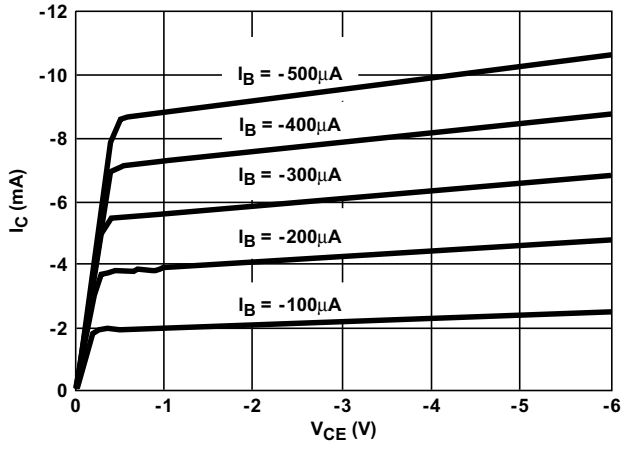


FIGURE 4. PNP I_C vs V_{CE}

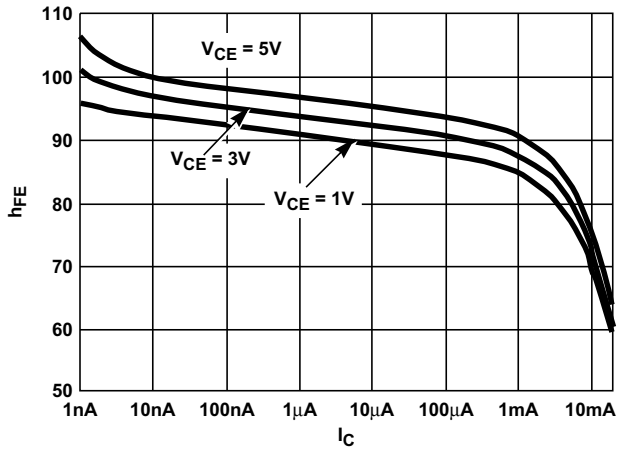


FIGURE 5. NPN h_{FE} vs I_C

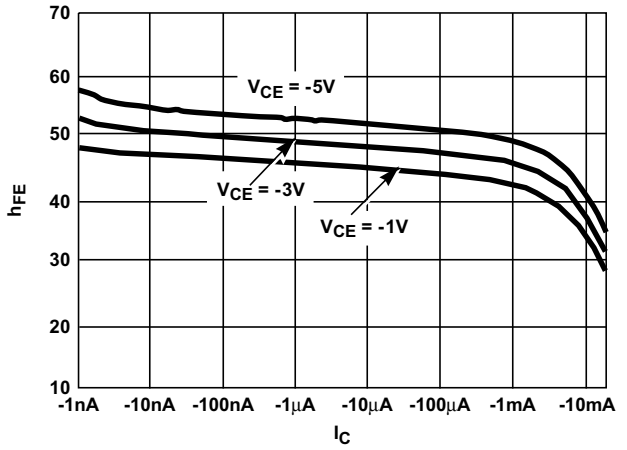


FIGURE 6. PNP h_{FE} vs I_C

Model Performance (Continued)

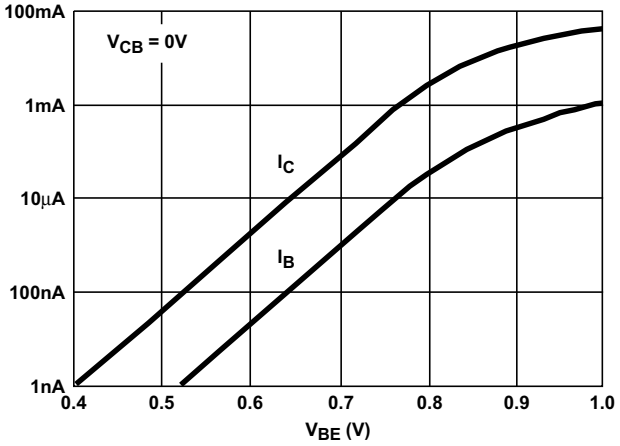


FIGURE 7. NPN I_C AND I_B vs V_{BE}

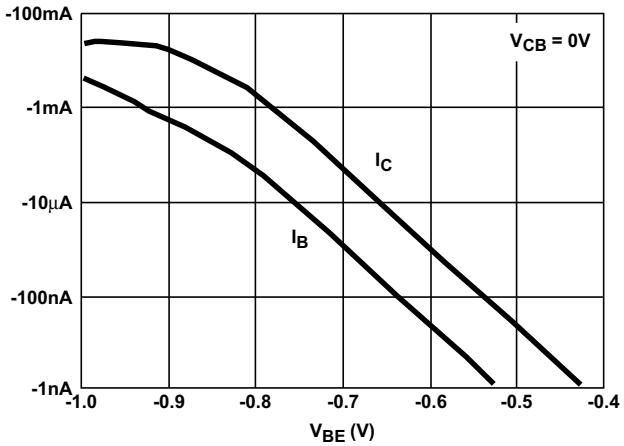
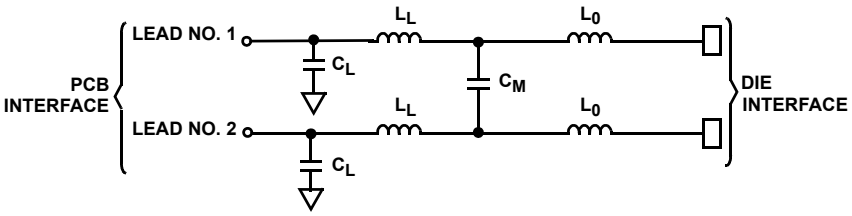


FIGURE 8. PNP I_C AND I_B vs V_{BE}

Package Models

Equivalent Circuit:



WHERE:
C_L = LEAD CAP TO PCB GND PLANE
C_M = LEAD TO LEAD CAP
L_L = LEAD INDUCTANCE
L_0 = BOND WIRE INDUCTANCE

TABLE 1. ELEMENT VALUES

	14 LEAD SOIC				16 LEAD SOIC			
LEAD NO.	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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