Data Sheet | August 1996 | File Number 3635.2

Dual Long-Tailed Pair Transistor Array

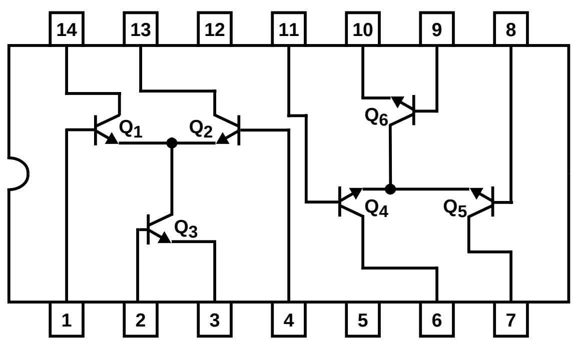
The HFA3102 is an all NPN transistor array configured as dual differential amplifiers with tail transistors. Based on Intersil bonded wafer UHF-1 SOI process, this array achieves very high f_T (10GHz) while maintaining excellent h_{FE} and V_{BE} matching characteristics over temperature. Collector leakage currents are maintained to under 0.01nA.

Ordering Information

PART NUMBER	TEMP. RANGE (^oC)	PACKAGE	PKG. NO.
HFA3102B	-40 to 85	14 Ld SOIC	M14.15
HFA3102B96	-40 to 85	14 Ld SOIC Tape and Reel	M14.15

Pinout/Functional Diagram

HFA3102
(SOIC)
TOP VIEW



Features

- High Gain-Bandwidth Product (f_T) 10GHz
- High Power Gain-Bandwidth Product 5GHz
- High Current Gain (h_{FE}) 70
- Noise Figure (Transistor) 3.5dB
- Low Collector Leakage Current . . . . <0.01nA
- Excellent h_{FE} and V_{BE} Matching
- Pin-to-Pin to UPA102G

Applications

- Single Balanced Mixers
- Wide Band Amplification Stages
- Differential Amplifiers
- Multipliers
- Automatic Gain Control Circuits
- Frequency Doublers, Tripplers
- Oscillators
- Constant Current Sources
- Wireless Communication Systems
- Radio and Satellite Communications
- Fiber Optic Signal Processing
- High Performance Instrumentation

Absolute Maximum Ratings $T_A = 25^oC$

V_{CEO} Collector to Emitter Voltage 8.0V
V_{CBO} Collector to Base Voltage 12.0V
V_{EBO} Emitterr to Base Voltage 12.0V
I_C, Collector Current 30mA

Operating Conditions

Temperature Range . . . . -40^{o}C to 85^{o}C

Thermal Information

Thermal Resistance (Typical, Note 1) θ_{JA} (^{o}C/W)
SOIC Package 125
Maximum Power Dissipation at 75^{o}C
Any One Transistor 0.25W
Maximum Junction Temperature (Die) . . . . 175^{o}C
Maximum Junction Temperature (Plastic Package) . . . . 150^{o}C
Maximum Storage Temperature Range . . . . -65^{o}C to 150^{o}C
Maximum Lead Temperature (Soldering 10s) . . . . 300^{o}C
(SOIC - Lead Tips Only)

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.

NOTE:

1. θ_{JA} is measured with the component mounted on an evaluation PC board in free air.

Electrical Specifications $T_A = 25^oC$

SYMBOLS	PARAMETER	TEST CONDITIONS		(NOTE 2) TEST LEVEL	ALL GRADES MIN	TYP	MAX	UNITS
$V_{(BR)CBO}$	Collector-to-Base Breakdown Voltage (Q_1, Q_2, Q_4, and Q_5)	$I_C = 100\mu A$, $I_E = 0$		A	12	18	-	V
$V_{(BR)CEO}$	Collector-to-Emitter Breakdown Voltage (Q_1 thru Q_6)	$I_C = 100\mu A$, $I_B = 0$		A	8	12	-	V
$V_{(BR)EBO}$	Emitter-to-Base Breakdown Voltage (Q_3 and Q_6)	$I_E = 50\mu A$, $I_C = 0$		A	5.5	6	-	V
I_{CBO}	Collector Cutoff Current (Q_1, Q_2, Q_4, and Q_5)	$V_{CB} = 5V$, $I_E = 0$		A	-	0.1	10	nA
I_{EBO}	Emitter Cutoff Current (Q_3 and Q_6)	$V_{EB} = 1V$, $I_C = 0$		A	-	-	100	nA
h_{FE}	DC Current Gain (Q_1 thru Q_6)	$I_C = 10mA$, $V_{CE} = 3V$		A	40	70	-	-
C_{CB}	Collector-to-Base Capacitance	$V_{CB} = 5V$, f = 1MHz		B	-	300	-	fF
C_{EB}	Emitter-to-Base Capacitance	$V_{EB} = 0$, f = 1MHz		B	-	200	-	fF
f_T	Current Gain-Bandwidth Product	$I_C = 10mA$, $V_{CE} = 5V$		C	-	10	-	GHz
f_{MAX}	Power Gain-Bandwidth Product	$I_C = 10mA$, $V_{CE} = 5V$		C	-	5	-	GHz
G_{NFMIN}	Available Gain at Minimum Noise Figure	$I_C = 3mA$, $V_{CE} = 3V$	f = 0.5GHz	C	-	17.5	-	dB
			f = 1.0GHz	C	-	12.4	-	dB
NF_{MIN}	Minimum Noise Figure	$I_C = 3mA$, $V_{CE} = 3V$	f = 0.5GHz	C	-	1.8	-	dB
			f = 1.0GHz	C	-	2.1	-	dB
$NF_{50\Omega}$	50Ω Noise Figure	$I_C = 3mA$, $V_{CE} = 3V$	f = 0.5GHz	C	-	3.3	-	dB
			f = 1.0GHz	C	-	3.5	-	dB
h_{FE1}/h_{FE2}	DC Current Gain Matching (Q_1 and Q_2, Q_4 and Q_5)	$I_C = 10mA$, $V_{CE} = 3V$		A	0.9	1.0	1.1	-
V_{OS}	Input Offset Voltage (Q_1 and Q_2), (Q_4 and Q_5)	$I_C = 10mA$, $V_{CE} = 3V$		A	-	1.5	5	mV
I_{OS}	Input Offset Current (Q_1 and Q_2), (Q_4 and Q_5)	$I_C = 10mA$, $V_{CE} = 3V$		A	-	5	25	µA

Electrical Specifications $T_A = 25^oC$ **(Continued)**

SYMBOLS	PARAMETER	TEST CONDITIONS	(NOTE 2) TEST LEVEL	ALL GRADES MIN	TYP	MAX	UNITS
dV_{OS}/dT	Input Offset Voltage TC (Q_1 and Q_2, Q_4 and Q_5)	I_C = 10mA, V_{CE} = 3V	C	-	0.5	-	$\mu V/^oC$
$I_{TRENCH-LEAKAGE}$	Collector-to-Collector Leakage (Pin 6, 7, 13, and 14)	ΔV_{TEST} = 5V	B	-	0.01	-	nA

NOTE:

2. Test Level: A. Production Tested; B. Typical or Guaranteed Limit Based on Characterization; C. Design Typical for Information Only

PSPICE Model for a Single Transistor

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.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= 1.689E-13    VJS= 9.982E-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)
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Common Emitter S-Parameters

V_{CE} = 5V and I_C = 5mA

FREQ. (Hz)	$\|S_{11}\|$	PHASE(S_{11})	$\|S_{12}\|$	PHASE(S_{12})	$\|S_{21}\|$	PHASE(S_{21})	$\|S_{22}\|$	PHASE(S_{22})
1.0E+08	0.833079	-11.7873	1.418901E-02	78.8805	11.0722	168.576	0.976833	-11.0509
2.0E+08	0.791776	-22.8290	2.695740E-02	68.6355	10.5177	157.897	0.930993	-21.3586
3.0E+08	0.734911	-32.6450	3.750029E-02	59.5861	9.75379	148.443	0.868128	-30.4451
4.0E+08	0.672811	-41.0871	4.572138E-02	51.9018	8.91866	140.361	0.799886	-38.1641
5.0E+08	0.612401	-48.2370	5.194147E-02	45.5043	8.10511	133.569	0.734033	-44.5998
6.0E+08	0.557126	-54.2780	5.659943E-02	40.2112	7.35944	127.882	0.674392	-49.9370
7.0E+08	0.508133	-59.4102	6.009507E-02	35.8226	6.69712	123.102	0.622181	-54.3777
8.0E+08	0.465361	-63.8123	6.274213E-02	32.1594	6.11750	119.047	0.577269	-58.1022
9.0E+08	0.428238	-67.6313	6.477134E-02	29.0743	5.61303	115.571	0.538952	-61.2587
1.0E+09	0.396034	-70.9834	6.634791E-02	26.4506	5.17405	112.556	0.506365	-63.9647
1.1E+09	0.368032	-73.9591	6.758932E-02	24.1974	4.79104	109.913	0.478663	-66.3116
1.2E+09	0.343589	-76.6285	6.857937E-02	22.2441	4.45546	107.570	0.455091	-68.3702
1.3E+09	0.322155	-79.0462	6.937837E-02	20.5358	4.15997	105.472	0.435008	-70.1958
1.4E+09	0.303268	-81.2548	7.003020E-02	19.0293	3.89845	103.576	0.417872	-71.8314
1.5E+09	0.286542	-83.2880	7.056718E-02	17.6908	3.66577	101.849	0.403238	-73.3108
1.6E+09	0.271660	-85.1723	7.101343E-02	16.4930	3.45770	100.262	0.390735	-74.6609
1.7E+09	0.258359	-86.9292	7.138717E-02	15.4143	3.27074	98.7956	0.380056	-75.9030
1.8E+09	0.246420	-88.5759	7.170231E-02	14.4370	3.10197	97.4307	0.370947	-77.0544
1.9E+09	0.235659	-90.1265	7.196964E-02	13.5469	2.94897	96.1533	0.363195	-78.1288
2.0E+09	0.225923	-91.5925	7.219757E-02	12.7319	2.80969	94.9515	0.356623	-79.1377
2.1E+09	0.217085	-92.9836	7.239274E-02	11.9824	2.68243	93.8156	0.351081	-80.0903
2.2E+09	0.209034	-94.3076	7.256046E-02	11.2901	2.56573	92.7373	0.346442	-80.9942
2.3E+09	0.201678	-95.5713	7.270498E-02	10.6480	2.45837	91.7097	0.342599	-81.8557
2.4E+09	0.194939	-96.7803	7.282977E-02	10.0503	2.35928	90.7271	0.339458	-82.6802
2.5E+09	0.188747	-97.9395	7.293764E-02	9.49212	2.26756	89.7844	0.336942	-83.4719
2.6E+09	0.183044	-99.0530	7.303093E-02	8.96908	2.18243	88.8775	0.334982	-84.2347
2.7E+09	0.177780	-100.124	7.311157E-02	8.47753	2.10322	88.0026	0.333518	-84.9716
2.8E+09	0.172909	-101.156	7.318117E-02	8.01430	2.02934	87.1565	0.332499	-85.6853
2.9E+09	0.168394	-102.152	7.324107E-02	7.57661	1.96027	86.3366	0.331879	-86.3781
3.0E+09	0.164200	-103.114	7.329243E-02	7.16204	1.89556	85.5404	0.331620	-87.0518

V_{CE} = 5V and I_C = 10mA

FREQ. (Hz)	$\|S_{11}\|$	PHASE(S_{11})	$\|S_{12}\|$	PHASE(S_{12})	$\|S_{21}\|$	PHASE(S_{21})	$\|S_{22}\|$	PHASE(S_{22})
1.0E+08	0.728106	-16.4319	1.273920E-02	75.4177	15.1273	165.227	0.959692	-14.2688
2.0E+08	0.670836	-31.2669	2.342300E-02	62.8941	13.9061	152.045	0.886232	-26.9507
3.0E+08	0.600268	-43.7663	3.132521E-02	52.5891	12.3970	141.185	0.796016	-37.3172
4.0E+08	0.531768	-54.0028	3.681579E-02	44.5019	10.9257	132.570	0.708892	-45.4503
5.0E+08	0.471795	-62.3880	4.057046E-02	38.2308	9.62995	125.781	0.633146	-51.7704
6.0E+08	0.421506	-69.3569	4.316292E-02	33.3405	8.53559	120.378	0.570209	-56.7206
7.0E+08	0.379961	-75.2612	4.499071E-02	29.4764	7.62375	116.005	0.518803	-60.6598
8.0E+08	0.345693	-80.3608	4.631140E-02	26.3755	6.86423	112.398	0.476987	-63.8540
9.0E+08	0.317301	-84.8420	4.728948E-02	23.8481	6.22797	109.365	0.442915	-66.4948
1.0E+09	0.293608	-88.8381	4.803091E-02	21.7581	5.69057	106.771	0.415044	-68.7193
1.1E+09	0.273680	-92.4452	4.860515E-02	20.0070	5.23257	104.518	0.392146	-70.6269
1.2E+09	0.256782	-95.7336	4.905871E-02	18.5224	4.83873	102.532	0.373261	-72.2899
1.3E+09	0.242344	-98.7555	4.942344E-02	17.2505	4.49716	100.759	0.357640	-73.7620
1.4E+09	0.229918	-101.551	4.972158E-02	16.1506	4.19854	99.1602	0.344698	-75.0832
1.5E+09	0.219152	-104.150	4.996903E-02	15.1915	3.93554	97.7028	0.333974	-76.2840
1.6E+09	0.209767	-106.577	5.017730E-02	14.3490	3.70234	96.3629	0.325102	-77.3877
1.7E+09	0.201539	-108.851	5.035491E-02	13.6040	3.49428	95.1215	0.317789	-78.4122
1.8E+09	0.194288	-110.988	5.050825E-02	12.9411	3.30758	93.9633	0.311800	-79.3715
1.9E+09	0.187867	-113.001	5.064218E-02	12.3482	3.13919	92.8761	0.306940	-80.2768
2.0E+09	0.182157	-114.902	5.076045E-02	11.8151	2.98658	91.8500	0.303051	-81.1365
2.1E+09	0.177056	-116.698	5.086598E-02	11.3338	2.84766	90.8766	0.300003	-81.9578
2.2E+09	0.172484	-118.399	5.096107E-02	10.8974	2.72068	89.9494	0.297686	-82.7460
2.3E+09	0.168370	-120.012	5.104755E-02	10.5001	2.60420	89.0626	0.296007	-83.5057
2.4E+09	0.164656	-121.542	5.112690E-02	10.1373	2.49697	88.2115	0.294889	-84.2405
2.5E+09	0.161293	-122.996	5.120031E-02	9.80479	2.39793	87.3920	0.294266	-84.9533
2.6E+09	0.158239	-124.378	5.126876E-02	9.49919	2.30619	86.6007	0.294081	-85.6466
2.7E+09	0.155458	-125.694	5.133304E-02	9.21750	2.22098	85.8348	0.294285	-86.3223
2.8E+09	0.152919	-126.947	5.139381E-02	8.95716	2.14162	85.0916	0.294836	-86.9822
2.9E+09	0.150595	-128.140	5.145164E-02	8.71595	2.06753	84.3690	0.295696	-87.6275
3.0E+09	0.148463	-129.279	5.150697E-02	8.49194	1.99820	83.6651	0.296834	-88.2595

Typical Performance Curves

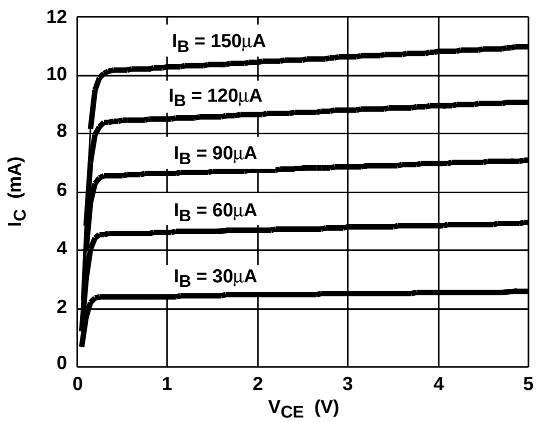


FIGURE 1. I_C vs V_{CE}

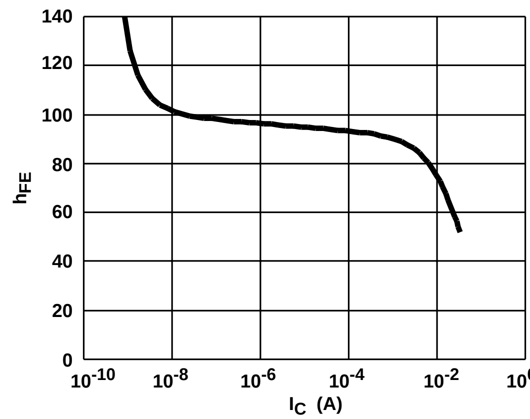


FIGURE 2. h_{FE} vs I_C

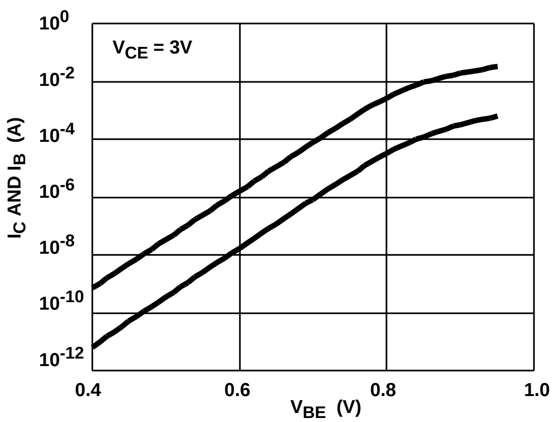


FIGURE 3. GUMMEL PLOT

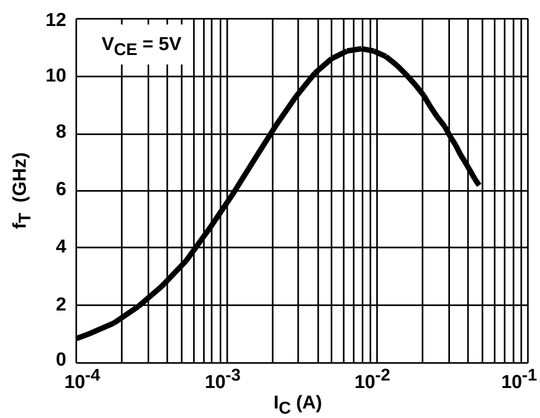


FIGURE 4. f_T vs I_C

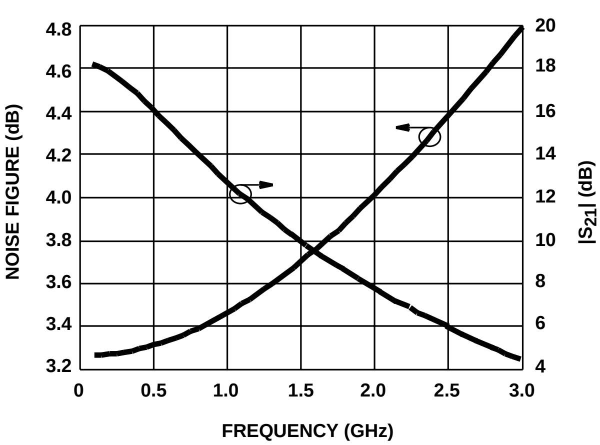


FIGURE 5. GAIN AND NOISE FIGURE vs FREQUENCY

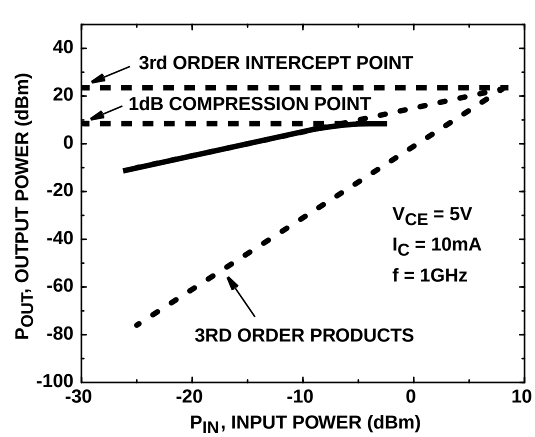


FIGURE 6. P_{1dB} AND 3RD ORDER INTERCEPT

Die Characteristics

PROCESS:

UHF-1

DIE DIMENSIONS:

53 mils x 52 mils x 14 mils
1340µm x 1320µm x 355.6µm

METALIZATION:

Type: Metal 1: AlCu(2%)/TiW
Thickness: Metal 1: 8kÅ ±0.5kÅ

Type: Metal 2: AlCu(2%)
Thickness: Metal 2: 16kÅ ±0.8kÅ

PASSIVATION:

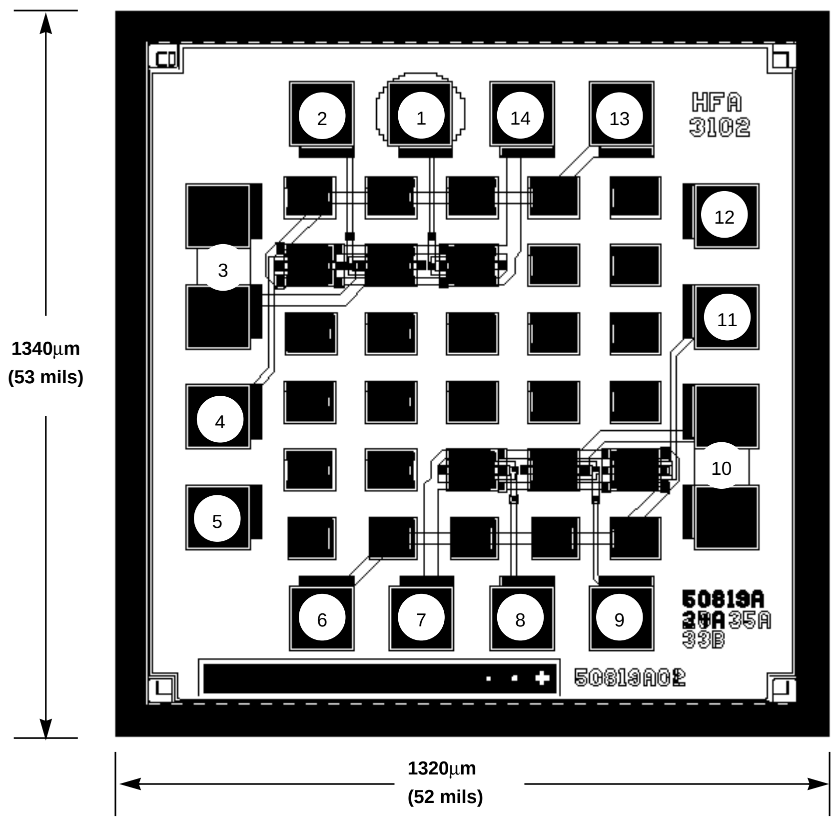
Type: Nitride
Thickness: 4kÅ ±0.5kÅ

SUBSTRATE POTENTIAL (Powered Up):

Floating

Metallization Mask Layout

HFA3102
TOP VIEW



Pad numbers correspond to the 14 pin SOIC pinout.

All Intersil semiconductor products are manufactured, assembled and tested under **ISO9000** quality systems certification.