

PRELIMINARY DATA SHEET

**NEC**

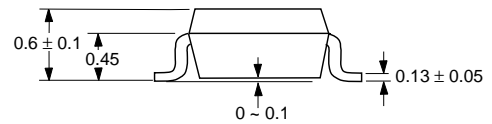
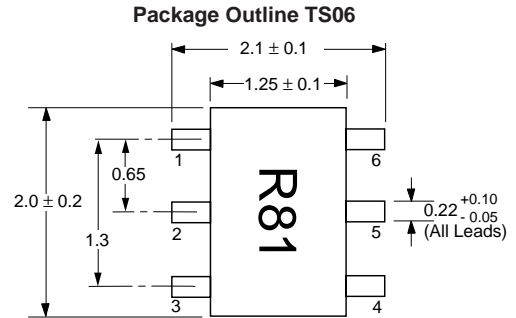
**NPN SILICON EPITAXIAL  
TWIN TRANSISTOR**

**UPA821TF**

**FEATURES**

- **LOW NOISE:**  
NF = 1.2 dB TYP at f = 1 GHz, V<sub>CE</sub> = 3 V, I<sub>c</sub> = 7 mA
- **HIGH GAIN:**  
|S<sub>21E</sub>|<sup>2</sup> = 9.0 dB TYP at f = 1 GHz, V<sub>CE</sub> = 3 V, I<sub>c</sub> = 7 mA
- **SMALL PACKAGE STYLE:**  
2 NE856 die in a 2 mm x 1.25 mm x 0.6 mm package

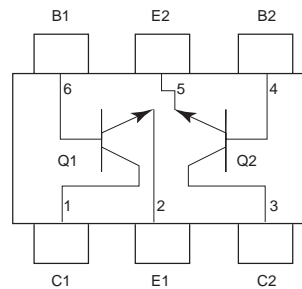
**OUTLINE DIMENSIONS** (Units in mm)



**DESCRIPTION**

The UPA821TF has two built-in low-voltage transistors which are designed for low-noise amplification in the VHF to UHF band. The two die are chosen from adjacent locations on the wafer. These features combined with the pin configuration make this device ideal for balanced or mirrored applications. Low noise figures, high gain, and high current capability equate to wide dynamic range and excellent linearity. The thinner package style allows for higher density designs.

**PIN CONFIGURATION** (Top View)



**PIN CONNECTIONS**

1. Collector (Q1)
2. Emitter (Q1)
3. Collector (Q2)
4. Base (Q2)
5. Emitter (Q2)
6. Base (Q1)

Note: Pin 3 is identified with a circle on the bottom of the package.

**ELECTRICAL CHARACTERISTICS** (T<sub>A</sub> = 25°C)

PART NUMBER PACKAGE OUTLINE			UPA821TF TS06		
SYMBOLS	PARAMETERS AND CONDITIONS	UNITS	MIN	TYP	MAX
I <sub>CBO</sub>	Collector Cutoff Current at V <sub>CB</sub> = 10 V, I <sub>E</sub> = 0	μA			1.0
I <sub>EBO</sub>	Emitter Cutoff Current at V <sub>EB</sub> = 1 V, I <sub>C</sub> = 0	μA			1.0
h <sub>FE</sub>	DC Current Gain <sup>1</sup> at V <sub>CE</sub> = 3 V, I <sub>c</sub> = 7 mA		70		140
f <sub>T</sub>	Gain Bandwidth at V <sub>CE</sub> = 3 V, I <sub>c</sub> = 7 mA	GHz	3.0	4.5	
C <sub>re</sub>	Feedback Capacitance <sup>2</sup> at V <sub>CB</sub> = 3 V, I <sub>E</sub> = 0, f = 1 MHz	pF		0.7	1.5
S <sub>21E</sub>   <sup>2</sup>	Insertion Power Gain at V <sub>CE</sub> = 3 V, I <sub>c</sub> = 7 mA, f = 1 GHz	dB	7	9	
NF	Noise Figure at V <sub>CE</sub> = 3 V, I <sub>c</sub> = 7 mA, f = 1 GHz	dB		1.2	2.5
h <sub>FE1</sub> /h <sub>FE2</sub>	h <sub>FE</sub> ratio, V <sub>CE</sub> = 3 V, I <sub>c</sub> = 7 mA h <sub>FE1</sub> = Smaller h <sub>FE</sub> value between Q1 and Q2 h <sub>FE2</sub> = Larger h <sub>FE</sub> value between Q1 and Q2		0.85	1.0	

Notes: 1. Pulsed measurement, pulse width ≤ 350 μs, duty cycle ≤ 2 %.

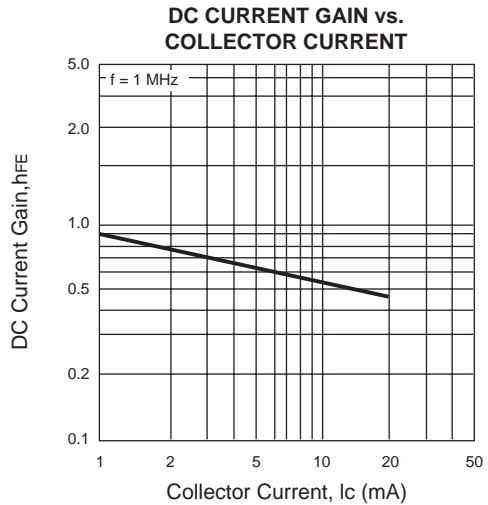
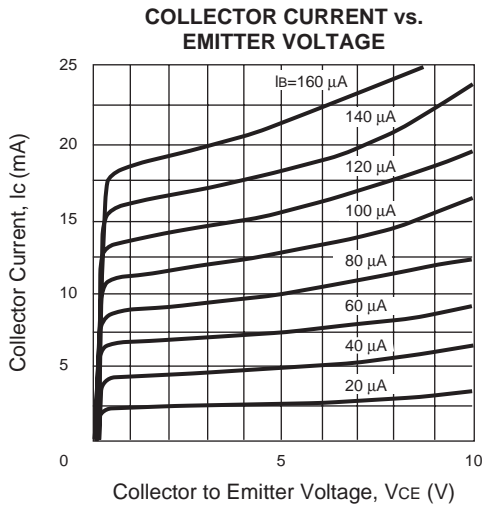
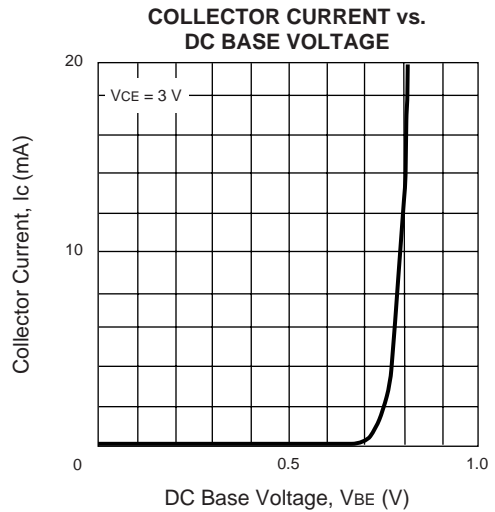
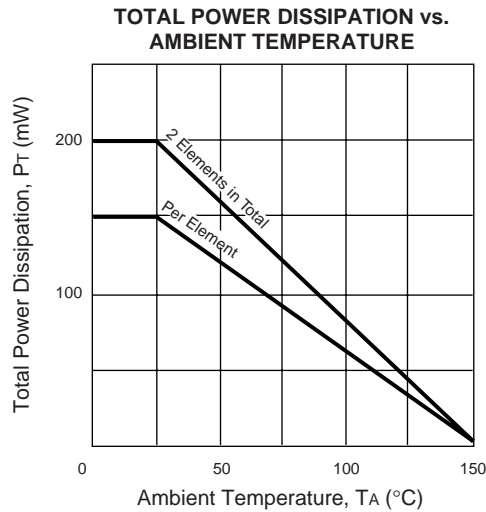
2. Collector to base capacitance when measured with capacitance meter (automatic balanced bridge method), with emitter connected to guard pin of capacitance meter.

**ABSOLUTE MAXIMUM RATINGS<sup>1</sup>** (T<sub>A</sub> = 25°C)

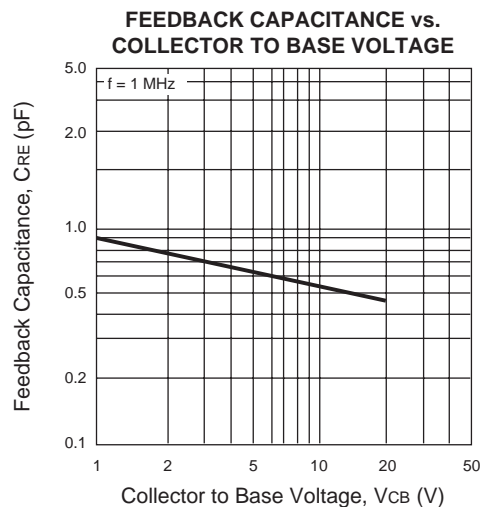
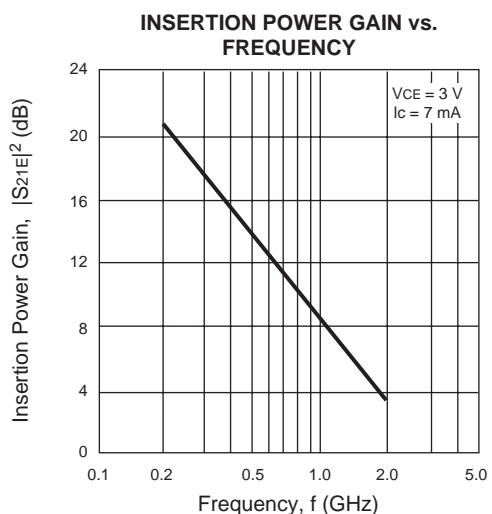
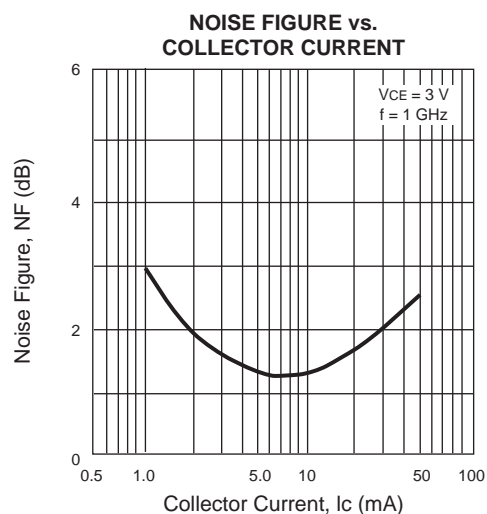
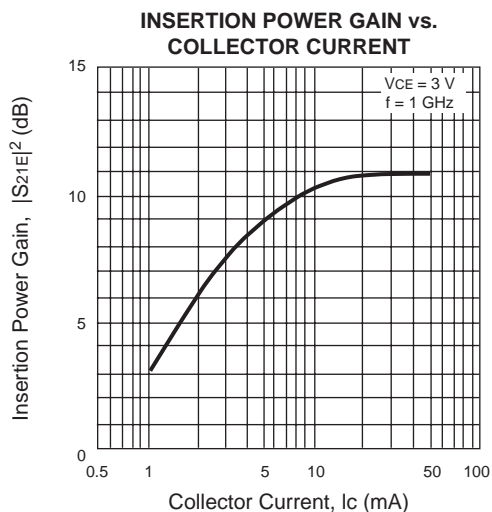
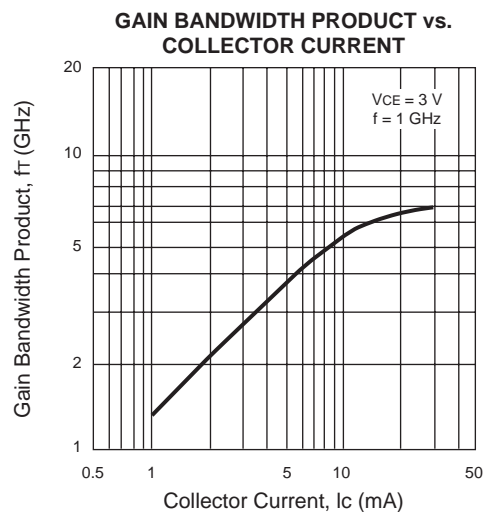
SYMBOLS	PARAMETERS	UNITS	RATINGS
V <sub>CB0</sub>	Collector to Base Voltage	V	20
V <sub>CE0</sub>	Collector to Emitter Voltage	V	12
V <sub>EB0</sub>	Emitter to Base Voltage	V	3
I <sub>c</sub>	Collector Current	mA	100
P <sub>T</sub>	Total Power Dissipation		
	1 Die	mW	150
	2 Die <sup>2</sup>	mW	200
T <sub>J</sub>	Junction Temperature	°C	150
T <sub>STG</sub>	Storage Temperature	°C	-65 to +150

Note: 1. Operation in excess of any one of these parameters may result in permanent damage.  
 2. When operating both devices, the power dissipation for either device should not exceed 110 mW.

**TYPICAL PERFORMANCE CURVES** (T<sub>A</sub> = 25°C)



**TYPICAL PERFORMANCE CURVES** ( $T_A = 25^\circ\text{C}$ )



## TYPICAL SCATTERING PARAMETERS

### Q1

$V_{CE} = 3\text{ V}$ ,  $I_C = 1\text{ mA}$ ,  $Z_0 = 50\ \Omega$

FREQUENCY (GHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
.10	.97	-20.45	2.38	162.85	.04	76.56	.98	-8.59
.20	.94	-40.17	2.31	148.19	.08	63.82	.94	-16.05
.30	.90	-59.57	2.25	135.26	.11	52.97	.89	-22.20
.40	.86	-77.29	2.10	123.99	.13	43.63	.83	-27.30
.50	.82	-94.54	2.03	113.53	.15	36.13	.78	-31.16
.60	.79	-110.15	1.92	104.19	.16	29.28	.74	-34.67
.70	.76	-124.06	1.80	95.54	.16	23.65	.70	-37.55
.80	.74	-136.61	1.69	87.82	.16	19.18	.67	-40.06
.90	.72	-148.19	1.59	80.80	.16	15.47	.65	-42.54
1.00	.71	-158.16	1.48	74.49	.16	12.65	.64	-44.88
1.20	.70	-175.72	1.30	63.28	.15	8.37	.61	-49.79
1.50	.71	162.88	1.09	49.18	.13	7.58	.59	-57.73
1.70	.72	151.31	.97	41.14	.12	11.56	.58	-64.34
2.00	.75	136.95	.83	31.08	.11	23.61	.57	-74.83
2.50	.78	117.97	.66	18.15	.13	45.08	.57	-95.23
3.00	.81	103.52	.54	10.02	.19	50.48	.58	-118.13

### Q2

$V_{CE} = 3\text{ V}$ ,  $I_C = 1\text{ mA}$ ,  $Z_0 = 50\ \Omega$

FREQUENCY (GHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
.10	.97	-20.79	2.52	162.21	.04	76.22	.98	-8.81
.20	.93	-40.50	2.43	147.42	.08	63.75	.93	-16.39
.30	.89	-59.73	2.35	134.45	.11	53.38	.87	-22.34
.40	.84	-76.87	2.20	123.37	.13	44.64	.81	-27.24
.50	.80	-93.28	2.11	113.14	.14	38.01	.76	-30.90
.60	.76	-107.72	1.99	104.15	.15	32.06	.71	-34.29
.70	.74	-120.25	1.85	96.02	.16	27.52	.68	-36.96
.80	.71	-131.32	1.74	88.78	.15	24.29	.65	-39.46
.90	.69	-141.35	1.64	82.34	.15	21.95	.62	-41.97
1.00	.68	-150.05	1.53	76.48	.15	20.46	.60	-44.52
1.20	.67	-165.04	1.36	66.07	.14	19.44	.57	-50.06
1.50	.67	176.90	1.17	52.95	.13	24.64	.53	-59.83
1.70	.68	166.97	1.06	45.23	.13	32.01	.51	-68.26
2.00	.69	154.69	.94	35.40	.14	44.56	.48	-82.95
2.50	.72	137.73	.79	21.71	.21	55.71	.45	-114.70
3.00	.75	124.46	.68	11.96	.30	51.65	.46	-152.23

## TYPICAL SCATTERING PARAMETERS

### Q1

$V_{CE} = 3\text{ V}$ ,  $I_C = 3\text{ mA}$ ,  $Z_0 = 50\ \Omega$

FREQUENCY (GHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
.10	.90	-29.42	6.73	156.08	.04	70.94	.93	-16.82
.20	.83	-56.61	6.15	138.83	.07	55.92	.82	-29.40
.30	.75	-82.38	5.66	124.38	.09	46.12	.70	-37.28
.40	.70	-104.35	5.08	112.82	.10	39.45	.61	-42.73
.50	.65	-122.97	4.52	102.90	.11	35.38	.54	-45.93
.60	.62	-138.09	4.00	94.98	.11	32.50	.49	-48.61
.70	.60	-150.60	3.57	88.01	.11	30.78	.45	-50.55
.80	.59	-161.35	3.21	82.00	.11	30.02	.42	-52.19
.90	.59	-170.46	2.90	76.74	.12	29.88	.40	-54.08
1.00	.59	-178.60	2.65	71.87	.12	30.03	.38	-55.78
1.20	.59	-167.50	2.25	62.99	.12	31.42	.36	-59.72
1.50	.61	150.72	1.82	51.53	.13	34.65	.33	-67.05
1.70	.63	141.52	1.61	44.61	.14	36.98	.32	-73.46
2.00	.66	130.09	1.38	35.44	.15	39.97	.31	-84.11
2.50	.70	114.27	1.10	21.83	.19	42.08	.31	-105.22
3.00	.75	102.28	.91	10.82	.22	41.10	.33	-128.59

### Q2

$V_{CE} = 3\text{ V}$ ,  $I_C = 3\text{ mA}$ ,  $Z_0 = 50\ \Omega$

FREQUENCY (GHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
.10	.90	-29.30	6.71	155.29	.04	71.05	.93	-16.80
.20	.82	-56.11	6.09	137.78	.07	56.98	.81	-28.76
.30	.73	-80.85	5.56	123.40	.09	48.29	.68	-35.65
.40	.67	-101.56	4.95	111.97	.10	42.87	.59	-40.13
.50	.62	-118.49	4.38	102.51	.11	39.94	.52	-42.64
.60	.59	-131.80	3.86	94.93	.11	38.27	.47	-44.51
.70	.57	-142.87	3.44	88.40	.11	37.56	.43	-45.87
.80	.56	-152.14	3.11	82.68	.12	37.77	.40	-47.30
.90	.55	-159.99	2.82	77.69	.12	38.47	.38	-48.65
1.00	.54	-166.88	2.59	73.06	.13	39.41	.36	-50.22
1.20	.55	-178.59	2.21	64.68	.13	41.56	.32	-54.00
1.50	.56	167.41	1.84	53.63	.15	45.41	.28	-62.05
1.70	.57	159.71	1.66	46.97	.17	47.04	.25	-70.04
2.00	.60	149.93	1.45	37.59	.19	48.39	.22	-85.71
2.50	.64	136.23	1.20	23.63	.25	47.57	.19	-125.28
3.00	.68	125.06	1.02	11.49	.31	42.77	.23	-169.77

## TYPICAL SCATTERING PARAMETERS

### Q1

$V_{CE} = 3\text{ V}$ ,  $I_C = 7\text{ mA}$ ,  $Z_0 = 50\ \Omega$

FREQUENCY (GHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
.10	.79	-44.32	13.71	146.95	.04	64.19	.84	-28.71
.20	.67	-82.73	11.45	126.15	.05	50.70	.64	-44.98
.30	.59	-113.49	9.41	111.03	.07	45.71	.49	-52.71
.40	.55	-134.72	7.67	100.87	.07	44.09	.40	-57.18
.50	.52	-150.16	6.37	93.24	.08	43.89	.35	-59.82
.60	.52	-161.98	5.44	87.20	.08	44.29	.31	-62.08
.70	.51	-171.56	4.71	81.95	.09	44.90	.28	-63.86
.80	.51	-179.64	4.17	77.28	.10	45.68	.26	-65.85
.90	.52	173.30	3.73	73.14	.10	46.53	.24	-67.95
1.00	.52	167.06	3.38	69.28	.11	47.24	.23	-70.01
1.20	.54	156.05	2.83	61.95	.12	47.51	.21	-75.34
1.50	.56	142.49	2.28	52.20	.14	47.48	.19	-85.78
1.70	.58	134.85	2.02	46.08	.16	47.00	.18	-94.72
2.00	.61	125.10	1.72	37.91	.18	45.50	.18	-108.59
2.50	.66	111.51	1.37	25.17	.22	41.98	.19	-134.34
3.00	.71	100.68	1.14	14.21	.25	37.45	.23	-157.18

### Q2

$V_{CE} = 3\text{ V}$ ,  $I_C = 7\text{ mA}$ ,  $Z_0 = 50\ \Omega$

FREQUENCY (GHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
.10	.78	-43.98	13.56	145.65	.04	65.30	.83	-28.08
.20	.64	-81.06	11.15	124.63	.05	53.73	.62	-42.31
.30	.55	-109.37	9.00	109.90	.07	50.12	.47	-48.09
.40	.50	-128.61	7.29	100.27	.07	49.49	.39	-50.66
.50	.48	-142.36	6.05	93.07	.08	50.25	.33	-51.72
.60	.47	-152.78	5.16	87.38	.09	50.94	.29	-52.25
.70	.46	-161.04	4.49	82.41	.10	51.76	.26	-52.80
.80	.46	-168.03	3.98	77.92	.11	52.62	.23	-53.35
.90	.46	-173.82	3.57	74.02	.12	53.24	.21	-54.00
1.00	.46	-179.09	3.24	70.24	.13	53.84	.19	-55.03
1.20	.47	171.98	2.75	63.22	.15	53.97	.16	-58.07
1.50	.50	160.99	2.25	53.72	.18	53.24	.12	-66.67
1.70	.51	154.69	2.02	47.63	.20	52.05	.09	-78.75
2.00	.54	146.49	1.75	39.20	.23	49.60	.07	-110.79
2.50	.59	134.74	1.44	26.11	.28	44.37	.09	174.41
3.00	.64	124.73	1.23	14.52	.33	38.05	.18	146.24

## ORDERING INFORMATION

PART NUMBER	QUANTITY	PACKAGING
UPA821TF-T1	3000	Tape & Reel

EXCLUSIVE NORTH AMERICAN AGENT FOR **NEC** RF, MICROWAVE & OPTOELECTRONIC SEMICONDUCTORS

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