

PRELIMINARY DATA SHEET

NEC

NPN SILICON EPITAXIAL TWIN TRANSISTOR

UPA827TF

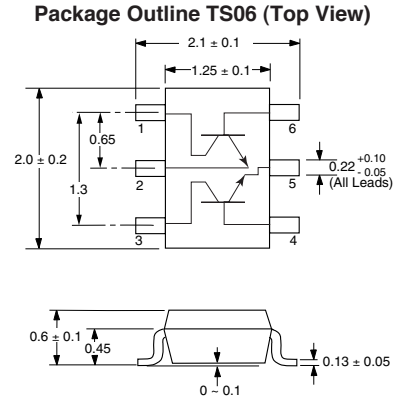
FEATURES

- **HIGH GAIN WITH LOW OPERATING CURRENT:**
 $IS_{21E}I^2 = 9 \text{ dB TYP at } f = 2 \text{ GHz, } V_{CE} = 2 \text{ V, } I_c = 7 \text{ mA}$
 $IS_{21E}I^2 = 8.5 \text{ dB TYP at } f = 2 \text{ GHz, } V_{CE} = 1 \text{ V, } I_c = 5 \text{ mA}$
- **SMALL PACKAGE STYLE:**
 2 NE686 die in a 2 mm x 1.25 mm x 0.6 mm package
- **Pb-FREE**

DESCRIPTION

The UPA827TF 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. This device is suitable for low voltage/low current, low noise applications, and its high f_t makes it an excellent choice for portable wireless applications. The thinner package style allows for higher density designs.

OUTLINE DIMENSIONS (Units in mm)



PIN CONNECTIONS

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

Note:

Pin 1 is the lower left most pin as the package lettering is oriented and read left to right.

ELECTRICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$)

PART NUMBER PACKAGE OUTLINE			UPA827TF TS06		
SYMBOLS	PARAMETERS AND CONDITIONS	UNITS	MIN	TYP	MAX
I_{CBO}	Collector Cutoff Current at $V_{CB} = 5 \text{ V, } I_E = 0$	μA			0.1
I_{EBO}	Emitter Cutoff Current at $V_{EB} = 1 \text{ V, } I_C = 0$	μA			0.1
h_{FE}	DC Current Gain ¹ at $V_{CE} = 2 \text{ V, } I_C = 7 \text{ mA}$		70		140
f_t	Gain Bandwidth (1) at $V_{CE} = 2 \text{ V, } I_C = 7 \text{ mA, } f = 2 \text{ GHz}$	GHz	10	13	
f_t	Gain Bandwidth (2) at $V_{CE} = 1 \text{ V, } I_C = 5 \text{ mA, } f = 2 \text{ GHz}$	GHz	8.5	12	
C_{re}	Feedback Capacitance ² at $V_{CB} = 2 \text{ V, } I_E = 0, f = 1 \text{ MHz}$	pF		0.4	0.6
$IS_{21E}I^2$	Insertion Power Gain (1) at $V_{CE} = 2 \text{ V, } I_C = 7 \text{ mA, } f = 2 \text{ GHz}$	dB	7.5	9	
$IS_{21E}I^2$	Insertion Power Gain (2) at $V_{CE} = 1 \text{ V, } I_C = 5 \text{ mA, } f = 2 \text{ GHz}$	dB	7	8.5	
NF	Noise Figure (1) at $V_{CE} = 2 \text{ V, } I_C = 3 \text{ mA, } f = 2 \text{ GHz}$	dB		1.5	2
NF	Noise Figure (2) at $V_{CE} = 1 \text{ V, } I_C = 3 \text{ mA, } f = 2 \text{ GHz}$	dB		1.5	2
h_{FE1}/h_{FE2}	h_{FE} ratio, $V_{CE} = 2 \text{ V, } I_C = 7 \text{ mA}$ h_{FE1} = Smaller h_{FE} value between Q1 and Q2 h_{FE2} = Larger h_{FE} value between Q1 and Q2		0.85	1.0	

Notes: 1. Pulsed measurement, pulse width $\leq 350 \mu\text{s}$, duty cycle $\leq 2\%$.
 2. Collector to base capacitance when measured with capacitance meter (automatic balanced bridge method), with emitter connected to guard pin of capacitances meter.

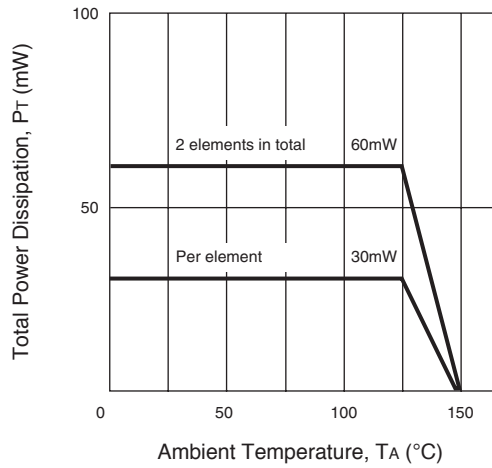
ABSOLUTE MAXIMUM RATINGS¹ ($T_A = 25^\circ\text{C}$)

SYMBOLS	PARAMETERS	UNITS	RATINGS
V _{CB0}	Collector to Base Voltage	V	5
V _{CE0}	Collector to Emitter Voltage	V	3
V _{EB0}	Emitter to Base Voltage	V	2
I _c	Collector Current	mA	10
P _T	Total Power Dissipation		
	1 Element	mW	30
	2 Elements	mW	60
T _J	Junction Temperature	°C	150
T _{STG}	Storage Temperature	°C	-65 to +150

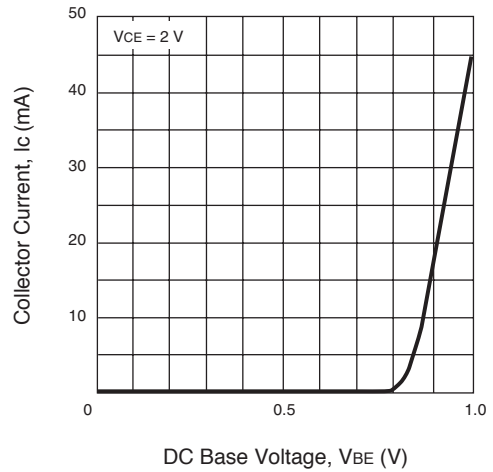
Note: 1. Operation in excess of any one of these parameters may result in permanent damage.

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

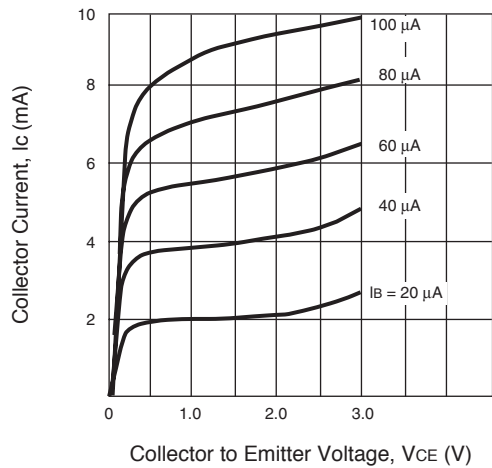
TOTAL POWER DISSIPATION vs. AMBIENT TEMPERATURE



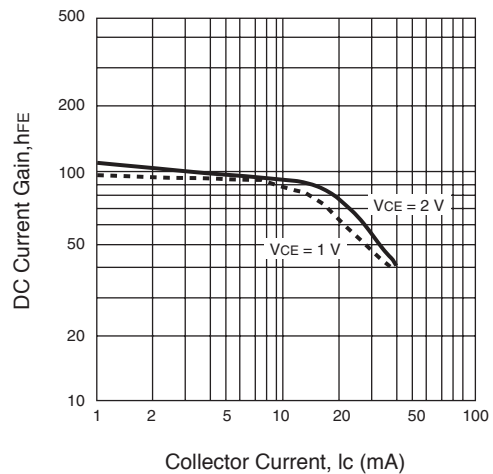
COLLECTOR CURRENT vs. DC BASE VOLTAGE



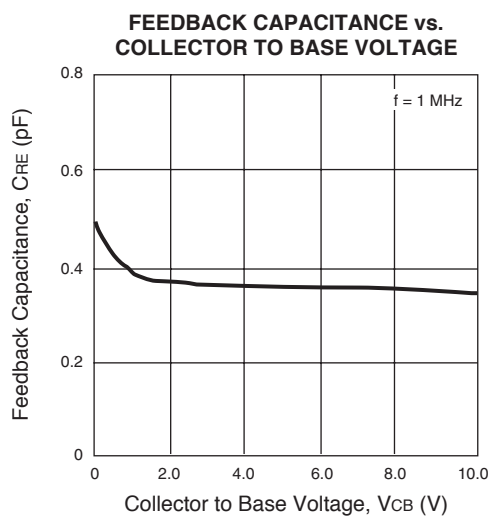
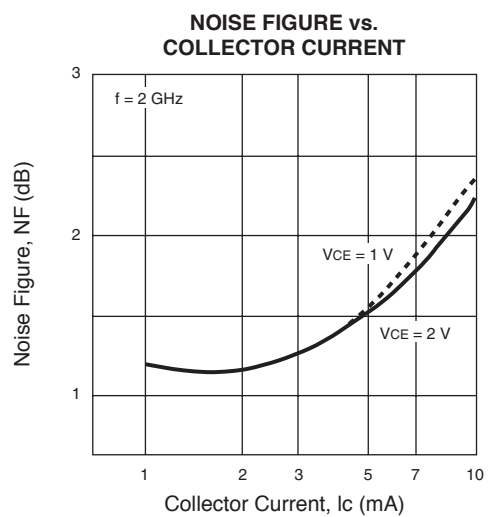
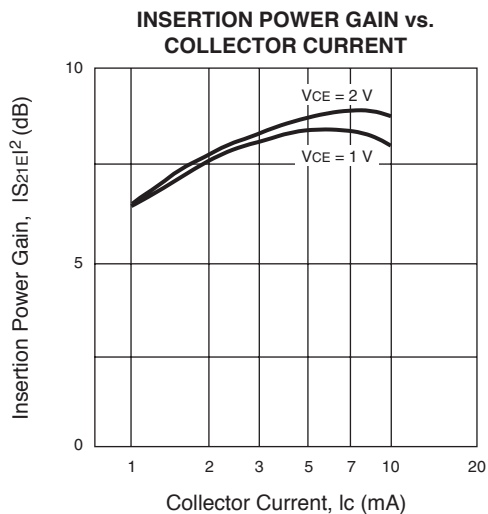
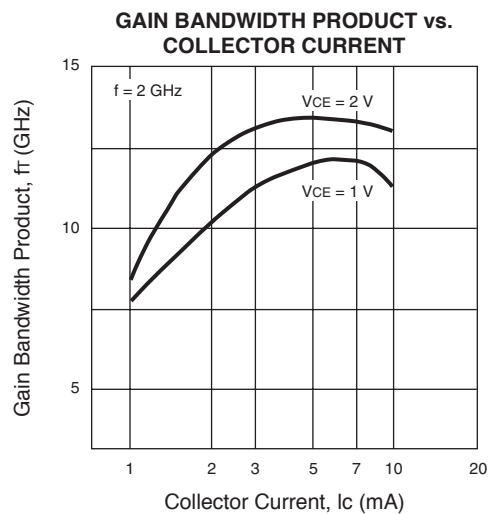
COLLECTOR CURRENT vs. EMITTER VOLTAGE



DC CURRENT GAIN vs. COLLECTOR CURRENT



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



TYPICAL SCATTERING PARAMETERS (T_A = 25°C)

Q1

V_{CE} = 2 V, I_C = 1 mA, Z_O = 50 Ω

FREQUENCY (GHz)	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
0.10	0.97	-3.79	2.37	173.89	0.02	86.19	0.99	-3.35
0.20	0.96	-7.62	2.35	168.24	0.03	83.85	0.99	-6.52
0.30	0.95	-11.53	2.40	162.95	0.05	80.08	0.98	-9.88
0.40	0.94	-15.36	2.38	157.51	0.06	77.05	0.97	-13.07
0.50	0.92	-19.27	2.39	152.51	0.08	74.32	0.96	-16.16
0.60	0.90	-23.25	2.38	147.98	0.09	71.00	0.95	-19.49
0.70	0.88	-27.31	2.37	143.24	0.10	68.16	0.93	-22.31
0.80	0.86	-31.26	2.37	139.10	0.12	65.24	0.91	-25.62
0.90	0.83	-35.44	2.37	134.35	0.13	62.59	0.89	-28.16
1.00	0.80	-39.13	2.33	129.91	0.14	59.95	0.86	-31.26
1.20	0.74	-47.66	2.32	121.47	0.16	55.12	0.82	-36.57
1.50	0.63	-61.74	2.31	109.55	0.19	48.35	0.75	-44.21
1.70	0.56	-70.44	2.23	101.17	0.20	44.53	0.70	-48.82
2.00	0.46	-86.95	2.16	90.13	0.22	38.96	0.64	-55.67
2.50	0.27	-120.95	2.03	70.78	0.24	32.87	0.54	-65.96
3.00	0.20	-171.57	1.83	54.75	0.25	27.71	0.46	-77.11

Q2

V_{CE} = 2 V, I_C = 1 mA, Z_O = 50 Ω

FREQUENCY (GHz)	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
0.10	0.97	-3.76	2.38	173.74	0.02	86.91	0.99	-3.32
0.20	0.96	-7.50	2.35	167.97	0.03	83.65	0.99	-6.56
0.30	0.95	-11.38	2.39	162.59	0.05	80.52	0.98	-9.72
0.40	0.94	-15.24	2.38	157.14	0.06	77.30	0.97	-12.95
0.50	0.92	-19.09	2.38	152.09	0.08	74.64	0.95	-15.89
0.60	0.91	-23.00	2.38	147.56	0.09	71.39	0.93	-19.16
0.70	0.89	-26.94	2.37	142.82	0.11	68.87	0.91	-21.99
0.80	0.86	-30.85	2.37	138.70	0.12	65.96	0.89	-25.12
0.90	0.84	-34.90	2.37	133.96	0.13	63.53	0.86	-27.55
1.00	0.82	-38.48	2.33	129.63	0.14	61.18	0.84	-30.48
1.20	0.76	-46.39	2.32	121.22	0.16	56.71	0.79	-35.31
1.50	0.67	-59.42	2.32	109.38	0.19	50.94	0.71	-42.55
1.70	0.61	-67.25	2.24	101.17	0.20	47.51	0.65	-47.09
2.00	0.53	-81.17	2.17	90.51	0.22	42.47	0.57	-53.85
2.50	0.38	-105.57	2.05	71.84	0.25	36.57	0.45	-64.55
3.00	0.30	-134.37	1.89	56.05	0.27	31.69	0.34	-77.62

TYPICAL SCATTERING PARAMETERS ($T_A = 25^\circ\text{C}$)**Q1**VCE = 2 V, Ic = 3 mA, Zo = 50 Ω

FREQUENCY (GHz)	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
0.10	0.90	-6.40	6.38	170.12	0.02	84.82	0.98	-5.79
0.20	0.88	-12.71	6.21	161.60	0.03	80.22	0.96	-11.39
0.30	0.85	-19.07	6.16	153.85	0.04	76.19	0.93	-16.48
0.40	0.81	-25.04	6.00	146.67	0.06	72.09	0.90	-21.27
0.50	0.76	-31.15	5.84	140.06	0.07	69.59	0.85	-25.20
0.60	0.71	-36.82	5.65	134.24	0.08	66.27	0.81	-29.17
0.70	0.66	-42.59	5.49	128.01	0.09	64.30	0.77	-32.16
0.80	0.61	-48.04	5.32	122.51	0.10	61.95	0.73	-35.33
0.90	0.55	-53.11	5.12	116.88	0.10	60.14	0.70	-37.63
1.00	0.50	-57.87	4.92	111.77	0.11	59.19	0.67	-39.81
1.20	0.40	-66.68	4.51	102.30	0.12	56.73	0.61	-43.76
1.50	0.27	-79.47	3.95	90.17	0.15	53.86	0.54	-49.15
1.70	0.20	-88.30	3.60	83.36	0.16	52.11	0.50	-52.50
2.00	0.11	-108.97	3.18	74.09	0.18	49.45	0.45	-57.74
2.50	0.07	-158.31	2.66	60.75	0.21	45.49	0.38	-64.84
3.00	0.16	118.39	2.29	48.87	0.24	40.58	0.32	-80.67

Q2VCE = 2 V, Ic = 3 mA, Zo = 50 Ω

FREQUENCY (GHz)	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
0.10	0.90	-6.34	6.39	169.68	0.02	84.84	0.98	-5.82
0.20	0.88	-12.58	6.20	160.94	0.03	80.33	0.96	-11.25
0.30	0.85	-18.91	6.14	153.06	0.04	76.31	0.92	-16.31
0.40	0.82	-24.80	5.97	145.83	0.06	73.00	0.88	-20.79
0.50	0.77	-30.57	5.79	139.18	0.07	70.49	0.83	-24.41
0.60	0.73	-36.24	5.59	133.26	0.08	67.69	0.79	-28.04
0.70	0.68	-41.66	5.41	127.08	0.09	65.74	0.74	-30.52
0.80	0.63	-46.88	5.23	121.55	0.10	63.80	0.70	-33.20
0.90	0.58	-51.46	5.02	116.05	0.11	62.24	0.66	-35.07
1.00	0.53	-55.76	4.80	111.07	0.11	61.38	0.63	-36.80
1.20	0.45	-63.47	4.39	102.03	0.13	59.31	0.57	-39.71
1.50	0.35	-74.44	3.84	90.52	0.15	56.69	0.49	-43.54
1.70	0.30	-82.13	3.52	84.07	0.17	54.93	0.44	-46.16
2.00	0.24	-95.31	3.13	74.96	0.19	52.36	0.38	-49.40
2.50	0.17	-125.55	2.66	61.81	0.23	48.10	0.29	-56.28
3.00	0.16	-165.06	2.31	49.68	0.27	43.08	0.20	-66.61

TYPICAL SCATTERING PARAMETERS (T_A = 25°C)

Q1

V_{CE} = 2 V, I_C = 7 mA, Z₀ = 50 Ω

FREQUENCY (GHz)	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
0.10	0.79	-10.59	12.26	165.48	0.01	83.48	0.96	-8.71
0.20	0.74	-20.57	11.58	153.36	0.03	77.65	0.91	-16.50
0.30	0.67	-30.03	10.98	142.68	0.04	73.57	0.84	-22.47
0.40	0.59	-38.34	10.23	133.14	0.05	70.32	0.77	-27.22
0.50	0.52	-45.42	9.42	124.76	0.06	68.50	0.72	-30.47
0.60	0.45	-51.28	8.61	117.78	0.07	66.94	0.67	-33.23
0.70	0.38	-56.02	7.87	111.39	0.07	65.98	0.62	-35.02
0.80	0.33	-59.86	7.22	105.98	0.08	65.26	0.59	-36.80
0.90	0.28	-63.19	6.63	101.18	0.09	64.24	0.56	-38.15
1.00	0.24	-65.89	6.12	96.90	0.10	63.87	0.53	-39.31
1.20	0.17	-70.37	5.29	89.57	0.11	62.59	0.49	-41.59
1.50	0.08	-78.15	4.37	80.22	0.13	60.52	0.44	-45.40
1.70	0.04	-88.25	3.92	74.77	0.15	58.88	0.42	-48.34
2.00	0.03	-118.89	3.40	67.28	0.17	56.41	0.38	-53.28
2.50	0.12	102.62	2.80	55.99	0.21	51.57	0.32	-63.74
3.00	0.21	98.26	2.38	45.77	0.24	45.88	0.27	-77.81

Q2

V_{CE} = 2 V, I_C = 7 mA, Z₀ = 50 Ω

FREQUENCY (GHz)	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
0.10	0.79	-10.37	12.25	164.70	0.01	82.96	0.95	-8.66
0.20	0.74	-20.08	11.49	152.30	0.03	78.29	0.90	-16.20
0.30	0.68	-29.16	10.81	141.44	0.04	74.48	0.82	-21.74
0.40	0.60	-36.85	10.00	131.96	0.05	71.50	0.76	-25.90
0.50	0.53	-43.25	9.14	123.66	0.06	70.09	0.69	-28.46
0.60	0.47	-48.47	8.31	116.90	0.07	68.61	0.64	-30.60
0.70	0.42	-52.50	7.57	110.84	0.08	67.97	0.60	-31.88
0.80	0.37	-56.05	6.92	105.69	0.08	67.35	0.56	-32.88
0.90	0.34	-59.04	6.36	101.15	0.09	66.54	0.53	-33.54
1.00	0.30	-61.69	5.87	97.08	0.10	66.31	0.51	-34.05
1.20	0.25	-66.62	5.07	90.12	0.12	64.95	0.46	-35.02
1.50	0.19	-75.77	4.24	81.19	0.14	63.09	0.41	-36.74
1.70	0.16	-84.55	3.82	75.92	0.16	61.07	0.37	-38.42
2.00	0.12	-101.92	3.34	68.51	0.18	58.41	0.32	-40.40
2.50	0.10	-148.42	2.79	57.44	0.23	53.55	0.25	-45.38
3.00	0.14	170.66	2.41	46.77	0.27	47.51	0.17	-52.42

ORDERING INFORMATION

PART NUMBER	QUANTITY	PACKAGING
UPA827TF-T1-A	3000	Tape & Reel, Pb-Free