NEC

NPN SILICON EPITAXIAL TWIN TRANSISTOR | UPA835TF

FEATURES

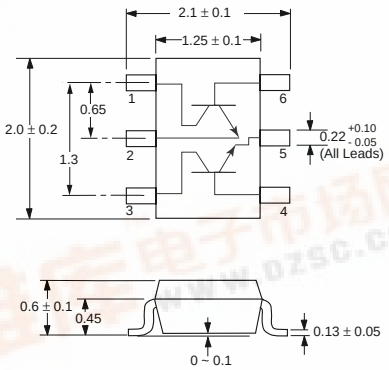
- **LOW NOISE:**
  Q1:NF = 1.5 dB TYP at f = 2 GHz, V_{CE} = 3 V, I_C = 3 mA
  Q2:NF = 1.2 dB TYP at f = 1 GHz, V_{CE} = 3 V, I_C = 7 mA
- **HIGH GAIN:**
  Q1: $|S_{21E}|^2$ = 8.5 dB TYP at f = 1 GHz, V_{CE} = 3 V, I_C = 10 mA
  Q2: $|S_{21E}|^2$ = 9.0 dB TYP at f = 1 GHz, V_{CE} = 3 V, I_C = 7 mA
- **6-PIN THIN-TYPE SMALL MINI MOLD PACKAGE**
- **2 DIFFERENT BUILT-IN TRANSISTORS (Q1: NE685, Q2: NE856)**

DESCRIPTION

The UPA835TF has two different built-in transistors for low cost amplifier and oscillator applications in the VHF/UHF band. Low noise figures, high gain, high current capability, and medium output give this device high dynamic range and excellent linearity for two-stage amplifiers. This device is also ideally suited for use in a VCO/buffer amplifier application. The thinner package style allows for higher density designs.

OUTLINE DIMENSIONS (Units in mm)

Package Outline TS06 (Top View)



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°C)

	PART NUMBER PACKAGE OUTLINE			UPA835TF TS06		
	SYMBOLS	PARAMETERS AND CONDITIONS	UNITS	MIN	TYP	MAX
Q1	I_{CBO}	Collector Cutoff Current at V_{CB} = 5 V, I_E = 0	µA			0.1
	I_{EBO}	Emitter Cutoff Current at V_{EB} = 1 V, I_C = 0	µA			0.1
	h_{FE}	DC Current Gain[1] at V_{CE} = 3 V, I_C = 10 mA		75		150
	f_T	Gain Bandwidth at V_{CE} = 3 V, I_C = 10 mA, f = 2 GHz	GHz		12	
	Cre	Feedback Capacitance[2] at V_{CB} = 3 V, I_E = 0, f = 1 MHz	pF		0.4	0.7
	$\|S_{21E}\|^2$	Insertion Power Gain at V_{CE} = 3 V, I_C =10 mA, f = 2 GHz	dB	7	8.5	
	NF	Noise Figure at V_{CE} = 3 V, I_C = 3 mA, f = 2 GHz	dB		1.5	2.5
Q2	I_{CBO}	Collector Cutoff Current at V_{CB} = 10 V, I_E = 0	µA			1.0
	I_{EBO}	Emitter Cutoff Current at V_{EB} = 1 V, I_C = 0	µA			1.0
	h_{FE}	DC Current Gain[1] at V_{CE} = 3 V, I_C = 7 mA		100		145
	f_T	Gain Bandwidth at V_{CE} = 3 V, I_C = 7 mA, f = 1 GHz	GHz	3.0	4.5	
	Cre	Feedback Capacitance[2] at V_{CB} = 3 V, I_E = 0, f = 1 MHz	pF		0.7	1.5
	$\|S_{21E}\|^2$	Insertion Power Gain at V_{CE} = 3 V, I_C =7 mA, f = 1 GHz	dB	7	9	
	NF	Noise Figure at V_{CE} = 3 V, I_C = 7 mA, f = 1 GHz	dB		1.2	2.5

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 capacitances meter.

ABSOLUTE MAXIMUM RATINGS[1] (T_A = 25°C)

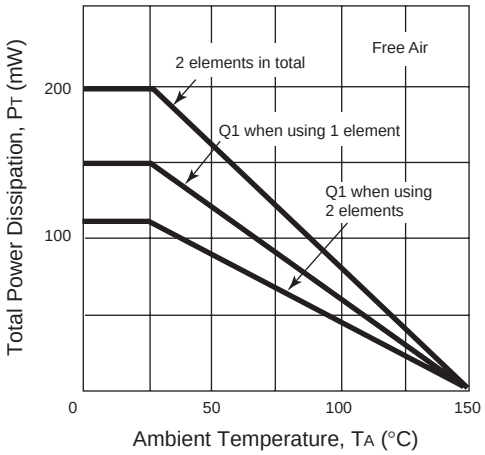
SYMBOLS	PARAMETERS	UNITS	RATINGS	
			Q1	Q2
V_{CBO}	Collector to Base Voltage	V	9	20
V_{CEO}	Collector to Emitter Voltage	V	6	12
V_{EBO}	Emitter to Base Voltage	V	2	3
I_C	Collector Current	mA	30	100
P_T	Total Power Dissipation	mW	150	150
			200[2]	
T_J	Junction Temperature	°C	150	150
T_{STG}	Storage Temperature	°C	-65 to +150	

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

TYPICAL PERFORMANCE CURVES (T_A = 25°C)

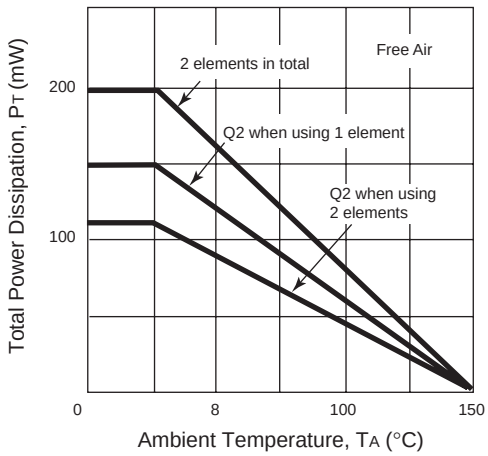
Q1

TOTAL POWER DISSIPATION vs. AMBIENT TEMPERATURE

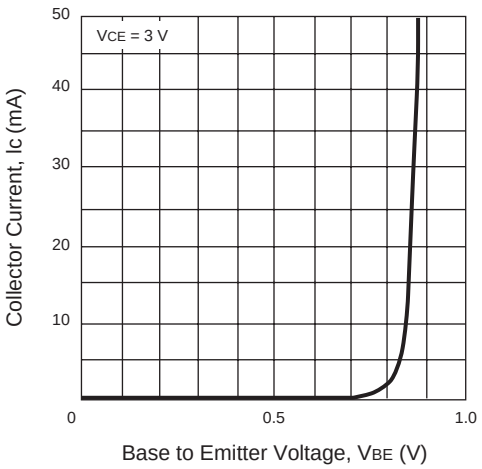


Q2

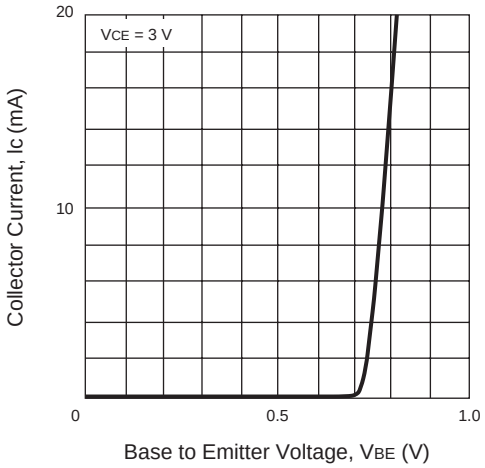
TOTAL POWER DISSIPATION vs. AMBIENT TEMPERATURE



COLLECTOR CURRENT vs. BASE TO EMITTER VOLTAGE



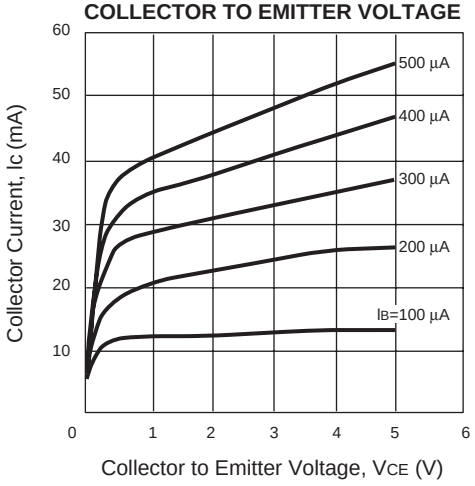
COLLECTOR CURRENT vs. BASE TO EMITTER VOLTAGE



TYPICAL PERFORMANCE CURVES (T_A = 25°C)

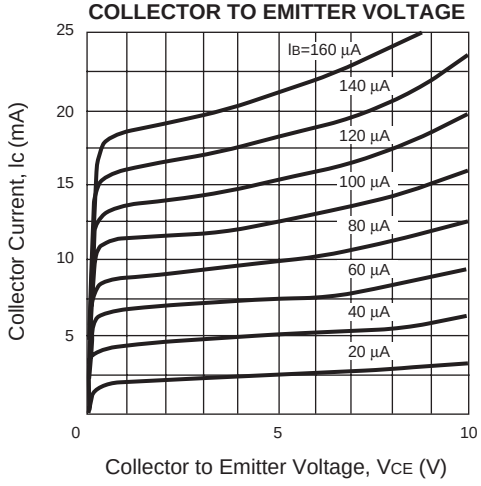
Q1

COLLECTOR CURRENT vs. COLLECTOR TO EMITTER VOLTAGE

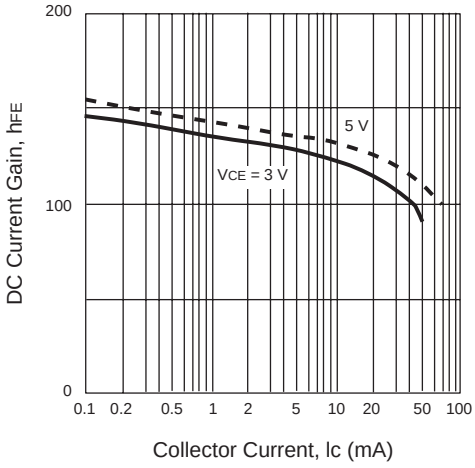


Q2

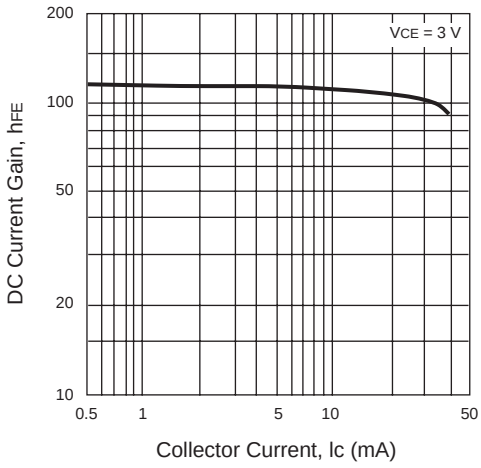
COLLECTOR CURRENT vs. COLLECTOR TO EMITTER VOLTAGE



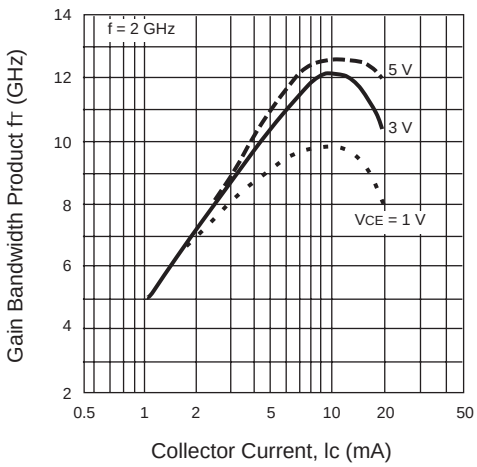
DC CURRENT GAIN vs. COLLECTOR CURRENT



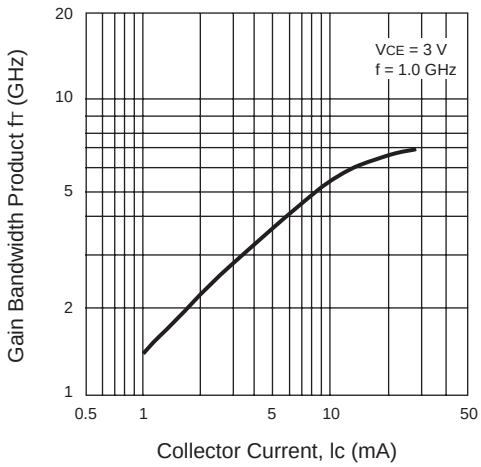
DC CURRENT GAIN vs. COLLECTOR CURRENT



GAIN BANDWIDTH PRODUCT vs. COLLECTOR CURRENT



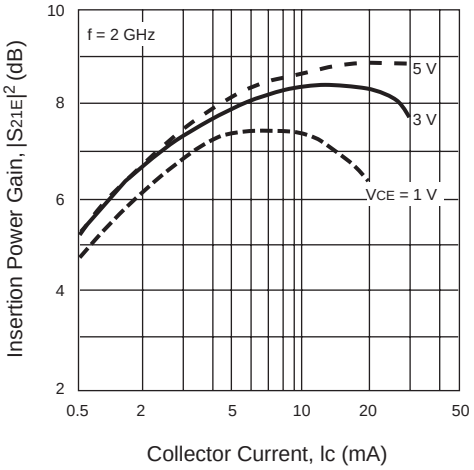
GAIN BANDWIDTH PRODUCT vs. COLLECTOR CURRENT



TYPICAL PERFORMANCE CURVES (T_A = 25°C)

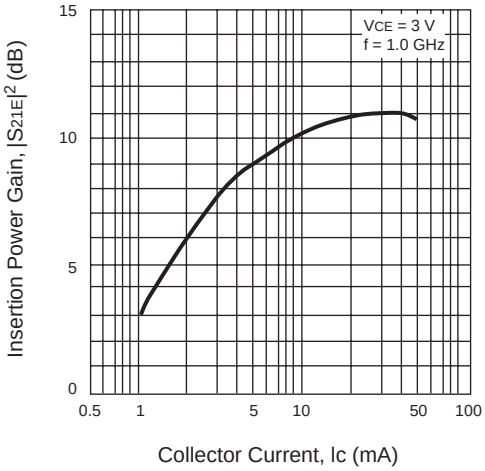
Q1

INSERTION POWER GAIN vs. COLLECTOR CURRENT

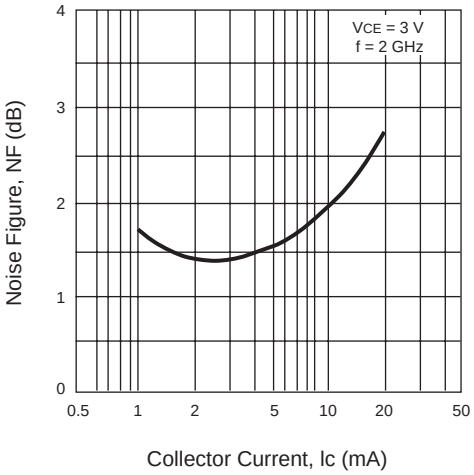


Q2

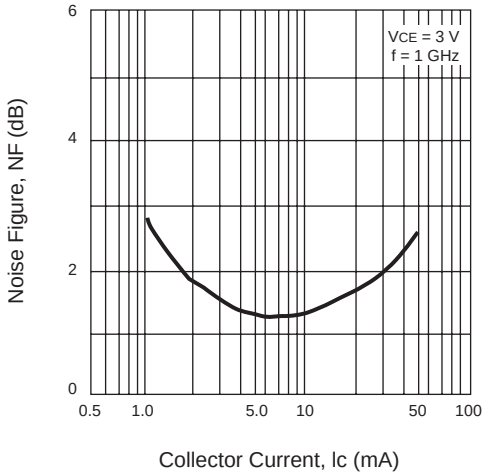
INSERTION POWER GAIN vs. COLLECTOR CURRENT



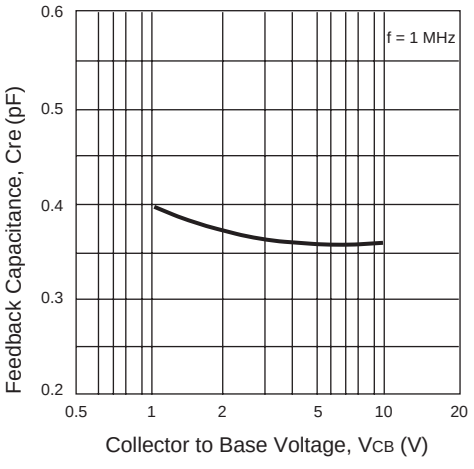
NOISE FIGURE vs. COLLECTOR CURRENT



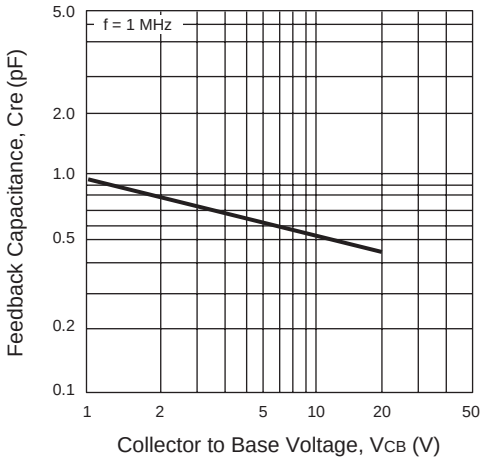
NOISE FIGURE vs. COLLECTOR CURRENT



FEEDBACK CAPACITANCE vs. COLLECTOR TO BASE VOLTAGE



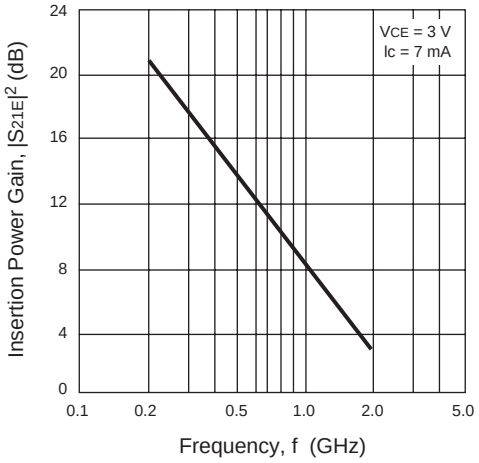
FEEDBACK CAPACITANCE vs. COLLECTOR TO BASE VOLTAGE



TYPICAL PERFORMANCE CURVES (T_A = 25°C)

Q2

INSERTION POWER GAIN vs. FREQUENCY



TYPICAL SCATTERING PARAMETERS

Q1

V_{CE} = 3 V, I_C = 1 mA, Z_0 = 50 Ω

FREQUENCY	S11		S21		S12		S22	
(GHz)	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
0.10	0.98	-5.93	2.38	172.32	0.02	85.76	1.00	-3.86
0.20	0.97	-11.90	2.36	165.08	0.04	81.15	0.99	-7.44
0.30	0.95	-18.17	2.39	158.35	0.06	76.27	0.97	-11.14
0.40	0.93	-24.00	2.35	151.83	0.07	72.22	0.96	-14.73
0.50	0.90	-30.10	2.35	145.70	0.09	68.30	0.94	-18.02
0.60	0.87	-36.17	2.33	140.22	0.10	64.18	0.92	-21.42
0.70	0.84	-42.49	2.30	134.45	0.12	60.68	0.89	-24.18
0.80	0.80	-48.69	2.29	129.32	0.13	56.90	0.87	-27.47
0.90	0.76	-55.28	2.29	123.53	0.14	53.94	0.84	-29.94
1.00	0.73	-61.26	2.24	118.31	0.15	51.07	0.81	-32.50
1.20	0.64	-74.79	2.19	108.30	0.16	45.85	0.76	-36.89
1.50	0.51	-96.77	2.10	93.80	0.18	39.24	0.69	-42.90
1.70	0.43	-112.09	2.00	84.74	0.19	36.24	0.65	-46.39
2.00	0.35	-138.38	1.84	72.75	0.19	32.40	0.60	-51.51
2.50	0.31	175.03	1.62	54.64	0.20	29.55	0.53	-59.91
3.00	0.35	140.64	1.41	40.02	0.21	28.96	0.47	-69.74

Q2

V_{CE} = 3 V, I_C = 1 mA, Z_0 = 50 Ω

FREQUENCY	S11		S21		S12		S22	
(GHz)	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
0.10	0.97	-20.79	2.52	162.21	0.04	76.22	0.98	-8.81
0.20	0.93	-40.50	2.43	147.42	0.08	63.75	0.93	-16.39
0.30	0.89	-59.73	2.35	134.45	0.11	53.38	0.87	-22.34
0.40	0.84	-76.87	2.20	123.37	0.13	44.64	0.81	-27.24
0.50	0.80	-93.28	2.11	113.14	0.14	38.01	0.76	-30.90
0.60	0.76	-107.72	1.99	104.15	0.15	32.06	0.71	-34.29
0.70	0.74	-120.25	1.85	96.02	0.16	27.52	0.68	-36.96
0.80	0.71	-131.32	1.74	88.78	0.15	24.29	0.65	-39.46
0.90	0.69	-141.35	1.64	82.34	0.15	21.95	0.62	-41.97
1.00	0.68	-150.05	1.53	76.48	0.15	20.46	0.60	-44.52
1.20	0.67	-165.04	1.36	66.07	0.14	19.44	0.57	-50.06
1.50	0.67	176.90	1.17	52.95	0.13	24.64	0.53	-59.83
1.70	0.68	166.97	1.06	45.23	0.13	32.01	0.51	-68.26
2.00	0.69	154.69	0.94	35.40	0.14	44.56	0.48	-82.95
2.50	0.72	137.73	0.79	21.71	0.21	55.71	0.45	-114.70
3.00	0.75	124.46	0.68	11.96	0.30	51.65	0.46	-152.23

TYPICAL SCATTERING PARAMETERS

Q1

V_{CE} = 3 V, I_C = 3 mA, Z_0 = 50 Ω

FREQUENCY	S_{11}		S_{21}		S_{12}		S_{22}	
(GHz)	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
0.10	0.94	-9.29	6.55	168.08	0.02	84.10	0.98	-6.91
0.20	0.90	-18.39	6.32	157.85	0.04	76.93	0.95	-13.21
0.30	0.85	-27.47	6.21	148.76	0.05	71.79	0.91	-18.80
0.40	0.80	-36.15	5.98	140.53	0.06	66.81	0.86	-23.80
0.50	0.74	-44.62	5.77	133.00	0.07	63.60	0.81	-27.41
0.60	0.67	-52.69	5.51	126.23	0.08	60.13	0.76	-31.19
0.70	0.60	-60.71	5.28	119.27	0.09	58.07	0.72	-33.67
0.80	0.54	-68.45	5.03	113.12	0.10	55.93	0.68	-36.31
0.90	0.47	-75.60	4.76	107.23	0.11	54.62	0.64	-38.10
1.00	0.42	-82.57	4.50	101.99	0.11	53.45	0.61	-39.74
1.20	0.32	-96.78	4.02	92.52	0.13	51.59	0.56	-42.63
1.50	0.21	-122.39	3.42	80.83	0.15	49.61	0.50	-46.74
1.70	0.17	-143.90	3.10	74.15	0.16	48.63	0.46	-49.50
2.00	0.16	179.12	2.70	64.83	0.18	46.70	0.42	-54.02
2.50	0.22	136.13	2.24	51.62	0.21	43.76	0.36	-63.34
3.00	0.29	115.80	1.89	39.81	0.23	40.27	0.31	-75.36

Q2

V_{CE} = 3 V, I_C = 3 mA, Z_0 = 50 Ω

FREQUENCY	S_{11}		S_{21}		S_{12}		S_{22}	
(GHz)	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
0.10	0.90	-29.30	6.71	155.29	0.04	71.05	0.93	-16.80
0.20	0.82	-56.11	6.09	137.78	0.07	56.98	0.81	-28.76
0.30	0.73	-80.85	5.56	123.40	0.09	48.29	0.68	-35.65
0.40	0.67	-101.56	4.95	111.97	0.10	42.87	0.59	-40.13
0.50	0.62	-118.49	4.38	102.51	0.11	39.94	0.52	-42.64
0.60	0.59	-131.80	3.86	94.93	0.11	38.27	0.47	-44.51
0.70	0.57	-142.87	3.44	88.40	0.11	37.56	0.43	-45.87
0.80	0.56	-152.14	3.11	82.68	0.12	37.77	0.40	-47.30
0.90	0.55	-159.99	2.82	77.69	0.12	38.47	0.38	-48.65
1.00	0.54	-168.88	2.59	73.06	0.13	39.41	0.36	-50.22
1.20	0.55	-178.59	2.21	64.68	0.13	41.56	0.32	-54.00
1.50	0.56	167.41	1.84	53.63	0.15	45.41	0.28	-62.05
1.70	0.57	159.71	1.66	46.97	0.17	47.04	0.25	-70.04
2.00	0.60	149.93	1.45	37.59	0.19	48.39	0.22	-85.71
2.50	0.64	136.23	1.20	23.63	0.25	47.57	0.19	-125.28
3.00	0.68	125.06	1.02	11.49	0.31	42.77	0.23	-169.77

TYPICAL SCATTERING PARAMETERS

Q1

V_{CE} = 3 V, I_C = 5 mA, Z_0 = 50 Ω

FREQUENCY	S_{11}		S_{21}		S_{12}		S_{22}	
(GHz)	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
0.10	0.90	-12.12	10.05	165.07	0.02	82.08	0.97	-9.12
0.20	0.84	-23.51	9.49	152.86	0.03	74.99	0.92	-17.06
0.30	0.77	-34.84	9.08	142.06	0.05	69.42	0.85	-23.23
0.40	0.69	-45.03	8.52	132.57	0.06	65.57	0.78	-28.22
0.50	0.60	-54.58	7.94	123.96	0.07	63.02	0.72	-31.57
0.60	0.52	-62.89	7.32	116.79	0.08	60.80	0.66	-34.45
0.70	0.44	-70.48	6.74	109.99	0.08	59.78	0.62	-36.34
0.80	0.38	-77.63	6.21	104.22	0.09	58.73	0.58	-38.08
0.90	0.32	-84.12	5.71	99.08	0.10	57.98	0.55	-39.38
1.00	0.28	-90.92	5.28	94.41	0.11	57.45	0.53	-40.58
1.20	0.20	-105.44	4.56	86.53	0.12	56.41	0.48	-42.73
1.50	0.13	-137.90	3.78	76.56	0.14	54.85	0.43	-46.37
1.70	0.11	-167.88	3.39	70.79	0.15	53.69	0.40	-49.23
2.00	0.13	152.80	2.93	62.58	0.18	51.42	0.37	-54.00
2.50	0.21	121.76	2.41	50.64	0.21	47.56	0.31	-64.32
3.00	0.28	107.74	2.03	39.80	0.24	42.91	0.26	-78.22

Q2

V_{CE} = 3 V, I_C = 5 mA, Z_0 = 50 Ω

FREQUENCY	S_{11}		S_{21}		S_{12}		S_{22}	
(GHz)	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
0.10	0.83	-36.95	10.41	149.93	0.04	67.41	0.87	-23.15
0.20	0.72	-69.61	9.00	130.38	0.06	54.36	0.70	-36.92
0.30	0.62	-97.36	7.70	115.33	0.07	48.48	0.56	-43.33
0.40	0.56	-117.96	6.47	104.59	0.08	46.08	0.46	-46.73
0.50	0.53	-133.20	5.47	96.45	0.09	45.55	0.40	-48.28
0.60	0.51	-145.02	4.72	89.97	0.10	45.75	0.35	-49.37
0.70	0.50	-154.27	4.13	84.56	0.10	46.29	0.32	-50.23
0.80	0.49	-162.17	3.68	79.59	0.11	47.21	0.29	-50.94
0.90	0.49	-168.79	3.31	75.30	0.12	48.13	0.27	-51.90
1.00	0.49	-174.60	3.02	71.24	0.13	48.87	0.25	-53.05
1.20	0.50	175.37	2.56	63.72	0.14	49.97	0.22	-56.22
1.50	0.52	163.26	2.11	53.63	0.17	50.87	0.18	-64.21
1.70	0.53	156.57	1.90	47.43	0.19	50.65	0.15	-73.44
2.00	0.56	147.71	1.65	38.70	0.22	49.28	0.11	-94.06
2.50	0.61	135.31	1.36	25.02	0.27	45.44	0.11	-153.25
3.00	0.66	124.98	1.16	13.38	0.32	39.42	0.18	-163.89

TYPICAL SCATTERING PARAMETERS

Q1

V_{CE} = 3 V, I_C = 10 mA, Z_0 = 50 Ω

FREQUENCY	S_{11}		S_{21}		S_{12}		S_{22}	
(GHz)	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
0.10	0.82	-17.52	16.52	159.99	0.02	80.28	0.94	-12.68
0.20	0.72	-33.22	14.93	144.21	0.03	72.82	0.85	-22.43
0.30	0.60	-46.83	13.32	131.03	0.04	68.07	0.75	-28.43
0.40	0.49	-57.62	11.65	120.45	0.05	65.62	0.67	-32.14
0.50	0.40	-65.90	10.15	112.22	0.06	65.03	0.60	-34.25
0.60	0.33	-72.93	8.90	105.92	0.07	63.86	0.56	-35.78
0.70	0.27	-79.33	7.89	100.37	0.08	63.74	0.52	-36.80
0.80	0.22	-85.38	7.07	95.73	0.08	63.50	0.49	-37.69
0.90	0.18	-91.73	6.39	91.61	0.09	63.16	0.46	-38.46
1.00	0.15	-98.81	5.83	87.88	0.10	62.77	0.45	-39.30
1.20	0.10	-118.22	4.95	81.32	0.11	61.85	0.41	-41.01
1.50	0.07	-176.19	4.05	72.83	0.14	59.79	0.38	-44.69
1.70	0.08	149.79	3.61	67.81	0.15	58.31	0.35	-47.69
2.00	0.13	125.94	3.12	60.46	0.18	55.55	0.32	-53.15
2.50	0.21	109.57	2.54	49.58	0.22	50.37	0.27	-65.07
3.00	0.29	100.79	2.14	39.46	0.25	45.03	0.21	-81.46

Q2

V_{CE} = 3 V, I_C = 7 mA, Z_0 = 50 Ω

FREQUENCY	S_{11}		S_{21}		S_{12}		S_{22}	
(GHz)	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
0.10	0.78	-43.98	13.56	145.65	0.04	65.30	0.83	-28.08
0.20	0.64	-81.06	11.15	124.63	0.05	53.73	0.62	-42.31
0.30	0.55	-109.37	9.00	109.90	0.07	50.12	0.47	-48.09
0.40	0.50	-128.61	7.29	100.27	0.07	49.49	0.39	-50.66
0.50	0.48	-142.36	6.05	93.07	0.08	50.25	0.33	-51.72
0.60	0.47	-152.78	5.16	87.38	0.09	50.94	0.29	-52.25
0.70	0.46	-161.04	4.49	82.41	0.10	51.76	0.26	-52.80
0.80	0.46	-168.03	3.98	77.92	0.11	52.62	0.23	-53.35
0.90	0.46	-173.82	3.57	74.02	0.12	53.24	0.21	-54.00
1.00	0.46	-179.09	3.24	70.24	0.13	53.84	0.19	-55.03
1.20	0.47	171.98	2.75	63.22	0.15	53.97	0.15	-58.07
1.50	0.50	160.99	2.25	53.72	0.18	53.24	0.18	-66.67
1.70	0.51	154.69	2.02	47.63	0.20	52.05	0.20	-78.75
2.00	0.54	146.49	1.75	39.20	0.23	49.60	0.23	-110.79
2.50	0.59	134.74	1.44	26.11	0.28	44.37	0.28	174.41
3.00	0.64	124.73	1.23	14.52	0.33	38.05	0.33	146.24

BUILT-IN TRANSISTORS

	Q1	Q2
3-pin small mini mold part No.	NE68530	NE85630

The UPA832TF features the Q1 and Q2 in inverted positions.

ORDERING INFORMATION

PART NUMBER	QUANTITY	PACKAGING
UPA835TF-T1	3000	Tape & Reel

BJT NONLINEAR MODEL PARAMETERS(1)

Parameters	Q1	Q2	Parameters	Q1	Q2
IS	7e-16	6e-16	MJC	0.34	0.55
BF	109	120	XCJC	0	0.3
NF	1	0.98	CJS	0	0
VAF	15	10	VJS	0.75	0.75
IKF	0.19	0.08	MJS	0	0
ISE	7.9e-13	32e-16	FC	0.5	0.5
NE	2.19	1.93	TF	2.5e-12	12e-12
BR	1	12	XTF	5.2	6
NR	1.08	0.991	VTF	4.58	10
VAR	12.4	3.9	ITF	0.01	0.2
IKR	Infinity	0.17	PTF	0	0
ISC	0	0	TR	1e-9	1e-9
NC	2	2	EG	1.11	1.11
RE	1.3	0.38	XTB	0	0
RB	10	4.16	XTI	3	3
RBM	8.34	3.6	KF	0	0
IRB	0.009	1.96e-4	AF	1	1
RC	10	2			
CJE	0.4e-12	2.8e-12			
VJE	0.81	1.3			
MJE	0.5	0.5			
CJC	0.18e-12	1.1e-12			
VJC	0.75	0.7			

(1) Gummel-Poon Model

UNITS

Parameter	Units
time	seconds
capacitance	farads
inductance	henries
resistance	ohms
voltage	volts
current	amps

MODEL RANGE

Frequency: 0.1 to 3.0 GHz

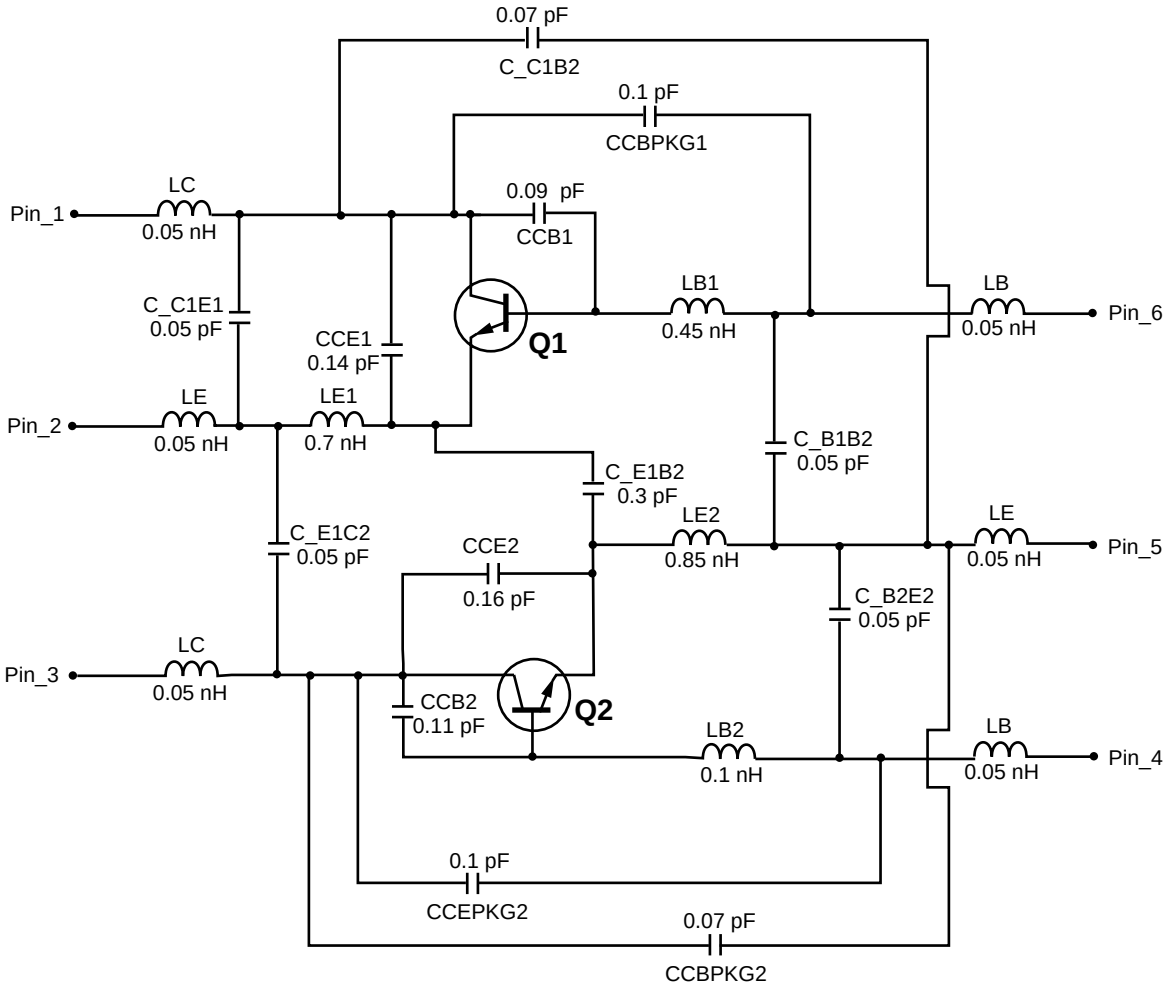
Bias: V_{CE} =0.5 V to 5 V, I_C = 1 mA to 10 mA

Date: 11/98

Note:

This nonlinear model utilized the latest data available. See our Design Parameter Library at **www.cel.com** for this data.

SCHEMATIC



MODEL RANGE

Frequency: 0.1 to 3.0 GHz
Bias: V_{CE} = 0.5 V to 5 V, I_C = 1 mA to 10 mA
Date: 11/98

BUILT-IN TRANSISTORS

	Q1	Q2
3-pin small mini mold part No.	NE68530	NE85630

The UPA832TF features the Q1 and Q2 in inverted positions.

ORDERING INFORMATION

PART NUMBER	QUANTITY	PACKAGING
UPA835TF-T1	3000	Tape & Reel