

NPN SILICON HIGH FREQUENCY TRANSISTOR

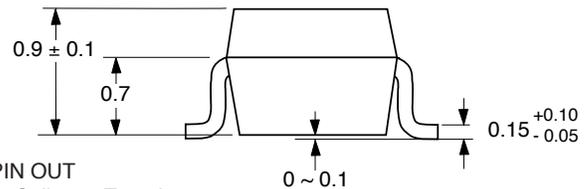
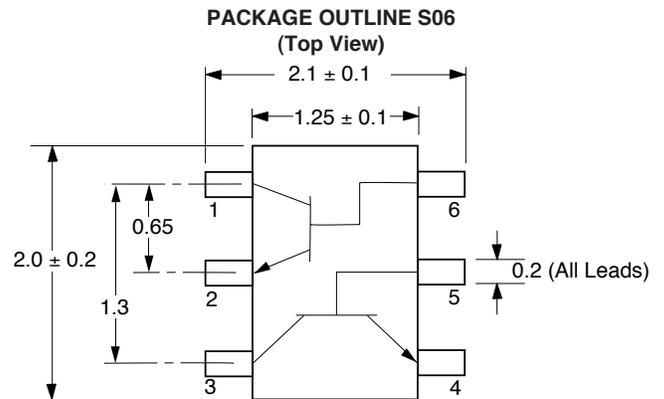
FEATURES

- **SMALL PACKAGE STYLE:**
2 NE856 Die in a 2 mm x 1.25 mm package
- **LOW NOISE FIGURE:**
NF = 1.2 dB TYP at 1 GHz
- **HIGH GAIN:**
 $IS_{21EI}^2 = 9.0$ dB TYP at 1 GHz
- **HIGH COLLECTOR CURRENT:** 100mA

DESCRIPTION

The UPA801T is two NPN high frequency silicon epitaxial transistors encapsulated in an ultra small 6 pin SMT package. Each transistor is independently mounted and easily configured for either dual transistor or cascode operation. The high f_t , low voltage bias and small size make this device ideally suited for pager and other hand-held wireless applications.

OUTLINE DIMENSIONS (Units in mm)



PIN OUT

1. Collector Transistor 1
2. Emitter Transistor 1
3. Collector Transistor 2
4. Emitter Transistor 2
5. Base Transistor 2
6. Base Transistor 1

Note:

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

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

| PART NUMBER PACKAGE OUTLINE | | | UPA801T S06 | | |
|--------------------------------|---|---------------|----------------|-----|-----|
| SYMBOLS | PARAMETERS AND CONDITIONS | UNITS | MIN | TYP | MAX |
| 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}^1 | Forward Current Gain at $V_{CE} = 3$ V, $I_C = 7$ mA | | 70 | 120 | 250 |
| f_t | Gain Bandwidth at $V_{CE} = 3$ V, $I_C = 7$ mA | GHz | 3.0 | 4.5 | |
| C_{re}^2 | Feedback Capacitance at $V_{CB} = 3$ V, $I_E = 0$, $f = 1$ MHz | pF | | 0.7 | 1.5 |
| IS_{21EI}^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 |
| h_{FE1}/h_{FE2} | h_{FE} Ratio: $h_{FE1} =$ Smaller Value of Q_1 or Q_2 $h_{FE2} =$ Larger Value of Q_1 or Q_2 | | 0.85 | | |

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

2. The emitter terminal should be connected to the ground terminal of the 3 terminal capacitance bridge.

For Tape and Reel version use part number UPA801T-T1, 3K per reel.

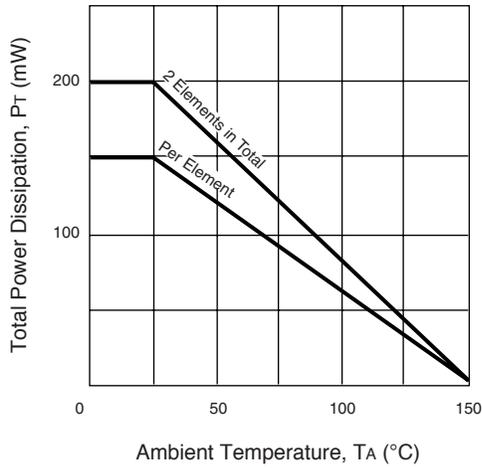
ABSOLUTE MAXIMUM RATINGS¹ ($T_A = 25^\circ\text{C}$)

| SYMBOLS | PARAMETERS | UNITS | RATINGS |
|------------------|------------------------------|-------|-------------|
| V _{CBO} | Collector to Base Voltage | V | 20 |
| V _{CEO} | Collector to Emitter Voltage | V | 12 |
| V _{EBO} | Emitter to Base Voltage | V | 3 |
| I _C | Collector Current | mA | 100 |
| P _T | Total Power Dissipation | | |
| | 1 Die | mW | 110 |
| | 2 Die | mW | 200 |
| T _J | Junction Temperature | °C | 150 |
| T _{STG} | Storage Temperature | °C | -65 to +150 |

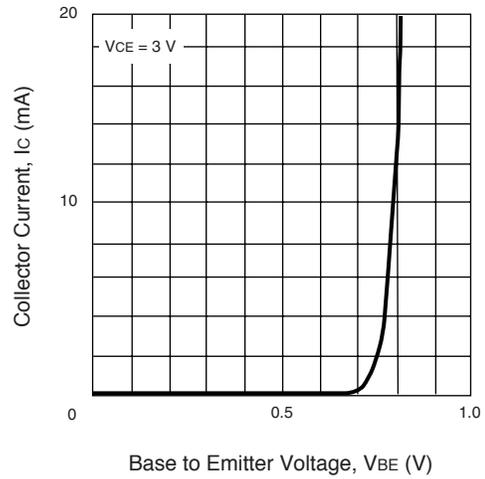
Note: 1. Operation in excess of any one of these parameters may result in permanent damage.

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

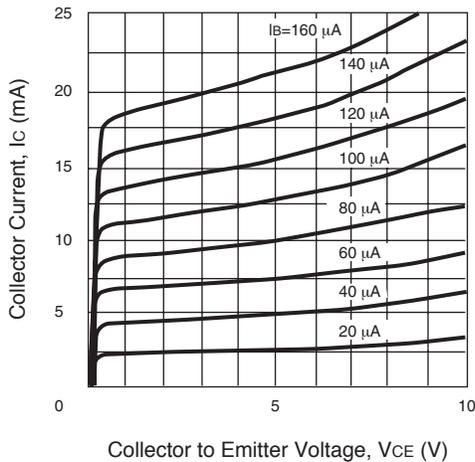
TOTAL POWER DISSIPATION vs. AMBIENT TEMPERATURE



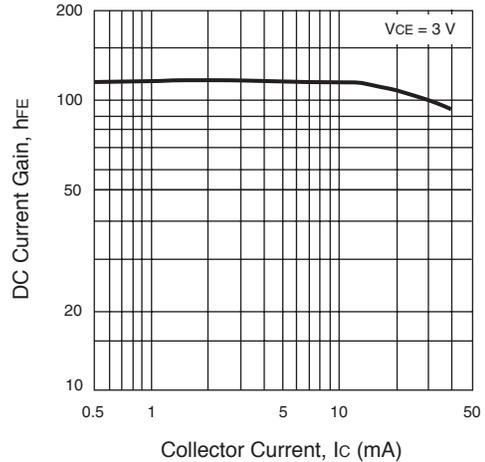
COLLECTOR CURRENT vs. BASE TO EMITTER VOLTAGE



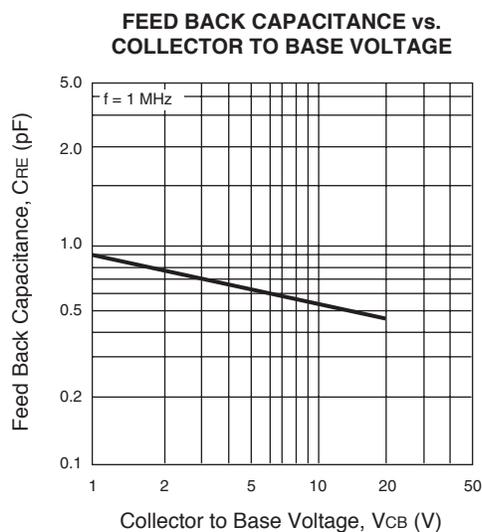
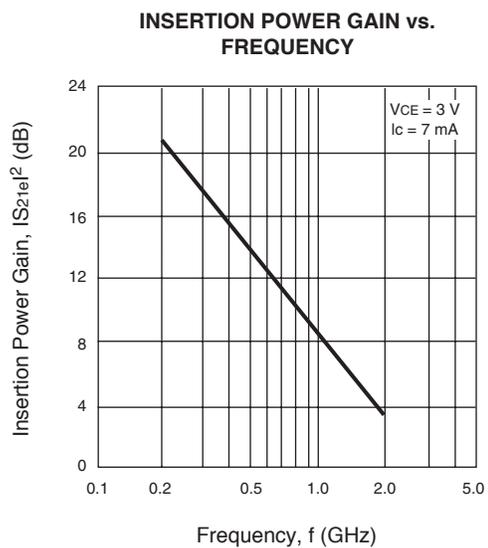
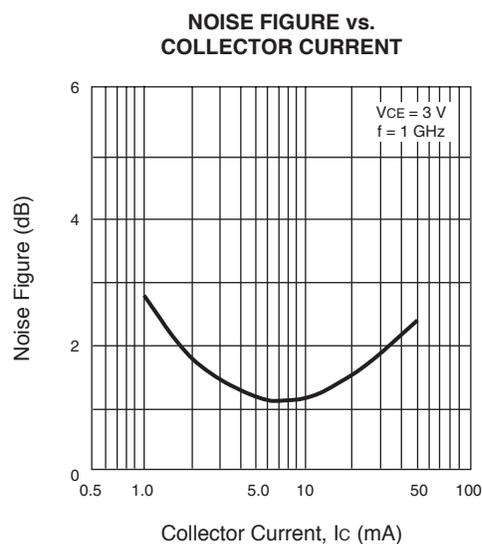
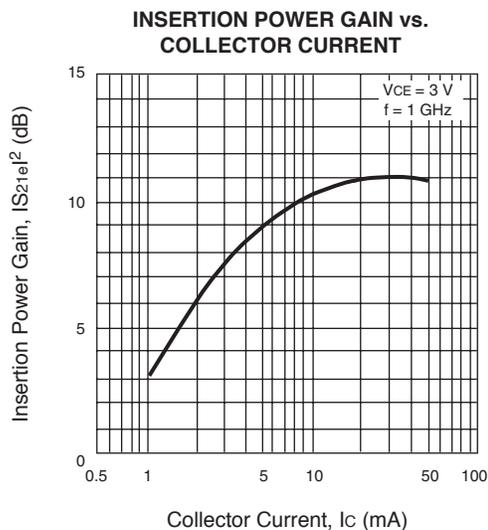
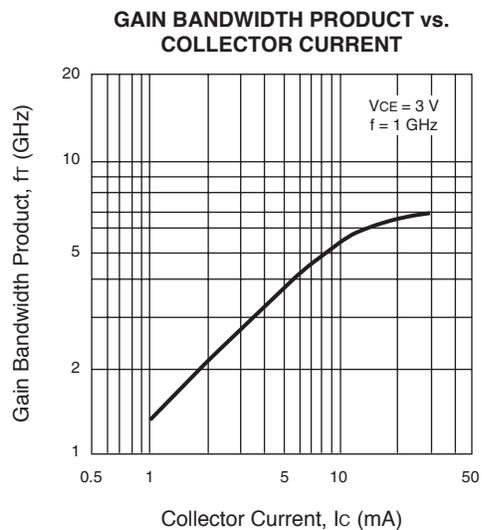
COLLECTOR CURRENT vs. COLLECTOR TO EMITTER VOLTAGE



DC CURRENT GAIN vs. COLLECTOR CURRENT



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



UPA801T

TYPICAL SCATTERING PARAMETERS (T_A = 25°C)

UPA801T

V_{CE} = 3 V, I_C = 1 mA, Z₀ = 50 Ω

| FREQUENCY (GHz) | S ₁₁ | | S ₂₁ | | S ₁₂ | | S ₂₂ | |
|--------------------|-----------------|--------|-----------------|-------|-----------------|------|-----------------|-------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG |
| 0.10 | .967 | -22.9 | 1.935 | 159.9 | .045 | 74.0 | .978 | -9.2 |
| 0.20 | .930 | -45.8 | 1.968 | 143.1 | .083 | 60.1 | .931 | -17.4 |
| 0.30 | .884 | -67.1 | 1.938 | 129.1 | .108 | 48.9 | .870 | -23.2 |
| 0.40 | .842 | -86.9 | 1.827 | 117.2 | .125 | 39.4 | .822 | -28.0 |
| 0.50 | .801 | -103.1 | 1.748 | 106.7 | .134 | 32.6 | .779 | -31.9 |
| 0.60 | .771 | -117.0 | 1.576 | 97.4 | .137 | 27.1 | .749 | -35.3 |
| 0.70 | .742 | -130.0 | 1.498 | 89.2 | .137 | 22.9 | .722 | -38.4 |
| 0.80 | .722 | -141.2 | 1.403 | 81.9 | .134 | 20.0 | .702 | -41.3 |
| 0.90 | .706 | -151.1 | 1.326 | 75.6 | .129 | 18.5 | .690 | -44.4 |
| 1.00 | .696 | -159.9 | 1.242 | 69.6 | .124 | 17.8 | .680 | -47.4 |
| 1.10 | .689 | -167.7 | 1.169 | 64.5 | .118 | 18.1 | .671 | -50.4 |
| 1.20 | .685 | -174.9 | 1.102 | 59.6 | .112 | 19.8 | .666 | -53.6 |
| 1.30 | .681 | 178.7 | 1.030 | 55.3 | .106 | 23.5 | .660 | -56.9 |
| 1.40 | .681 | 172.6 | .979 | 50.9 | .103 | 28.0 | .658 | -60.4 |
| 1.50 | .683 | 166.8 | .925 | 47.2 | .100 | 33.6 | .654 | -64.0 |
| 1.60 | .684 | 161.4 | .884 | 43.6 | .102 | 40.4 | .651 | -67.6 |
| 1.70 | .684 | 156.1 | .842 | 40.4 | .107 | 47.5 | .651 | -71.5 |
| 1.80 | .686 | 151.4 | .804 | 37.3 | .115 | 53.5 | .649 | -75.1 |
| 1.90 | .689 | 146.6 | .773 | 34.6 | .127 | 57.9 | .646 | -79.2 |
| 2.00 | .690 | 142.1 | .738 | 32.3 | .141 | 62.1 | .646 | -83.0 |

V_{CE} = 3 V, I_C = 3 mA, Z₀ = 50 Ω

| FREQUENCY (GHz) | S ₁₁ | | S ₂₁ | | S ₁₂ | | S ₂₂ | |
|--------------------|-----------------|--------|-----------------|-------|-----------------|------|-----------------|-------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG |
| 0.10 | .899 | -30.5 | 5.578 | 153.7 | .042 | 69.0 | .923 | -17.3 |
| 0.20 | .808 | -60.0 | 5.327 | 134.4 | .069 | 54.5 | .793 | -29.2 |
| 0.30 | .723 | -86.7 | 4.877 | 119.6 | .084 | 46.0 | .679 | -36.4 |
| 0.40 | .660 | -106.2 | 4.341 | 108.1 | .093 | 41.1 | .604 | -39.5 |
| 0.50 | .610 | -125.9 | 3.883 | 98.5 | .098 | 38.8 | .550 | -42.0 |
| 0.60 | .583 | -138.6 | 3.388 | 90.9 | .102 | 37.4 | .613 | -44.2 |
| 0.70 | .560 | -150.0 | 3.046 | 84.3 | .106 | 37.8 | .487 | -45.9 |
| 0.80 | .547 | -159.4 | 2.741 | 78.5 | .108 | 38.1 | .468 | -47.9 |
| 0.90 | .538 | -167.4 | 2.498 | 73.4 | .112 | 39.5 | .455 | -49.9 |
| 1.00 | .535 | -174.4 | 2.287 | 68.9 | .116 | 41.0 | .444 | -52.3 |
| 1.10 | .534 | 179.3 | 2.111 | 64.6 | .120 | 43.0 | .435 | -54.7 |
| 1.20 | .533 | 173.4 | 1.965 | 60.2 | .125 | 45.1 | .429 | 57.2 |
| 1.30 | .533 | 168.3 | 1.830 | 56.3 | .131 | 46.7 | .424 | -59.9 |
| 1.40 | .534 | 163.2 | 1.721 | 52.7 | .139 | 48.3 | .422 | -62.8 |
| 1.50 | .538 | 158.7 | 1.620 | 49.2 | .146 | 49.8 | .417 | -65.7 |
| 1.60 | .542 | 154.3 | 1.544 | 45.7 | .155 | 51.3 | .414 | -68.8 |
| 1.70 | .545 | 150.0 | 1.464 | 42.7 | .164 | 52.4 | .415 | -72.0 |
| 1.80 | .548 | 146.1 | 1.396 | 39.5 | .174 | 53.0 | .412 | -75.3 |
| 1.90 | .552 | 142.0 | 1.336 | 36.6 | .187 | 53.7 | .411 | -78.8 |
| 2.00 | .556 | 138.3 | 1.280 | 33.6 | .199 | 54.1 | .411 | -82.3 |

TYPICAL SCATTERING PARAMETERS (T_A = 25°C)

VCE = 3 V, Ic = 5 mA, Z₀ = 50 Ω

| FREQUENCY (GHz) | S ₁₁ | | S ₂₁ | | S ₁₂ | | S ₂₂ | |
|--------------------|-----------------|--------|-----------------|-------|-----------------|------|-----------------|-------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG |
| 0.10 | .819 | -38.9 | 8.934 | 148.0 | .038 | 65.8 | .868 | -23.6 |
| 0.20 | .701 | -73.4 | 8.007 | 127.6 | .060 | 53.1 | .687 | -36.7 |
| 0.30 | .608 | -102.3 | 6.898 | 112.6 | .072 | 47.6 | .560 | -42.4 |
| 0.40 | .549 | -123.6 | 5.819 | 101.8 | .079 | 45.2 | .483 | -45.4 |
| 0.50 | .511 | -139.6 | 4.970 | 93.5 | .086 | 45.7 | .434 | -47.2 |
| 0.60 | .494 | -151.0 | 4.255 | 86.9 | .093 | 46.5 | .402 | -48.6 |
| 0.70 | .481 | -160.8 | 3.750 | 81.4 | .099 | 47.2 | .379 | -49.9 |
| 0.80 | .475 | -168.6 | 3.328 | 76.3 | .107 | 48.9 | .361 | -51.5 |
| 0.90 | .472 | -175.7 | 3.004 | 72.0 | .113 | 49.7 | .350 | -53.4 |
| 1.00 | .471 | 178.2 | 2.734 | 67.7 | .122 | 50.9 | .340 | -55.4 |
| 1.10 | .473 | 172.8 | 2.522 | 64.0 | .130 | 51.6 | .332 | -57.3 |
| 1.20 | .474 | 167.6 | 2.355 | 60.2 | .139 | 52.3 | .328 | 59.7 |
| 1.30 | .474 | 162.9 | 2.176 | 56.7 | .148 | 53.1 | .322 | -62.3 |
| 1.40 | .477 | 158.4 | 2.038 | 53.2 | .158 | 53.3 | .319 | -65.2 |
| 1.50 | .481 | 154.4 | 1.921 | 49.8 | .168 | 53.7 | .315 | -68.2 |
| 1.60 | .484 | 150.3 | 1.818 | 46.7 | .177 | 53.3 | .313 | -70.9 |
| 1.70 | .489 | 146.5 | 1.726 | 43.9 | .190 | 53.3 | .312 | -73.9 |
| 1.80 | .490 | 142.9 | 1.647 | 40.6 | .200 | 53.0 | .312 | -77.2 |
| 1.90 | .495 | 139.3 | 1.578 | 37.6 | .212 | 52.7 | .309 | -80.8 |
| 2.00 | .501 | 136.0 | 1.505 | 35.0 | .223 | 52.0 | .309 | -84.0 |

VCE = 3 V, Ic = 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 | .750 | -45.7 | 11.858 | 144.0 | .035 | 63.3 | .816 | -28.5 |
| 0.20 | .618 | -84.9 | 10.093 | 122.3 | .053 | 53.2 | .609 | -41.8 |
| 0.30 | .528 | -114.5 | 8.219 | 107.7 | .054 | 50.6 | .481 | -46.7 |
| 0.40 | .483 | -134.3 | 6.684 | 97.9 | .073 | 50.6 | .411 | -49.1 |
| 0.50 | .459 | -148.5 | 5.565 | 90.5 | .081 | 50.7 | .365 | -50.5 |
| 0.60 | .447 | -158.8 | 4.737 | 84.6 | .089 | 52.3 | .337 | -51.5 |
| 0.70 | .441 | -167.4 | 4.134 | 79.7 | .098 | 53.5 | .337 | -51.5 |
| 0.80 | .439 | -174.4 | 3.653 | 75.2 | .107 | 54.2 | .300 | -54.2 |
| 0.90 | .437 | 179.2 | 3.283 | 71.1 | .117 | 54.9 | .290 | -55.9 |
| 1.00 | .437 | 173.7 | 2.978 | 67.2 | .126 | 55.6 | .281 | -57.9 |
| 1.10 | .440 | 168.6 | 2.732 | 63.7 | .136 | 55.8 | .275 | -59.8 |
| 1.20 | .443 | 163.9 | 2.533 | 60.0 | .147 | 55.3 | .270 | -52.3 |
| 1.30 | .444 | 159.6 | 2.357 | 66.6 | .158 | 55.4 | .267 | -64.7 |
| 1.40 | .449 | 155.5 | 2.216 | 53.4 | .169 | 55.3 | .264 | -67.5 |
| 1.50 | .450 | 151.6 | 2.077 | 50.3 | .180 | 54.7 | .259 | -70.5 |
| 1.60 | .455 | 147.9 | 1.972 | 47.4 | .192 | 64.5 | .258 | -73.3 |
| 1.70 | .459 | 144.3 | 1.868 | 44.3 | .202 | 53.9 | .256 | -76.3 |
| 1.80 | .462 | 140.9 | 1.789 | 41.3 | .214 | 53.0 | .255 | -79.6 |
| 1.90 | .466 | 137.5 | 1.702 | 38.4 | .226 | 52.3 | .253 | -83.0 |
| 2.00 | .470 | 134.4 | 1.635 | 36.1 | .238 | 51.5 | .253 | -86.4 |

ORDERING INFORMATION

| PART NUMBER | QUANTITY | PACKAGING |
|--------------|----------|-------------|
| UPA801T-T1-A | 3000 | Tape & Reel |

NONLINEAR MODEL

BJT NONLINEAR MODEL PARAMETERS (1)

| Parameters | Q1, Q2 | Parameters | Q1, Q2 |
|------------|---------|------------|----------|
| IS | 6e-16 | MJC | 0.55 |
| BF | 120 | XCJC | 0.3 |
| NF | 0.98 | CJS | 0 |
| VAF | 10 | VJS | 0.75 |
| IKF | 0.08 | MJS | 0 |
| ISE | 32e-16 | FC | 0.5 |
| NE | 1.93 | TF | 12e-12 |
| BR | 12 | XTF | 6 |
| NR | 0.991 | VTF | 10 |
| VAR | 3.9 | ITF | 0.2 |
| IKR | 0.17 | PTF | 0 |
| ISC | 0 | TR | 1e-9 |
| NC | 2 | EG | 1.11 |
| RE | 0.38 | XTB | 0 |
| RB | 4.16 | XTI | 3 |
| RBM | 3.6 | KF | 1.56e-18 |
| IRB | 1.96e-4 | AF | 1.49 |
| RC | 2 | | |
| CJE | 2.8e-12 | | |
| VJE | 1.3 | | |
| MJE | 0.5 | | |
| CJC | 1.1e-12 | | |
| VJC | 0.7 | | |

(1) Gummel-Poon Model

Note:

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

UNITS

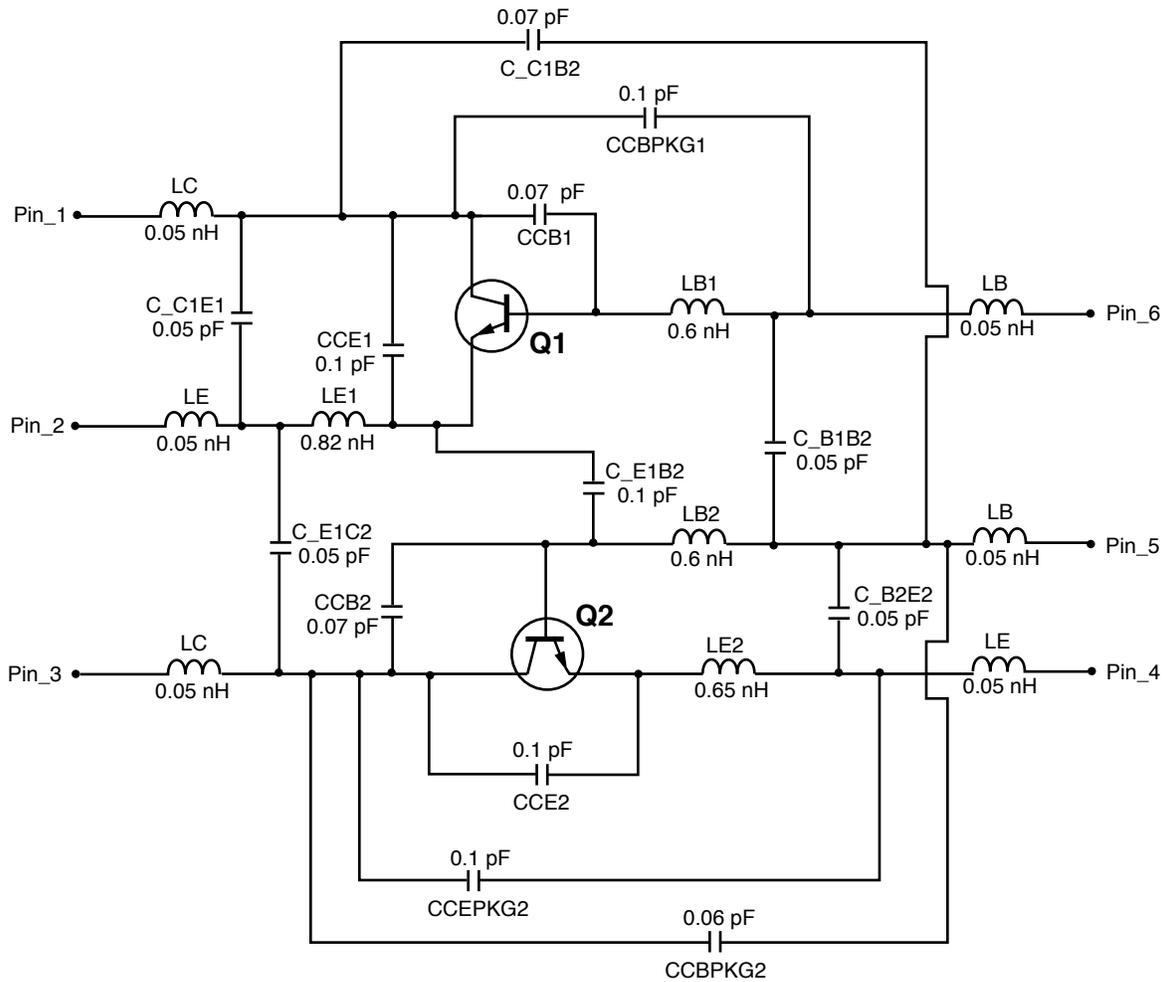
| Parameter | Units |
|-------------|---------|
| time | seconds |
| capacitance | farads |
| inductance | henries |
| resistance | ohms |
| voltage | volts |
| current | amps |

MODEL RANGE

Frequency: 0.1 to 3.0 GHz
Bias: VCE = 1 V to 5 V, IC = 1 mA to 10 mA
Date: 12/98

NONLINEAR MODEL

SCHEMATIC



MODEL RANGE

Frequency: 0.1 to 3.0 GHz
 Bias: $V_{CE} = 1\text{ V to }5\text{ V}$, $I_C = 1\text{ mA to }10\text{ mA}$
 Date: 12/98

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