



NPN SILICON HIGH FREQUENCY TRANSISTOR

UPA801T

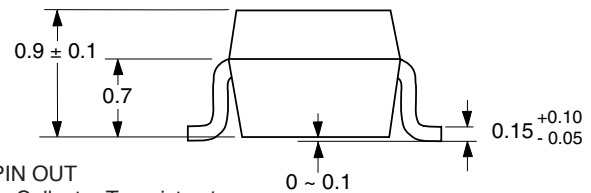
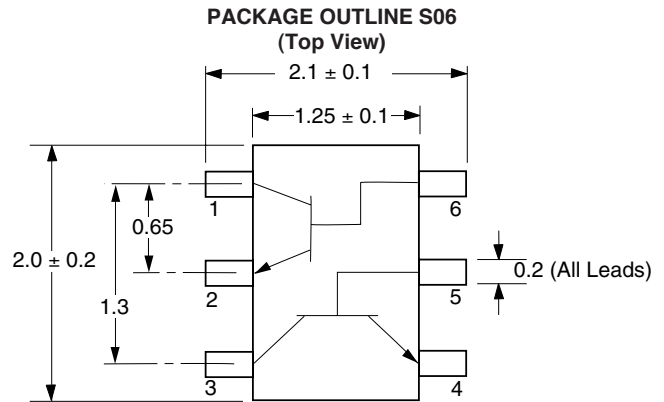
FEATURES

- **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:**
 $IS_{21E}I^2 = 9.0$ dB TYP at 1 GHz
- **HIGH COLLECTOR CURRENT:** 100mA

DESCRIPTION

NEC's 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 |
| $IS_{21E}I^2$ | 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 ≤ 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.

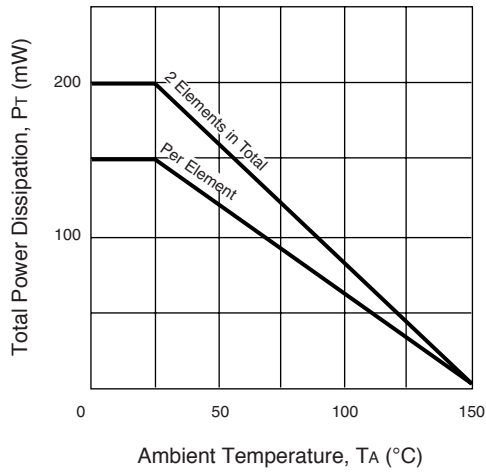
ABSOLUTE MAXIMUM RATINGS¹ ($T_A = 25^\circ\text{C}$)

| SYMBOLS | PARAMETERS | UNITS | RATINGS |
|------------------|------------------------------|-------|-------------|
| V _{CB0} | Collector to Base Voltage | V | 20 |
| V _{CE0} | Collector to Emitter Voltage | V | 12 |
| V _{EB0} | 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 |

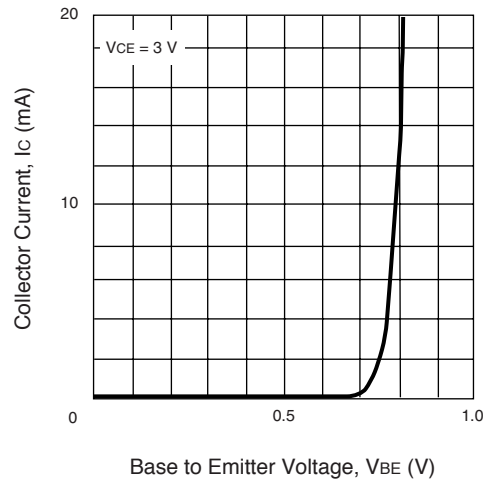
Note: 1. Operation in excess of any one of these parameters may result in permanent damage.

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

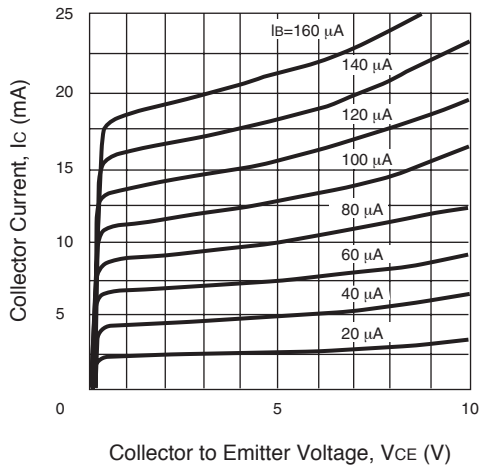
TOTAL POWER DISSIPATION vs. AMBIENT TEMPERATURE



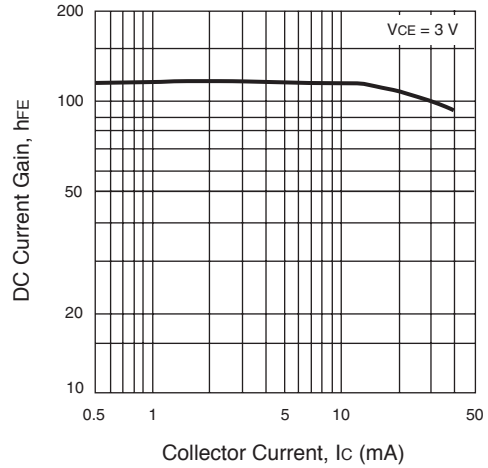
COLLECTOR CURRENT vs. BASE TO EMITTER VOLTAGE



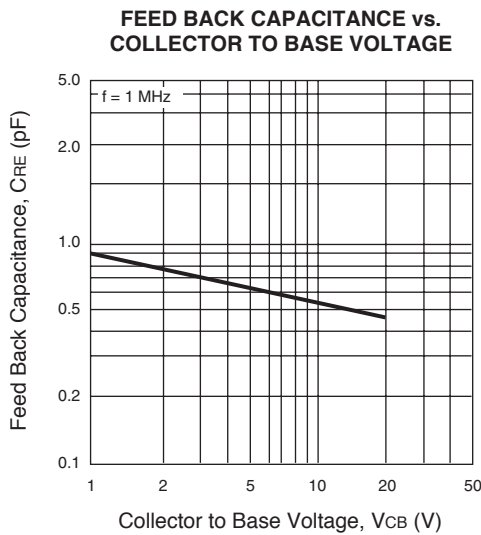
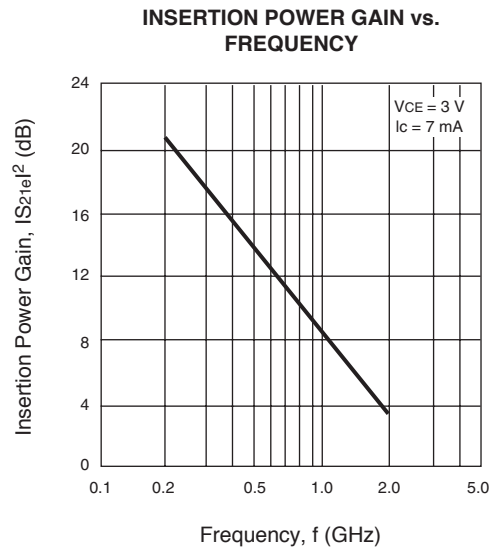
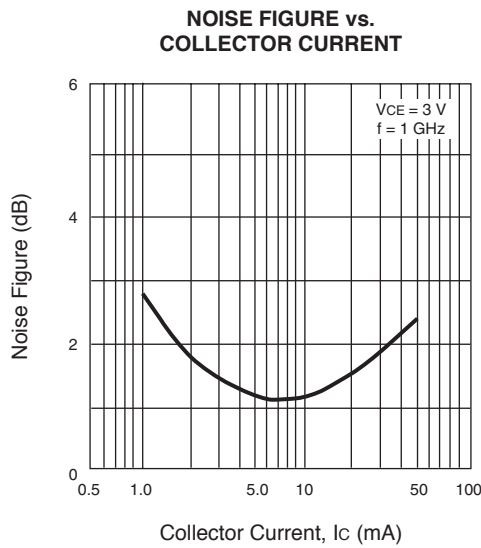
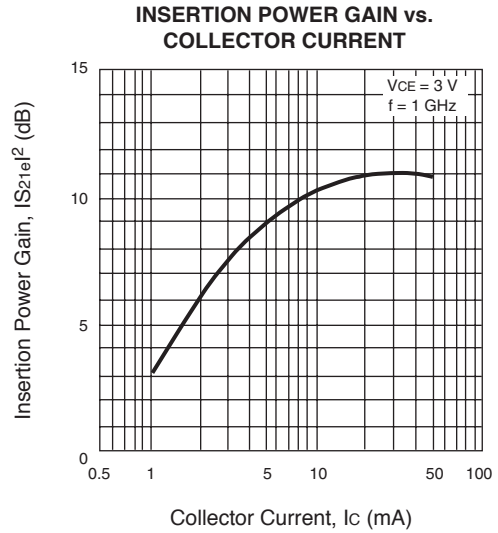
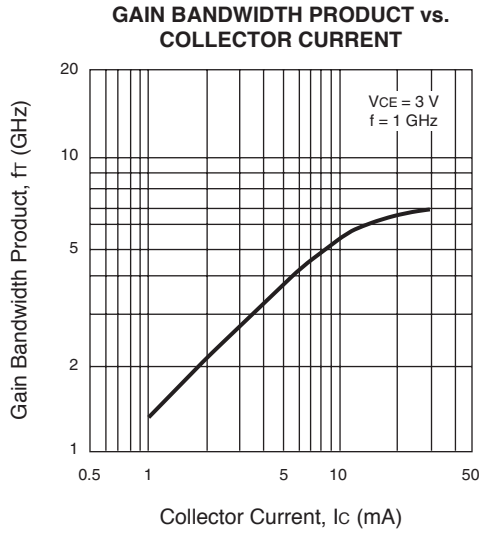
COLLECTOR CURRENT vs. COLLECTOR TO EMITTER VOLTAGE



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)

V_{CE} = 3 V, I_C = 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 |

V_{CE} = 3 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 | .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

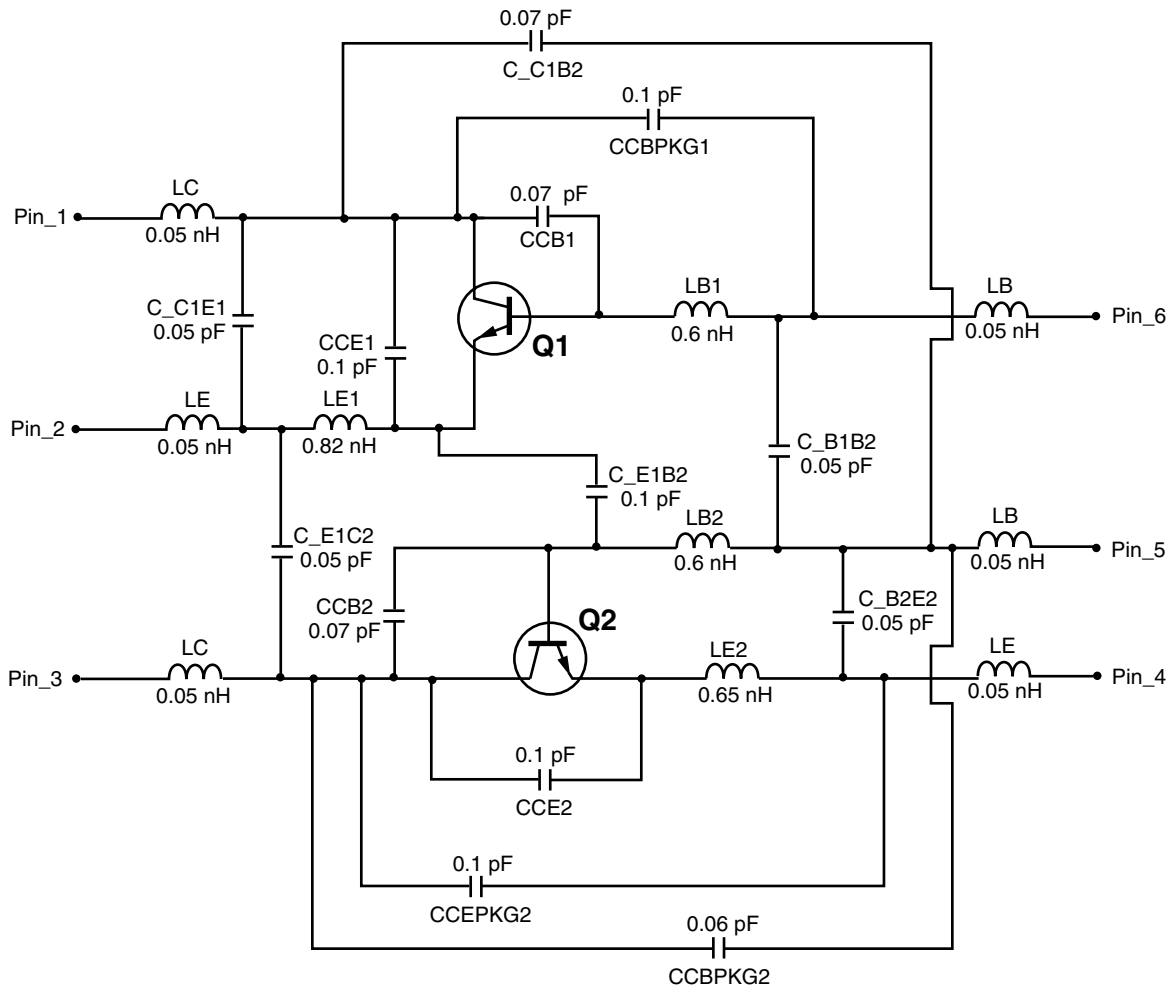
| Parameter | Units |
|-------------|---------|
| time | seconds |
| capacitance | farads |
| inductance | henries |
| resistance | ohms |
| voltage | volts |
| current | amps |

MODEL RANGE

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

Life Support Applications

These NEC products are not intended for use in life support devices, appliances, or systems where the malfunction of these products can reasonably be expected to result in personal injury. The customers of CEL using or selling these products for use in such applications do so at their own risk and agree to fully indemnify CEL for all damages resulting from such improper use or sale.

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DATA SUBJECT TO CHANGE WITHOUT NOTICE

9/99

Subject: Compliance with EU Directives

CEL certifies, to its knowledge, that semiconductor and laser products detailed below are compliant with the requirements of European Union (EU) Directive 2002/95/EC Restriction on Use of Hazardous Substances in electrical and electronic equipment (RoHS) and the requirements of EU Directive 2003/11/EC Restriction on Penta and Octa BDE.

CEL Pb-free products have the same base part number with a suffix added. The suffix –A indicates that the device is Pb-free. The –AZ suffix is used to designate devices containing Pb which are exempted from the requirement of RoHS directive (*). In all cases the devices have Pb-free terminals. All devices with these suffixes meet the requirements of the RoHS directive.

This status is based on CEL’s understanding of the EU Directives and knowledge of the materials that go into its products as of the date of disclosure of this information.

| Restricted Substance per RoHS | Concentration Limit per RoHS (values are not yet fixed) | Concentration contained in CEL devices | |
|-------------------------------|---|--|-----|
| | | -A | -AZ |
| Lead (Pb) | < 1000 PPM | Not Detected | (*) |
| Mercury | < 1000 PPM | Not Detected | |
| Cadmium | < 100 PPM | Not Detected | |
| Hexavalent Chromium | < 1000 PPM | Not Detected | |
| PBB | < 1000 PPM | Not Detected | |
| PBDE | < 1000 PPM | Not Detected | |

If you should have any additional questions regarding our devices and compliance to environmental standards, please do not hesitate to contact your local representative.

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