

## SILICON RFIC LOW CURRENT AMPLIFIER FOR CELLULAR/CORDLESS TELEPHONES

### FEATURES

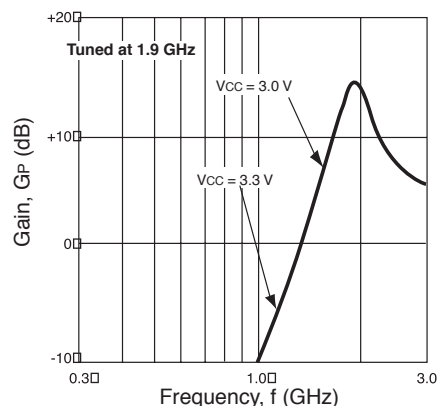
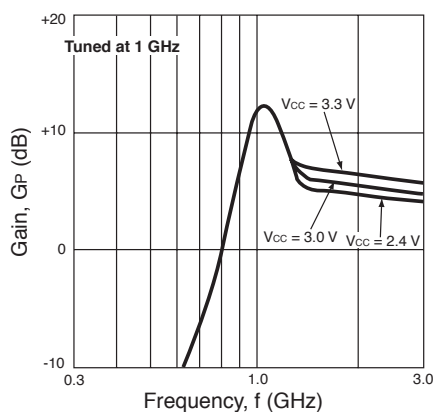
- **SUPPLY VOLTAGE:**  $V_{CC} = 2.4$  to  $3.3$  V
- **LOW CURRENT CONSUMPTION:**  
UPC8151TB;  $I_{CC} = 4.2$  mA TYP @  $3.0$  V
- **HIGH EFFICIENCY:**  
UPC8151TB;  $P_{1dB} = +2.5$  dBm TYP @  $f = 1$  GHz
- **POWER GAIN:**  
UPC8151TB;  $G_P = 12.5$  dB TYP @  $f = 1$  GHz
- **OPERATING FREQUENCY:**  
100 MHz to 1900 MHz (Output port LC matching)
- **EXCELLENT ISOLATION:**  
UPC8151TB;  $ISOL = 38$  dB TYP @  $f = 1$  GHz
- **HIGH DENSITY SURFACE MOUNTING:**  
6 pin super minimold or SOT-363 package

### DESCRIPTION

The UPC8151TB is a silicon RFIC designed as a buffer amplifier for cellular or cordless telephones. This low current amplifier operates on  $3.0$  V and is housed in a 6 pin super minimold package.

The IC is manufactured using the 20 GHz  $f_T$  NESAT™ III silicon bipolar process. This process uses silicon nitride passivation film and gold electrodes. These materials protect the chip surface from external pollution and prevent corrosion/migration. Thus, this IC has excellent performance, uniformity and reliability.

INSERTION POWER GAIN vs.  
FREQUENCY AND VOLTAGE



### ELECTRICAL CHARACTERISTICS

( $T_A = 25^\circ\text{C}$ ,  $V_{CC} = V_{OUT} = 3.0$  V,  $Z_L = Z_S = 50\ \Omega$ , at LC matched frequency)

| PART NUMBER<br>PACKAGE OUTLINE |                                                                                                                                                                        |       | UPC8151TB<br>SO6 |               |              |
|--------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|------------------|---------------|--------------|
| SYMBOLS                        | PARAMETERS AND CONDITIONS                                                                                                                                              | UNITS | MIN              | TYP           | MAX          |
| $I_{CC}$                       | Circuit Current, No signal                                                                                                                                             | mA    | 2.8              | 4.2           | 5.8          |
| $G_P$                          | Power Gain<br>$f = 1.00$ GHz<br>$f = 1.90$ GHz                                                                                                                         | dB    | 9.5<br>12.0      | 12.5<br>15.0  | 14.5<br>17.0 |
| $ISOL$                         | Isolation<br>$f = 1.00$ GHz<br>$f = 1.90$ GHz                                                                                                                          | dB    | 33.0<br>29.0     | 38.0<br>34.0  | —<br>—       |
| $P_{1dB}$                      | Output Power at 1 dB Compression Point<br>$f = 1.00$ GHz<br>$f = 1.90$ GHz                                                                                             | dBm   | -1.0<br>-3.0     | +2.5<br>+0.5  | —<br>—       |
| NF                             | Noise Figure<br>$f = 1.00$ GHz<br>$f = 1.90$ GHz                                                                                                                       | dB    | —<br>—           | 6.0<br>6.0    | 7.5<br>7.5   |
| $RL_{IN}$                      | Input Return Loss(without matching circuit)<br>$f = 1.00$ GHz<br>$f = 1.90$ GHz                                                                                        | dB    | 2.0<br>1.0       | 5.0<br>4.0    | —<br>—       |
| $RL_{OUT}$                     | Output Return Loss (with external matching circuit)<br>$f = 1.00$ GHz<br>$f = 1.90$ GHz                                                                                | dB    |                  | 10.0<br>12.0  |              |
| $IM_3$                         | 3rd Order Intermodulation Distortion<br>$f_1 = 1.000$ GHz, $f_2 = 1.001$ GHz, $P_{O(each)} = -20$ dBm<br>$f_1 = 1.900$ GHz, $f_2 = 1.901$ GHz, $P_{O(each)} = -20$ dBm | dBc   |                  | -62.0<br>54.0 |              |

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

| SYMBOLS          | PARAMETERS                           | UNITS | RATINGS     |
|------------------|--------------------------------------|-------|-------------|
| V <sub>CC</sub>  | Supply Voltage                       | V     | 3.6         |
| P <sub>D</sub>   | Total Power Dissipation <sup>2</sup> | mW    | 200         |
| T <sub>A</sub>   | Operating Temperature                | °C    | -40 to +85  |
| T <sub>STG</sub> | Storage Temperature                  | °C    | -55 to +150 |

- Notes:
1. Operation in excess of any one of these parameters may result in permanent damage.
  2. Mounted on a 50 x 50 x 1.6 mm epoxy glass PWB (T<sub>A</sub> = 85°C).

RECOMMENDED  
OPERATING CONDITIONS

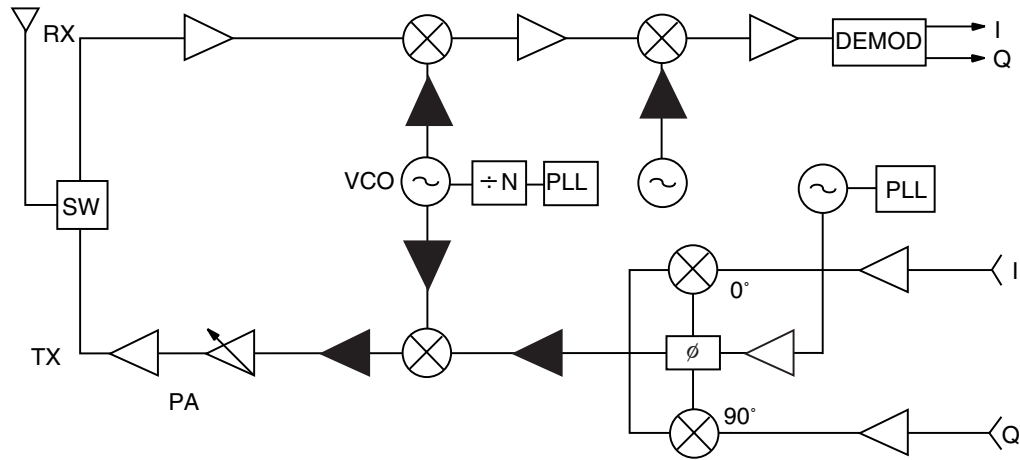
| SYMBOLS         | PARAMETERS            | UNITS | MIN | TYP | MAX  |
|-----------------|-----------------------|-------|-----|-----|------|
| V <sub>CC</sub> | Supply Voltage        | V     | 2.4 | 3.0 | 3.3  |
| T <sub>A</sub>  | Operating Temperature | °C    | -40 | +25 | +85  |
| f               | Operating Frequency   | MHz   | 100 |     | 1900 |

PIN FUNCTIONS

| Pin No.     | Symbol          | Applied Voltage                            | Description                                                                                                                                                                                                                                                    | Internal Equivalent Circuit |
|-------------|-----------------|--------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|
| 1           | INPUT           |                                            | Signal input pin. An internal matching circuit provides a 50 Ω match over a wide bandwidth. This pin must be coupled to signal source with a blocking capacitor.                                                                                               |                             |
| 4           | OUTPUT          | V <sub>CC</sub> through external inductor. | Signal output pin. This output is designed as an open collector. Due to the high impedance output this pin should be externally equipped with an LC matching circuit.                                                                                          |                             |
| 6           | V <sub>CC</sub> | 2.4 to 3.3                                 | Power supply pin. This pin should be externally equipped with a bypass capacitor to minimize ground impedance.                                                                                                                                                 |                             |
| 2<br>3<br>5 | GND             | 0                                          | Ground pin. This pin should be connected to system ground with minimum inductance. Ground pattern on the board should be formed as wide as possible. All the ground pins must be connected together with wide ground pattern to minimize impedance difference. |                             |

## TYPICAL APPLICATION EXAMPLE

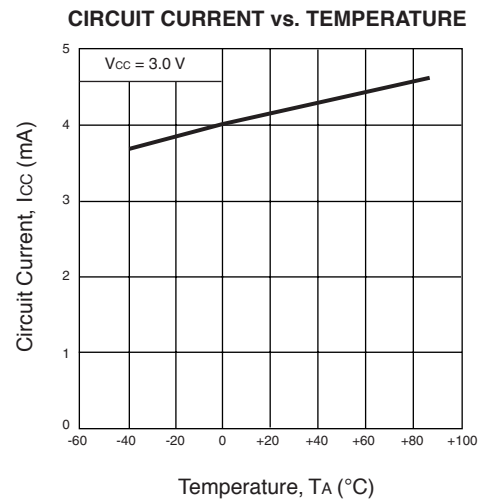
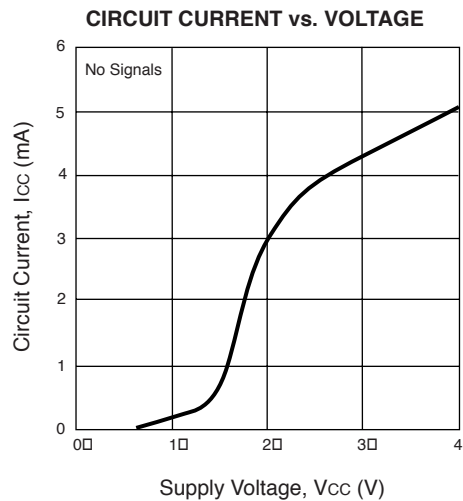
### Location Examples in Digital Cellular



## PRODUCT LINE-UP ( $T_A = +25^\circ\text{C}$ , $V_{CC} = 3.0\text{ V}$ , $Z_L = Z_S = 50\ \Omega$ )

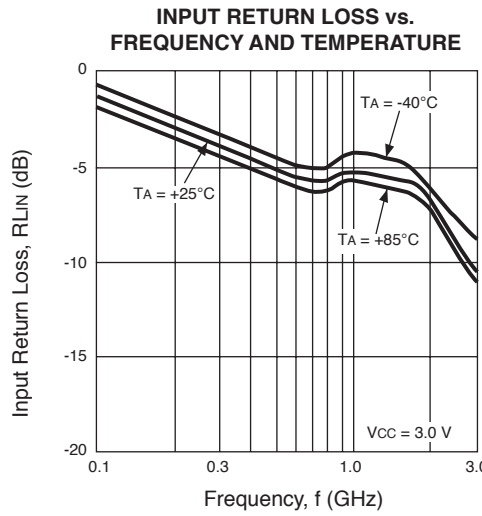
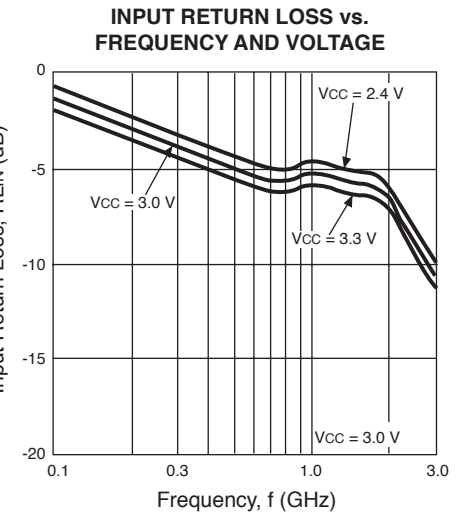
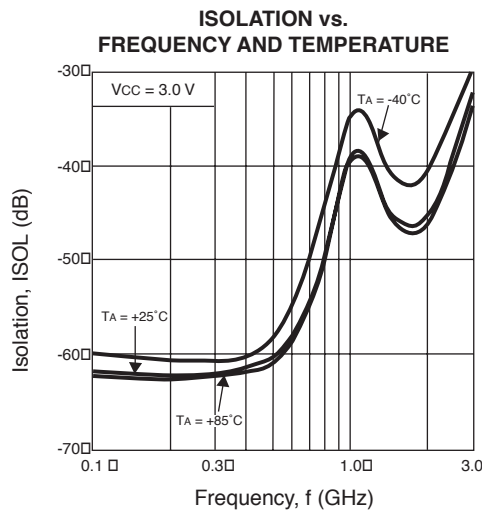
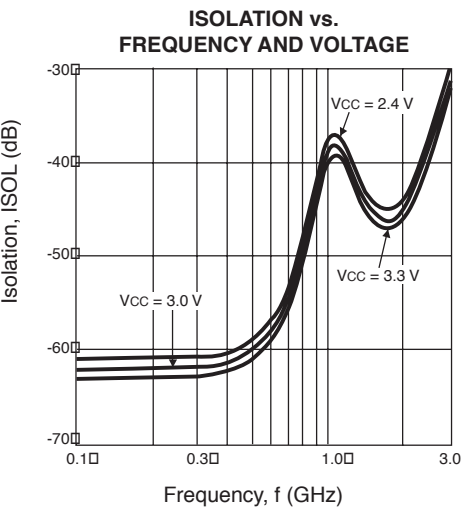
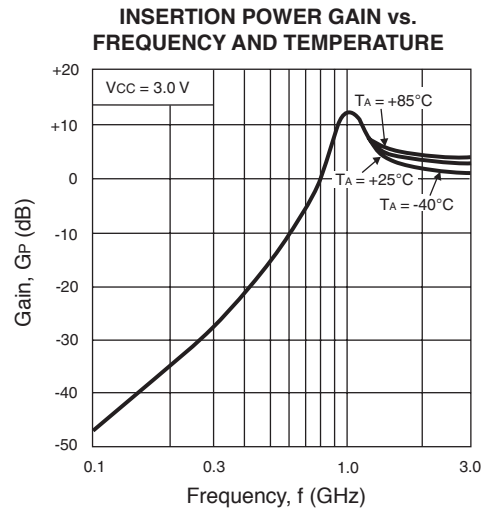
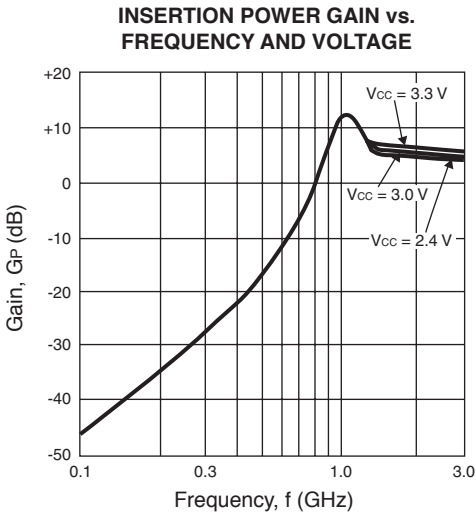
| PARAMETER<br>PART NO. | Icc<br>(mA) | OUTPUT PORT MATCHING FREQUENCY |              |               |            |              |               | PACKAGES             |
|-----------------------|-------------|--------------------------------|--------------|---------------|------------|--------------|---------------|----------------------|
|                       |             | 1 GHz                          |              |               | 1.9 GHz    |              |               |                      |
|                       |             | Gp<br>(dB)                     | ISOL<br>(dB) | P1dB<br>(dBm) | Gp<br>(dB) | ISOL<br>(dB) | P1dB<br>(dBm) |                      |
| UPC8128TB             | 2.8         | 12.5                           | 39           | -4.0          | 13.0       | 37           | -4.0          | 6 pin super minimold |
| UPC8151TB             | 4.5         | 12.5                           | 38           | +2.5          | 15.0       | 34           | +0.5          | 6 pin super minimold |
| UPC8152TB             | 5.6         | 23.0                           | 40           | -4.5          | 17.5       | 35           | -8.5          | 6 pin super minimold |

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



TYPICAL PERFORMANCE CURVES (TA = 25°C unless otherwise specified)

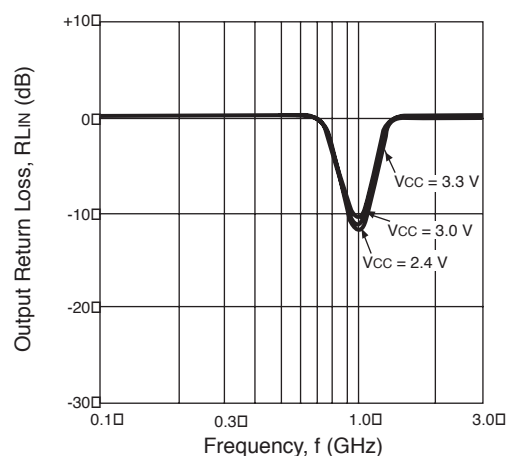
1.0 GHz OUTPUT PORT MATCHING



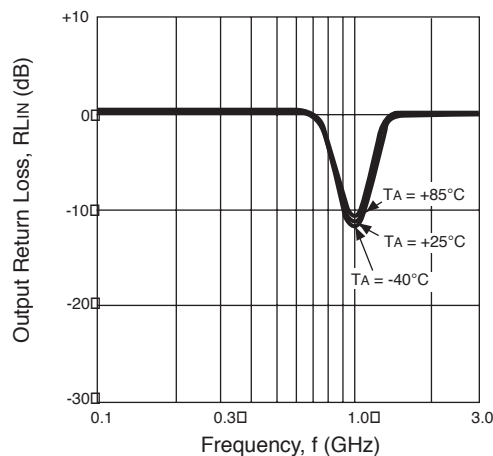
# TYPICAL PERFORMANCE CURVES (TA = 25°C unless otherwise specified)

## 1.0 GHz OUTPUT PORT MATCHING

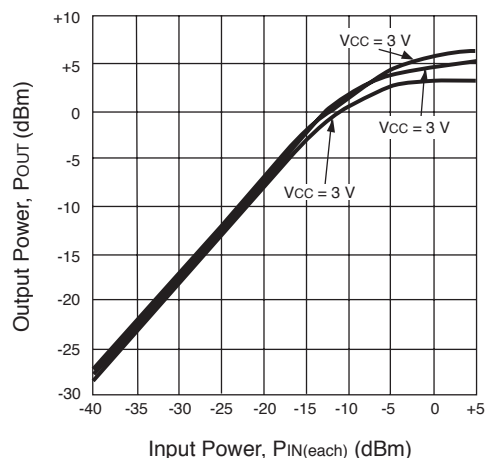
**OUTPUT RETURN LOSS vs. FREQUENCY AND VOLTAGE**



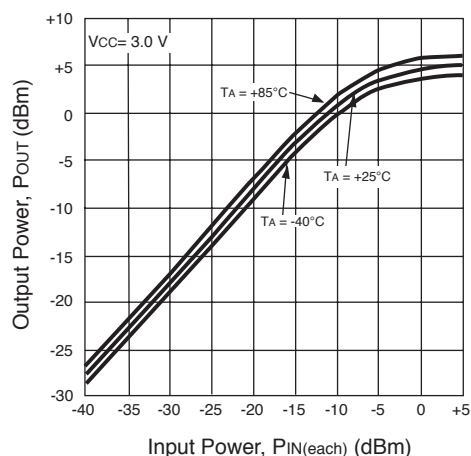
**OUTPUT RETURN LOSS vs. FREQUENCY AND TEMPERATURE**



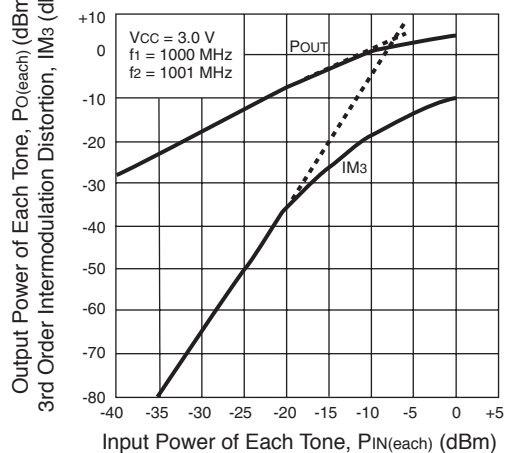
**OUTPUT POWER vs. INPUT POWER AND VOLTAGE**



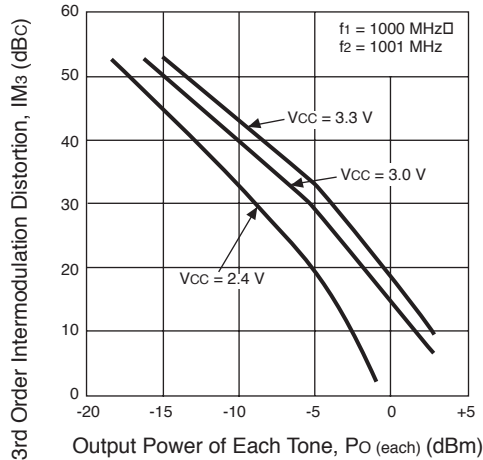
**OUTPUT POWER vs. INPUT POWER AND TEMPERATURE**



**OUTPUT POWER OF EACH TONE AND 3rd ORDER INTERMODULATION DISTORTION vs. INPUT POWER OF EACH TONE**

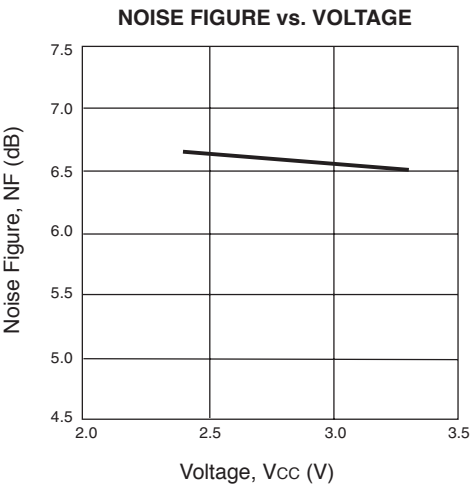


**3rd ORDER INTERMODULATION DISTORTION vs. OUTPUT POWER OF EACH TONE AND VOLTAGE**

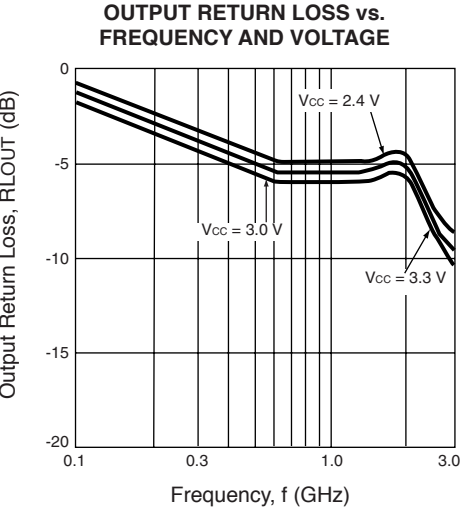
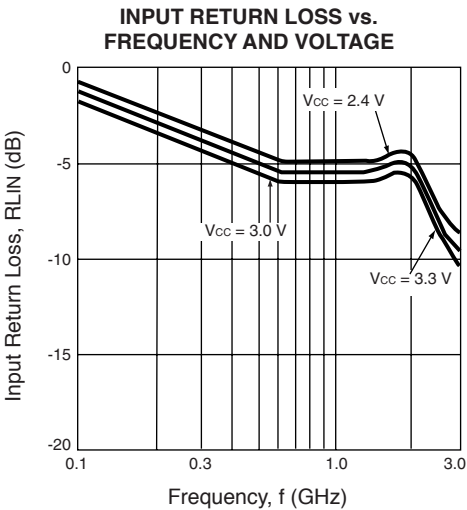
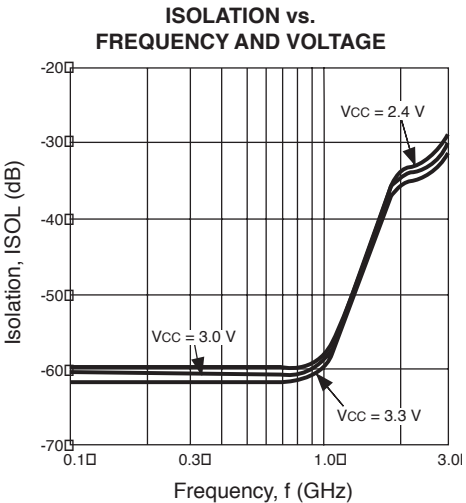
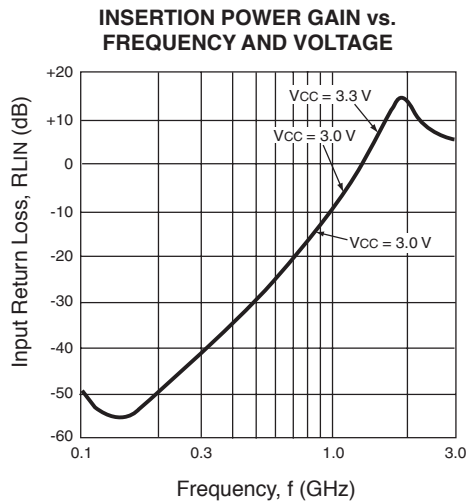


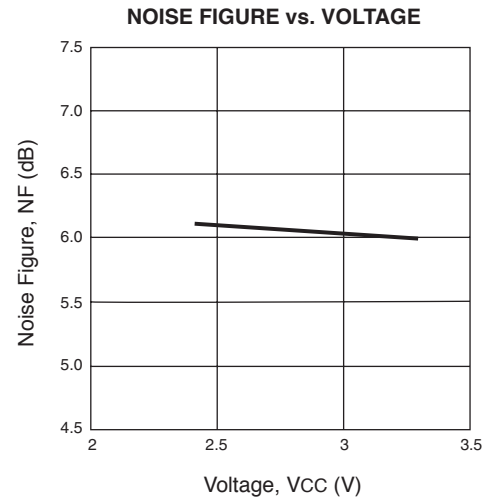
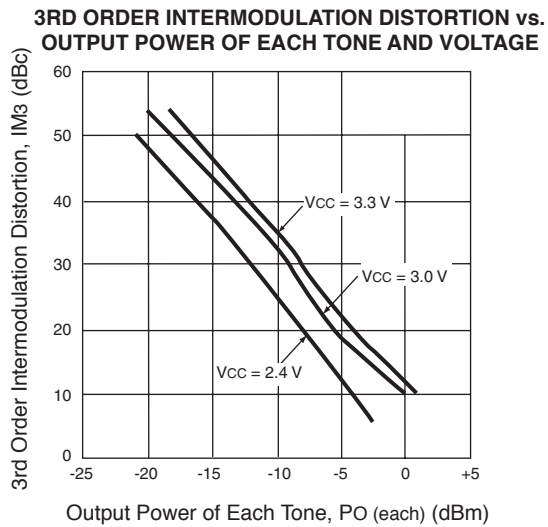
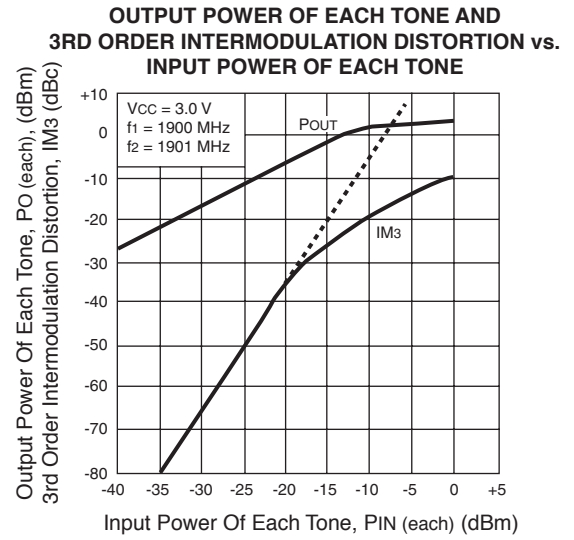
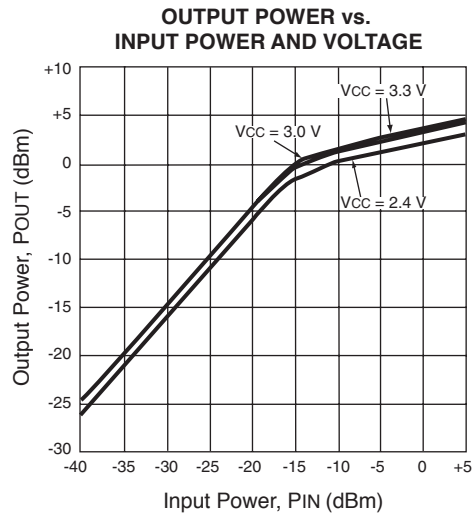
TYPICAL PERFORMANCE CURVES (TA = 25°C unless otherwise specified)

1.0 GHz Output Port Matching

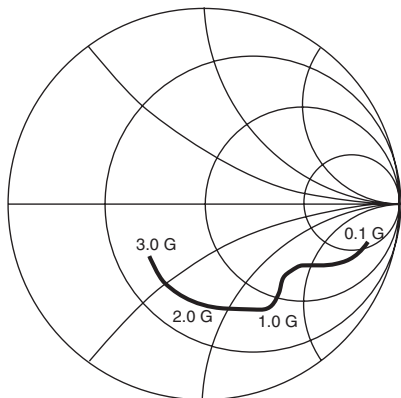
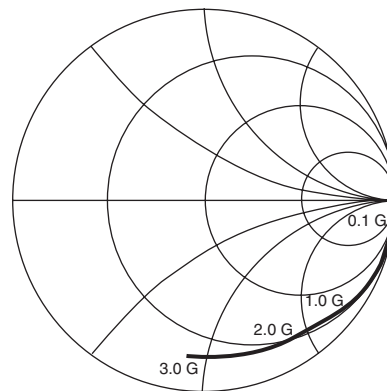


1.9 GHz Output Port Matching



**TYPICAL PERFORMANCE CURVES** ( $T_A = 25^\circ\text{C}$  unless otherwise specified)**1.9 GHz Output Port Matching**

# TYPICAL SCATTERING PARAMETERS (T<sub>A</sub> = 25°C)

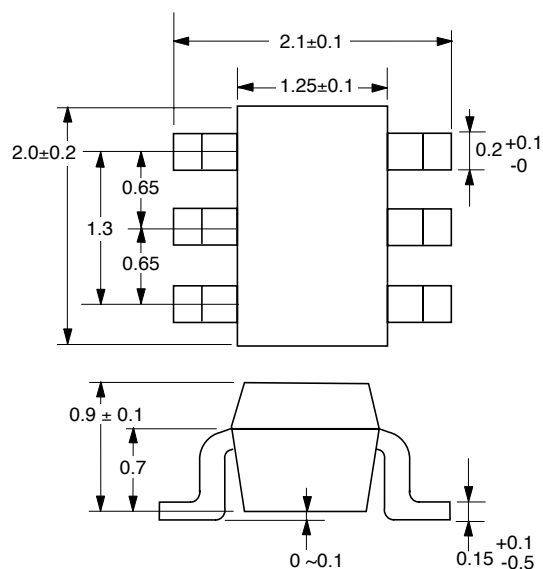
S<sub>11</sub>—FrequencyS<sub>22</sub>—FrequencyV<sub>CC</sub> = V<sub>OUT</sub> = 3.0 V, I<sub>CC</sub> = 4.2 mA

| FREQUENCY | S <sub>11</sub> |        | S <sub>21</sub> |        | S <sub>12</sub> |       | S <sub>22</sub> |        |
|-----------|-----------------|--------|-----------------|--------|-----------------|-------|-----------------|--------|
| MHz       | MAG             | ANG    | MAG             | ANG    | MAG             | ANG   | MAG             | ANG    |
| 100       | .843            | -16.0  | 1.202           | -178.9 | .000            | 69.5  | .996            | -3.3   |
| 200       | .752            | -27.1  | 1.197           | -177.5 | .003            | 120.2 | 1.009           | -6.9   |
| 300       | .666            | -32.4  | 1.221           | -175.4 | .003            | 103.2 | .998            | -9.9   |
| 400       | .603            | -36.8  | 1.299           | -174.5 | .004            | 92.8  | .986            | -13.8  |
| 500       | .555            | -40.5  | 1.398           | -174.0 | .005            | 88.8  | .968            | -17.3  |
| 600       | .528            | -44.8  | 1.513           | -174.9 | .005            | 95.2  | .968            | -20.4  |
| 700       | .517            | -49.9  | 1.691           | -176.2 | .007            | 67.5  | .971            | -23.1  |
| 800       | .525            | -54.4  | 1.815           | -178.2 | .007            | 72.4  | .972            | -25.8  |
| 900       | .545            | -58.9  | 2.008           | 179.5  | .006            | 84.5  | .960            | -29.3  |
| 1000      | .571            | -62.8  | 2.189           | 175.7  | .009            | 78.3  | .936            | -32.8  |
| 1100      | .580            | -67.3  | 2.399           | 171.2  | .007            | 60.0  | .926            | -36.3  |
| 1200      | .588            | -71.3  | 2.560           | 165.9  | .007            | 89.5  | .933            | -39.5  |
| 1300      | .571            | -76.4  | 2.736           | 157.5  | .008            | 67.2  | .941            | -42.0  |
| 1400      | .563            | -82.3  | 2.865           | 151.3  | .008            | 79.6  | .930            | -45.0  |
| 1500      | .553            | -88.8  | 2.946           | 143.3  | .006            | 79.9  | .906            | -48.1  |
| 1600      | .552            | -95.2  | 3.077           | 137.0  | .006            | 91.4  | .895            | -51.5  |
| 1700      | .551            | -101.5 | 3.083           | 130.1  | .009            | 102.3 | .888            | -54.8  |
| 1800      | .550            | -107.5 | 3.174           | 123.9  | .009            | 100.5 | .884            | -57.3  |
| 1900      | .536            | -113.3 | 3.164           | 117.4  | .006            | 109.5 | .885            | -60.5  |
| 2000      | .517            | -119.8 | 3.193           | 110.7  | .009            | 115.9 | .881            | -63.4  |
| 2100      | .495            | -127.1 | 3.149           | 104.4  | .010            | 124.2 | .870            | -66.6  |
| 2200      | .484            | -135.3 | 3.143           | 97.3   | .011            | 122.4 | .867            | -69.8  |
| 2300      | .484            | -142.6 | 3.135           | 90.5   | .012            | 131.7 | .866            | -72.3  |
| 2400      | .490            | -148.5 | 3.120           | 83.5   | .015            | 138.1 | .868            | -75.5  |
| 2500      | .499            | -152.5 | 3.053           | 78.4   | .016            | 136.3 | .866            | -78.7  |
| 2600      | .499            | -155.8 | 2.991           | 71.4   | .018            | 142.9 | .864            | -82.5  |
| 2700      | .485            | -157.4 | 2.958           | 68.0   | .018            | 143.9 | .858            | -86.6  |
| 2800      | .464            | -160.6 | 2.810           | 62.9   | .021            | 142.5 | .852            | -89.7  |
| 2900      | .439            | -164.1 | 2.866           | 57.5   | .022            | 149.3 | .872            | -93.4  |
| 3000      | .416            | -168.6 | 2.713           | 54.5   | .025            | 148.4 | .864            | -96.6  |
| 3100      | .403            | -173.6 | 2.635           | 48.0   | .030            | 143.6 | .867            | -101.0 |



## OUTLINE DIMENSIONS (Units in mm)

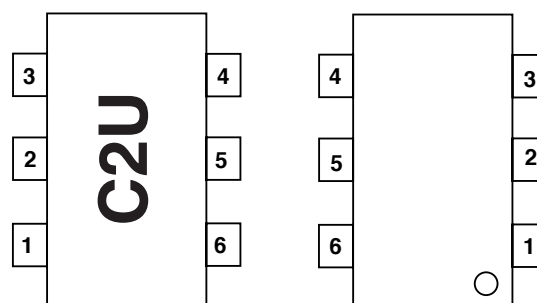
### PACKAGE OUTLINE S06



## LEAD CONNECTIONS

(Top View)

(Bottom View)



1. INPUT
2. GND
3. GND
4. OUTPUT
5. GND
6. Vcc

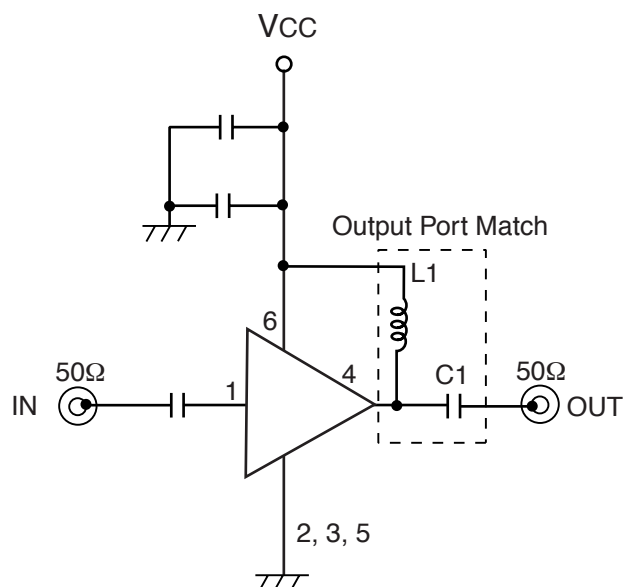
## ORDERING INFORMATION

| PART NUMBER    | QUANTITY | MARKING |
|----------------|----------|---------|
| UPC8151TB-E3-A | 3K/Reel  | C2U     |

Note:

Embossed tape, 8 mm wide. Pins 1, 2 and 3 face perforated side of tape.

## TEST CIRCUIT



| FOUR     | L1     | C1      | All Other<br>Caps = 1000 pF |
|----------|--------|---------|-----------------------------|
| 900 MHz  | 12 nH  | 0.68 pF |                             |
| 1900 MHz | 2.7 nH | 0.47 pF |                             |

EXCLUSIVE NORTH AMERICAN AGENT FOR RF, MICROWAVE & OPTOELECTRONIC SEMICONDUCTORS

**CEL** CALIFORNIA EASTERN LABORATORIES • Headquarters • 4590 Patrick Henry Drive • Santa Clara, CA 95054-1817 • (408) 988-3500 • Telex 34-6393 • FAX (408) 988-0279  
24-Hour Fax-On-Demand: 800-390-3232 (U.S. and Canada only) • Internet: <http://WWW.CEL.COM>

DATA SUBJECT TO CHANGE WITHOUT NOTICE

9/29/2000