



# BIPOLAR ANALOG INTEGRATED CIRCUITS

# UPC2711TB, UPC2712TB

## 5 V, SUPER MINIMOLD SILICON MMIC WIDEBAND AMPLIFIER

### FEATURES

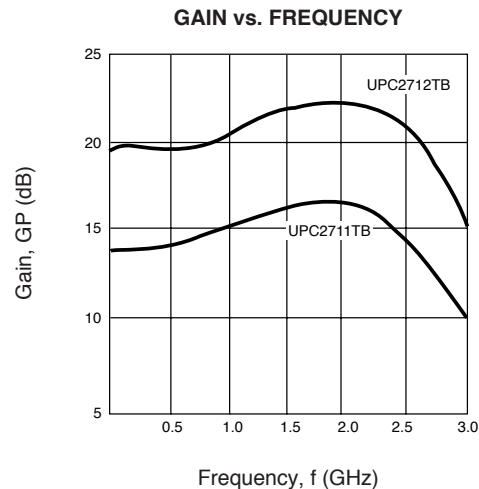
- **HIGH DENSITY SURFACE MOUNTING:**  
6 pin super minimold or SOT-363 package
- **SUPPLY VOLTAGE:**  $V_{CC} = 4.5$  to  $5.5$  V
- **WIDEBAND RESPONSE:**  
UPC2711TB:  $f_u = 2.9$  GHz TYP  
UPC2712TB:  $f_u = 2.6$  GHz TYP
- **POWER GAIN:**  
UPC2711TB:  $G_P = 13$  dB TYP  
UPC2712TB:  $G_P = 20$  dB TYP

### DESCRIPTION

The UPC2711TB and UPC2712TB are Silicon MMIC Wideband Amplifiers manufactured using NEC's 20 GHz  $f_T$  NESAT™ III silicon bipolar process. These devices are designed for use as buffer amps in DBS tuners. The UPC2711/12TB are pin compatible and have comparable performance as the larger UPC2711/12T, so they are suitable for use as a replacement to help reduce system size. These IC's are housed in a 6 pin super minimold or SOT-363 package.

Stringent quality assurance and test procedure ensure the highest reliability and performance.

### TYPICAL PERFORMANCE CURVES



### ELECTRICAL CHARACTERISTICS ( $T_A = +25$ °C, $V_{CC} = 5.0$ V, $Z_L = Z_s = 50$ W)

| PART NUMBER<br>PACKAGE OUTLINE |                                                                                              |       | UPC2711TB<br>S06 |           |      | UPC2712TB<br>S06 |           |      |
|--------------------------------|----------------------------------------------------------------------------------------------|-------|------------------|-----------|------|------------------|-----------|------|
| SYMBOLS                        | PARAMETERS AND CONDITIONS                                                                    | UNITS | MIN              | TYP       | MAX  | MIN              | TYP       | MAX  |
| $I_{CC}$                       | Circuit Current (no signal)                                                                  | mA    | 9                | 12        | 15   | 9                | 12        | 15   |
| $G_P$                          | Power Gain, $f = 1$ GHz                                                                      | dB    | 11               | 13        | 16.5 | 18               | 20        | 23.5 |
| $f_u$                          | Upper Limit Operating Frequency<br>(The gain at $f_u$ is 3 dB down from the gain at 100 MHz) | GHz   | 2.7              | 2.9       |      | 2.2              | 2.6       |      |
| $\Delta G_P$                   | Gain Flatness, $f = 0.1$ GHz to 2.5 GHz                                                      | dB    |                  | $\pm 0.8$ |      |                  | $\pm 0.8$ |      |
| $P_{O(SAT)}$                   | Maximum Output Level, $f = 1$ GHz, $P_{IN} = 0$ dBm                                          | dBm   | -2               | +1        |      | 0                | +3        |      |
| NF                             | Noise Figure, $f = 1$ GHz                                                                    | dB    |                  | 5         | 6.5  |                  | 4.5       | 6    |
| RLIN                           | Input Return Loss, $f = 1$ GHz                                                               | dB    | 20               | 25        |      | 9                | 12        |      |
| RLOUT                          | Output Return Loss, $f = 1$ GHz                                                              | dB    | 9                | 12        |      | 10               | 13        |      |
| ISOL                           | Isolation, $f = 1$ GHz                                                                       | dB    | 25               | 30        |      | 28               | 33        |      |

The information in this document is subject to change without notice. Before using this document, please confirm that this is the latest version.

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

| SYMBOLS          | PARAMETERS                           | UNITS | RATINGS     |
|------------------|--------------------------------------|-------|-------------|
| V <sub>CC</sub>  | Supply Voltage                       | V     | 6           |
| P <sub>IN</sub>  | Input Power                          | dBm   | +10         |
| P <sub>T</sub>   | Total Power Dissipation <sup>2</sup> | mW    | 200         |
| T <sub>OP</sub>  | Operating Temperature                | °C    | -45 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 double sided copper clad 50 x 50 x 1.6 mm epoxy glass PWB (T<sub>A</sub> = +85°C).

**RECOMMENDED OPERATING CONDITIONS**

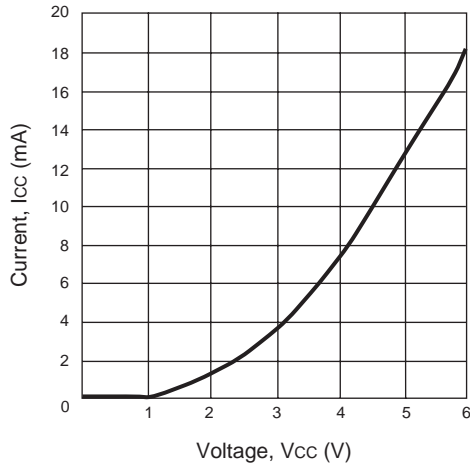
| SYMBOL          | PARAMETER             | UNITS | MIN | TYP | MAX |
|-----------------|-----------------------|-------|-----|-----|-----|
| V <sub>CC</sub> | Supply Voltage        | V     | 4.5 | 5.0 | 5.5 |
| T <sub>OP</sub> | Operating Temperature | °C    | -40 | +25 | +85 |

**PIN DESCRIPTION**

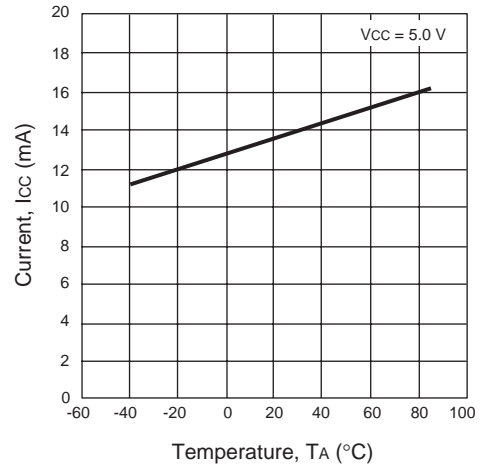
| Pin No.     | Pin Name        | Applied Voltage (V) | Description                                                                                                                                                                                                                                                                                         | Internal Equivalent Circuit |
|-------------|-----------------|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|
| 1           | Input           |                     | Signal input pin. An internal matching circuit, configured with resistors, enables 50 Ω connection over a wide bandwidth. A multi-feedback circuit is designed to cancel the deviations of h <sub>FE</sub> and resistance. This pin must be coupled to the signal source with a blocking capacitor. |                             |
| 4           | Output          |                     | Signal output pin. An internal matching circuit, configured with resistors, enables 50 Ω connection over a wide bandwidth. This pin must be coupled to the output load with a blocking capacitor.                                                                                                   |                             |
| 6           | V <sub>CC</sub> | 4.5 to 5.5          | 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 PERFORMANCE CURVES** ( $T_A = 25^\circ\text{C}$ )

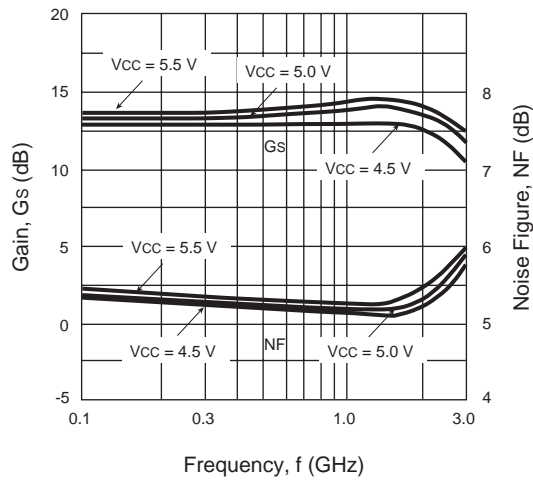
**UPC2711TB  
CURRENT vs. VOLTAGE**



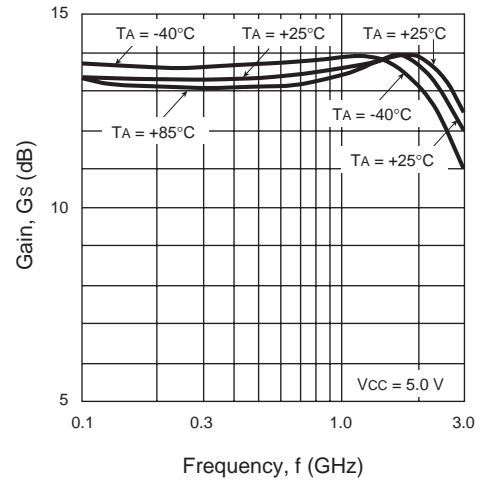
**UPC2711TB  
CURRENT vs. TEMPERATURE**



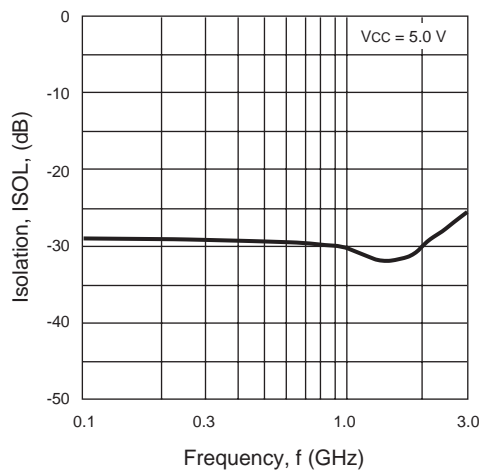
**UPC2711TB  
GAIN AND NOISE FIGURE vs.  
FREQUENCY AND VOLTAGE**



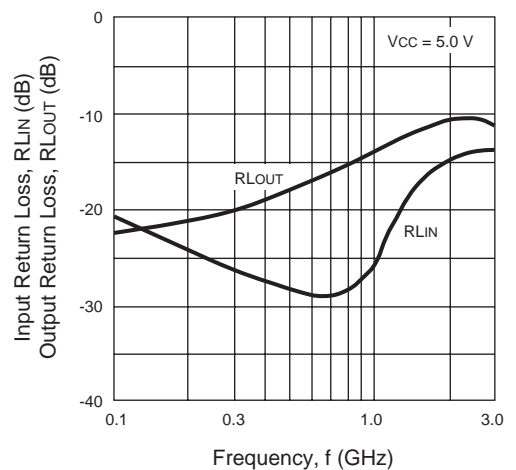
**UPC2711TB  
GAIN vs. FREQUENCY AND  
TEMPERATURE**



**UPC2711TB  
ISOLATION vs. FREQUENCY**

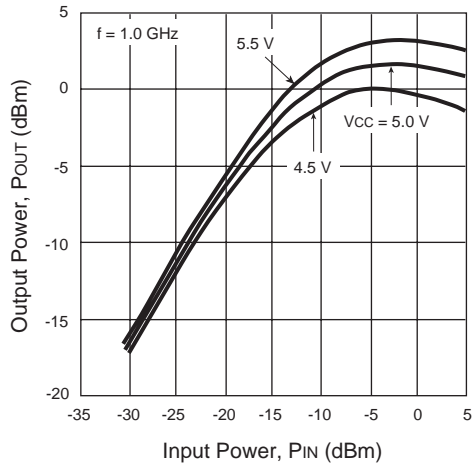


**UPC2711TB  
INPUT RETURN LOSS AND  
OUTPUT RETURN LOSS vs. FREQUENCY**

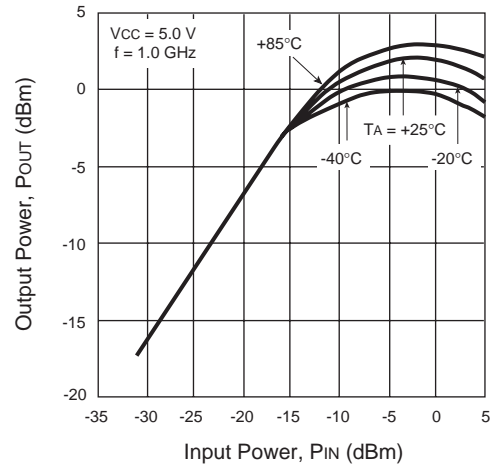


**TYPICAL PERFORMANCE CURVES** ( $T_A = 25^\circ\text{C}$ )

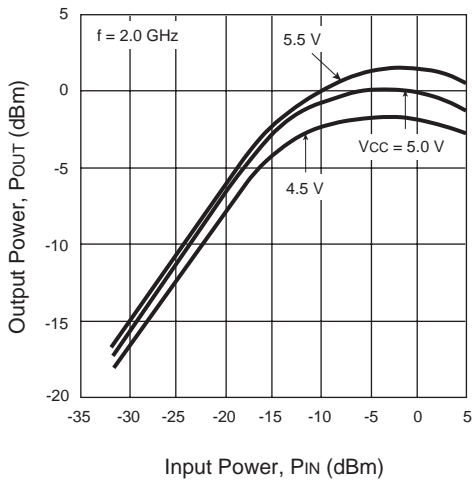
**UPC2711TB**  
**OUTPUT POWER vs.**  
**INPUT POWER VOLTAGE**



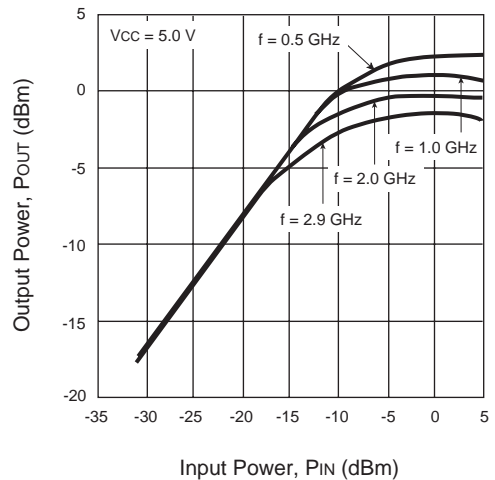
**UPC2711TB**  
**OUTPUT POWER vs.**  
**INPUT POWER AND TEMPERATURE**



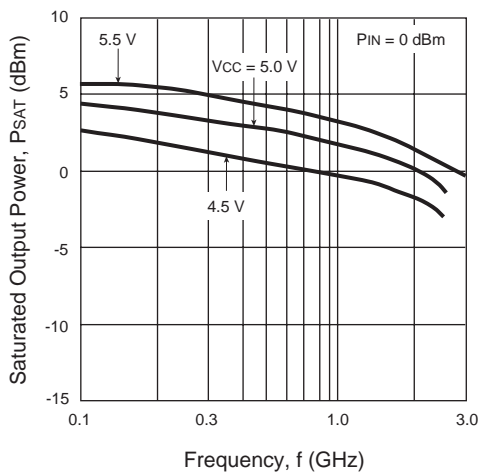
**UPC2711TB**  
**OUTPUT POWER vs.**  
**INPUT POWER AND VOLTAGE**



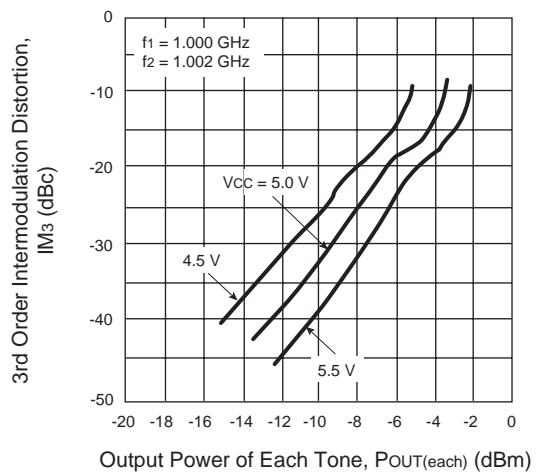
**UPC2711TB**  
**OUTPUT POWER vs.**  
**INPUT POWER AND FREQUENCY**



**UPC2711TB**  
**SATURATED OUTPUT POWER vs.**  
**FREQUENCY AND VOLTAGE**

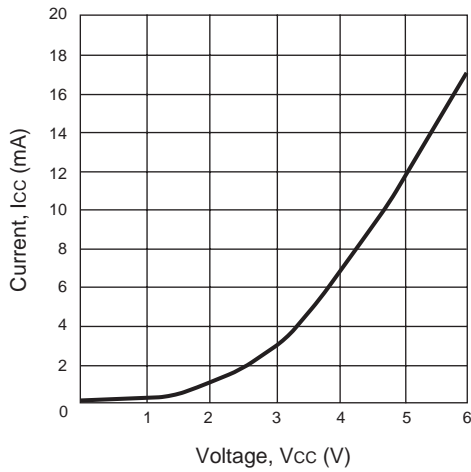


**UPC2711TB**  
**3RD ORDER INTERMODULATION**  
**DISTORTION vs. OUTPUT POWER**  
**AND VOLTAGE**

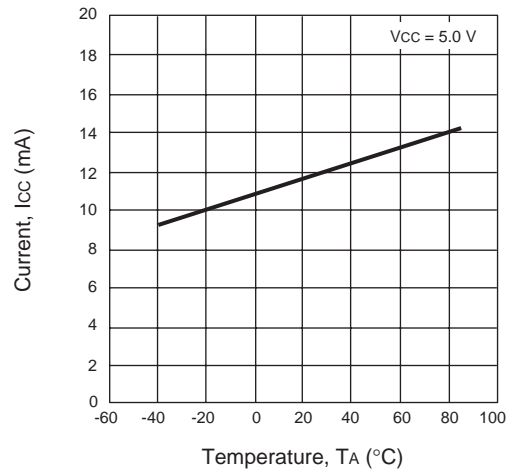


TYPICAL PERFORMANCE CURVES (TA = 25°C)

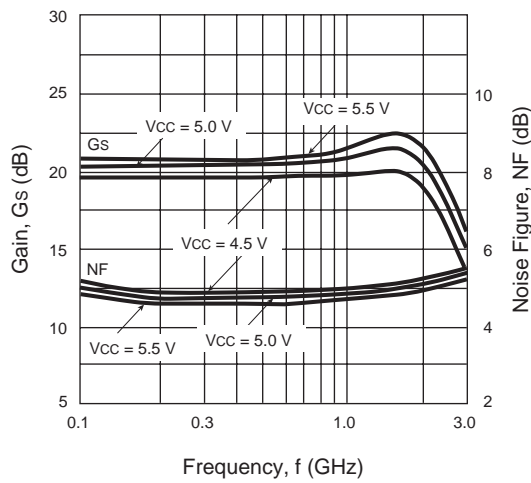
UPC2712TB  
CURRENT vs. VOLTAGE



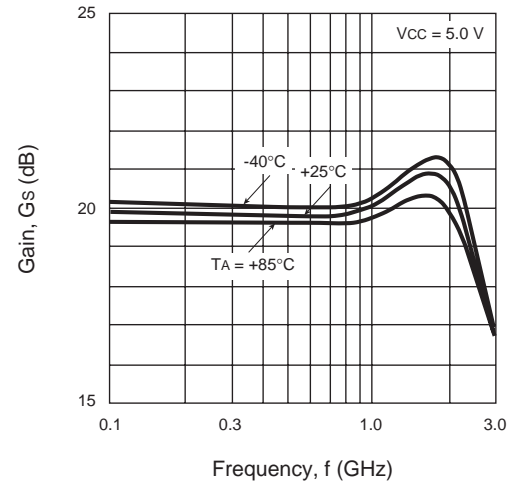
UPC2712TB  
CURRENT vs. TEMPERATURE



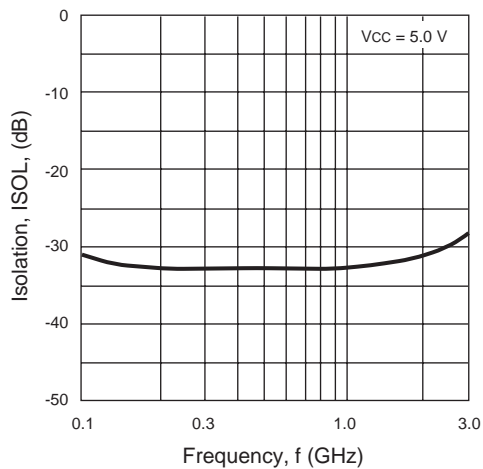
UPC2712TB  
GAIN AND NOISE FIGURE vs.  
FREQUENCY AND VOLTAGE



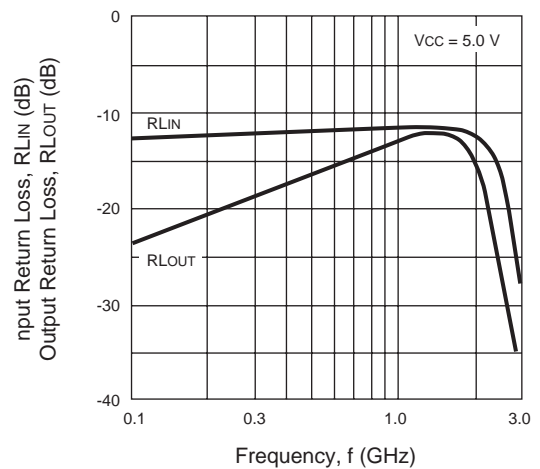
UPC2712TB  
GAIN vs.  
FREQUENCY AND TEMPERATURE



UPC2712TB  
ISOLATION vs. FREQUENCY

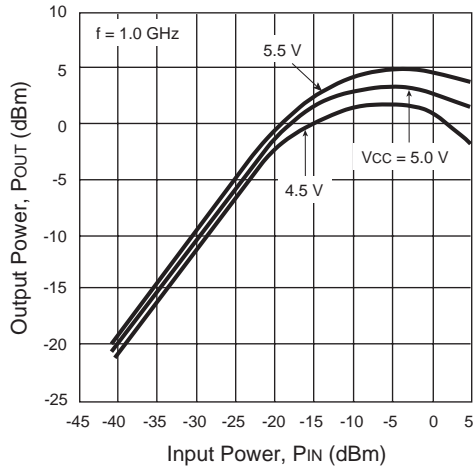


UPC2712TB  
INPUT RETURN LOSS AND OUTPUT  
RETURN LOSS vs. FREQUENCY

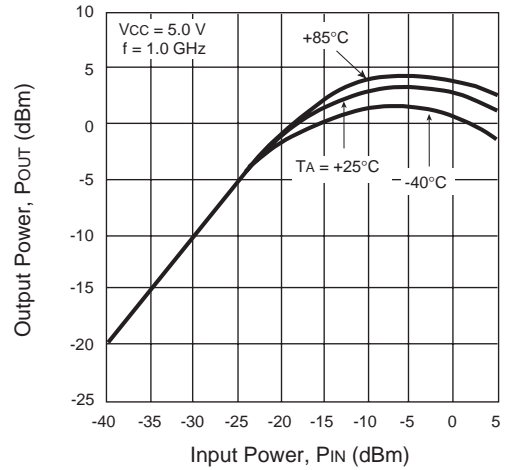


TYPICAL PERFORMANCE CURVES (TA = 25°C)

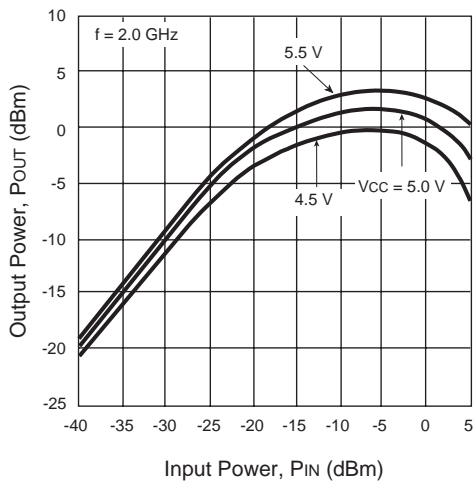
**UPC2712TB  
OUTPUT POWER vs.  
INPUT POWER VOLTAGE**



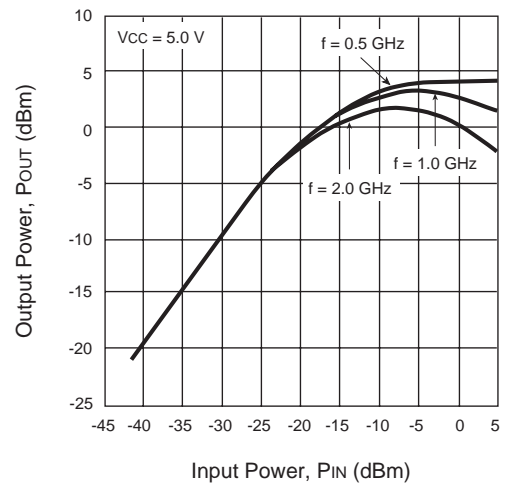
**UPC2712TB  
OUTPUT POWER vs.  
INPUT POWER AND TEMPERATURE**



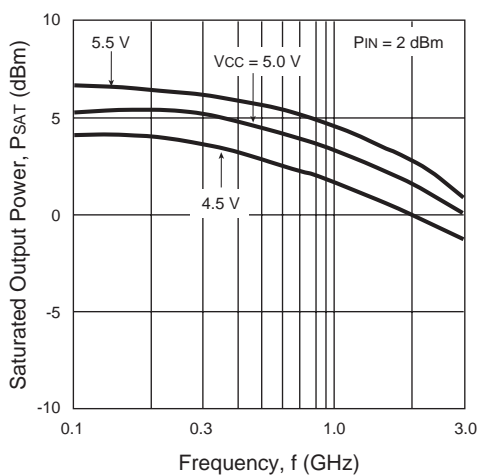
**UPC2712TB  
OUTPUT POWER vs.  
INPUT POWER AND VOLTAGE**



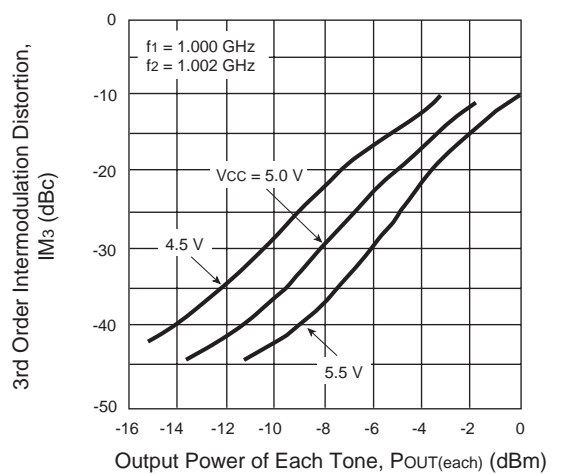
**UPC2712TB  
OUTPUT POWER vs.  
INPUT POWER AND FREQUENCY**



**UPC2712TB  
SATURATED OUTPUT POWER vs.  
FREQUENCY AND VOLTAGE**



**UPC2712TB  
3RD ORDER INTERMODULATION  
DISTORTION vs. OUTPUT POWER  
AND VOLTAGE**



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

**UPC2711TB**

V<sub>CC</sub> = 5 V, I<sub>CC</sub> = 13.8 mA

| FREQUENCY<br>(MHz) | S <sub>11</sub> |         | S <sub>21</sub> |         | S <sub>12</sub> |         | S <sub>22</sub> |        | K    |
|--------------------|-----------------|---------|-----------------|---------|-----------------|---------|-----------------|--------|------|
|                    | MAG             | ANG     | MAG             | ANG     | MAG             | ANG     | MAG             | ANG    |      |
| 100.00             | 0.085           | -22.40  | 4.447           | -14.90  | 0.035           | -12.70  | 0.113           | -3.10  | 3.18 |
| 200.00             | 0.086           | -25.00  | 4.468           | -30.10  | 0.035           | -23.00  | 0.119           | 1.20   | 3.21 |
| 300.00             | 0.098           | -29.20  | 4.491           | -44.90  | 0.034           | -32.10  | 0.136           | 1.60   | 3.23 |
| 400.00             | 0.081           | -29.40  | 4.510           | -60.30  | 0.033           | -42.50  | 0.142           | 6.50   | 3.34 |
| 500.00             | 0.066           | -33.90  | 4.540           | -74.90  | 0.033           | -50.10  | 0.156           | 10.10  | 3.32 |
| 600.00             | 0.041           | -54.50  | 4.572           | -90.20  | 0.033           | -59.60  | 0.161           | 12.70  | 3.34 |
| 700.00             | 0.053           | -104.30 | 4.624           | -105.30 | 0.032           | -69.30  | 0.161           | 8.80   | 3.33 |
| 800.00             | 0.070           | -119.70 | 4.664           | -120.70 | 0.031           | -78.40  | 0.176           | 6.20   | 3.36 |
| 900.00             | 0.098           | -121.90 | 4.729           | -136.10 | 0.032           | -86.60  | 0.192           | 1.90   | 3.27 |
| 1000.00            | 0.101           | -112.50 | 4.781           | -152.00 | 0.031           | -94.90  | 0.228           | 0.10   | 3.29 |
| 1100.00            | 0.090           | -108.50 | 4.843           | -167.90 | 0.031           | -103.90 | 0.256           | -0.60  | 3.15 |
| 1200.00            | 0.060           | -95.60  | 4.945           | 175.80  | 0.029           | -111.00 | 0.290           | -1.10  | 3.24 |
| 1300.00            | 0.019           | -79.20  | 4.999           | 159.50  | 0.029           | -120.20 | 0.308           | -0.30  | 3.16 |
| 1400.00            | 0.023           | 54.80   | 5.062           | 143.00  | 0.028           | -128.90 | 0.322           | -1.40  | 3.18 |
| 1500.00            | 0.062           | 80.70   | 5.114           | 126.40  | 0.029           | -133.10 | 0.327           | -2.20  | 3.08 |
| 1600.00            | 0.087           | 80.40   | 5.142           | 109.50  | 0.029           | -140.90 | 0.333           | -4.80  | 3.07 |
| 1700.00            | 0.113           | 78.70   | 5.160           | 92.70   | 0.029           | -146.20 | 0.344           | -7.00  | 3.02 |
| 1800.00            | 0.126           | 72.00   | 5.146           | 75.40   | 0.030           | -151.40 | 0.356           | -9.70  | 2.88 |
| 1900.00            | 0.154           | 63.50   | 5.123           | 58.00   | 0.032           | -159.70 | 0.371           | -11.10 | 2.70 |
| 2000.00            | 0.178           | 59.00   | 5.113           | 41.30   | 0.035           | -168.30 | 0.378           | -12.00 | 2.51 |
| 2100.00            | 0.212           | 54.20   | 5.063           | 24.00   | 0.036           | -175.70 | 0.383           | -12.80 | 2.39 |
| 2200.00            | 0.232           | 55.20   | 5.006           | 6.90    | 0.038           | 175.20  | 0.378           | -13.60 | 2.27 |
| 2300.00            | 0.246           | 53.80   | 4.954           | -10.40  | 0.041           | 165.20  | 0.367           | -16.10 | 2.13 |
| 2400.00            | 0.248           | 53.60   | 4.865           | -27.70  | 0.045           | 155.30  | 0.359           | -18.00 | 1.99 |
| 2500.00            | 0.240           | 49.20   | 4.783           | -45.00  | 0.048           | 143.60  | 0.356           | -21.10 | 1.88 |
| 2600.00            | 0.238           | 43.70   | 4.664           | -62.30  | 0.049           | 131.20  | 0.359           | -23.60 | 1.85 |
| 2700.00            | 0.240           | 36.20   | 4.529           | -79.60  | 0.052           | 119.80  | 0.366           | -26.20 | 1.76 |
| 2800.00            | 0.262           | 31.70   | 4.384           | -96.60  | 0.054           | 108.70  | 0.374           | -28.60 | 1.72 |
| 2900.00            | 0.285           | 28.80   | 4.255           | -113.10 | 0.056           | 95.50   | 0.372           | -31.10 | 1.68 |
| 3000.00            | 0.316           | 29.70   | 4.117           | -129.60 | 0.057           | 83.60   | 0.361           | -35.00 | 1.69 |

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

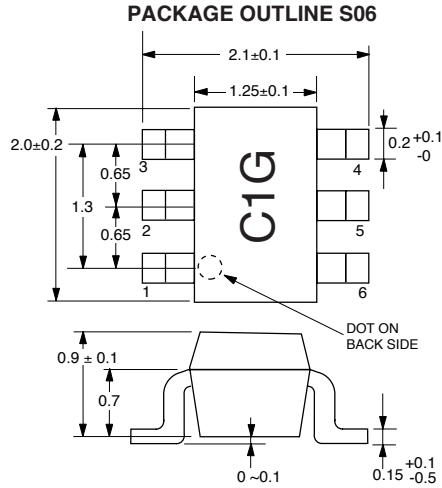
**UPC2712TB**

V<sub>CC</sub> = 5 V, I<sub>CC</sub> = 13.9 mA

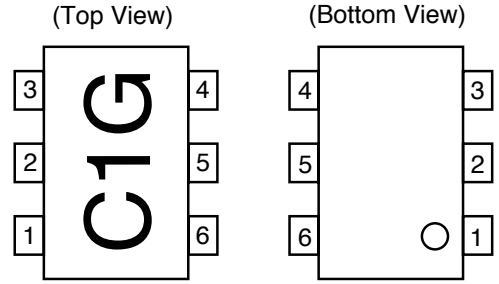
| FREQUENCY<br>(MHz) | S <sub>11</sub> |        | S <sub>21</sub> |         | S <sub>12</sub> |         | S <sub>22</sub> |        | K    |
|--------------------|-----------------|--------|-----------------|---------|-----------------|---------|-----------------|--------|------|
|                    | MAG             | ANG    | MAG             | ANG     | MAG             | ANG     | MAG             | ANG    |      |
| 100.00             | 0.303           | -8.10  | 8.864           | -16.70  | 0.023           | -11.40  | 0.043           | 2.30   | 2.32 |
| 200.00             | 0.291           | -10.10 | 8.827           | -33.50  | 0.023           | -19.20  | 0.055           | 11.50  | 2.35 |
| 300.00             | 0.295           | -11.80 | 8.936           | -49.50  | 0.022           | -25.50  | 0.078           | 8.50   | 2.38 |
| 400.00             | 0.276           | -11.30 | 9.044           | -67.60  | 0.023           | -34.60  | 0.095           | 13.40  | 2.33 |
| 500.00             | 0.265           | -11.00 | 9.051           | -82.20  | 0.023           | -42.80  | 0.112           | 13.60  | 2.37 |
| 600.00             | 0.243           | -12.30 | 9.096           | -98.80  | 0.023           | -50.00  | 0.120           | 11.10  | 2.35 |
| 700.00             | 0.222           | -20.30 | 9.089           | -115.20 | 0.023           | -59.80  | 0.120           | 1.70   | 2.37 |
| 800.00             | 0.219           | -25.40 | 9.080           | -131.50 | 0.023           | -66.20  | 0.136           | -6.00  | 2.38 |
| 900.00             | 0.230           | -33.90 | 9.096           | -147.60 | 0.023           | -73.00  | 0.155           | -14.40 | 2.39 |
| 1000.00            | 0.267           | -35.50 | 9.044           | -164.20 | 0.024           | -82.90  | 0.189           | -17.50 | 2.26 |
| 1100.00            | 0.290           | -35.50 | 9.197           | 179.50  | 0.024           | -89.50  | 0.212           | -19.90 | 2.12 |
| 1200.00            | 0.316           | -33.20 | 9.421           | 162.40  | 0.024           | -98.40  | 0.240           | -21.40 | 2.02 |
| 1300.00            | 0.317           | -30.60 | 9.524           | 144.90  | 0.024           | -107.00 | 0.245           | -23.20 | 1.94 |
| 1400.00            | 0.314           | -29.40 | 9.512           | 126.60  | 0.026           | -115.70 | 0.248           | -27.10 | 1.82 |
| 1500.00            | 0.296           | -28.10 | 9.574           | 109.10  | 0.026           | -122.30 | 0.236           | -31.80 | 1.78 |
| 1600.00            | 0.290           | -29.40 | 9.598           | 91.10   | 0.027           | -133.20 | 0.231           | -38.00 | 1.74 |
| 1700.00            | 0.278           | -31.10 | 9.480           | 72.90   | 0.028           | -139.40 | 0.221           | -43.80 | 1.72 |
| 1800.00            | 0.282           | -34.90 | 9.372           | 54.30   | 0.029           | -148.10 | 0.215           | -49.80 | 1.69 |
| 1900.00            | 0.284           | -35.50 | 9.193           | 35.60   | 0.030           | -157.60 | 0.199           | -53.00 | 1.70 |
| 2000.00            | 0.280           | -36.60 | 9.198           | 18.40   | 0.031           | -167.40 | 0.170           | -55.30 | 1.69 |
| 2100.00            | 0.273           | -36.00 | 9.011           | 0.10    | 0.033           | -175.10 | 0.134           | -56.20 | 1.68 |
| 2200.00            | 0.244           | -38.20 | 8.784           | -17.90  | 0.033           | 176.50  | 0.090           | -55.20 | 1.74 |
| 2300.00            | 0.222           | -40.00 | 8.717           | -35.10  | 0.034           | 164.80  | 0.050           | -53.70 | 1.74 |
| 2400.00            | 0.189           | -45.70 | 8.388           | -52.90  | 0.036           | 154.80  | 0.025           | 1.80   | 1.75 |
| 2500.00            | 0.177           | -52.90 | 8.217           | -70.10  | 0.037           | 143.50  | 0.039           | 33.40  | 1.74 |
| 2600.00            | 0.164           | -57.40 | 7.890           | -87.40  | 0.039           | 133.30  | 0.071           | 39.30  | 1.72 |
| 2700.00            | 0.158           | -59.60 | 7.597           | -104.60 | 0.041           | 123.80  | 0.099           | 34.30  | 1.70 |
| 2800.00            | 0.143           | -53.90 | 7.313           | -121.40 | 0.041           | 114.00  | 0.131           | 26.00  | 1.72 |
| 2900.00            | 0.128           | -44.30 | 7.078           | -138.40 | 0.043           | 101.40  | 0.149           | 22.80  | 1.70 |
| 3000.00            | 0.111           | -22.20 | 6.086           | -154.90 | 0.046           | 90.20   | 0.157           | 19.40  | 1.70 |



**OUTLINE DIMENSIONS** (Units in mm)



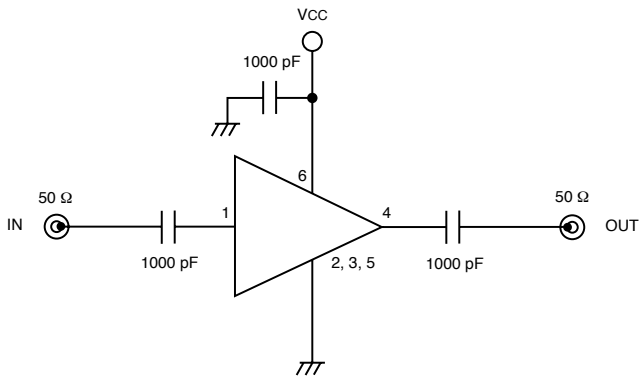
**PIN CONNECTIONS**



Marking is an example of UPC2711TB

- 1. Input    4. Output
- 2. GND    5. GND
- 3. GND    6. Vcc

**TEST CIRCUIT**



**ORDERING INFORMATION (Solder Contains Lead)**

| PART NUMBER  | MARKING | QTY     |
|--------------|---------|---------|
| UPC2711TB-E3 | C1G     | 3K/reel |
| UPC2712TB-E3 | C1H     | 3K/reel |

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

**ORDERING INFORMATION (Pb-Free)**

| PART NUMBER    | MARKING | QTY     |
|----------------|---------|---------|
| UPC2711TB-E3-A | C1G     | 3K/reel |
| UPC2712TB-E3-A | C1H     | 3K/reel |

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



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