

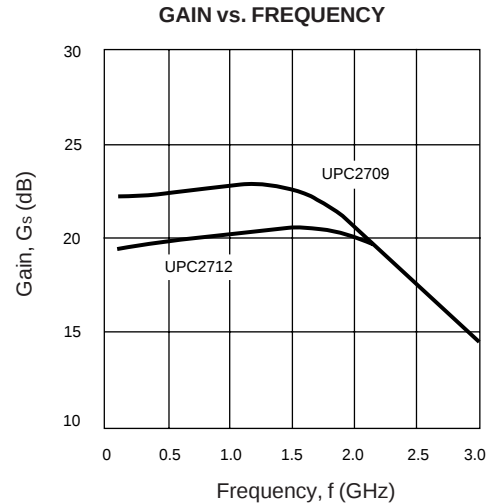
### FEATURES

- **WIDE FREQUENCY RESPONSE:** 2.5 GHz
- **HIGH GAIN:** 23 dB (UPC2709T)
- **SATURATED OUTPUT POWER:** +11.5 dBm (UPC2709T)
- **INTERNAL CURRENT REGULATION MINIMIZES GAIN CHANGE OVER TEMPERATURE**
- **5 V SINGLE SUPPLY VOLTAGE**
- **SUPER SMALL PACKAGE**
- **TAPE AND REEL PACKAGING OPTION AVAILABLE**

### DESCRIPTION

The UPC2709T and UPC2712T are Silicon Monolithic integrated circuits manufactured using the NESAT III process. These devices are suitable as buffer amplifiers for wide-band applications. They are designed for low cost gain stages in cellular radios, GPS receivers, DBS tuners, PCN, and test/measurement equipment.

NEC's stringent quality assurance and test procedures ensure the highest reliability and performance.



### ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25°C, f = 1 GHz, V<sub>CC</sub> = 5 V)

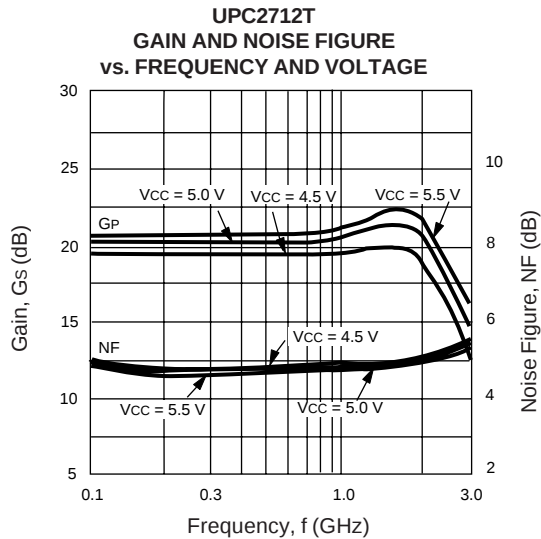
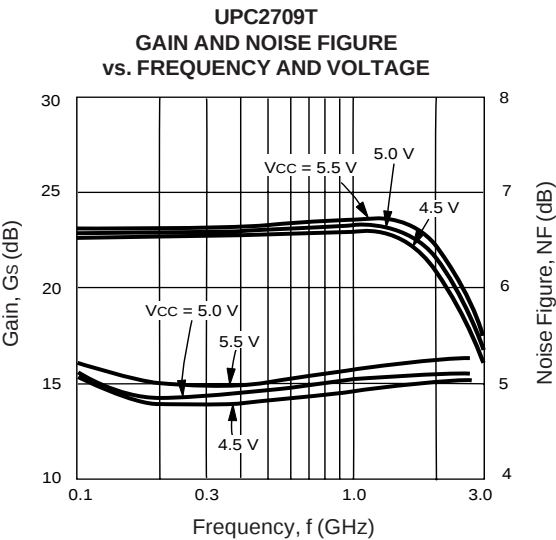
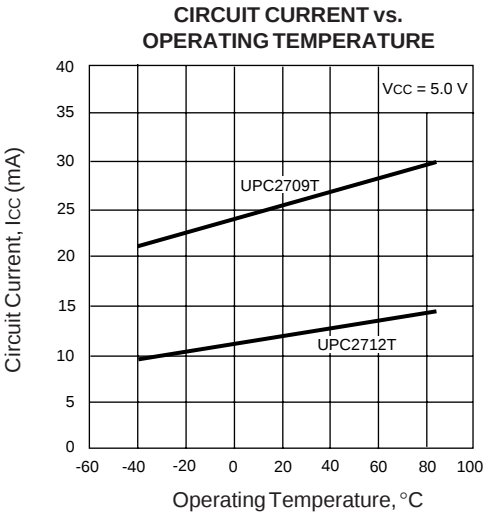
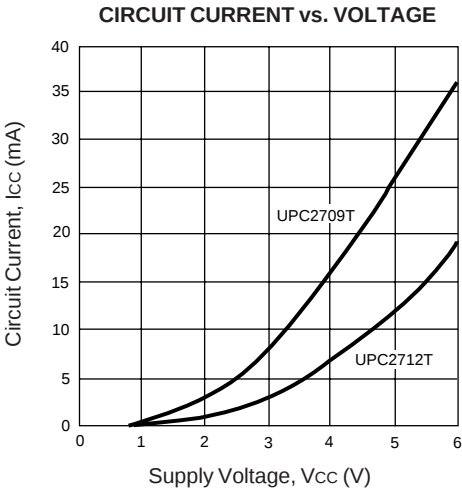
| PART NUMBER<br>PACKAGE OUTLINE |                                                                                                       |       | UPC2709T<br>T06 |        |      | UPC2712T<br>T06 |        |      |
|--------------------------------|-------------------------------------------------------------------------------------------------------|-------|-----------------|--------|------|-----------------|--------|------|
| SYMBOLS                        | PARAMETERS AND CONDITIONS                                                                             | UNITS | MIN             | TYP    | MAX  | MIN             | TYP    | MAX  |
| I <sub>CC</sub>                | Circuit Current (no signal)                                                                           | mA    | 19              | 25     | 32   | 9               | 12     | 15   |
| G <sub>s</sub>                 | Small Signal Gain                                                                                     | dB    | 21              | 23     | 26.5 | 18              | 20     | 23.5 |
| f <sub>u</sub>                 | Upper Limit Operating Frequency<br>(The gain at f <sub>u</sub> is 3 dB down from the gain at 0.1 GHz) | GHz   | 2.0             | 2.3    |      | 2.2             | 2.6    |      |
| ΔG <sub>s</sub>                | Gain Flatness, f = 0.1 ~ 1.8 GHz<br>f = 0.1 ~ 2.0 GHz                                                 | dB    |                 | ±1.0   |      |                 | ±0.8   |      |
| P <sub>SAT</sub>               | Saturated Output Power                                                                                | dBm   | 9               | 11.5   |      | 0               | 3      |      |
| P <sub>1dB</sub>               | Output Power at 1 dB Compression Point                                                                | dBm   |                 | 7.5    |      |                 | -2.5   |      |
| NF                             | Noise Figure                                                                                          | dB    |                 | 5      | 6.5  |                 | 4.5    | 6    |
| R <sub>LIN</sub>               | Input Return Loss                                                                                     | dB    | 7               | 10     |      | 9               | 12     |      |
| R <sub>LOUT</sub>              | Output Return Loss                                                                                    | dB    | 7               | 10     |      | 10              | 13     |      |
| ISOL                           | Isolation                                                                                             | dB    | 26              | 31     |      | 28              | 33     |      |
| ΔG <sub>T</sub>                | Gain -Temperature Coefficient                                                                         | dB/°C |                 | -0.002 |      |                 | -0.003 |      |
| R <sub>TH</sub>                | Thermal Resistance (Junction to Ambient)                                                              | °C/W  |                 |        | 200  |                 |        | 200  |

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

| SYMBOLS          | PARAMETERS                                    | UNITS    | RATINGS     |
|------------------|-----------------------------------------------|----------|-------------|
| V <sub>CC</sub>  | Supply Voltage                                | V        | 6           |
| I <sub>CC</sub>  | Total Circuit Current<br>UPC2709T<br>UPC2712T | mA<br>mA | 60<br>30    |
| P <sub>IN</sub>  | Input Power                                   | dBm      | +10         |
| P <sub>T</sub>   | Power Dissipation <sup>2</sup>                | mW       | 280         |
| T <sub>OP</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 50 x 50 x 1.6 mm epoxy glass PWB (T<sub>A</sub> = +85°C).

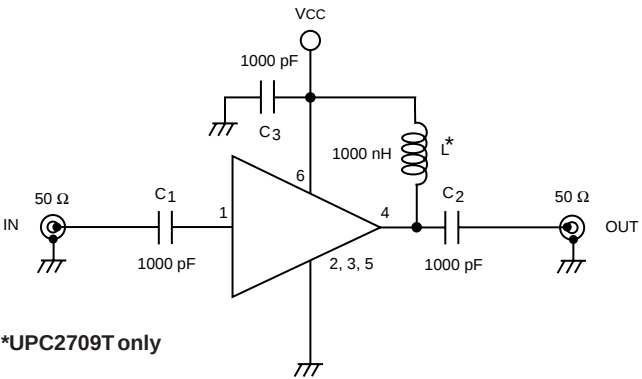
TYPICAL PERFORMANCE CURVES (T<sub>A</sub> = 25°C)



RECOMMENDED  
OPERATING CONDITIONS

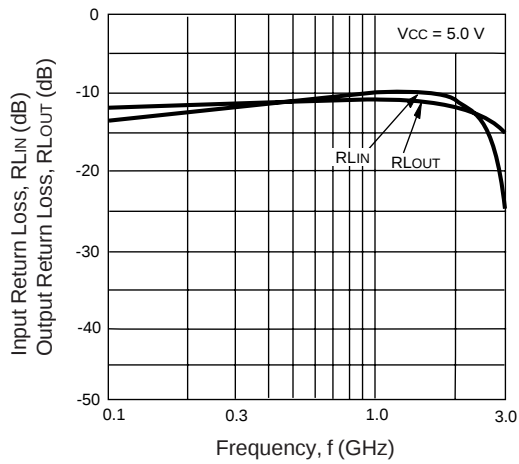
| SYMBOL          | PARAMETER      | UNITS | MIN | TYP | MAX |
|-----------------|----------------|-------|-----|-----|-----|
| V <sub>CC</sub> | Supply Voltage | V     | 4.5 | 5.0 | 5.5 |

TEST CIRCUIT

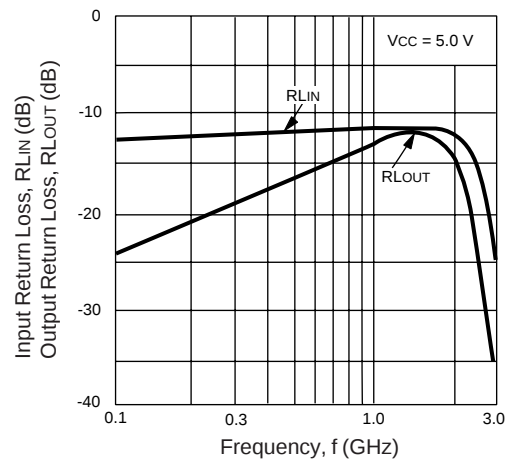


# TYPICAL PERFORMANCE CURVES ( $T_A = 25^\circ\text{C}$ )

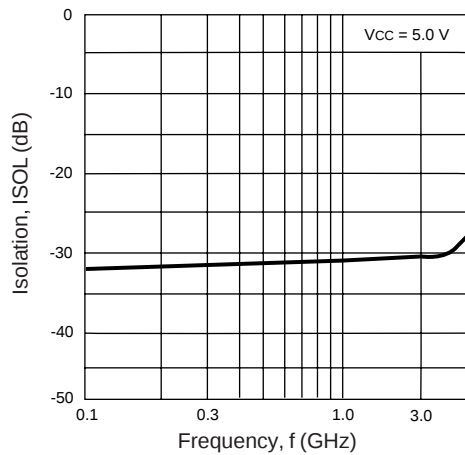
**UPC2709T**  
INPUT RETURN LOSS AND OUTPUT  
RETURN LOSS vs. FREQUENCY



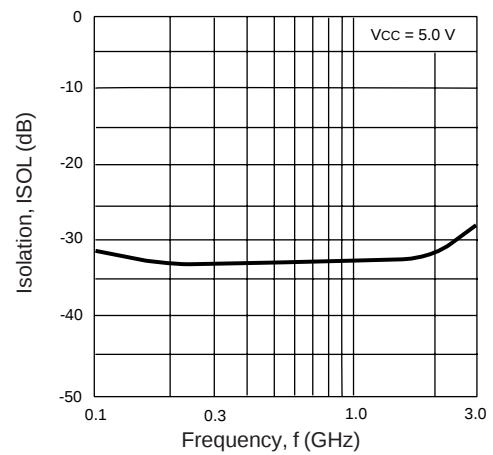
**UPC2712T**  
INPUT RETURN LOSS AND OUTPUT  
RETURN LOSS vs. FREQUENCY



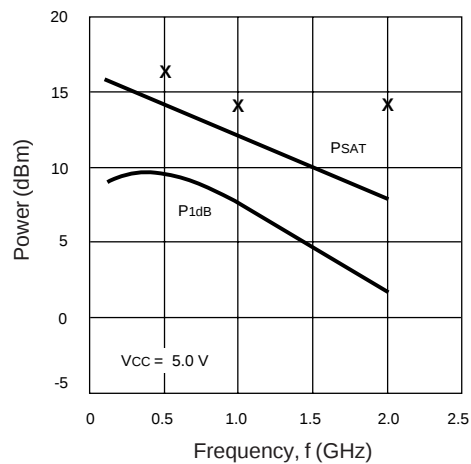
**UPC2709T**  
ISOLATION vs. FREQUENCY



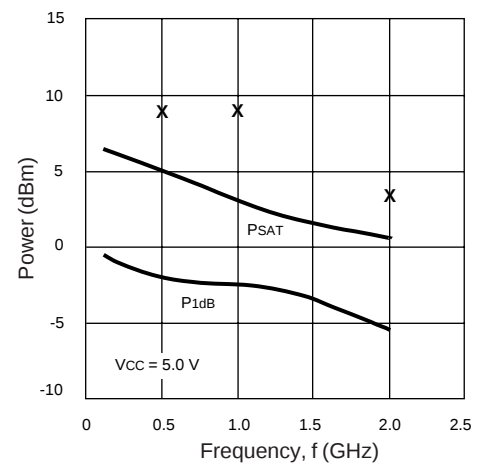
**UPC2712T**  
ISOLATION vs. FREQUENCY



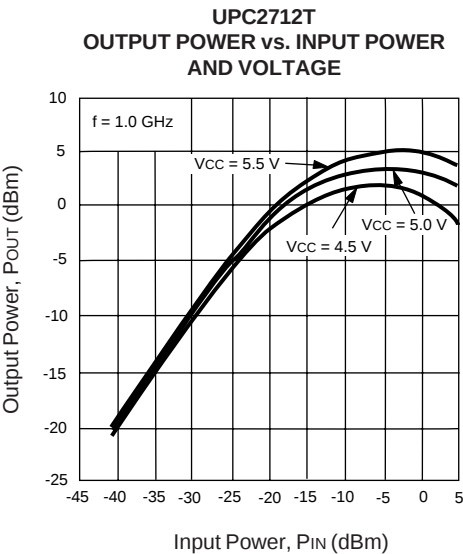
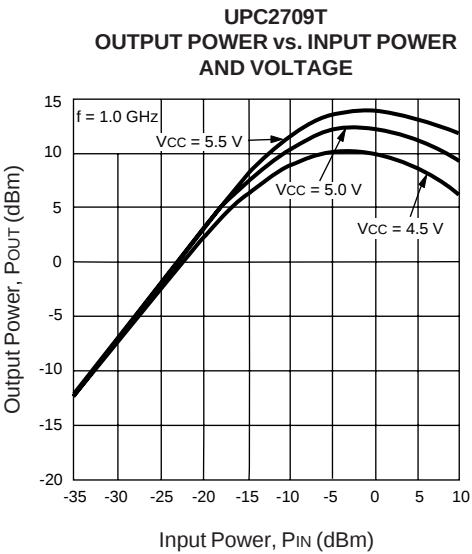
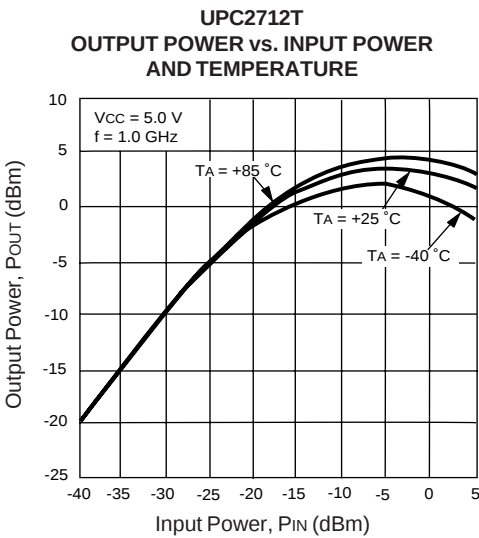
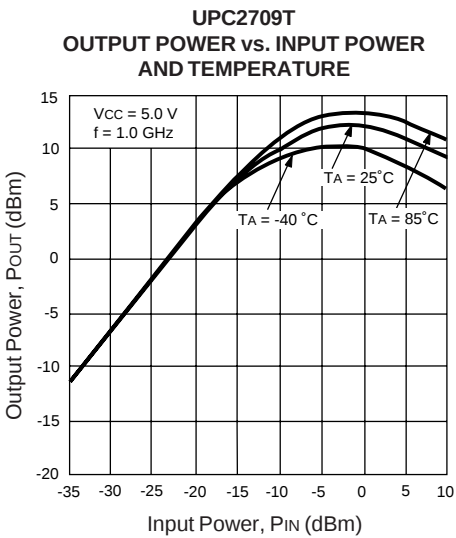
**UPC2709T**  
POWER vs. FREQUENCY



**UPC2712T**  
POWER vs. FREQUENCY



TYPICAL PERFORMANCE CURVES (TA = 25°C)



# UPC2709T, UPC2712T

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

### UPC2709T

V<sub>CC</sub> = 5 V, I<sub>CC</sub> = 25 mA

| FREQUENCY | S <sub>11</sub> |       | S <sub>21</sub> |        | S <sub>12</sub> |      | S <sub>22</sub> |        | K <sup>1</sup> | S <sub>21</sub> |
|-----------|-----------------|-------|-----------------|--------|-----------------|------|-----------------|--------|----------------|-----------------|
| (GHz)     | MAG             | ANG   | MAG             | ANG    | MAG             | ANG  | MAG             | ANG    |                | (dB)            |
| 0.10      | 0.258           | -4.1  | 12.7            | -3.7   | 0.022           | 7.5  | 0.234           | -4.6   | 1.66           | 22.1            |
| 0.20      | 0.261           | -2.9  | 12.8            | -12.2  | 0.024           | 3.1  | 0.240           | -6.9   | 1.52           | 22.1            |
| 0.30      | 0.266           | -3.4  | 12.9            | -19.6  | 0.025           | 6.3  | 0.251           | -9.6   | 1.45           | 22.2            |
| 0.40      | 0.271           | -4.6  | 13.0            | -27.0  | 0.025           | 6.5  | 0.260           | -13.5  | 1.42           | 22.3            |
| 0.50      | 0.272           | -6.8  | 13.1            | -34.2  | 0.026           | 5.6  | 0.272           | -17.9  | 1.36           | 22.3            |
| 0.60      | 0.275           | -8.1  | 13.3            | -41.3  | 0.026           | 10.5 | 0.288           | -22.1  | 1.32           | 22.5            |
| 0.70      | 0.277           | -10.4 | 13.5            | -49.2  | 0.026           | 9.9  | 0.303           | -28.6  | 1.29           | 22.6            |
| 0.80      | 0.278           | -12.7 | 13.6            | -57.4  | 0.026           | 11.0 | 0.312           | -33.5  | 1.27           | 22.7            |
| 0.90      | 0.279           | -14.0 | 13.7            | -65.7  | 0.026           | 11.8 | 0.319           | -38.4  | 1.25           | 22.7            |
| 1.00      | 0.279           | -15.2 | 13.8            | -72.3  | 0.027           | 15.6 | 0.324           | -43.4  | 1.20           | 22.8            |
| 1.10      | 0.279           | -18.1 | 13.9            | -81.1  | 0.027           | 15.8 | 0.328           | -51.2  | 1.19           | 22.9            |
| 1.20      | 0.276           | -20.7 | 14.0            | -90.3  | 0.027           | 17.7 | 0.332           | -59.0  | 1.19           | 22.9            |
| 1.30      | 0.271           | -23.3 | 13.9            | -99.8  | 0.027           | 16.7 | 0.332           | -67.1  | 1.20           | 22.9            |
| 1.40      | 0.263           | -25.6 | 13.8            | -109.3 | 0.027           | 19.2 | 0.326           | -75.1  | 1.22           | 22.8            |
| 1.50      | 0.255           | -26.9 | 13.6            | -118.5 | 0.027           | 20.4 | 0.314           | -82.5  | 1.25           | 22.7            |
| 1.60      | 0.246           | -28.6 | 13.2            | -128.3 | 0.028           | 20.6 | 0.302           | -90.6  | 1.27           | 22.4            |
| 1.70      | 0.238           | -30.2 | 12.7            | -138.0 | 0.029           | 21.6 | 0.282           | -98.9  | 1.30           | 22.1            |
| 1.80      | 0.237           | -31.7 | 12.3            | -147.5 | 0.030           | 27.9 | 0.254           | -106.8 | 1.33           | 21.8            |
| 1.90      | 0.232           | -33.1 | 11.7            | -157.2 | 0.030           | 31.0 | 0.226           | -113.6 | 1.40           | 21.4            |
| 2.00      | 0.222           | -33.6 | 11.0            | -166.1 | 0.031           | 33.2 | 0.198           | -120.8 | 1.47           | 20.8            |
| 2.10      | 0.209           | -34.4 | 10.3            | -174.3 | 0.032           | 34.6 | 0.168           | -126.7 | 1.54           | 20.3            |
| 2.20      | 0.194           | -33.1 | 9.7             | -177.5 | 0.033           | 35.8 | 0.143           | -132.5 | 1.61           | 19.7            |
| 2.30      | 0.184           | -30.3 | 9.0             | -169.5 | 0.034           | 36.1 | 0.114           | -137.7 | 1.69           | 19.1            |
| 2.40      | 0.176           | -26.8 | 8.4             | -162.0 | 0.034           | 38.5 | 0.089           | -144.4 | 1.81           | 18.5            |
| 2.50      | 0.173           | -23.2 | 7.8             | -154.8 | 0.035           | 39.2 | 0.065           | -150.6 | 1.90           | 17.8            |

### UPC2712T

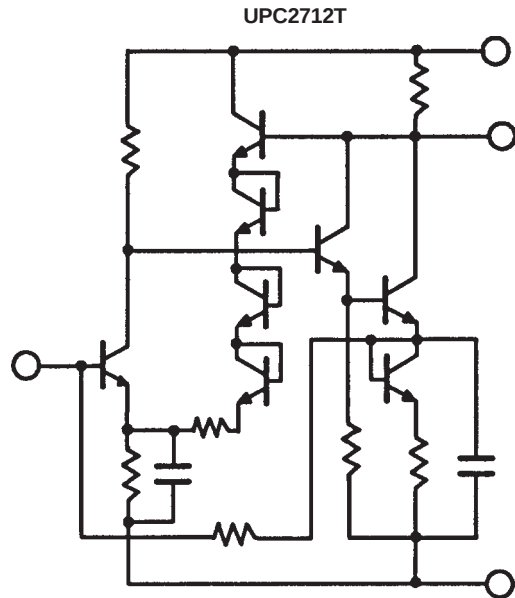
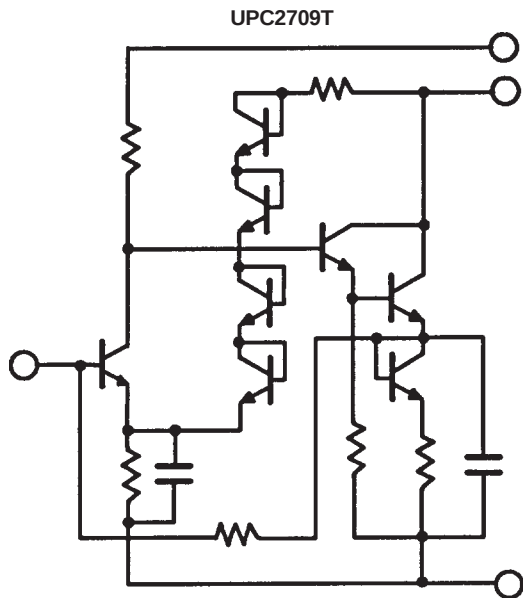
V<sub>CC</sub> = 5 V, I<sub>CC</sub> = 12 mA

| FREQUENCY | S <sub>11</sub> |        | S <sub>21</sub> |        | S <sub>12</sub> |       | S <sub>22</sub> |        | K <sup>1</sup> | S <sub>21</sub> |
|-----------|-----------------|--------|-----------------|--------|-----------------|-------|-----------------|--------|----------------|-----------------|
| (GHz)     | MAG             | ANG    | MAG             | ANG    | MAG             | ANG   | MAG             | ANG    |                | (dB)            |
| 0.10      | 0.262           | -9.3   | 9.3             | -6.4   | 0.021           | -1.6  | 0.071           | 7.8    | 2.46           | 19.3            |
| 0.20      | 0.261           | -12.3  | 9.4             | -17.4  | 0.022           | -3.3  | 0.078           | 7.2    | 2.33           | 19.5            |
| 0.30      | 0.260           | -17.0  | 9.5             | -27.7  | 0.022           | -5.1  | 0.091           | 6.4    | 2.29           | 19.6            |
| 0.40      | 0.258           | -21.9  | 9.6             | -37.5  | 0.023           | -6.8  | 0.110           | 4.3    | 2.16           | 19.7            |
| 0.50      | 0.257           | -27.1  | 9.8             | -46.9  | 0.024           | -8.5  | 0.128           | -1.1   | 2.05           | 19.8            |
| 0.60      | 0.255           | -32.0  | 9.9             | -56.4  | 0.024           | -10.2 | 0.146           | -6.8   | 2.01           | 19.9            |
| 0.70      | 0.254           | -38.1  | 10.0            | -65.7  | 0.025           | -12.0 | 0.166           | -14.9  | 1.90           | 20.0            |
| 0.80      | 0.252           | -41.9  | 10.2            | -75.9  | 0.026           | -13.7 | 0.181           | -22.9  | 1.80           | 20.1            |
| 0.90      | 0.250           | -46.5  | 10.3            | -86.0  | 0.026           | -15.4 | 0.194           | -32.7  | 1.77           | 20.3            |
| 1.00      | 0.248           | -51.0  | 10.4            | -96.4  | 0.027           | -17.2 | 0.204           | -40.5  | 1.69           | 20.4            |
| 1.10      | 0.246           | -57.5  | 10.6            | -106.4 | 0.028           | -18.9 | 0.212           | -50.9  | 1.62           | 20.5            |
| 1.20      | 0.240           | -62.5  | 10.6            | -117.7 | 0.028           | -20.6 | 0.221           | -59.7  | 1.60           | 20.5            |
| 1.30      | 0.236           | -67.8  | 10.7            | -128.9 | 0.029           | -22.3 | 0.235           | -70.9  | 1.54           | 20.6            |
| 1.40      | 0.232           | -72.4  | 10.8            | -140.6 | 0.030           | -24.1 | 0.244           | -81.3  | 1.48           | 20.6            |
| 1.50      | 0.224           | -77.7  | 10.8            | -152.7 | 0.031           | -25.8 | 0.247           | -94.4  | 1.44           | 20.7            |
| 1.60      | 0.218           | -82.1  | 10.9            | -164.9 | 0.031           | -27.5 | 0.246           | -106.3 | 1.44           | 20.7            |
| 1.70      | 0.210           | -86.2  | 10.9            | -177.6 | 0.032           | -29.3 | 0.240           | -119.4 | 1.42           | 20.7            |
| 1.80      | 0.201           | -89.3  | 10.7            | -169.5 | 0.033           | -31.0 | 0.234           | -131.5 | 1.42           | 20.6            |
| 1.90      | 0.190           | -93.5  | 10.5            | -156.4 | 0.033           | -32.7 | 0.221           | -143.3 | 1.46           | 20.4            |
| 2.00      | 0.180           | -96.9  | 10.3            | -143.7 | 0.034           | -34.4 | 0.210           | -159.0 | 1.46           | 20.3            |
| 2.10      | 0.173           | -98.4  | 10.0            | -129.8 | 0.035           | -36.2 | 0.187           | -173.4 | 1.48           | 20.0            |
| 2.20      | 0.169           | -101.3 | 9.7             | -119.3 | 0.035           | -37.9 | 0.169           | -167.5 | 1.54           | 19.7            |
| 2.30      | 0.161           | -100.3 | 8.8             | -107.2 | 0.036           | -39.6 | 0.156           | -151.8 | 1.63           | 18.9            |
| 2.40      | 0.157           | -100.0 | 8.4             | -95.8  | 0.037           | -41.3 | 0.134           | -132.8 | 1.69           | 18.4            |
| 2.50      | 0.156           | -99.4  | 7.7             | -84.9  | 0.037           | -43.1 | 0.125           | -114.0 | 1.80           | 17.8            |
| 2.60      | 0.156           | -100.0 | 7.3             | -75.4  | 0.038           | -44.8 | 0.118           | -89.8  | 1.85           | 17.3            |
| 2.70      | 0.159           | -98.4  | 6.8             | -64.5  | 0.038           | -46.5 | 0.108           | -65.4  | 2.00           | 16.6            |
| 2.80      | 0.164           | -101.7 | 6.5             | -56.1  | 0.039           | -48.3 | 0.110           | -50.2  | 2.02           | 16.2            |
| 2.90      | 0.168           | -100.1 | 5.8             | -47.0  | 0.039           | -50.0 | 0.122           | -32.2  | 2.21           | 15.3            |
| 3.00      | 0.172           | -101.1 | 5.5             | -36.2  | 0.040           | -51.7 | 0.136           | -15.6  | 2.28           | 14.8            |

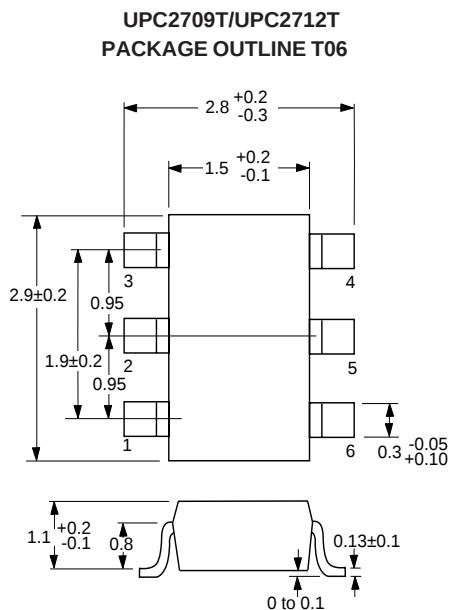
Note:

1. K factor calculations: 
$$K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2 |S_{12} S_{21}|}, \Delta = S_{11} S_{22} - S_{21} S_{12}$$

## EQUIVALENT CIRCUIT



## OUTLINE DIMENSIONS (Units in mm)



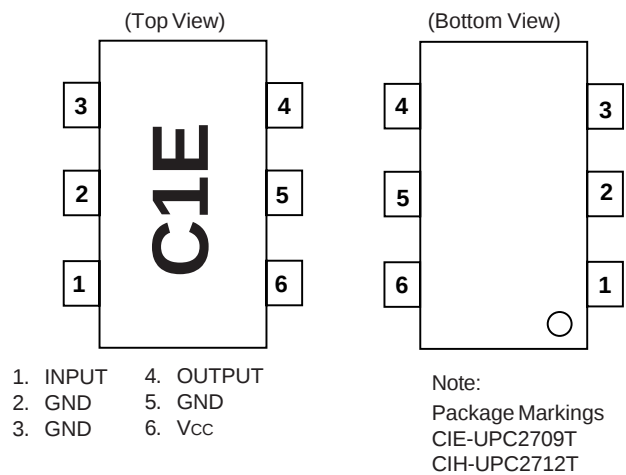
Note:  
All dimensions are typical unless otherwise specified.

## ORDERING INFORMATION

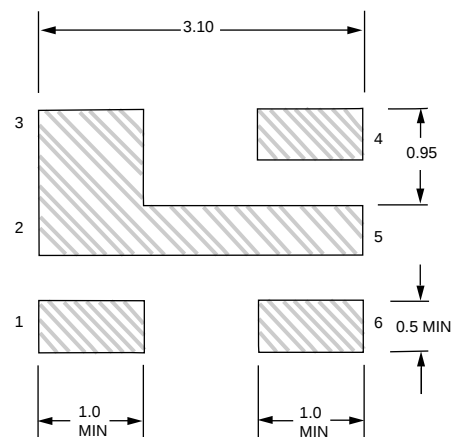
| PART NUMBER | QTY     |
|-------------|---------|
| UPC2709T-E3 | 3K/Reel |
| UPC2712T-E3 | 3K/Reel |

Embossed Tape, 8 mm wide.

## LEAD CONNECTIONS



## RECOMMENDED P.C.B. LAYOUT (Units in mm)



EXCLUSIVE AGENT FOR **NEC Corporation** RF & MICROWAVE SEMICONDUCTOR PRODUCTS - U.S. & CANADA