



# 3 V SILICON RFIC FREQUENCY UPCONVERTER

## UPC8106TB

### FEATURES

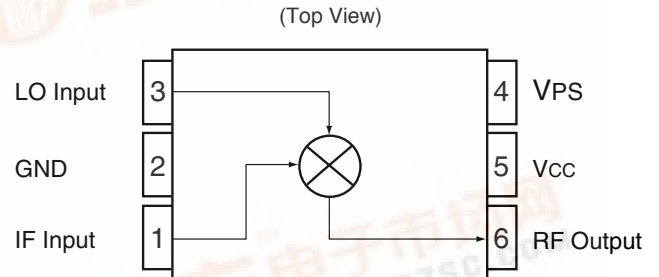
- **RECOMMENDED OPERATING FREQUENCY:**  
 $f_{RFout} = 0.4 \text{ GHz to } 2.0 \text{ GHz}$   
 $f_{Fin} = 100 \text{ MHz to } 400 \text{ MHz}$
- **SUPPLY VOLTAGE:**  
 $V_{CC} = 2.7 \text{ to } 5.5 \text{ V}$
- **HIGH DENSITY SURFACE MOUNTING:**  
 6 pin super mini mold package
- **LOW CARRIER LEAKAGE:**  
 Due to double balanced mixer
- **BUILT-IN POWER SAVE FUNCTION**

### DESCRIPTION

NEC's UPC8106TB is a silicon RFIC designed as a frequency upconverter for cellular/cordless telephone transmitter stages and features improved intermodulation. This device is housed in a 6 pin super mini mold or SOT-363 package making it ideal for reducing system size. The UPC8106TB is manufactured using NEC's 20 GHz  $f_T$  NESAT™ III silicon bipolar process.

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

### INTERNAL BLOCK DIAGRAM



### APPLICATION

- **CELLULAR/CORDLESS TELEPHONE**

### ELECTRICAL CHARACTERISTICS

( $T_A = 25^\circ\text{C}$ ,  $V_{CC} = V_{RFout} = 3 \text{ V}$ ,  $f_{Fin} = 240 \text{ MHz}$ ,  $P_{LOin} = -5 \text{ dBm}$ ,  $V_{PS} \geq 2.7 \text{ V}$  unless otherwise specified)

PART NUMBER PACKAGE OUTLINE			UPC8106TB S06		
SYMBOLS	PARAMETERS AND CONDITIONS	UNITS	MIN	TYP	MAX
$I_{CC}$	Circuit Current at $V_{PS} \geq 2.7 \text{ V}$ $V_{PS} = 0 \text{ V}$	mA $\mu\text{A}$	4.5	9	13.5 10
CG	Conversion Gain at $f_{RFout} = 0.9 \text{ GHz}$ , $P_{IFin} = -30 \text{ dBm}$ $f_{RFout} = 1.9 \text{ GHz}$ , $P_{IFin} = -30 \text{ dBm}$	dB dB	6 4	9 7	12 10
$P_{SAT}$	Saturated Output Power at $f_{RFout} = 0.9 \text{ GHz}$ , $P_{IFin} = 0 \text{ dBm}$ $f_{RFout} = 1.9 \text{ GHz}$ , $P_{IFin} = 0 \text{ dBm}$	dBm dBm	-4 -6.5	-2 -4	
$OIP_3$	Output Third-Order Intercept Point at $f_{Fin1} = 240.0 \text{ MHz}$ $f_{Fin2} = 240.4 \text{ MHz}$ $P_{IFin} = -20 \text{ dBm}$ $f_{RFout} = 0.9 \text{ GHz}$ $f_{RFout} = 1.9 \text{ GHz}$	dBm dBm		+5.5 +2.0	
$IM_3$	Third-Order Intermodulation Level at $f_{Fin1} = 240 \text{ MHz}$ $f_{Fin2} = 240.4 \text{ MHz}$ $P_{IFin} = -20 \text{ dBm}$ $f_{RFout} = 0.9 \text{ GHz}$ $f_{RFout} = 1.9 \text{ GHz}$	dBc dBc		-31 -30	
NF	SSB Noise Figure, $f_{RFout} = 0.9 \text{ GHz}$	dB		8.5	
$T_{PS(RISE)}$	Power Save Rise Time at $V_{PS}$ : GND $\rightarrow$ VCC	$\mu\text{S}$		2.0	
$T_{PS(FALL)}$	Power Save Fall Time at $V_{PS}$ : VCC $\rightarrow$ GND	$\mu\text{S}$		2.0	

# UPC8106TB

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

SYMBOLS	PARAMETERS	UNITS	RATINGS
V <sub>CC</sub>	Supply Voltage Pins 5 & 6	V	6.0
V <sub>PS</sub>	Power Save Voltage	V	6.0
P <sub>T</sub>	Total Power Dissipation <sup>2</sup>	mW	200
T <sub>OP</sub>	Operating Temperature	°C	-40 to +85
T <sub>STG</sub>	Storage Temperature	°C	-55 to +150
P <sub>IN</sub>	Input Power	dBm	+10

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).

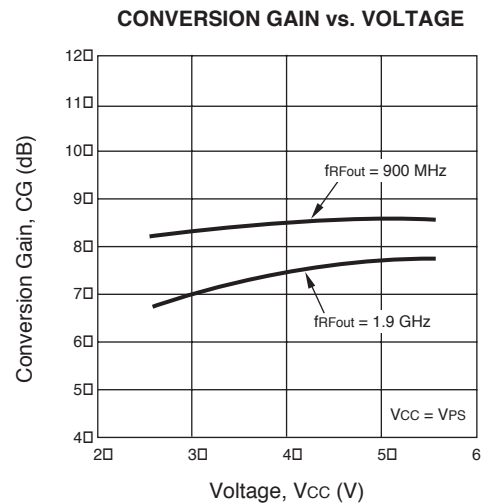
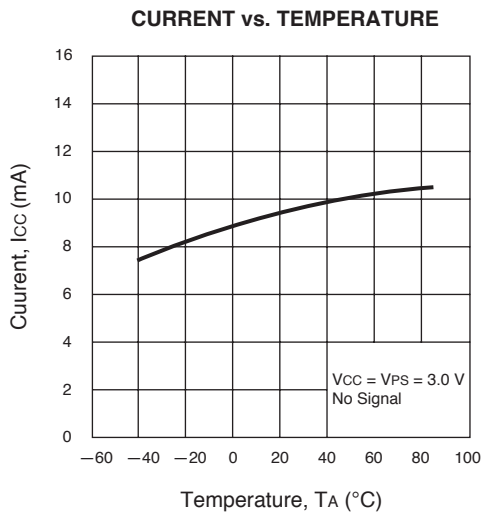
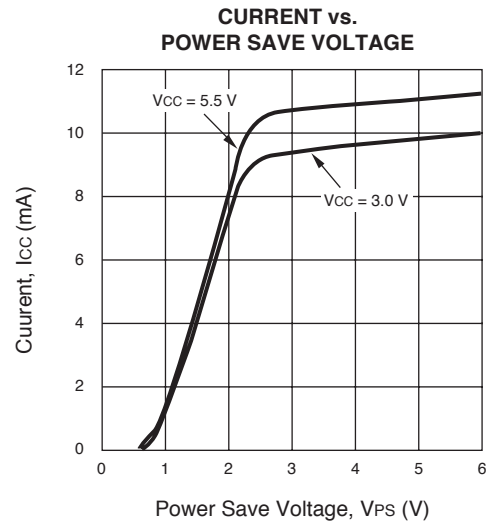
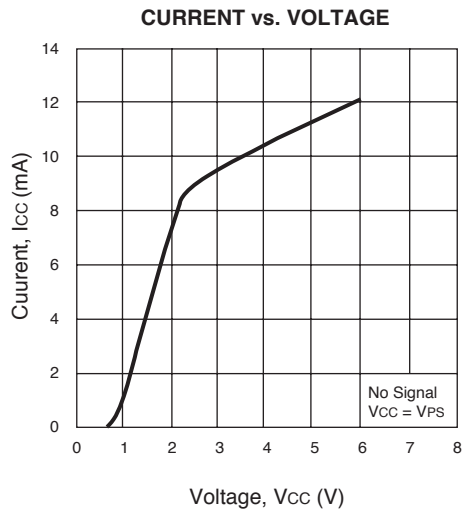
## RECOMMENDED OPERATING CONDITIONS

SYMBOLS	PARAMETERS	UNITS	MIN	TYP	MAX
V <sub>CC</sub>	Supply Voltage <sup>1</sup>	V	2.7	3.0	5.5
T <sub>OP</sub>	Operating Temperature	°C	-40	+25	+85
P <sub>LO</sub>	LO Input Level <sup>2</sup>	dBm	-10	-5	0
f <sub>RfOut</sub>	RF Output Frequency <sup>3</sup>	GHz	0.4		2.5
f <sub>iFin</sub>	IF Input Frequency	MHz	100		400

Notes:

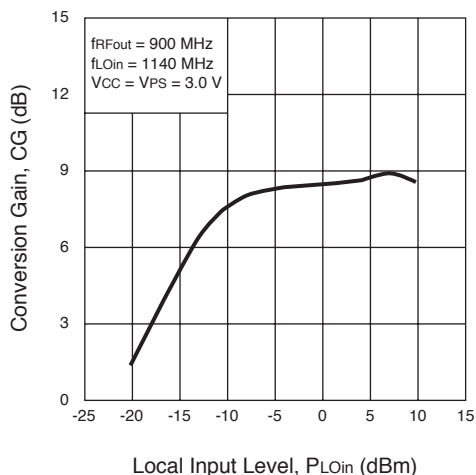
1. The same voltage should be supplied to pin 5 and 6.
2. Z<sub>S</sub> = 50 Ω (without matching).
3. With external matching circuit.

## TYPICAL PERFORMANCE CURVES (T<sub>A</sub> = +25°C, V<sub>CC</sub> = V<sub>RfOut</sub>)

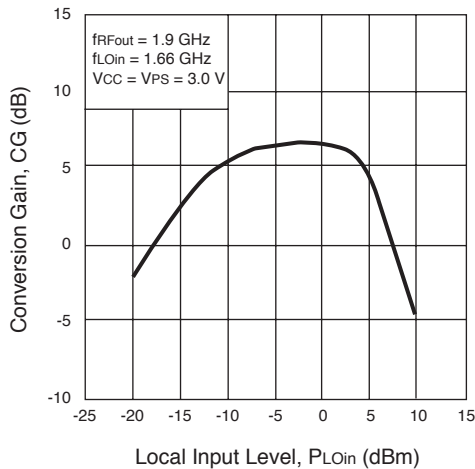


**TYPICAL PERFORMANCE CURVES** ( $T_A = +25^\circ\text{C}$ ,  $V_{CC} = V_{RFout}$ )

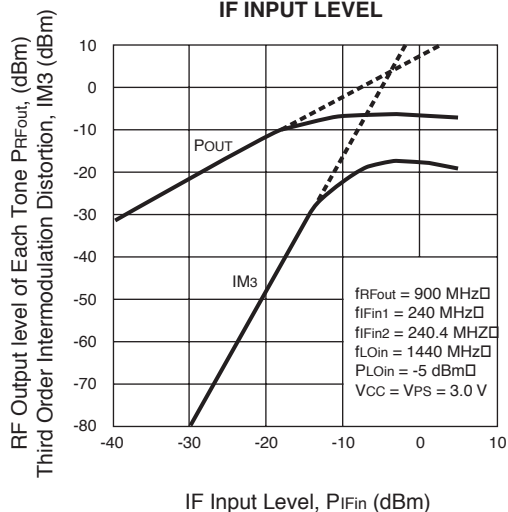
**CONVERSION GAIN vs. LOCAL INPUT LEVEL**



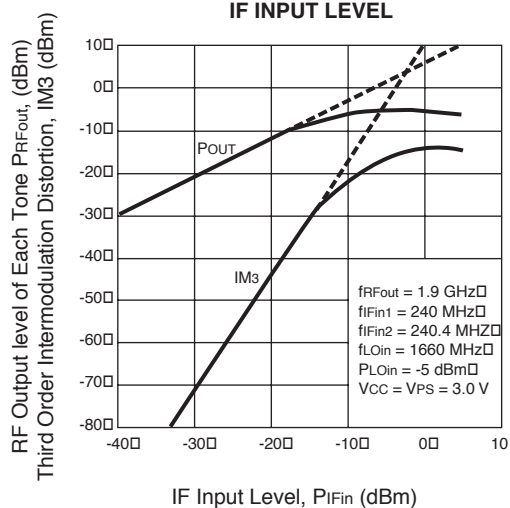
**CONVERSION GAIN vs. LOCAL INPUT LEVEL**



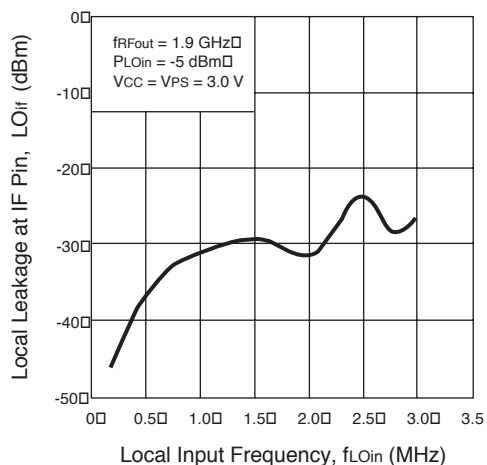
**RF OUTPUT LEVEL AND IM3 vs. IF INPUT LEVEL**



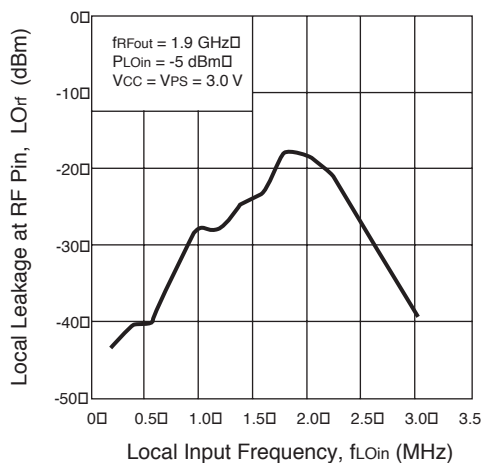
**RF OUTPUT LEVEL AND IM3 vs. IF INPUT LEVEL**



**LOCAL LEAKAGE AT IF PIN vs. LOCAL INPUT FREQUENCY**

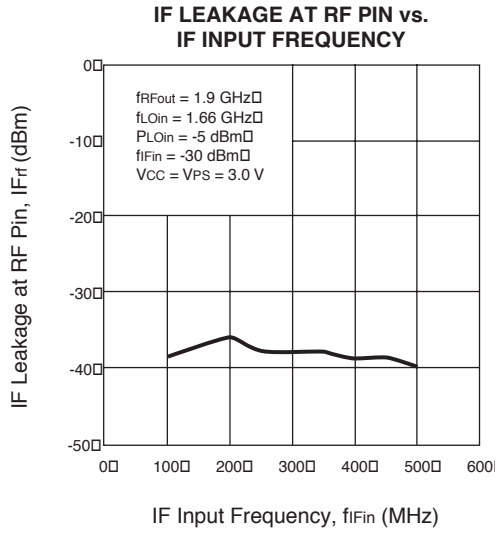


**LOCAL LEAKAGE AT RF PIN vs. LOCAL INPUT FREQUENCY**



# UPC8106TB

## TYPICAL PERFORMANCE CURVES ( $T_A = +25^\circ\text{C}$ , $V_{CC} = V_{RFout}$ )

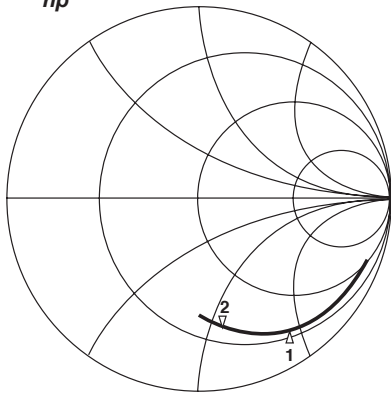


## S-PARAMETERS FOR EACH PORT ( $V_{CC} = V_{PS} = V_{RFout} = 3.0 \text{ V}$ )

LO port

$S_{11}$        $Z$   
 REF 1.0 Units  
 2    200.0 mUnits/  
 $\nabla$     21.201  $\Omega$  -53.748  $\Omega$   
**hp**

MARKER 1  
 1.15 GHz  
 MARKER 2  
 1.65 GHz



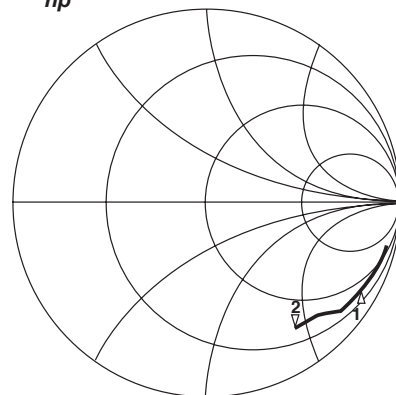
START 0.4 GHz

STOP 1.9 GHz

LO port

$S_{22}$        $Z$   
 REF 1.0 Units  
 2    200.0 mUnits/  
 $\nabla$     26.961  $\Omega$  -87.312  $\Omega$   
**hp**

MARKER 1  
 900 MHz  
 MARKER 2  
 1.9 GHz



START 0.4 GHz

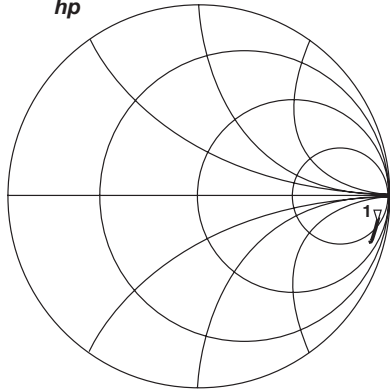
STOP 1.9 GHz

**S-PARAMETERS FOR EACH PORT** ( $V_{CC} = V_{PS} = V_{RFout} = 3.0\text{ V}$ )

IF port

S11 Z  
 REF 1.0 Units  
 1 200.0 mUnits/  
 ▽ 194.16 Ω -579.53 Ω  
**hp**

MARKER 1  
 240 MHz

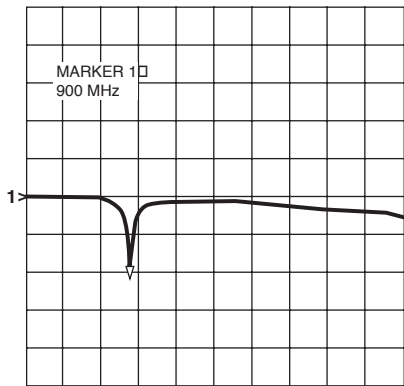


START 0.1 GHz STOP 0.4 GHz

**S-PARAMETERS FOR MATCHED RF OUTPUT**

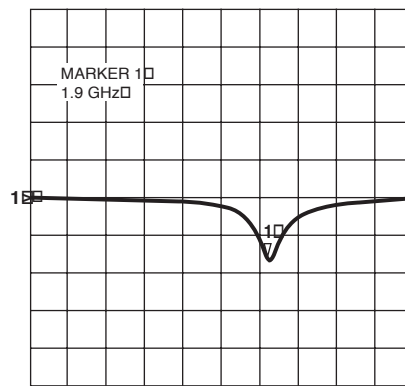
( $V_{CC} = V_{PS} = V_{RFout} = 3.0\text{ V}$ ) - with TEST CIRCUITS 1 and 2 - (S22 data is monitored at RF connector on board.)

900 MHz (LC-matched) in test circuit  
 S11 log MAG  
 REF 0.0 dB  
 1 10.0 dB/  
 ▽ -19.567 dB  
**hp**



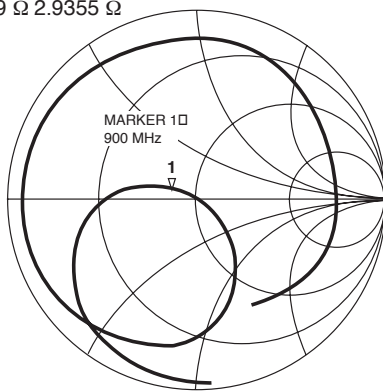
START 100 MHz STOP 3000 MHz

1.9 GHz (LC-matched) in test circuit  
 S22 log MAG  
 REF 0.0 dB  
 1 10.0 dB/  
 ▽ -15.213 dB  
**hp**

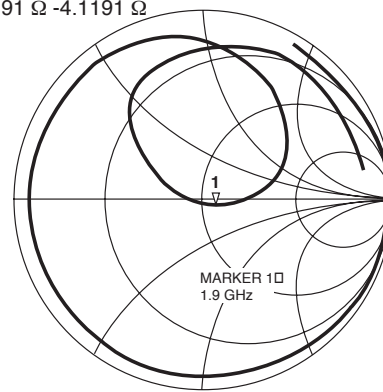


START 100 MHz STOP 3000 MHz

S22  
 REF 1.0 Units  
 1 200.0 mUnits/  
 ▽ 36.59 Ω 2.9355 Ω  
**hp**



S22  
 REF 1.0 Units  
 1 200.0 mUnits/  
 ▽ 58.191 Ω -4.1191 Ω  
**hp**



**PIN FUNCTIONS**

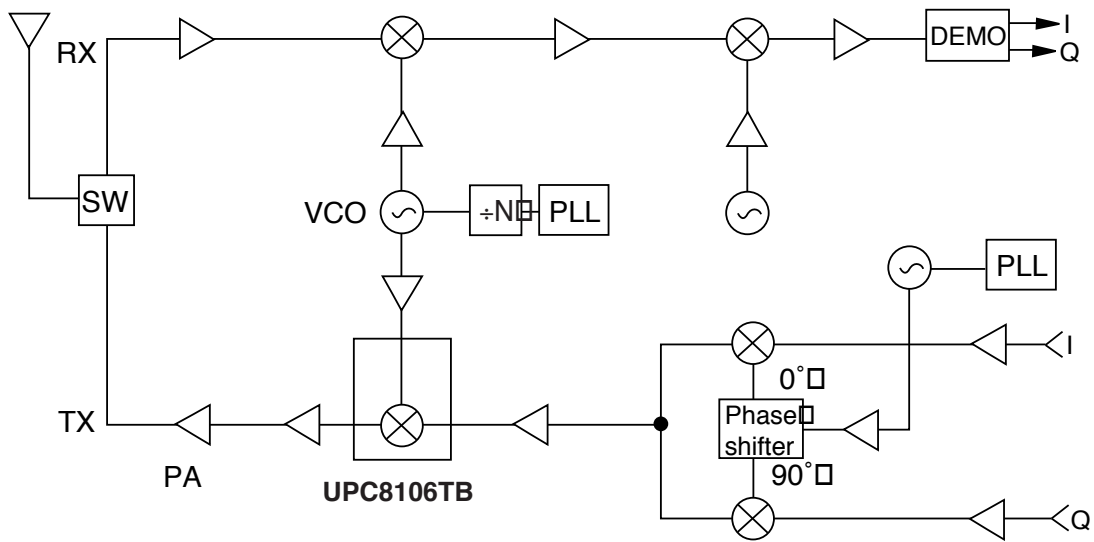
Pin No.	Symbol	Supply Voltage (V)	Pin <sup>1</sup> Voltage (V)	Description	Equivalent Circuit						
1	IF Input	–	1.3	This pin is the IF input to the double balanced mixer. The input is a high impedance.							
2	GND	0	–	GND pin. Ground pattern on the board should be as wide as possible. Trace length should be kept as short as possible to minimize ground impedance.							
3	LOIN	–	2.4	LO input pin. Recommended input level is -10 to 0 dBm.							
5	Vcc	2.7 to 5.5	–	Supply voltage pin.							
6	RF Output	2.7 to 3.6	–	This pin is the RF output. This pin is designed as an open collector. Due to the high impedance output, this pin requires an external LC matching circuit.							
4	VPS	Vcc/GND	–	Power save control pin. Bias controls operation as follows: <table border="1" style="margin: 10px auto;"> <thead> <tr> <th>Pin Bias</th> <th>Control</th> </tr> </thead> <tbody> <tr> <td>Vcc</td> <td>ON</td> </tr> <tr> <td>GND</td> <td>Power Save</td> </tr> </tbody> </table>	Pin Bias	Control	Vcc	ON	GND	Power Save	
Pin Bias	Control										
Vcc	ON										
GND	Power Save										

Note:

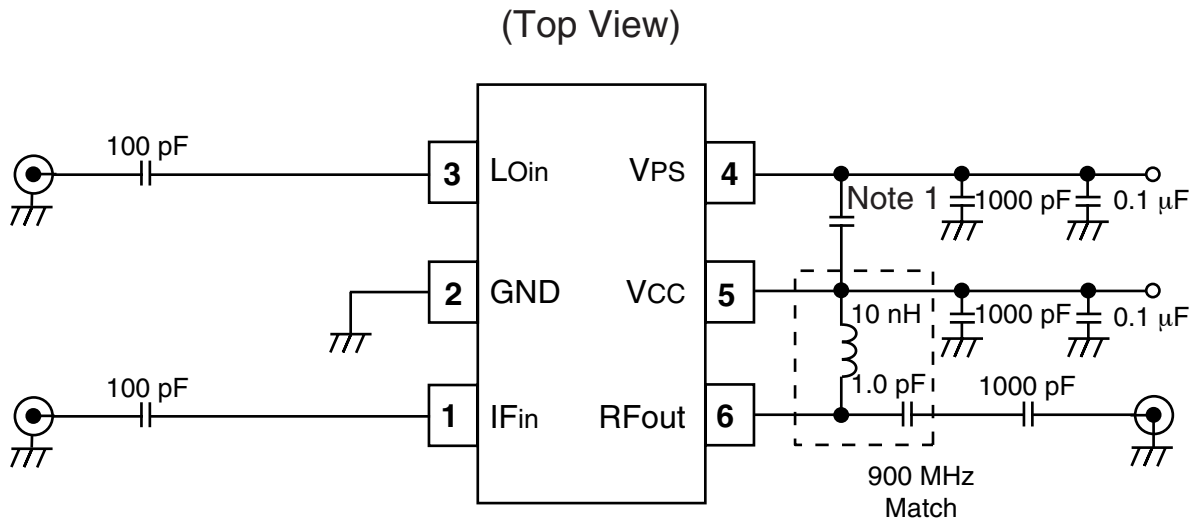
1. Each pin voltage is measured with Vcc = Vps = VRFout = 3.0 V

SYSTEM APPLICATION EXAMPLE

EXAMPLE OF DECT 900 MHz Cordless Phone



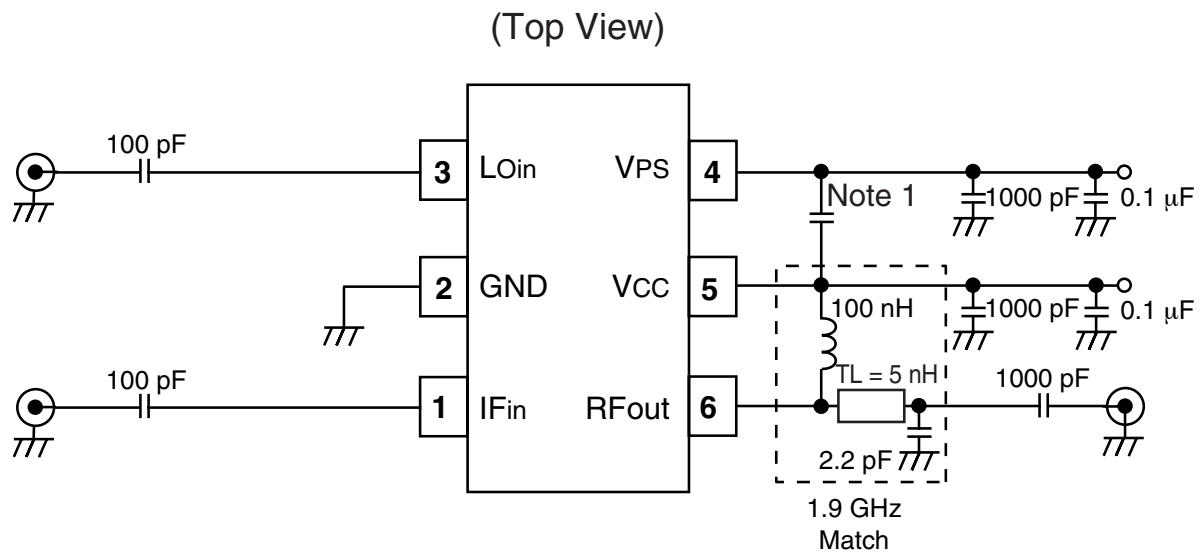
**TEST CIRCUIT 1** (RF<sub>OUT</sub> = 900 MHz)



Note:

1. In case of unstable operation, connect 100 pF capacitor between pins 4 and 5.

**TEST CIRCUIT 2** (RF<sub>OUT</sub> = 1.9 GHz)



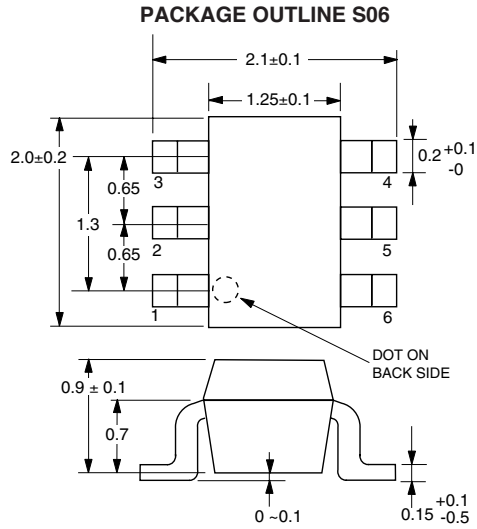
Note:

1. In case of unstable operation, connect 100 pF capacitor between pins 4 and 5.



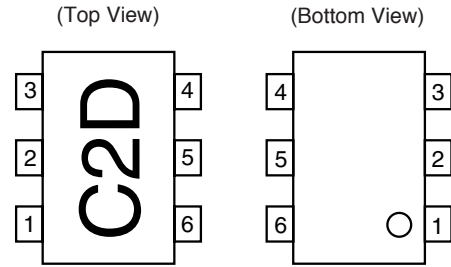
# UPC8106TB

## OUTLINE DIMENSIONS (Units in mm)



Note:  
All dimensions are typical unless otherwise specified.

## LEAD CONNECTIONS



1. IF INPUT
2. GND
3. LO INPUT
4. POWER SAVE
5. VCC
6. RF OUTPUT

## ORDERING INFORMATION

PART NUMBER	QTY
UPC8106TB-E3-A	3K/Reel

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

### Life Support Applications

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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	

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