



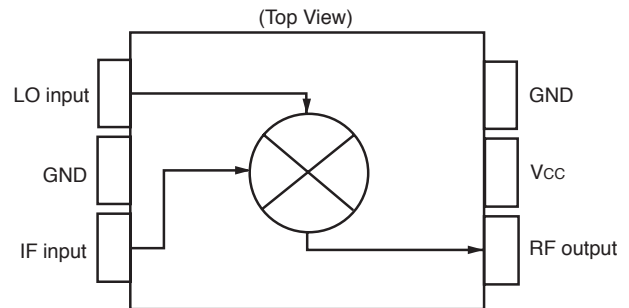
# SILICON RFIC HI-IP3 FREQUENCY UP-CONVERTER FOR WIRELESS TRANSCEIVER

## UPC8187TB

### FEATURES

- **HIGH OUTPUT FREQUENCY:**  
 $f_{RFout} = 0.8$  to  $2.5$  GHz
- **SUPPLY VOLTAGE:**  
 $V_{CC} = 2.7$  to  $3.3$  V
- **HIGH IP3 AND CONVERSION GAIN:**  
OIP<sub>3</sub> = +10 dBm typ at  $f_{RFout} = 0.9$  GHz  
CG = +11 dBm typ at  $f_{RFout} = 0.9$  GHz
- **HIGH-DENSITY SURFACE MOUNTING:**  
6-pin super minimold package

### BLOCK DIGRAM



### DESCRIPTION

NEC's UPC8187TB is a silicon monolithic integrated circuit designed as a frequency up-converter for wireless transceivers. This IC has higher operating frequency, lower distortion and higher conversion gain than the conventional UPC8163TB. This device is manufactured using NEC's 30 GHz  $f_{max}$  UHS0 (Ultra High Speed Process) silicon bipolar process.

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

### APPLICATIONS

- TDMA, PCS, CDMA
- Digital Cellular/Cordless Phones
- Wireless Tranceivers

### ELECTRICAL CHARACTERISTICS

( $T_A = 25^\circ\text{C}$ ,  $V_{CC} = V_{RFOUT} = 2.8$  V,  $f_{IFin} = 150$  MHz,  $PL_{Oin} = -5$  dBm)

PART NUMBER PACKAGE OUTLINE			UPC8187TB S06			
SYMBOLS	PARAMETERS AND CONDITIONS <sup>1</sup>	UNITS	MIN	TYP	MAX	
I <sub>CC</sub>	Circuit Current (no signal)	mA	11	15	19	
CG1	Conversion Gain,	$f_{RFout} = 0.83$ GHz, $PI_{Fin} = -20$ dBm	dB	8	14	
CG2		$f_{RFout} = 1.9$ GHz, $PI_{Fin} = -20$ dBm	dB	8	14	
CG3		$f_{RFout} = 2.4$ GHz, $PI_{Fin} = -20$ dBm	dB	7	10	13
PO(SAT) <sub>1</sub>	Saturated RF Output Power,	$f_{RFout} = 0.83$ GHz, $PI_{Fin} = 0$ dBm	dBm	+1.5	+4	–
PO(SAT) <sub>2</sub>		$f_{RFout} = 1.9$ GHz, $PI_{Fin} = 0$ dBm	dBm	0	+2.5	–
PO(SAT) <sub>3</sub>		$f_{RFout} = 2.4$ GHz, $PI_{Fin} = 0$ dBm	dBm	-1.5	+1	–
OIP <sub>31</sub>	Output Third-Order Distortion Intercept Point, $f_{RFout} = 0.83$ GHz	$f_{IFin1} = 150$ MHz $f_{IFin2} = 151$ MHz	dBm	–	10	–
OIP <sub>32</sub>			dBm	–	10	–
OIP <sub>33</sub>			dBm	–	8.5	–
IIP <sub>31</sub>	Input Third-Order Distortion Intercept Point, $f_{RFout} = 0.83$ GHz	$f_{IFin1} = 150$ MHz $f_{IFin2} = 151$ MHz	dBm	–	-1.0	–
IIP <sub>32</sub>			dBm	–	-1.0	–
IIP <sub>33</sub>			dBm	–	-1.5	–
SSB•NF1	SSB Noise Figure,	$f_{RFout} = 0.83$ GHz	dB	–	11	–
SSB•NF2		$f_{RFout} = 1.9$ GHz	dB	–	12	–
SSB•NF3		$f_{RFout} = 2.4$ GHz	dB	–	12.5	–

Note:

1.  $f_{RFout} < f_{LOin}$  @  $f_{RFout} = 0.83$  GHz  
 $f_{LOin} < f_{RFout}$  @  $f_{RFout} = 1.9$  GHz/2.4 GHz

# UPC8187TB

## ABSOLUTE MAXIMUM RATINGS<sup>1</sup>

(T<sub>A</sub> = +25°C unless otherwise specified)

SYMBOLS	PARAMETERS	UNITS	RATINGS
V <sub>CC</sub>	Supply Voltage	V	3.6
P <sub>D</sub>	Power Dissipation <sup>2</sup>	mW	270
T <sub>A</sub>	Operating Ambient Temperature	°C	-40 to +85
T <sub>STG</sub>	Storage Temperature	°C	-55 to +150
P <sub>IN</sub>	Maximum Input Power	dBm	+10

Notes:

- Operation in excess of any one of these conditions may result in permanent damage.
- Mounted on a double-sided copper clad 50x50x1.6 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	2.8	3.3
T <sub>A</sub>	Operating Ambient Temperature	°C	-40	+25	+85
P <sub>LOin</sub>	Local Input Level <sup>2</sup>	dBm	-10	-5	0
f <sub>RFout</sub>	RF Output Frequency <sup>3</sup>	GHz	0.8	–	2.5
f <sub>IFin</sub>	IF Input Frequency	MHz	50	–	400

Notes:

- Same voltage applied to pins 5 and 6.
- Z<sub>s</sub> = 50 Ω (without matching).
- With external matching circuit.

## SERIES PRODUCTS<sup>1</sup> (T<sub>A</sub> = +25°C, V<sub>CC</sub> = V<sub>PS</sub> = V<sub>RFout</sub> = 3.0 V, Z<sub>S</sub> = Z<sub>L</sub> = 50 Ω)

Part Number	I <sub>CC</sub> (mA)	f <sub>RFout</sub> (GHz)	CG (dB)			OIP <sub>3</sub> (dBm)			P <sub>O(SAT)</sub>		
			@RF 0.9 GHz <sup>2</sup>	@RF 1.9 GHz	@RF 2.4 GHz	@RF 0.9 GHz <sup>2</sup>	@RF 1.9 GHz	@RF 2.4 GHz	@RF 0.9 GHz <sup>2</sup>	@RF 1.9 GHz	@RF 2.4 GHz
UPC8187TB	15	0.8 to 2.5	11	11	10	+10	+10	+8.5	+4	+2.5	+1
UPC8106TB	9	0.4 to 2.0	9	7	–	+5.5	+2.0	–	-2	-4	–
UPC8172TB	9	0.8 to 2.5	9.5	8.5	8.0	+7.5	+6.0	+4.0	+0.5	0	-0.5
UPC8109TB	5	0.4 to 2.0	6	4	–	+1.5	-1.0	–	-5.5	-7.5	–
UPC8163TB	16.5	0.8 to 2.0	9	5.5	–	+9.5	+6.0	–	+0.5	-2	–

Notes:

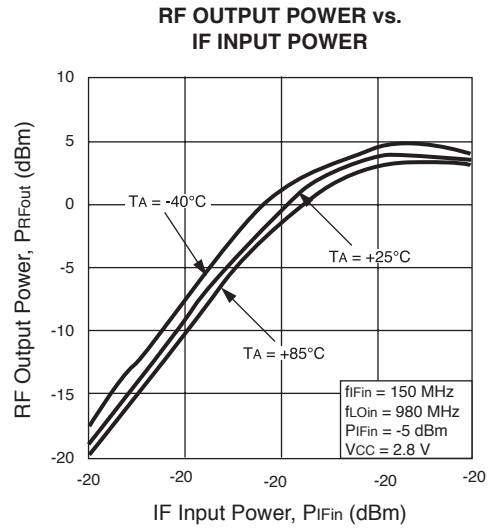
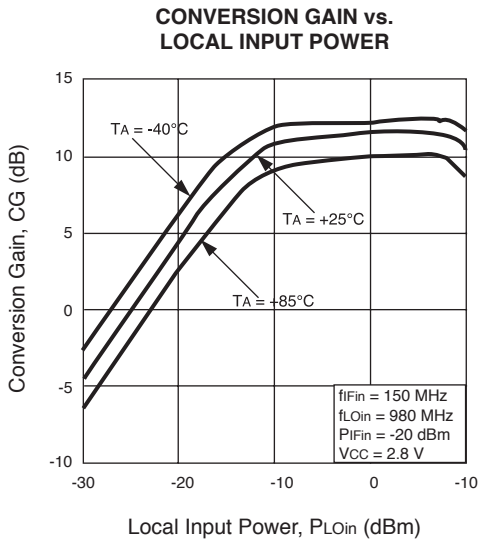
- Typical performance.
- f<sub>RFout</sub> = 0.83 GHz @ UPC8163TB and UPC8187TB.

## PIN FUNCTIONS (Pin Voltage is measured at V<sub>CC</sub> = V<sub>PS</sub> = V<sub>RFOUT</sub> = 2.8V)

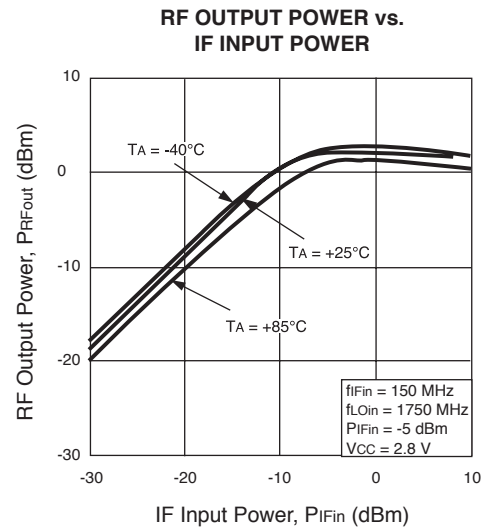
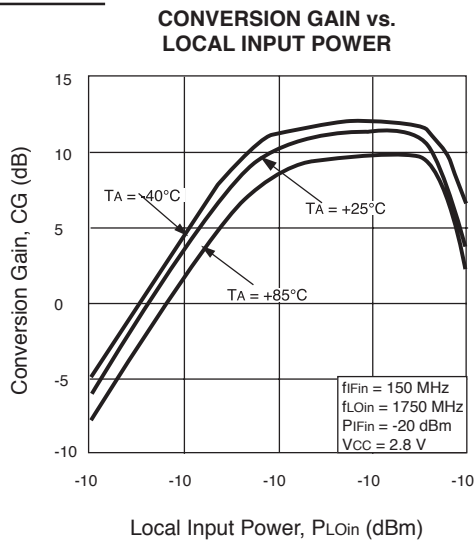
Pin No.	Pin Name	Applied Voltage (V)	Pin Voltage (V)	Function and Explanation	Equivalent Circuit
1	IFinput	–	1.2	This pin is the IF input pin to the double balanced mixer (DBM). The input is designed as a high impedance. The circuit helps suppress spurious signals. Also this symmetrical circuit can keep specified performance insensitive to process-condition distribution. For that reason, a double balanced mixer is adopted.	
2 4	GND	GND	–	GND pin. Ground pattern on the board should be formed as wide as possible. Track length should be kept as short as possible to minimize ground inductance.	
3	LOinput	–	2.1	Local input pin. Recommended input level is -10 to 0 dBm.	
5	V <sub>CC</sub>	2.7 to 3.3	–	Supply voltage pin.	
6	RFoutput	Same bias as V <sub>CC</sub> through external inductor	–	This pin is the RF output from the double balanced mixer. This pin is designed as an open collector. Due to the high impedance output, this pin should be externally equipped with an LC matching circuit to the next stage.	

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

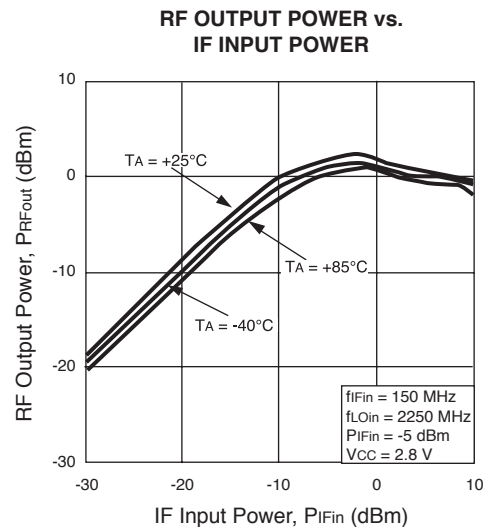
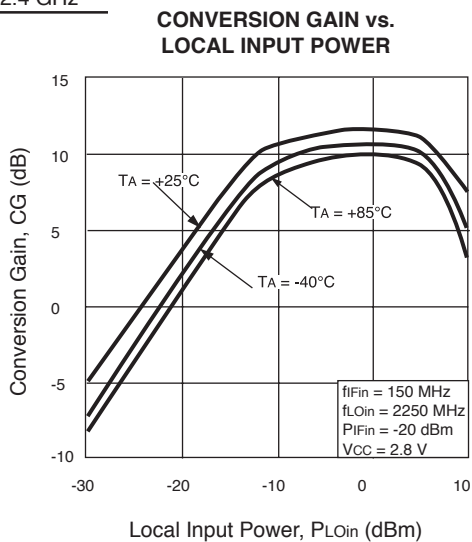
$f_{RFout} = 0.83\text{ GHz}$



$f_{RFout} = 1.9\text{ GHz}$

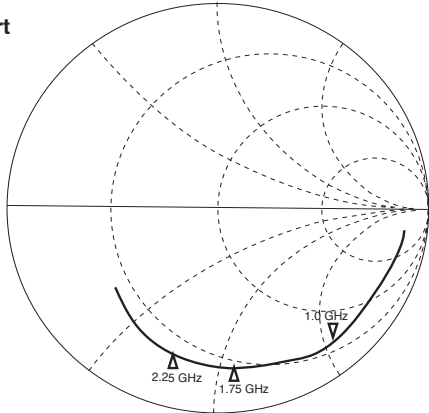


$f_{RFout} = 2.4\text{ GHz}$



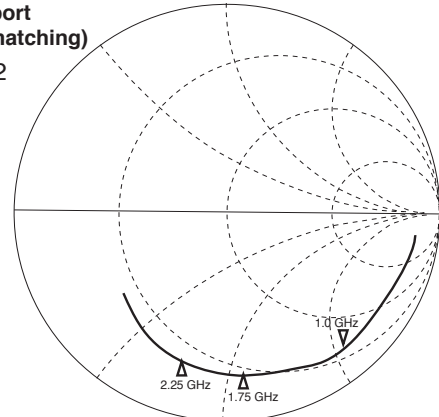
TYPICAL SCATTERING PARAMETERS (TA = 25°C)

LO port  
S11



START 0.1 GHz  
STOP 3.1 GHz

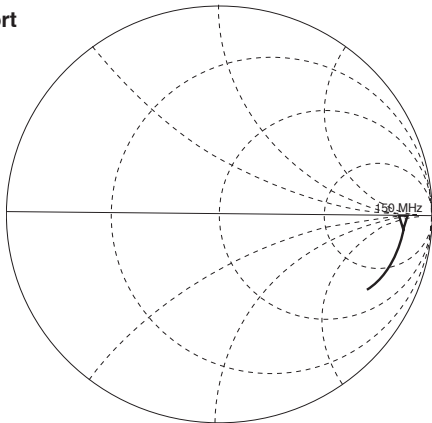
RF port  
(without matching)  
S22



START 0.1 GHz  
STOP 3.1 GHz

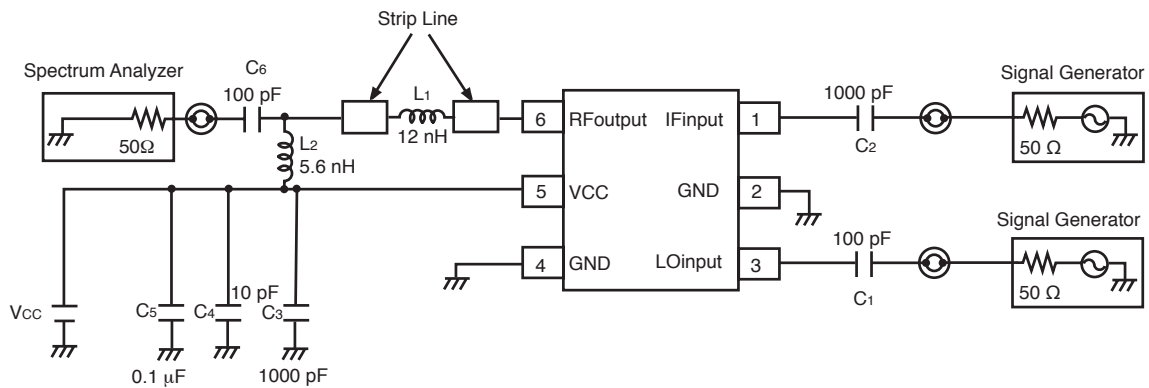
VCC = VRFOUT = 2.8 V  
parameters are monitored at DUT pins

IF port  
S11

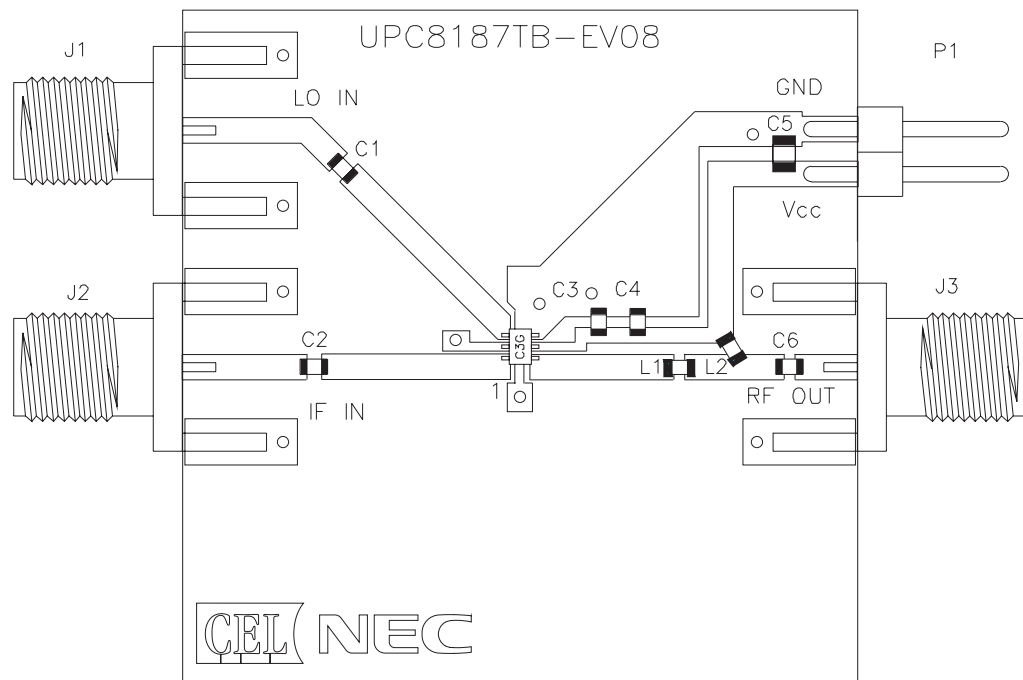


START 0.1 GHz  
STOP 1.0 GHz

**TEST CIRCUIT 1 (f<sub>RFout</sub> = 0.83 GHz)**



**ILLUSTRATION OF THE TEST CIRCUIT 1 ASSEMBLED ON EVALUATION BOARD**



**COMPONENT LIST**

FORM	SYMBOL	VALUE
Chip Capacitor	C1, C6	100 pF
	C4	10 pF
	C2, C3	1000 pF
	C5	0.1 μF
	Chip Inductor	L1
L2		5.6 nH

1. 1.5 x 1.5 x 0.028", Getek laminate, double sided copper
2. Ground pattern on rear board
3. Solder plated patterns
4. ○ Through holes

TEST CIRCUIT 2 (f<sub>RFout</sub> = 1.9 GHz)

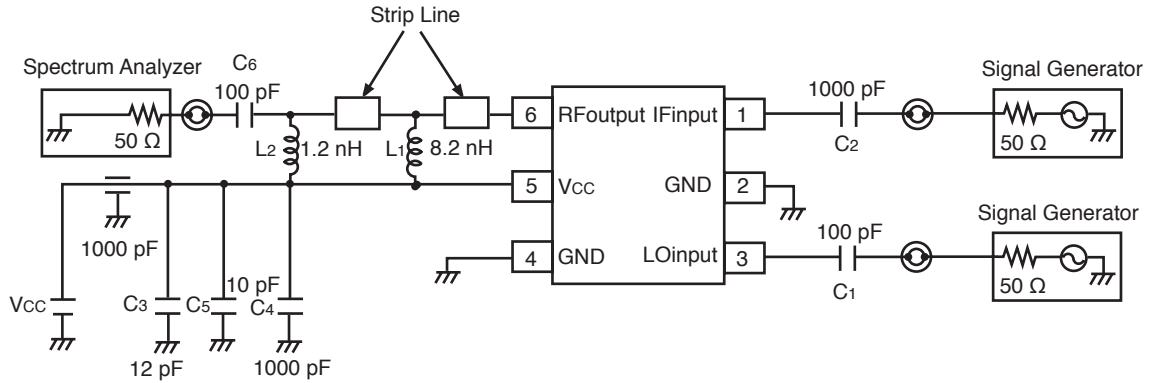
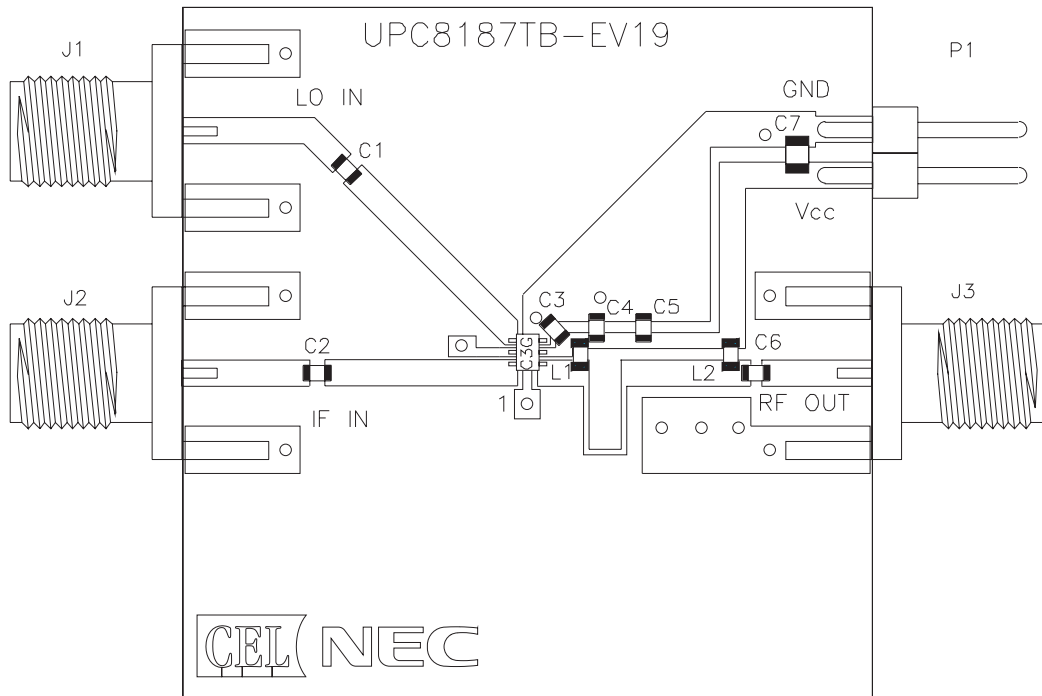


ILLUSTRATION OF TEST CIRCUIT 2 ASSEMBLED ON EVALUATION BOARD

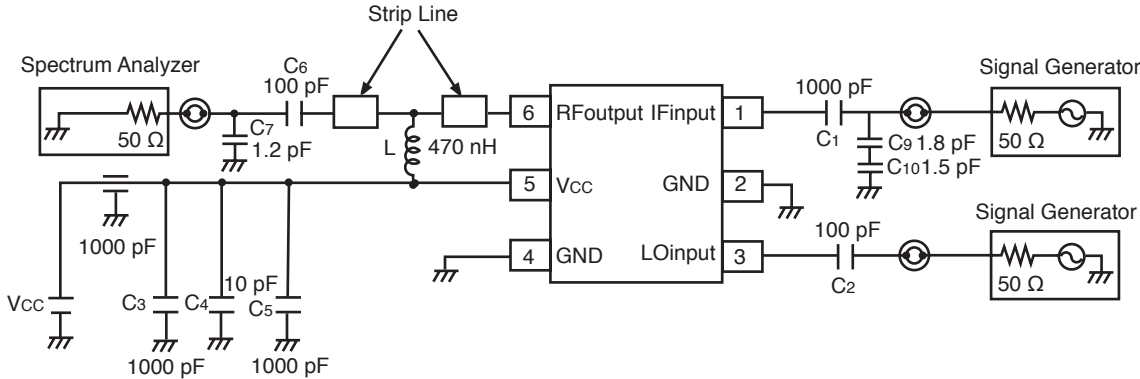


COMPONENT LIST

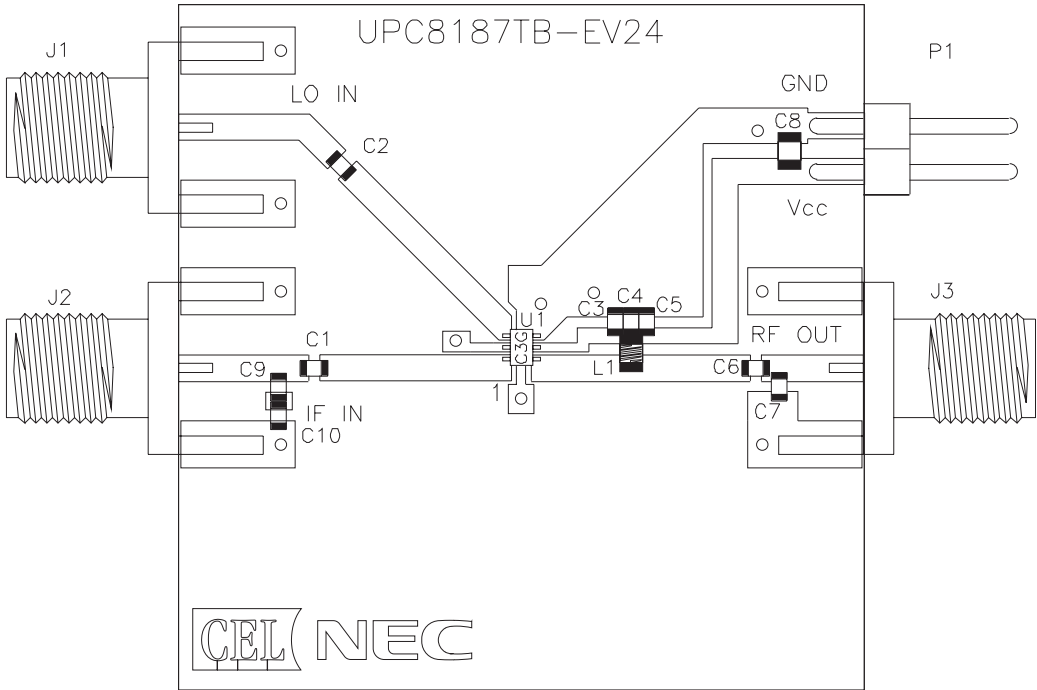
FORM	SYMBOL	VALUE
Chip Capacitor	C1, C2, C4	1000 pF
	C7	0.1 μF
	C6	100 pF
	C3	12 pF
	C5	10 pF
Chip Inductor	L1	8.2 nH
	L2	1.2 nH

1. 1.5 x 1.5 x 0.028", Getek laminate, double sided copper
2. Ground pattern on rear board
3. Solder plated patterns
4. ◯ Through holes

**TEST CIRCUIT 3 (f<sub>RFout</sub> = 2.4 GHz)**



**ILLUSTRATION OF TEST CIRCUIT 3 ASSEMBLED ON EVALUATION BOARD**

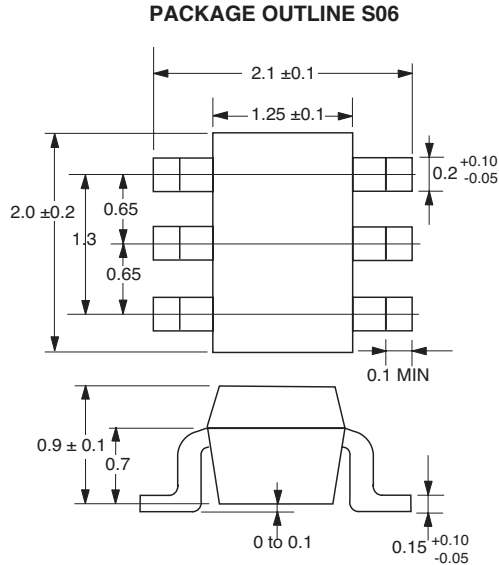


**COMPONENT LIST**

FORM	SYMBOL	VALUE
Chip Capacitor	C1, C3, C5	1000 pF
	C2, C6	100 pF
	C4	10 pF
	C7	1.2 pF
	C9	1.8 pF
	C10	1.5 pF
Chip Inductor	L	470 nH

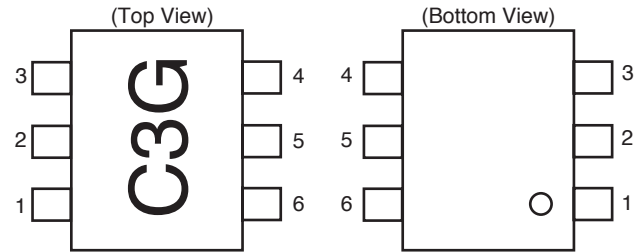
1. 1.5 x 1.5 x 0.028", Getek laminate, double sided copper
2. Ground pattern on rear board
3. Solder plated patterns
4. ○ Through holes

**OUTLINE DIMENSIONS** (Units in mm)



Note:  
All dimensions are typical unless otherwise specified.

**PIN CONNECTIONS**



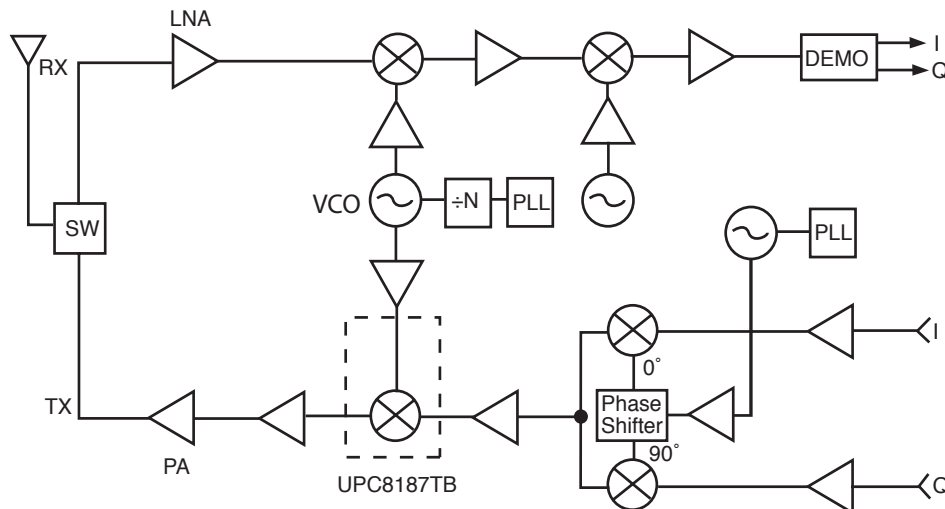
PIN NO.	PIN NAME
1	IFinput
2	GND
3	LOinput
4	GND
5	Vcc
6	RFoutput

**ORDERING INFORMATION**

Part Number	Quantity
UPC8187TB-E3-A	3 K pcs/reel

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

**SYSTEM APPLICATION EXAMPLE** (Schematic of IC location in the system)



**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.

EXCLUSIVE NORTH AMERICAN AGENT FOR **NEC** 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

06/14/2001



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.

Important Information and Disclaimer: Information provided by CEL on its website or in other communications concerning the substance content of its products represents knowledge and belief as of the date that it is provided. CEL bases its knowledge and belief on information provided by third parties and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. CEL has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. CEL and CEL suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall CEL’s liability arising out of such information exceed the total purchase price of the CEL part(s) at issue sold by CEL to customer on an annual basis.

See CEL Terms and Conditions for additional clarification of warranties and liability.