

FEATURES

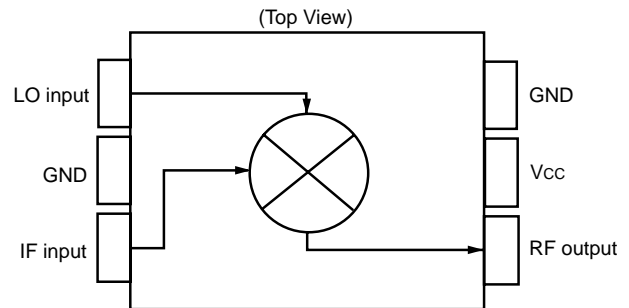
- **HIGH OUTPUT FREQUENCY:**
f_{RFout} = 0.8 to 2.5 GHz
- **SUPPLY VOLTAGE:**
V_{CC} = 2.7 to 3.3 V
- **HIGH IP₃ AND CONVERSION GAIN:**
OIP₃ = +10 dBm typ at f_{RFout} = 0.9 GHz
CG = +11 dBm typ at f_{RFout} = 0.9 GHz
- **HIGH-DENSITY SURFACE MOUNTING:**
6-pin super minimold package

DESCRIPTION

The 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.

BLOCK DIGRAM



APPLICATIONS

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

ELECTRICAL CHARACTERISTICS

(T_A = 25°C, V_{CC} = V_{RFOUT} = 2.8 V, f_{IFin} = 150 MHz, P_{LOin} = -5 dBm)

| PART NUMBER PACKAGE OUTLINE | | | UPC8187TB S06 | | | |
|--------------------------------|--|--|------------------|------|------|----|
| SYMBOLS | PARAMETERS AND CONDITIONS ¹ | UNITS | MIN | TYP | MAX | |
| I _{CC} | Circuit Current (no signal) | mA | 11 | 15 | 19 | |
| CG1 | Conversion Gain, | f _{RFout} = 0.83 GHz, P _{IFin} = -20 dBm | dB | 8 | 14 | |
| CG2 | | f _{RFout} = 1.9 GHz, P _{IFin} = -20 dBm | dB | 8 | 14 | |
| CG3 | | f _{RFout} = 2.4 GHz, P _{IFin} = -20 dBm | dB | 7 | 10 | 13 |
| P _{O(SAT)1} | Saturated RF Output Power, | f _{RFout} = 0.83 GHz, P _{IFin} = 0 dBm | dBm | +1.5 | +4 | - |
| P _{O(SAT)2} | | f _{RFout} = 1.9 GHz, P _{IFin} = 0 dBm | dBm | 0 | +2.5 | - |
| P _{O(SAT)3} | | f _{RFout} = 2.4 GHz, P _{IFin} = 0 dBm | dBm | -1.5 | +1 | - |
| OIP ₃₁ | Output Third-Order Distortion Intercept Point, | f _{RFout} = 0.83 GHz | dBm | - | 10 | - |
| OIP ₃₂ | | f _{RFout} = 1.9 GHz | | | | |
| OIP ₃₃ | | f _{RFout} = 2.4 GHz | | | | |
| IIP ₃₁ | Input Third-Order Distortion Intercept Point, | f _{RFout} = 0.83 GHz | dBm | - | -1.0 | - |
| IIP ₃₂ | | f _{RFout} = 1.9 GHz | | | | |
| IIP ₃₃ | | f _{RFout} = 2.4 GHz | | | | |
| SSB•NF1 | SSB Noise Figure, | f _{RFout} = 0.83 GHz | dB | - | 11 | - |
| SSB•NF2 | | f _{RFout} = 1.9 GHz | | | | |
| SSB•NF3 | | f _{RFout} = 2.4 GHz | | | | |

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 RATINGS¹

(T_A = +25°C unless otherwise specified)

| SYMBOLS | PARAMETERS | UNITS | RATINGS |
|------------------|--------------------------------|-------|-------------|
| V _{CC} | Supply Voltage | V | 3.6 |
| P _D | Power Dissipation ² | mW | 270 |
| T _A | Operating Ambient Temperature | °C | -40 to +85 |
| T _{STG} | Storage Temperature | °C | -55 to +150 |
| P _{IN} | Maximum Input Power | dBm | +10 |

Notes:

1. Operation in excess of any one of these conditions may result in permanent damage.
2. Mounted on a double-sided copper clad 50x50x1.6 mm epoxy glass PWB, T_A = +85°C.

RECOMMENDED OPERATING CONDITIONS

| SYMBOLS | PARAMETERS | UNITS | MIN | TYP | MAX |
|--------------------|----------------------------------|-------|-----|-----|-----|
| V _{CC} | Supply Voltage ¹ | V | 2.7 | 2.8 | 3.3 |
| T _A | Operating Ambient Temperature | °C | -40 | +25 | +85 |
| P _{LOin} | Local Input Level ² | dBm | -10 | -5 | 0 |
| f _{RFout} | RF Output Frequency ³ | GHz | 0.8 | – | 2.5 |
| f _{IFin} | IF Input Frequency | MHz | 50 | – | 400 |

Notes:

1. Same voltage applied to pins 5 and 6.
2. Z_s = 50 (without matching).
3. With external matching circuit.

SERIES PRODUCTS¹ (T_A = +25°C, V_{CC} = V_{PS} = V_{RFout} = 3.0 V, Z_S = Z_L = 50)

| Part Number | I _{CC} (mA) | f _{RFout} (GHz) | CG (dB) | | | OIP ₃ (dBm) | | | P _o (SAT) | | |
|-------------|----------------------|--------------------------|--------------------------|-------------|-------------|--------------------------|-------------|-------------|--------------------------|-------------|-------------|
| | | | @RF 0.9 GHz ² | @RF 1.9 GHz | @RF 2.4 GHz | @RF 0.9 GHz ² | @RF 1.9 GHz | @RF 2.4 GHz | @RF 0.9 GHz ² | @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:

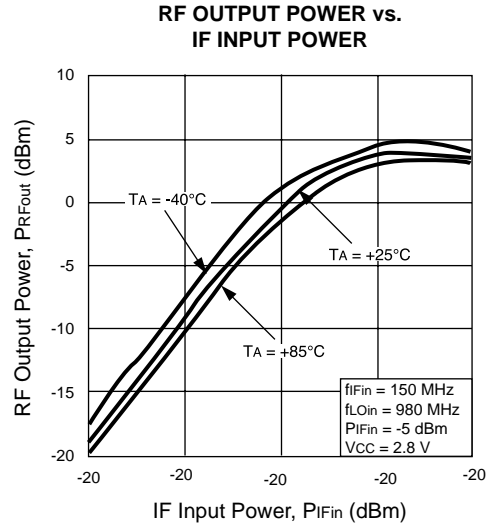
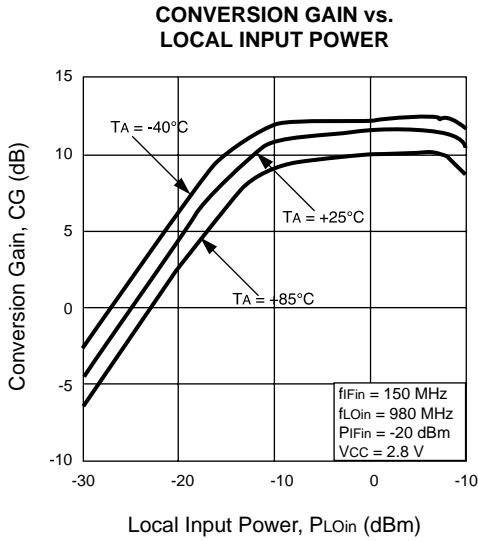
1. Typical performance.
2. f_{RFout} = 0.83 GHz @ UPC8163TB and UPC8187TB.

PIN FUNCTIONS (Pin Voltage is measured at V_{CC} = V_{PS} = V_{RFOUT} = 2.8V)

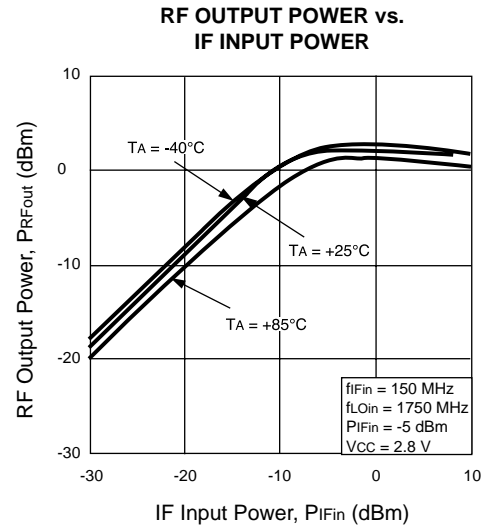
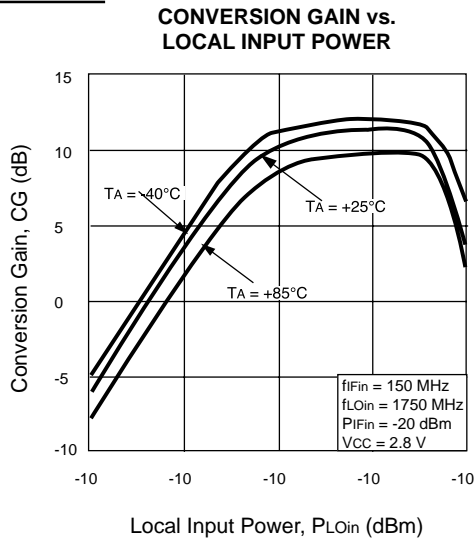
| Pin No. | Pin Name | Applied Voltage (V) | Pin Voltage (V) | Function and Explanation | Equivalent Circuit |
|---------|-----------------|--|-----------------|---|--------------------|
| 1 | IFinput | – | 1.2 | This pin is the IF input pin to the double balanced mixer (DBM). The input is designed as 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 _{CC} | 2.7 to 3.3 | – | Supply voltage pin. | |
| 6 | RFoutput | Same bias as V _{CC} 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, $T_A = 25^\circ\text{C}$)

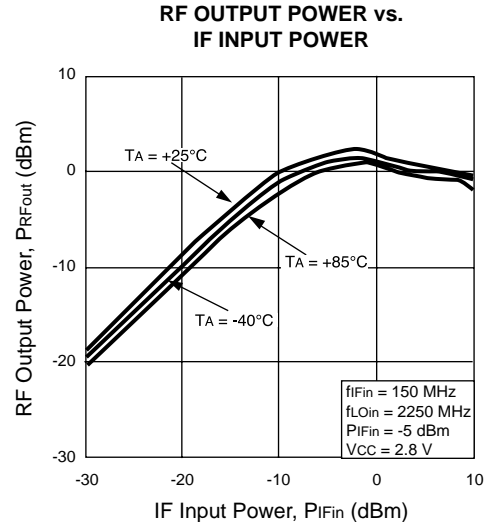
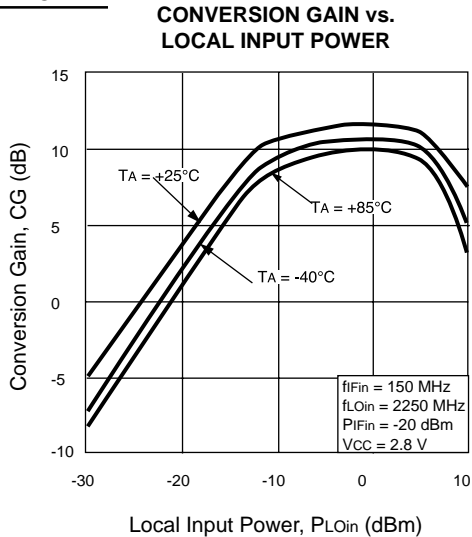
$f_{RFout} = 0.83\text{ GHz}$



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

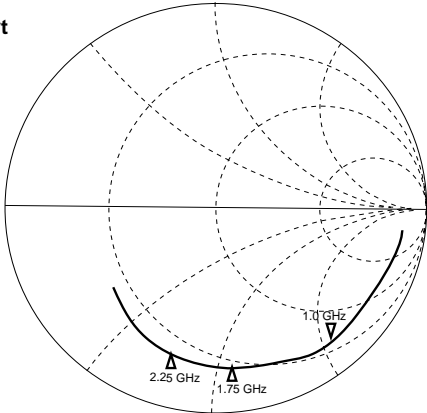


$f_{RFout} = 2.4\text{ GHz}$



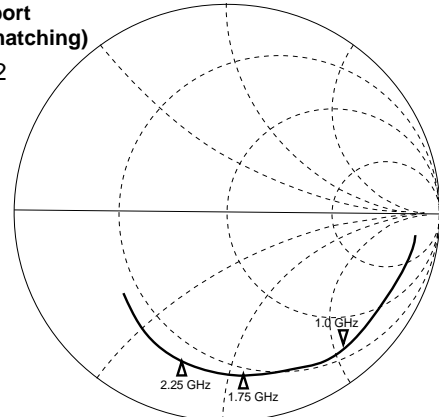
TYPICAL SCATTERING PARAMETERS ($T_A = 25^\circ\text{C}$)

LO port
S11



START 0.1 GHz
STOP 3.1 GHz

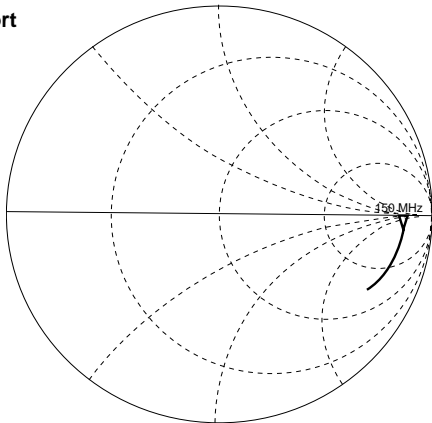
RF port
(without matching)
S22



START 0.1 GHz
STOP 3.1 GHz

$V_{CC} = V_{RFOUT} = 2.8\text{ V}$
parameters are monitored at DUT pins

IF port
S11



START 0.1 GHz
STOP 1.0 GHz

TEST CIRCUIT 1 (f_{RFOut} = 0.83 GHz)

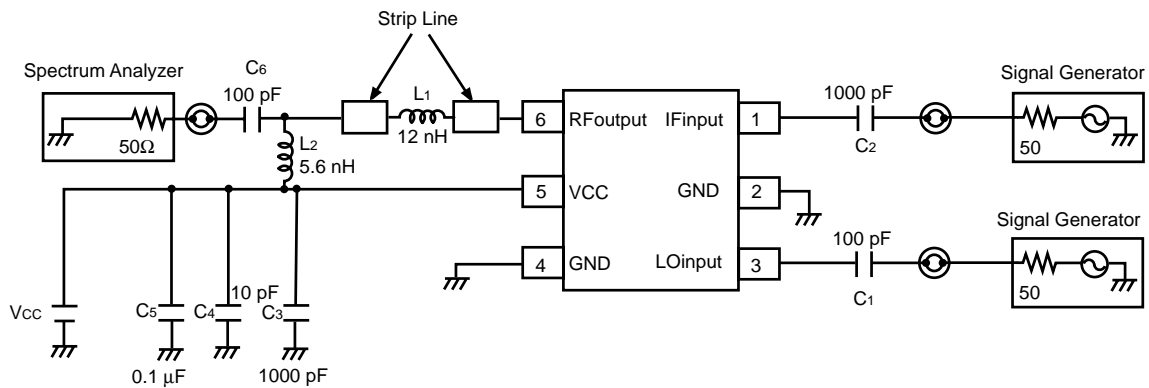
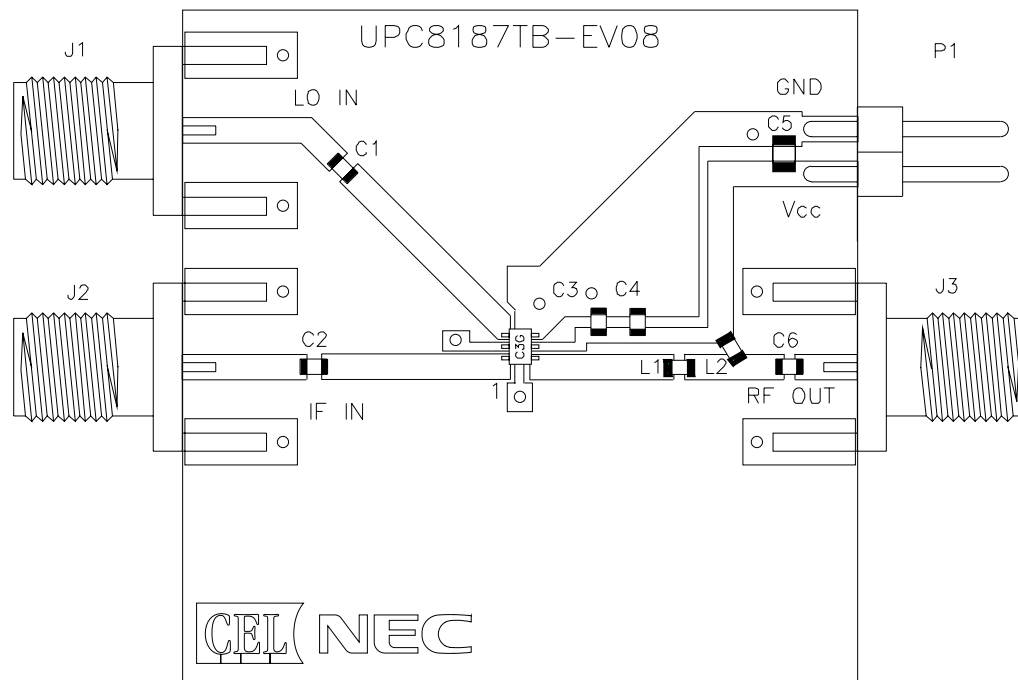


ILLUSTRATION OF THE TEST CIRCUIT 1 ASSEMBLED ON EVALUATION BOARD



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_{RFout} = 1.9 GHz)

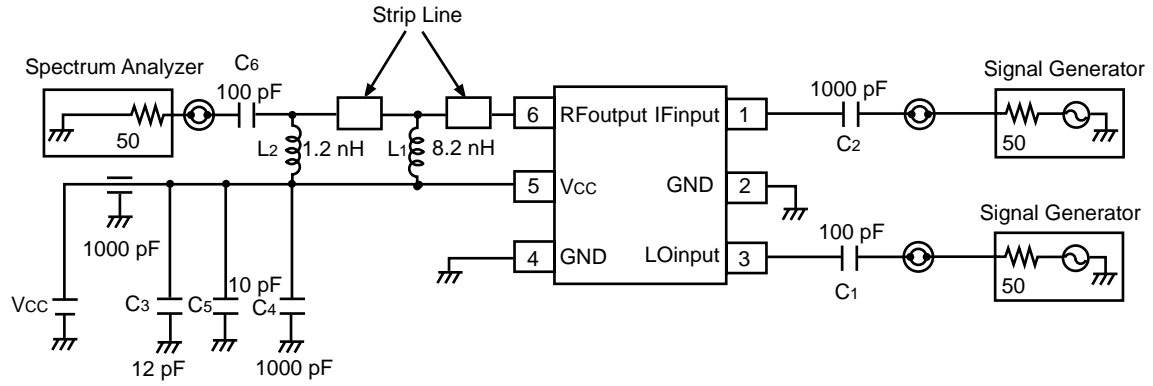
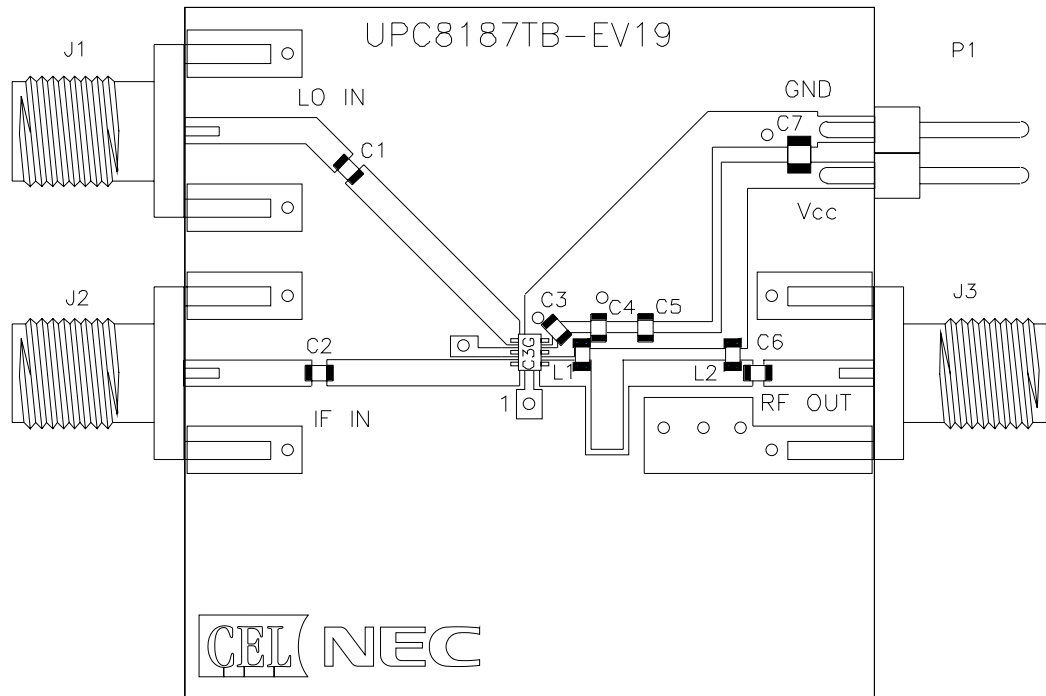


ILLUSTRATION OF TEST CIRCUIT 2 ASSEMBLED ON EVALUATION BOARD



COMPONENT LIST

| FORM | SYMBOL | VALUE |
|----------------|------------|---------|
| Chip Capacitor | C1, C2, C4 | 1000 pF |
| | C7 | 0.1μF |
| | 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_{RFout} = 2.4 GHz)

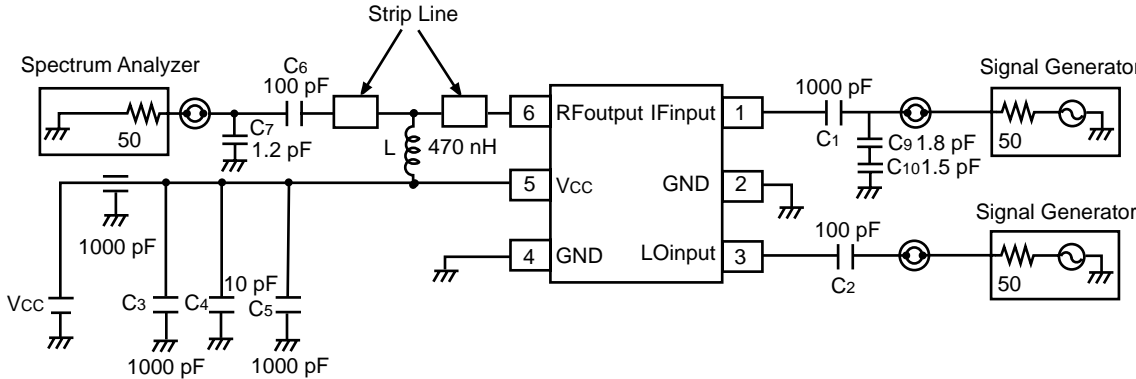
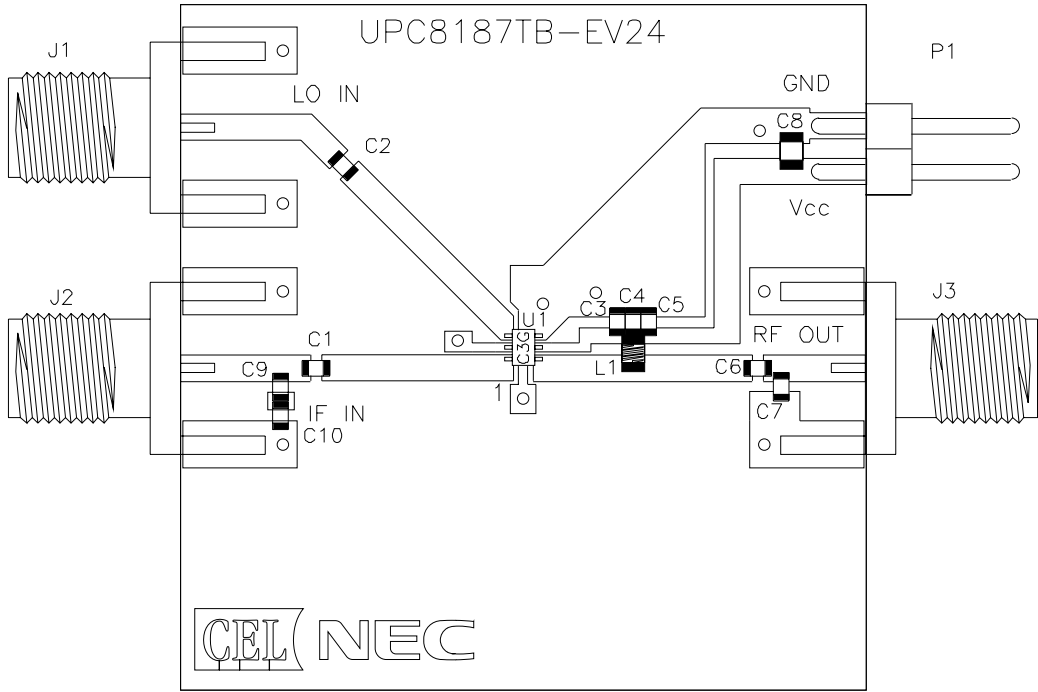


ILLUSTRATION OF TEST CIRCUIT 3 ASSEMBLED ON EVALUATION BOARD

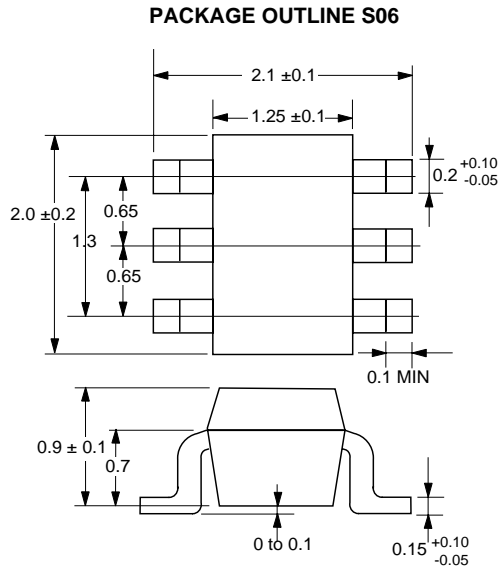


COMPONENT LIST

| 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 |

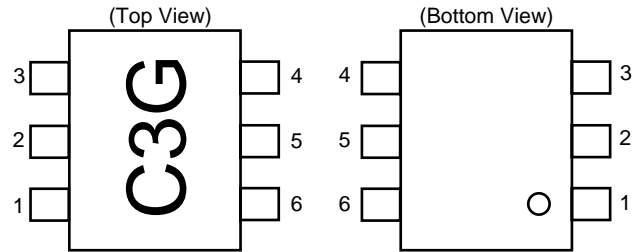
1. 1.5 x 1.5 x 0.028", Getek laminate, double sided copper
2. Ground pattern on rear board
3. Solder plated patterns
4. ○ Through holes

OUTLINE DIMENSIONS (Units in mm)



Note:
 All dimensions are typical unless otherwise specified.

PIN CONNECTIONS



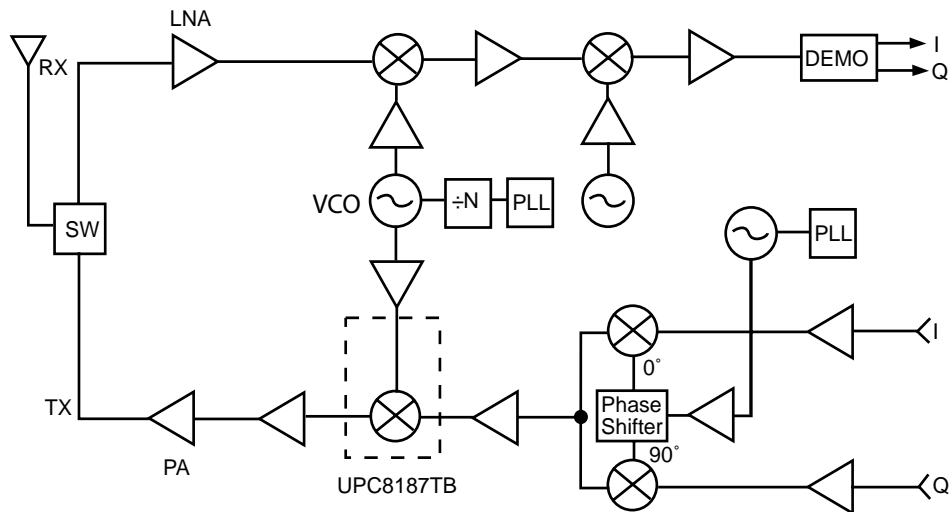
| PIN NO. | PIN NAME |
|---------|----------|
| 1 | IFinput |
| 2 | GND |
| 3 | LOinput |
| 4 | GND |
| 5 | Vcc |
| 6 | RFoutput |

ORDERING INFORMATION

| Part Number | Quantity |
|--------------|--------------|
| UPC8187TB-E3 | 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)



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