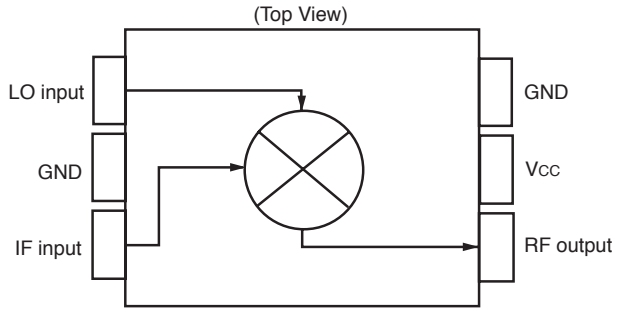
SILICON RFIC HI-IP3 FREQUENCY UP-CONVERTER FOR WIRELESS TRANSCEIVER

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_3 = +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°C, V_{CC} = V_{RFOUT} = 2.8 V, f_{IFin} = 150 MHz, PLOin = -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	11	14
CG2		f_{RFout} = 1.9 GHz, P_{IFin} = -20 dBm		dB	8	11	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	–
	Output Third-Order Distortion Intercept Point,						
OIP_31	f_{RFout} = 0.83 GHz		$f_{IFin}1$ = 150 MHz	dBm	–	10	–
OIP_32	f_{RFout} = 1.9 GHz		$f_{IFin}2$ = 151 MHz	dBm	–	10	–
OIP_33	f_{RFout} = 2.4 GHz			dBm	–	8.5	–
	Input Third-Order Distortion Intercept Point,						
IIP_31	f_{RFout} = 0.83 GHz		$f_{IFin}1$ = 150 MHz	dBm	–	-1.0	–
IIP_32	f_{RFout} = 1.9 GHz		$f_{IFin}2$ = 151 MHz	dBm	–	-1.0	–
IIP_33	f_{RFout} = 2.4 GHz			dBm	–	-1.5	–
SSB•NF1	SSB Noise Figure,	f_{RFout} = 0.83 GHz	$f_{IFin}1$ = 150 MHz	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

ABSOLUTE MAXIMUM RATINGS[1]

(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

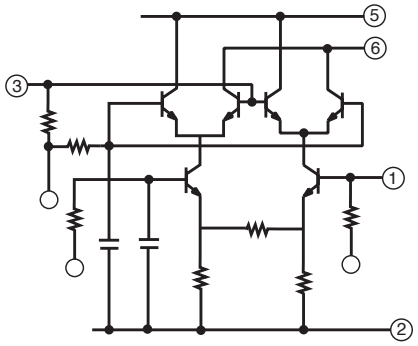
Notes:
1. Same voltage applied to pins 5 and 6.
2. Z_S = 50 Ω (without matching).
3. With external matching circuit.

SERIES PRODUCTS[1] (T_A = +25°C, V_{CC} = V_{PS} = V_{RFout} = 3.0 V, Z_S = Z_L = 50 Ω)

Part Number	I_{CC}	f_{RFout}	CG (dB			OIP_3 (dBm)			$P_{O(SAT)}$		
	(mA)	(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	@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.

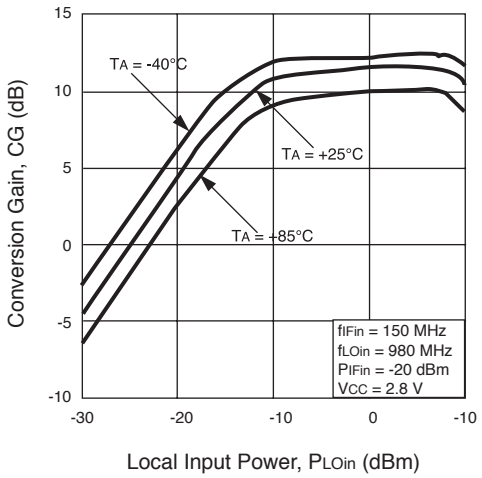
PIN FUNCTIONS (Pin Voltage is measured at V_{CC} = V_{PS} = V_{RFOUT} = 2.8V)

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.	

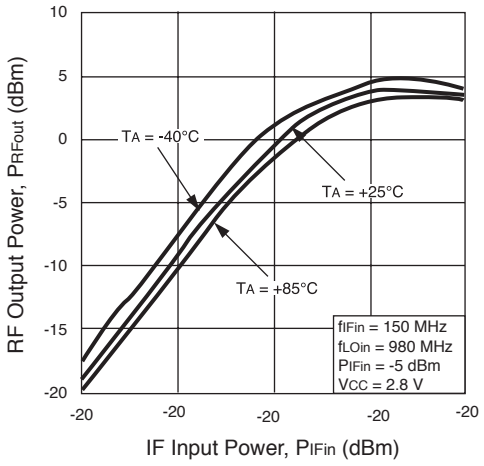
TYPICAL PERFORMANCE CURVES (Unless otherwise specified, T_A = 25˚C)

f_{RFout} = 0.83 GHz

CONVERSION GAIN vs. LOCAL INPUT POWER

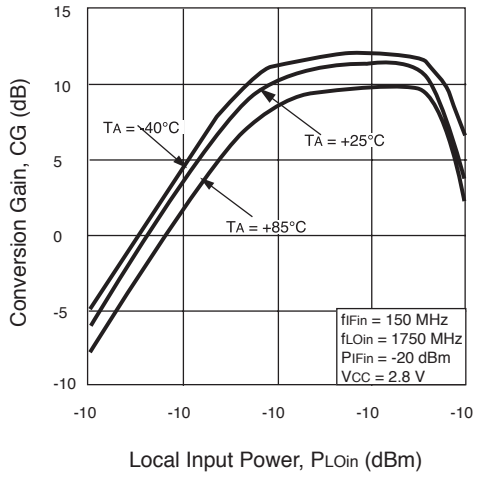


RF OUTPUT POWER vs. IF INPUT POWER

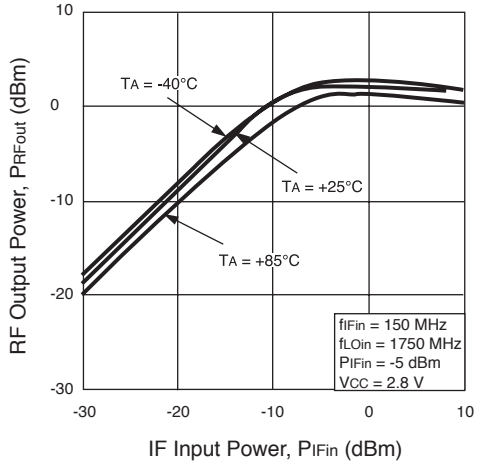


f_{RFout} = 1.9 GHz

CONVERSION GAIN vs. LOCAL INPUT POWER

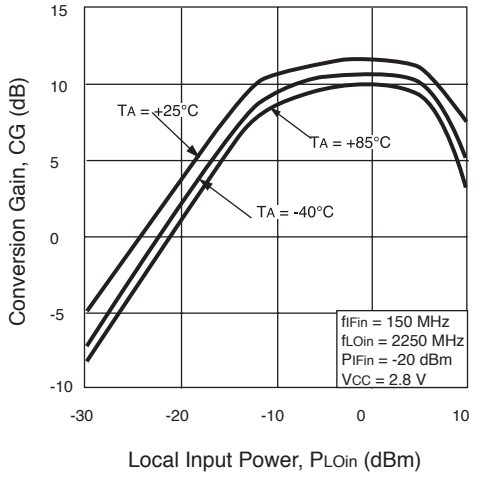


RF OUTPUT POWER vs. IF INPUT POWER

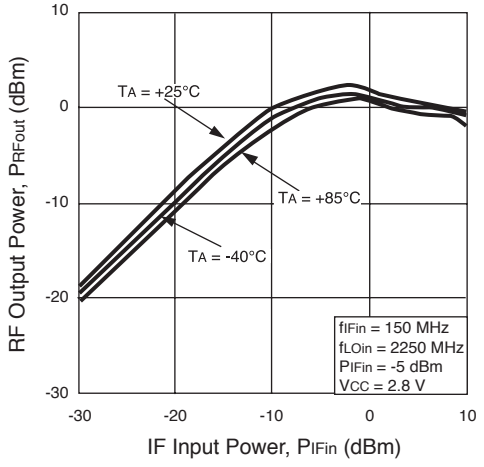


f_{RFout} = 2.4 GHz

CONVERSION GAIN vs. LOCAL INPUT POWER



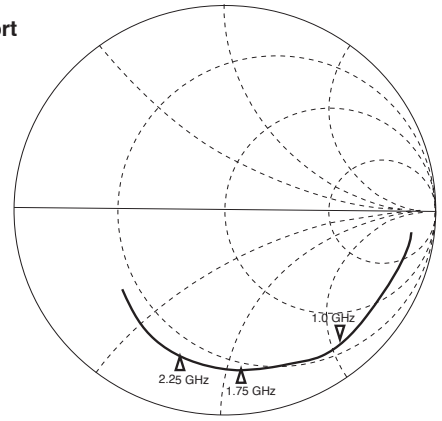
RF OUTPUT POWER vs. IF INPUT POWER



TYPICAL SCATTERING PARAMETERS (T_A = 25°C)

LO port

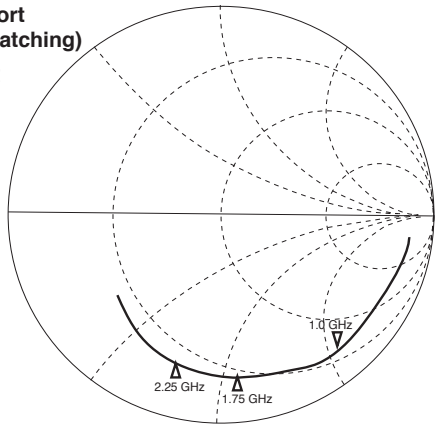
S11



START 0.1 GHz
STOP 3.1 GHz

RF port (without matching)

S22



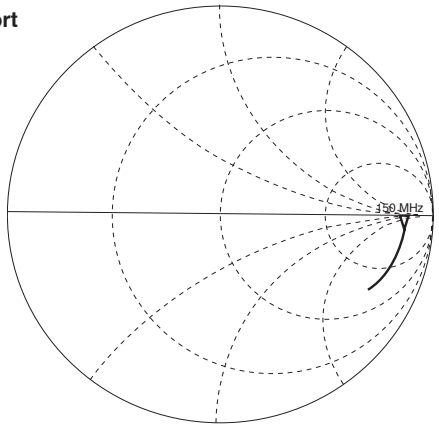
START 0.1 GHz
STOP 3.1 GHz

V_{CC} = V_{RFOUT} = 2.8 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)

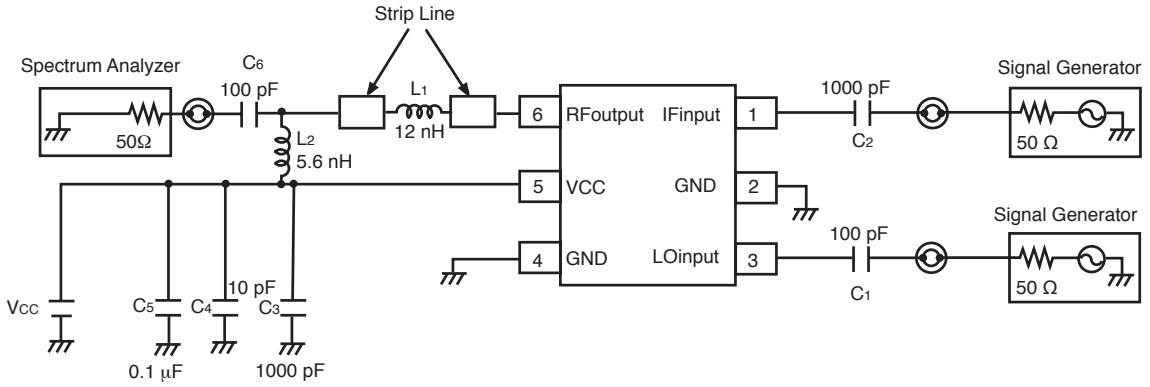
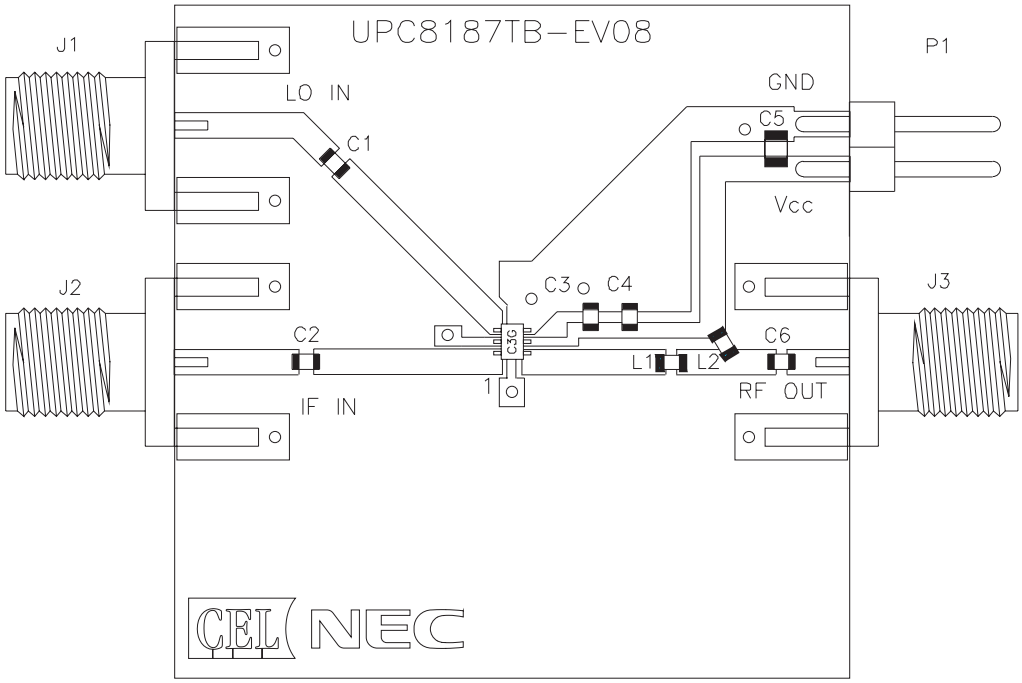


ILLUSTRATION OF THE TEST CIRCUIT 1 ASSEMBLED ON EVALUATION BOARD



COMPONENT LIST

FORM	SYMBOL	VALUE
Chip Capacitor	C_1, C_6	100 pF
	C_4	10 pF
	C_2, C_3	1000 pF
	C_5	0.1μF
Chip Inductor	L_1	12 nH
	L_2	5.6nH

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)

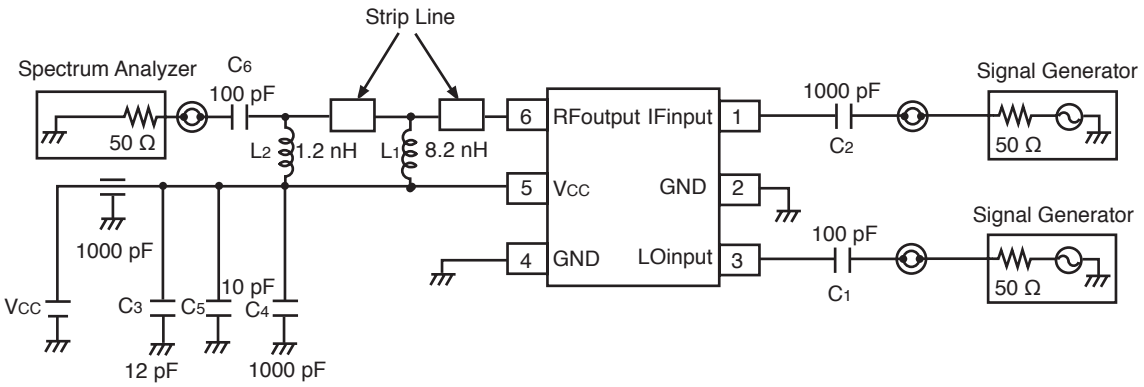
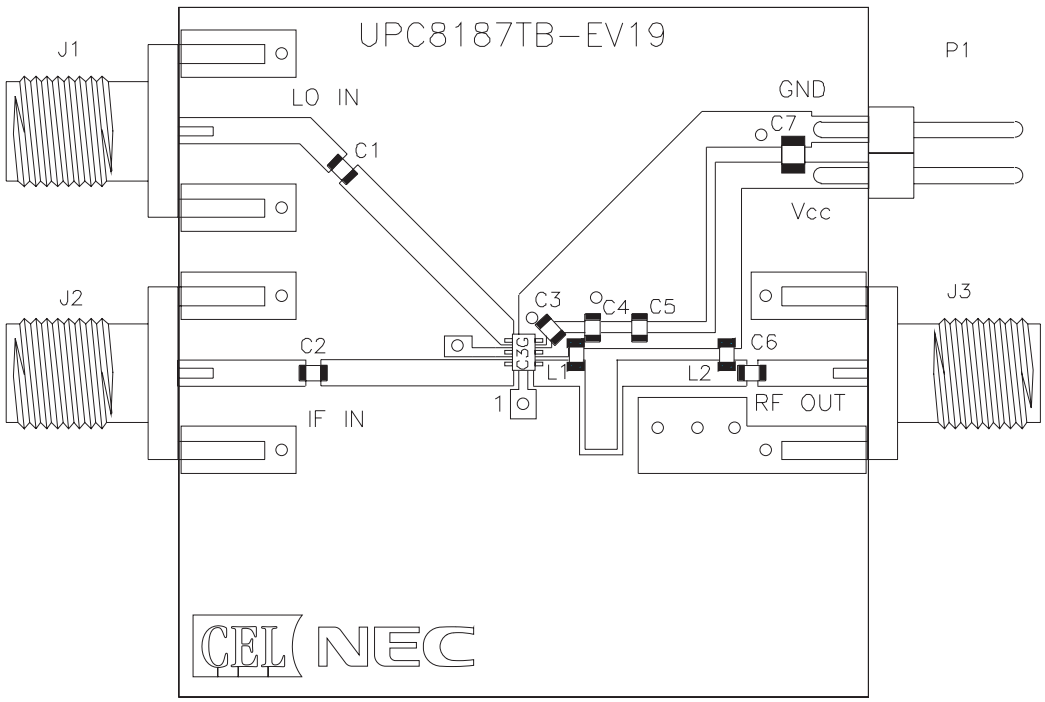


ILLUSTRATION OF TEST CIRCUIT 2 ASSEMBLED ON EVALUATION BOARD



COMPONENT LIST

FORM	SYMBOL	VALUE
Chip Capacitor	C_1, C_2, C_4	1000 pF
	C_7	0.1μF
	C_6	100 pF
	C_3	12 pF
	C_5	10 pF
Chip Inductor	L_1	8.2 nH
	L_2	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)

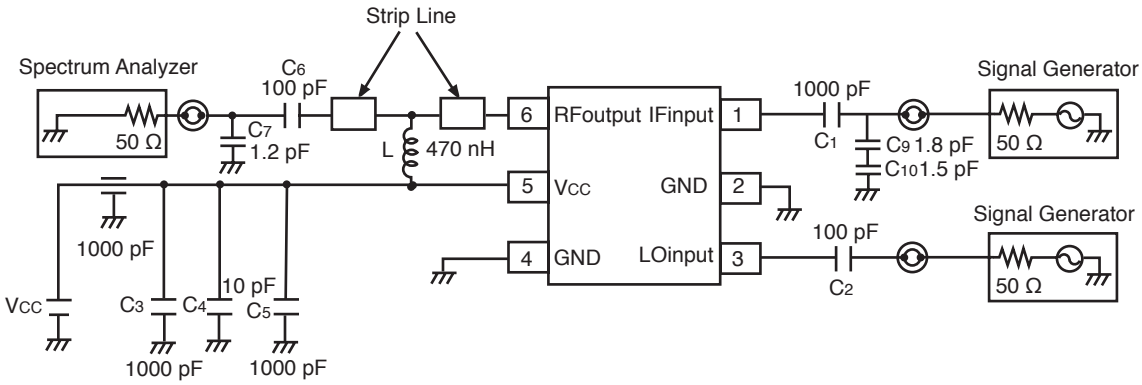
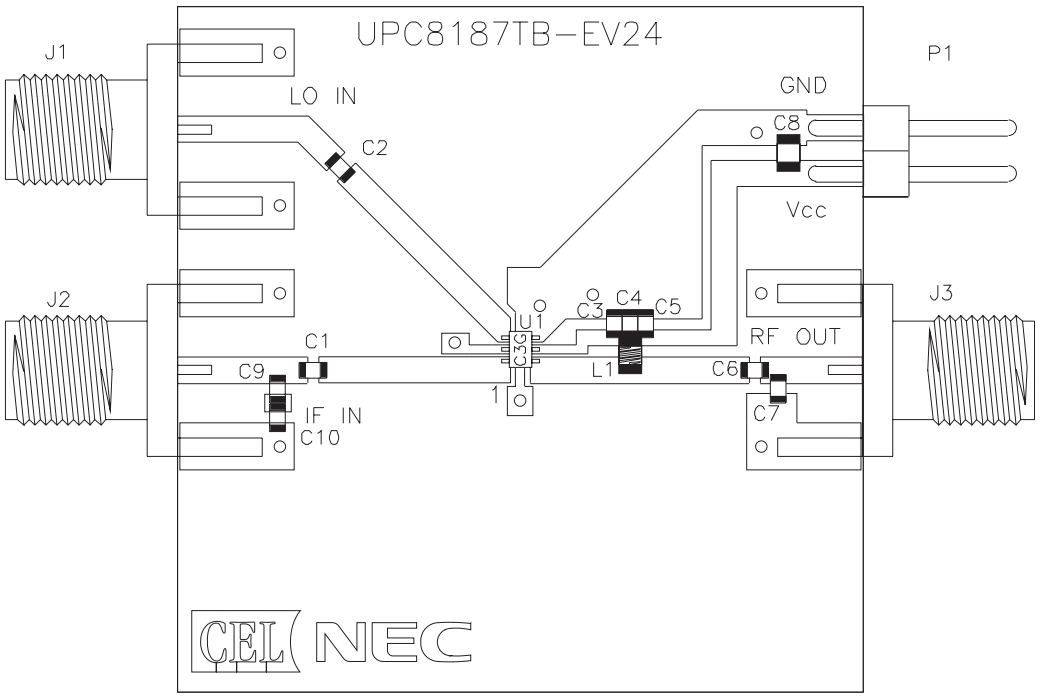


ILLUSTRATION OF TEST CIRCUIT 3 ASSEMBLED ON EVALUATION BOARD



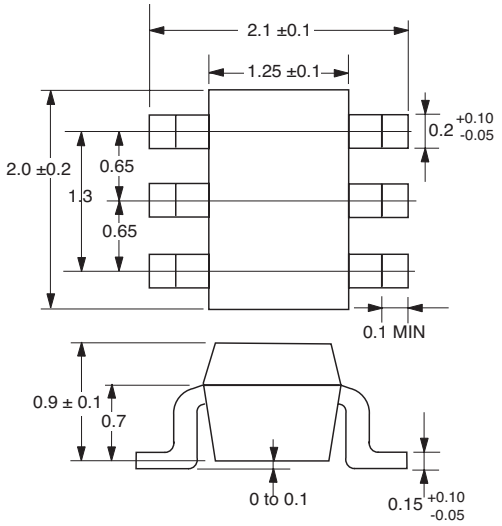
COMPONENT LIST

FORM	SYMBOL	VALUE
Chip Capacitor	C_1, C_3, C_5	1000 pF
	C_2, C_6	100 pF
	C_4	10 pF
	C_7	1.2 pF
	C_9	1.8 pF
	C_{10}	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

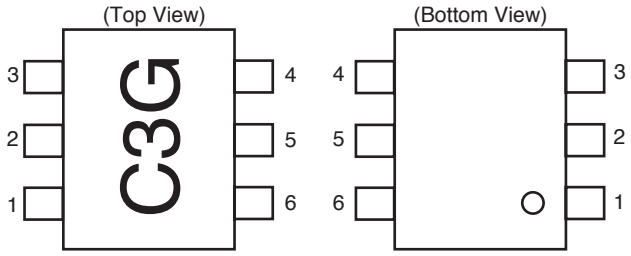
OUTLINE DIMENSIONS (Units in mm)

PACKAGE OUTLINE S06



Note:
All dimensions are typical unless otherwise specified.

PIN CONNECTIONS



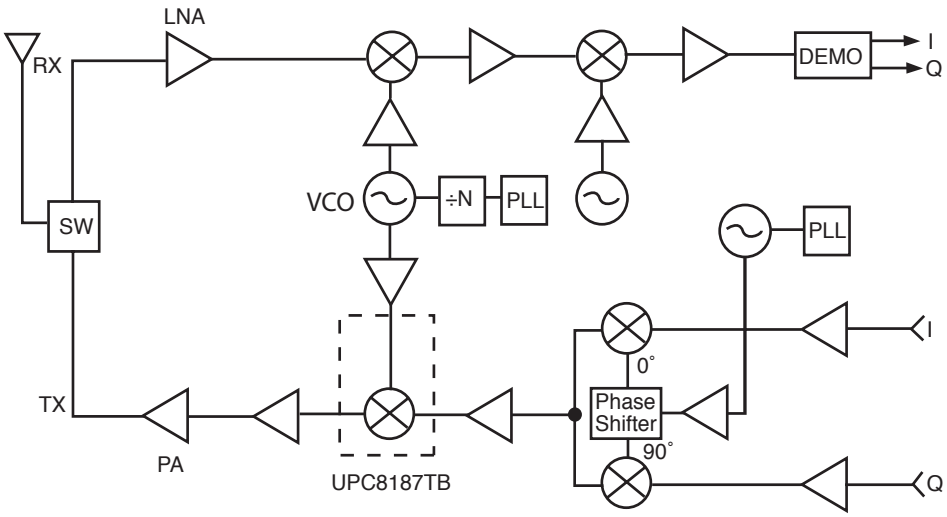
PIN NO.	PIN NAME
1	IF_{input}
2	GND
3	LO_{input}
4	GND
5	V_{CC}
6	RF_{output}

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.

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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	
Lead (Pb)	< 1000 PPM	-A	-AZ
		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.