

## DESCRIPTION


Demonstration circuit 1131A is optimized for evaluation of the LT5557 active downconverting mixer with transformer-based IF output matching. Its RF input and LO input ports are internally matched to  $50\Omega$ , from 1.6 to 2.3GHz, and from 1 to 5GHz, respectively. The IF output is  $50\Omega$  matched to 240MHz using an L-C bandpass network followed by an 8:1 transformer.

The LT5557 active mixer is optimized for high linearity, wide dynamic range downconverter applications. The IC includes a high-speed differential LO buffer amplifier driving a double-balanced mixer. Broadband, integrated transformers on the RF and LO inputs provide single-ended  $50\Omega$  interfaces. The differential IF output

allows convenient interfacing to differential IF filters and amplifiers, or is easily matched to drive a single-ended  $50\Omega$  load, with or without an external transformer.

The LT5557's high level of integration minimizes the total solution cost, board space and system-level variation.

**Design files for this circuit board are available. Call the LTC factory.**

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**Table 1. Typical Demonstration Circuit Performance Summary ( $V_{CC} = 3.3V$ , EN = High,  $T_A = 25^\circ C$ ,  $f_{RF} = 1950MHz$ ,  $P_{RF} = -6dBm$ ,  $f_{LO} = 1710MHz$ ,  $P_{LO} = -3dBm$ , IF output measured at 240MHz, unless otherwise noted. Test circuit shown in Figure 2.)**

PARAMETER	CONDITION	VALUE
Supply Voltage		2.9 to 3.9V
Total Supply Current	EN = High (> 2.7V)	81.6mA
Maximum Shutdown Current	EN = Low (< 0.3V)	100 $\mu$ A
RF Input Frequency Range	Return Loss > 12dB	1600 to 2300MHz
LO Input Frequency Range	Return Loss > 10dB	1000 to 4200MHz
IF Output Frequency Range	Return Loss > 10dB	220 to 260MHz
LO Input Power		-8 to 2dBm
Conversion Gain		2.9dB
Input 3 <sup>rd</sup> Order Intercept	2 RF tones, -6dBm/tone, $\Delta f = 1MHz$	24.7dBm
Single-Sideband Noise Figure		11.7dB
LO to RF Leakage		< -45dBm
LO to IF Leakage		< -42dBm
RF to LO isolation		> 42dB
RF to IF isolation		> 41dB
2RF-2LO Output Spurious Product ( $f_{RF} = f_{LO} \pm f_{IF}/2$ )	$f_{RF} = 1830MHz$ , $P_{RF} = -6dBm$ , $f_{IF} = 240MHz$	-53dBc
3RF-3LO Output Spurious Product ( $f_{RF} = f_{LO} \pm f_{IF}/3$ )	$f_{RF} = 1790MHz$ , $P_{RF} = -6dBm$ , $f_{IF} = 240MHz$	-70dBc
Input 1dB Compression		8.8dBm

## APPLICATION NOTE

### ABSOLUTE MAXIMUM INPUT RATING

Supply Voltage ( $V_{CC1}$ , $V_{CC2}$ , IF <sup>+</sup> , IF <sup>-</sup> ) .....	4V
Enable Voltage .....	-0.3V to $V_{CC} + 0.3V$
LO Input Power .....	+10dBm
LO Input DC Voltage .....	-1V to $V_{CC} + 1V$
RF Input Power .....	+12dBm
RF Input DC Voltage .....	$\pm 0.1V$

CAUTION: This part is sensitive to electrostatic discharge (ESD). Observe proper ESD precautions when handling the LT5557.

### FREQUENCY RANGE

Demonstration circuit 1131A is optimized for evaluating the LT5557 IC for downconverting a RF signal in the frequency range of 1.6GHz to 2.3GHz to a 240MHz IF frequency with either low-side or high-side LO injection.

The LT5557's RF input is internally matched to 50 $\Omega$  from 1.6GHz to 2.3GHz with better than 12dB return loss. Its LO input port is internally matched to 50 $\Omega$  from 1GHz to 5GHz with better than 10dB return loss. The frequency range of both ports is easily extended with simple external matching. Please refer to the LT5557 datasheet Applications Information section.

Demonstration circuit 1131A utilizes a transformer for impedance transformation and differential to single-ended conversion on the IF output port. The IF output is 50 $\Omega$  matched for 240MHz, but can be modified for other IF frequencies. Equations for calculating component values, as well as values for several common IF frequencies are given in the LT5557 datasheet Applications Information section.

## QUICK START PROCEDURE

Demonstration circuit 1131A is easy to set up to evaluate the performance of the LT5557. Refer to Figure 1 for proper measurement equipment setup and follow the procedure below:

### TEST EQUIPMENT AND SETUP

Refer to Figure 1 for proper measurement equipment setup.

Use high performance signal generators with low harmonic output for 2-tone measurements. Otherwise, low-pass filters at the signal generator outputs should be used to suppress higher-order harmonics.

High quality combiners that provide broadband 50 $\Omega$  termination on all ports and have good port-to-port isolation should be used. Attenuators on the outputs of the signal generators are recommended to further improve source isolation, to prevent the sources from modulating each other and generating intermodulation products.

Spectrum analyzers can produce significant internal distortion products if they are overdriven. Generally, spectrum analyzers are designed to operate at their best with about -30dBm to -40dBm at their input. Sufficient spectrum analyzer input attenuation should be used to avoid saturating the instrument.

Before performing measurements on the DUT, the system performance should be evaluated to ensure that: 1) a clean input signal is obtained, and 2) the spectrum analyzer internal distortion is minimized.

**Note 1:** Care should be taken to never exceed absolute maximum input ratings.

**Note 2:** DC power should never be applied to the EN pin before it is applied to the  $V_{CC}$  pin.

# QUICK START GUIDE FOR DEMONSTRATION CIRCUIT 1131A

## HIGH SIGNAL LEVEL DOWNCONVERTING MIXER

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1. Connect all test equipment as shown in Figure 1.
2. Apply 3.3V DC supply power, and verify that the current consumption is approximately 81.6mA.
3. Apply RF and LO input signals to perform AC measurements.
4. Set the LO signal generator (#1) to provide a 1710MHz, -3dBm, CW signal to the demo board LO IN port.
5. Set the RF signal generators (#2 and #3) to provide two -6dBm CW signals to the demo board RF IN port—one at 1950MHz, and the other at 1951MHz.
6. Set the Spectrum Analyzer's frequency range to capture the 240MHz IF output. Sufficient spectrum analyzer input attenuation should be used to avoid saturating the instrument.
7. Conversion gain and Input 3<sup>rd</sup> order intercept can be measured:
  - a.  $G_c = P_1 - P_{in}$
  - b.  $IIP3 = (P_1 - P_3) / 2 + P_{in}$Where P1 is the lowest power level of the two fundamental output tones at either 240MHz or at 241MHz, P3 is the largest 3<sup>rd</sup> order product at either 239MHz or at 242MHz, and P<sub>in</sub> is the input power (in this case, -6dBm). All units are in dBm.
8. To measure the 2RF-2LO output spurious product, turn off signal generator 3. Set signal generator 2 to  $f_{RF} = f_{LO} + f_{IF}/2$ . In this case,  $f_{RF} = 1710\text{MHz} + 240\text{MHz} / 2 = 1830\text{MHz}$ . Then the desired output would be at 120MHz, and the 2RF-2LO output spur would be at 240MHz. The dBc difference between the two outputs is the 2RF-2LO output spurious product.
9. Follow the same procedure for 3RF-3LO output spurious product measurement. This time, set signal generator 2 to  $f_{RF} = f_{LO} + f_{IF}/3 = 1710\text{MHz} + 240\text{MHz} / 3 = 1790\text{MHz}$ . The desired output would be at 80MHz, and the 3RF-3LO output spur would be at 240MHz. The dBc difference between the two outputs is the 3RF-3LO output spurious product.
10. Measure RF to LO isolation, LO leakages, and Input 1dB compression.
11. Single-Sideband Noise Figure can be measured on a noise figure meter. Refer to noise figure meter manual for instructions. Be sure to use a high quality signal generator and a band-pass filter on the LO input. A band-pass filter on the RF input port is required for image suppression.

# QUICK START GUIDE FOR DEMONSTRATION CIRCUIT 1131A

## HIGH SIGNAL LEVEL DOWNCONVERTING MIXER

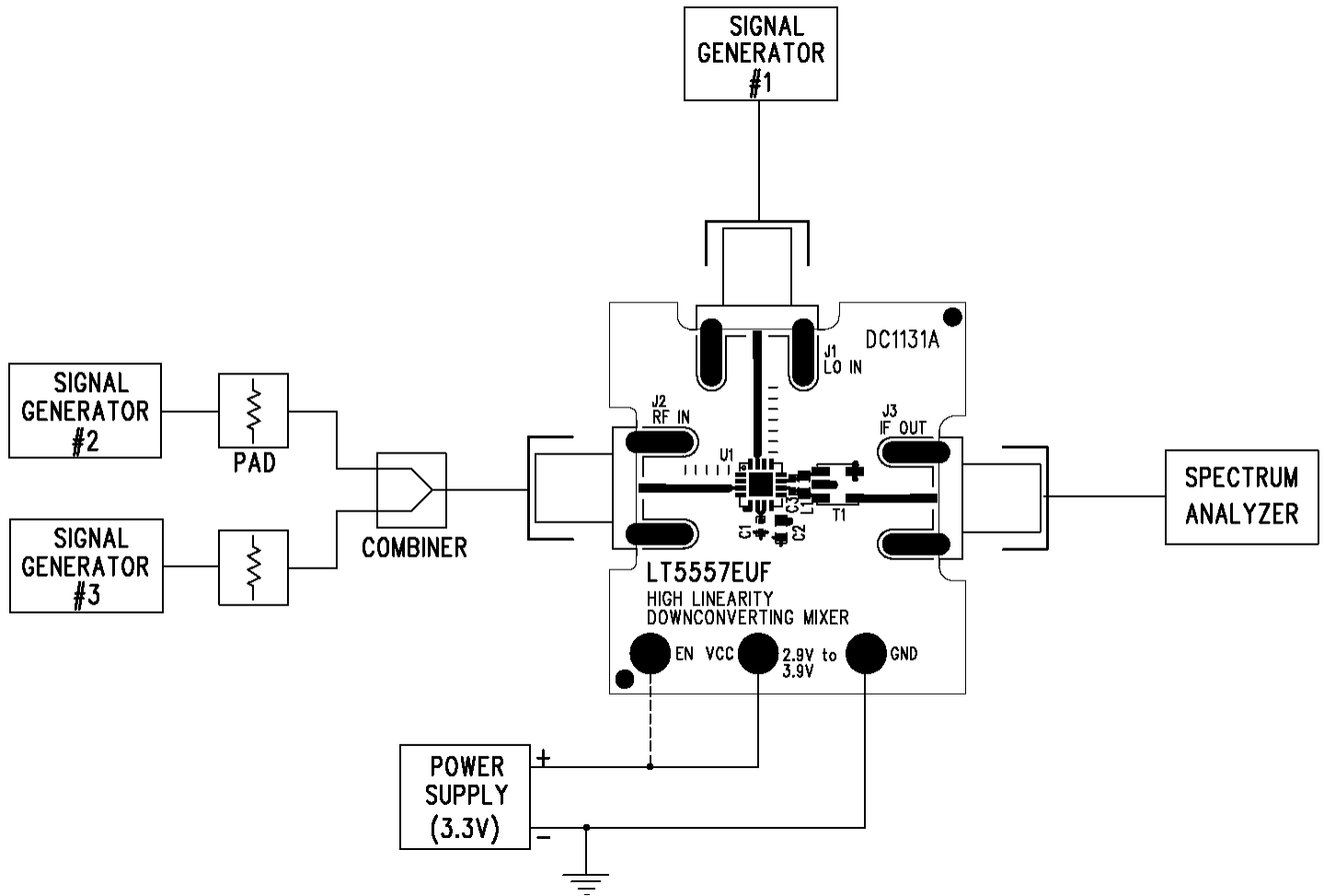
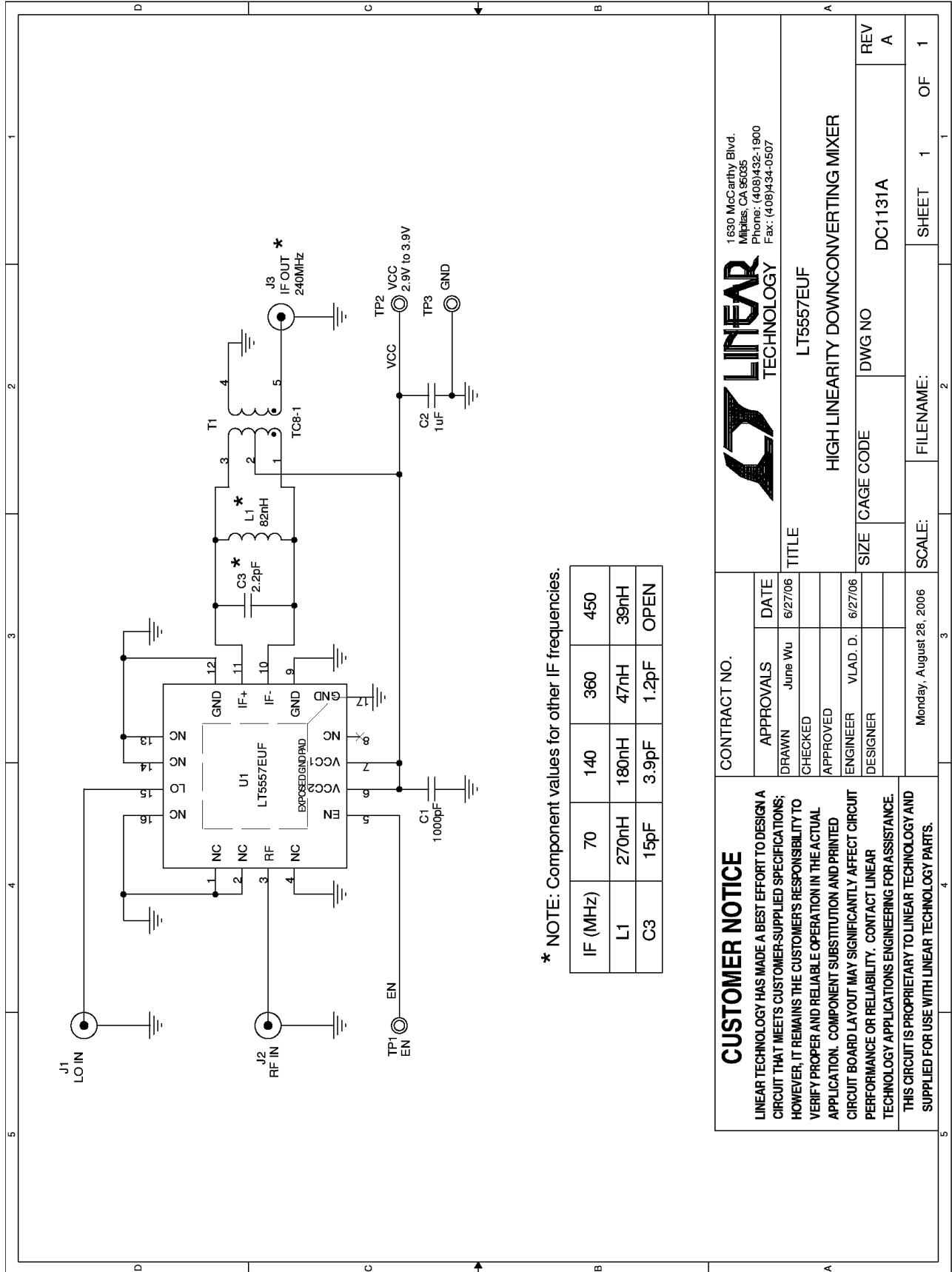


Figure 1. Proper Measurement Equipment Setup

# QUICK START GUIDE FOR DEMONSTRATION CIRCUIT 1131A

## HIGH SIGNAL LEVEL DOWNCONVERTING MIXER



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 THIS CIRCUIT IS PROPRIETARY TO LINEAR TECHNOLOGY AND SUPPLIED FOR USE WITH LINEAR TECHNOLOGY PARTS.

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APPROVALS	DATE
DRAWN June Wu	6/27/06
CHECKED _____	
APPROVED _____	
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DESIGNER _____	

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**LT5557EUF**

HIGH LINEARITY DOWNCONVERTING MIXER

REV A

DC1131A

SHEET 1 OF 1

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