DESCRIPTION

Demonstration circuit 910A is optimized for evaluation of the LT5557 active downconverting mixer with discrete IF output balun for lower cost applications. Its RF input and LO input ports are internally matched to 50Ω, from 1.6 to 2.3GHz, and from 1 to 5GHz, respectively. The IF output is 50Ω matched to 240MHz using a discrete balun. Compared to the transformer-based matching technique, the discrete balun approach yields narrower IF output bandwidth, higher conversion gain, and slightly degraded IIP3 and noise figure.

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 50Ω interfaces. The differential IF output allows convenient interfacing to differential IF filters and amplifiers, or is easily matched to drive a single-ended 50Ω 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.

Table 1. Typical Demonstration Circuit Performance Summary (V_{CC} = 3.3V, EN = High, T_A = 25°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)	100µA
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 3rd Order Intercept	2 RF tones, -6dBm/tone, Δf = 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^+, IF^-) 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..................................... ±0.1V

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

FREQUENCY RANGE

Demonstration circuit 910A 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 50Ω from 1.6GHz to 2.3GHz with better than 12dB return loss. Its LO input port is internally matched to 50Ω 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 910A utilizes a low cost discrete balun for narrowband IF output matching to 240MHz. Component values for other IF frequencies can be calculated using equations given in the datasheet Applications Information section.

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 50Ω 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.

QUICK START PROCEDURE

Demonstration circuit 910A 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:

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.

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 3rd order intercept can be measured:

   a. Gc = P1 – Pin

   b. IIP3 = (P1 – P3) / 2 + Pin

   Where P1 is the lowest power level of the two fundamental output tones at either 240MHz or at 241MHz, P3 is the largest 3rd order product at either 239MHz or at 242MHz, and Pin 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} = 1710MHz + 240MHz / 2 = 1830MHz. 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 $f_{RF} = f_{LO} + f_{IF}/3$ = 1710MHz + 240MHz / 3 = 1790MHz. 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.

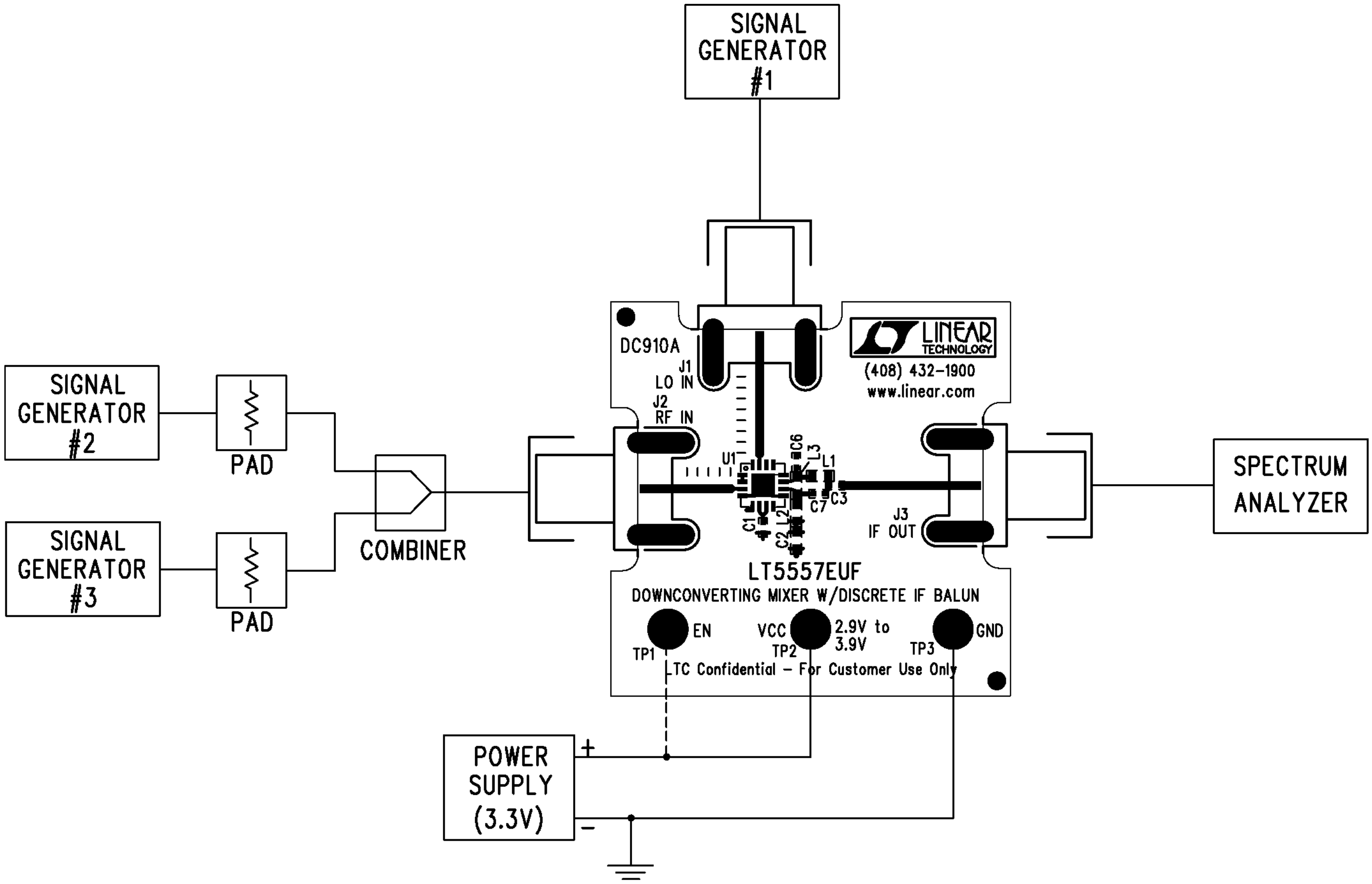
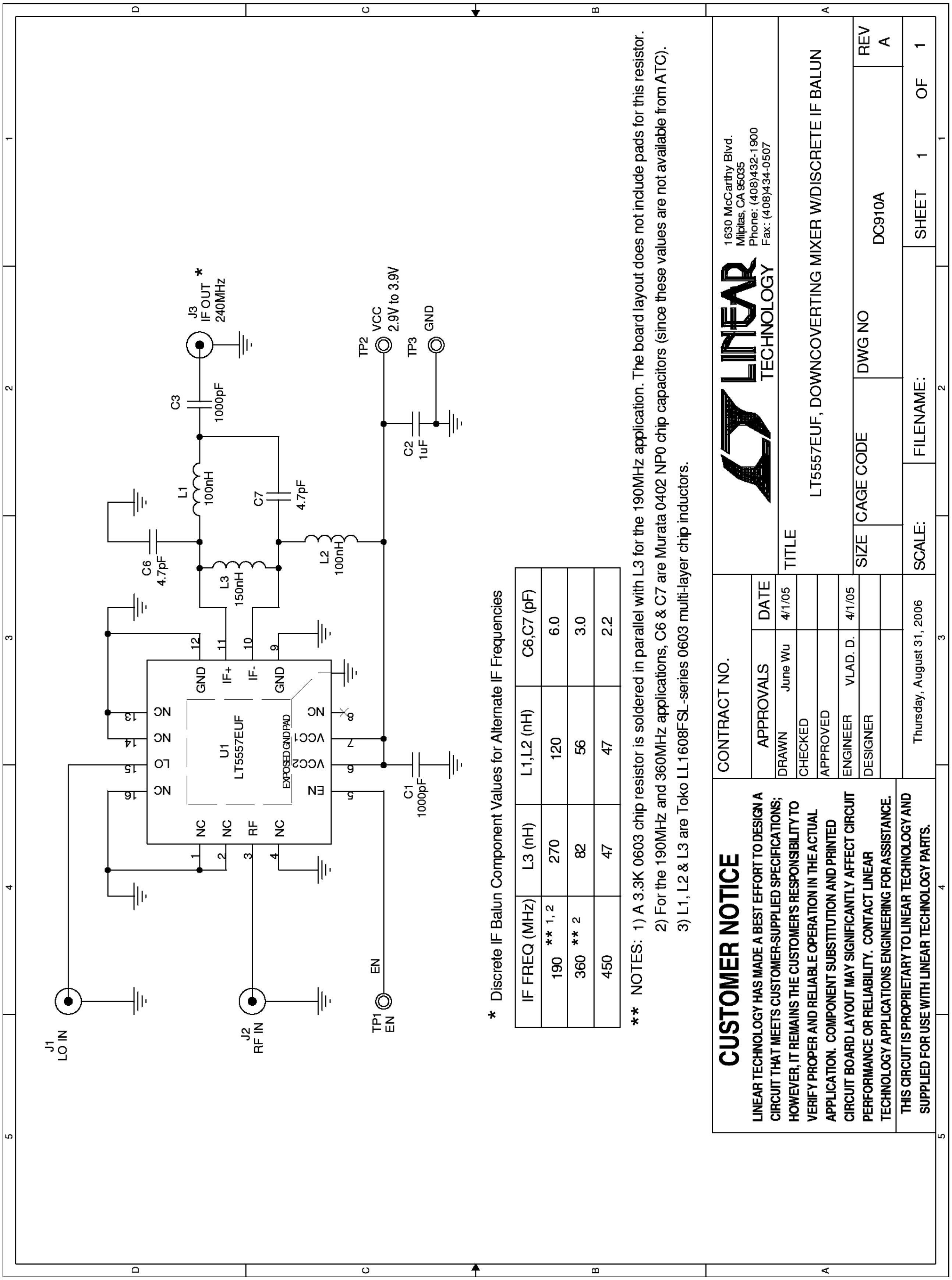


Figure 1. Proper Measurement Equipment Setup


J1
LO IN
J2
RF IN
TP1
EN
EN
J3
IF OUT *
240MHz
TP2
VCC
2.9V to 3.9V
TP3
GND
C1
1000pF
C2
1uF
C3
1000pF
C6
4.7pF
C7
4.7pF
L1
100nH
L2
100nH
L3
150nH
U1
LT5557EUF
EXPOSED GND PAD
NC
NC
RF
NC
EN
VCC2
VCC1
NC
GND
IF-
IF+
GND
NC
NC
LO
NC
* Discrete IF Balun Component Values for Alternate IF Frequencies
IF FREQ (MHz) | L3 (nH) | L1,L2 (nH) | C6,C7 (pF)
190 ** 1, 2 | 270 | 120 | 6.0
360 ** 2 | 82 | 56 | 3.0
450 | 47 | 47 | 2.2
** NOTES: 1) A 3.3K 0603 chip resistor is soldered in parallel with L3 for the 190MHz application. The board layout does not include pads for this resistor.
2) For the 190MHz and 360MHz applications, C6 & C7 are Murata 0402 NP0 chip capacitors (since these values are not available from ATC).
3) L1, L2 & L3 are Toko LL1608FSL-series 0603 multi-layer chip inductors.
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ENGINEER VLAD. D. 4/1/05
DESIGNER
Thursday, August 31, 2006
LINEAR TECHNOLOGY
1630 McCarthy Blvd.
Milpitas, CA 95035
Phone: (408)432-1900
Fax: (408)434-0507
TITLE
LT5557EUF, DOWNCOVERTING MIXER W/DISCRETE IF BALUN
SIZE
CAGE CODE
DWG NO
DC910A
REV
A
SCALE:
FILENAME:
SHEET 1 OF 1