

## DESCRIPTION

Demonstration circuit DC991A is optimized for a down-converting mixer tests & measurements for input frequency range of 700MHz to 1680MHz, an output frequency range of 110 MHz to 170MHz (12 dB return loss BW). The LO port frequency range is 515 to 915MHz (10 dB return loss BW).

The LT<sup>®</sup>5560 is a high performance broadband Up/Down-converting active mixer. This double-balanced mixer can be driven by a single-ended LO source and requires -2dBm of LO power. The signal ports can be impedance matched to a broad range of frequencies, which allow the LT<sup>®</sup>5560 to be used as

an up- or down-conversion mixer in a wide variety of applications.

The LT<sup>®</sup>5560 is characterized with a supply current of 10mA; however, the DC current is adjustable, which allows the performance to be optimized for each application by changing the value of resistor R1. For I<sub>CC</sub>=10mA the value of R1=3-ohm. Operation at a lower supply current will, however, degrade linearity.

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

LT is a registered trademark of Linear Technology Corporation.

**Table 1. Typical Performance Summary (T<sub>A</sub> = 25°C)**

PARAMETER	CONDITION (f <sub>INPUT</sub> = 900MHz, f <sub>LO</sub> =760MHz)	VALUE
Supply Voltage		2.7V to 5.3V
Supply Current	V <sub>CC</sub> = 3V, EN = High, R1=3	10mA
Maximum Shutdown Current	V <sub>CC</sub> = 3V, EN = 0.3V	10μA
Signal Input Frequency Range	Requires External Matching	< 4000 MHz
LO Signal Frequency Range	Requires External Matching	< 4000 MHz
Signal Output Frequency Range	Requires External Matching	< 4000 MHz
IF Input Return Loss	Z <sub>0</sub> = 50 , with External Matching	15dB
LO Input Return Loss	Z <sub>0</sub> = 50 , with External Matching	15dB
RF Output Return Loss	Z <sub>0</sub> = 50 , with External Matching	15dB
LO Input Power		-6dBm to 1dBm
Conversion Gain	P <sub>INPUT</sub> = -20dBm, P <sub>LO</sub> = -2dBm	2.6dB
SSB Noise Figure	P <sub>LO</sub> = -2dBm	10.1dB
Input 3 <sup>rd</sup> Order Intercept	2-Tone, -20dBm/Tone, Δf = 1MHz, P <sub>LO</sub> = -2dBm	+9.7dBm
Input 2 <sup>nd</sup> Order Intercept	2-Tone, -20dBm/Tone, Δf = 1MHz, P <sub>LO</sub> = -2dBm	+47dBm
Input 1dB Compression	P <sub>LO</sub> = -2dBm	0dBm
LO to IN leakage	P <sub>LO</sub> = -2dBm	-57dBm
LO to OUT leakage	P <sub>LO</sub> = -2dBm	-63dBm

# QUICK START GUIDE FOR DEMONSTRATION CIRCUIT DC991A

## LOW POWER ACTIVE DOWN-CONVERTING MIXER

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### QUICK START PROCEDURE

Demonstration circuit DC991A is easy to set up to evaluate the performance of the LT<sup>®</sup>5560. Refer to Figure 1 for proper measurement equipment setup and follow the procedure below:

#### NOTE:

- a. Use high performance signal generators with low harmonic output for 2<sup>nd</sup> & 3<sup>rd</sup> order distortion measurements. Otherwise, low-pass filters at the signal generator outputs should be used to suppress harmonics, particularly the 2<sup>nd</sup> harmonic.
  - b. High quality combiners that provide a 50 Ohm 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 and to reduce reflection into the sources.
1. Connect all test equipment as shown in Figure 1.
  2. Set the DC power supply's current limit to 15mA, and adjust output voltage to 3V.
  3. Connect Vcc to the 3V DC supply, and then connect EN to 3V; the Mixer is enabled (on).
  4. Set Signal Generator #1 to provide a 760MHz, -2dBm, CW signal to the demo board LO input port.
  5. Set the Signal Generators #2 and #3 to provide two -20dBm CW signals to the demo board RF input port—one at 900MHz, and the other at 901MHz.
  6. To measure 3<sup>rd</sup> order distortion and conversion gain, set the Spectrum Analyzer start and stop frequencies to 138MHz and 143MHz, respectively. Sufficient spectrum analyzer input attenuation should be used to avoid distortion in the instrument.
  7. The 3<sup>rd</sup> order intercept point is equal to  $(P_1 - P_3) / 2 + P_{in}$ , where  $P_1$  is the power level of the two fundamental output tones at 140MHz and 141MHz,  $P_3$  is the 3<sup>rd</sup> order product at 139MHz and 142MHz, and  $P_{in}$  is the input power (in this case, -20dBm). All units are in dBm.
  8. Using the same signal generators settings, output IM2 product can be measured at 1MHz, which is a difference between two input frequencies (900 and 901MHz). However we recommend increasing the frequency of the second signal generator from 901MHz to 1045MHz and measure OIM2 product at 145MHz frequency (1045MHz-900MHz=145MHz). At 145MHz the mixer output matching circuit has good return loss. To measure input 2<sup>nd</sup> order distortion, set the Spectrum Analyzer center frequency to 145MHz.
  9. The 2<sup>nd</sup> order intercept point is equal to  $P_1 - P_2 + P_{in}$ , where  $P_1$  is the power level of the fundamental output tone at 140MHz,  $P_2$  is the 2<sup>nd</sup> order product at 145MHz, and  $P_{in}$  is the input power (in this case -20dBm).

# QUICK START GUIDE FOR DEMONSTRATION CIRCUIT DC991A LOW POWER ACTIVE DOWN-CONVERTING MIXER

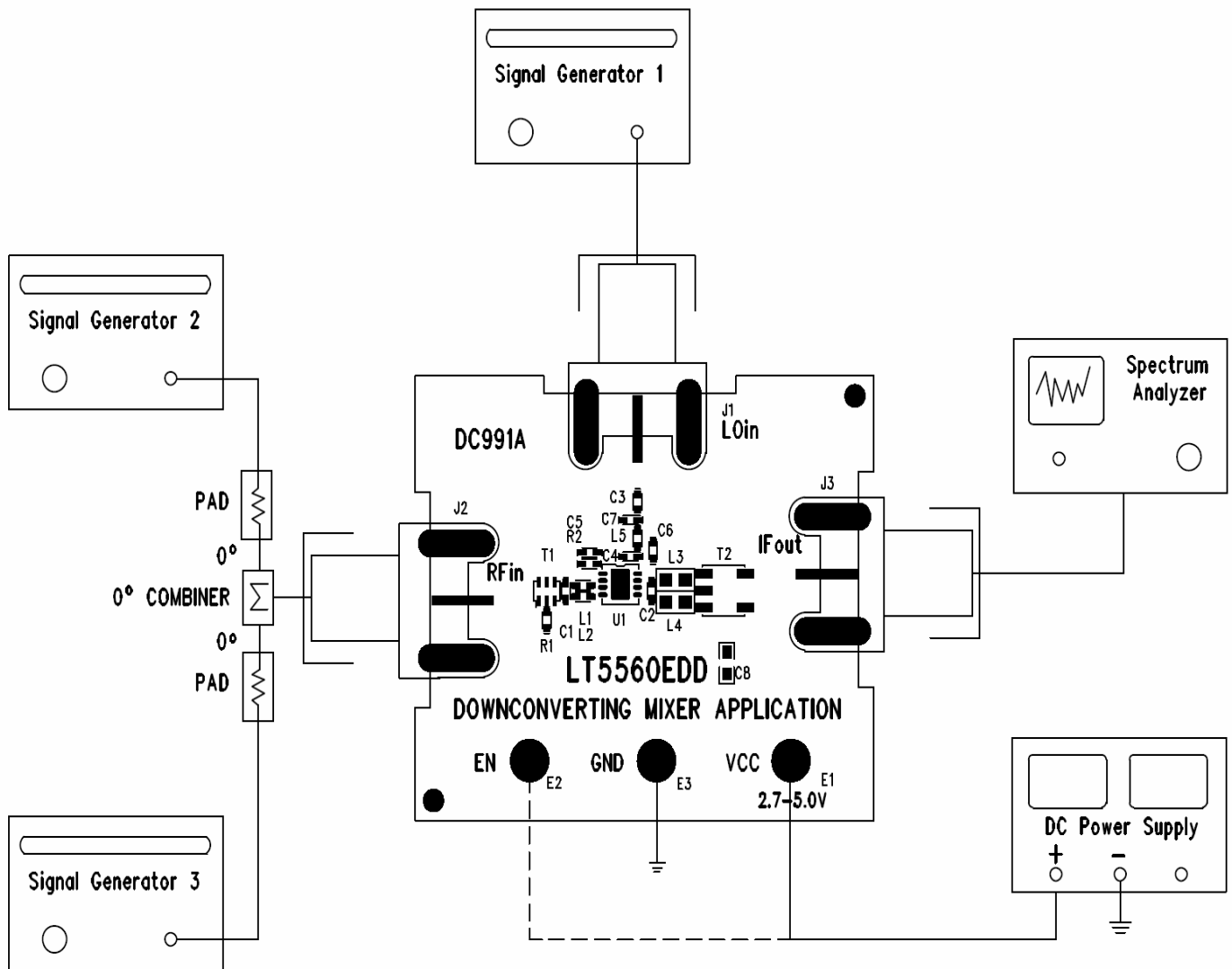
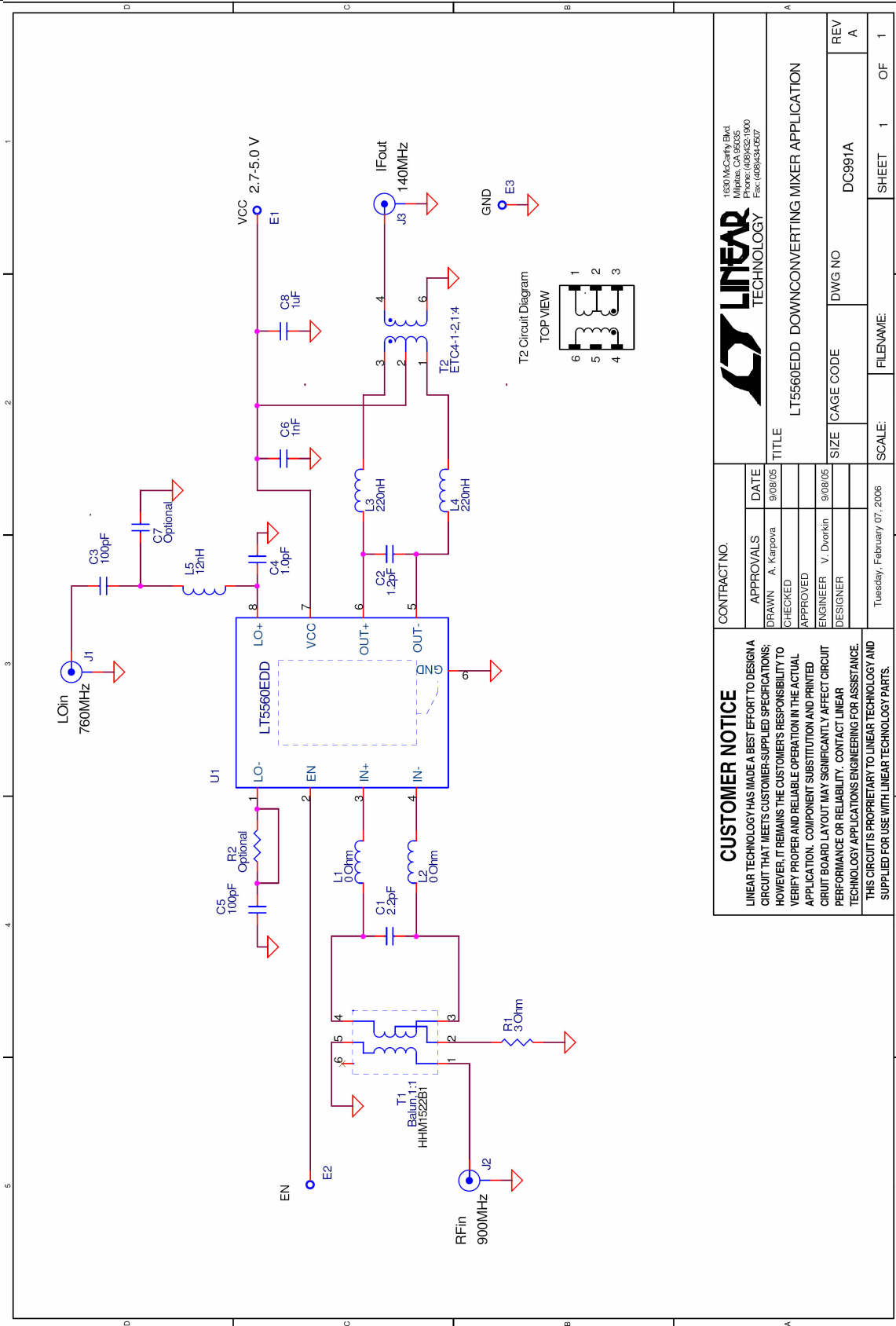


Figure 1. Proper Measurement Equipment Setup

# QUICK START GUIDE FOR DEMONSTRATION CIRCUIT DC991A

## LOW POWER ACTIVE DOWN-CONVERTING MIXER



<b>CONTRACT NO.</b>		<b>DATE</b>	
APPROVALS	DATE	APPROVALS	DATE
DRAWN: A. Karpova	9/08/05	CHECKED	
APPROVED		ENGINEER: V. Dvorkin	9/08/05
DESIGNER		DESIGNER	
<p><b>CUSTOMER NOTICE</b></p> <p>LINEAR TECHNOLOGY HAS MADE A BEST EFFORT TO DESIGN A CIRCUIT THAT MEETS CUSTOMER-SUPPLIED SPECIFICATIONS; HOWEVER, IT REMAINS THE CUSTOMER'S RESPONSIBILITY TO VERIFY PROPER AND RELIABLE OPERATION IN THE ACTUAL APPLICATION. COMPONENT SUBSTITUTION AND PRINTED CIRCUIT BOARD LAYOUT MAY SIGNIFICANTLY AFFECT CIRCUIT PERFORMANCE OR RELIABILITY. CONTACT LINEAR TECHNOLOGY APPLICATIONS ENGINEERING FOR ASSISTANCE.</p> <p>THIS CIRCUIT IS PROPRIETARY TO LINEAR TECHNOLOGY AND SUPPLIED FOR USE WITH LINEAR TECHNOLOGY PARTS.</p>			
<p><b>LINEAR TECHNOLOGY</b></p> <p>1600 MacCarthy Blvd. Milpitas, CA 95035 Phone: (408)432-1900 Fax: (408)434-6507</p>		<p><b>TITLE</b></p> <p>LT5560EDD DOWNCONVERTING MIXER APPLICATION</p>	
SIZE	CAGE CODE	DWG NO	REV
SCALE:	FILENAME:	DC991A	A
Tuesday, February 07, 2006		SHEET	1 OF 1