

## DESCRIPTION

Demonstration circuit DC963B is optimized for an up-converting mixer test & measurement for input frequency range of 45MHz to 190MHz, output frequency range of 850MHz to 935MHz, (12dB return loss BW). The LO port frequency range is 520MHz to 920MHz (10dB return loss BW).

The LT<sup>®</sup>5560 is a 0.01MHz to 4000MHz low power, high performance broadband Up/Down-converting active mixer. This double-balanced mixer can be driven by a single-ended LO source and requires minus 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> = 140MHz, f <sub>LO</sub> =760MHz)	VALUE
Supply Voltage		2.7V to 5.0V
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	< 4000MHz
LO Signal Frequency Range	Requires External Matching	< 4000MHz
Signal Output Frequency Range	Requires External Matching	< 4000MHz
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	2.4dB
SSB Noise Figure	P <sub>LO</sub> = -2dBm	9.3dB
Input 3 <sup>rd</sup> Order Intercept	2-Tone, -20dBm/Tone, •f = 1MHz, P <sub>LO</sub> = -2dBm	+9.0dBm
Input 2 <sup>nd</sup> Order Intercept	2-Tone, -20dBm/Tone, •f = 1MHz, P <sub>LO</sub> = -2dBm	+47dBm
Input 1dB Compression	P <sub>LO</sub> = -2dBm	-2.8dBm
LO to IN leakage	P <sub>LO</sub> = -2dBm	-54dBm
LO to OUT leakage	P <sub>LO</sub> = -2dBm	-41dBm

### QUICK START PROCEDURE

Demonstration circuit DC963B 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 140MHz, and the other at 141MHz.
  6. To measure 3<sup>rd</sup> order distortion and conversion gain, set the Spectrum Analyzer start and stop frequencies to 898MHz and 903MHz, 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 900MHz and 901MHz,  $P_3$  is the 3<sup>rd</sup> order product at 899MHz and 902MHz, and  $P_{in}$  is the input power (in this case, -20dBm). All units are in dBm.
  8. Output 2<sup>nd</sup> order distortion product (OIM2) can be measured at 1041MHz, (140MHz+141MHz) + 760MHz = 1041MHz. To measure 2<sup>nd</sup> order distortion, set the Spectrum Analyzer start and stop frequencies to 1040MHz and 1042MHz, respectively. Sufficient spectrum analyzer input attenuation should be used to avoid distortion in the instrument.
  9. The input referred 2<sup>nd</sup> order intercept point (IIP2) is equal to  $P_1 - P_2 + P_{in}$ , where  $P_1$  is the power level of the fundamental output tone at 900MHz or 901MHz,  $P_2$  is the 2<sup>nd</sup> order distortion product at 1041MHz, and  $P_{in}$  is the input power (in this case -20dBm).

# QUICK START GUIDE FOR DEMONSTRATION CIRCUIT DC963B

## LOW POWER ACTIVE UP-CONVERTING MIXER

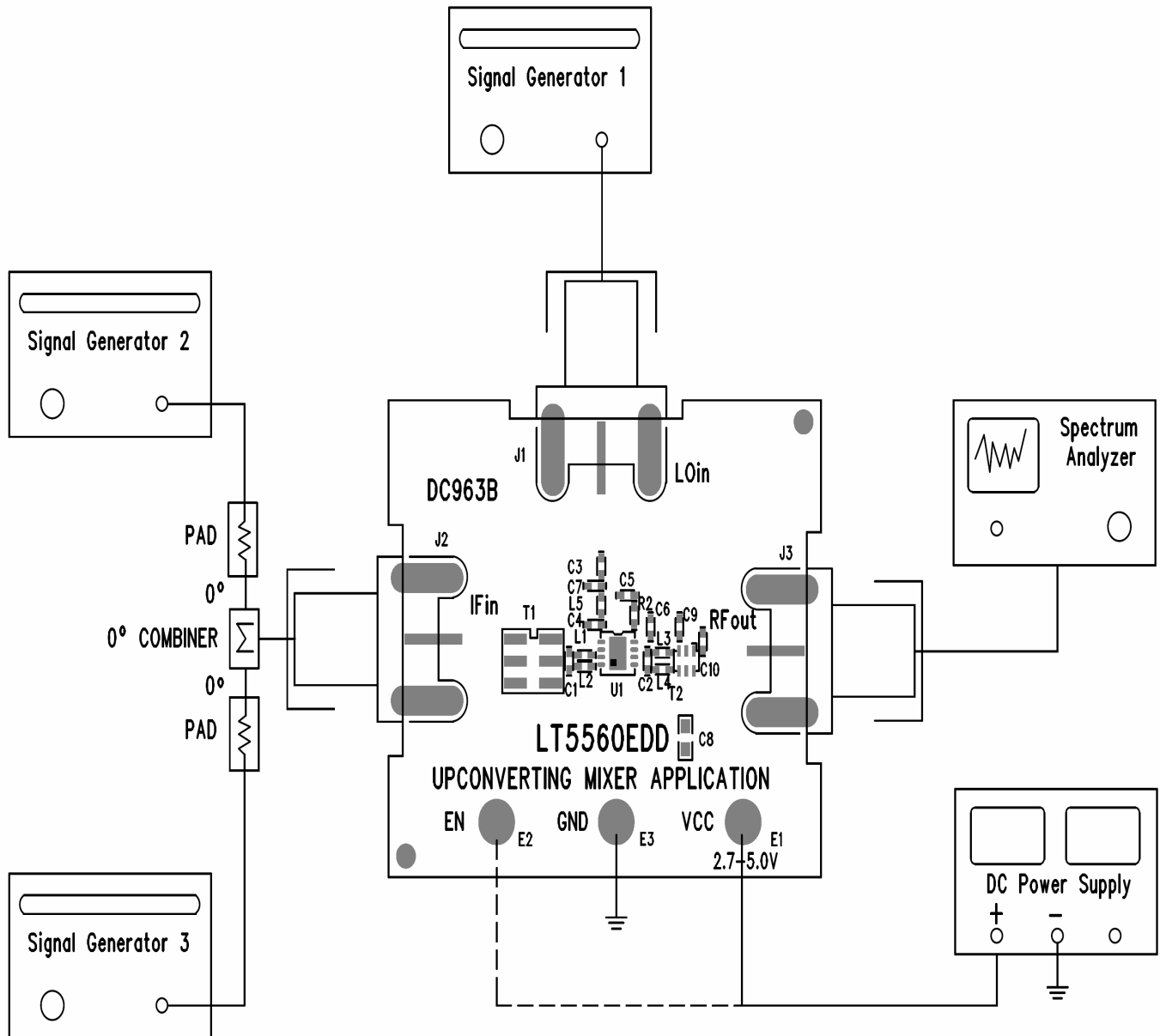
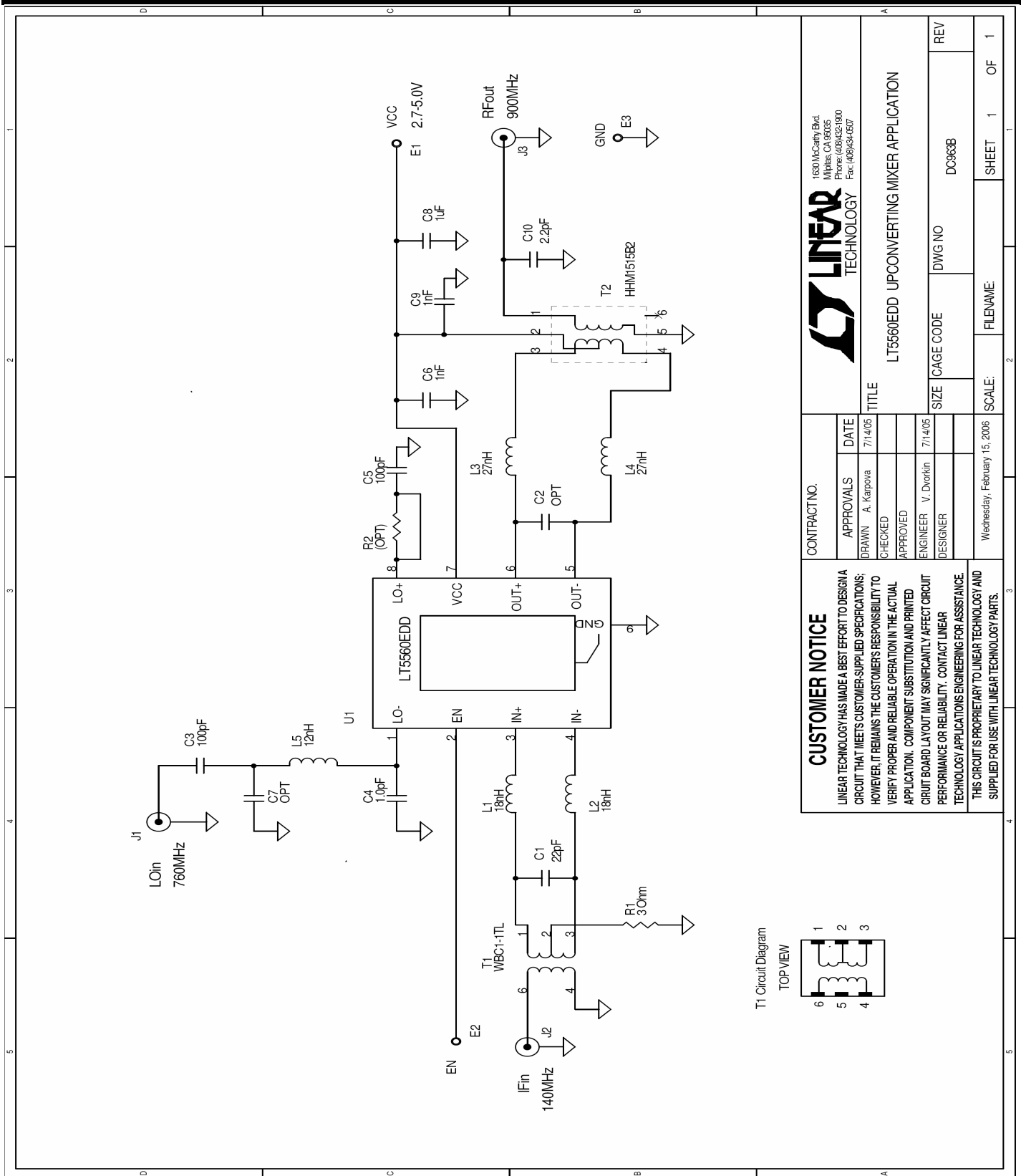


Figure 1. Proper Measurement Equipment Setup

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## LOW POWER ACTIVE UP-CONVERTING MIXER



<b>CUSTOMER NOTICE</b>		<b>CONTRACT NO.</b>	
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. THIS CIRCUIT IS PROPRIETARY TO LINEAR TECHNOLOGY AND SUPPLIED FOR USE WITH LINEAR TECHNOLOGY PARTS.			
APPROVALS	DATE	TITLE	
DRAWN: A. Kaipova	7/14/05	LT5560EDD UPCONVERTING MIXER APPLICATION	
CHECKED		SIZE	CAGE CODE
APPROVED		REV	DC963B
ENGINEER: V. Dvorkin	7/14/05	DWG NO	
DESIGNER		SCALE:	FILENAME:
Wednesday, February 15, 2006		SHEET	1 OF 1

