

# QUICK START GUIDE FOR DEMONSTRATION CIRCUIT 678A

## 40MHZ TO 900MHZ DIRECT CONVERSION QUADRATURE DEMODULATOR

LT5517

### DESCRIPTION

Demonstration circuit 678A is a 40MHz to 900MHz Direct Conversion Quadrature Demodulator featuring the LT5517. The LT5517 is a direct conversion quadrature demodulator optimized for high linearity receiver applications where high dynamic range is important. It is suitable for communications receivers where an RF signal is directly converted into I and Q baseband signals with a bandwidth up to 130MHz. The LT5517 incorporates balanced I and Q mixers, LO buffer amplifiers and a precision, broadband quadrature generator derived from an on-chip divide-by-two circuit.

The superior linearity and low noise performance of the LT5517 is achieved across its full frequency range. A

well-balanced divide-by-two circuit generates precision quadrature LO carriers to drive the I mixer and the Q mixer. Consequently, the outputs of the I-channel and the Q-channel are well matched in amplitude, and their phases are 90° apart. The LT5517 also provides excellent 50Ω impedance matching at the 2XLO port across its entire frequency range.

Demonstration circuit 678A is designed for operations in the frequency range between 40MHz and 900MHz.

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

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

PARAMETER	CONDITION (f <sub>RF</sub> = 800MHz, f <sub>LO</sub> = 1602MHz)	VALUE
Supply Voltage		4.5V to 5.25V
Supply Current	V <sub>CC</sub> = 5V, EN = High	90mA
Maximum Shutdown Current	V <sub>CC</sub> = 5V, EN = Low	20μA
RF Frequency Range		40MHz to 900MHz
2XLO Frequency Range		80MHz to 1800MHz
2XLO Input Power		-15dBm to 0dBm
Conversion Gain	Voltage Gain, Load Impedance = 1kΩ, P <sub>RF</sub> = -10dBm, P <sub>2XLO</sub> = -10dBm	3.3dB
Noise Figure	P <sub>2XLO</sub> = -10dBm	12.4dB
Input 3 <sup>rd</sup> Order Intercept	2-Tone, -10dBm/Tone, Δf = 200kHz, P <sub>2XLO</sub> = -10dBm	21dBm
Input 2 <sup>nd</sup> Order Intercept	2-Tone, -10dBm/Tone, Δf = 200kHz, P <sub>2XLO</sub> = -10dBm	58dBm
Input 1dB Compression	P <sub>2XLO</sub> = -10dBm	10dBm
Baseband Bandwidth		130MHz
I/Q Gain Mismatch	P <sub>RF</sub> = -10dBm, P <sub>2XLO</sub> = -10dBm, output frequency = 1MHz	0.03dB
I/Q Phase Mismatch	P <sub>RF</sub> = -10dBm, P <sub>2XLO</sub> = -10dBm, output frequency = 1MHz	0.7°
Output Impedance	Differential	120Ω
2XLO to RF leakage	P <sub>2XLO</sub> = -10dBm	-69dBm
LO to RF leakage	P <sub>2XLO</sub> = -10dBm	-80dBm
RF to 2XLO Isolation	P <sub>RF</sub> = -10dBm	63dB

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### APPLICATION NOTE

#### FREQUENCY RANGE

Demonstration circuit 678A is designed for the broad frequency range between 40MHz and 900MHz. However, further improvements in performance at specific frequencies may be achieved by employing appropriate external RF input matching.

#### 2XLO INPUT

The 2XLO frequency is required to be twice the desired operating frequency in order for the chip to generate the quadrature Local Oscillator (LO) signals for the demodulator. The on-chip divide-by-two circuit delivers well-matched, quadrature LO carriers to the I mixer and the Q mixer.

### QUICK START PROCEDURE

Demonstration circuit 678A is easy to set up to evaluate the performance of the LT5517. 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-tone measurements. Otherwise, low-pass filters at the signal generator outputs should be used to suppress higher-order harmonics.
  - b. High quality combiners that provide 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 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 120mA, and adjust output voltage to 5V.
  3. Connect Vcc to the 5V DC supply, and then connect EN to 5V; the demodulator is enabled (on).

The 2XLO port is also internally matched to 50Ω impedance. No external matching is required for its entire operating frequency range.

#### OUTPUT FILTERING

Proper filtering of unwanted high frequency mixing products at the I- and Q-outputs is important to maintain superior linearity. The most convenient method is to terminate each output with a shunt capacitor to ground. The capacitor value should be optimized depending upon the operating frequency. However, the capacitors may reduce baseband output bandwidth. In the standard demonstration circuit 678A, each I- and Q-output is terminated with a 10pF shunt capacitor.

4. Set Signal Generator #1 to provide a 1602MHz, -10dBm, CW signal to the demo board 2XLO input port.
5. Set the Signal Generators #2 and #3 to provide two -10dBm CW signals to the demo board RF input port—one at 799.9MHz, and the other at 800.1MHz.
6. Set the Spectrum Analyzer's start frequency to 100kHz and stop frequency to 1400kHz. Perform input 2<sup>nd</sup> order and 3<sup>rd</sup> order distortion measurement. Sufficient spectrum analyzer input attenuation should be used to avoid saturating the instrument.
7.  $IIP2 = P1 - P2 + Pin$ ,  $IIP3 = (P1 - P3) / 2 + Pin$ . Where P1 is the power level of the two fundamental output tones at 900kHz and 1100kHz, P2 is the 2<sup>nd</sup> order product at 200kHz, P3 is the 3<sup>rd</sup> order product at 700kHz and 1300kHz, and Pin is the input power (in this case, -10dBm). All units are in dBm.
8. Voltage conversion gain can also be measured. But beware that the gain is reduced by combiner loss plus 6.85dB, because the load impedance to each output pin is 50Ω in this setup. Please refer to the LT5517 data sheet for more detailed explanation.

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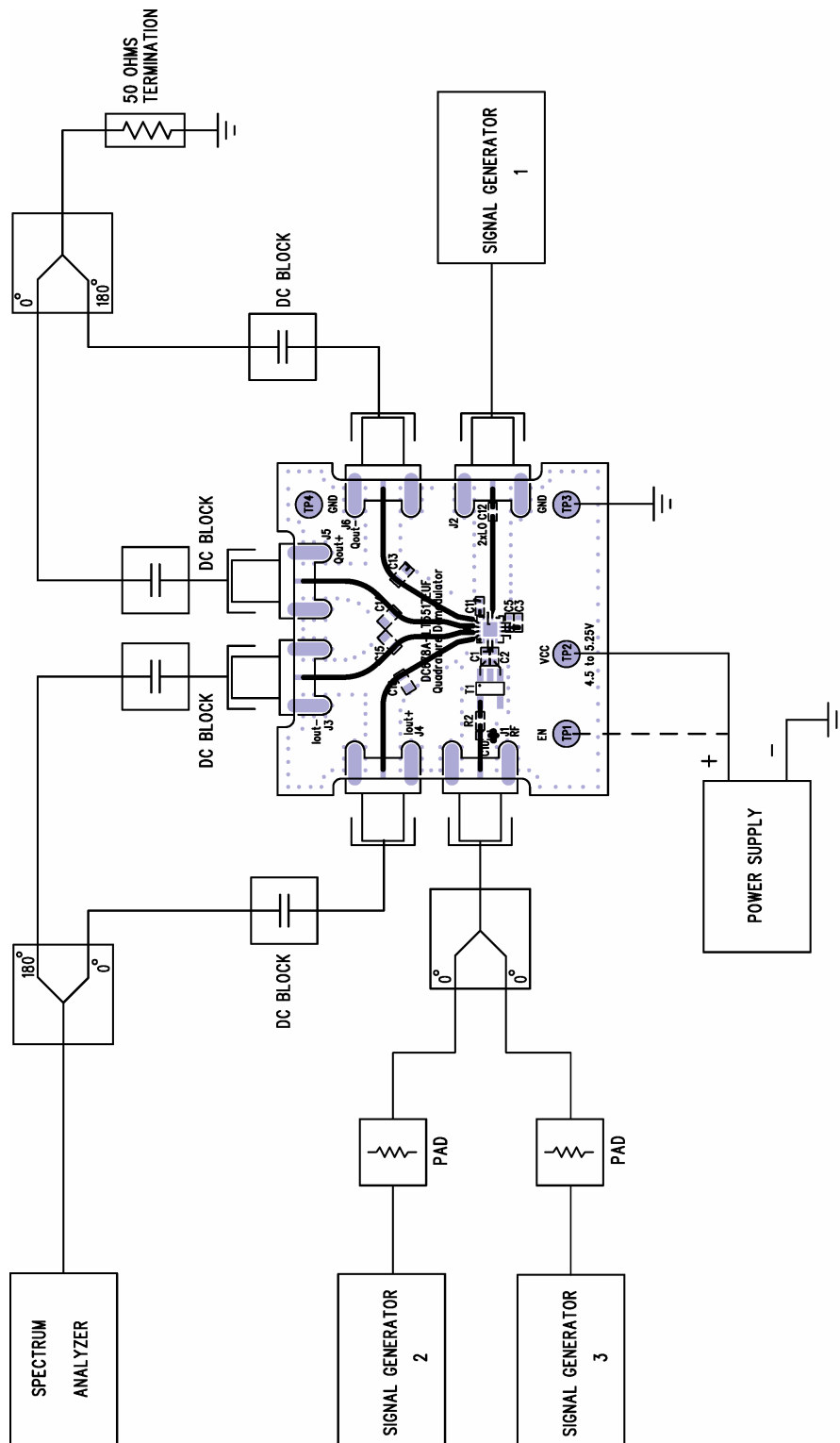
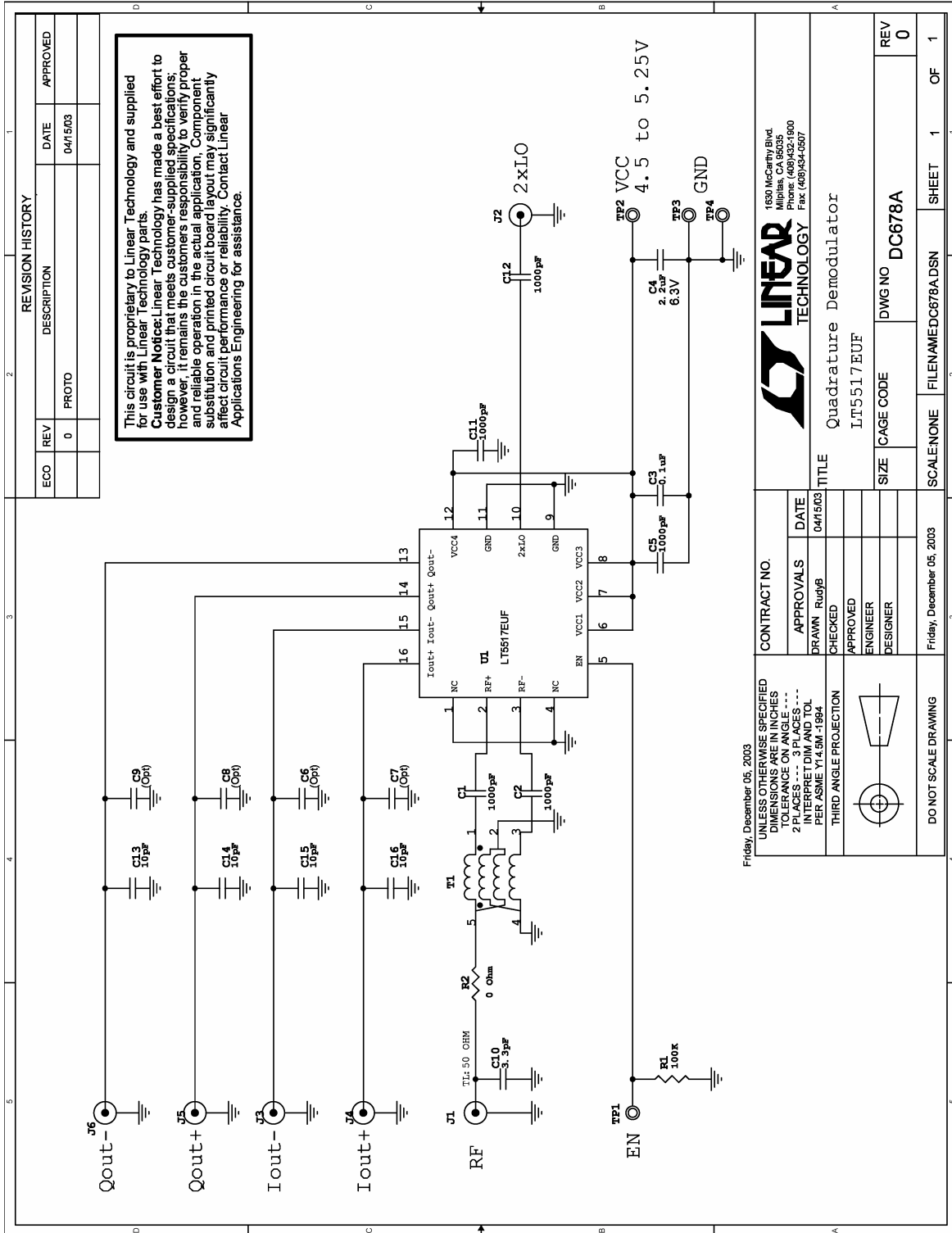


Figure 1. Proper Measurement Equipment Setup

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<i>Item</i>	<i>Qty</i>	<i>Reference</i>	<i>Part Description</i>	<i>Manufacture / Part #</i>
1	5	C1,C2,C5,C11,C12	Cap., NPO 1000pF 25V 5%	AVX 06033A102JAT1A
2	1	C3	Cap., X7R 0.1uF 16V 20%	Taiyo Yuden EMK107BJ104MA
3	1	C4	Cap., X5R 2.2uF 6.3V 10%	Taiyo Yuden JMK107BJ225KA-T
4	0	C6,C7,C8,C9 (Opt)	Cap., NPO 4.7pF 25V 10%	04023A4R7KAT2A
5	1	C10	Cap., NPO 3.3pF 25V 10%	AVX 06033A3R3KAT2A
6	4	C13-C16	Cap., NPO 10pF 50V 10%	AVX 08055A100ZAT1A
7	6	J1,J2,J3,J4,J5,J6	CON., SMA 50-OHM	E.F. JOHNSON 142-0701-851
8	1	R1	Res., Chip 100K 0.1W 5%	AAC CR16-104JM
9	1	R2	Jumper, Chip 0 Ohm 0.06W 5%	AAC CJ06-000M
10	4	TP1,TP2,TP3,TP4	Turret, Testpoint	Mill Max 2501-2
11	1	T1	XFMR., 4:1 Imp. Ratio	Tyco/Elect. M/ACOM MABAES0054
12	1	U1	I.C., LT5517EUF	Linear Tech. Corp. LT5517EUF
13	1		FAB., PRINTED CIRCUIT BOARD	DEMO CIRCUIT 678A
14	1		STENCIL	STENCIL # 678A

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