HPMX-2006
Demonstration Circuit Board

rev AP060596A

Applications Bulletin

Introduction

The circuit board described is designed for use with HPMX-2006 up converter / amplifier MMIC. The board can be set up to test the mixer alone or to test the mixer/amp combination. It allows testing the MMIC at different frequencies including 900 MHz and 1500 -2500 MHz.

Assembly Notes

Figures 2 and 3 show the parts used on the board and their placement. Table 4 lists the parts you will need to assemble the circuit board for the different operating frequency bands.

If you are not familiar with surface mount PC board assembly, please read Application Note MR102993A which details a recommended assembly technique.

1) **Always** use bypass capacitors on the Vcc lines. Vcc can be set anywhere from 2.7 to 5.5 Volts. **It is strongly recommended that you do not exceed the maximum IC voltage ratings shown on the IC data sheet.**

2) The board has been laid out to allow the use of E.F. Johnson SMA connectors (part no. 142-0701-631 or 142-0701-621), available from DigiKey and other suppliers.

3) Most of the components used on the board are the 0402 variety of chip component (40 mils x 20 mils).

Using the Board

The board can be set up for different input and output configurations. Figure 2 shows the schematic of the board for a typical 1500 - 2500 MHz test set-up. It uses unbalanced LO and IF inputs. Figures 8 and 9 show modifications to the output for different operating frequency bands.

The board does not include coupling capacitors at the LO, IF, amplifier inputs or at the RF output. You can either use connectorized coupling capacitors, or you can cut the transmission lines at those pins and mount a capacitor on the circuit board.

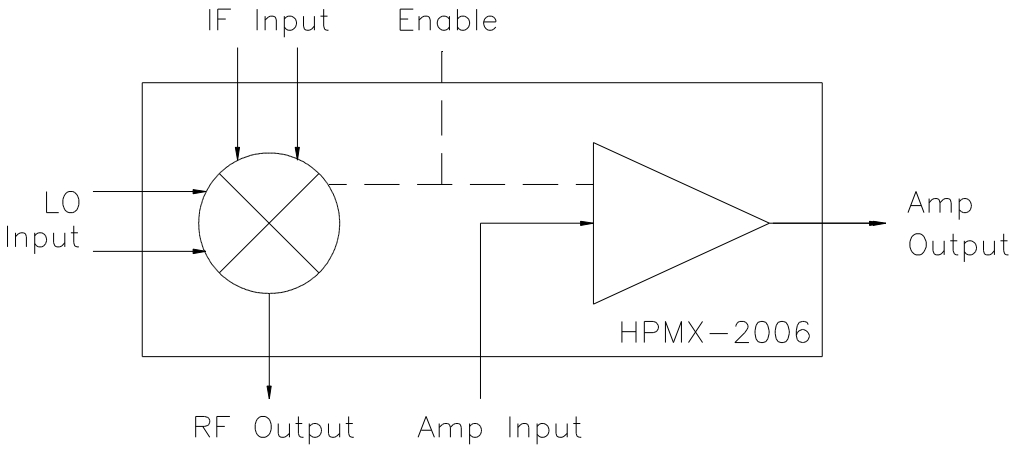

Table 1. HPMX-2006 IC pinout

Pin No.	Pin Function Name	Description	
1	LO	differential mixer LO input	-3 dBm from single-ended, 50 Ω source
2	LObar		
3	Ref.	internal voltage reference	≈ Vcc/2 ≥ 1.5 V
4	IF	differential mixer IF input	-6 dBm from single-ended, 50 Ω source
5	IFbar		
6	AmpVee1	ground	* 0V
7	AmpRFin	amplifier input	- 9.5 dBm from 50 Ω source
8	Enable	chip (amp and mixer) enable input	<0.4V disables; >2.5V enables IC
9	MxRFout	mixer RF output	- 9.0 dBm into 50 Ω source
10	gnd1	ground	0V
11	Amp1Vee2	ground	* 0V
12	AmpVee2	ground	* 0V
13	AmpRFout	amplifier output	+3.8 dBm into 50 Ω source
14	AmpVcc	amplifier Vcc input	3V, 23 mA
15	gnd	ground	0V
16	MxVcc	mixer Vcc input	3V, 15 mA

* note: leave these three pins open to disable the amplifier. AmpVcc pin (pin 14) must be connected to Vcc at all times for proper operation of the IC even if the amplifier is disabled. When the amplifier is disabled, DC current drain drops to that of the mixer alone (15 mA).

Table 2. HPMX-2006 typical performance. Vcc = 3.0V, Temp=25°C, LO= -3 dBm @ 1750 MHz, IF= -6 dBm @ 150 MHz. Mixer and amplifier performance was measured independently.

Parameter	Description	Measured	Units
Icc MX	mixer current drain	15	mA
Icc AMP	amplifier current drain	23	mA
P1dB MX	mixer SSB power output at 1 dB compression point	- 9	dBm
P1dB AMP	amplifier power output at 1 dB compression point	+4.5	dBm
Po mixer @ Vif=30mVpp	Mixer Output Power (IF port terminated with 50 Ω resistor)	- 28	dBm
g	small signal amplifier gain	14.5	dB
LOleak	mixer LO leakage	- 21	dBc
iso	mixer output to amplifier input isolation	30	dB
	mixer phase noise @ 1 dB compression	- 144	dBm/Hz

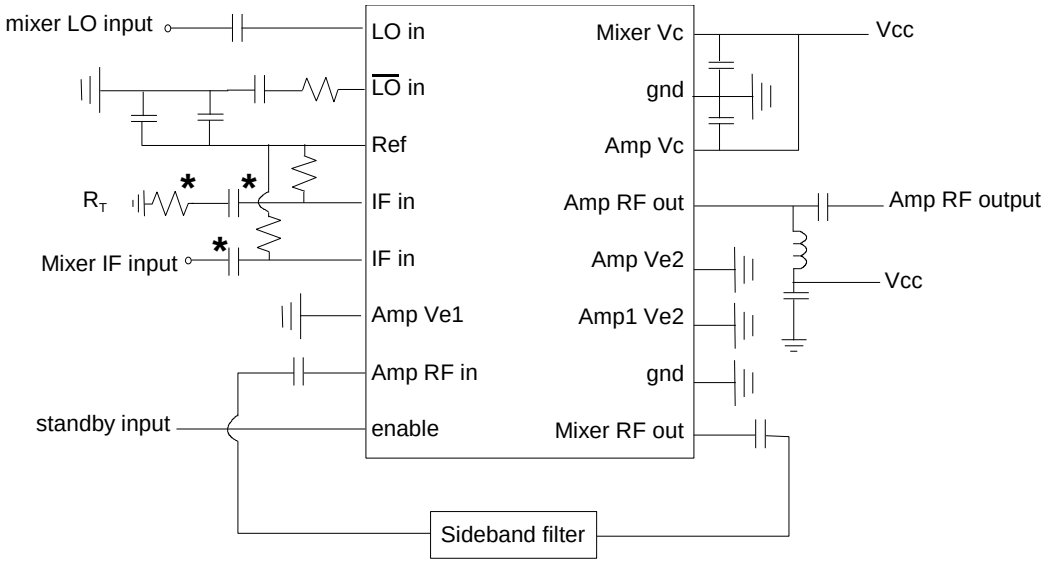

Figure 1. Typical application circuit for the HPMX-2006 upconverter/amplifier IC. Component values match those of test board- refer to table 4. R_T (optional) should be the same value as the IF source impedance. Asteriks indicate off-board components.

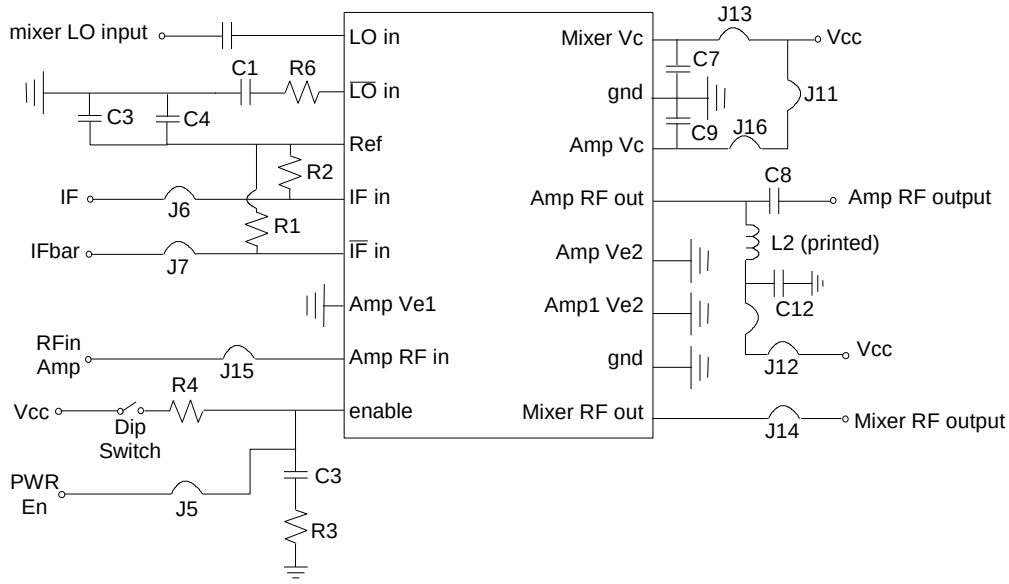

Figure 2. Schematic diagram of typical demo board use. Amplifier output tuned at 1500-2500 MHz. This schematic corresponds to the component placement diagram figure 3. Component values are shown in table 4. Note: L1 (shown in figure 4) is replaced by a jumper. C12 is used to tune the output at any specific frequency, by moving it along printed inductor L2. R3, R4 and C11 are optional components to allow dynamic testing of the chip enable function.

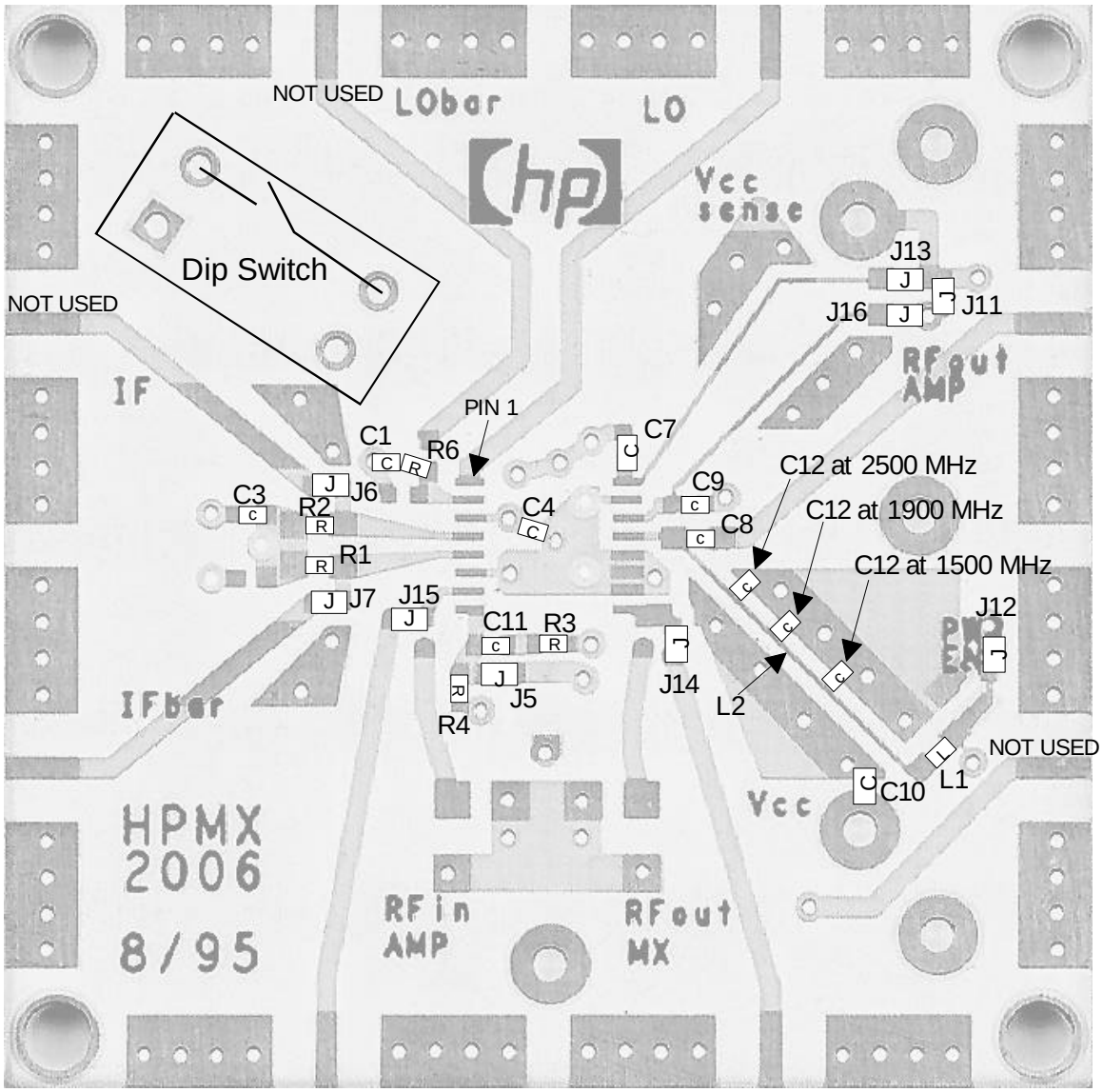

Figure 3. Typical demonstration test circuit board component placement for 1500-2500 MHz test board shown in figure 2. C12 positions along L2 are approximate - accurate placement should be determined by the board user. L1 is replaced by a 0Ω jumper. Note: C4 mounts on the bottom of the board. The solder mask will have to be removed from the pads to mount C4.

Table 3. Demonstration board I/O definitions and typical signal levels for operation at 1900 MHz. Note- I/O levels are for amplifier and mixer tested separately.

Board Label	Function	Typical Signal
LO	differential mixer LO input	-3 dBm, 1750 MHz from a
LObar	Z ≈ 50 Ω	50 Ω, single-ended source
IF	differential mixer IF input	-6 dBm, 150 MHz from a
IFbar	hi-Z (open base)	50 Ω, single-ended source
RFin AMP	RF amplifier input	- 9.5 dBm, 1900 MHz from a 50 Ω source
Vcc	power connection	3 V, 38 mA
PWR En	chip disable (power down) input	PWR En >2.5V,chip enabled PWR En <0.4V,chip disabled
RFout AMP	RF amplifier output	3.8 dBm,1900 MHz into 50 Ω
RFout MX	Mixer Output	-9 dBm, 1900 MHz into 50 Ω

Table 4. Demonstration board component values. Figure 5 shows parts placement for all the components listed. Not all components are used for all operational configurations. Refer to figures 6-9 for more details.

Component	Value	Function
C1	X pF	LObar termination capacitor. X=12 if < 1.75GHz, X=2.7 if > 1.75 GHz
C3	1000 pF	ref. pin bypass capacitor
C4	10 pF	ref. pin bypass capacitor
C5	100 pF	Vcc bypass capacitor for 900 MHz
C7	.01 µF	Vcc bypass capacitor at mixer Vcc input pin
C8	2.2 pF	Amplifier RF output coupling/tuning capacitor
C9	22 pF	Amplifier Vcc bypass capacitor
C10	1000 pF	Vcc bypass capacitor
C11	1000 pF	PWR En line termination capacitor (optional, use with R3 and R4)
C12	100 pF	Sets value of printed inductor L2, also Vcc bypass
C14	1.3 pF	Used in place of J14 and with L3 for 900 MHz operation only (optional)
C15	3.3 pF	Used in place of J15 for 900 MHz operation only (optional for improved VSWR)
R1	50 Ω	IF input termination/bias resistor
R2	50 Ω	IF input termination/bias resistor
R3	50 Ω	Enable input termination resistor (optional, use with R4 and C11)
R4	200 Ω	Switch + 200 Ω resistor. Remove for dynamic testing
R6	X Ω	LObar termination resistor X=12 for ≤ 1.75 GHz or X=0 for >1.75 GHz
J5	0 Ω	Connects to Enable input. Remove if DIP switch is used
J6	0 Ω	Connects IF line to mixer IF input.
J7	0 Ω	Connects IFBar line to mixer IFbar input
J8	0 Ω	Jumper that connects LObar to the IC. If used, omit C1 and R6
J9	0 Ω	Connects mixer output to filter, use only with filter
J10	0 Ω	Connects filter output to amplifier input, use only with filter
J11	0 Ω	Connects the Vcc line to the AmpVcc pin of the IC.
J12	0 Ω	Connects the Vcc line to the AmpRFout pin of the IC
J13	0 Ω	Connects the Vcc line to the MxVcc pin of the IC
J14	0 Ω	Connects IC mixer output to RFout MX connector. Remove if using on-board filter
J15	0 Ω	Connects RFin AMP connector to IC amplifier input. Remove if using on-board filter
J16	0 Ω	Connects the Vcc line to the AmpVcc pin of the IC.
L1	4.7 nH	Used only at 900 MHz. At higher frequencies, replace with a jumper
L2	printed	Used to tune output of amplifier. Tuned by moving C12 along the line.
L3	27 nH	Optional - used only at 900 MHz to improve mixer output VSWR
Filter		optional Siemens DECT filter CGR1.89
DIP Switch		Used to enable/disable the IC. Figure 3 shows the active switch.

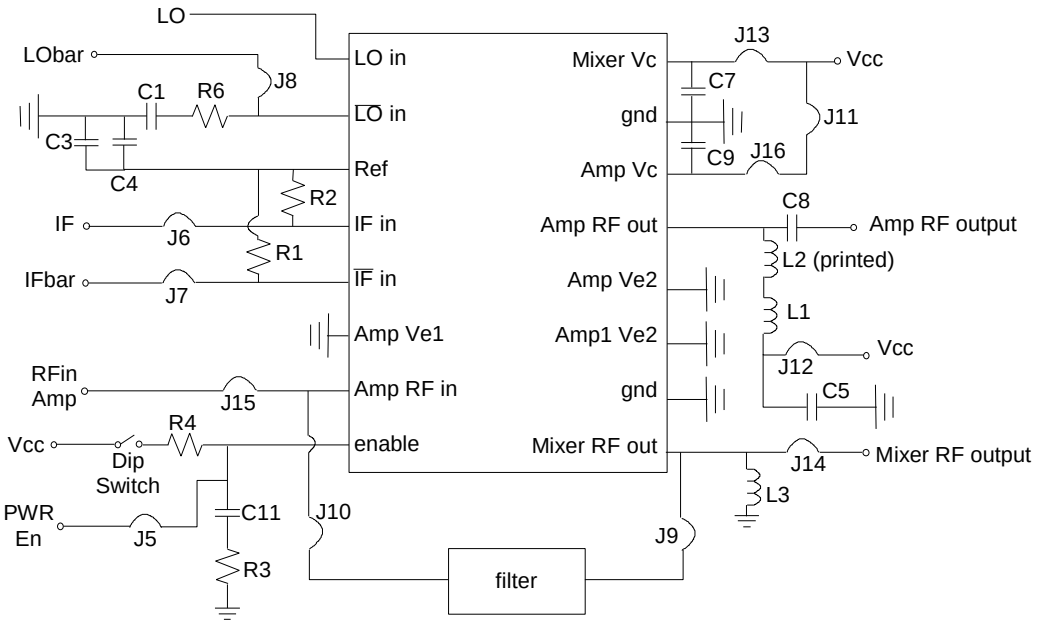

Figure 4. HPMX-2006 demonstration board schematic diagram . Amplifier output tuned at 900 MHz. Component values are listed in Table 4. Labels match those silk-screened onto the circuit board. See figure 5 for component placement on the board.

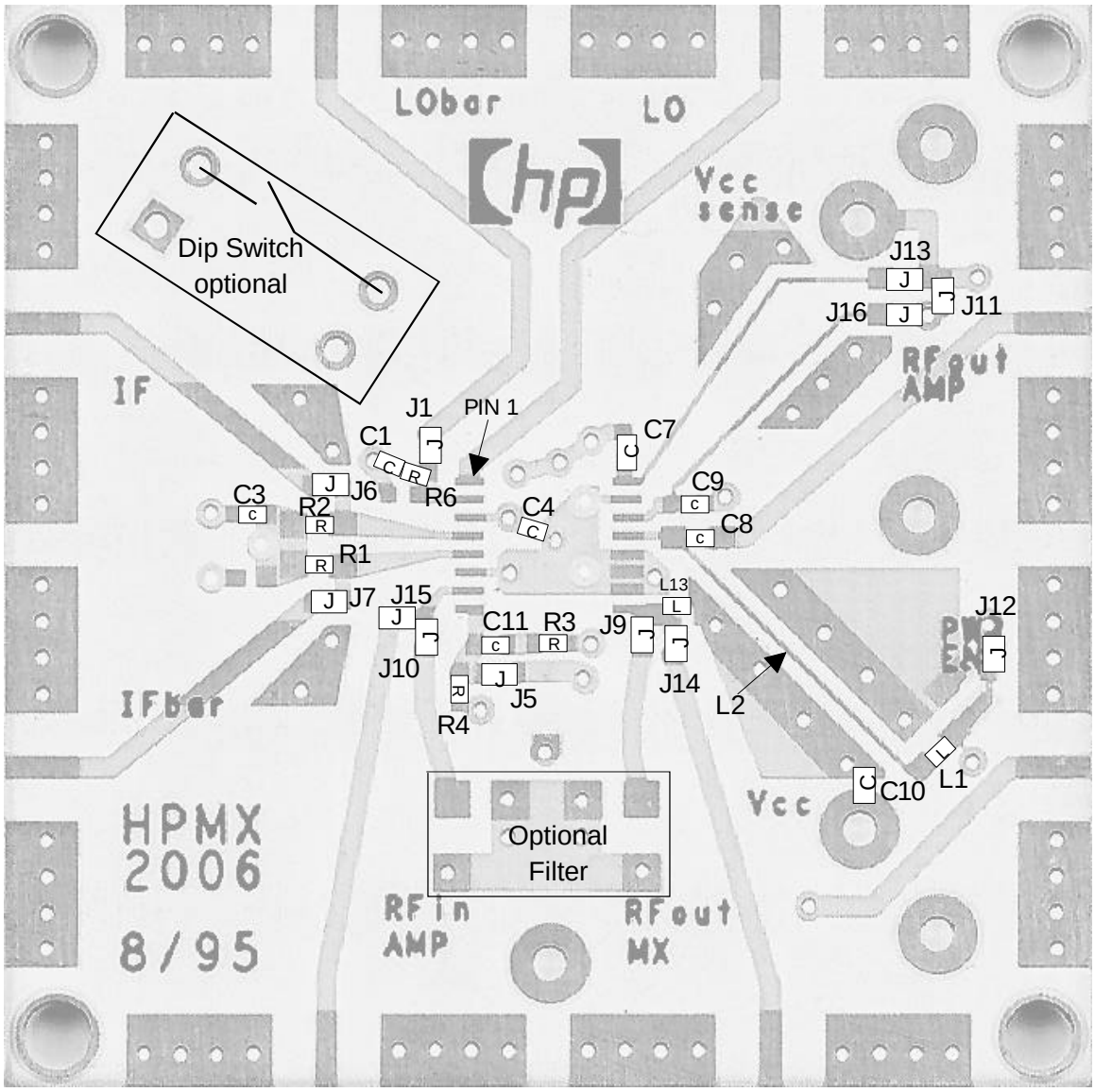

Figure 5. Component placement on the demonstration circuit board. The IC and SMA type connectors are not shown. Position of C12 along L2 will depend upon the intended output frequency. Figure 3 shows approximate positions for different frequencies. Note: C4 is mounted on the bottom side of the board- the solder mask will have to be removed from the pads in order to install C4. Component values are listed in table 4, board schematic in figure 4.

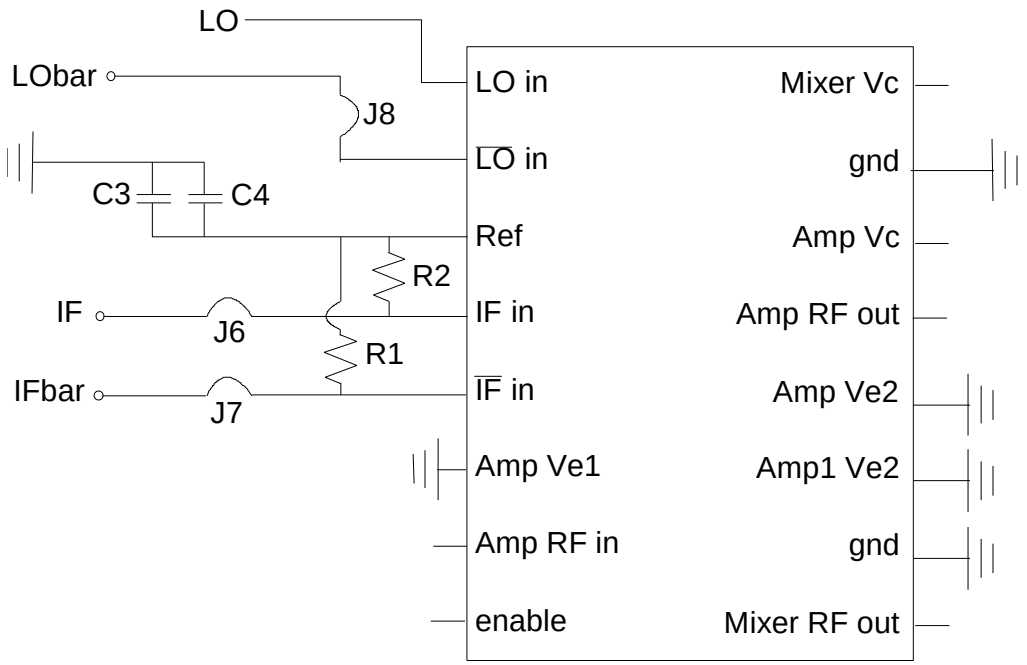

Figure 6. Detail of circuit options showing how to use balanced (differential) mixer LO and IF input lines. Component values are listed in Table 4.

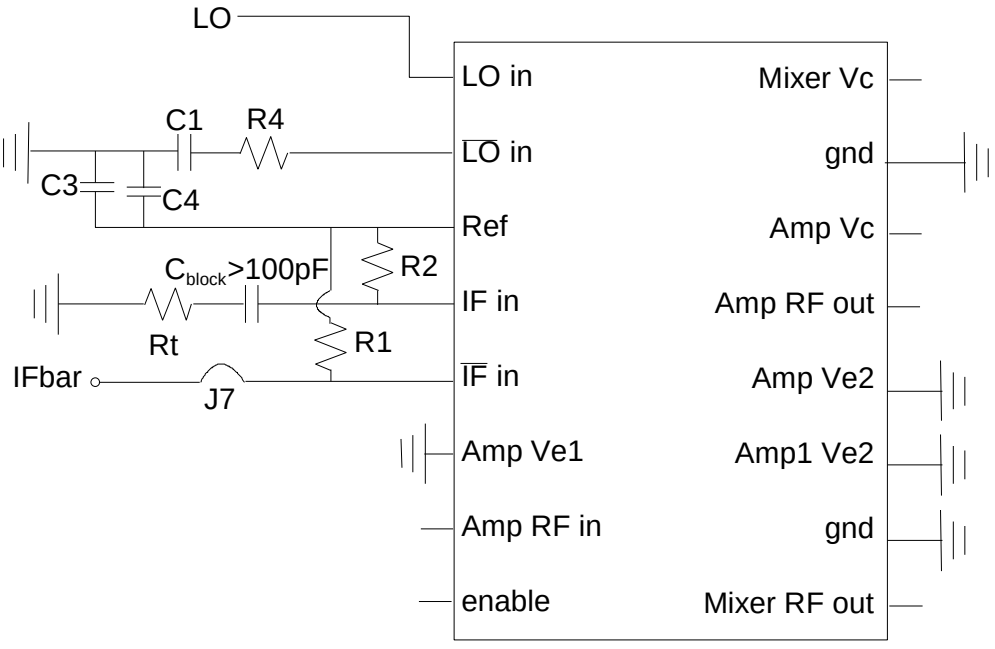

Figure 7. Detail of circuit options showing how to use unbalanced (single-ended) mixer LO and IF input lines. Component values are listed in Table 4. Rt is optional, should be the same value as the IF source impedance.

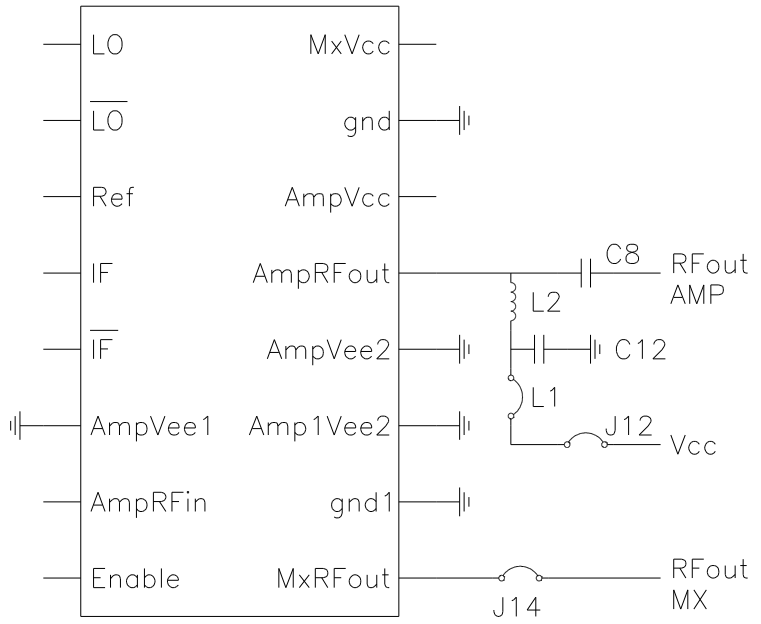

Figure 8. Detail of the demonstration board circuit with output network for 1500-2500 MHz operation. Component values are listed in table 4. Note: C12 is moved along the printed inductor (L2) to tune the output for minimum VSWR. See figure 3 for approximate C12 positions. L1 (shown in figure 3) is replaced with a jumper.

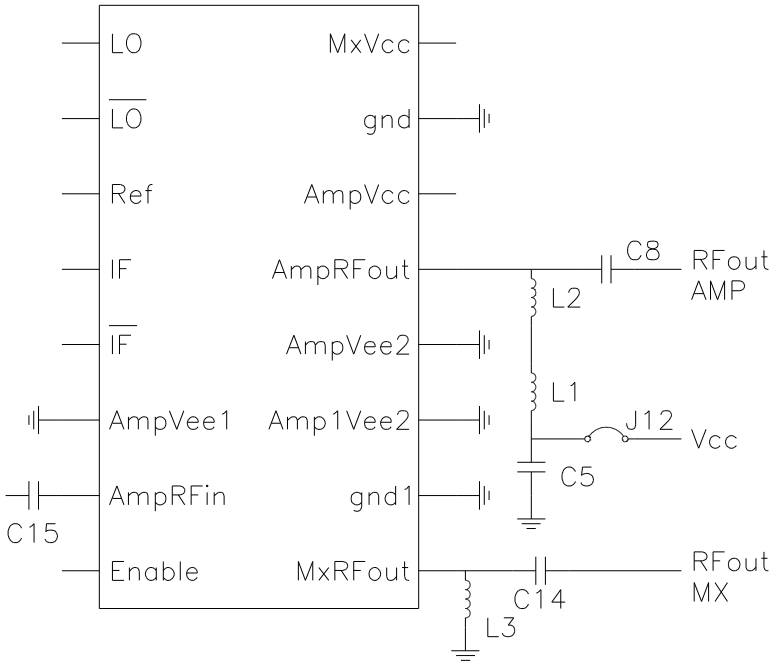

Figure 9. Detail of the demonstration board circuit with output network for 900 MHz operation. Component values are listed in table 4. C12 is not used. Note: C15 replaces J15 to tune the amplifier input. C14 replaces J14. L3 and C14 improve the mixer output VSWR.

Note: this is a preliminary printing of this applications note. Any error reports, omissions, deletions, etc., or comments should be directed to Albert Pham, CMCD Applications Engineer, 510-505-5548.