Lab 4 Report

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I. Mixer conversion loss

1. Connect the system based on the schematic shown in Fig. 1.

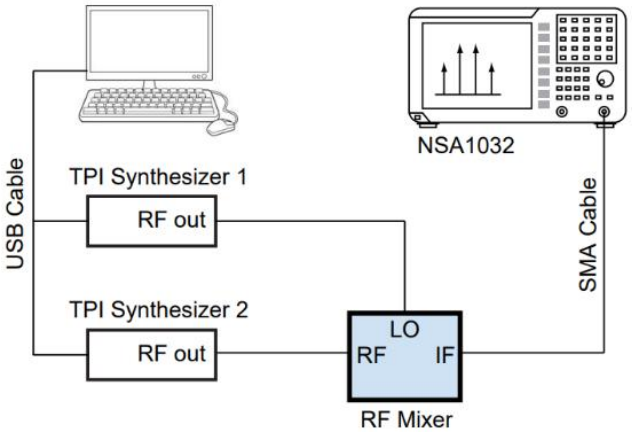

Fig. 1. Mixer characterization setup.

2. Set the output power of the first TPI synthesizer to 10 dBm.

3. Set the output power of the second TPI synthesizer to 0 dBm.

4. Power on the amplifier and spectrum analyzer.

5. Set the frequencies of the TPI synthesizers to investigate how the conversion-loss changes with frequency. The conversion loss can be calculated as.

Conversion Loss (dB) = *RF Port Power* (dBm)−*IF Port Power* (dBm).

TABLE I. Table Type Styles

RF Port Frequency (MHz)	LO Port Frequency (MHz)	RF Port Power (dBm)	IF Port Power (dBm)	Conversion Loss (dB)
1000	1030	0.48	-7.78	8.26
1500	1530	-0.54	-4.91	4.37
2000	2030	-0.6	-5.2	4.6
2500	2530	-0.38	-6.56	6.18
3000	3030	-0.8	-4.53	3.73
3500	3530	-0.368	-6.4	6.032
4000	4030	-0.368	-6.3	5.932

The frequencies set by the TPI synthesizer, the measured data and the calculated conversion loss are shown in Table 1. Among them, since the spectrum meter can only measure up to 3.2GHz, the RF output power above 3.2GHz is calculated according to the average of the previous data -0.368dBm.

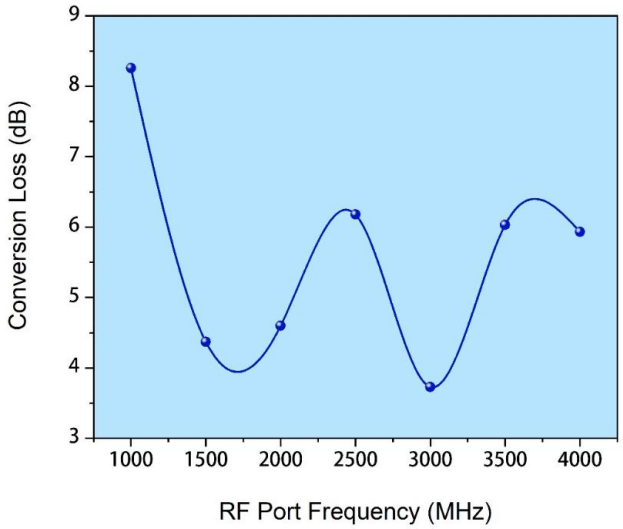

Fig. 2. The conversion loss as a function of RF port frequency.

The curve of conversion loss with frequency is shown in Fig. 2. As can be seen from the graph, the conversion loss is around 6dB, which is in line with the typical values in the datasheet.

II. LO Feed-through

1. Now we use the same setup as in part 1 to measure the LO feedthrough at different frequencies. Set the output power of the first TPI synthesizer to 10 dBm. Turn off the second TPI synthesizer to block the RF port of the mixer.

2. Set the output frequency of the first TPI synthesizer from 1 GHz to 3 GHz in increment of 0.4 GHz, and note down the measured IF port power.

3. Calculate the LO feedthrough at those frequencies by the following equation

LO Feedthrough (dB) = LO Port Power (dBm)−IF Port Power (dBm).

TABLE II. LO and IF port power of various LO frequencies from 1G to 3G

LO Port Frequency (GHz)	LO Port Power (dBm)	IF Port Power (dBm)	LO Feedthrough (dB)
1	10.45	-12.62	23.07

1.4	9.74	-22.85	32.59
1.8	10.78	-12.86	23.64
2.2	9.24	-6.99	16.23
2.6	9.85	-10.69	20.54
3.0	8.89	-17.06	25.95

The LO port frequency set by the TPI synthesizer, the measured data and the calculated LO feedthrough are shown in Table 2.

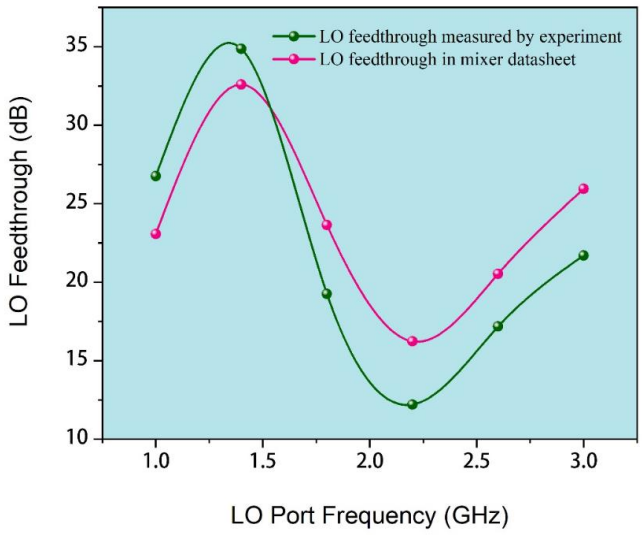

Fig. 3. Measured LO feedthrough and LO feedthrough in the mixer datasheet as a function of LO port frequency.

Fig. 3 shows the experimentally measured LO feedthrough values compared with those in the mixer datasheet. As can be seen from the graph, our measurements are very close to the typical values in the datasheet, with the same trend at different frequencie.

III. MIXER P1DB

1. Use the same setup as the previous experiments. Set output power and frequency of the first TPI synthesizer to 10 dBm and 2500 MHz. Set the output frequency of the second TPI synthesizer to 2530 MHz.
2. Vary the output power of second TPI synthesizer and measure the IF output power of mixer at each input level. The RF output power set by the TPI synthesizer and the measured IF port power data are shown in Table 3.

TABLE III. IF PORT POWER OF VARIOUS RF OUTPUT POWER

RF output power (dBm)	IF port power (dBm)
0	-6.14
1	-5.23
2	-4.19
3	-3.44
4	-2.8
5	-2.2
6	-1.77
7	-1.37
8	-1.08
9	-0.84

3. Extract the P1dB of the mixer and compare it with the datasheet.

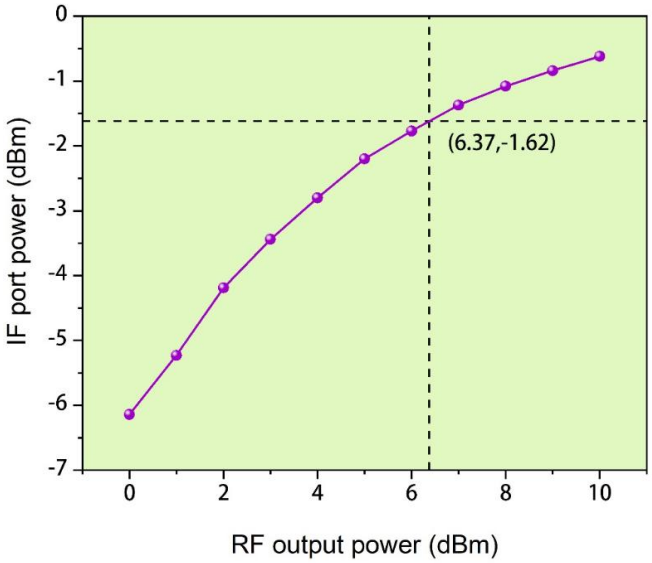

Fig. 4. IF port power as a function of RF output power.

The variation of the mixer IF port power with the output power of the RF is shown in Fig. 4. From the figure, we can get that P1dB is about 6.37dBm, while the data sheet shows a typical value of 9dBm for the 1dB compression point.

There is an error between our measured data and the typical values in the mixer data table. However, this error can be expected, because our TPI synthesizer can output the maximum power of only 10dBm, as can be seen from the figure, when the RF output power of 10dBm, the mixer output power is still approximately linear, so our measurement of the 1dB compression point is certainly inaccurate, the actual results should be greater than the results of our current measurements.

IV. APPENDIX

4.1			4.2			4.3	
			GHz	10 dBm			
RF f	RF	IF	LO	LO	IF	RF dB	IF
1000	0.48	-7.78	1	10.45	-12.62	0	-6.14
1500	-0.54	-4.91	1.4	9.74	-22.85	1	-5.23
2000	-0.6	-5.2	1.8	10.78	-12.86	2	-4.19
2500	-0.38	-6.56	2.2	9.24	-6.99	3	-3.44
3000	-0.8	-4.53	2.6	9.85	-10.69	4	-2.8
3500	0	-6.4	3	8.89	-17.06	5	-2.2
4000	0	-6.3				6	-1.77
						7	-1.37
						8	-1.08
						9	-0.84
						10	-0.62

Fig. 5 Appendix data