Exercise of Electronics for Communication Systems Prof. C. Abbate, G. Busatto - A.A. 2018/2019

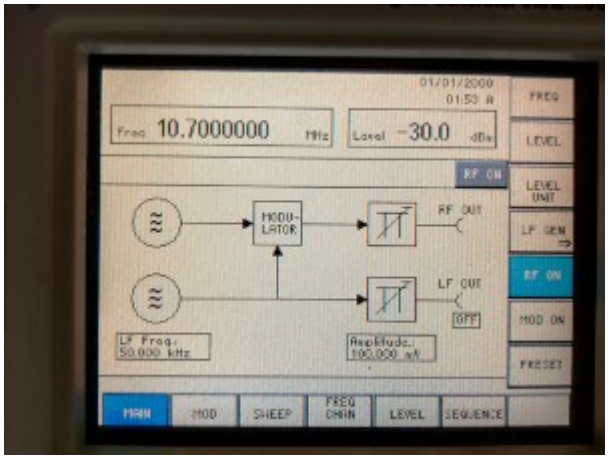
09 – Experimental characterization of a Mixer for FM Receiver

21/11/2018 – Diego Tuzi – 50435 – diego.tuzi@studentmail.unicas.it

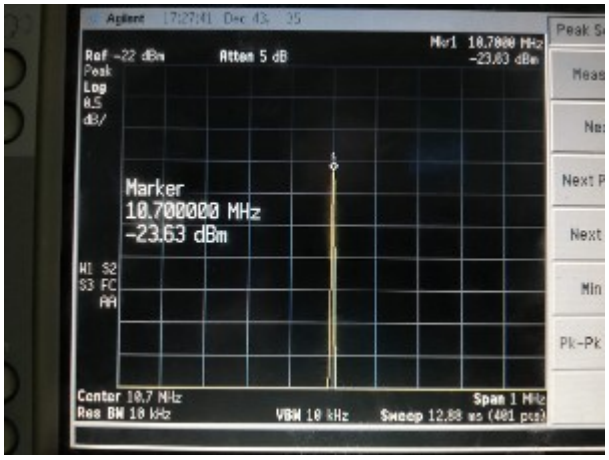
TUNING OF THE MIXER

For performing the tuning of the Mixer we will use it as an amplifier. For this purpose, connect the RF generator to the RF lead of the circuit and measure its output with the spectrum analyzer. Note that the OL input of the mixer is not connected.

- Remove the jumper JP2_Vcc, It allows us to disconnect the power supply from the LO during the test of the mixer;
- Remove the jumper JP1 which connects the output of the LO to the second input of the mixer;
- Insert the jumper JP1_Vcc to connect the power supply to the mixer;
- Set frequency and amplitude of the RF generator to 10.7MHz and -30dBm, respectively;
- Set the spectrum analyzer with: center frequency = 10.7MHz; span = 1MHz; amplitude = 0.5dB/div;
- Trim the medium frequency transformer T1 (MF1) in such a way to have the maximum gain of the amplifier.



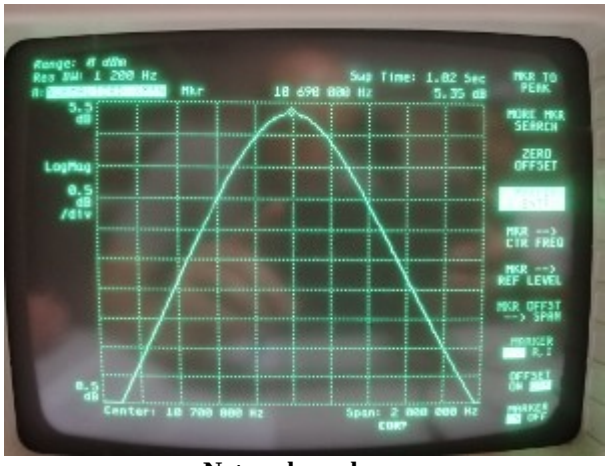
RF generator
Freq=10,7 MHz
Level=-30dBm



Spectrum Analyzer
After T1 tuning maximum gain at 10,7 MHz
Maximum Gain=6,5 dB

MEASUREMENT OF THE FREQUENCY RESPONSE OF THE TUNED AMPLIFIER

To perform this operation we will use the Network Analyzer: Calibrate the network analyzer and connect its terminal to the BNC connectors RF_in and IF_out for measuring the frequency response of the amplifier.



Network analyzer
Center Frequency = 10,7 MHz; Span = 2 MHz

Maximum Gain=5,35 dB
Bandwidth = 1,29 Mhz
Center Frequency = 10,7 MHz

Q=8,29

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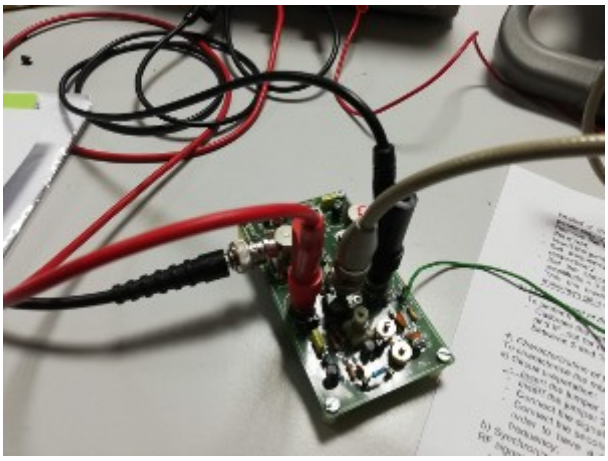
CHARACTERIZATION OF THE MIXER

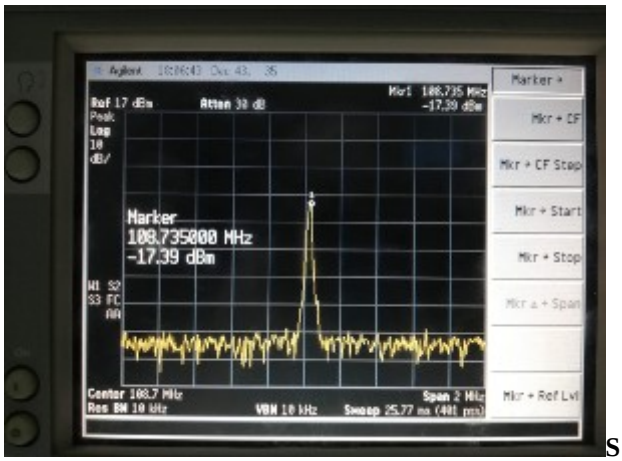
To characterize the mixer we will use the signal generator and spectrum analizer.

Circuit preparation:
Insert the jumper JP2_Vcc in order to supply the power to the LO;
Insert the jumper JP1 in order to connect the LO output to the mixer input;
Connect the signal generator to the BNC RFin of the mixer;
Connect the second section of the power supply to the "+Vcontr" terminal of the LO in order to have a tuning voltage variable between 0 and 12V vary the oscillation frequency;



Synchronization of the LO to the 108.7MHz in order to prepare the mixer to receive an RF signal of 98MHz:
In absence of input RF signal (the generator connected to the mixer with the output disabled) regulate Vcontr in such a way to measure with the spectrum analyzer the first harmonic of the mixer output at the frequency of 108.7MHz;

Power supply
Vcc=12 V; Vcontr=4,1V



Spectrum Analyzer
LO at 108,7 MHz

Feed the RF input with a sinusoidal signal having amplitude of -6dBm and frequency of 98MHz;
Set the amplitude of the spectrum analyzer to a scale which allows you a good frequency resolution around 10.7MHz;
Perform a further regulation of "+Vcontr" in order to have the maximum value measured with the spectrum analyzer. If the trimming of T1 was performed correctly this maximum should correspond to 10.7MHz.

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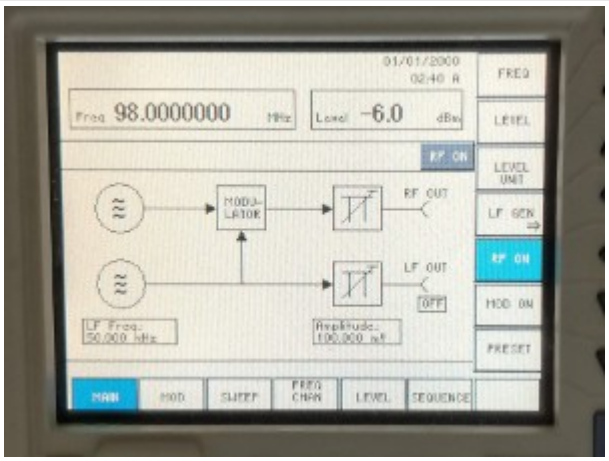
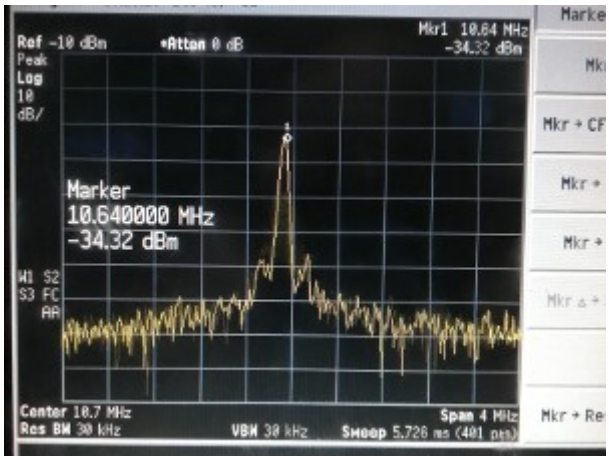
Power supply
Vcc=12 V; Vcontr=2,4V



RF generator
Freq=98 MHz; Level=-6 dBm



Spectrum Analyzer
Mixer output at 10,7 MHz

Characterization of the Mixer:
Set the scales of the spectrum analyzer to visualize the intermodulation products with n and m up to 3;
Report on a table frequencies and amplitudes of the intermodulation harmonics identified including 10.7MHz;
Character * means amplitude lower than -90 dBm;

$f_{IF} = |n \cdot f_{RF} \pm m \cdot f_{LO}|$
$f_{RF} = 98\ MHz$
$f_{LO} = 108{,}7\ MHz$

n	+/-	*m*	***F MHz***	***A dBm***
1	+/-	0	98,0	-57
0	+/-	1	108,7	-69
1	**-**	**1**	**10,7**	**-32**
1	+	1	206,7	-72
2	+/-	0	196,0	-77

$f_{IF} = |n \cdot f_{RF} \pm m \cdot f_{LO}|$
$f_{RF} = 88\ MHz$
$f_{LO} = 98{,}7\ MHz$

n	+/-	*m*	***F MHz***	***A dBm***
1	**-**	**1**	**10,7**	**-32**
1	+	1	186,7	-70

$f_{IF} = |n \cdot f_{RF} \pm m \cdot f_{LO}|$
$f_{RF} = 108\ MHz$
$f_{LO} = 118{,}7\ MHz$

n	+/-	*m*	***F MHz***	***A dBm***
1	**-**	**1**	**10,7**	**-13**
1	+	1	226,7	-82

$f_{IF} = |n \cdot f_{RF} \pm m \cdot f_{LO}|$
$f_{RF} = 98\ MHz$
$f_{LO} = 108{,}7\ MHz$

n	***+/-***	***m***	***F MHz***	***A dBm***
2	-	1	87,3	-81
2	+	1	304,7	-75
2	-	2	21,4	-85
2	+	2	413,4	-87
0	+/-	2	217,4	-87
1	-	2	119,4	*
1	+	2	315,4	-82
3	+/-	0	294,0	-90
3	-	1	185,3	*
3	+	1	402,7	-91
3	-	2	76,6	*
3	+	2	551,4	-72
3	-	3	32,1	*
3	+	3	620,1	-65
0	+/-	3	326,1	*
1	-	3	228,1	*
1	+	3	424,1	*
2	-	3	130,1	*
2	+	3	522,1	-69

$f_{IF} = |n \cdot f_{RF} \pm m \cdot f_{LO}|$
$f_{RF} = 88\ MHz$
$f_{LO} = 98{,}7\ MHz$

n	***+/-***	***m***	***F MHz***	***A dBm***
2	+	1	274,7	-72
3	+	2	461,4	-76
3	+	3	560,1	-65
2	+	3	472,1	-71

$f_{IF} = |n \cdot f_{RF} \pm m \cdot f_{LO}|$
$f_{RF} = 108\ MHz$
$f_{LO} = 118{,}7\ MHz$

n	***+/-***	***m***	***F MHz***	***A dBm***
2	+	1	334,7	*
3	+	2	561,4	-70
3	+	3	680,1	-59
2	+	3	572,1	-68