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

12 – Reception of FM signals

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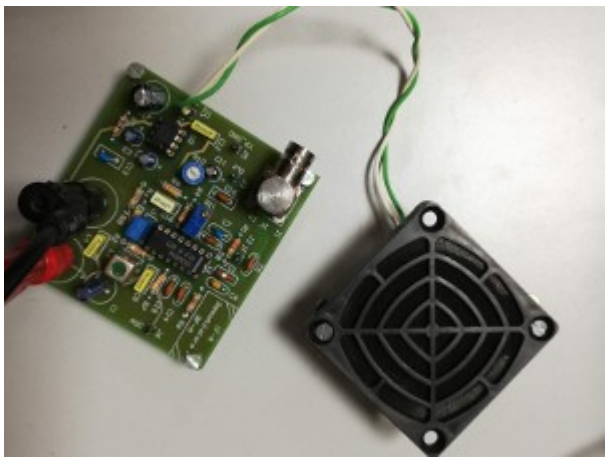
VERIFICATION AND CALIBRATION OF FM DEMODULATOR

Operation of the ceramic filter

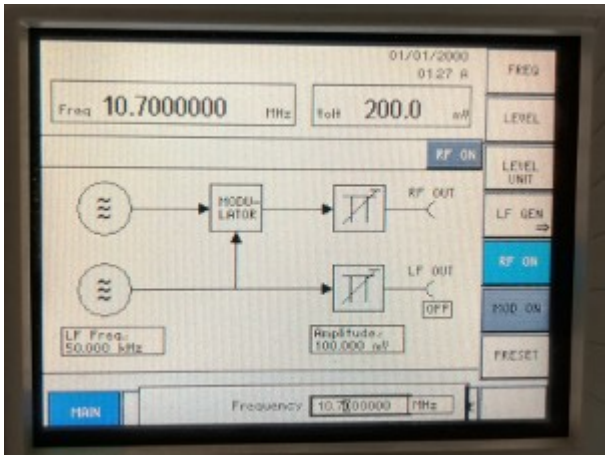
After powering up the circuit with a voltage of 12VDC, with no input signal, reduce the volume of the output stage by setting to zero the resistance of R10 trimmer.

Power supply
Vcc=12V

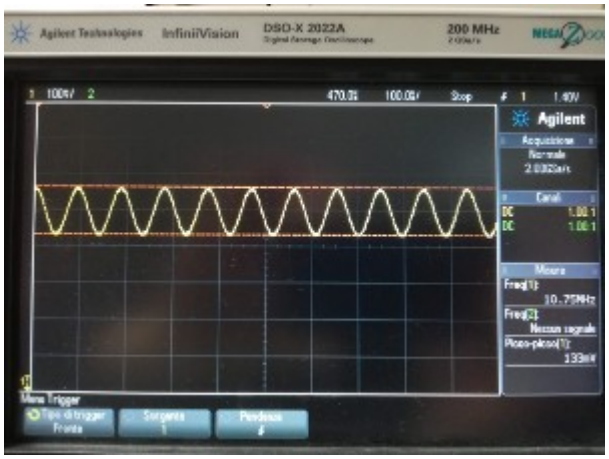


Circuit configuration

Apply through the BNC cable a sinusoidal signal whose amplitude is equal to 200mVpp and 10.7MHz frequency, obtained by means of the function generator. Using the oscilloscope, measure the amplitude and frequency of the signal at the output of the ceramic filter FC1 (test point J2 IF).



RF generator
Freq=98 MHz; Level=200mV



Oscilloscope
Freq=10,7 MHz; Level 177mV

Identify the harmonic response of the ceramic filter (peak frequency and lower and upper cutoff frequencies). For this purpose, change up and down the value of the frequency of the input signal.

Low cut off frequency	Peak Frequency	High cut off frequency
10,5 MHz	10,67 MHz	11,1 MHz

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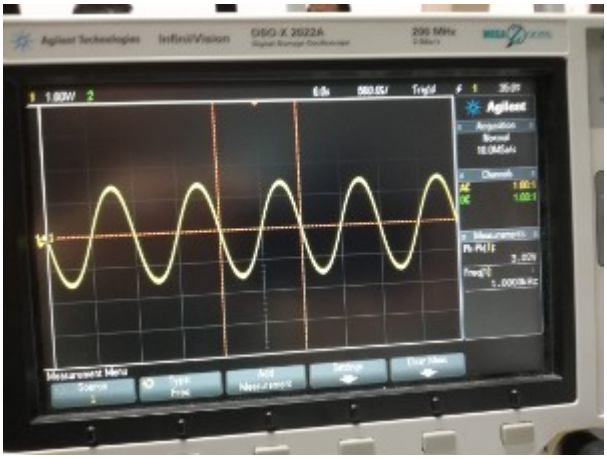
Tuning of IF transformer

Through the function generator, and with the same amplitude, synthesize a frequency-modulated signal, having a frequency deviation of 100kHz and modulating frequency of 1kHz. Display with the oscilloscope the signal at the output of the demodulator on the test points out. Adjust the core of the transformer L2 in order to maximize the amplitude of the sinusoid at the output of the demodulator.

	
FM generator Freq=10,7 MHz; Mod. Signal Freq=1KHz; Dev=100 KHz	**Oscilloscope** Regulating L2 maximum at 3Vpp

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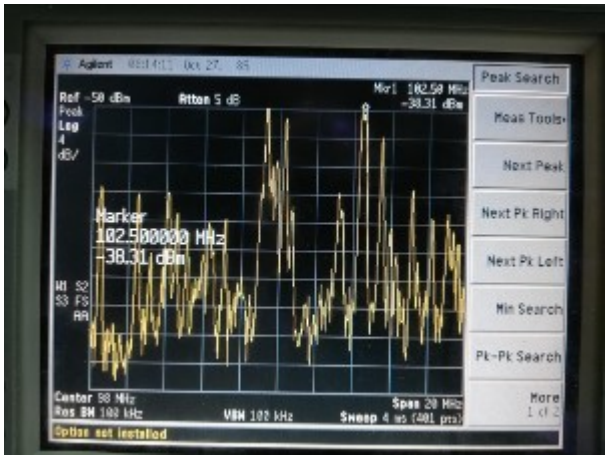
RECEPTION OF FM SIGNALS

Identification of the channel received by the antenna

Connect the antenna to the spectrum analyzer. Set: start-frequency=88MHz, stop-frequency=108MHz, Scale/div=4dB, Ref-Level=-50dBm. Identify the channels with the level larger than -70dBm and report their frequency and amplitude on a table. Suggestion: use a single sweep to help the measurement (in sweep menu).



Spectrum analyzer
start-frequency=88MHz
stop-frequency=108MHz
Scale/div=4dB
Ref-Level=-50dBm

Frequency [MHz]	Amplitude [dBm]
88.50	-61.84
90.50	-62.48
91.80	-67.46
92.15	-60.92
92.55	-62.99
94.30	-65.35
95.10	-66.87
97.30	-43.20
97.90	-58.01
98.35	-50.36
98.65	-62.98
101.20	-63.12
101.45	-64.54
102.50	-37.11
103.50	-57.16
103.90	-68.79
105.15	-63.94
106.25	-65.84
107.00	-69,25

Assembling the FM receiver

Connect the various blocks for realizing an FM receiver. In particular, connect the antenna at the input of LNA, the output of the same to the mixer input and the mixer output to the input of FM demodulator. Connect the tuning voltage from the power supply section 2 to the control voltage of LNA and to the local oscillator (range 0V-12V).

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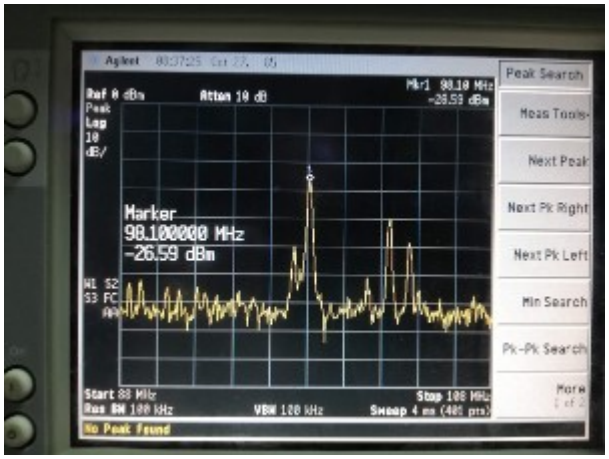
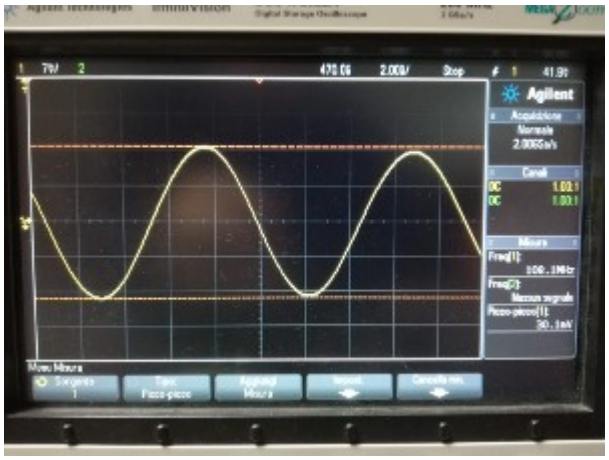
Analysis of the received test signal

On the other table we have placed the FM transmitter of 200mW presented in theory class. It is radiating an FM signal at a given frequency through the transmitting antenna. Before receiving the signal, connect the output of the receiving antenna to the spectrum analyzer and measure frequency and level of the received signal.

	
FM Transmitter Output Power=200mW	**Spectrum analyzer** Measured Freq=98,1 MHz; Level=-26,6 dBm

Reception of test signal

Disconnect the antenna from the spectrum analyzer and connect it to input of the receive, i.e. the input of the LNA. Adjust the tuning voltage (Vcontr) in order to tune the receiver on the received signal. When you get the largest signal measure the frequency of the local oscillator.

	
Power supply Vcc=12V; Vcontr=4,6V	**Oscilloscope at LO out** Measured Freq=108,8 MHz

Comment the results.

As you expect, LO frequency is equal to 98.1 MHz + 10.7 MHz.

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After the turn off of the transmitter used for the test signal, try to receive several channels from a commercial radio stations. For each of them measure the frequency of the local oscillator and note them in a table.

Vcontr [V]	**Frequency of LO out [MHz]**
3.80	107.00
4.10	108.50
4.60	108.80
4.80	109.20
9.50	113.10
10.90	113.50
11.80	115.50

The role of LNA

Exclude the LNA connecting the antenna directly to the mixer, and try to receive commercial radio stations and the test signal. Comment on the results.

Referring to previous table you can note that commercial stations at Vcontr=4.5V and 10.9V are not received. Without LNA, signals with low level are no amplified and it isn't possible to demodulate.