Frequency Measurements and Mixer

Introduction

In this laboratory experience the student will measure the frequency of some signal using a frequency counter and a frequency translating device (mixer).

Available instrumentation

For this practical session you will use the following instrumentation:

- waveform generator (Hameg 8130, Hameg 8131 or similar)
- LED signal generator (output C and D, 5 MHz)
- analog oscilloscope
- frequency counter (Hameg HM 8122 or similar)

For manuals and documentation: http://led.polito.it/main it/instrumentation.asp or see the "Addendum" at the end of these pages

Mixer

The internal scheme and the pins of the mixer are shown in figures 1 and 2.

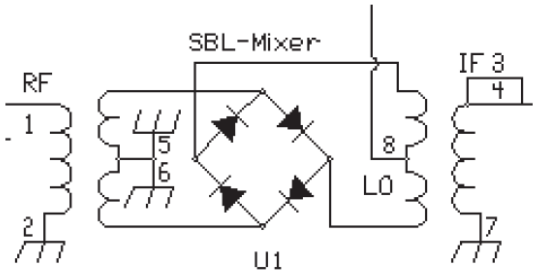


Figure 1: simplified scheme of the SBL-3 mixer

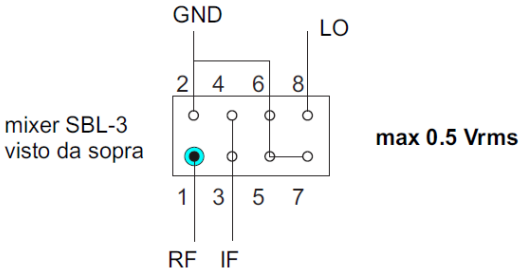


Figure 2: pin scheme for the SBL-3 mixer (as seen from the top)

Frequency measurements

You can measure the frequency of the signals indicated in table I with the frequency counter. Following the manual instructions you must evaluate the uncertainty. For the trigger related uncertainty you can use a S/N value of 80dB. What's happen to the trigger uncertainty if the S/N is reduced to a value of 40dB?

Table I: frequency measurements

Signal	f /Hz	δf /Hz
1 kHz from waveform generator		
15 kHz from waveform generator		
5 MHz from waveform generator		
5 MHz from LED sign.gen. output C		
5 MHz from LED sign.gen. output D		

Frequency difference measurement

Compute the frequency difference between output C and output D, starting from the measurements you reported on the table I. Now you can evaluate the uncertainty of the frequency difference.
Using the analog oscilloscope you can measure the frequency of the signal from the output C and then the frequency of the signal from the output D. Compute the frequency difference and then try to give an estimation of the uncertainty of the frequency difference.

Now you have to mount the circuit of figure 3 on your breadboard. Which is the frequency bandwidth of the RC circuit? Why are you using this band pass filter? Now you can measure the frequency difference by using the frequency counter and the oscilloscope.

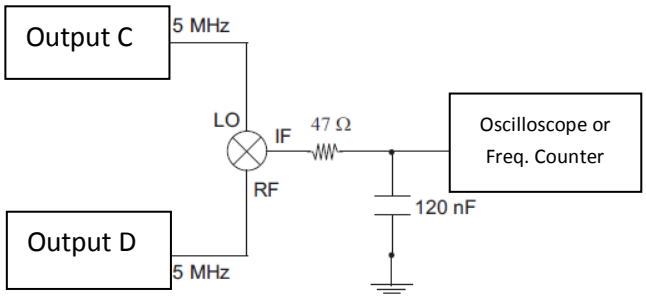
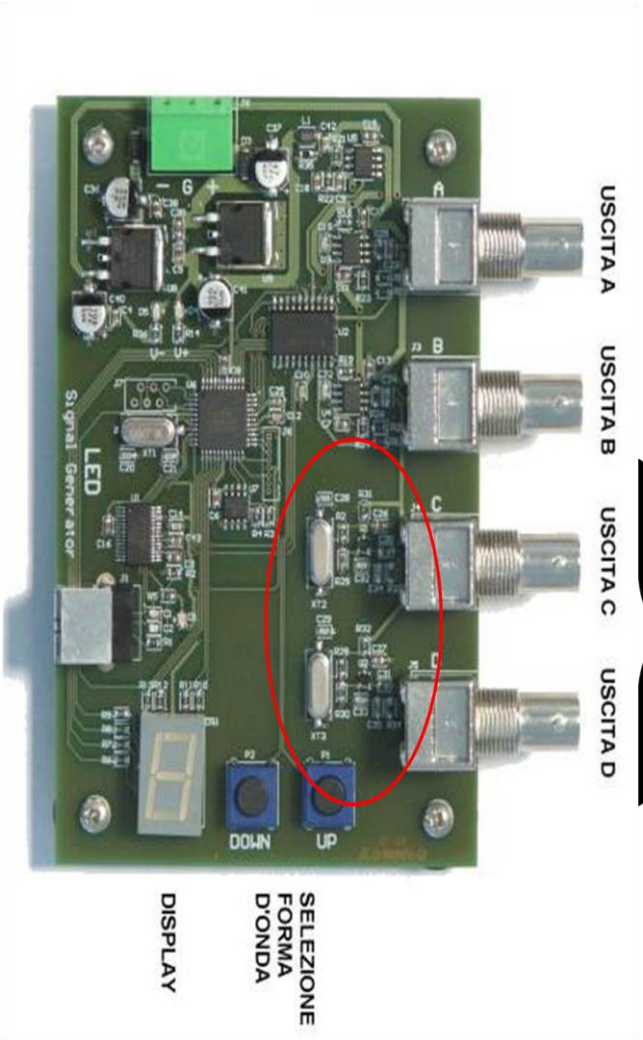


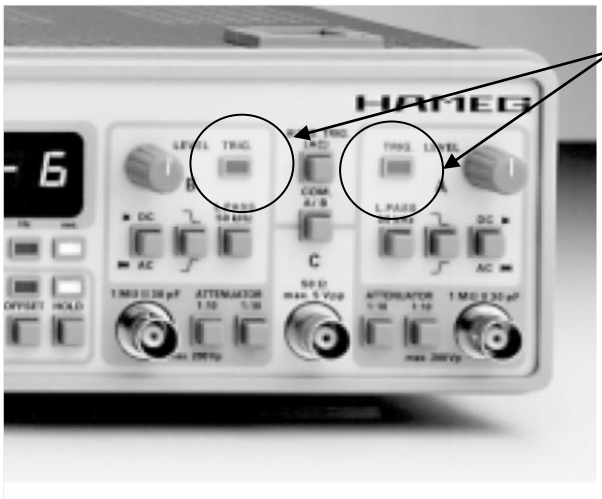
Figure 3: Frequency difference measurement using the mixer.

Frequency Measurements and Mixer: addendum

…LED signal generator



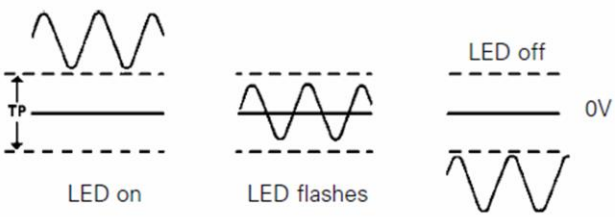
…triggering the frequency counter



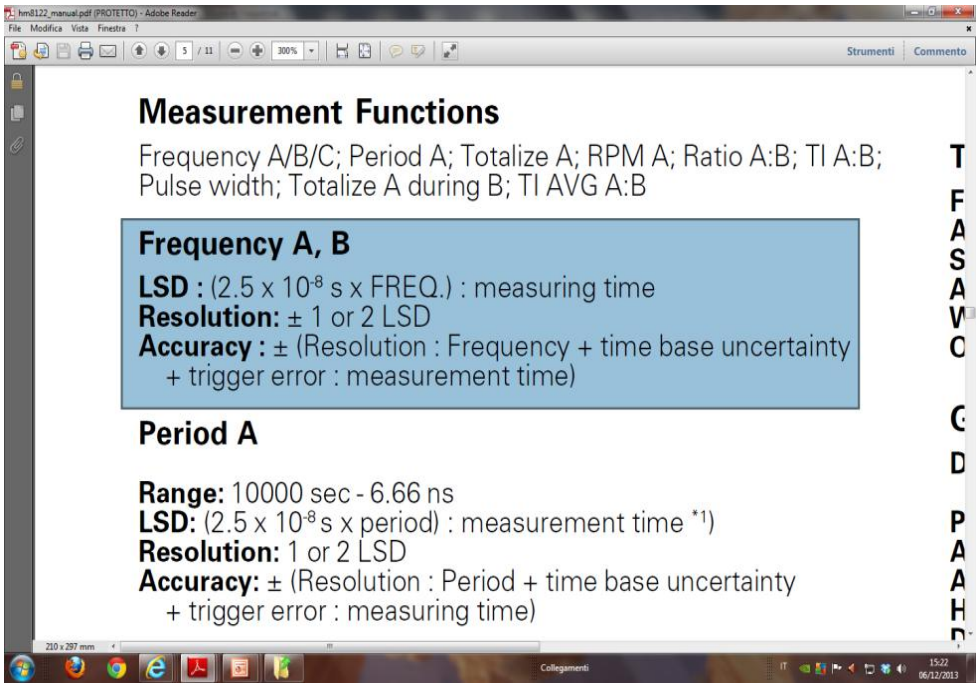
Led On: the signal is above the trigger level

Led Off: the signal is below the trigger level

Blinking: the signal is crossing the hysteresis band, correct triggering.



…frequency counter uncertainty: look at the specification using the online manual!!!



Measurement Functions

Frequency A/B/C; Period A; Totalize A; RPM A; Ratio A:B; TI A:B; Pulse width; Totalize A during B; TI AVG A:B

Frequency A, B

LSD : (2.5 x 10^{-8} s x FREQ.) : measuring time
Resolution: ± 1 or 2 LSD
Accuracy : ± (Resolution : Frequency + time base uncertainty + trigger error : measurement time)

Period A

Range: 10000 sec - 6.66 ns
LSD: (2.5 x 10^{-8} s x period) : measurement time *1)
Resolution: 1 or 2 LSD
Accuracy: ± (Resolution : Period + time base uncertainty + trigger error : measuring time)