6. Tutorial Band Pass Filter V1.0
Calculations, Simulations and Experiments

UFO Doctor, Nov. 7th, 2011, rev Dec 17th, 2011

1. Introduction

This report deals about calculations, simulation and experiments for amplifications of FSK-Signals in the 8 and 24 kHz range with 5% frequency variations.
The first step is to design and test a high impedance microphone amplifier.

2. Theory on filter computation

The old text book Tietze/Schenk, published 1980, page 14 and 308 is a good help.
Here the recent EXCEL calculations:

3. Simulations at 8 kHz

Number Pi	3.14156	
fo	8425.5	Hz

Highpass for fo

Parameter	Calc. Value	Selected Value	Units	Formula
Cut off Fc	8425.5		Hz	Choose a frequency
C	2.20E-11	22 pF	F	First free Selection
R	8.59E+05	1 Meg		R=1/(2*Pi*C*fc)

Highpass for 3 * fo

Parameter	Calc. Value	Selected Value	Units	Formula
Cut off fo	25276.5		Hz	Choose a frequency
C	6.80E-12	6.8 pF	F	First free Selection
R	9.26E+05	1 Meg		R=1/(2*Pi*C*fo)

Band Pass for fo

Parameter	Comp Value	Selected Value	Units	Formula
Center fc	8425.5		Hz	Choose a frequency
R1	1799.03521	1800	Ohm	R1=R2/(-2*A)
R2	3.78E+05	330k fix+100kTrim	Ohm	R2=Q/(Pi*Fc*C)
R3	1988.40734	1800+180	Ohm	R3=-A*R1/(2*Q^2+A)
C	1.00E-09	1nF	F	First free Selection
Q	10	10		Second Selection
Gain A	-105	-105		Third Selection

Band Pass for 3 * fo

Parameter	Comp Value	Selected Value	Units	Formula
Center fc	25276.5		Hz	Choose a frequency
R1	1817.20728	1800	Ohm	R1=R2/(-2*A)
R2	3.82E+05	330k fix+100kTrim	Ohm	R2=Q/(Pi*Fc*C)
R3	2008.49226	1800+180	Ohm	R3=-A*R1/(2*Q^2+A)
C	3.30E-10	330pF	F	First free Selection
Q	10	10		Second Selection
Gain A	-105	-105		Third Selection

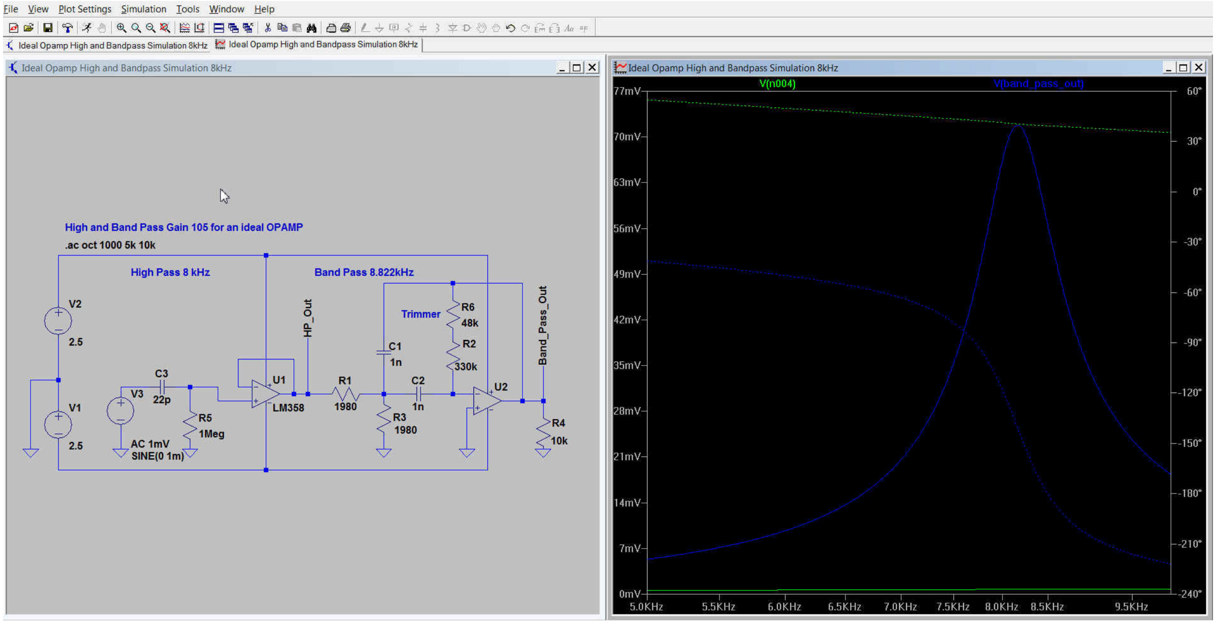

Fig. 1. Band pass with ideal OPAMP: ok, Gain about 70

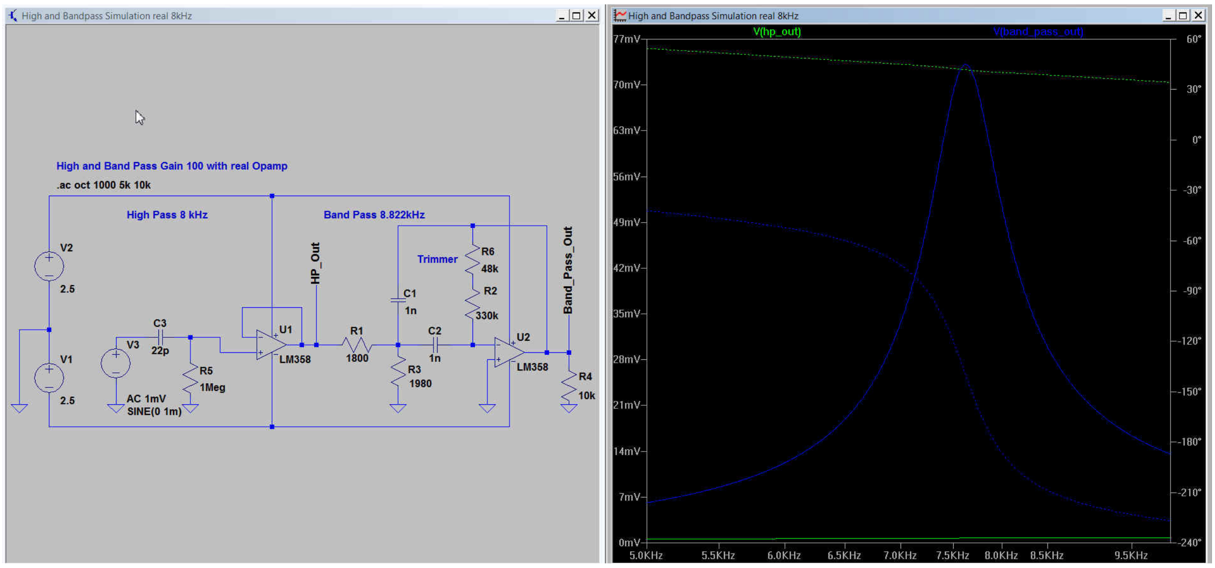

Fig. 2. Band pass with the real low cost OPAMP LM358: quite ok!
The center frequency is a little bit too low, at about 7.6kHz and the gain is about 70

3. Simulations at 25 kHz

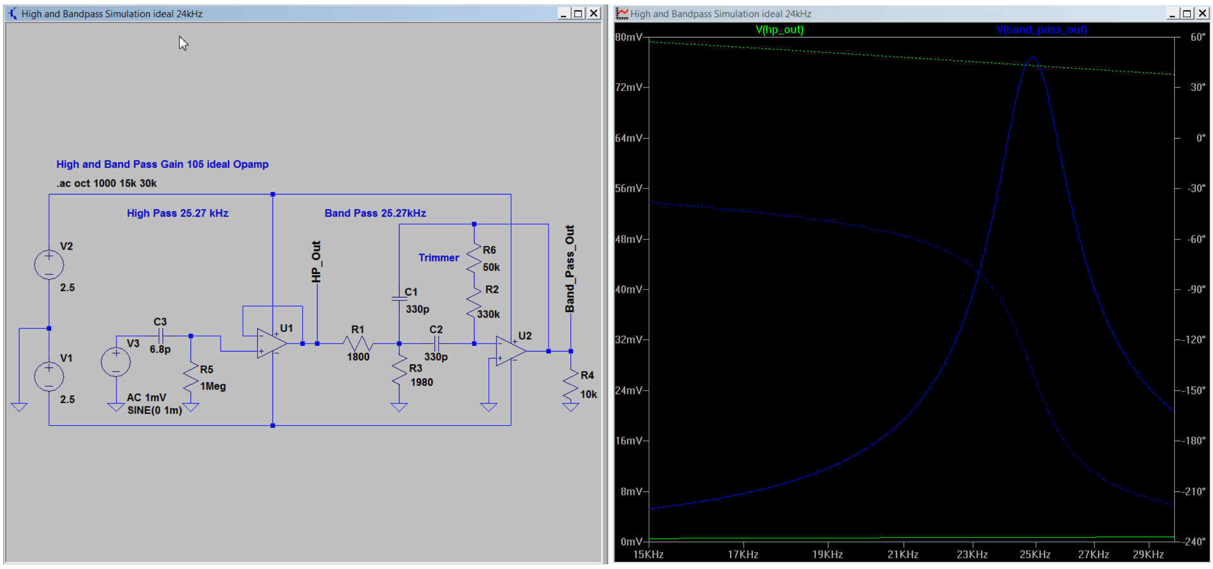

Fig. 3. Band pass with an ideal OPAMP: Center frequency ok, Gain 75, ok

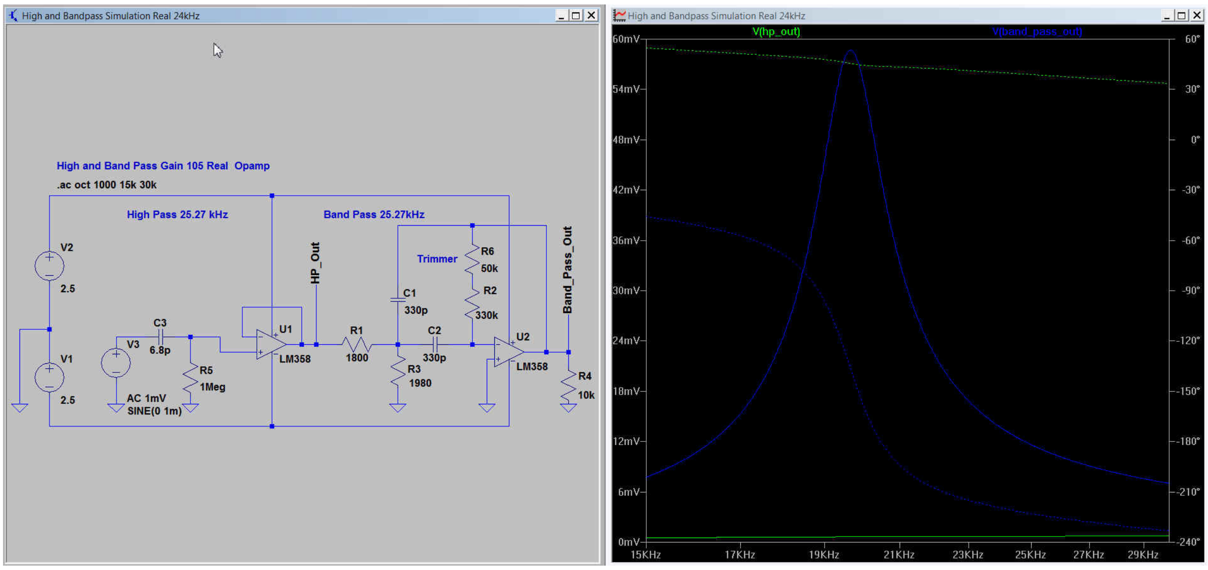

Fig. 4. Band pass with a real low cost OPAMP: this is not ok!
The center frequency is low and the gain is less than 60

We need an Opamp with a Gain-Bandwidth product of more than 10 MHz
No problem, such an Opamp is available but must be tested.

4. Experiments

Not done here up to now