Laboratorium 1

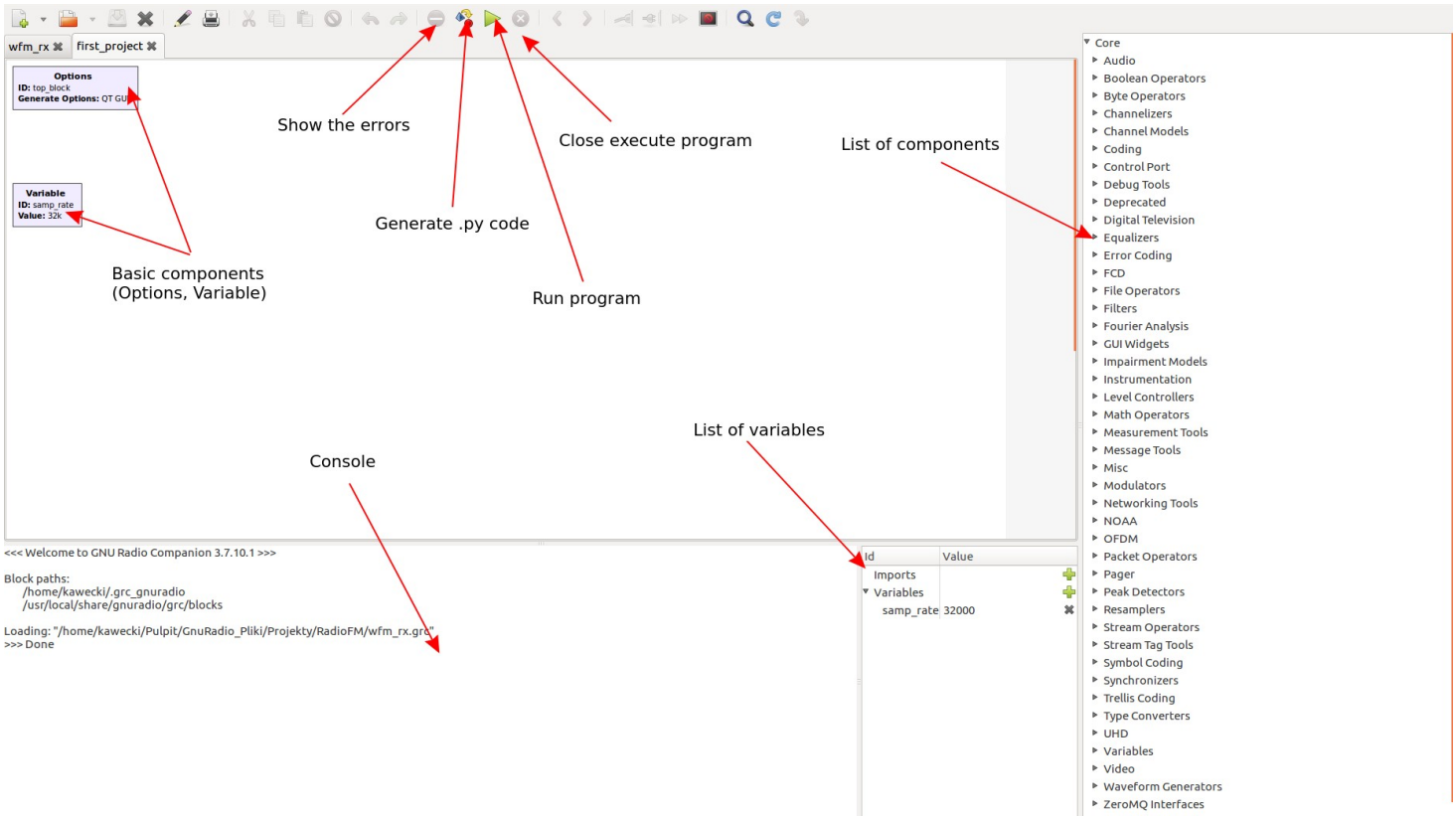
Introduction to GnuRadio environment

I. Introduction

GnuRadio is a free software publish by General Public License. It allows user to project and implement signal processing without a necessary to use specific devices, for example – signal generator or oscilloscope. We can generate these signals via delivered components GnuRadio Companion program.
GnuRadio has a graphical user interface which allows to project and model operations demanding during signal processing. GnuRadio allows to generate a python code which is known as a omnipresent at using in all over the world. GnuRadio is an alternative for programs like Matlab or LabView in signal processing topic. This software is very initial and helpful during aquiring knowledge topic connected with processing signal analog and digital.

II. The first project

After run a GRC program, new project with two main basic component will be created. The first of each is a „Options" and the next is a „Variable" declared as a system sampling frequency. At the right sight you can find a list of GRC environment components. To use this component You have to drag and drop it from list to canvas. Below the main view of program is presented, which is accessible after creating a new project.



2

Excercise 1

The main goal of this excercise is to project and implement multiplication of sinusoidal and cosinusoid signal and display it's wave on the chart. User has to have an accessibility to control the aplitude of each signal.

1. Run GRC program
2. Open the properties of block „Options" via double click. Set ID of your program and select a type of graphical user interface for example WX GUI.
3. Move from the components list to canvas two signal sources. The first one is a source of a cosinusoidal wave, 2000Hz frequency and amplitude 1V. In the field of sample frequency, please set a name of declared variable (samp_rate).

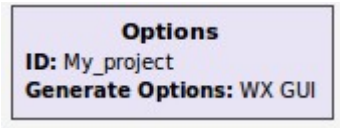
   The second source of signal is sinusoid with 1000Hz frequency and 1V aplitude. In the field of sample rate please set a name of declared variable.

   Attention! Please remember to set appropriate types of data: Complex, Float, Short, Byte. In this case use float.

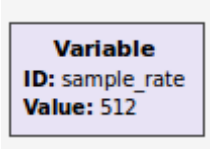
4. Add matematic operator „Multiply” and multiply both signals. At the output of multiply of both signals should be generated multiplication of components. We can connect components by means of single click „in/out” each of them.
5. Add a component throttle one the output of multiply. This block limits the number of bits which go through inside this component.
6. To show data drag and drop component „WX GUI Scope Sink” and define the amount of input signals in the field of „Num Inputs”.
7. To allow hearing the signal add component „Audio Sink” and define the frequency equal 48KHz.
8. To change amplitude value by user please add „WX GUI Slider” and set ID=”amplitude_slider”. Set this id in sinusoidal signal source component (in field Amplitude).

Basic components, block used during laboratory

1) Options – the main parameters of program. We can set our project ID, author, title and description. ID which we set allows to save this program in python language with the same name with .py extension. It is very important to choose in the field of „Generate Options” type of graphical user interface which will be used in our applications. You have to pay your attention on QT GUI and WX GUI. In the case of not setting this field error will be shown.

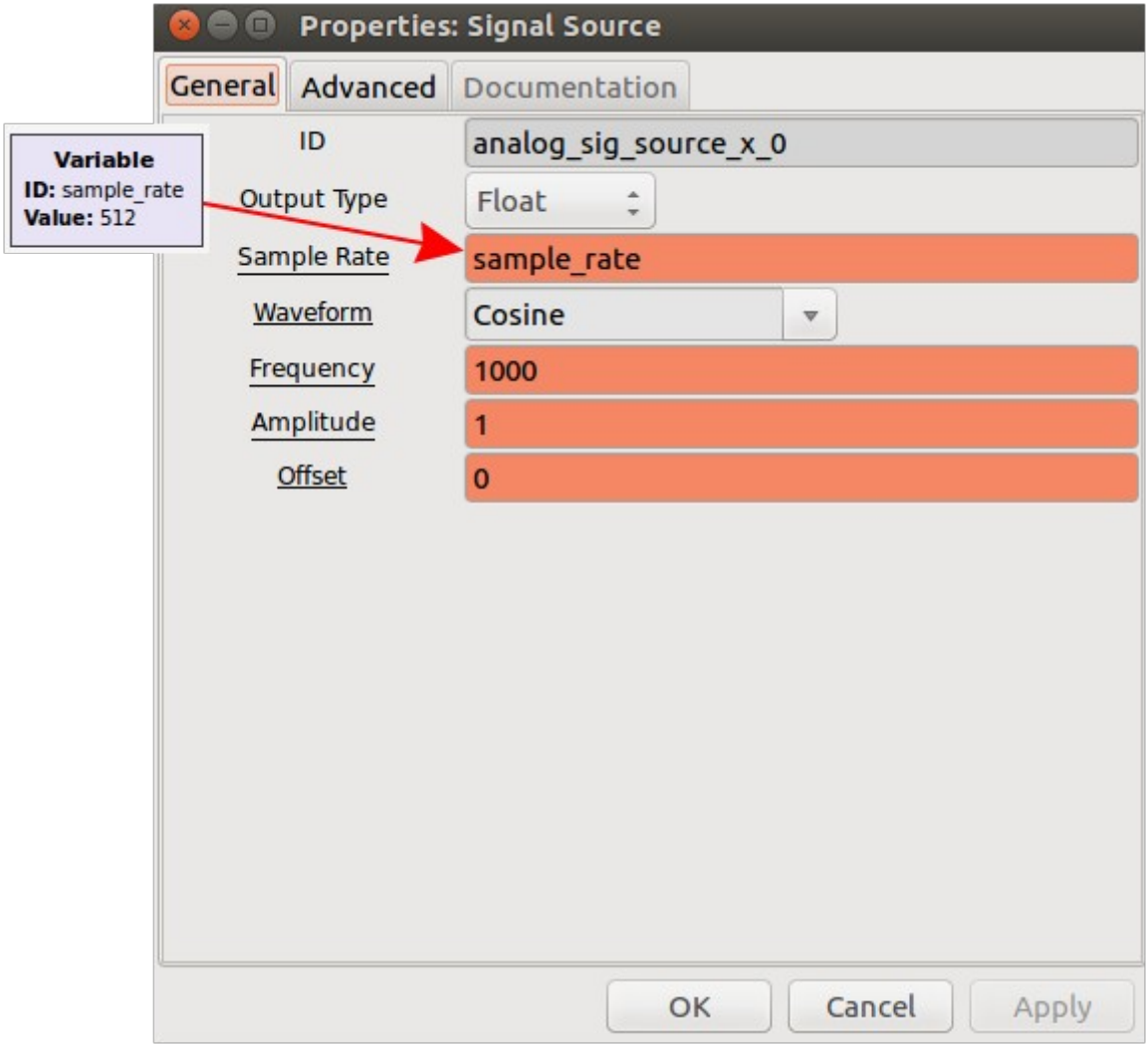


2) Variable – it is a variable which we can set in our project. It is necessary to set ID variable and put value.



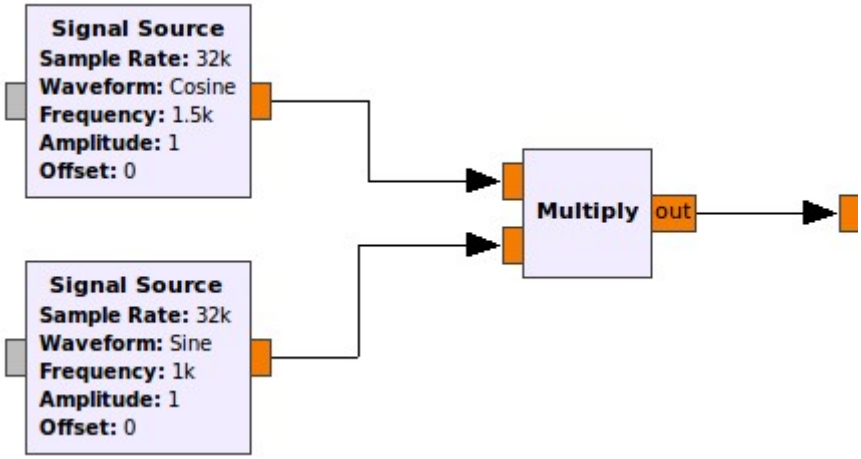
3) Signal Source – block allows to create a source of signal with choosen parameters. We define sample rate, wave of signal for example sinusoide, cosinusoide, frequency, amplitude and offset. Please remember to use variable during values defining.

Example: „sample_rate” variable put in „Sample Rate” field.



4) Multiply – multiply operator. We can connect blocks by using single click on one of each ex. click on „Signal Source” and on operator „Multiply”. On the below example we use this operator to multiply sin and cos.

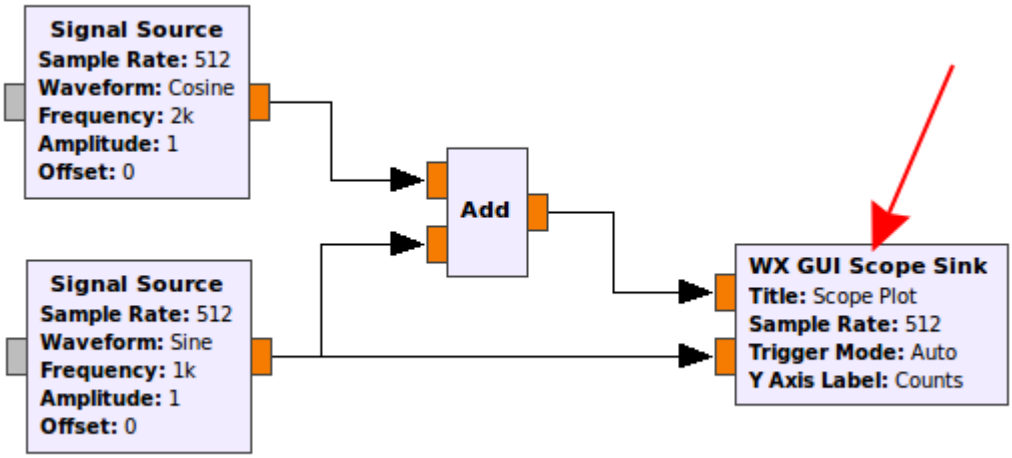
Accoring to this we can use mathematic operators „Math Operators” like Add, Subtract, Divide.



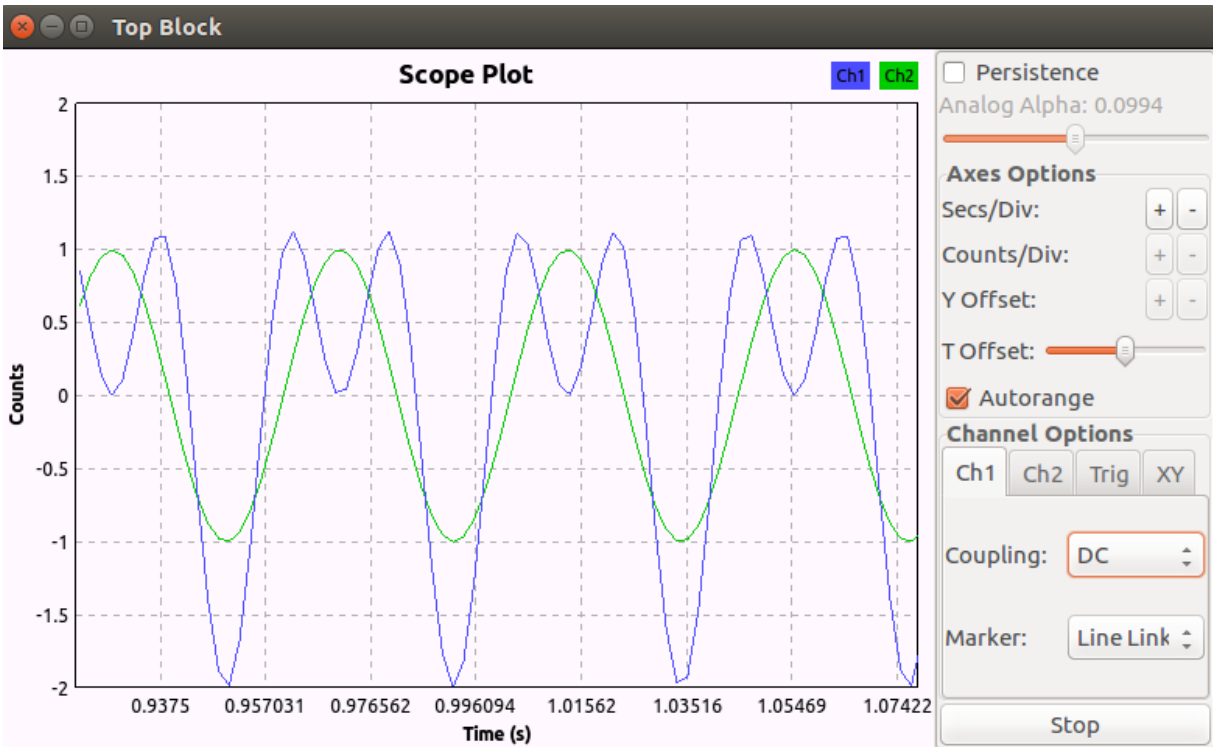
5) Components to use GUI – Graphical User Interface

Using graphic library WX GUI:

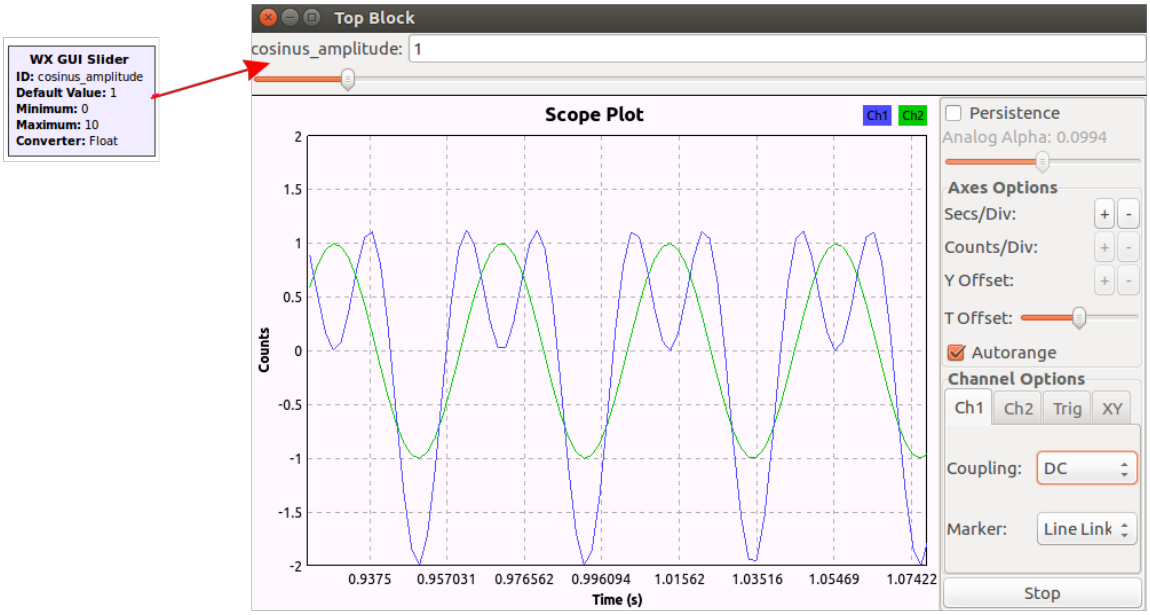
WX GUI Scope Sink: It allows to visualize emerget signal by adding signals (input 1) and signal with sin wave (input 2).



By WX GUI Scope Sink we can display a chart of added signals (input 1) and sinus chart (input 2). Below visualization of graphical components of above mentioned operation was presented.



WX GUI Slider: slider which is dedicated to change choosen value in user GUI. By using this slider it is obligatory to create before a WX GUI Scope Sink a block to allow this slider to be displayed.



Using QT GUI

QT GUI Sink: Input data chart

QT GUI Check Box: check box

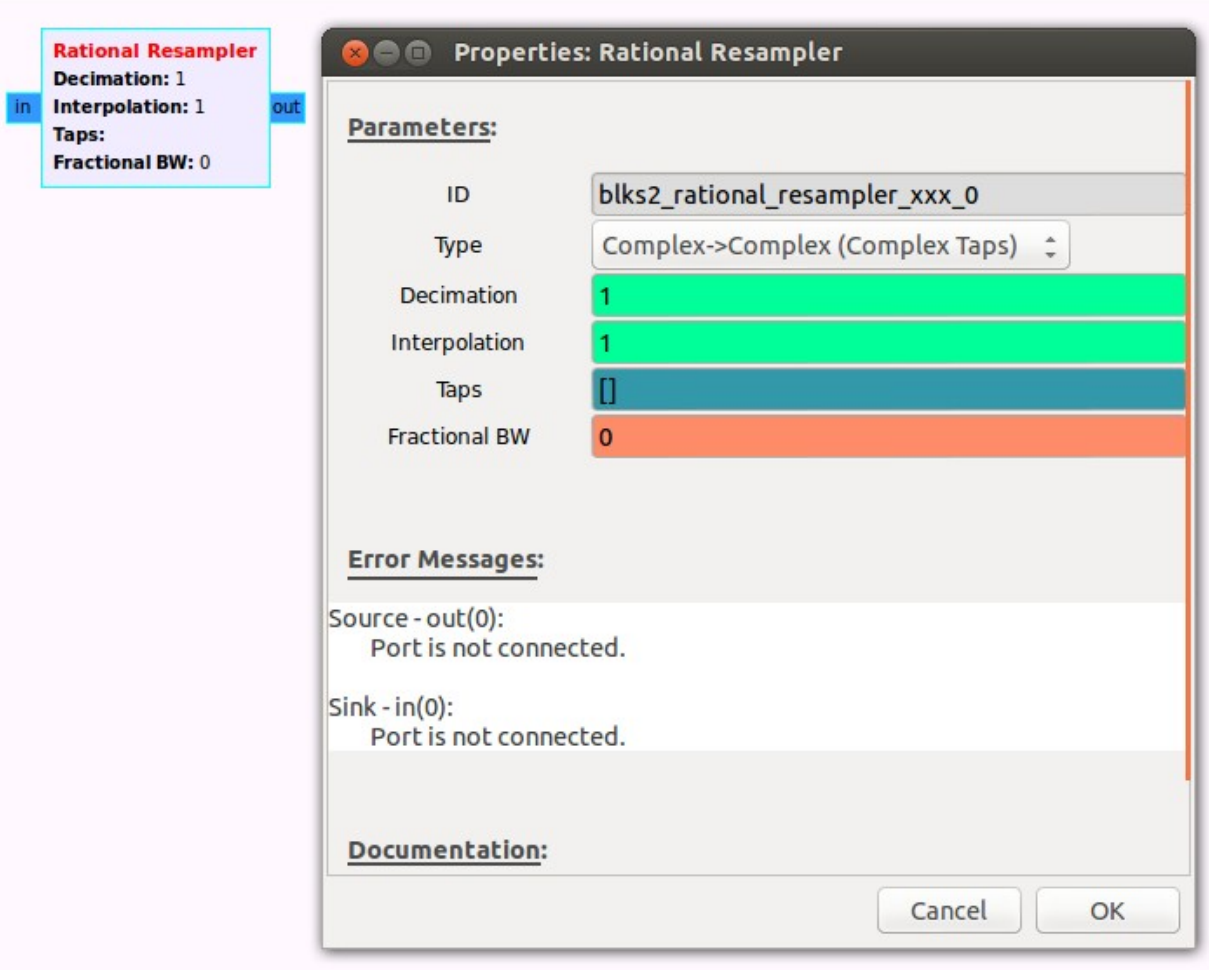
QT GUI Chooser: possibility to choose a few options

QT GUI Label: label

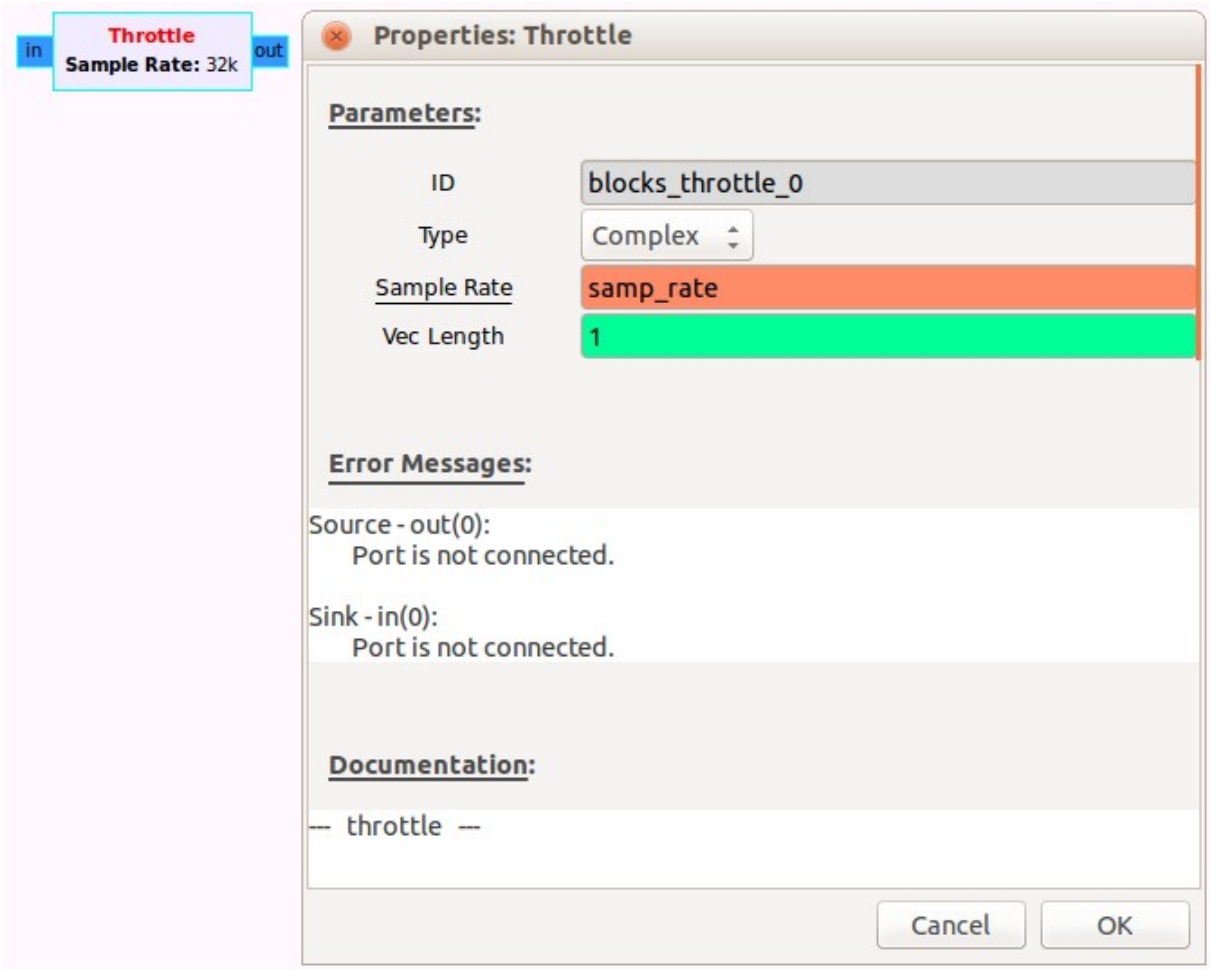
QT GUI Push Button: button

QT GUI Tab Widget: widget

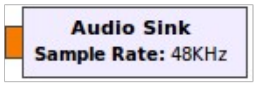
6) Rational Resampler - block which is responsible for changing sample frequency of signal.

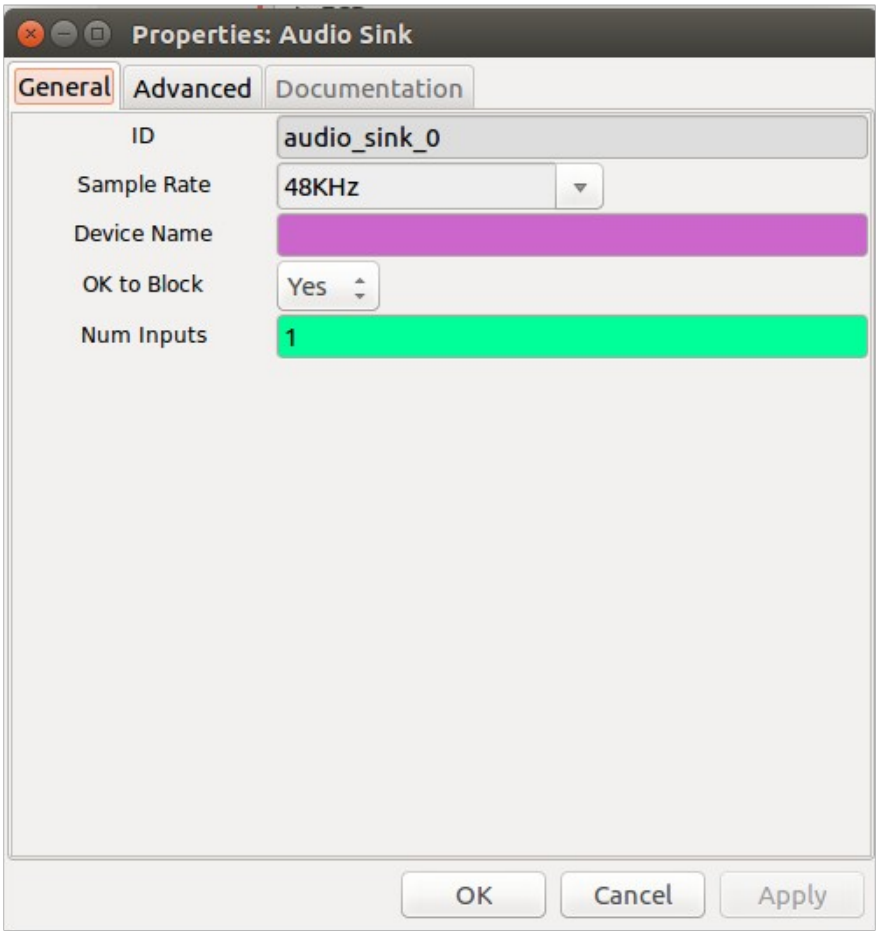


7) Throttle – block used during real time type chart generation. It limits the number of bytes which goes through this component. Usually this frequency is fitted to signal sample rate. Skipping this block causes that processing data will be drawn on the chart with a maximum speed that processor allows to use for it. All processor resources will be use only for drawing charts.



8) Audio Sink - komponent which allows to display audio signal with using sound card. In the field „Num Inputs” we define the number of input signals. For typicall aplications in the field of „Sample Rate” we should set 48KHz.





9) File Operators:

Wav File Sink – Saving data about signal wave to the file

Wav File Source – Reading data from the file regarding signal wave

IV. Excercises

1. Please save to the file with .wav extension the wave of signal produced from introduction excercise. Use component „Wav File Sink”.

2. Create a display program which are saved in Excercise 1. Show signals on the chart and display it via Audio Sink component and computer sound card.