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Implementation of Band-pass filter

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What is Gnu radio?

GNU Radio is a software library, which can be used to develop complete applications for radio engineering and signal processing.

Introduction

GNU Radio is a free and open-source software development toolkit that provides signal processing blocks to implement software radios. It can be used with readily-available low-cost external RF hardware to create software-defined radios, or without hardware in a simulation-like environment.

GNU Radio is licensed under the GNU General Public License (GPL) version 3. All of the code is copyright of the Free Software Foundation. While all the applications are implemented using python language while critical signal processing path is done using C++ language.

Idea behind GNURADIO

The goal is to give ordinary software people the ability to 'hack' the electromagnetic spectrum, i.e. to understand the radio spectrum and think of clever ways to use it.

Why GNURADIO

Instead of purchasing multiple expensive radios, a single generic radio can be implemented using gnu radio software and with support of minimal hardware to receive and transmit processed signal at required frequencies and any data type can be passed from one block to another i.e.it can be in bits, bytes, vectors, bursts or more complex data types

Since the performance critical blocks are implemented in C++ using processor floating point extensions the developers are able to implement real-time, high-throughput radio systems in a simple-to-use, rapid-application-development environment.

One can use it to write applications to receive data out of digital streams or to send data into digital streams, which is then transmitted using hardware. GNU Radio has filters, channel codes, synchronisation elements, equalizers, demodulators, vocoders, decoders, and many other elements which are called as blocks that are typically found in radio systems.

Features

The main features of gnu radio are **flexibility** and **configurability.**

Extending GNU Radio is also quite easy, if you find a specific block that is missing you can quickly create and add it.

What is Band-pass filter?

A band-pass filter is a device that passes frequencies within a certain range and rejects (attenuates) frequencies outside that range.

An example of an analogue electronic band-pass filter is an RLC circuit (a resistor–inductor–capacitor circuit). These filters can also be created by combining a low-pass filter with a high-pass filter. Bandpass is an adjective that describes a type of filter or filtering process; it is to be distinguished from passband, which refers to the actual portion of affected spectrum. Hence, one might say "A dual bandpass filter has two passbands". A bandpass signal is a signal containing a band of frequencies not adjacent to zero frequency, such as a signal that comes out of a bandpass filter.

An ideal bandpass filter would have a completely flat passband (e.g. with no gain/attenuation throughout) and would completely attenuate all frequencies outside the passband. Additionally, the transition out of the passband would be instantaneous in frequency. In practice, no bandpass filter is ideal. The filter does not attenuate all frequencies outside the desired frequency range completely; in particular, there is a region just outside the intended passband where frequencies are attenuated, but not rejected. This is known as the filter roll-off, and it is usually expressed in dB of attenuation per octave or decade of frequency. Generally, the design of a filter seeks to make the roll-off as narrow as possible, thus allowing the filter to perform as close as possible to its intended design. Often, this is achieved at the expense of pass-band or stop-band ripple.

The bandwidth of the filter is simply the difference between the upper and lower cutoff frequencies. The shape factor is the ratio of bandwidths measured using two different attenuation values to determine the cutoff frequency, e.g., a shape factor of 2:1 at 30/3 dB means the bandwidth measured between frequencies at 30 dB attenuation is twice that measured between frequencies at 3 dB attenuation.

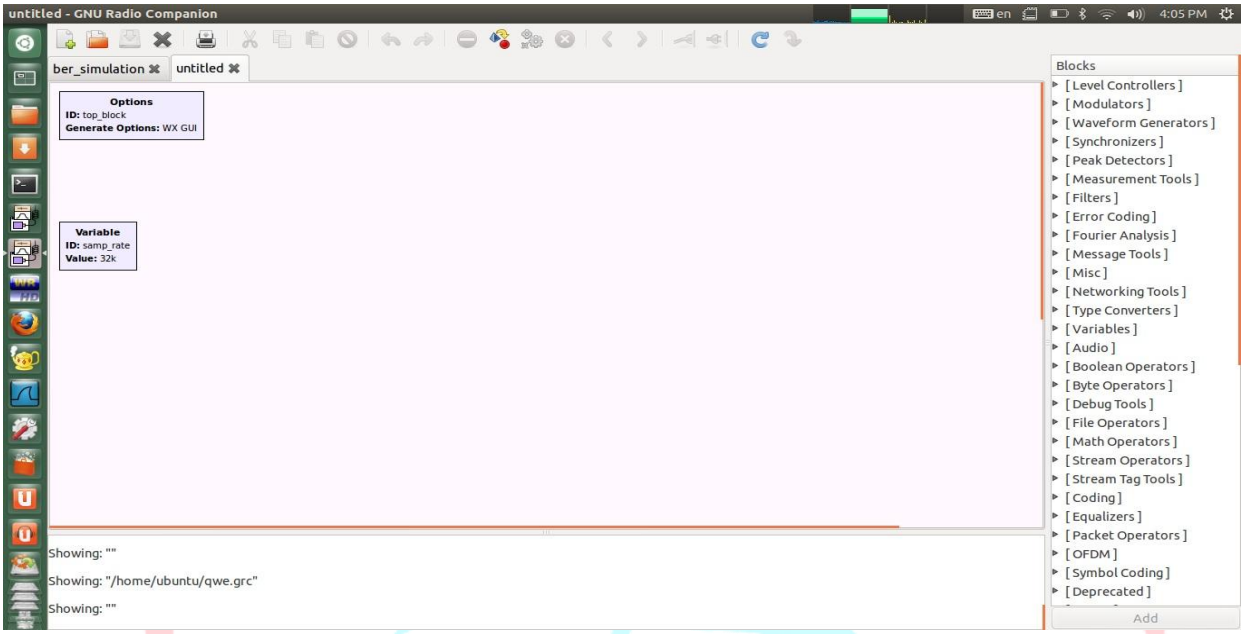
Optical band-pass filters are common in photography and theatre lighting work. These filters take the form of a transparent coloured film or sheet.

Bandpass filters are widely used in wireless transmitters and receivers. The main function of such a filter in a transmitter is to limit the bandwidth of the output signal to the band allocated for the transmission. This prevents the transmitter from interfering with other stations. In a

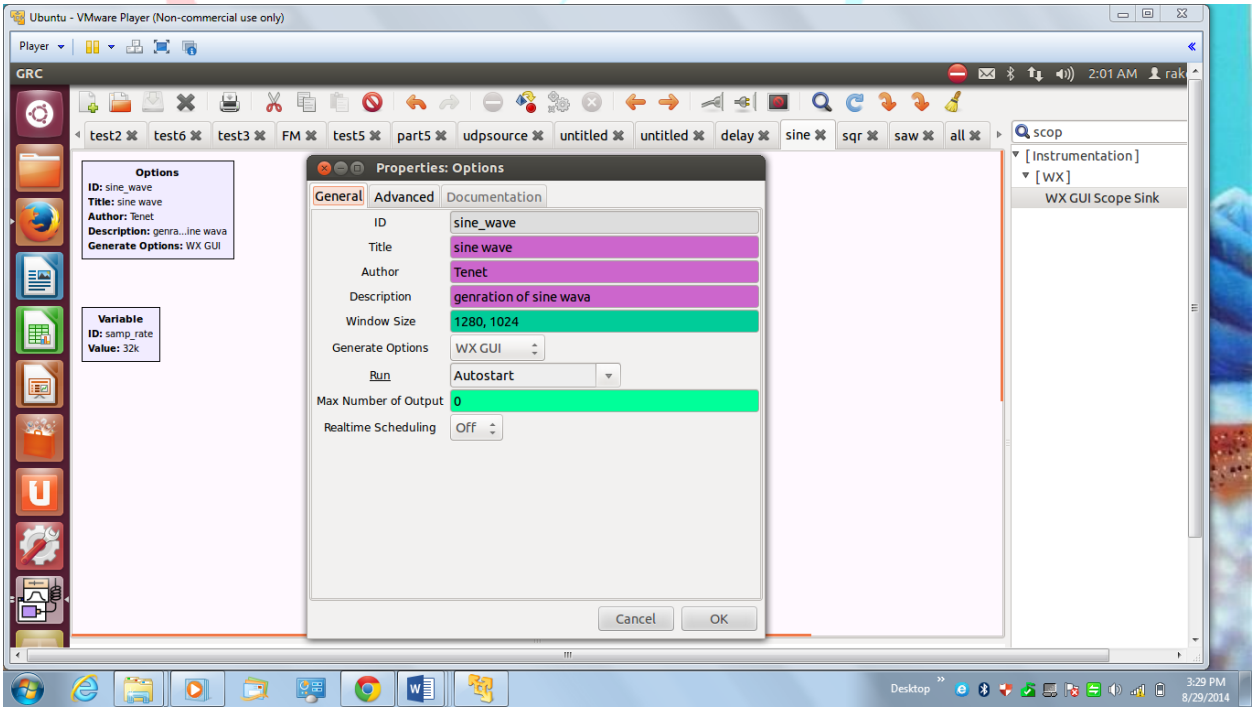
receiver, a bandpass filter allows signals within a selected range of frequencies to be heard or decoded, while preventing signals at unwanted frequencies from getting through. A bandpass filter also optimizes the signal-to-noise ratio and sensitivity of a receiver.

Band pass filter

The GNUradio Companion with basic blocks (Options block and Variable block)

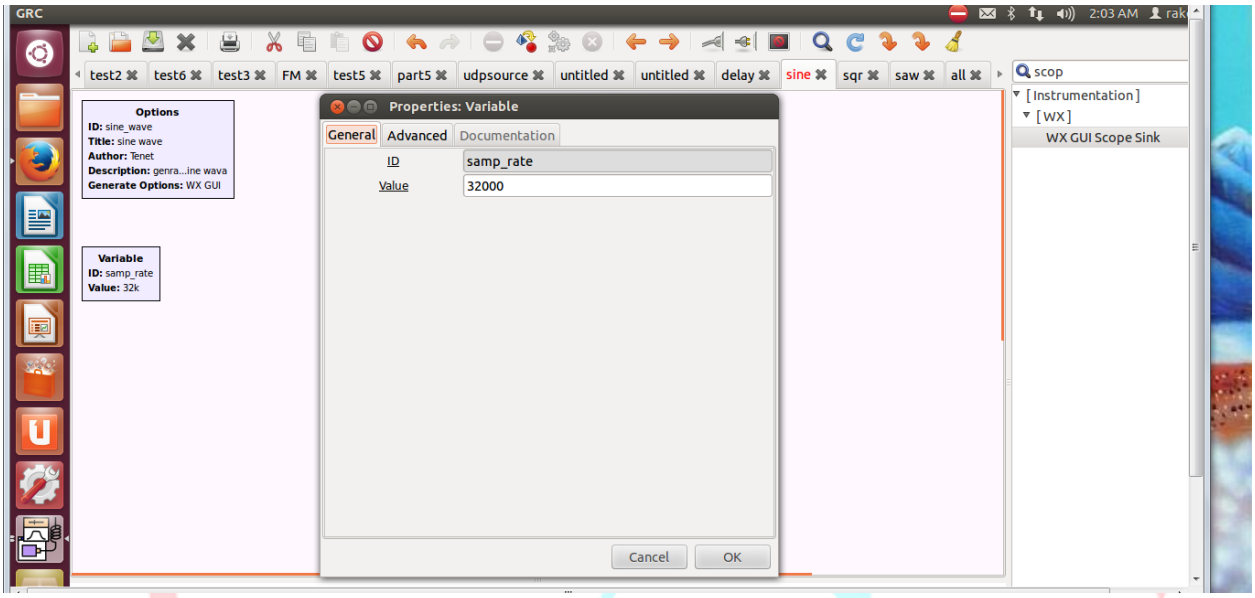


Options block defines the ID, Title and Description of the experiment.

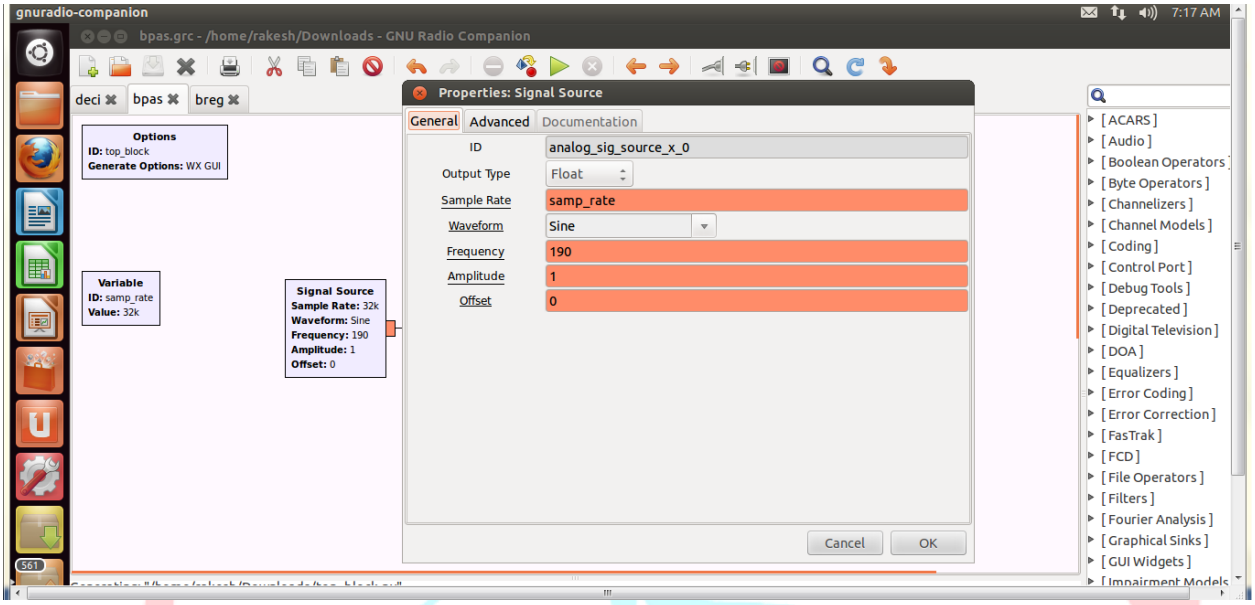


Variable Block defines to declare variables globally. This block maps a value to a unique variable. This variable block has no graphical representation. The variable can be referenced (by ID) from other blocks in the flowgraph.

- ID = samp_rate
- Value = 32000Hz
-

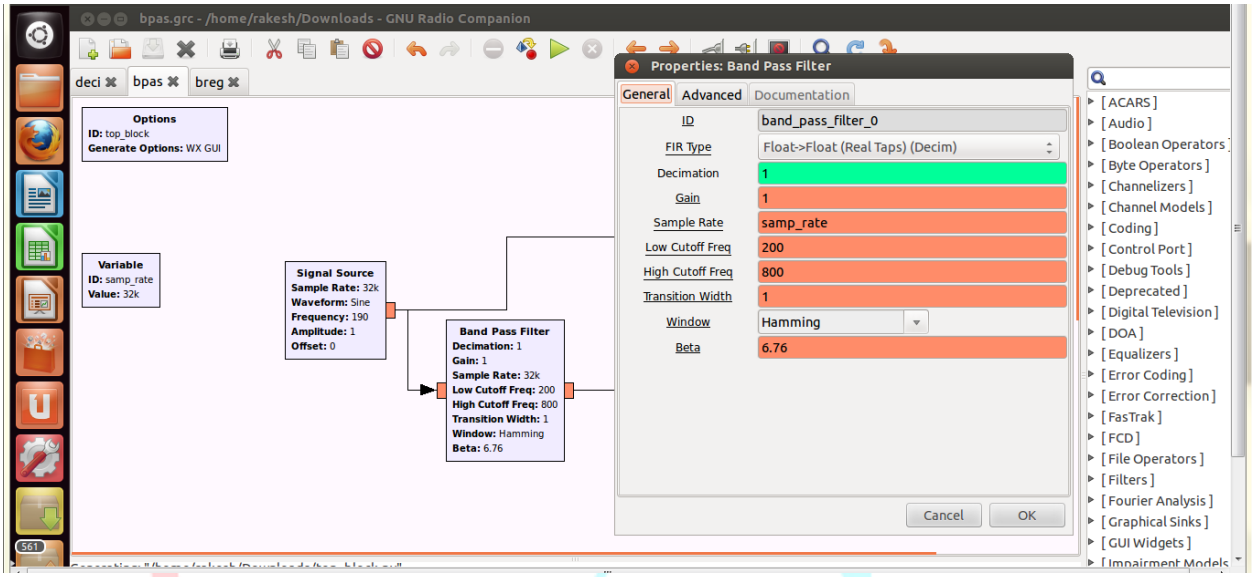


Signal source is a wave form genrator. Very first block genrates the sine wave, second block genrates the square wave, third block genrates triangler wave and finaly fourth block genrates the sawtooth waveform.



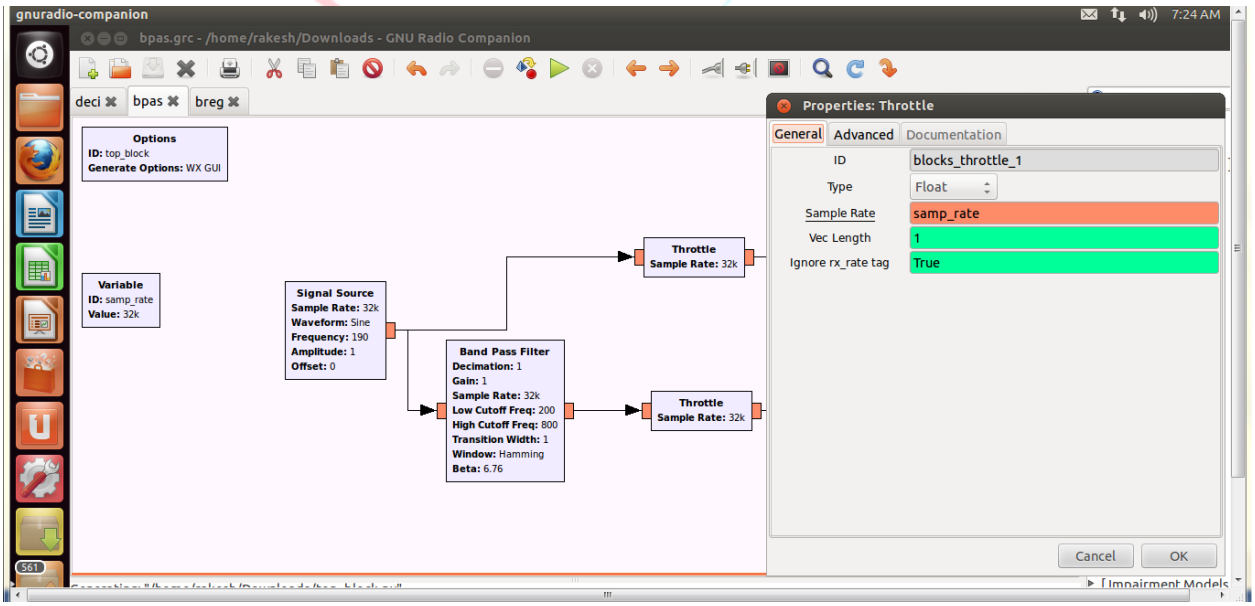
- ID:analog_sig_source_0
- Output type: float
- Freq: 190Hz
- Amplitude: 1V

Band pass filter: this filter is a convenience wrapper for an fir filter. Sample rate, cutoff freqency and transition width are in Hertz.
ID: band_pass_filter_xxx_0
Type: float
Low cutoff freq: 200Hz
High cutoff freq: 800Hz



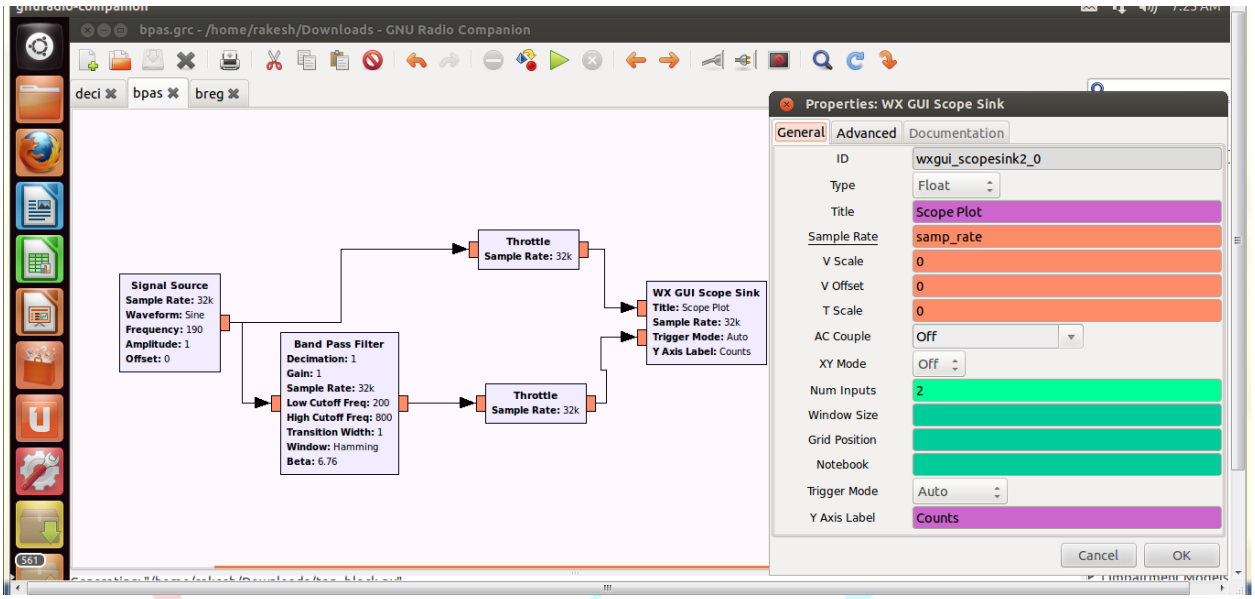
Throttel block: Throttel is a device that control the flow of samples such that average rate does not exceeds samples/sec. Throttle is used because no hardware interface has done.

- ID: blocks_throttel
- Type: float
- Vec length: 1

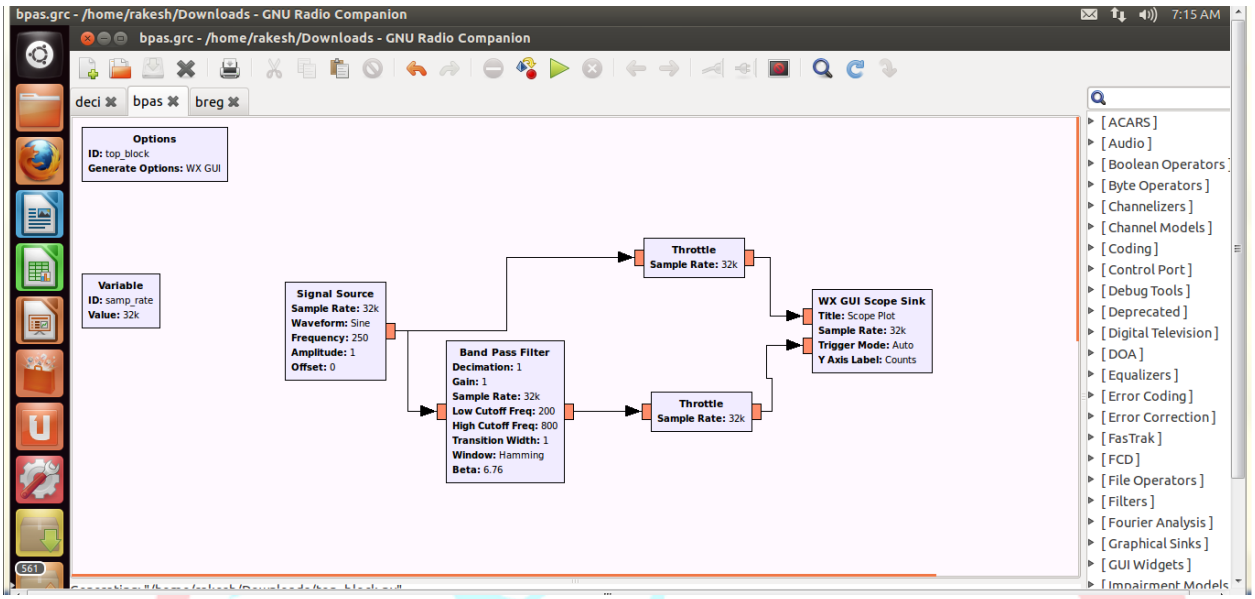


WX GUI scope sink: The WX GUI Scope sink is the destination block of the flow chart. This block is used to view the time domain representation of the output. The simulation output of the received signal is seen with this block.

- ID: wxgui_scopesink2_0
- Type: float



The Complete block representation



Genrated output