WinFIR, Version 1.2, May 2022. (Freeware)

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What's new in version 1.2:
- Added "Half-band" filter synthesis.
- The "Filter Analysis" is much more flexible.

Presentation:
WinFIR is an application to design digital "**Finite Impulse Response**" (FIR) **filters**.

- WinFIR is completely free software.
- It is easy to use and intuitive for people knowing a little about the "FIR" and their limitations.
- It is ergonomic: optimizing a filter while examining its Frequency response is easy.
- The calculation of the filter coefficients (taps) is based on the classical "Parks-McClellan" algorithm to which several iterative optimizations have been added.
  The maximum number of coefficients is 4095.
- The frequency response can be easily examined, by displacing a cursor on the graphic.
- The filters are stored on the disk in text format. Therefore the files are easy to maintain.
- For an easy access to the filter coefficients, the application includes its own text editor.
  The coefficients can be modified or new coefficients can be "pasted" in the editor to analyze the frequency response.
- To analyze the real performance of the filter implementation, the coefficients format can be set to 64 bit float (= double) or 32 bit float or 32 bit integer or 16 bit integer.

The Main Dialog Box:
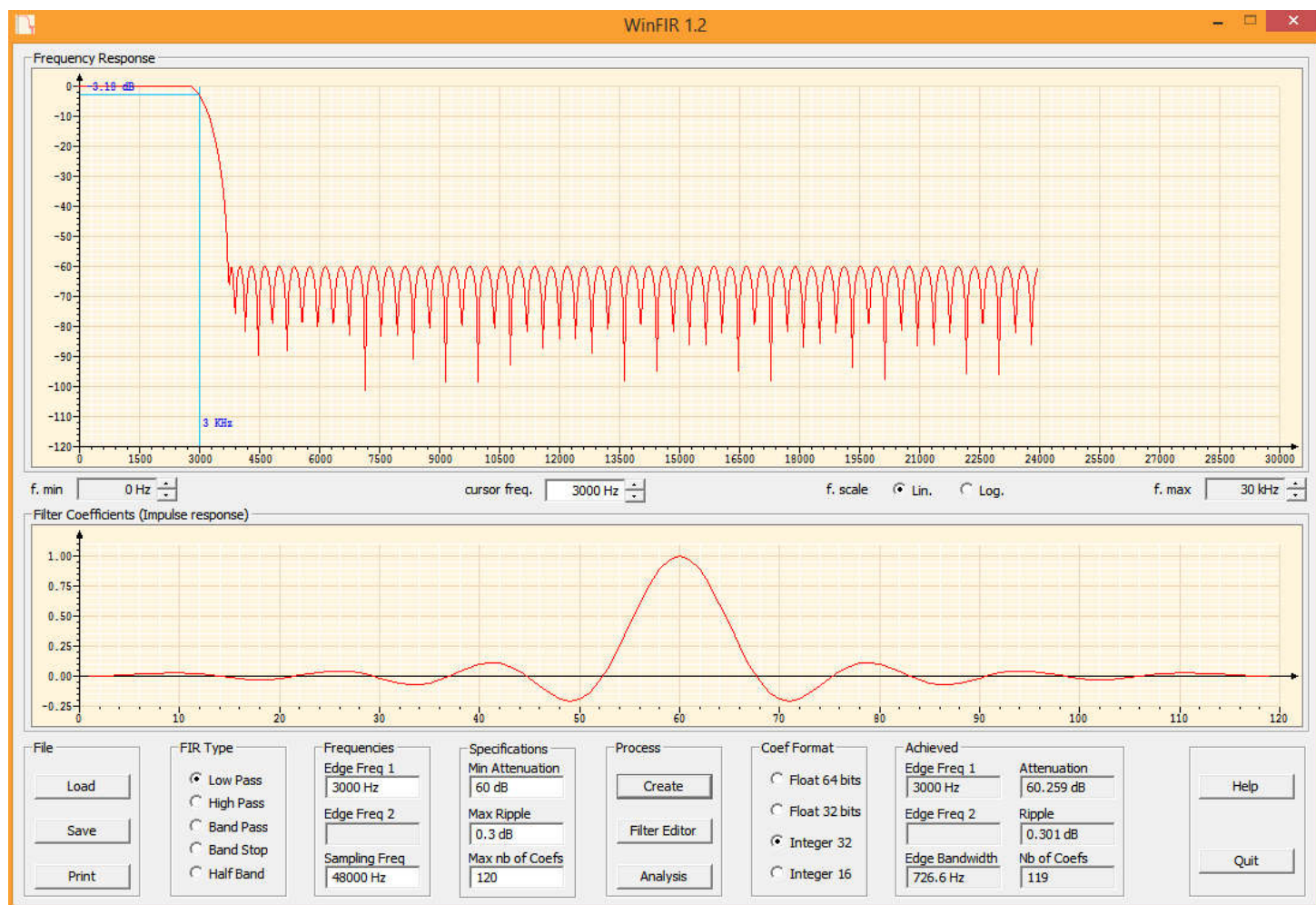
The upper diagram displays the Frequency Response.
You can adjust the frequency range and chose between a linear or logarithmic frequency scale.

When clicking on the graphic, a marker is displayed and it can be moved with the mouse.
The marker indicates the level (in dB) at the selected frequency.

Under the graphic showing the Frequency Response, a second graphic displays the filter coefficients.
This is only a coarse indication of their value and distribution, to get an idea of the filter impulse response.

The edition boxes and the buttons used to specify the filter characteristics are located at the bottom of the dialog window.

Five types of filters are available: low pass, high pass, band pass, band stop and half-band filters.
Half-band filters are often used for "Decimation" and "Polyphase" filtering.
They can be implemented very efficiently since $((N-1)/2) - 1$ coefficients are null.

Clicking on the "Create" button starts the filter creation process.

Warning: creating a filter with a lot of coefficients will take a lot of time, up to several minutes, depending on the performance of your PC.. Be patient!
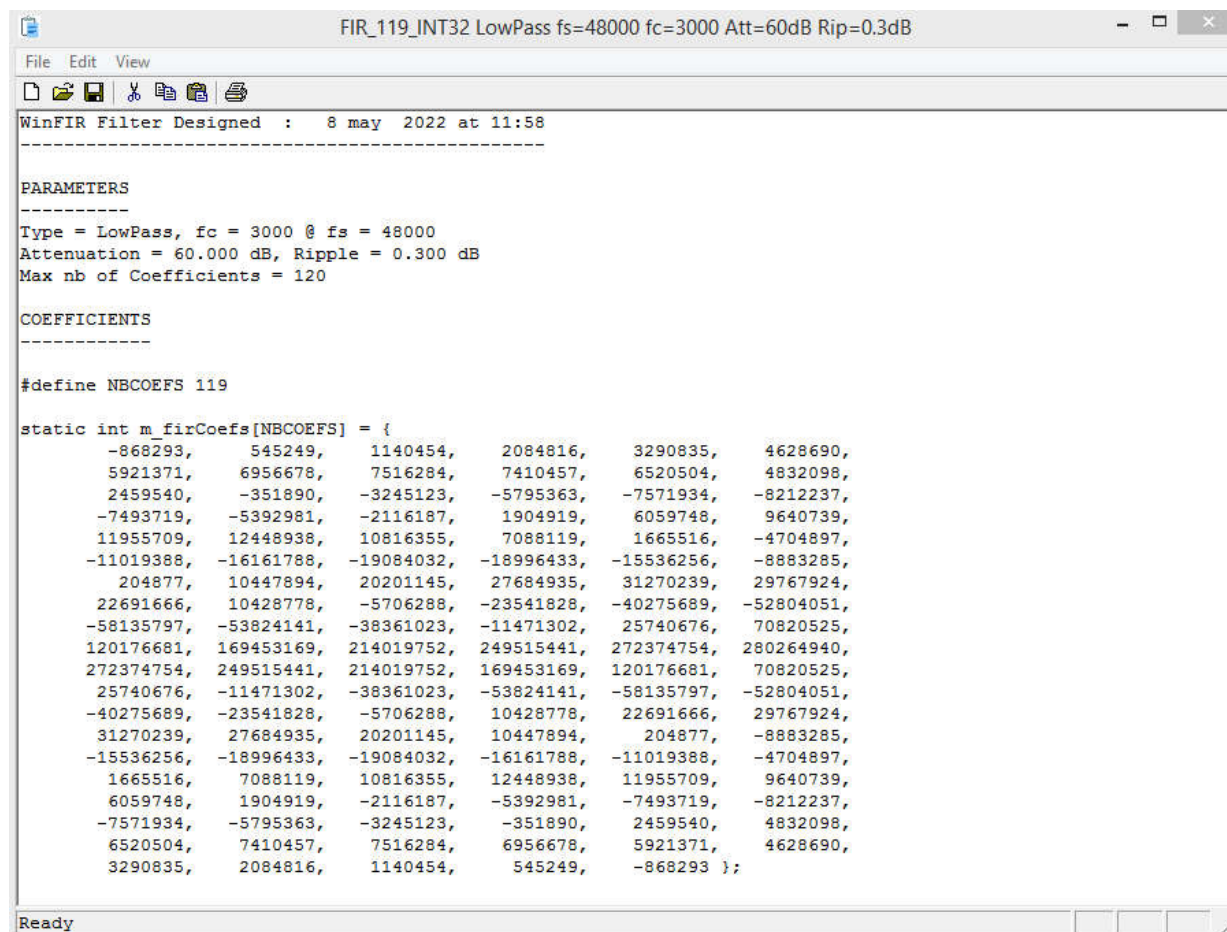
Once that a filter has been created or analyzed the achieved performances are displayed (attenuation, ripple,...).

Hints: creating a filter is an iterative process. Sometimes, relieving the specifications permits to achieve a better filter.
For example, specifying a large attenuation or a low ripple for a filter with few taps is counterproductive.
Also, do not forget to have a look at the "Edge bandwidth", a filter with a lower attenuation and an higher ripple will have a narrower "Edge bandwidth", this means that the transition between the pass band and the stop band will be steeper.

The Filter Editor:

```
                    FIR_119_INT32 LowPass fs=48000 fc=3000 Att=60dB Rip=0.3dB          - □  ×

File  Edit  View

WinFIR Filter Designed  :   8 may  2022 at 11:58
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PARAMETERS
----------
Type = LowPass, fc = 3000 @ fs = 48000
Attenuation = 60.000 dB, Ripple = 0.300 dB
Max nb of Coefficients = 120

COEFFICIENTS
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#define NBCOEFS 119

static int m_firCoefs[NBCOEFS] = {
     -868293,     545249,    1140454,    2084816,    3290835,    4628690,
     5921371,    6956678,    7516284,    7410457,    6520504,    4832098,
     2459540,    -351890,   -3245123,   -5795363,   -7571934,   -8212237,
    -7493719,   -5392981,   -2116187,    1904919,    6059748,    9640739,
    11955709,   12448938,   10816355,    7088119,    1665516,   -4704897,
   -11019388,  -16161788,  -19084032,  -18996433,  -15536256,   -8883285,
      204877,   10447894,   20201145,   27684935,   31270239,   29767924,
    22691666,   10428778,   -5706288,  -23541828,  -40275689,  -52804051,
   -58135797,  -53824141,  -38361023,  -11471302,   25740676,   70820525,
   120176681,  169453169,  214019752,  249515441,  272374754,  280264940,
   272374754,  249515441,  214019752,  169453169,  120176681,   70820525,
    25740676,  -11471302,  -38361023,  -53824141,  -58135797,  -52804051,
   -40275689,  -23541828,   -5706288,   10428778,   22691666,   29767924,
    31270239,   27684935,   20201145,   10447894,     204877,   -8883285,
   -15536256,  -18996433,  -19084032,  -16161788,  -11019388,   -4704897,
     1665516,    7088119,   10816355,   12448938,   11955709,    9640739,
     6059748,    1904919,   -2116187,   -5392981,   -7493719,   -8212237,
    -7571934,   -5795363,   -3245123,    -351890,    2459540,    4832098,
     6520504,    7410457,    7516284,    6956678,    5921371,    4628690,
     3290835,    2084816,    1140454,     545249,    -868293 };

Ready
```

The editor is used to access the filter description and its coefficients in text format.
It is accessible through the "Filter Editor" button.
When opened, the text editor is automatically refreshed when the filter parameters are modified.

Filter Analysis

You can enter any set of coefficients inside the editor and request for the frequency response "Analysis", even if those coefficients are not coherent with the filter specifications.

You will just receive a warning, but the analysis will be performed and the frequency response curve will be updated.
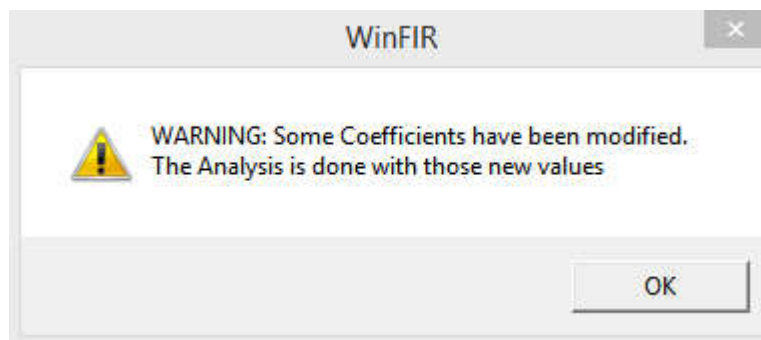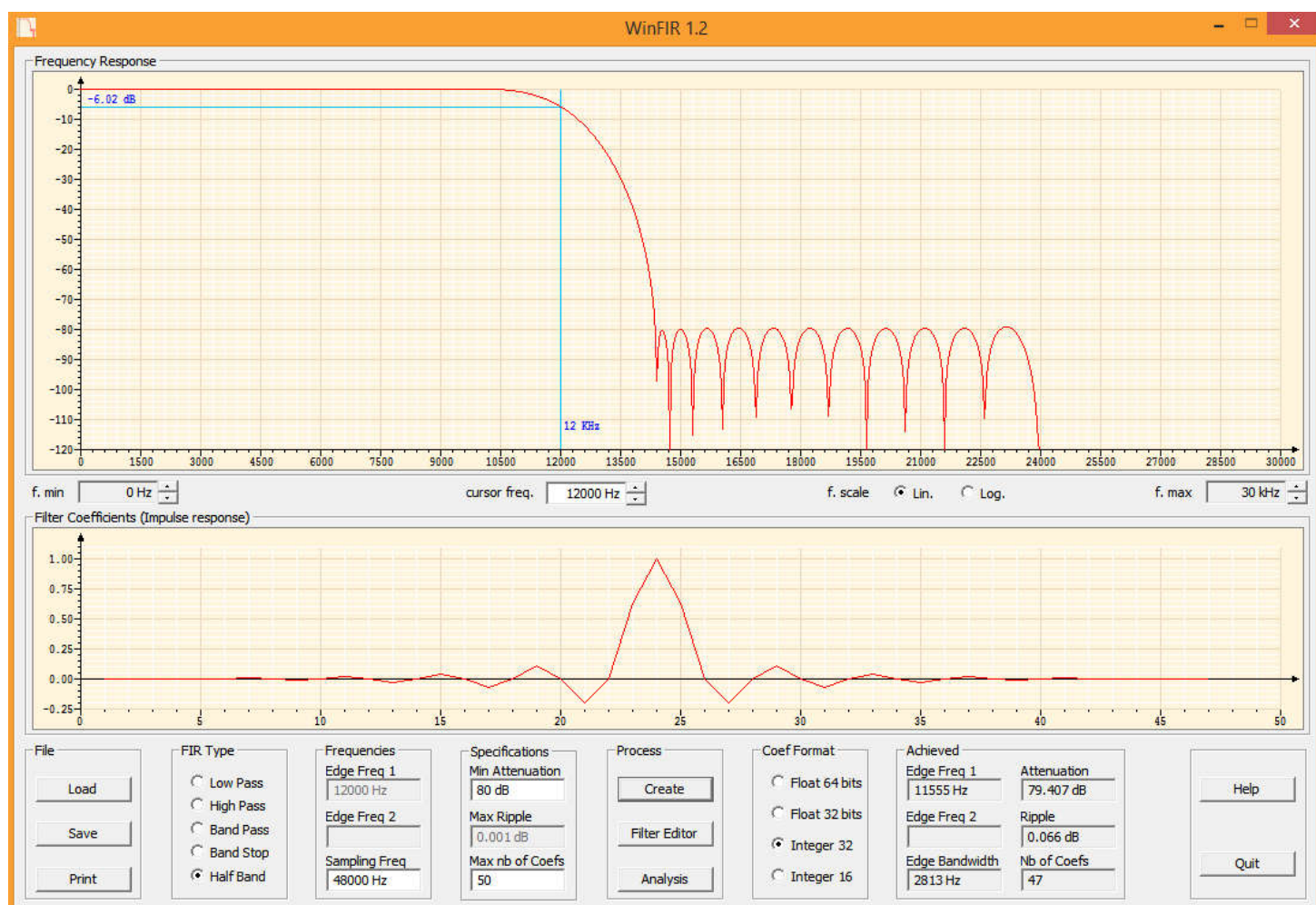

For correctly parsing the "Editor" content, some strings must still be present:

"WinFIR", "#define NBCOEFS ..." and the structure "m_firCoefs[NBCOEFS]".

The filter Type "Type = ..." and the sampling frequency "fs = ..." can be present but this is not mandatory, the values taken from the main dialog will be used and the editor window updated.

Example of a simple half-band filter

File   Edit   View

```
WinFIR Filter Designed  :   8 may  2022 at 12: 2
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PARAMETERS
----------
Type = HalfBand, fs = 48000
Attenuation = 80.000 dB
Max nb of Coefficients = 50

COEFFICIENTS
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#define NBCOEFS 47

static int m_firCoefs[NBCOEFS] = {
       -453871,          0,     1322238,          0,     -3026732,          0,
       6070332,          0,   -10976157,          0,     18598655,          0,
     -29983057,          0,     47030877,          0,    -73329271,          0,
     118300910,          0,  -216346926,          0,   679663913, 1073741823,
     679663913,          0,  -216346926,          0,   118300910,          0,
     -73329271,          0,     47030877,          0,    -29983057,          0,
      18598655,          0,   -10976157,          0,     6070332,          0,
      -3026732,          0,     1322238,          0,     -453871 };
```

Ready