LPP260A Quick User's Guide

Before to install the setup.exe, please make sure that the Net Framework 4.0 is already installed on the PC used.

After install the setup.exe and run the app "**LPP260A**" then the system show the following window

and after few seconds the main window
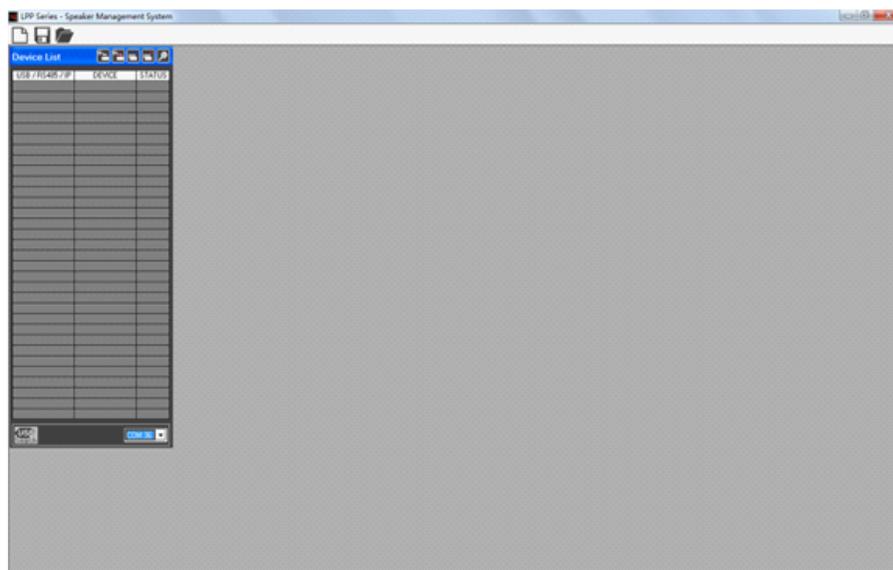
Below is introduction for the "Device List":

USB / RS485 / IP	DEVICE	STATUS
192.168.0.100	LPP260A	Off-line

Device List

: Connect all device

: Disconnect all device

: Add device to the List

: Remove one or more device from the List

: Search Device

LPP480A : Device Name

Off-line : Connection status of the device, by double clicking this characters, user can switch between "On-line" and "Off-line" mode.

Click the icon, you will see below conversation window. Click the preferable connection mode and device model. (In this case, device model shall be "LPP260A")

Note: When you connect under TCP/IP mode, please input the IP address of the device; if under RS485 mode, please input the ID of the device as well.
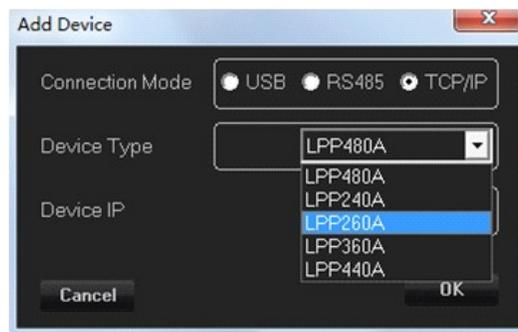
Once you have confirm the information, click "OK" to finish, and you will see the name of device you just added, as below image shows. Double click the device name, you will see the editing page.

You can also add the device into the "Device List" with the icon, set configuration in below boxes according to your connection mode, so to Search and connect the device.

The User has the possibility to connect the device via **USB** or **RS485** or **TCP/IP**

* If the **USB** is selected, the User must set the number of the COM used to connect the device
By the way, using the button "Check" the Sw will scan the Pc ports looking for the potentially connected ones: set on the Com Select window the found Com ports until found the working one.
In order to use the USB connection for remotely controlling the LPP260A, need first set on the unit the communication interface as USB.
To set the USB interface on the LPP260A the following steps have to be done:
1. press the "PM3/UTILITY" button on the front panel, for entering the "UTILITY MENU"
2. use the "PM1/ENTER" encoder for selecting the "Interface Utility" field
3. press the "PM1/ENTER" button, for entering the "Interface Setup" field
4. use the "PM2/ESC" encoder, for selecting the USB interface
5. after operated the selection, press the "PM2/ESC" button the necessary times for moving back on the several fields up to the default screen, showing "LPP260A" and the current loaded preset

* If the **RS485** is selected, the User must set the number of the COM used to connect the device and the ID number set on the device. When the RS485 is used and the User want connect several devices then if important that all device have an unique ID otherwise some device can not working
Use the button "Check" to see all COM connected on the PC.
In order to use the RS485 connection for remotely controlling the LPP260A, need first set on the unit the communication interface as RS485 and assign an ID to the unit.
To set the RS485 interface on the LPP260A the following steps have to be done:
1. press the "PM3/UTILITY" button on the front panel, for entering the "UTILITY MENU"

2. use the "PM1/ENTER" encoder for selecting the "Interface Utility" field
3. press the "PM1/ENTER" button, for entering the "Interface Setup" field
4. use the "PM2/ESC" encoder, for selecting the RS485 interface
5. use the "PM3/UTILITY" encoder, for selecting the RS485 interface's ID number
6. after operated the selection, press the "PM2/ESC" button the necessary times for moving back on the several fields up to the default screen, showing "LPP80A" and the current loaded preset

* If the **TCP/IP** is selected, the User can click the 🔍 icon, and select "TCP/IP Mode" in the checkbox as below image suggests, and input the device IP address range:

Search Device

☑ TCP/IP Mode

Search IP on the range:
Host Address: 192.168.168.6
From: 192 . 168 . 0 . 1
To: 192 . 168 . 0 . 100

☐ USB Mode
☐ RS485 Mode

Cancel   OK
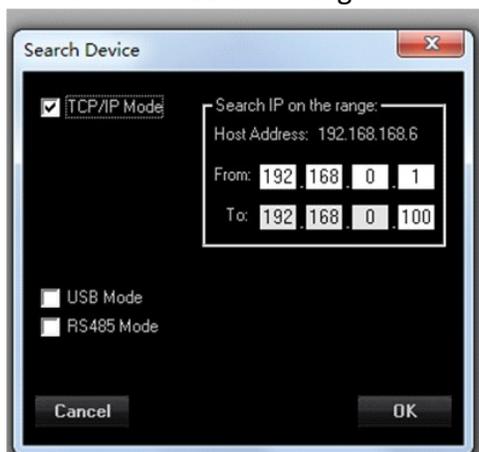
In order to use the TCP/IP connection for remotely controlling the LPP260A, need first set on the unit the communication interface as TCP/IP and assign an IP address to the unit, if not used DHCP mode. t
To set the TCP/IP interface on the LPP260A the following steps have to be done:
1. press the "PM3/UTILITY" button on the front panel, for entering the "UTILITY MENU"
2. use the "PM1/ENTER" encoder for selecting the "Interface Utility" field
3. press the "PM1/ENTER" button, for entering the "Interface Setup" field
4. use the "PM2/ESC" encoder, for selecting the TCP/IP interface
5. use the "PM3/UTILITY" encoder, for selecting the DHCP mode On/Off
6. if set the DHCP mode OFF, press the "PM1/ENTER" button fo entering the field for the IP address assignment
7. after operated the selection, press the "PM2/ESC" button the necessary times for moving back on the several fields up to the default screen, showing "LPP260A" and the current loaded preset

Once decided the Interfacing Connection and set the necessary parameters there where required, from the all USB. RS485 and TCP/IP windows, press the button "OK" and the system will start to check the device(s).
When found the connected device(s) the Sw will show a list of the devices found (if no device are found then is possible to continue in demo mode "Off-line") on the window "Device List".

If no devices found, the Sw will ask if the user want to continue in demo mode for evaluating the available process of the **LPP260A**.

to edit the device, double click on the name of the device present on the "List ID"

LPP Series - Speaker Management System

USB / RS485 / IP	DEVICE	STATUS
192.168.0.100	LPP260A	Off-line

USB Search — COM 2

EDITING Windows

on the Edit window is possible edit all parameters of the Input and output Output channel, save and load configuration on the sw PC, copy the input channel to another input channel, insert and change a User password in order to lock/unlock the interface, link the channel and see the current version of the firmware and software.

On the ALL Editing Windows, the Top Bar is fixed and shows ever the several available "tools'' useful for the User to manage the Editing Job so as to save it on Pc or within the unit.

TOOL BAR

Load: Load a previously saved Full Configuration from a defined Pc directory. The configuration loaded will be the one edited with its parameters set on the several editing windows. The configuration loaded is containing the ALL parameters set in the several Editing Windows
Save: Save the current Full Configuration (the all parameters set within the all Editing Windows) into a defined Pc directory. The saved configuration is containing the ALL parameters set in the several Editing Windows

Store: Save the current Full Configuration (the all parameters set within the all Editing Windows) into one of 16 available locations within the **LPP260A**. The saved configuration is containing the ALL parameters set in the several Editing Windows and can be recalled also from the unit's front panel.
Recall: Load a previously saved Full Configuration from one of 16 available locations within the **LPP260A**. The configuration loaded will be the one edited with its parameters set on the several editing windows.

Copy (located after Recall): tool for copying the all parameters of one input channel to an other one. The Phase Correction FIR, available on each Input Path, are not included in this copy tool.
Copy (located before Default): tool for copying the all parameters of one output channel to an other one. The Xover FIR, available on each output Path, are included in this copy tool. The Routing available on each couple of outputs (1/2, 3/4) is not included in the copy tool.
Default: tool which can be used to bring back the **LPP260A** to the default setup, which is matching the one got by the Hw reset. All parameters are flatted and the all outputs are in MUTE

User (password selection): by default (when released by the factory) the password for locking permanently the **LPP260A** is set as "**000000**". Using the USER tool, the user can define is own password of six characters. Just providing at the very beginning the password "000000". a windows is entered allowing the user to assign a new password and confirm it.

Lock: momentary lock of the units' controls. When set, the all parameters cannot be accessed by the user, but no password is required for setting/resetting the lock itself. Used for avoiding to accidentally modify a setting during a live performance or if the user need to leave the editing session momentarily.

Password: this tool is allowing to LOCK the **LPP260A** by Password. When the unit is locked providing a Password, no control is accessible and to exit this status it is necessary to provide again the password allowing so to UNLOCK the unit.

Link Input: this powerful tool is giving to the user the possibility, checking the related boxes, to LINK together 2 or more input channels. When two or more input channels, with their own particular setting of parameters, are linked, from the link moment ahead the all parameters set to one of the linked channel will be set in the same way also on the other linked channels. The link function is not affecting the status of the parameters of the linked channels, preceding the Link action.

Link Output: as for the inputs, this tool is giving to the user the possibility, checking the related boxes, to LINK together 2 or more output channels. When two or more output channels, with their own particular setting of parameters, are linked, from the link moment ahead the all parameters set to one of the linked channel will be set in the same way also on the other linked channels. The link function is not affecting the status of the parameters of the linked channels, preceding the Link action.

R: button allowing to access the ROUTING Main Editing Page
G: button allowing to access the GAINS Main Editing Page
A/B: buttons allowing to access the INPUT CHANNELS Editing Pages
1/2/3/4/5/6: buttons allowing to access the OUTPUT CHANNELS Editing Pages

i: info button, giving information about the Firmware and Pc Sw version.

ROUTING WINDOW
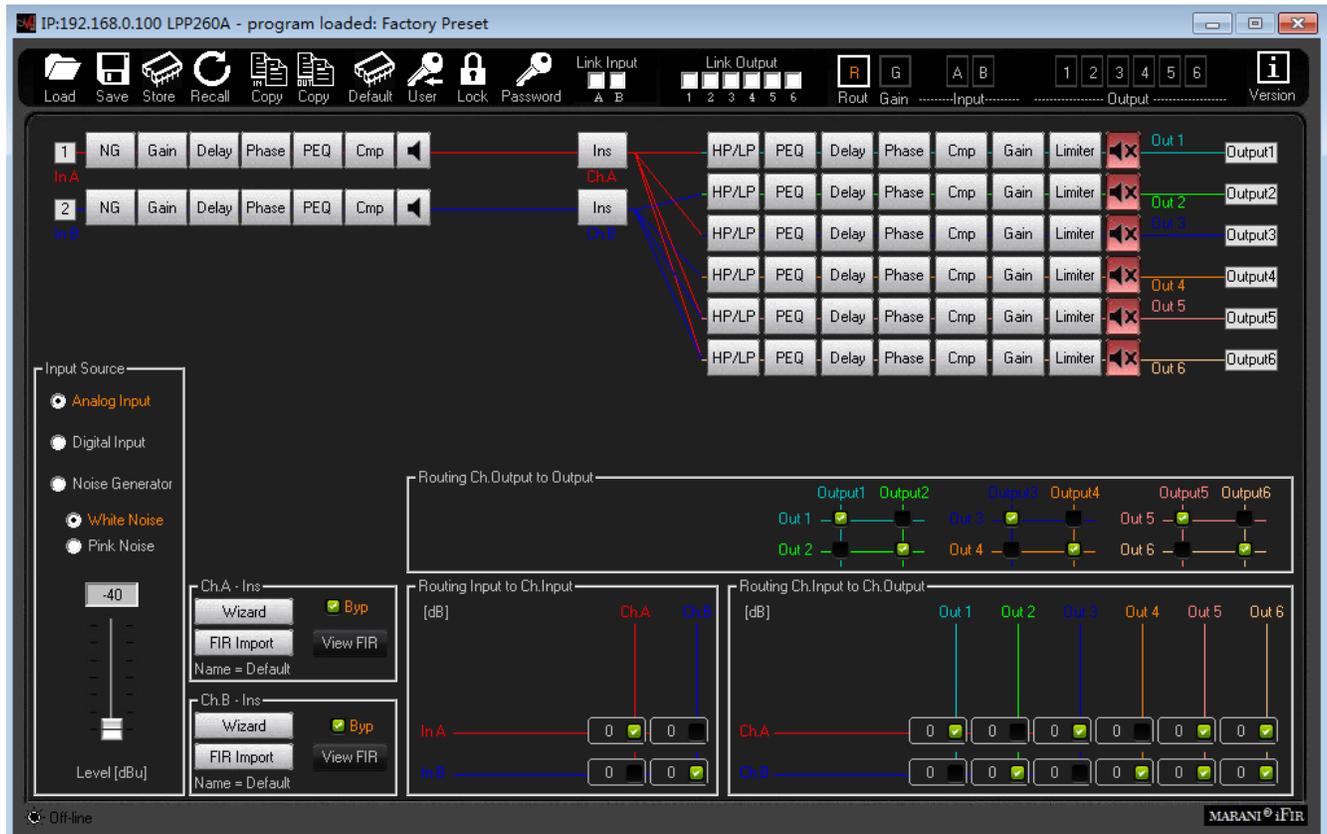
This Window is guesting a synoptic image of the several processes available on the Input and Output paths of the **LPP260A**, so as a series of "frames" for the selection of Input sources and Signal Routings.

Input Source frame: The Signal Sources to the **LPP260A** inputs can be selected in between several options, in alternative to each others.

- **Analog Input** is selecting as Inputs for the **LPP260A**, the ANLOG INPUT coming from the XLR Balanced connectors on the unit's back panel. The max accepted input level for the Analog Inputs is +20dBu.

- **Digital Input** is selecting as Inputs for the **LPP260A**, the DIGITAL INPUT coming from the XLR connectors CHA and CHB on the unit's back panel. In order to select the Digital Inputs, need the inner button located in between the ChC Input and CH1 Output to be pressed.

- **Noise Generator** is selecting as Inputs for the **LPP260A**, the White or Pink Noise generated internally by the Unit and controlled in Level by the related Slider ranging from -40dBu up to 0dBu.

ChA/B - Ins frames: here are available the controls for the use of a 1024 Taps FIR located on the Input path, which has been added mainly for being use for **PHASE CORRECTION** purposes, there where used together with the "Wizard" process embedded in the **LPP260A** Sw (see NOTE A), able to control a measurement process bringing to the calculation of the necessary coefficients for the phase linearization of a 2 way system, which in the case of the **LPP260A** can be identified as being a system processed by any of the 2 Inputs and 2 of the 6 available outputs.

Nevertheless, the FIR on the input paths can also work with coefficients loaded by external files and generated by Third Party Sw able to generate FIR coefficients. In this case, the FIR turn to be a 1024 Taps standard FIR, which can be loaded with any sort of coefficients for getting any sort of result (PEQ, Min Phase, Lin Phase, etc.). For the use of the external coefficients, need to generate them as text files and import them. See the details on the NOTE B.

- **Wizard**: this control is launching the "Wizard" Sw for the related FIR (see NOTE A for the Wizard Sw)
- **FIR Import**: here external coefficients can be imported into the FIR. Pressing the "FIR Import" button, the following window open and from the clicking on the LOAD icon, a .txt file (see NOTE B) with the Third Party calculated coefficients can be imported.
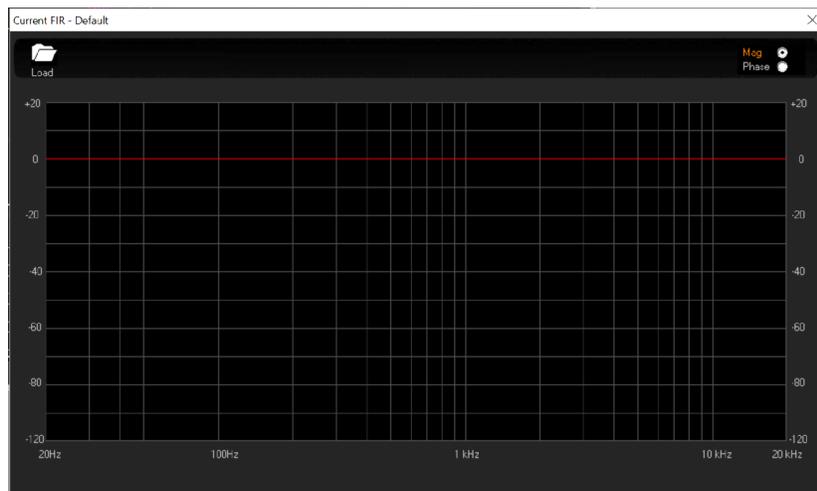
The Amplitude and Phase responses can be seen on the graphic which will show the characteristics of the imported filter.

- **View FIR**: once imported, or even internally generated, the FIR coefficients, the response of the FIR can be seen recalling it on graphic just pressing the 'View FIR" button.
- **Byp**: this check box is useful for making the loaded Fir Active or not. When not active, checked box, the fIR is simply transparent on the related input path. The Byp can therefore be used as powerful tool for A/B comparison between the system responses using or not the FIR.

Routing Ch Output to Output frame: Due to the availability on each input channel of the **LPP260A** of a 1024Tap FIR for phase correction purposes (see later), the Unit has been conceived as a possible unit able to provide 2 times of   Mono Input processes with FIR for phase correction and two outputs for driving a 2 ways Loudspeaker System. From this point of view, each pair of output channels (1/2, 3/4) can be seen as pair of outputs for driving a 2 ways system which input has its own processes and its own phase correction FIR. In this perspective, has been chosen to give the user the possibility of routing the pair of outputs to the physical outputs of the unit. This touting can be performed within the "Routing Ch Output to Output" frame.

Routing Input to Ch Input frame: The "Routing Input to Ch Input" frame is allowing the user to send one input to more than one FIR filter on the input path, so to have the possibility to control more two or more way systems with different FIR for phase correction, still providing them the same input source if required. The way of routing the signal is here in MIXER MODE, giving the **LPP260A** the possibility to not only assign one input to the desired FIR for phase correction, but also to control on any FIR the level of the assigned input.

Routing Ch Output to Ch Output frame: this routing is the "classic" routing allowing to assign each Input to each output of the **LPP260A**. Particularly, being here the routing AFTER the FIR for phase correction, it is here possible to extend the principle of making a flexible controller with FIR on Input for phase correction and processes for 2ways outputs only, having here the possibility to assign one input and its own FIR for phase correction to more than two outputs, so extending the possibility to control system with more than two ways. The way of routing the signal is here in MIXER MODE, giving the LPP260A the possibility to not only assign one input to the desired output, but also to control on any output the level of the assigned input.

Synoptic Image: The Synoptic Image is showing in clear way the defined routings , so as gives the possibility to directly MUTE/UNMUTE any input and nay output, just clicking on the related loudspeaker icons. Clicking on any block of the Input path or Output path, the user is immediately brought to the editing window of the related Input or Output channel. A click on the 'INS" blocks of the Input paths, is opening the "wizard" process for the related FIR phase correction coefficients calculation (see NOTE A)

GAIN WINDOW
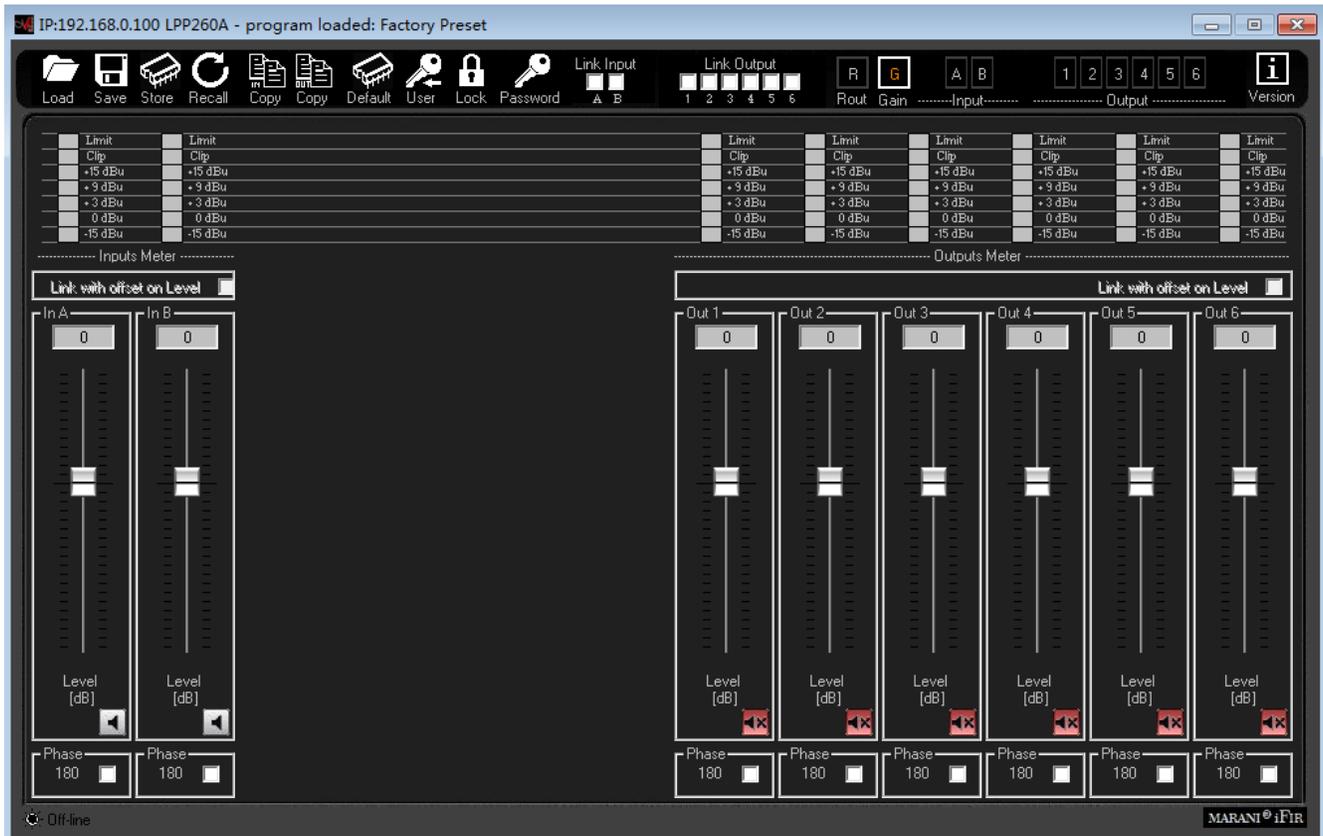
This "simple" window is allowing a quick control of the Input and Output Gains, so as the Input and Output Mutes. More, a complete "one shot" view of the ALL Input and Outputs Meters is given here.

IMPORTANT NOTE: the **LPP260A** has in internal Algorithm controlling the level coming from the Processes including gain variations as, Filtering Gains or Simply Level Gains, there where the Gain coming from the processes themselves can be a positive one. In this case, it is possible, given an input level close the the max available, to have internal processes overflow. The **LPP260A** inner Clip limiting Algorithm is detecting the potential or already occurring overflows and is containing them up to a 12dB Headroom, with a process "distortion free" based on level reduction tabled coefficients. When overflow over 12dB occurring, the Algorithm is containing them with a no distortion free process, which progressively is increasing the distortion level as more as the overflow containment is exceeding the +12dBu. The result of this "transparent to the user process", is a NOT CLIPPED output signal even with large excess of gaining internal processes and Input levels close to the max accepted by the unit. The process is active ONLY in case of Overflow occurring; when the signal is not exceeding with the sum of the Input level and the processes gain, the unit's dynamic, then the process is not active.

Input Meters: the input meters show the Input levels from -15dBu up to +15dBu. The Limit Led is indicating if Active the RMS Compressors. The Clip Led is indicating if the Clip limiter Algorithm described here above is active on the Input path.

Output Meters: the output meters show the output levels from -15dBu up to +15dBu. The Limit Led is indicating if the RMS Compressors or the Peak Limiter. The Clip Led is indicating if the Clip limiter Algorithm described here above is active on the Output path.

Sliders: the sliders control the Input/Output levels ranging from -18dBu up to +12dBu.

Mute Controls: useful for MUTING/UNMUTING the related Input/Output

Phase (Polarity): control for inverting the signal polarity (180Deg.)

INPUT WINDOW
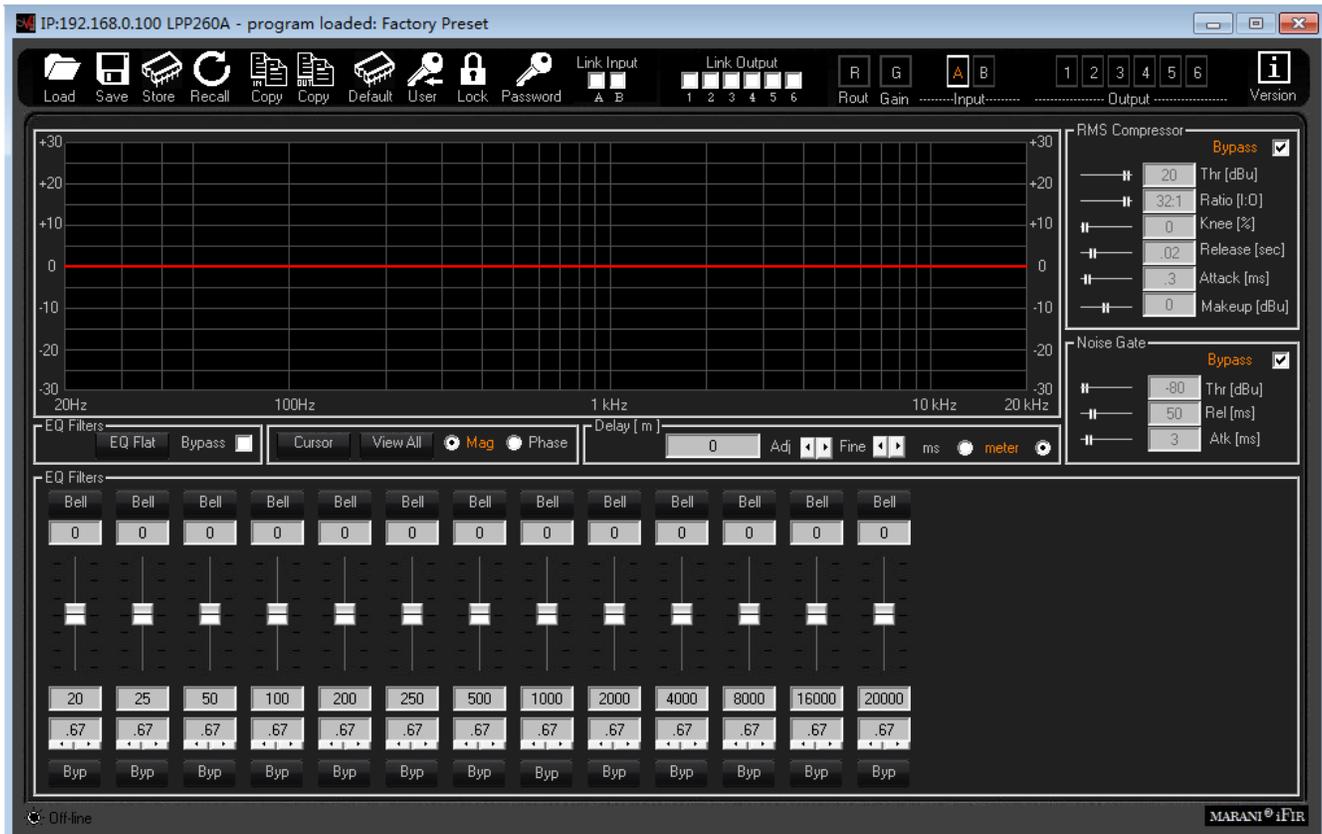
All the processes available on the Input Paths can be edited within the Input Windows.

Eq Flat and Bypass Controls: the EQ Flat control is allowing to flat in one shot the 13 bands Parametric Eq. The Bypass control, instead, is allowing to temporarily Bypass the Eq, without resetting the current setting.

EQ Filters: within this frame, the all 13 filters of the PEQ can be defined in terms of type, gain, Freq, Q
- **Fitlers type**: on top of the Slider and the box showing the gain level, there is a button that once pressed is opening a wide list of filters type which can be selected, for each filter of the parametric Eq. The available filters are **Bell** (constant Q), **Hi/Low Shelving 1st/2nd/Q** (classic first and second order and symmetrical ones with variable Q), **Lp/Hp 1st/2nd/Q** (classic 6dB/Oct first order, 12dB/Oct second order and variable Q), **Band Pass**, **Notch**, **All Pass 1st/2nd Ord**.
- **Gain**: the filter types which can gain, have the gain controlled by a slider ranging from -15dBu up to +15dBu.
- **Freq**: here can be inserted the Center, Cutting Frequency of the selected filter, ranging from 20Hz up to 20kHz.
- **Q**: there where usable, the Q can be set with a range depending from the selected filter.
- **Byp:** any filter of the 13 of the Parametric Eq, can be singularly bypassed, so to have the possibility to a quick A/B comparison between the signal when active or not the filter currently in editing phase.

Cursor: clicking on this control, cursors will appear on the graphic showing the amplitude response of the parametric Eq, for the setting of the filters' gain by mouse action.

View All: this control is opening a window showing the full Eq setting on each Input or Output or combination of them.

Mag and Phase: it is possible to decide if showing on the Window's graphic the Magnitude response of the Parametric Eq setting (Mag selected) or the Phase response (Phase selected).

Delay: the Input delay can be set here. The delay (in ms or meter) can be set using the button up/down "Adj" with step 1ms or "Fine" with step 10.4us (max input delay = 480ms =163.5meter)

RMS Compressor: the **LPP260A** is implementing a powerful RMS compressor on Inputs and Outputs, which compression coefficient is calculated on the base of tabled values giving a compression step of 0.2dB.
- **Bypass**: Compressor Active or not (Note that the all parameters here below are not accessible when the Compressor is set in Bypass)
- **Threshold:** from -10dBu to +20dBu step 0.2dBu
- **Ratio**: [input:Output] from 2:1 to 32:1 step 1
- **Knee**: from 0% to 100% (0% hard knee, 100% soft knee
- **Release**-time: from 0.001sec to 10sec step 0.001 sec
- **Attack**-time: from 0.1ms to 5000ms step variable
- **Make-Up**: from -12dB to +12dB step 0.1dB

Noise Gate: a noise gate is available
- **Bypass**: Noise Gate Active or not
- **Threshold:** from --80dBu to -50dBu step 5dBu
- **Release**-time: from 10ms to 1sec step variable
- **Attack**-time: from 1ms to 1sec step variable

OUTPUT WINDOW
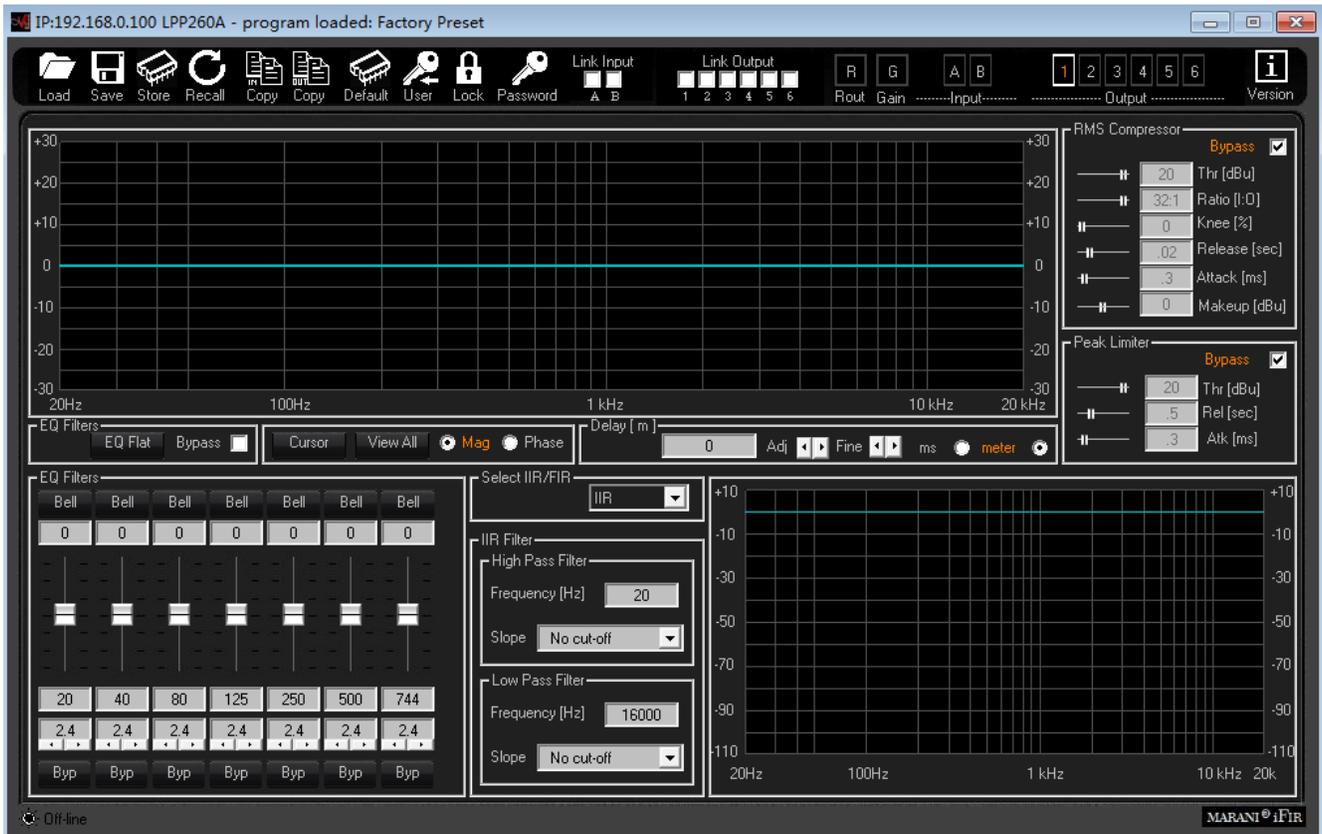
All the processes available on the Output Paths can be edited within the Output Windows.

Eq Flat and Bypass Controls: the EQ Flat control is allowing to flat in one shot the 7 bands Parametric Eq. The Bypass control, instead, is allowing to temporarily Bypass the Eq, without resetting the current setting.

EQ Filters: within this frame, the all 7 filters of the PEQ can be defined in terms of type, gain, Freq, Q
- **Fitlers type**: on top of the Slider and the box showing the gain level, there is a button that once pressed is opening a wide list of filters type which can be selected, for each filter of the parametric Eq. The available filters are **Bell** (constant Q), **Hi/Low Shelving 1st/2nd/Q** (classic first and second order and symmetrical ones with variable Q), **Lp/Hp 1st/2nd/Q** (classic 6dB/Oct first order, 12dB/Oct second order and variable Q), **Band Pass**, **Notch**, **All Pass 1st/2nd Ord**.
- **Gain**: the filter types which can gain, have the gain controlled by a slider ranging from -15dBu up to +15dBu.
- **Freq**: here can be inserted the Center, Cutting Frequency of the selected filter, ranging from 20Hz up to 20kHz.
- **Q**: there where usable, the Q can be set with a range depending from the selected filter.
- **Byp:** any filter of the 7 of the Parametric Eq, can be singularly bypassed, so to have the possibility to a quick A/B comparison between the signal when active or not the filter currently in editing phase.

Cursor: clicking on this control, cursors will appear on the graphic showing the amplitude response of the parametric Eq, for the setting of the filters' gain by mouse action.

View All: this control is opening a window showing the full Eq setting on each Input or Output or combination of them.

Mag and Phase: it is possible to decide if showing on the Window's graphic the Magnitude response of the Parametric Eq setting (Mag selected) or the Phase response (Phase selected).

Delay: the Input delay can be set here. The delay (in ms or meter) can be set using the button up/down "Adj" with step 1ms or "Fine" with step 20.8us (max input delay = 340ms =116meter)

RMS Compressor: the **LPP260A** is implementing a powerful RMS compressor on Inputs and Outputs, which compression coefficient is calculated on the base of tabled values giving a compression step of 0.2dB.
- **Bypass**: Compressor Active or not (Note that the all parameters here below are not accessible when the Compressor is set in Bypass)
- **Threshold:** from -10dBu to +20dBu step 0.2dBu
- **Ratio**: [input:Output] from 2:1 to 32:1 step 1
- **Knee**: from 0% to 100% (0% hard knee, 100% soft knee
- **Release**-time: from 0.001sec to 10sec step 0.001 sec
- **Attack**-time: from 0.1ms to 5000ms step 0.1ms
- **M**ake-Up**: from -12dB to +12dB step 0.1dB

Peak Limiter: a Peak Limiter for Loudspeaker protection is available
- **Bypass**: Peak limiter Active or not
- **Threshold:** from --10dBu to 20dBu step 0.2dBu
- **Release**-time: from 0.04sec to 6sec step 0.01sec
- **Attack**-time: from 0.1ms to 900ms step 0.1ms

Xover Section

The Xover Section of the LPP260A it is a particular and pretty powerful one, which can even become "tricky" if used in combination with the Parametric Eq.
Basically the PURE Xovering Section can be in standard operation, operated by IIR filters or FIR filters.
The FIR filters used for the Xover Section are 512 Taps ones and therefore cannot be used for cutting frequencies lowest than 250Hz.
Actually has to be said that the LPP260A is working at a sample rate of 96kHz, but the FIR both on the Input path (the Phase Correction one) and the outputs, are processing with a decimation factor of 2 , so running at 48kHz.
Back the the Xover, for cutting frequencies lower than 250Hz, of for any other reason coming from the user, IIR classic Lp/Hp filters can be used.

IIR Xover

If selecting IIR in the "Select IIR/FIR" frame, the Xover section is implementing IIR Hp/Lp, and the interface for the IIR filters setting is the following
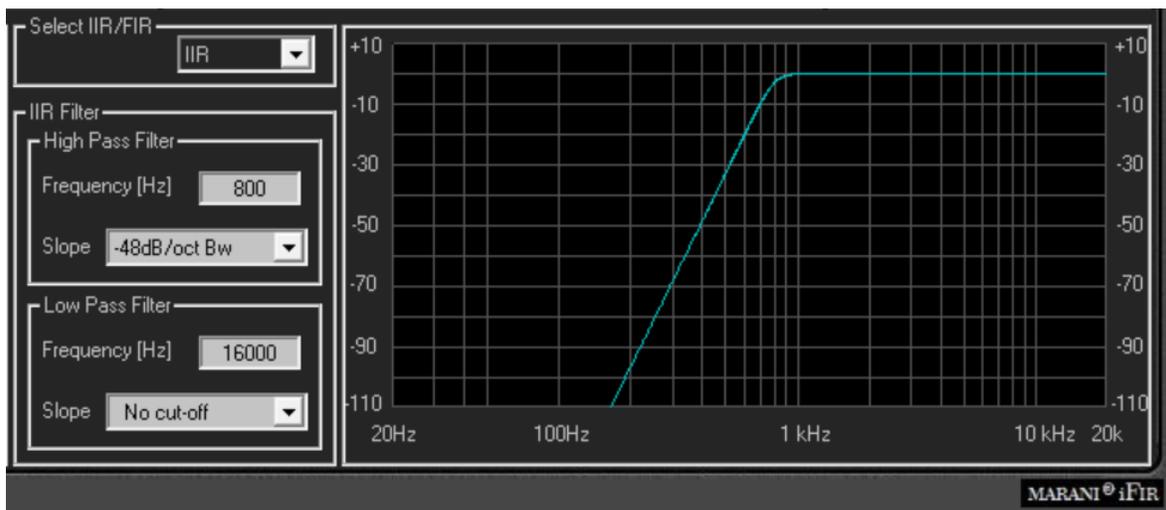
To edit the Hp or LP filter cutting frequency, input the value on the text box and press enter (Frequency from 20Hz to 20kHz step 1Hz)

To edit the Hp or LP filter type and slope, click on the relative Box and select the type (bypass, Butterworth, Linkwiz Riley, Bessel)

FIR Xover

If selecting FIR in the "Select IIR/FIR" frame, the Xover section is implementing FIR Hp/Lp, and the interface for the IIR filters setting is the following
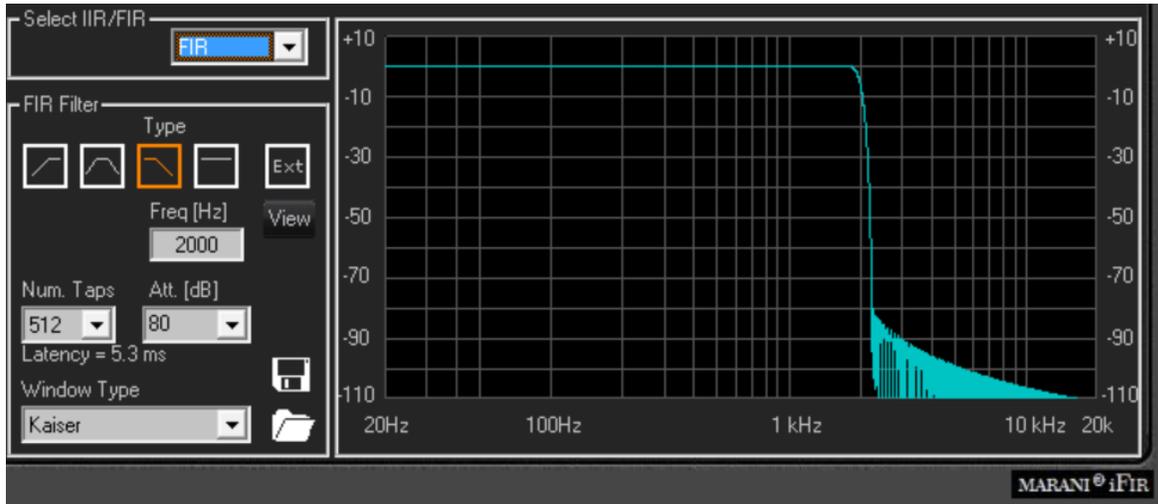
Here is possible to select the FIR type, and the all parameters for its configuration.
Particularly,

a. click on the icon to select the Filter **Type** (High Pass, Band Pass, Low Pass or Bypass)
b. insert the Cut-Off **Freq[Hz]**, input the value on the text box and press enter (Frequency from 250Hz to 20kHz step 1Hz)
c. select the number of the **Num. Taps** of the FIR (from 256 to 512). The FIR latency is dependent from the number of the taps and, being the FIR running at 48kHz, the latency can be calculated as follow:

$$\text{FIR Latency} = \text{Ntaps}/2 \times \text{Ts} = \text{Ntaps} \times \text{Ts}/2 = \text{Ntaps} \times 10.4us$$

d. select the max attenuation **Att.[dB]** for the out band signal
e. select the **Window Type** of the filter

Once the filter is set, it will be displayed in the window aside the parameters set. In order to make it active and performing on the Signal path, need to load it within the **LPP260A** clicking on the blinking icon

which is appearing as soon as a modification ton the currently loaded FIR is done.

Once the set FIR is uploaded into the **LPP260A**, the following Icons will become available

Allowing to save into a Pc directory the current edited filter for future use, or to upload from a Pc directory, previously saved FIR filters.

Also for the FIR used in the Output Xover Section, it is possible to upload coefficients imported from text files coming from Third Party Sw.

- **EXT** Icon: here external coefficients can be imported into the FIR. Clicking on the "EXT" Icon button, the following window open and from the clicking on the LOAD icon, a .txt or .csv file (see NOTE B) with the Third Party calculated coefficients can be imported.
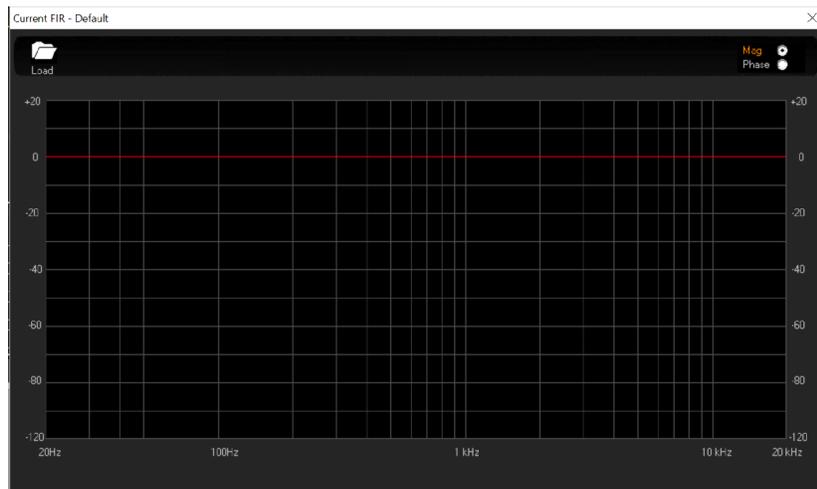
The Amplitude and Phase responses can be seen on the graphic which will show the characteristics of the imported filter.
- **View** : once imported, or even internally generated, the FIR coefficients, the response of the FIR can be seen recalling it on graphic just pressing the 'View " button.

FIR on Output not as Xover filter, using imported coefficients.

If the user would like to use an IIR filter as Xover, being necessary in example a cutting frequency below 250Hz, but still having available the FIR in the Xover section, a trick can be used for getting the result.

Particularly, we coujld say that we have three p[ossible way of using the FILTERS of the output channels.

1. 7 bands parametric Eq + IIR Xover (no FIR used): the Xover cutting frequencies can be set everywhere by the user, without limitation

2. 7 bands parametric Eq + FIR Xover (no IIR used): the Xover cutting frequencies can be set everywhere above 250Hz/300Hz by the user, no reasonable slopes can be achieved with the FIR for lower cutting frequencies.

3. If necessary to set a cutting Frequency for a Lp or Hp below 250Hz, but still we'd like to have the IFR available, eventually for working with imported coefficients, a trick for getting the result can be used. If we'd like to combine the IIR filters for Hp/Lp for low frequencies and still have FIR filters available, let say for further filtering, as PEQ one or any sort of phase configuration, then the user can operate in the following way, "sacrificing" some of the filters of the PEQ: the user can create the Low Freq Hp or Lp, using the variable Q Hp/Lp filters available in the Peq. They are in cascade, therefore, for a Hp/Lp 48dB/Oct, you can use 4 of them leaving still 4 more filters available.

Would be necessary to consume all of them for a Bp with 48dB/Oct Hp/Lp...but is a very rare case. Anyway, in this way, the user can have the IIR Hp or Lp, plus 4 more filters for Peq correction still of Low Freq and an available FIR 512Taps which can be used as the user desires if uploading the coefficients from an external source.

The user can see each one of the PEQ Filters as a IIOrd Cell, which if set as Hp or Lp with variable Q, can give a 12dB/Oct filter.

In example, setting the Filter N1. of the PEQ, set as Lp-Q at 1kHz and with Q=0.7, then can be gotten a 12dB/Oct Butterwoth Lp Pass with 1kHz Cutting Frequency.

Selecting now the second filters also as Lp-Q, and also with 1kHz cutting Frequency, and setting the Q of the first filter to 0.55 and the Q of the second to 1.3, then a 4th order Butterworth can be set up.

Basically, to get Lp, filters from 12dB/Oct, up to 48dB/Oct, need you to set as follow the Q, given the same cutting freq. to all of them:

Butterworth

12dB/Oct -----> One Cell   / Q1=0.70
24dB/Oct -----> Two Cells   / Q1=0.55, Q2=1.30
36dB/Oct -----> Three Cells / Q1=1.95, Q2=0,70, Q3=0.50
48dB/Oct -----> Four Cells / Q1=2.55, Q2=0.90, Q3=0.60,Q4=0.50

Linkwitz-Riley

12dB/Oct -----> One Cell   / Q1=0.70
24dB/Oct -----> Two Cells   / Q1=0.70, Q2=0.70
36dB/Oct -----> Three Cells / Q1=0.55, Q2=1,30, Q3=0.70
48dB/Oct -----> Four Cells / Q1=0.55, Q2=1.30, Q3=0.55, Q4=1.30

Bessel

12dB/Oct -----> One Cell   / Q1=0.50
24dB/Oct -----> Two Cells   / Q1=0.55, Q2=0.80

Technical Data

Analog Input	2 x XLR electronically balanced
Analog Output	6 x XLR electronically balanced
Digital Input	1 x AES/EBU; Gain 0dBu
Minimum Load	150 ohm
THD+N	0.001% at 1kHz 0dBu
S/N	>110dBA
Ground Noise	-92dBu
Frequency Response	20Hz – 20kHz; -0.5dBu at 20Hz and 20kHz
AD & DA Converters	24bit -96kHz
Device Presets	up to 32 User Presets
Front Panel	2 x 24 character LCD display with green LED back light 7-LED meter per input channel -15dBu to +15dBu, clip and limiter mode 7-LED meter per output channel -15dBu to +15dBu, clip and limiter mode Blue LED (Edit) per channel Red LED (Mute) per channel NAV/PM1 Rotary encoder push button switch PM2, PM3, ENTER, ESC, UTILITY push button switches EDIT/MUTE push button per channel USB type A connector
Rear Panel	(2) x XLR female connectors (2 x Analog Input or 1 x AES/EBU) 6 x XLR male connectors (Output) 1 x RJ45 connector for RS485 (Input) 1 x RJ45 connector for RS485 (Output) 1 x RJ45 connector for TCP-IP 1 x Ground-lift toggle switch 1 x Analog/Digital toggle switch IEC C13 16A connector; Power on/off switch
Main AC	90-240VAC (50/60Hz) – 40W
Dimensions	19"x 1.75"x 9" (483x44x229mm) 1RU

NOTE A

FIR WIZARD - User Guide v1.0

The FIR Wizard is a smart and easy-to-use software tool designed for enhancing the audio quality of a loudspeaker by compensating the linear distortions, both in magnitude and phase, through FIR filtering.

The tool guides the user through the loudspeaker IR measurement and allows generating state of the art equalization FIR filters, with few essential synthesis parameters, that "invert" unwanted phase shift, with the aim to linearize the phase response of the loudspeaker.

A magnitude equalization option is also available, allowing to flatten the amplitude response of the loudspeaker, or to set up a target magnitude curve.

Moreover, the Wizard allows to reduce the nominal latency of the generated FIR filter, in such way to fulfill the latency constraint of live sound systems, while preserving, almost unchanged, the correction capability of the filter itself.

Preliminary

The FIR Wizard is a tool to aid the user in "optimizing" the response of a loudspeaker, but driver choice as well as good cabinet and Xover design still remain the primary steps to achieve the best sound quality.

In general, before using the FIR Wizard, the user should do all the needed steps to correctly setup its sound system and to start from a reasonable loudspeaker response.

For example, in a multi-way loudspeaker, the response of each driver should be aligned in time to avoid dips in the Xover point, that can not be filled by FIR filtering without introducing audible artifacts.

Moreover, a preliminary coarse loudspeaker equalization is required to start from an almost flat overall frequency response, especially when FIR filtering is used to compensate both magnitude and phase. This allows to avoid strong boost of some frequencies, that may introduce undesired audible ringing effects.

If a non-flat target response is desired, the preferred procedure should be anyway to start from an nearly flat response and apply a post equalization after computing the compensation FIR filter, or, even better, to apply a target curve in the FIR filter itself.

Starting Up

The image below shows the home page of the FIR Wizard.
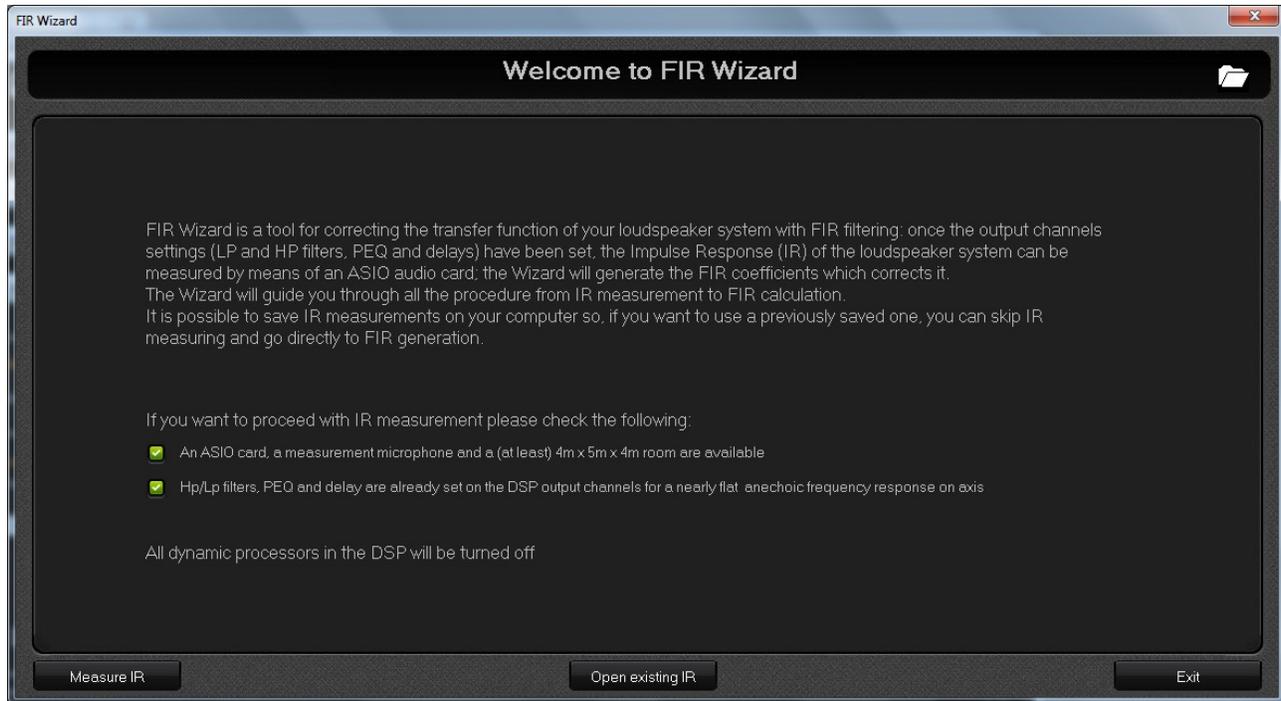
From the home page, the user can choose to:

1) Start from an existing Wizard project: click the open button at top right of the screen and a file browse window appears allowing to select a Wizard project file (.zwz)

2) Start from an existing IR, that has been already measured and saved from the FIR Wizard: click the "Open existing IR" button at the botton center of the screen and open an IR file (.oir) from the file browse window.

3) Start with a new IR measurement: to do this, be sure you have an ASIO sound card, a measurement microphone and, at least, a 4m x 5m x 4m (L x W x H) obstacle free measuring room (if the available space is a little bit smaller check for possible tricks described in the following section). Moreover, as already described in the "Preliminary" section, it is suggested to set up the Xover, the PEQ and the output delays to have a nearly flat frequency response on axis. Then, click the two reminder checkboxes to enable the "Measure IR" button and click it to proceed with IR measurement steps. At this time, all the dinamic processes in the DSP will be automatically turned off, as well as the equalization FIR filter that could be already active.

Measurement Geometry

After clicking the "Measure IR" button, the "Measurement Geometry" page is shown and three different geometry set up is suggested.
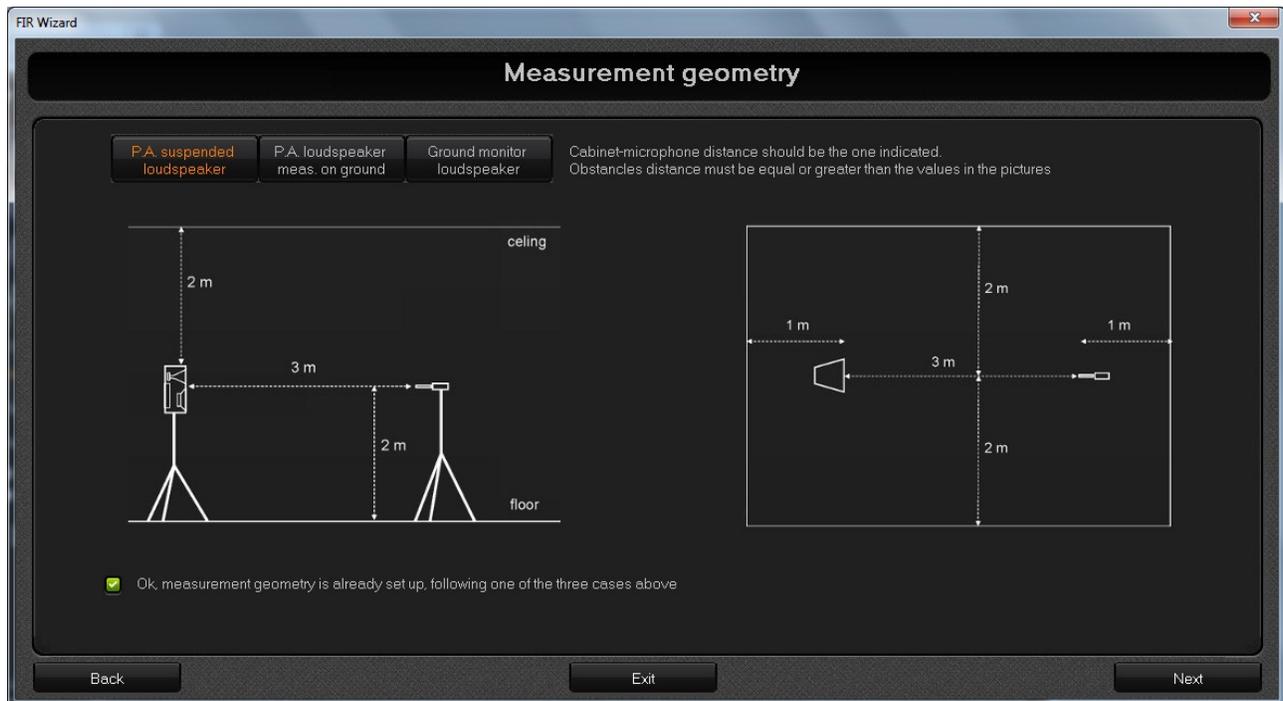
Clicking the buttons at top left of the screen. the three measurement scenarios are shown (vertical section on the left, planimetry on the right). This is just a visualization and reminder for the user that should check every time the correct geometry and choose one of the three options. The choice doesn't affect any following measurement or calculation parameters, which are actually compatible with all the three scenarios.

For each measurement geometry, the minimum distances between loudspeaker, microphone and obstacles has been computed in order to maintain a minimum distance between:

1) the direct sound wave path, from the loudspeaker to the microphone

2) the reflected sound wave path, from an obstacle (e.g. the floor or the wall) to the microphone

This will allow the Wizard algorithm to cancel out reflected components in the IR without corrupting the direct component information, at least in a useful, well defined frequency band.
This technique creates a sort of virtual anechoic room, which is fundamental to make the FIR equalization strictly related to the sound system and independent from the measurement space: in this way, the FIR will work fine also in other environments.

Here below, the three measurement scenarios are briefly described.

1) Loudspeaker system and microphone suspended at half height

In this case, the measurement space should be at least 4m x 5m x 4m (L x W x H).
The microphone should be in axis with the loudspeaker; obstacles should be at least 2m far from the microphone.

FIR Wizard

Measurement geometry

| P.A. suspended loudspeaker | P.A. loudspeaker meas. on ground | Ground monitor loudspeaker |

Cabinet-microphone distance should be the one indicated.
Obstancles distance must be equal or greater than the values in the pictures

celing

2 m

3 m

2 m

floor

2 m

1 m

1 m

3 m

2 m
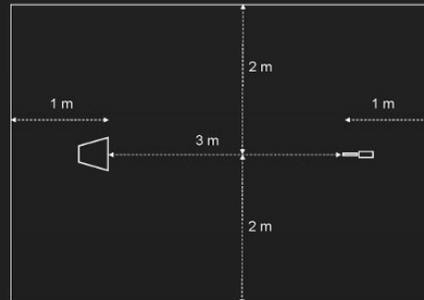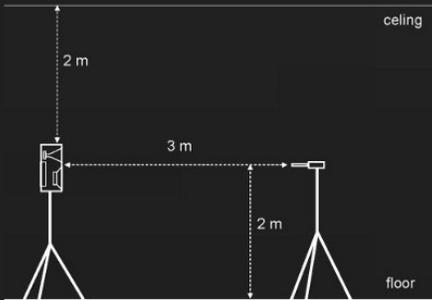
☑ Ok, measurement geometry is already set up, following one of the three cases above

| Back | Exit | Next |

2) Loudspeaker system and microphone lying on the ground

The loudspeaker must be tilted to point the microphone, that should be stricly in contact with the floor. The floor should be very reflecting (smooth), especially beneath the mic: a fine metal sheet under the mic can be useful for this purpose.
As the picture below shows, in this measurement setup a lower room height is required with respect to the preceeding scenario, so it can be used when the room height is less than 4m.
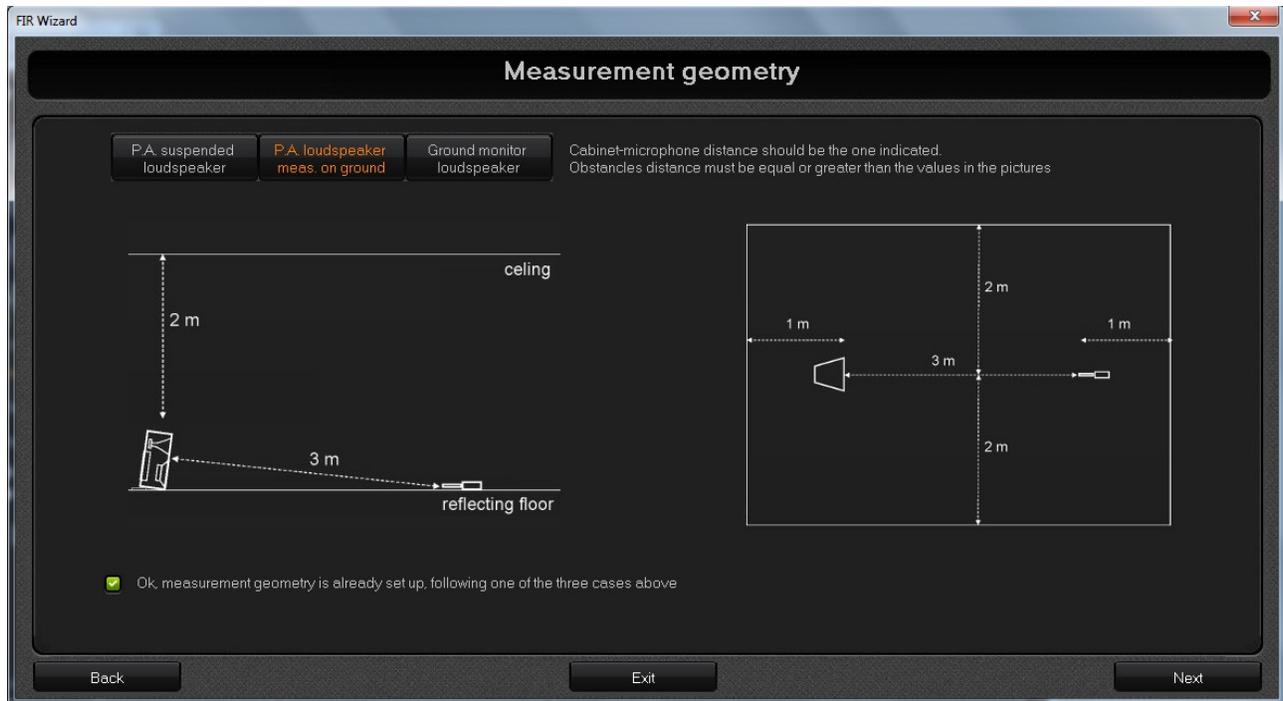
3) Ground monitor in operating position

The microphone should be in axis with the loudspeaker at an height of about 1.7m, where the listener's head will stay.
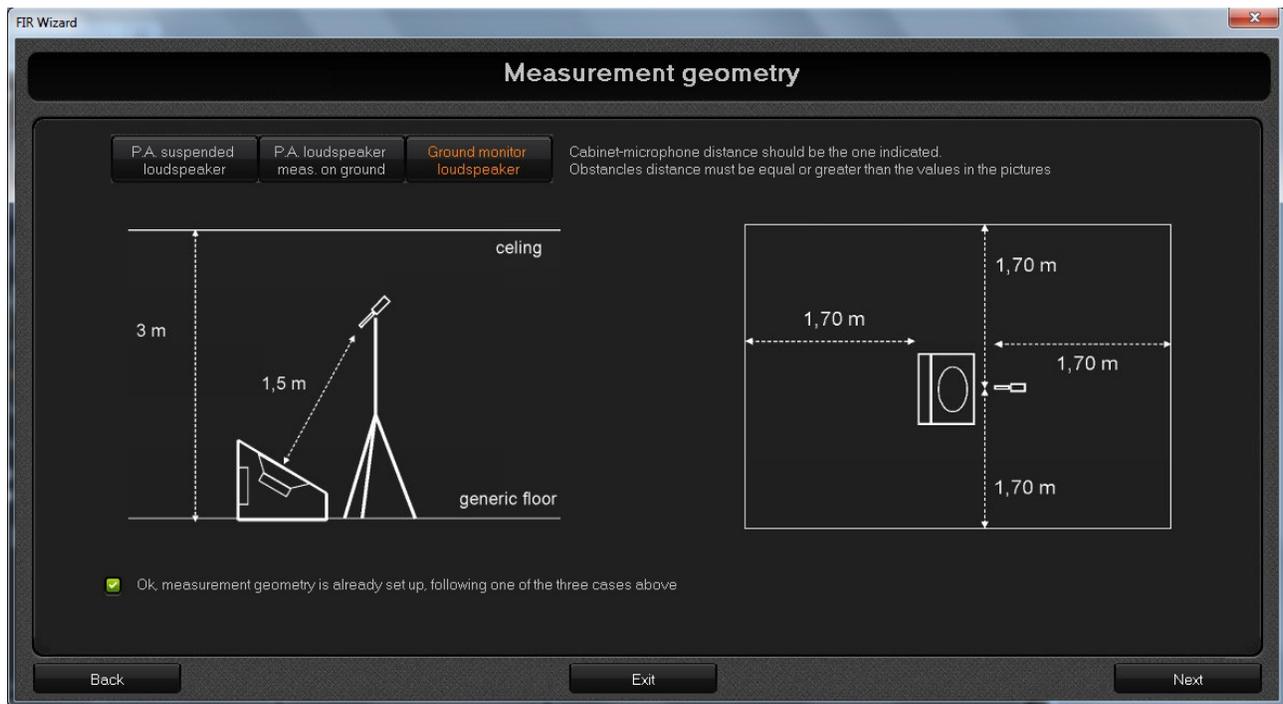
So, arrange the measurement choosing one of the three geometry setup and click "Next" button to proceed.

Wiring
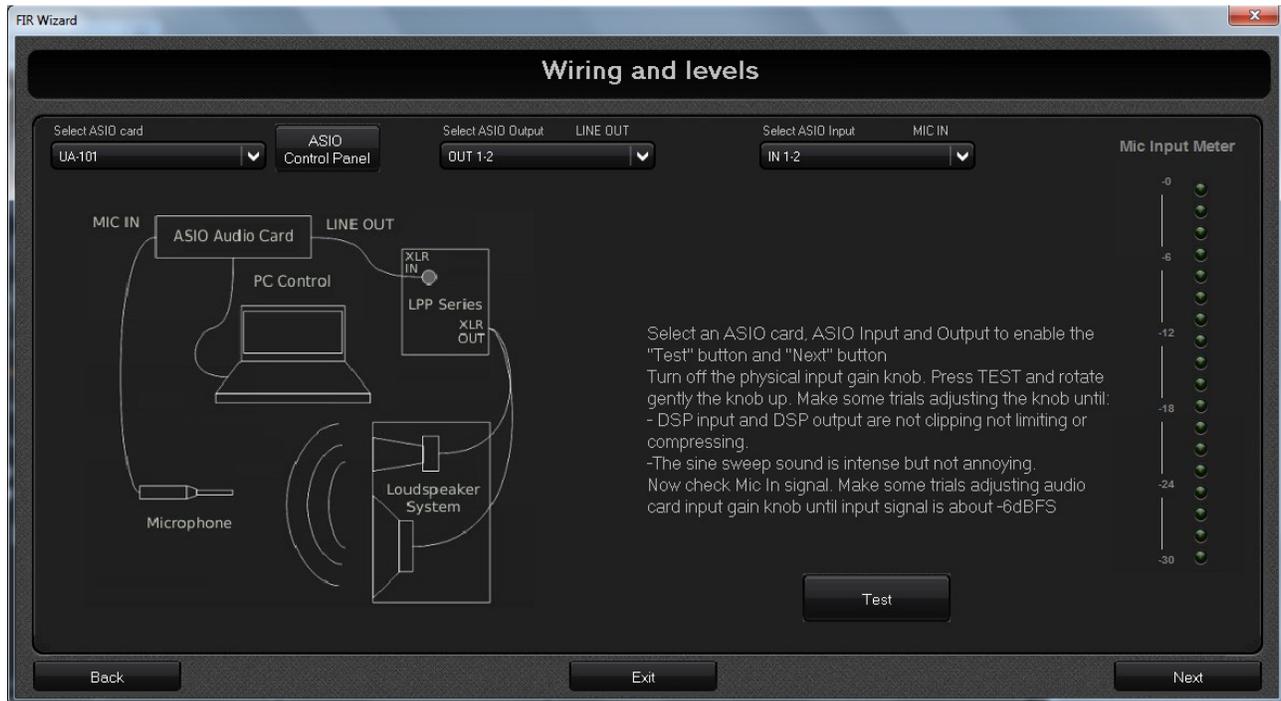
Connect an ASIO audio card to the PC where the FIR wizard is running, with its proper connection (USB, Firewire, etc.). Connect the (normally balanced) ASIO card output (XLR or TRS) to the balanced input (XLR) of the DSP device (e.g the LPP Controller).

Connect the microphone output to the mic input (normally XLR) of the audio card and turn the phantom power (if needed). If the mic has its own preamplifier, connect it to a line input of the audio card. Finally, connect the DSP device to the loudspeaker system.

Therefore, in the FIR Wizard "Wiring and levels" page, select the ASIO audio card and the right input/output channels. using the list box at the top of the screen,

Now, click the "Test" button to start the microphone test, making sure the loudspeaker amplifier volume is low. Then, start rising the amplifier volume untill a strong but not annoying "sine sweep" is heard. Click "Test" button again and adjust the microphone preamp gain until the measured signal peak reach roughly the -6 dBFS value.
If during the microphone test some glitches occur, it is probably due to a latency issue of the sound card. To solve the problem, open the sound card control panel clicking the "ASIO Control Panel" button and try to choose an higher latency value (or, equivalently, a large buffering).

Click "Next" button and you are ready to measure the IR of the loudspeaker.

IR Measurement
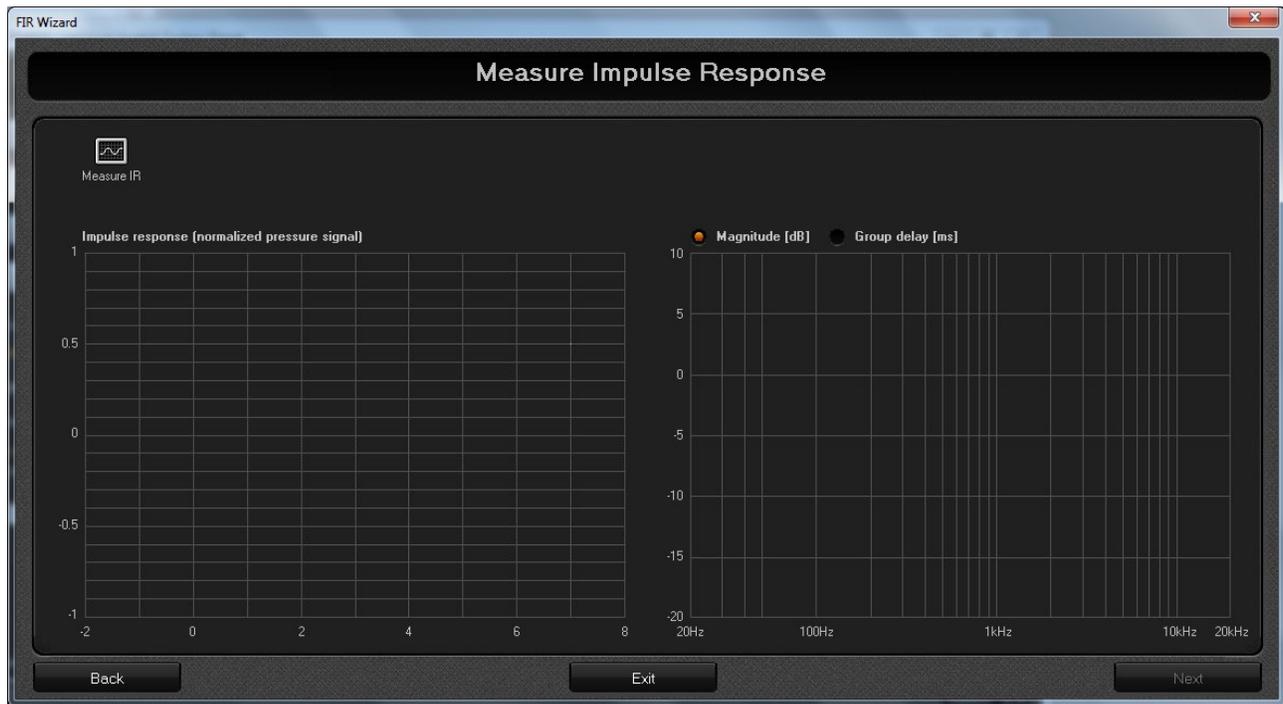
Clicking the "Measure IR" button at the top left of the screen, the measurement process starts and an activity progress bar shows the activity completion status. Wait in silence for the process completion. After the sine sweep, the Wizard starts the IR computation and the measured IR is plotted on the left graph with its peak centered on zero, while the magnitude and group delay frequency response is shown on the right graph.

FIR Wizard

View Impulse Response

Measure IR

Save IR

Impulse response (normalized pressure signal)
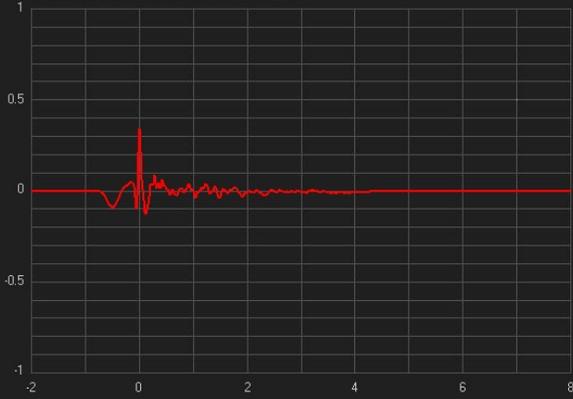
● Magnitude [dB]　● Group delay [ms]
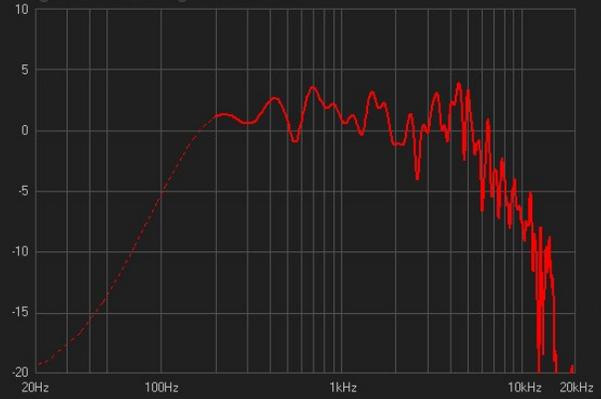
Back　　　　Exit　　　　Next
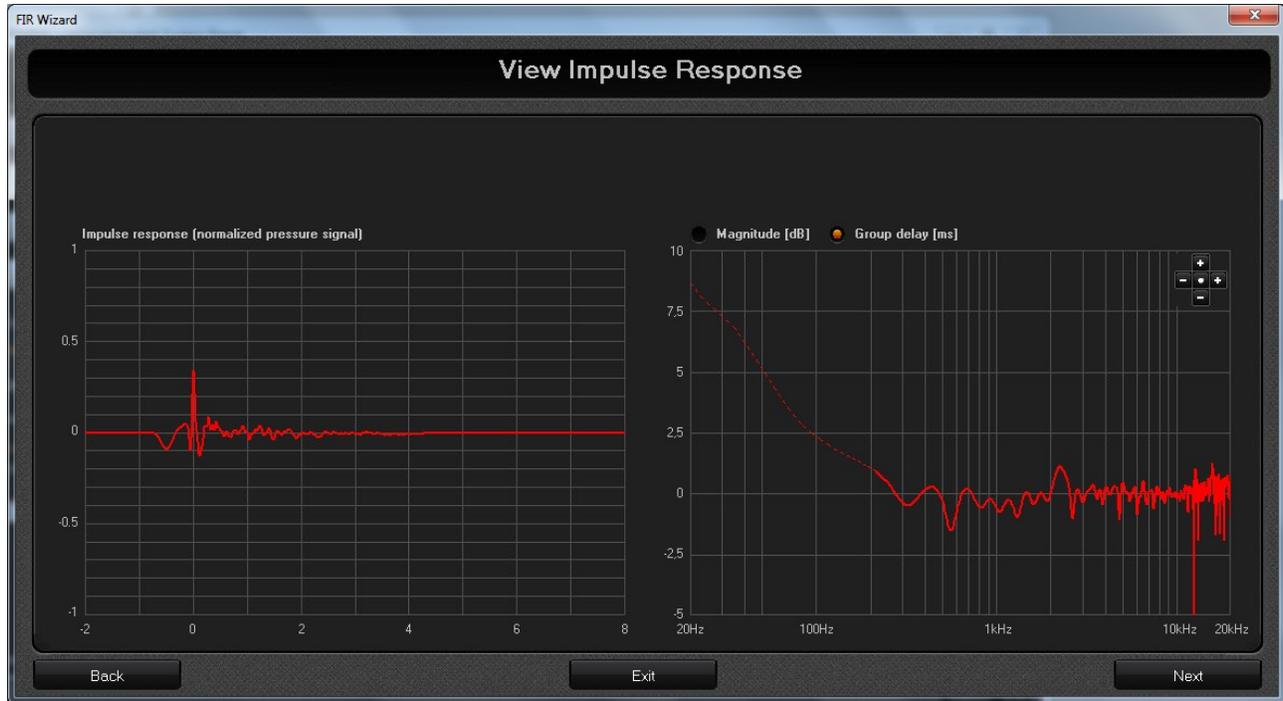
Discontinuities in the group delay view may appear (as the picture above shows near 12kHz), due to the poor phase computation accuracy in the frequency points where the magnitude response has a very deep dip.

Now, you can save the IR by clicking the "Save IR" button at the top right of the screen.
Choosing to start from an existing IR at the Wizard home page would have lead you directly here.

The IR computed by the Wizard (and shown in the left plot) is a cut of the real measured IR at the microphone position. The calculation engine applies a windowing process to the first 10ms of the real IR (centered on its peak value) to remove unwanted obstacle reflections, in such a way to provide an environment independent IR.
This remarks the need to arrange the measurement environment as described in the "Measurement Geometry" section.
The picture below shows an example of how the IR plot would appear when the geometry constraint is not respected: reflections closer to the IR peak (see the blue circle) are not removed by the windowing process. This implies that the compensating filter will try to "correct" also the room response, so to violate the assumption of the "environment independent equalization".
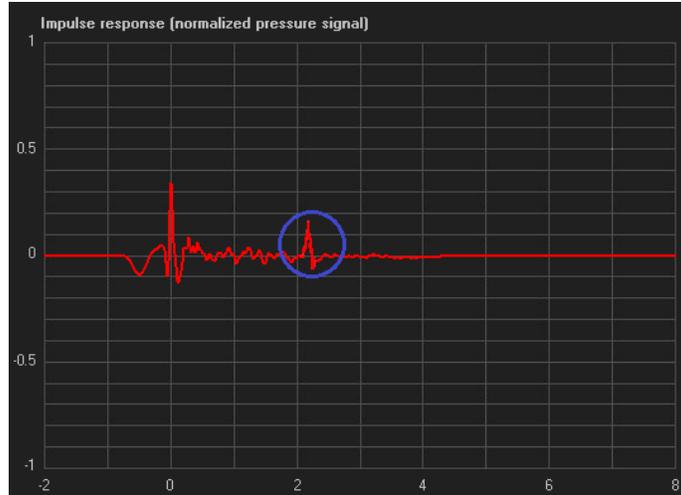
As a consequence of the windowing process, the computed IR is not accurate in the low frequency range: it is not possible to estimate the frequency response below the reciprocal of the analisys time interval, due to the time-frequency duality. So, to avoid misleading view, the frequency response plot shows a dotted line below 200Hz.

To proceed with the FIR filter computation, click "Next" button and the "Calculate FIR" page will be shown.

FIR Calculation
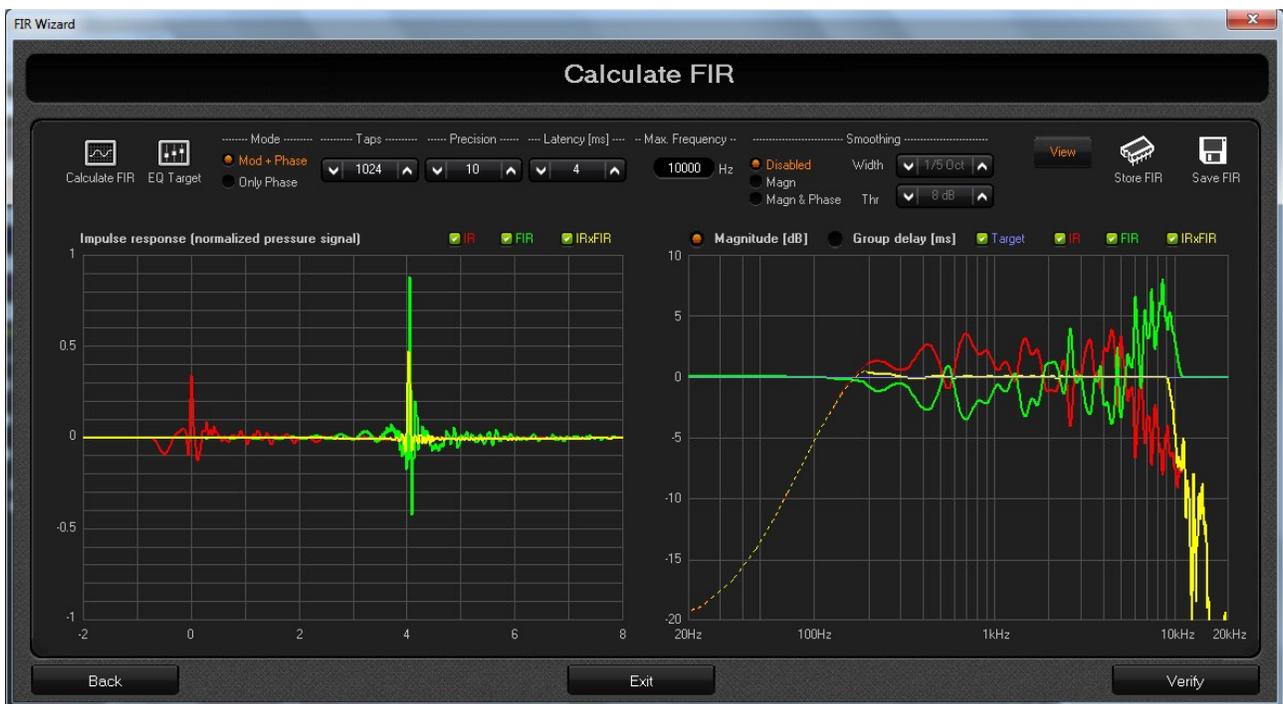
In this page the FIR filter coefficients are computed starting from default settings (or from the parameters set of the FIR Wizard project, when a project file is recalled at the Wizard home page).

The two graphs in the screen show the time and frequency response of:

1) the loudspeaker IR (red line), as it appears in the preceeding page.
2) the compensating FIR filter (green line), which is normalized so that when the FIR filtering is enabled or disabled, the sound loudness remains roughly unchanged. This is very important for performing listening tests and it is a good feature in general.
3) the convolution between the IR and the FIR filter (IRxFIR, yellow line). It represents the result of the IR compensation process, that corresponds to what would be the IR if it is measured with FIR processing enabled, or in other words, the new loudspeaker IR when the computed FIR filter is applied.
4) The target magnitude curve, that is shown only in the frequecy domain when the magnitude view is selected. By default the target magnitude is flat, but it can be changed by the user as described afterwards.

Curves in the graphs are overlaid to allow a better comparison between the IR, the FIR filter and the resulting convolution. Anyway, if needed, each curve can be hide acting on the checkboxes at the top right of the plotting area as shown in the picture below, where FIR filter and target curve are hidden.
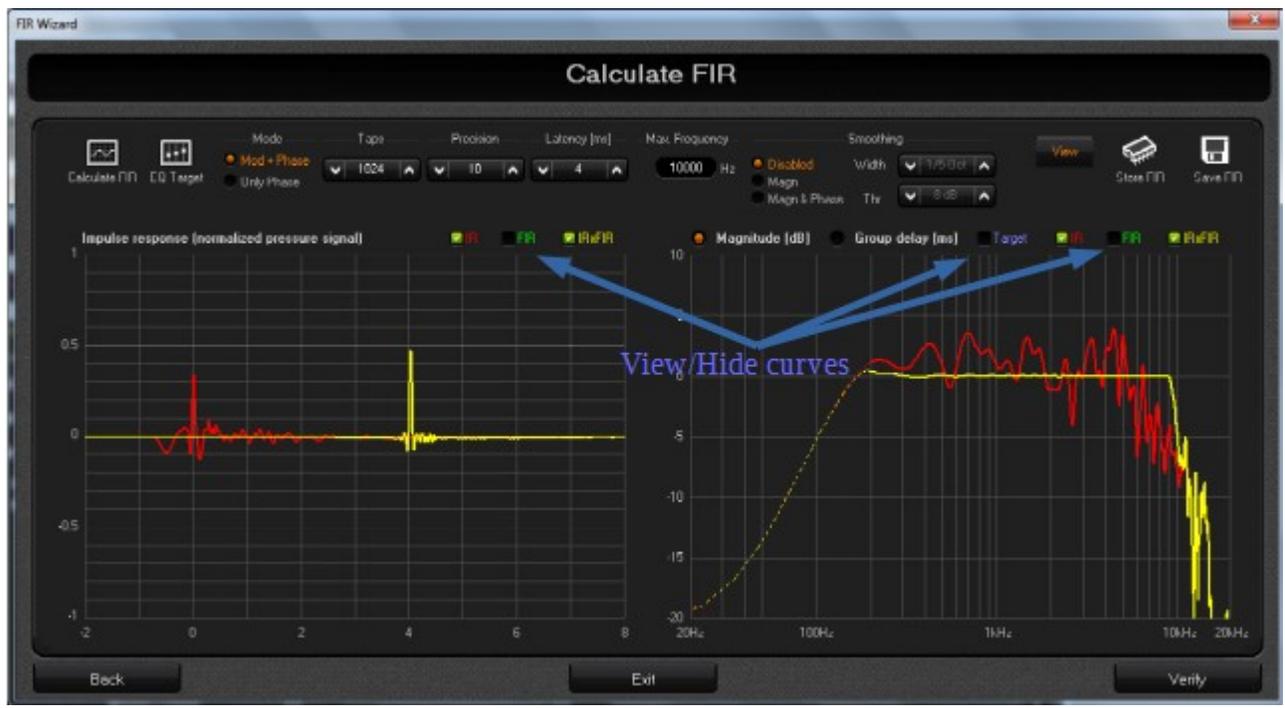
Left clicking a point in the plotting area allows to show the cursor coordinates, while right cliking shows the plot zoom menu.
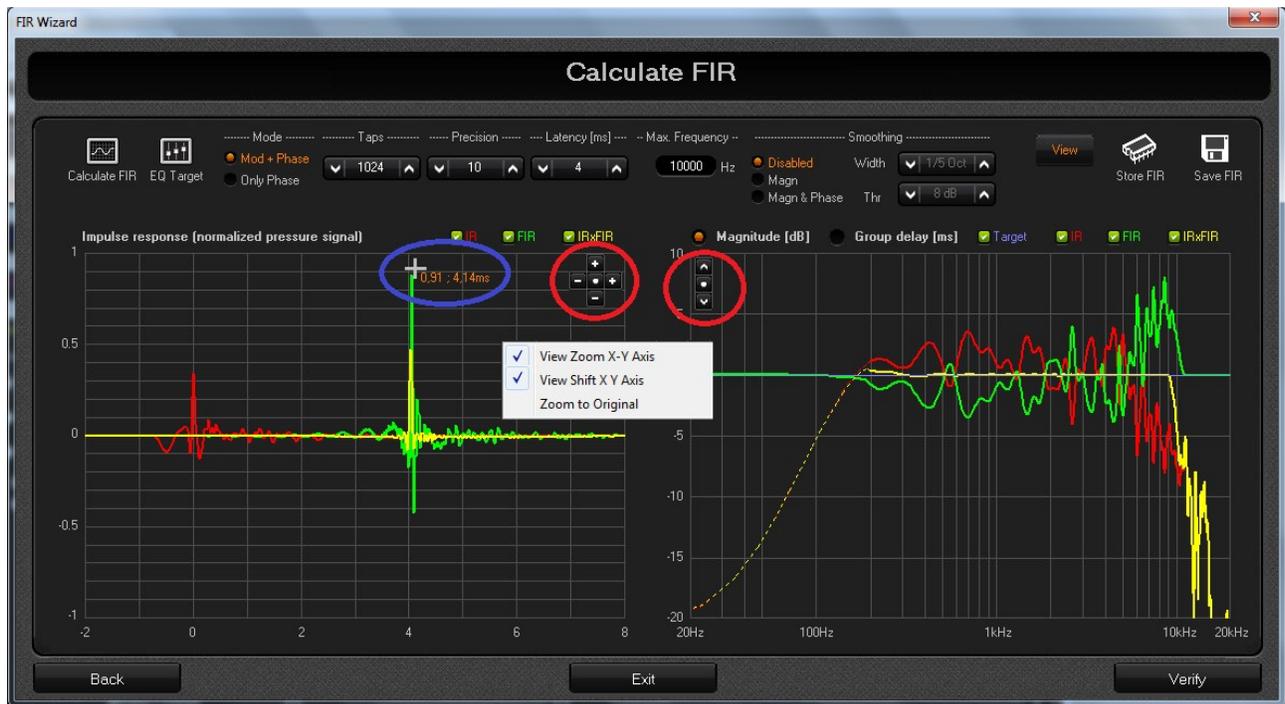
Let's now analize in more details the linearization capability of the computed FIR by comparing the time and frequency domain plots of the IR and the IRxFIR curves, for a flat target magnitude.

In the time domain what we should ideally get is a unitary pulse centered at 0ms (Dirac delta), that is the TD equivalent to a flat frequency response.
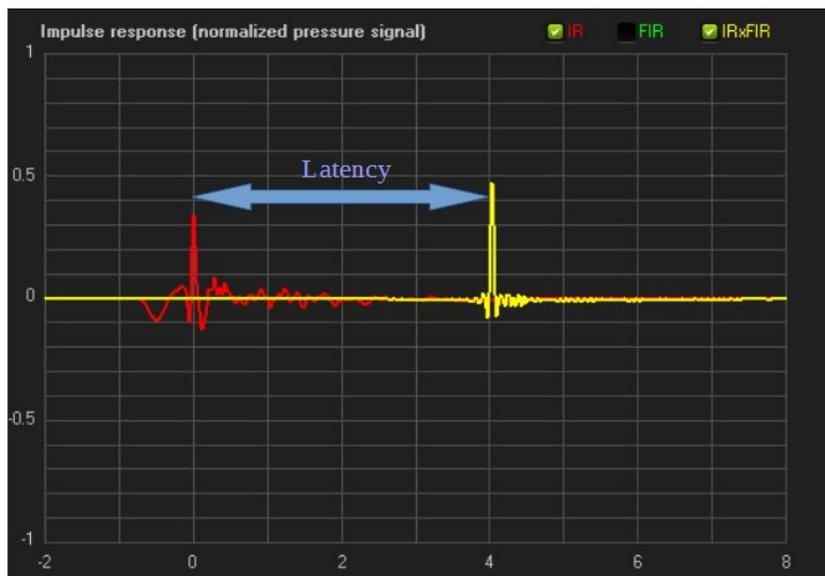
Looking the chart above, we can immediately note that the IRxFIR (the yellow curve) is much closer to the ideal Dirac delta than the measured IR (the red curve). This is the improvement added by the FIR filter.

The slightly difference between the IRxFIR and the Dirac delta is due to the fact that the FIR filter is not working on the whole frequency response, but it is limited to a frequency range from about 200Hz to a MaxFreq (10kHz in this example). The lower limit depends on the IR measurement technique (as described in the "IR Measurement" section), and on the poor resolution of the FIR filter at low frequencies. The upper limit (MaxFreq) is a user defined parameter that will be described afterwards.

Moreover, the time domain graph shows the latency added by the FIR filter, that is defined as the time distance between the peak of the IR and the peak of the IRxFIR curve.

The magnitude plot here below shows the flattening effect of the FIR filter in the yellow curve, as well as the frequency range where the filter is acting.

The graph below shows the group delay flattening effect (see the yellow curve), that is the main achievement of the FIR filter: a flat group delay means a linear phase of the sound system (the group delay is the derivative of the phase with respect to the frequency).
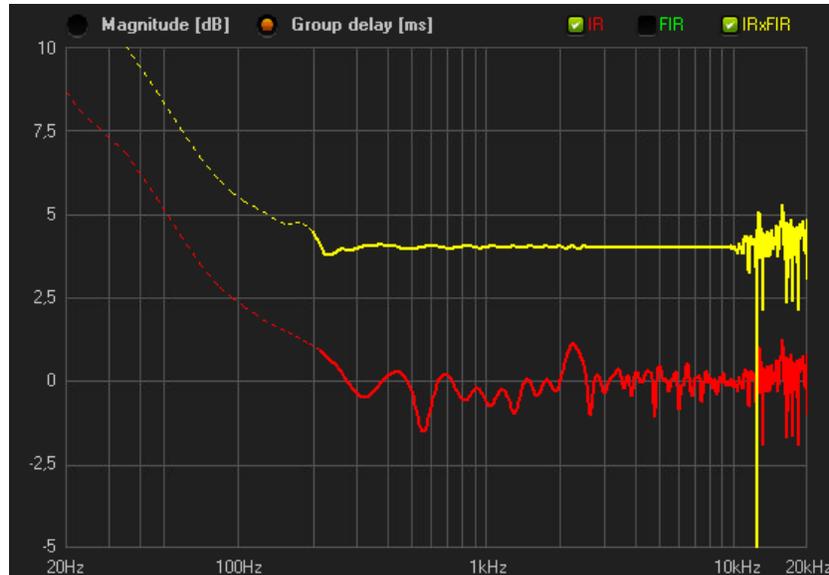
Let's now describe the user parameters related to the FIR filter generation. Note that, every time a user parameter is changed, the "Calculate FIR" button at the top left of the screen start blinking, meaning the FIR filter needs to be recalculated. Once the button is clicked the synthesis algorithm computes the FIR filter with the new parameters and the corresponding plots are updated.

- *Mode*

Two different working mode is available:
1) "Magn+Phase". When this option is selected the FIR filter will compensate both magnitude and phase of the measured IR. For the magnitude response a target curve can be applied.
2) "Phase only". In this mode the FIR filter works on the phase response only, leaving the IR magnitude unchanged.

- *Max Frequency*

Before calculating the FIR, the first thing the user should do is to look the frequency response of the IR, mainly to check the upper cut frequency. This is useful to set the maximum operating frequency above which the FIR filter will be neuter leaving the original IR unchanged. Moreover, it should be remarked that:
1) The frequency response at very high frequencies can strongly depend on microphone position, since the most of audio transducers are very directive in this frequency range. So it is worth to try different microphone positions moving it of few centimeters, and choosing the one which gives the best result.

2) The frequency response at very high frequencies can be the real one or just what the microphone captures. If you are using a shoddy microphone, results in the high frequency range can be not affordable. This doesn't mean that a satisfactory FIR equalization can't be done on a slightly reduced band: just choose a max frequency value and try listening the result.

- *Precision*

The precision parameter, ranging from 1 to 10, is a measure of how accurate the magnitude correction should be, with respect to the target curve. In particular, if the IR shows a deep dips in the frequency response, using high values of the precision parameter implies that the FIR filter will totally compensate them, with corresponding peaks in the FIR frequency response, which can result in undesired audible ringing effects (tonal components will become visible in the time domain FIR plot). On the contrary, using low values of the precision parameter limits the FIR to accurately compensate only little lacks of the original IR, and to be less accurate on severe dips. This parameter should be tried empirically and results can be checked basing on plotted curves and listening tests.

The following picture compare two magnitude plots, where the precision parameter is set to 10 (max accuracy) in the right side graph and to 1 (min accuracy) in the left side graph. Group delay plots are not shown since the precision parameter doesn't affect the phase compensation accuracy.

- *Smoothing*

The smoothing parameters allows limiting the FIR filter action in such a way to "correct" the IR in its average behaviour. In other words, when the smoothing is enabled, the FIR filter doesn't apply a punctual IR compensation, but it is limited to correct only an averaged IR response.

Smoothing may slightly degrades the compensation capabilty of the FIR filter in axis (i.e. in the meausured point), but it generally allows to enlarge the listening area where the IR correction is effective.

The smoothing can be applied to the magnitude response only or to both magnitude and phase.

For the magnitude smoothing, the algorithm scans the frequency response of the FIR filter searching for frequency points where the magnitude is above a given threshold Thr [dB], (or below -Thr [dB]). In those points, a moving average window is applied, with the aim to smooth the magnitude peaks. This way, choosing a proper threshold value, a selective smoothing can be applied to the magnitude response.

The averaging window width is a control parameter, by which the user can increase or decrease the averaging effect.

The picture below shows how the magnitude smoothing works, by comparing the magnitude response before (left side plot) and after (right side plot) enabling the smoothing.

Setting up the threshold to 0dB, the smoothing is applied to the whole magnitude response, as shown in the following picture (left side plot, smoothing disabled; right side plot, smoothing enabled)

When the "Magn+Phase" mode is selected, the phase smoothing is always applied to the whole frequency range, even if the threshold is not equal to 0dB.

The following picture shows the phase smoothing effect, by comparing the group delay response before (left side plot) and after (right side plot) enabling the smoothing.
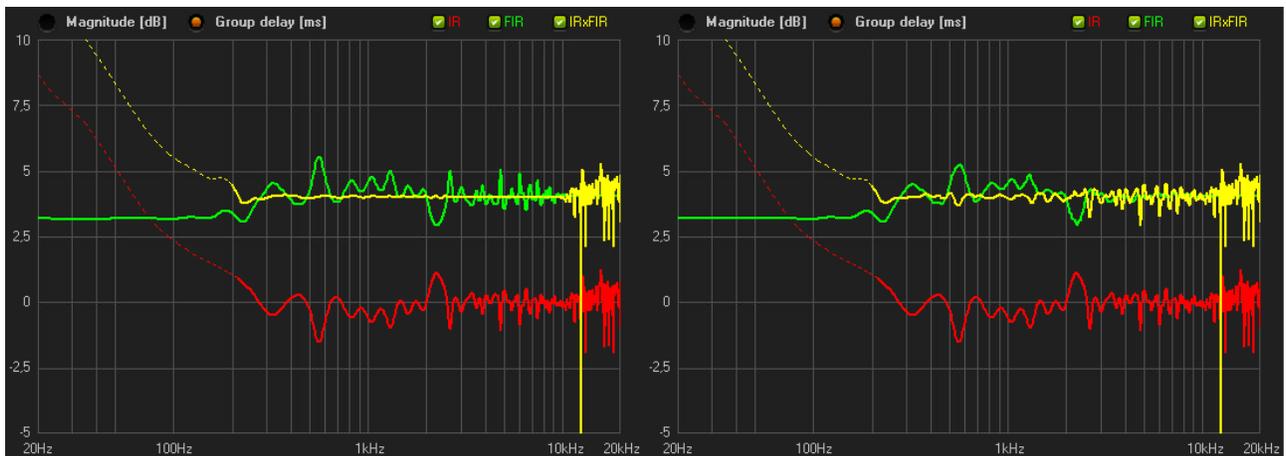
- *Latency*

The latency parameter allows to control the I/O delay added by the FIR filtering. As a general rule, higher latencies should be preferred where the compensation accuracy is the main target, while lower latency values is often used in live sound system, where the I/O delay is a critical application parameter.

The effectiveness in reducing the latency, leaving unchanged the compensation capability of the FIR filter, depends on the original loudspeaker IR, but, in the most cases, latency values greater or equal to 2.5ms allow to preserve almost unchanged the filter correction effects.

The following pictures compare the frequency responses (both in magnitude and group delay) of two filters with a latency value of 5ms (in the left side graph) and of 2.5ms (in the right side graph).
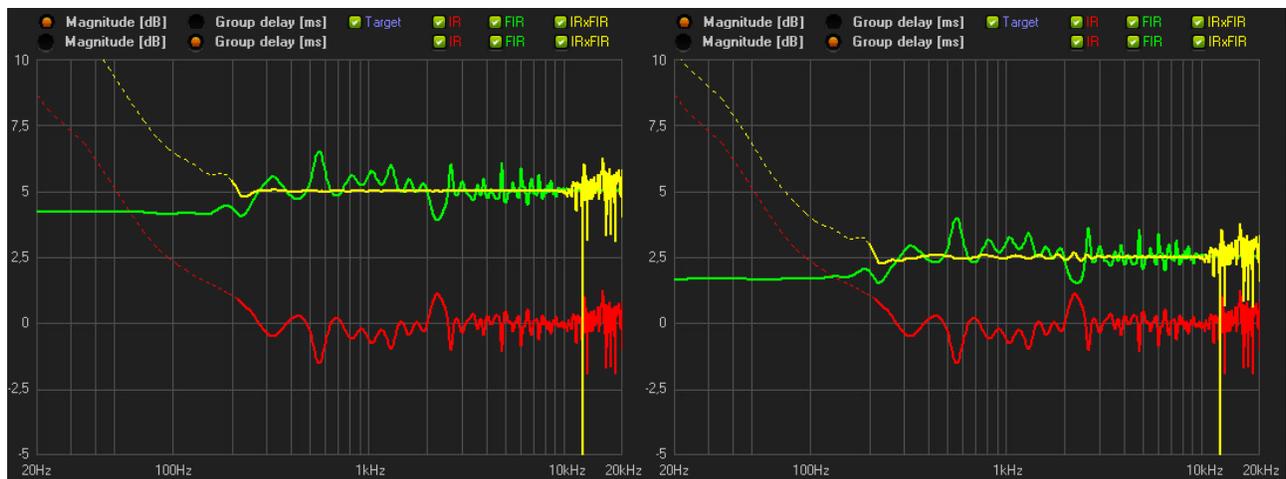
Reducing the latency below 2.5ms is even possible, with a lower compensation accuracy.

The picture below shows the magnitude and group delay plots for a latency value equals to 1.5ms: the frequency response starts to be significantly different from the ideal one, especially for the magnitude response (see the yellow curves)

As a general rule, it is suggested to try different values for the latency parameter and choose the lower one that still gives satisfying equalization results for the particular application, basing on plotted curves and listening tests.

- *Target Curve*

To set up a target magnitude curve, click the "EQ Target" button at the top left of the "Calculate FIR" page, and the "EQ Target" window is shown.
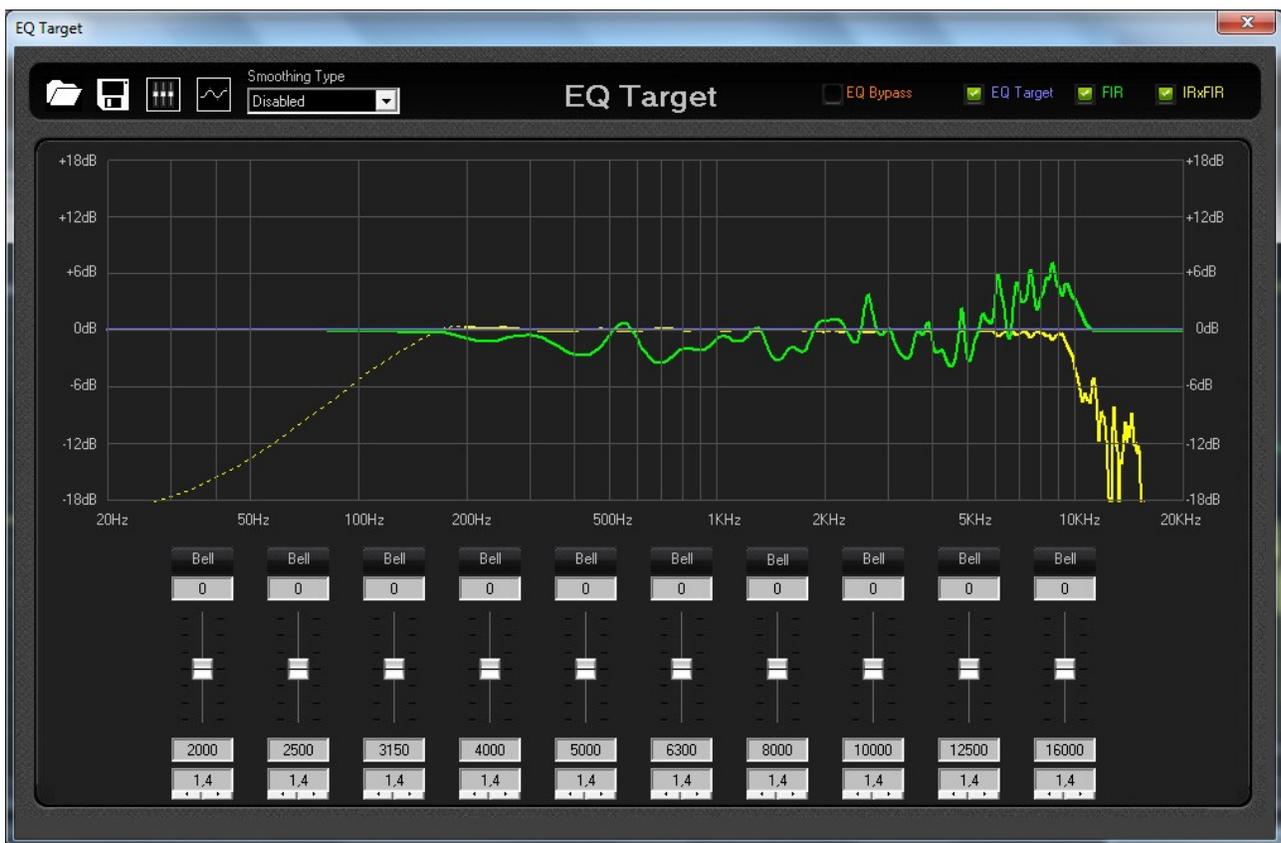
In the "EQ Target" page, the magnitude response of the target curve (blue line), of the FIR filter (green line) and of the IRxFIR (yellow curve) are overlaid. Curves in the plot can be hidden through the corresponding checkboxes at the top right of the screen.

To change the target curve, up to ten parametric IIR filter is available. The IIR filter prototype is just a drawing aid, since the target magnitude is included in the compensating FIR filter generation.

The parametric filter can be set by the controls at the botton of the screen or by dragging the cursors in the plotting area.

The EQ target can be bypassed (or enabled) by clicking the "EQ Bypass" checkbox at the top center of the screen. Clicking the "Flat EQ Target" button, the gain of each parametric filter is set to 0dB to flatten the target curve.

Enabling the target curve smoothing allows to reduce unwanted ripples in the magnitude response when low frequency filters are set with high gain and/or high Q.

The target curve can be also saved in a file to be easily recalled from a different Wizard project.

To apply the target curve to the compensating FIR filter the "EQ Target" window should be closed and the "OK" button must be clicked in the confirmation popup.
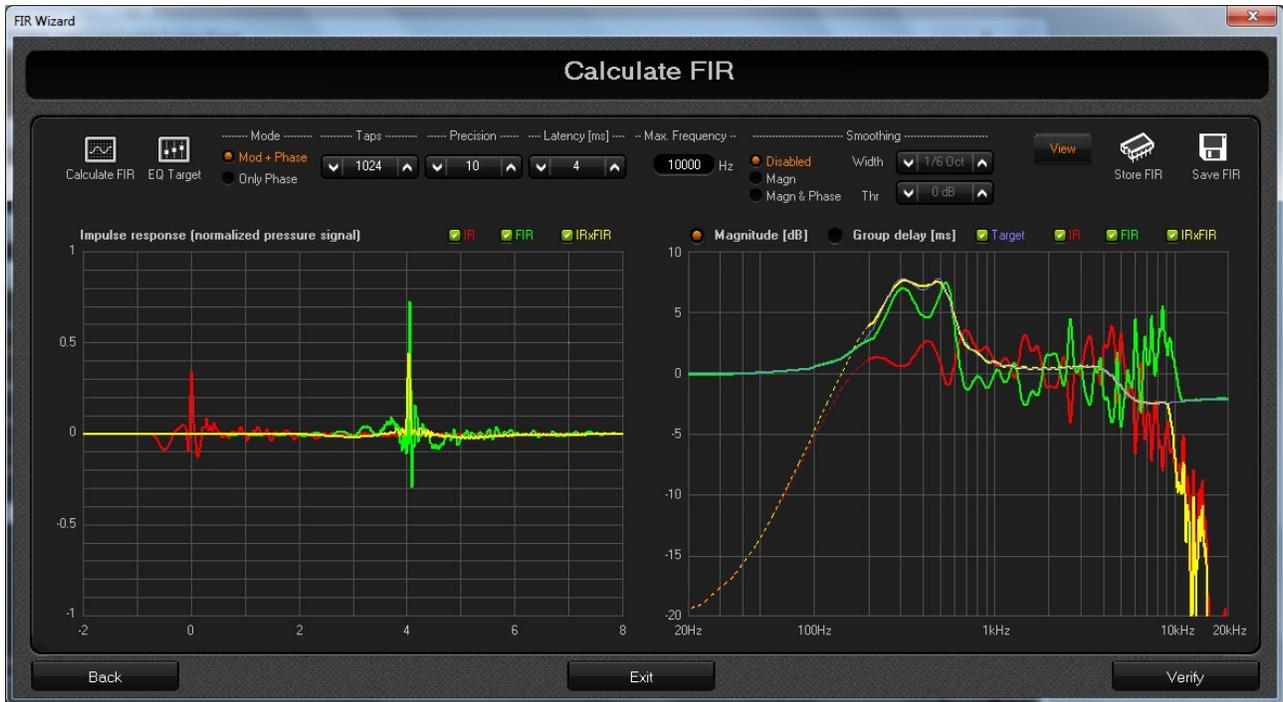
In "Phase Only" mode the target curve can't be set.

Once the FIR filter is computed with the user defined parameters, the corresponding coefficients can be saved in a file (and recalled from outside the Wizard) or stored in the DSP to start listening tests.
To save the filter file, click the "Save FIR" button at the top right of the "Calculate FIR" page: a file browse window appears allowing to select a folder in the PC and to enter a file name.
To store the FIR filter in the device, click the "Store FIR" button at the top right of the screen.

Once the FIR filter is stored in the DSP, the user has the possibility to verify the equalization result by measuring the new loudspeaker IR with the FIR filtering enabled. To do this, click the "Verify" button at the botton right of the "Calculate FIR" page and the "Verify" page is shown.

Clicking the "Verify" button when the computed FIR filter is not yet stored in the DSP, even allows to proceed with the verify process, but care should be taken, since the IR measurement will be performed using the last stored FIR filter, that may not have been generated with the actual loudspeaker response, resulting in a misleading behaviour.
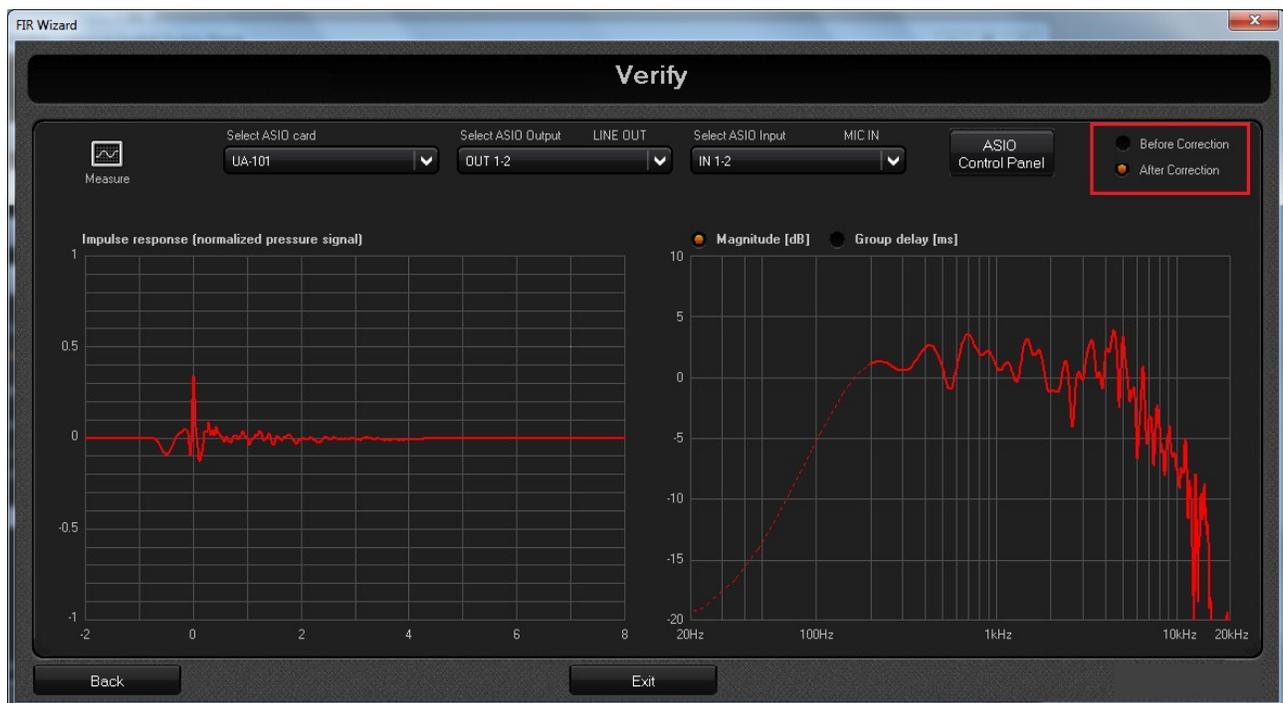
To start the verify process, click the "Measure" button at the top left of the screen and wait in silence. After the sine sweep completion, the new IR is computed and shown in the time/frequency domain plots. It is possible to compare the original and the compensated IR by acting on the "Before / After Correction" option button in the top right of the screen.

Now, it's the time to listen the sound improvement of the FIR filtering. So, close the Wizard window or click the "Exit" button and a message is shown on the screen asking to save the Wizard project. After saving (or skipping) the project file, the Wizard window is closed and you can enable the FIR filtering on the DSP to listen the IR equalization result.

NOTE B

For importing External FIR Calculated coefficients into the MARANI **LPP260A**, the file format has to be the following:

FIR FILE FORMAT

- Standard floating point txt file
- One coefficient for each row
- Decimal separator: "."
- Max coefficient value: 4.0
- Max filter length (i.e. max file rows): Up to 1024 taps (shorter filters are allowed)

Just to be make sure, here below an example of "FIRFormat.txt" which can be imported by the **LPP260A**:

FIRFormat.txt

-2.65204521320808E-06
-2.1021137868951E-06
-1.21276289563775E-06
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