PPA Series Software Manual

Version 1.0

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Content

1. Block Diagram of Signal Processing

For the analog inputs, both available configurations are shown. The Dual Range Converter (green box)uses the same input signal with different gains at the two A/D Converter channels. The DRC algorithm in the DSP decides which of the signals is to be used to achieve the best signal-to-noise ratio.

The Dual Input configuration is optional. It can be used e.g. for stereo-setups where the amplifier for left and right channel is built in into one speaker (e.g. 2.1 configuration with passive satellite speakers)
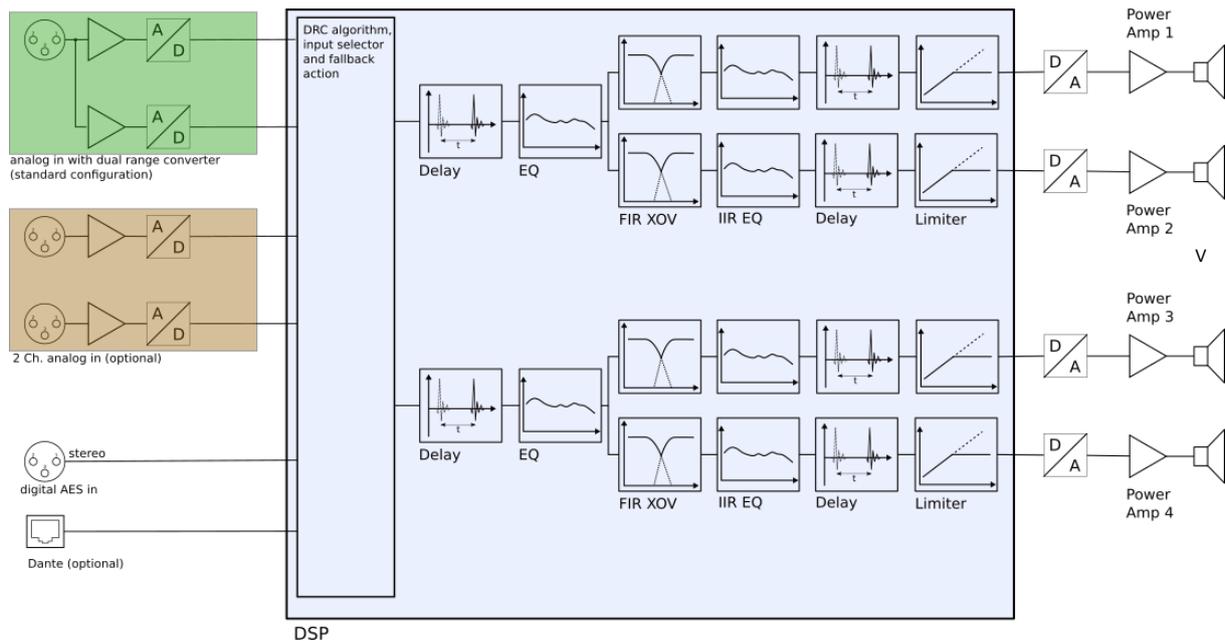

Figure 1 Signal Processing Block Diagram

2. PC Software

The Four Audio System Software can be downloaded from

http://four-audio.com/downloads/fa-system/changelog.html

2.1. Application Key

Certain features of the software are protected by key files. To unlock the features, the files need to be installed. Without installing at least one key (that we ship with the software), you will not be able to do anything.

Click on *File – Install Application Key* and navigate to your application key.

2.2. Example: Generate a Preset for a 2.1 Speaker Setup

The following example is to explain the general function of the PPA software. Let's assume you want to configure a PPA2200-3 to drive one subwoofer and two satellites. The satellites have a passive crossover network for mid/high frequency driver. The PPA must provide the crossover for the subwoofer.

The PPA software consists of two main windows.

1. PPA Manager (Figure 2)
2. On starting up the software, the PPA Manager is visible. Devices connected to the computer appear in a list and basic settings as e.g. input or preset selection can be carried out directly. Via the Menu or Settings button, you can e.g. upload presets.

The manager is visible for all users.
3. PPA Developer (Figure 3)
    To create a preset for the PPA, the PPA Developer window is used. It allows to import speaker measurements, design crossovers, IIR and FIR filters, set limiters etc.. The Developer button only appears if the correct developer key is installed.
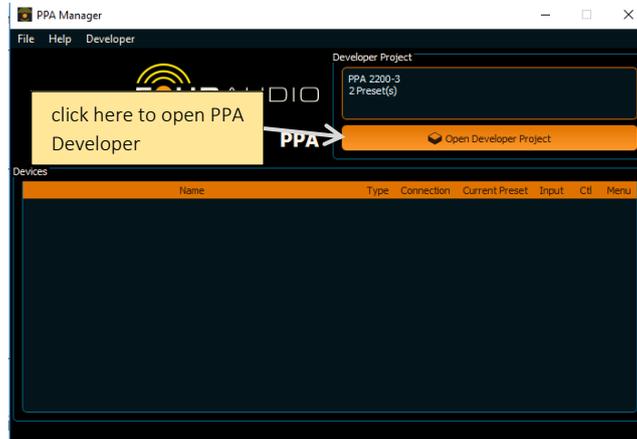

Figure 2 PPA Manager

Having the developer key installed open the PPA Developer by clicking on *open Developer Project.*
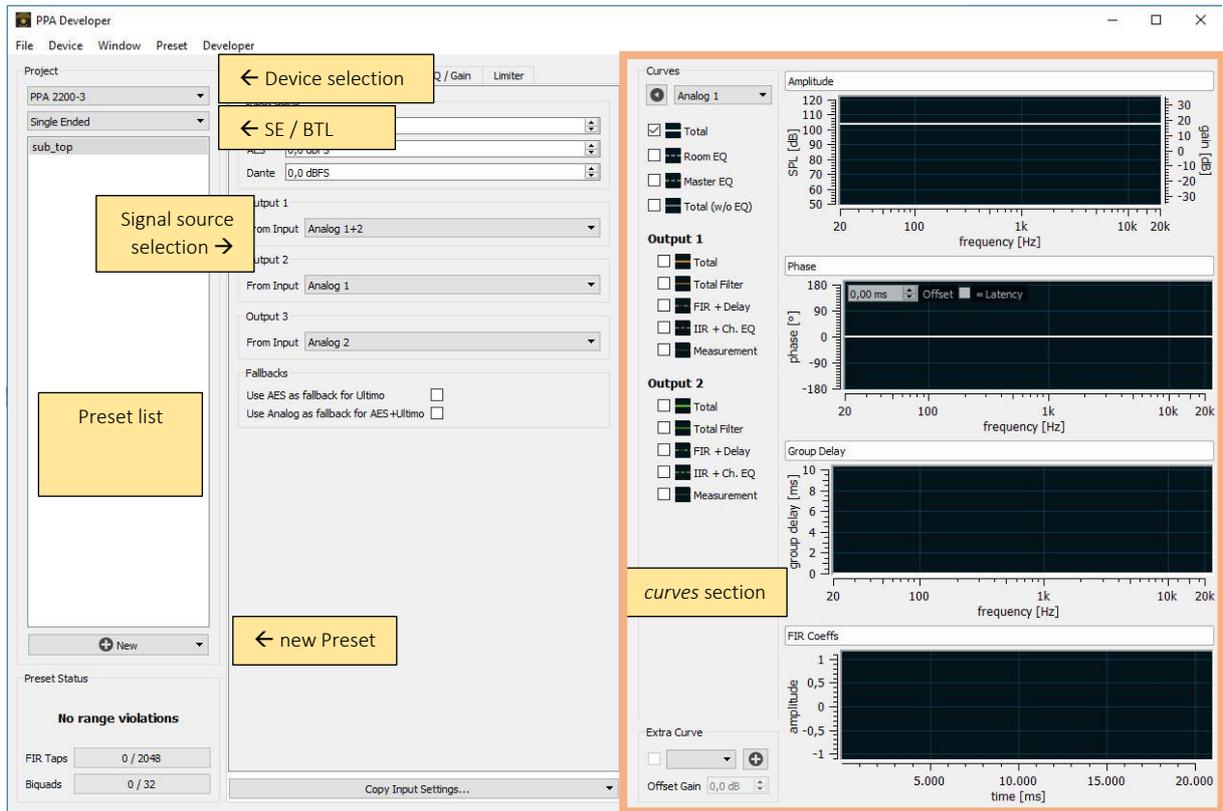
Figure 3 PPA Developer

First select a PPA device (in this example we are using a PPA-2200-3) and select Single Ended or Bridge Tied Load mode. Our desired setup needs SE mode. On changing the model or bridging mode with at least one preset present in your list, you are asked to convert these presets to the new configuration. Double-clicking a preset name allows to change its name.

Select the input source. Choose between

✓ analog 1, analog 2, analog 1+2 (both signals summed up. There is **no gain compensation** of -6 dB!) Applies for 2Ch PPA configuration

✓ analog DRC: If your device is configured as DRC choose this option for analog in.

✓ AES for digital AES input. Choose between Channel 1, 2 or the sum of both.

✓ Dante for digital input using the optional Dante interface.

✓ Device Settings: This means that the input is used, which has been chosen for the device, either at the display or in the PPA Manager.

In our example, we are going to use analog inputs 1, 2 and the sum as shown in the above figure.

2.2.1. Speaker Tab

In the speaker tab, you can import speaker measurements. Without dedicated measurements, you can create usual linear-phase FIR crossovers without compensating the speaker. Using measured speaker responses makes
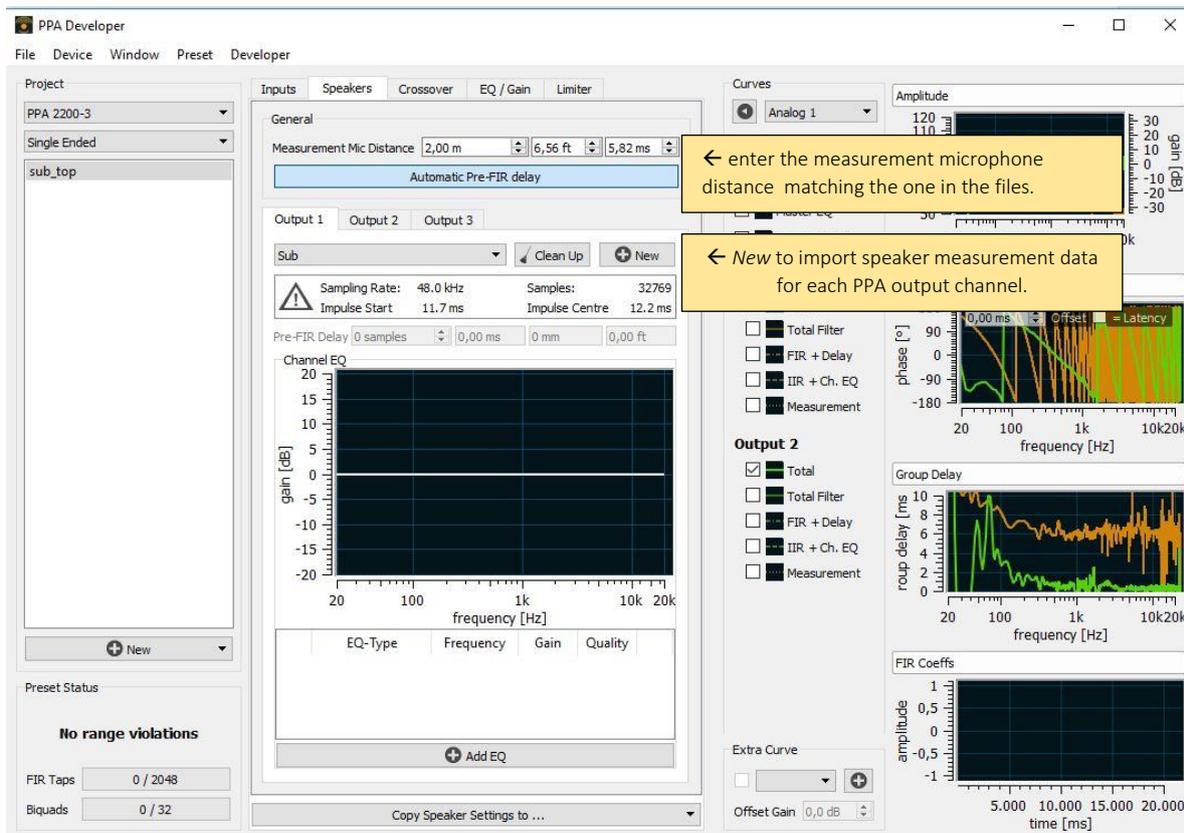
Figure 4 Speakers tab

it very easy to create crossovers with speaker compensation.

For each output click on *new* and load the .spk files. Load the subwoofer file to Output 1 (which is the internally bridged channel of the X-PRO3 module) and the satellite file to outputs 2 and 3.

Enter the correct microphone distance used when measuring the speakers.
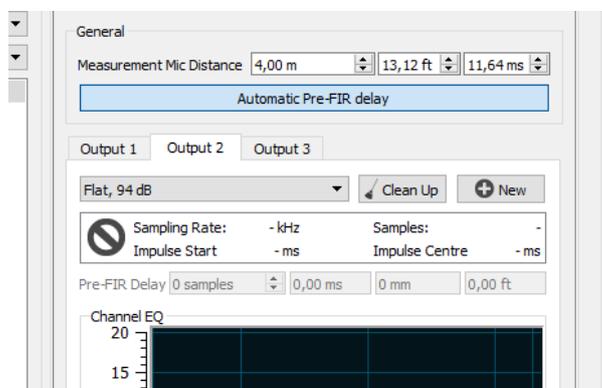
Figure 5 Loading Speaker Measurement Files

2.2.2. Crossover Tab

Activate the crossover tab and select the crossover type *FIR with speaker compensation*.

The target SPL of 100 dB and the latency of 10ms are ok for this example.
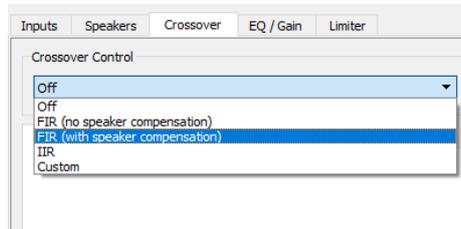
In the *curves* section select the **measurements** for Output one and two. For this example we are using a crossover frequency of 400 Hz .
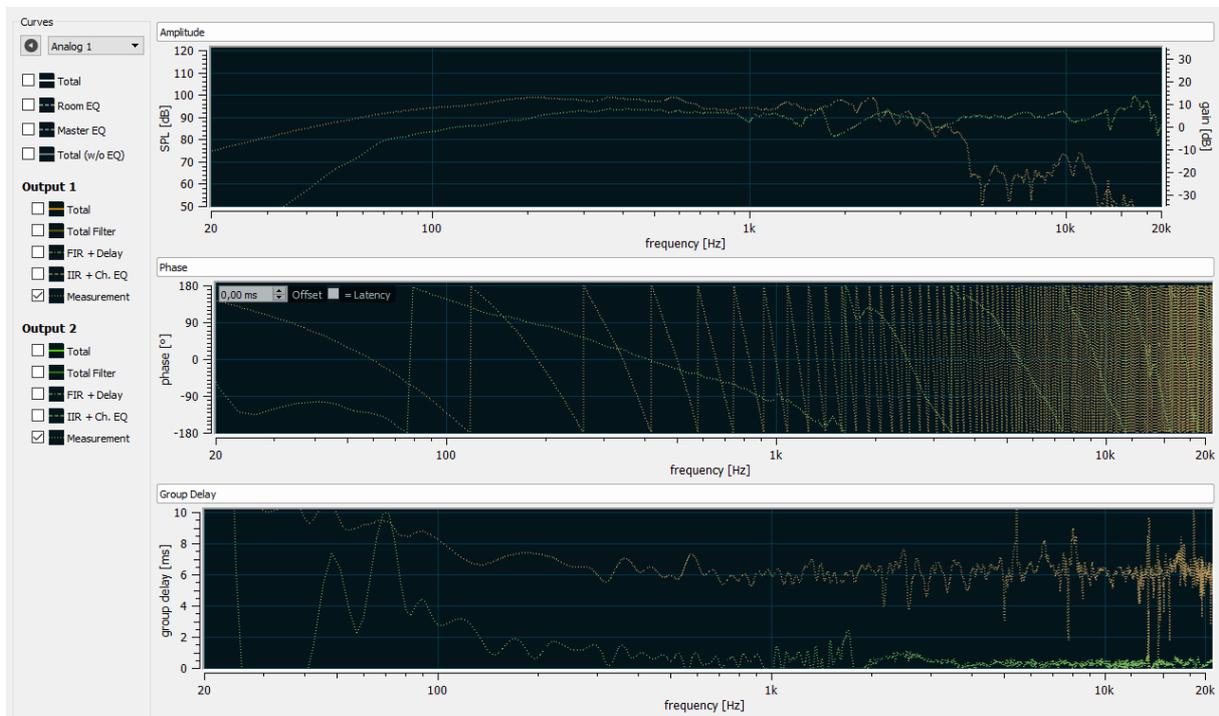
Figure 6 Measurement Curves

Next, the crossover parameters for LF/MF crossover between output channel 1 and the satellite channels 2 and 3 (Figure 8) are set.
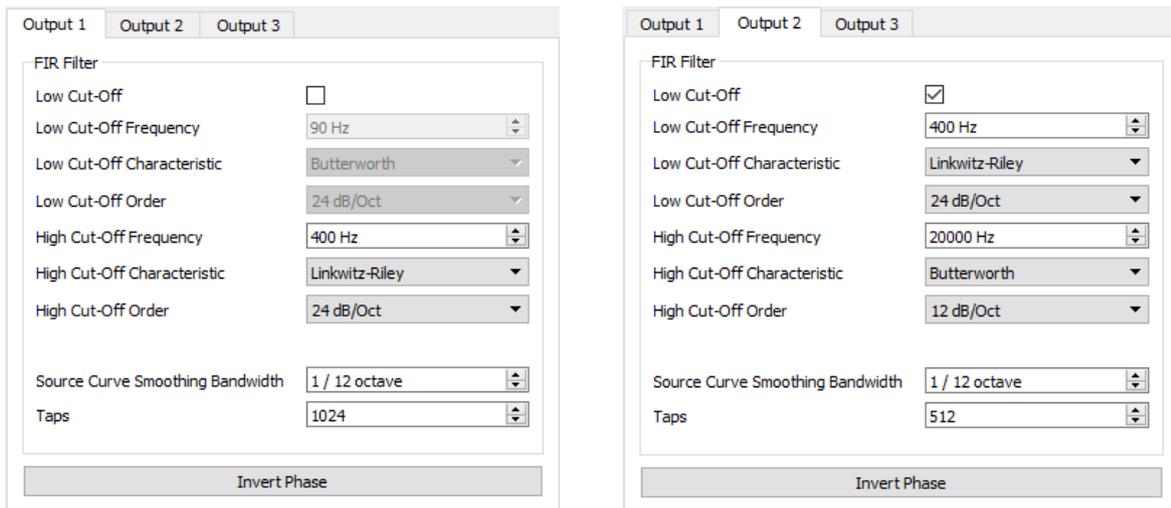
Figure 7 XOV Settings for Subwoofer and Satellites

For output 1, we set the high-cut frequency to 400 Hz with a slew-rate of 24 db/Oct. For outputs 2 and 3, we use the same value as low-cut and set a high-cut at 20 kHz with Butterworth characteristic.

Now set the amount of FIR filter coefficients. A total of 2048 taps is available. As low frequencies require longer filters, we use 1024 taps for the subwoofer path and 512 taps each for the satellites.

Additionally, we activate the *total* tickbox for channel one and two in the *curves* section. This displays the output frequency and phase responses of the amplifier outputs. The orange curve represents output 1, the green one is output 2. These responses are calculated from the speaker measurement and the applied FIR crossover filters (and optional EQs/IIR filters and gains), that is, you see the frequency response of an imaginary measurement of speaker and DSP amp on axis.

The latency can be adjusted. This latency is the exact latency of the filter combined with the speaker. You can play with the setting and see how low you can adjust the latency without compromising the overall response or the linear-phase. The filter calculation algorithm automatically adjusts the frequency at which the overall system will be linear-phase to match the latency.
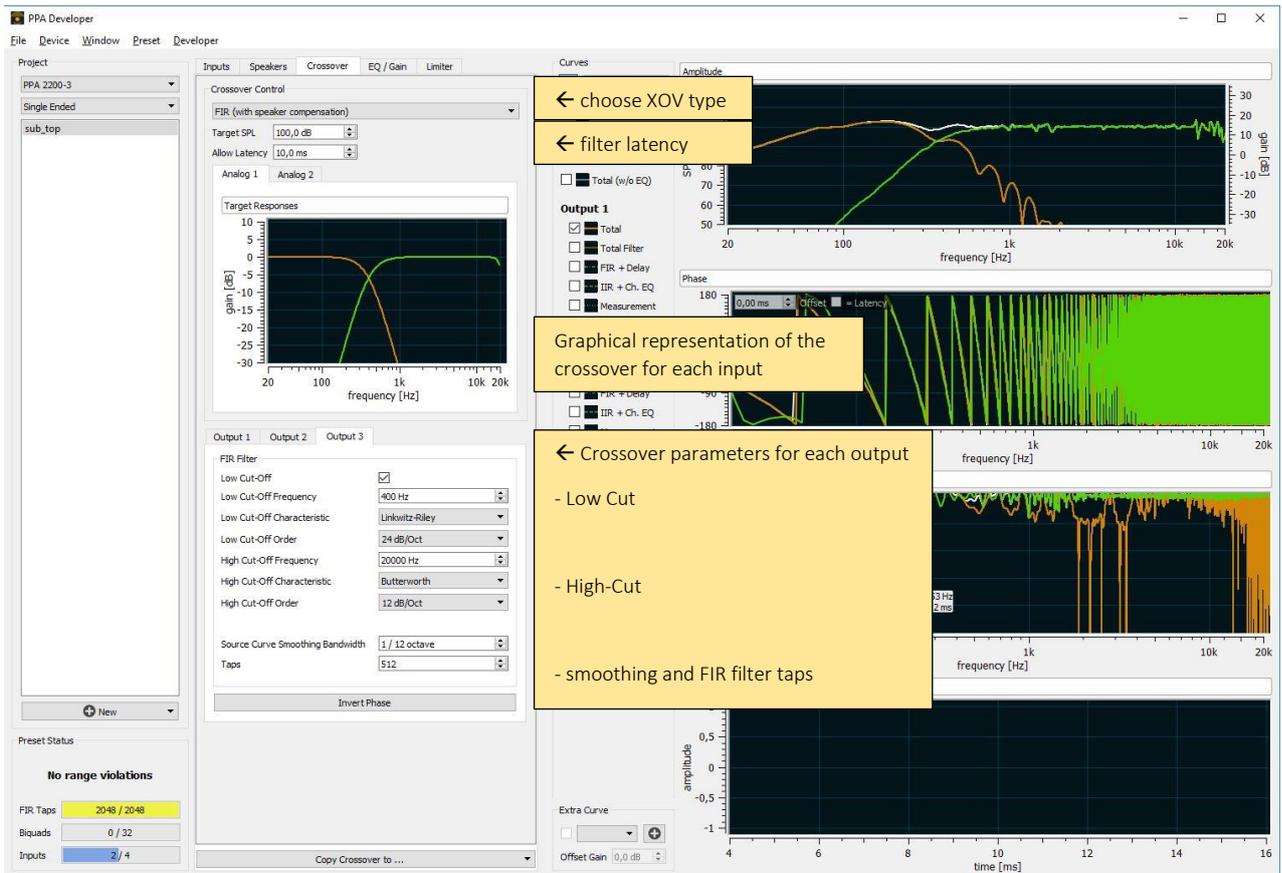
Figure 8 Crossover Tab
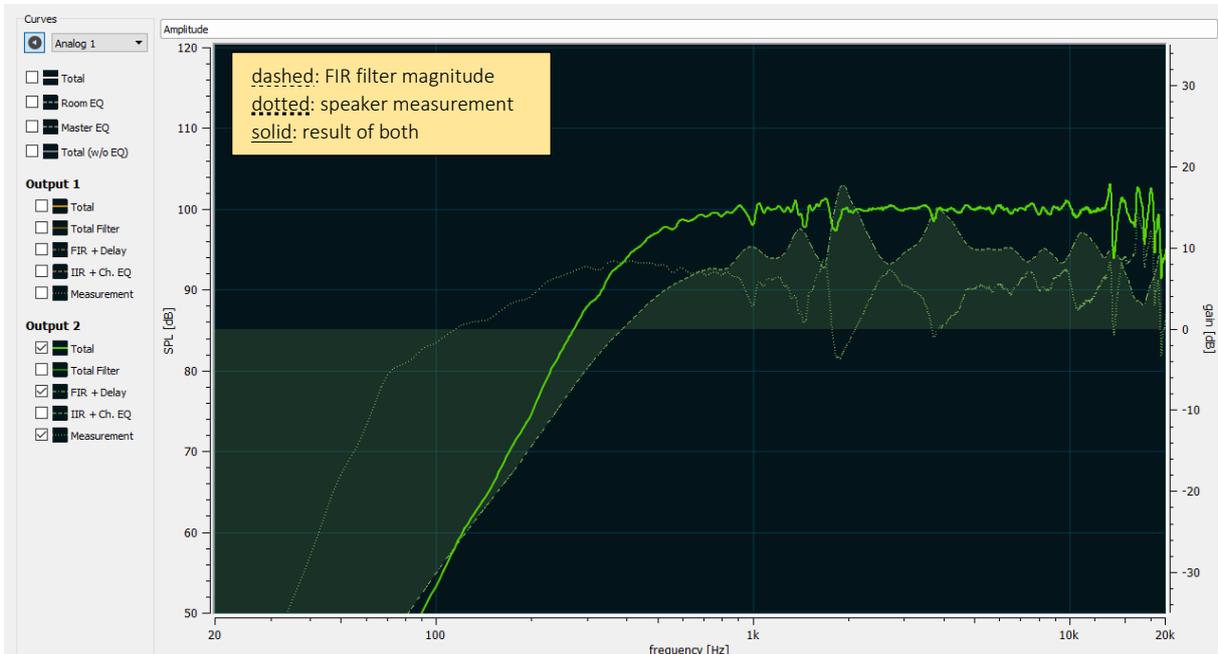
Figure 9 Speaker Measurement and FIR Filter for one Satellite

2.2.3. EQ Gain Tab

The EQs are applied to the signal additionally to the FIR filters. You can add Master EQs belonging to the system setup or add Room EQs which the end user will be able to change with the end user control application.
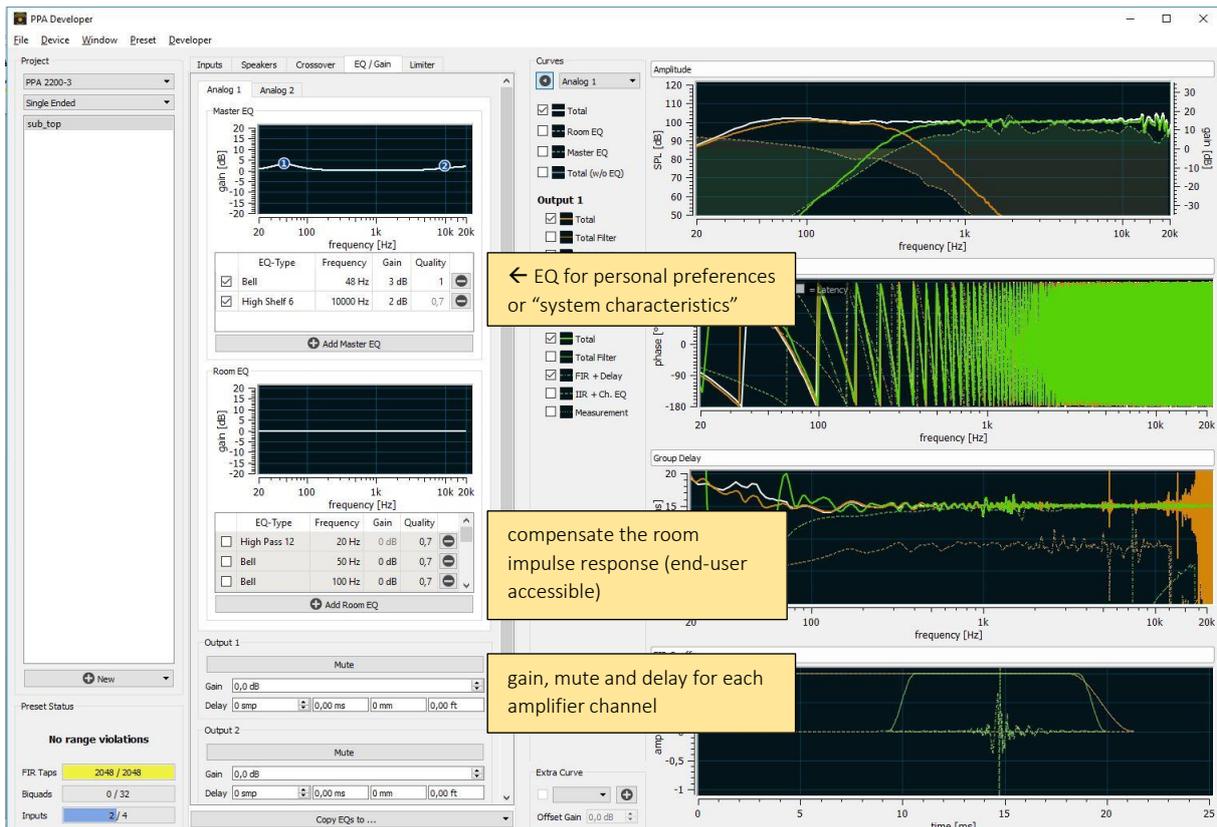
Figure 10 EQ and gain tab

2.2.4. Limiter Tab

To adjust the limiters for each output consult the chassis datasheets. A "simple" limiter consists of a look-ahead Peak and a RMS section for each output. It is also possible to use 2-band limiters per output, e.g. to adjust limiters for a coaxial driver or a speaker with a passive crossover.
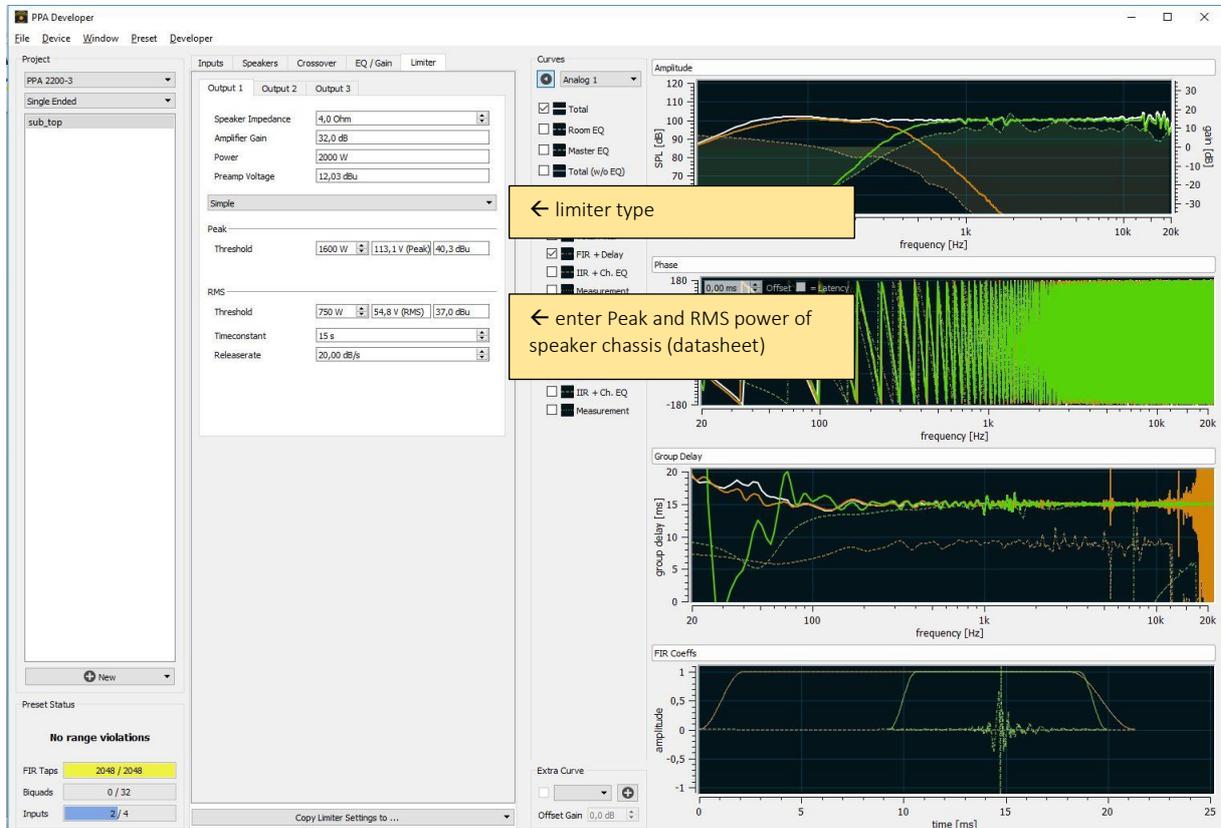
Figure 11 Limiter tab

2.2.5. Upload Project to Device

Close the PPA Developer window (remember, all changes are auto-saved). To upload your project to the PPA device click on the gear-wheel and select *Upload Developer Project*.
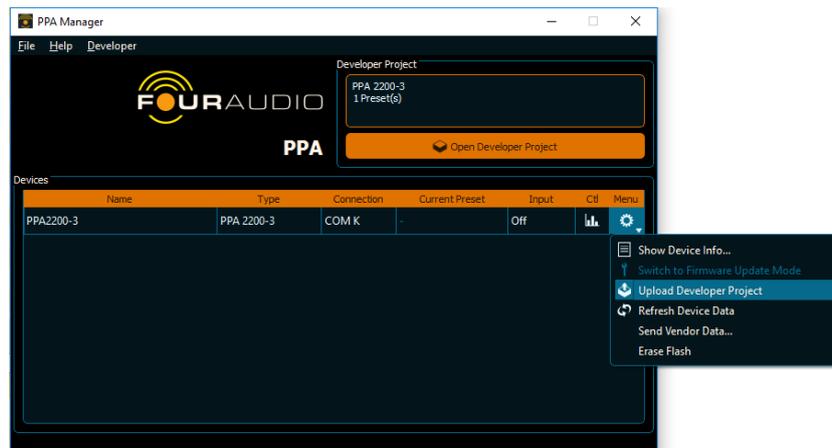
Figure 12 Upload Developer Project to Device

2.3. Importing Speaker Measurements

In general, regardless of the file format, the following needs to be considered when carrying out measurements for speaker equalization:

Measurements must not be smoothed!

Measurements must be free of reflections and noise!

The following formats are supported:

1) SPK files (*.spk)
2) MLSSA frequency domain files (*.frq)
3) Text files (*.txt, *.csv)

Text files containing a frequency spectrum require a certain structure:

1. An optional header can be placed at the top and skipped in the import wizard

2. Three columns of subsequent values containing

   1. Frequency   2. Real part or magnitude   3. Imag. Part or phase
   Frequencies must be **linearly spaced** and ranging from **0** to **half the sampling rate**.
   Columns must be separated by white space, comma or semicolon.

Example:

FFT degree:	14
Sampling rate:	96 kHz
Samples in time domain:	16384
Lines in frequency domain:	8193 (0 Hz … 48kHz)
Line distance:	5,859375 Hz

File entries

```
Freq[Hz]          Real[Pa]          Imag[Pa]
0.000000E+00      0.000000E+00      -2.526122E-10
5.859375E+00      0.000000E+00      1.192093E-07
1.171875E+01      6.837189E-03      -9.961390E-02
…
…
4.798828E+04      -1.115020E+00     -1.757477E+00
4.799414E+04      1.508967E+00      -2.896538E+00
4.800000E+04      -4.855079E+00     2.351044E-10…
```

These options are available during import:

Feature	Options	Comment
Number of header lines	---	Enter number of header lines
Column separator	Comma Semicolon White space	Select format
Decimal mark	Dot Comma	Select format
Colums	Frequency/Real/Imag Frequency/Magnitude[Pa]/Phase Frequency/Magnitude[dB]/Phase	Select format
Sample rate	---	Detected value
Number of lines	---	Detected value

2.4. Mapping of DSP channels to physical outputs

The settings in the TABs *Speaker*, *Crossover*, *EQ/Gain*, *Limiter* are referring to DSP processing channels. The term ***Output* is misleading** here and will be changed in the GUI application. It is referred to as **channel** in this manual.

The following table shows the available Bridge Tied Load modes for the devices.

	SE mode	BTL mode 1	BTL mode 2	BTL mode 3
Devices with 1 output				
500_1	Single Ended			
2200_1	Single Ended			
Devices with 2 outputs				
2200_2	Single Ended			
500_2	Single Ended			
1000_2	Single Ended	Bridge Tied Load 1(+)+2(-)		
1600_2	Single Ended	Bridge Tied Load 1(+)+2(-)		
PR4x1000_2	Single Ended	Bridge Tied Load 1(+)+2(-)		
Devices with 3 outputs, BTL not supported				
500_3	Single Ended			
Devices with 3 outputs, BTL supported for outputs 2+3				
2200_3	Single Ended	Bridge Tied Load 2(+)+3(-)		
Devices with 3 outputs, BTL supported for outputs 1+2				
1000_3	Single Ended	Bridge Tied Load 1(+)+2(-)		
Devices with 4 outputs, BTL supported for outputs 1+2 and 3+4				
1000_4	All Outputs SE	1(+)+2(-) BTL, 3+4 SE	1+2 SE, 3(+)+4(-) BTL	1(+)+2(-) BTL, 3(+)+4(-) BTL
Devices with 4 outputs, BTL supported for outputs 3+4 only				
500_4	Single Ended	Bridge Tied Load 3(+)+4(-)		

For devices without BTL mode there is no selection box in the software.

The following table shows the mapping between DSP channels to physical outputs.

1+: DSP channel 1 non-inverted phase

1-: DSP channel 1 phase inverted

Mode	Amp Out 1	Amp Out 2	Amp Out 3	Amp Out 4
Devices with 1 output				
Single Ended	1+			
Devices with 2 outputs, BTL supported for outputs 1+2				
Single Ended	1+	2+		
Bridge Tied Load 1(+)+2(-)	1+	1-		
Devices with 3 outputs, BTL not supported				
Single Ended	1+	2+	3+	
Devices with 3 outputs, BTL supported for outputs 2+3				
Single Ended	1+	2+	3+	
Bridge Tied Load 2(+)+3(-)	1+	2+	2-	
Devices with 3 outputs, BTL supported for outputs 1+2				
Single Ended	1+	2+		
Bridge Tied Load 1(+)+2(-)	1+	1-		
Devices with 4 outputs, BTL supported for outputs 1+2 and 3+4				
All Outputs SE	1+	2+	3+	4+
1(+)+2(-) BTL, 3+4 SE	1+	1-	2+	3+
1+2 SE, 3(+)+4(-) BTL	1+	2+	3+	3-
1(+)+2(-) BTL, 3(+)+4(-) BTL	1+	1-	2+	2-
Devices with 4 outputs, BTL supported for outputs 3+4 only				
Single Ended	1+	2+	3+	4+
Bridge Tied Load 3(+)+4(-)	1+	2+	3+	3-

Output used in Bridge Tied Load mode
Output used in Single Ended mode
Output not available

2.5. Custom Mapping Between Processing Channels and Outputs

The *Crossover* tab contains two vertically aligned sections:

Upper section: General crossover settings

Lower section: Detailed crossover settings per channel.

The basic settings for the crossover (frequency, characteristic, order) can be adjusted in the upper section. Detailed crossover settings per channel, total lower and upper frequency for the complete system and some expert tweaks are adjusted in the lower section.

By default, processing channels from lower to higher indexes are assigned to adjacent and ascending frequency bands, e.g. the default preset for a PPA 500-3 uses the following settings when the user selects a FIR (with speaker compensation) crossover:

| Channel 1 | Woofer | 90 Hz – 1 kHz | Linkwitz-Riley | 24 dB/oct |
| Channel 2 | Mid-Range | 1 kHz – 3 kHz | Linkwitz-Riley | 24 dB/oct |
| Channel 3 | Tweeter | 3 kHz – 20 kHz | Linkwitz-Riley | 24 dB/oct |

The basic parameters (frequency, characteristic and order) are locked between 2 adjacent processing channels. Adjustments of crossover parameters in the upper section are always synchronized to both channels belonging to this very crossover, that is both channels always use the same frequency, order and characteristic.

If this behavior is undesired, the settings between adjacent channels can be unlocked. For this, click the **lock** button right next to the corresponding setting. If the unlocked symbol is displayed, the settings for the crossover can be adjusted in the lower section, individually for each processing channel.

It is e.g. possible, then, to create crossovers with overlapping frequency bands, to change the order of the frequency bands (e.g. having the woofer in channel 3 and the tweeter in channel 1), etc.
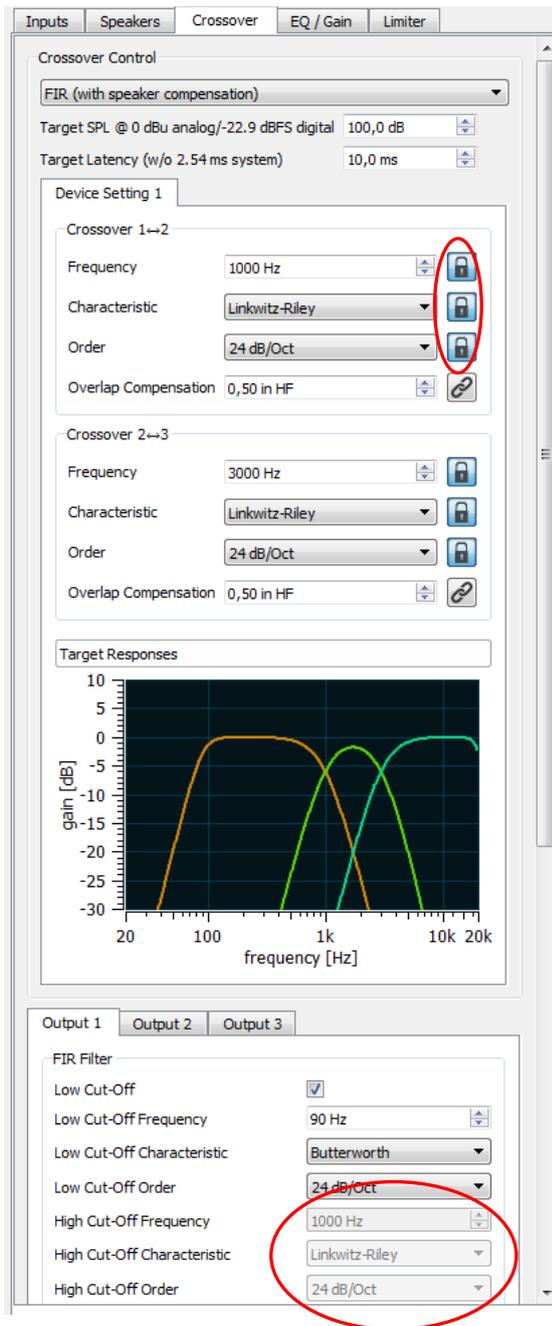
Settings locked / synced between Channels 1 and 2
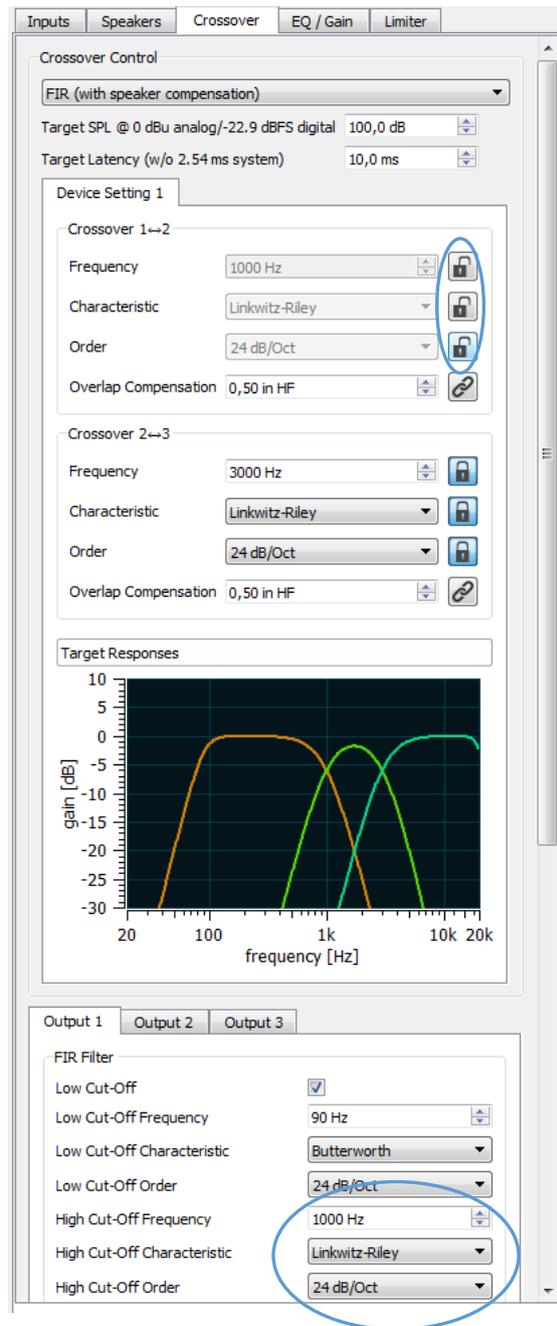
Settings unlocked, can be adjusted in Channels 1 and 2, individually

2.6. Virtual Channels (GUI name: Virtual Outputs)

Virtual Channels are used for creating setups using more channels than amplifier outputs available on a single PPA device. A virtual channel represents the neighboring crossover flank on another device, thereby creating one coherent crossover spread over two (or more physical devices).

Example: 3-way System with Subwoofer + 2-way Speaker running on different PPA devices

Preset	Type / Device	Used Ch. of preset	Necessary Virtual Channels
1	Subwoofer / PPA 2200-1	1	2 above
2	2-way Speaker / PPA 1000-2	2 + 3	1 below

Preset 1 and 2 are **identical** 3-way presets using the same channel settings and imported measurements. After creating the preset, it can be converted for another device type with other mapping of channels to physical outputs.

Preset	Preset Ch 1	Preset Ch 2	Preset Ch 3
1	DSP Ch 1	Virtual HF 1	Virtual HF 2
2	Virtual LF 1	DSP Ch 1	DSP Ch 2

Virtual Channels are used for filter calculation only. They are not loaded to the devices.

2.7. Firmware Update

To update the PPA firmware, follow these steps:

1. Open the *Four Audio PPA softwar*e. The *PPA Manager* window opens.
2. Connect to the amplifier you wish to update via USB / Ethernet.
3. The amplifier will appear in the PPA Manager's device list
4. Click on the gear wheel and select *Update Firmware* **(Fehler! Verweisquelle konnte nicht gefunden werden.)**
5. Select the firmware file.
6. The software will transfer the firmware to the PPA device and notify the user when finished. Do not power off the device or remove the USB / network cable during this process.
7. You may disconnect the USB / network cable after the file transfer is completed.
8. The amp will restart automatically displaying the new firmware version in the display footer. Please, note that a restart after a firmware update takes a little longer than usual since the proper file system for presets needs to be restored.
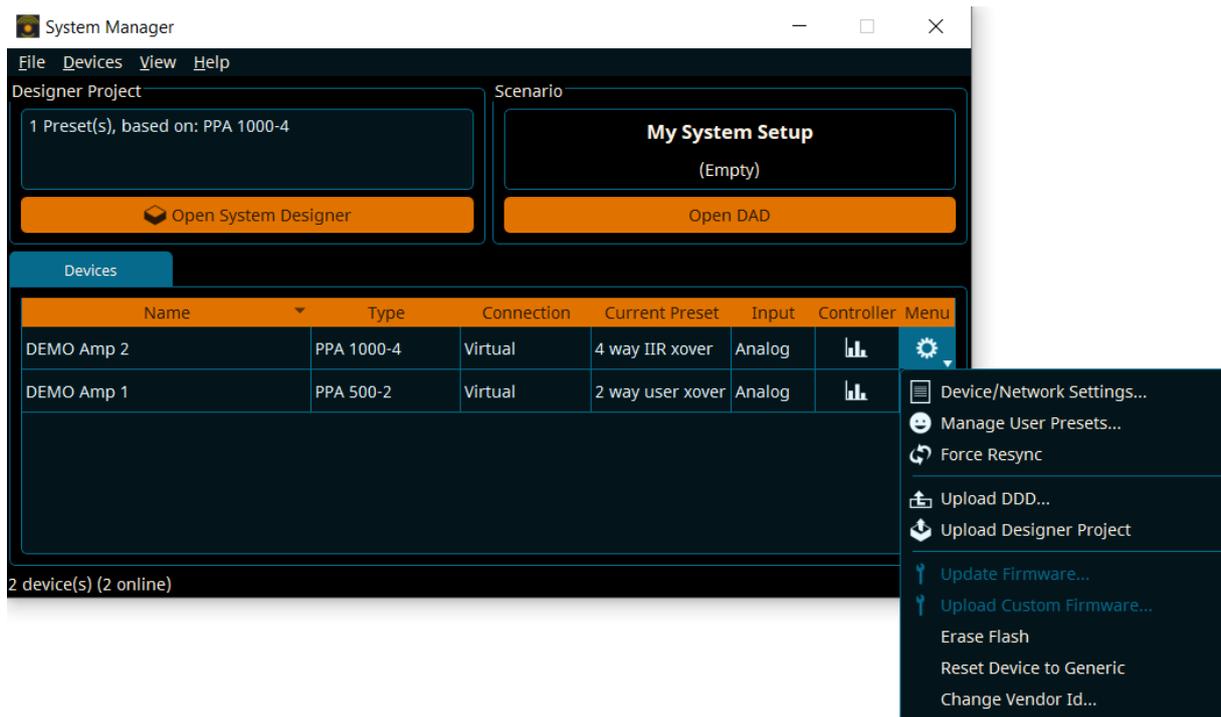
Figure 13 System Manager with Device List and Info Window opened

3. Contact

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4. Document Revision History

Date	item	Version	By
2021-07-04			
2017-06-27		1.9	RTh
2017-06-09		1.8	StM
2017-04-27		1.0.1	StM
2016-07-06		1.0	StM
2021-09-28	First revision, split off from previous manual covering hard- and software	0.1	RTh

The manufacturer reserves the right to make technical changes and modifications within the framework of legal norms as well as improving the performance characteristics of the product at any time.