Chapter 7: Signal Processing (SP) Tool Kit reference

The Signal Processing (SP) Tool Kit contains the signal processing blocks that are available for use in your system design. The SP Tool Kit is visible any time you are working in the **ESP-88** window. Use this chapter as a reference to available signal processing blocks.

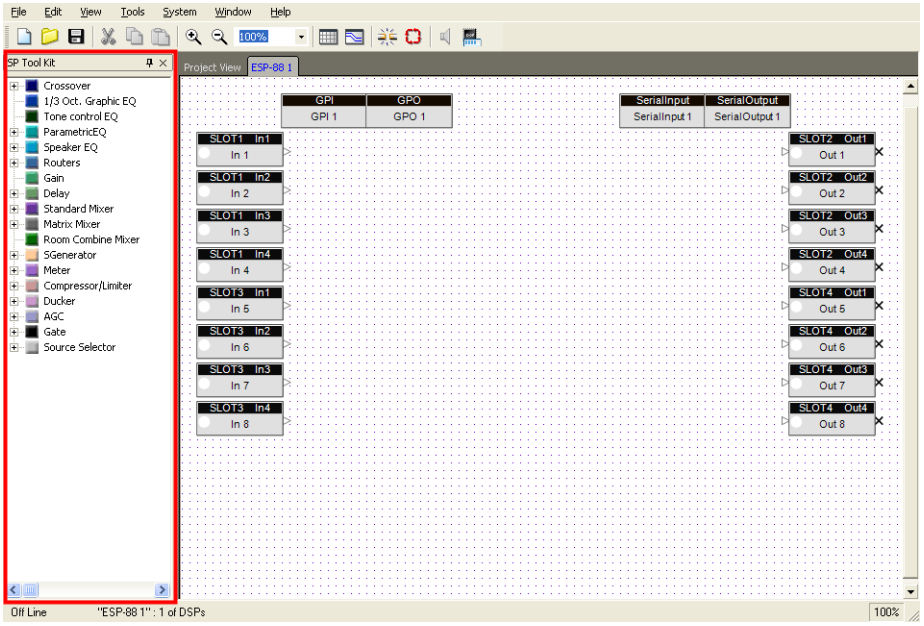


Figure 7.1 - ESP-88 window with SP Tool Kit to the left

Crossovers

A crossover divides an input signal into two or more frequency ranges, and sends each frequency range to a separate output.

2 way crossover

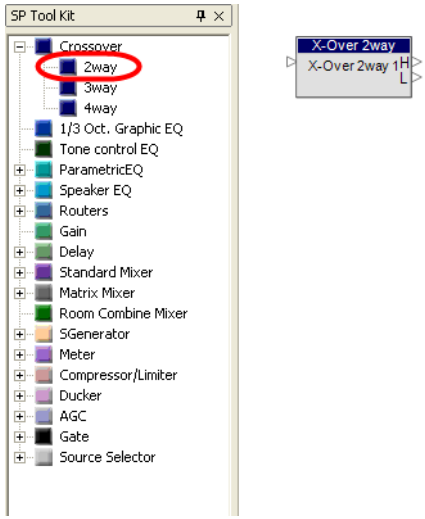


Figure 7.2 - 2 way crossover

The 2 way crossover divides an input signal into two frequency ranges, high and low, and sends these signals to two outputs marked **H** (high) and **L** (low). Double-click on the 2 way crossover block to open the control panel.

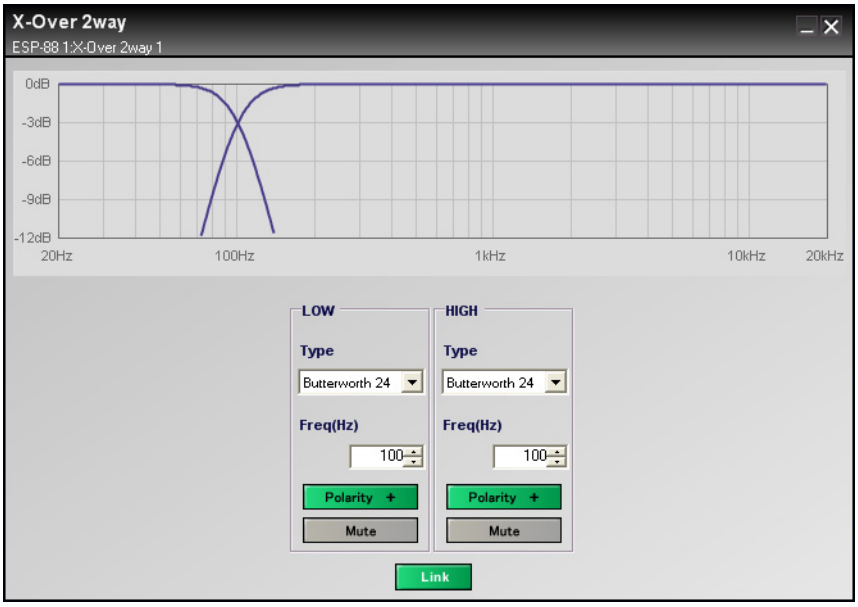


Figure 7.3 - 2 way crossover control panel

The top section of the control panel is a graphical representation of the crossover settings. The line to the left represents the low frequency output level and the line to the right represents the high frequency output level. Use the bottom section of the control panel to adjust crossover settings.

Type

Type	Slope
Butterworth 6	6 dB/oct
Butterworth 12	12 dB/oct
Butterworth 18	18 dB/oct
Butterworth 24	24 dB/oct
Butterworth 36	36 dB/oct
Butterworth 48	48 dB/oct
Bessel 12	12 dB/oct
Bessel 18	18 dB/oct
Bessel 24	24 dB/oct

Bessel 36	36 dB/oct
Bessel 48	48 dB/oct
Linkwitz-Riley 12	12 dB/oct
Linkwitz-Riley 24	24 dB/oct
Linkwitz-Riley 36	36 dB/oct
Linkwitz-Riley 48	48 dB/oct

Frequency

Set the low pass and high pass cutoff frequencies.

Polarity

Set the polarity of the output signal.

Mute

Mute the output signal.

Link

Press the **Link** button to lock the low pass and high pass frequencies to the same number. This is only an option when both the low and high types are set to Butterworth or Linkwitz-Riley. If link is off, the low pass and high pass frequencies can be adjusted independently.

3 way crossover

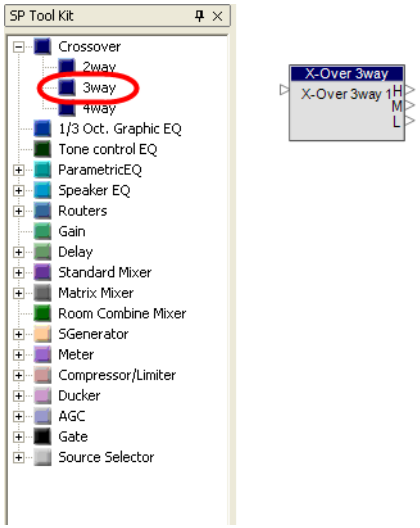


Figure 7.4 - 3 way crossover

The 3 way crossover divides an input signal into three frequency ranges, high, mid, and low, and sends these signals to three outputs marked **H** (high), **M** (mid), and **L** (low). Double-click on the 3 way crossover block to open the control panel.

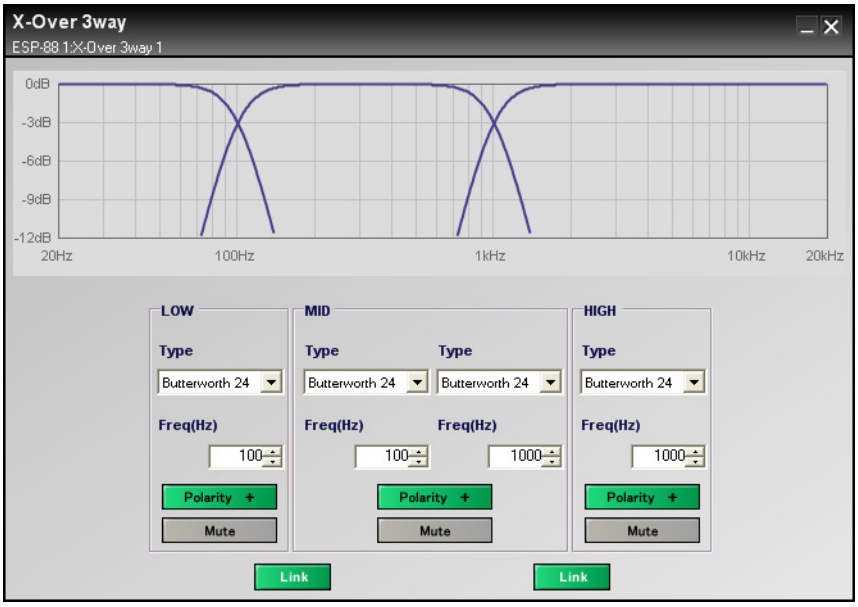


Figure 7.5 - 3 way crossover control panel

The top section of the control panel is a graphical representation of the crossover settings. The line to the left represents the low frequency output level, the middle line represents the mid frequency output level, and the line to the right represents the high frequency output level. Use the bottom section of the control panel to adjust crossover settings. The mid section includes type and frequency settings for both ends of the mid frequency curve.

Link

Press the **Link** button between the low and mid groups to lock the low pass and mid high pass frequencies to the same number. Press the **Link** button between the mid and high groups to lock the mid low pass and high pass frequencies to the same number. Linking is only an option when both types are set to Butterworth or Linkwitz-Riley. If link is off, the frequencies can be adjusted independently.

4 way crossover

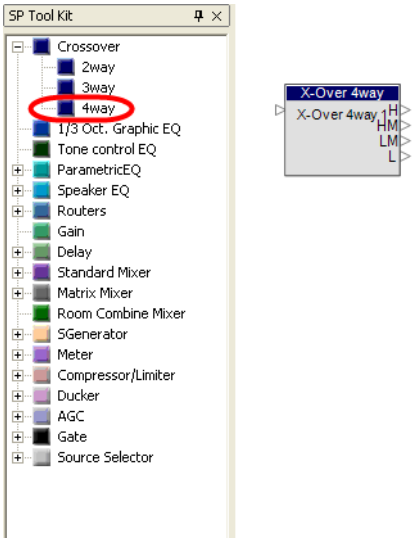


Figure 7.6 - 4 way crossover

The 4 way crossover divides an input signal into four frequency ranges, high, high mid, low mid, and low, and sends these signals to four outputs marked **H** (high), **HM** (high mid), **LM** (low mid), and **L** (low). Double-click on the 4 way crossover block to open the control panel.

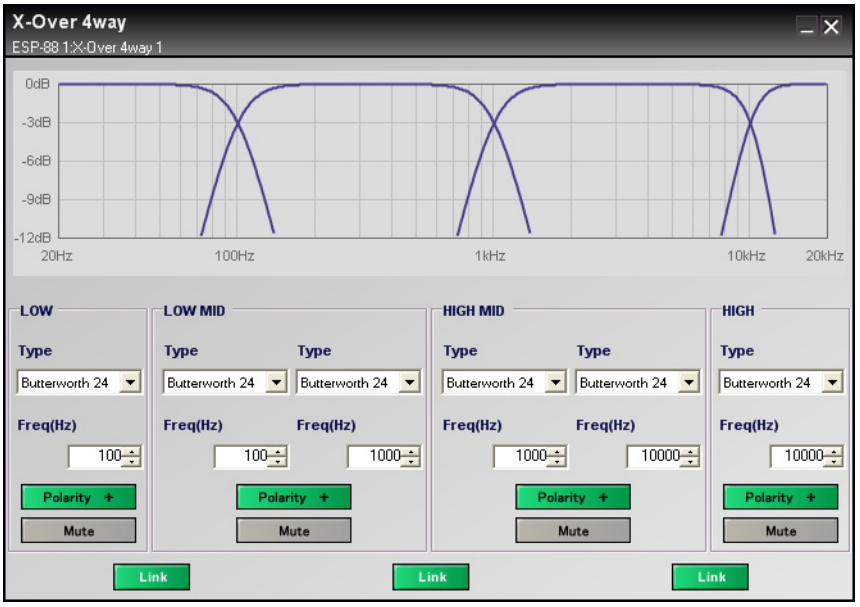


Figure 7.7 - 4 way crossover control panel

The top section of the control panel is a graphical representation of the crossover settings. The line to the left represents the low frequency output level, the left-middle line represents the low mid frequency output level, the right-middle line represents the high mid frequency output level, and the line to the right represents the high frequency output level. Use the bottom section of the control panel to adjust crossover settings. The low mid and high mid sections include type and frequency settings for both ends of these curves.

Link

Press the **Link** button between the low and low mid groups to lock the low pass and low mid high pass frequencies to the same number. Press the **Link** button between the low mid and high mid groups to lock the low mid low pass and high mid high pass frequencies to the same number. Press the **Link** button between the high mid and high groups to lock the high mid low pass and high pass frequencies to the same number. Linking is only an option when both types are set to Butterworth or Linkwitz-Riley. If link is off, the frequencies can be adjusted independently.

1/3 Oct Graphic EQ

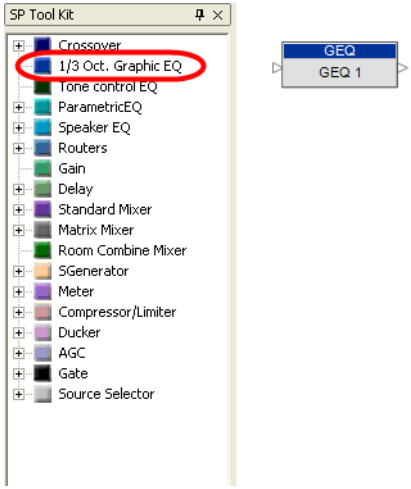


Figure 7.8 - 1/3 Oct Graphic EQ

The 1/3 octave graphic equalizer boosts or cuts output level at 31 different frequencies from 20 Hz to 20 kHz. Double-click on the 1/3 Oct Graphic EQ block to open the control panel.

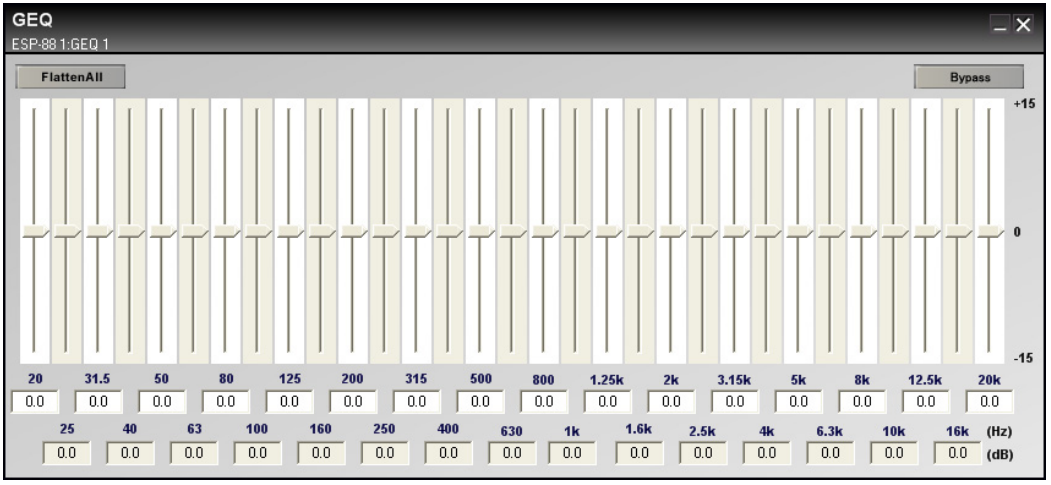


Figure 7.9 - 1/3 Oct Graphic EQ control panel

Adjust the gain slider at each frequency to boost or cut the level from -15 dB to 15 dB. Type in a boost or cut value in the fields below each slider to set the gain.

Press the **Flatten All** button to return all sliders to 0.0.

Press the **Bypass** button to bypass all equalizer settings.

Tone control EQ

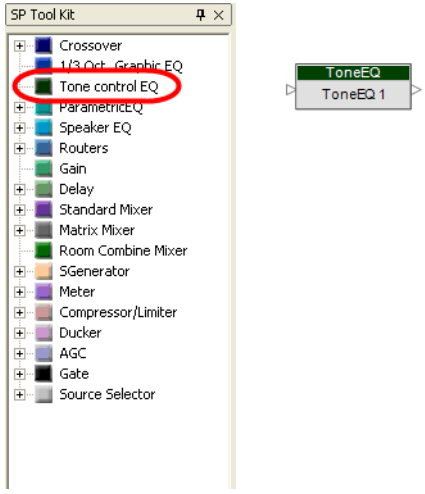


Figure 7.10 - Tone control EQ

The Tone control EQ boosts or cuts output level at the low, mid and high bandwidths. Double-click on the Tone control EQ block to open the control panel.

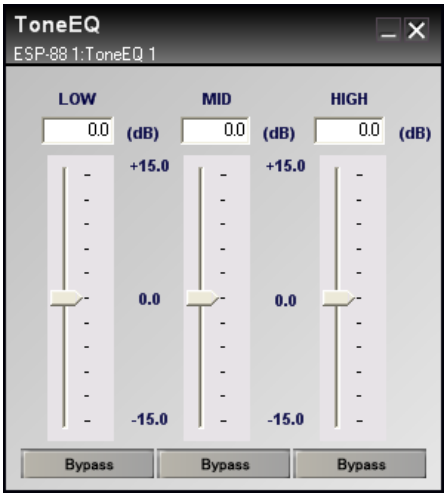


Figure 7.11 - Tone control EQ control panel

Adjust the gain slider at each bandwidth to boost or cut the level from -15 dB to 15 dB. You can also type in a boost or cut value in the fields above each slider to set the gain.

Press the **Bypass** button under a gain slider to bypass the gain adjustment for the bandwidth.

Parametric EQ

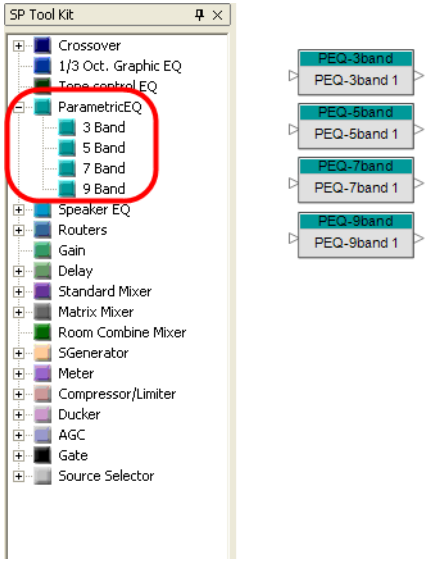


Figure 7.12 - Parametric EQs

The Parametric EQ allows you to adjust the equalization curve for an input signal at multiple filter bands according to center frequency, type of filter, amount of cut or boost (gain) and width of frequency range affected by each filter band (Q/BW). There are four different types of Parametric EQ's: 3 band, 5 band, 7 band, and 9 band. The control panels differ only in the amount of bands available for boost or cut. Double-click on a Parametric EQ block to open the control panel. The 5 band Parametric EQ control panel is shown below.

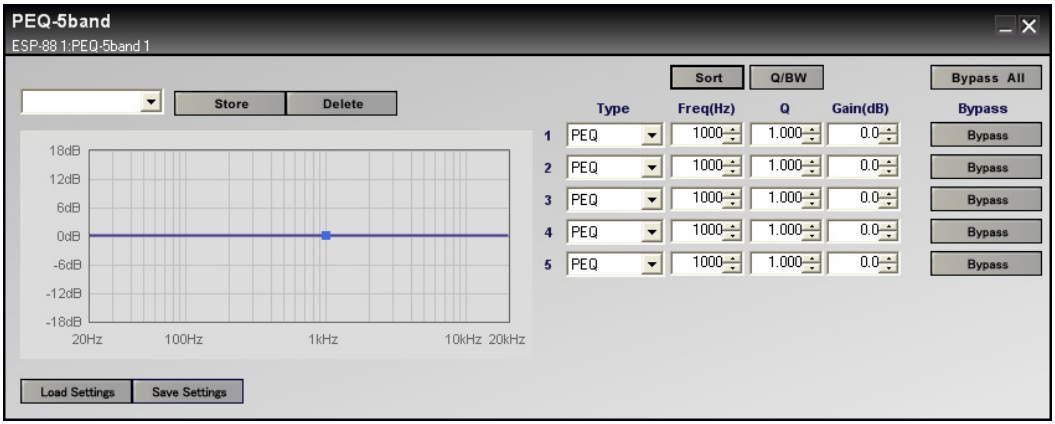


Figure 7.13 - 5 band Parametric EQ control panel

The left side of the control panel is a graphical representation of the equalization curve. The dark line represents the EQ curve and the blue boxes represent the center frequency of each filter band. When you first open the control panel, the center frequencies are all set at 1000 Hz, so the blue boxes are all at the same point. You can adjust the center frequency and gain for each filter band by dragging the blue box with your mouse in the left side of the control panel.

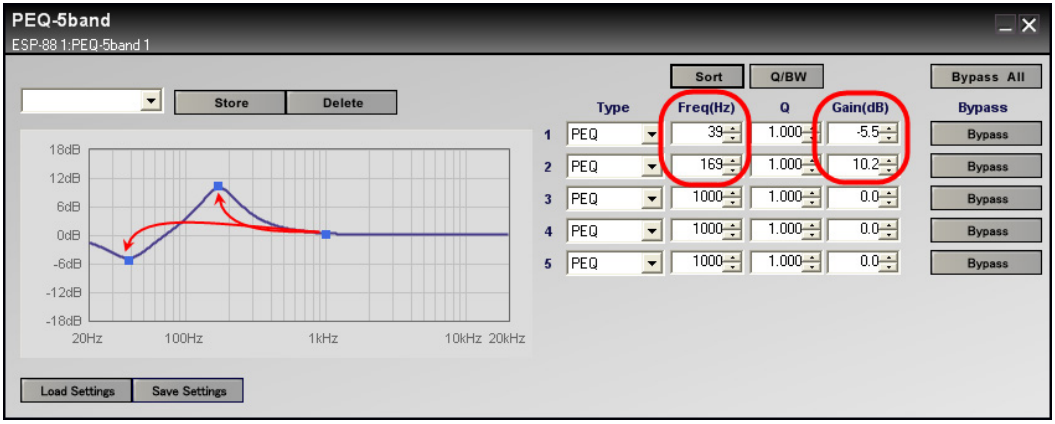
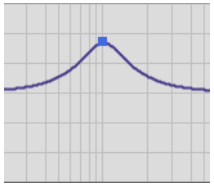
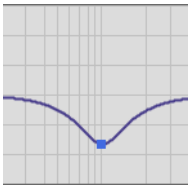
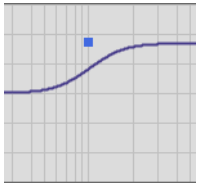
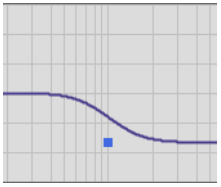
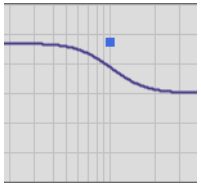
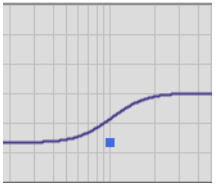
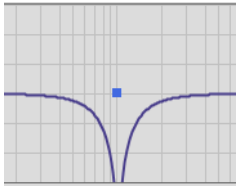
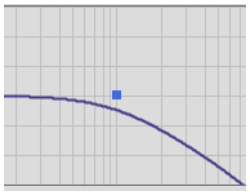
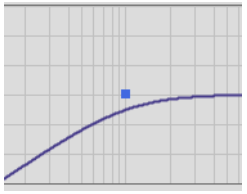


Figure 7.14 - Drag the blue boxes to set frequency and gain

The right side of the control panel shows settings for each filter band.

Type

PEQ	Boosts and cuts the signal in the vicinity of the specified frequency.  
High Shelf	Boosts and cuts the signal above the specified frequency.  
Low Shelf	Boosts and cuts the signal below the specified frequency.  
Notch	Attenuates the signal at the specified frequency. 

Low Pass	Attenuates the signal above the specified frequency. 
High Pass	Attenuates the signal below the specified frequency. 

Frequency

The center frequency of the filter band, in Hz, from 20 to 20,000 Hz.

Q or BW

The bandwidth that is affected by the filter. Only available when using **PEQ** and **Notch** type filters. Q is the ratio of the center frequency divided by the bandwidth. Press the **Q/BW** button to toggle between the two unit systems.

Gain

The amount of cut or boost to the signal in dB, from -20 to 20. Only available when using **PEQ**, **High Shelf**, and **Low Shelf** type filters. When using **Low Pass** and **High Pass** filters, this field is used to adjust the slope of the attenuation curve (-6 dB/Oct, or -12 dB/Oct).

Bypass

Use the **Bypass** buttons to bypass a given filter. Use the **Bypass All** button to turn on or off all bypass buttons.

Sort

Press the **Sort** button to sort the filters from lowest to highest center frequency.

Storing and saving equalization settings

Use the **Store** button to store the current EQ settings. The settings are stored as a “snapshot”, and can be recalled using the dropdown menu. Press the **Delete** button to delete a snapshot. Select **Default Setting** to clear any changes you have made.

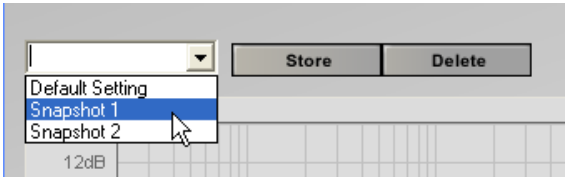


Figure 7.15 - Store and recall EQ curve snapshots

Snapshots are available only within the Parametric EQ block that you are currently working with. To make settings available to other Parametric EQ blocks, as well as for other ControlSpace projects, press the **Save Settings** button to save your settings as a .peq file on your hard drive.

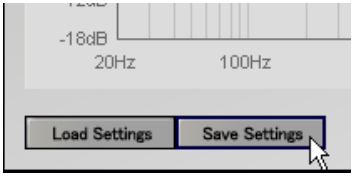


Figure 7.16 - Save settings

To load these settings into another Parametric EQ block, open the block’s control panel, and press the **Load Settings** button. Choose the saved .peq file that you want to load.

Speaker EQ

Use a speaker EQ block to apply Bose equalization settings to Bose loudspeakers. Four types of EQ blocks are available: a single loudspeaker, a two-output speaker EQ with crossover, and two bass array blocks.

Single Speaker

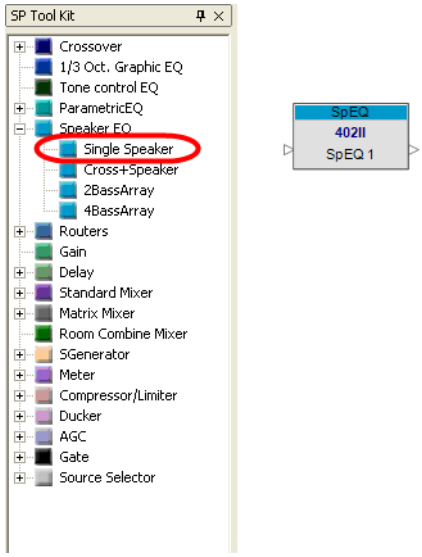


Figure 7.17 - Single Speaker EQ

The Single Speaker EQ block applies the appropriate equalization the input signal for the selected Bose loudspeaker. To choose a setting, double-click on the Single Speaker EQ block to open the control panel.

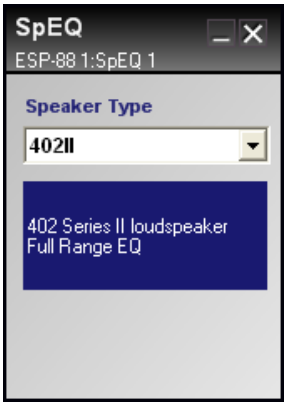


Figure 7.18 - Single Speaker EQ control panel

The following speaker EQ settings are available:

402II	402® Series II loudspeaker Full Range EQ
402II HF	402 Series II loudspeaker bi-amped @180Hz
502A	502®A loudspeaker Full Range EQ
502A HF	502A loudspeaker bi-amped @160Hz
802III	802® Series III loudspeaker Full Range EQ
802III HF	802 Series III loudspeaker bi-amped @125Hz
802III STK	Stacked 802 Series III loudspeaker EQ
802III STK HF	Stacked 802 Series III loudspeaker bi-amped @125Hz
MA12 WALL	MA12 loudspeaker Full Range Wall Mount EQ Curve
MA12 FREE	MA12 loudspeaker Full Range Free Field EQ Curve
MA12 HF	MA12 loudspeaker bi-amped @160Hz
MA12 STK WALL	Stacked MA12 loudspeaker Full Range Wall Mount EQ Curve
MA12 STK FREE	Stacked MA12 loudspeaker Full Range Free Field EQ Curve

MA12 STK HF	Stacked MA12 loudspeaker bi-amped @160Hz
MB4 100Hz LP	MB4 loudspeaker Low Pass @ 100Hz
MB4 160Hz LP	MB4 loudspeaker Low Pass @ 160Hz
MB4 200Hz LP	MB4 loudspeaker Low Pass @ 200Hz
MB4 280Hz LP	MB4 loudspeaker Low Pass @ 280Hz
MB24 100Hz LP	LT MB24 loudspeaker Low Pass @ 100Hz
MB24 160Hz LP	LT MB24 loudspeaker Low Pass @ 160Hz
MB24 200Hz LP	LT MB24 loudspeaker Low Pass @ 200Hz
MB24 280Hz LP	LT MB24 loudspeaker Low Pass @ 280Hz
502B	502®B loudspeaker Low Pass @ 160 Hz
502BEX	502BEX loudspeaker Low Pass @ 200 Hz
AWCS	Acoustic Wave® Cannon System II
LT3202	LT3202® loudspeaker Full Range EQ
LT3202CLUSTER	LT3202 loudspeaker Cluster EQ
LT4402	LT4402® loudspeaker Full Range EQ
LT4402CLUSTER	LT4402 Cluster EQ
LT9402	LT9402™ loudspeaker Full Range EQ
LT9402CLUSTER	LT9402 Cluster EQ
LT9702	LT9702® loudspeaker Full Range EQ
LT9702CLUSTER	LT9702 Cluster EQ
M8	Model 8 loudspeaker Full Range EQ
M16	Model 16 loudspeaker Full Range EQ
M32	Model 32 loudspeaker Full Range EQ
FS1B 100Hz LP	FreeSpace® Model 1B loudspeaker Low Pass @ 100Hz

FS1B SURFACE	FreeSpace® Model 1B loudspeaker Surface Mount EQ
FS1B FLUSH	FreeSpace Model 1B loudspeaker Flush Mount EQ
FS3B 100Hz LP	FreeSpace 3 Bass Low Pass @ 100Hz
FS3B 150Hz LP	FreeSpace 3 Bass Low Pass @ 150Hz
LT9403	LT9403 loudspeaker Full Range EQ
LT6403	LT6403 loudspeaker Full Range EQ
Flat	Flat EQ

Crossover + Speaker EQ

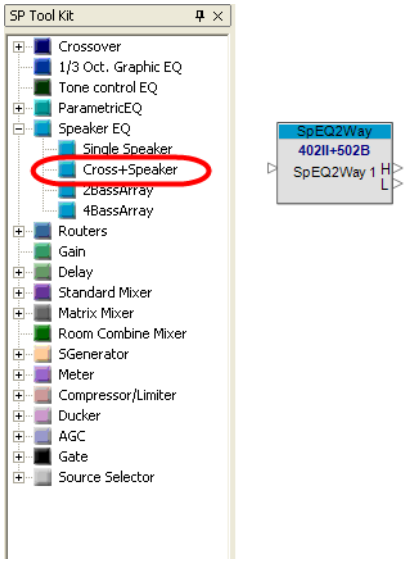


Figure 7.19 - Cross + Speaker

The crossover plus speaker EQ block is used when a signal is sent to a pair of low frequency and high frequency Bose loudspeakers. The Cross + Speaker block applies equalization to the input signal and splits the signal into low and high outputs. To choose a speaker combination, double-click on the Cross + Speaker EQ block to open the control panel.

Figure 7.20 - Cross + Speaker control panel

The following high and low frequency loudspeaker EQ combinations are available:

402II+502B	402® Series II loudspeaker bi-amped with 502®B loudspeaker
402II+502BEX	402 Series II loudspeaker bi-amped with 502BEX loudspeaker
402II+MB4	402 Series II loudspeaker bi-amped with MB4
402II+AWCS	402 Series II loudspeaker bi-amped with AWCS
502A+502B	502®A loudspeaker bi-amped with 502B
502A+MB4	502A loudspeaker bi-amped with MB4
502A+AWCS	502A loudspeaker bi-amped with AWCS
802III+502B	802® Series III loudspeaker bi-amped with 502B
802III+502BEX	802 Series III loudspeaker bi-amped with 502BEX
802III+MB4	802 Series III loudspeaker bi-amped with MB4
802III+AWCS	802 Series III loudspeaker bi-amped with AWCS
802IIIST+502B	Stacked 802 Series III loudspeakers bi-amped with 502B

802IIIST+502X	Stacked 802® Series III loudspeakers bi-amped with 502®BEX
802IIISTK+MB4	Stacked 802 Series III loudspeakers bi-amped with MB4
802IIISTK+AWCS	Stacked 802 Series III loudspeakers bi-amped with AWCS
MA12+502B	MA12 loudspeaker bi-amped with 502B
MA12+MB4	MA12 loudspeaker bi-amped with MB4
MA12STK+502B	Stacked MA12 loudspeaker bi-amped with 502B
MA12STK+MB4	Stacked MA12 loudspeaker bi-amped with MB4
LT3202+MB4	LT3202® loudspeaker bi-amped with MB4
LT3202+MB24	LT3202 loudspeaker bi-amped with MB24
LT4402+MB4	LT4402® loudspeaker bi-amped with MB4
LT4402+MB24	LT4402 loudspeaker bi-amped with MB24
LT9402+MB4	LT9402™ loudspeaker bi-amped with MB4
LT9402+MB24	LT9402 loudspeaker bi-amped with MB24
LT9402+502BEX	LT9402 loudspeaker bi-amped with 502BEX
LT9702+MB4	LT9702® loudspeaker bi-amped with MB4
LT9702+MB24	LT9702 loudspeaker bi-amped with MB24
LT9702+502BEX	LT9702 loudspeaker bi-amped with 502BEX
M8+MB4	Model 8 loudspeaker bi-amped with MB4
M8+FS3B	Model 8 loudspeaker bi-amped with FS3B
M8+FS1B	Model 8 loudspeaker bi-amped with FS1B
M16+FS3B	Model 16 loudspeaker bi-amped with FS3B
M32+MB4	Model 32 loudspeaker bi-amped with MB4
M32+FS3B	Model 32 loudspeaker bi-amped with FS3B
M32+FS1B	Model 32 loudspeaker bi-amped with FS1B

M32+502BEX	Model 32 loudspeaker bi-amped with 502BEX

2 Bass Array

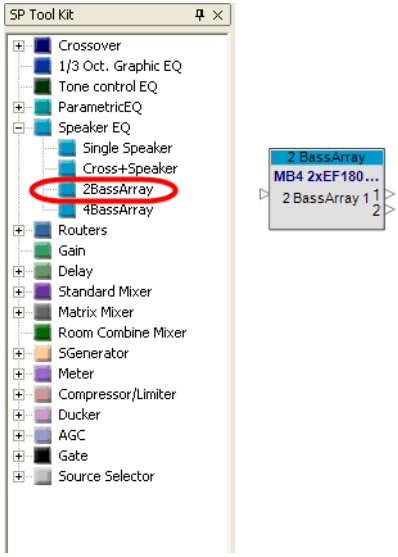


Figure 7.21 - 2 Bass Array

The 2 output bass array block is used to create two loudspeaker end-fire and broad-fire bass arrays using two MB4 loudspeakers. This block sets the EQ and delay required when using this bass array. To choose a configuration, double-click on the 2 Bass Array block to open the control panel.

Figure 7.22 - 2 Bass Array control panel

MB4 2x EF180Hz	MB4 2x Endfire Bass Array, 180Hz crossover. The MB4 2x Endfire Bass Array preset provides 180 degree conical dispersion @ 160Hz. The crossover is set at 180Hz and is recommended for use with MA12, MB4 and 02 Series speakers. An MB4 2x Endfire Bass array uses two MB4 loudspeakers spaced 23 inches (58.4 cm) on center from each other.
MB4 2x EF280Hz	MB4 2x Endfire Bass Array, 280Hz crossover. The MB4 2x Endfire Bass Array preset provides 180 degree conical dispersion @ 160Hz. The crossover is set at 280Hz and is recommended for use with MA12, MB4 and LT Series speakers. An MB4 2x Endfire Bass array uses two MB4 loudspeakers spaced 23 inches (58.4 cm) on center from each other.

MB4 2x BS180Hz	MB4 2x Broadside Bass Array, 180Hz crossover. The MB4 2x Broadside Bass Array preset provides 360 degree horizontal coverage with a 10 to 15 dB suppression in energy going up and down from 80 – 200Hz. The crossover is set at 180Hz and is recommended for use with MA12, MB4 and 02 Series speakers. An MB4 2x Broadside Bass array uses two MB4 loudspeakers spaced 45 inches (114.3 cm) on center from each other.
MB4 2x BS280Hz	MB4 2x Broadside Bass Array, 280Hz crossover. The MB4 2x Broadside Bass Array preset provides 360 degree horizontal coverage with a 10 to 15 dB suppression in energy going up and down from 80 – 200Hz. The crossover is set at 280Hz and is recommended for use with the LT Series. An MB4 2x Broadside Bass array uses two MB4 loudspeakers spaced 45 inches (114.3 cm) on center from each other.

4 Bass Array

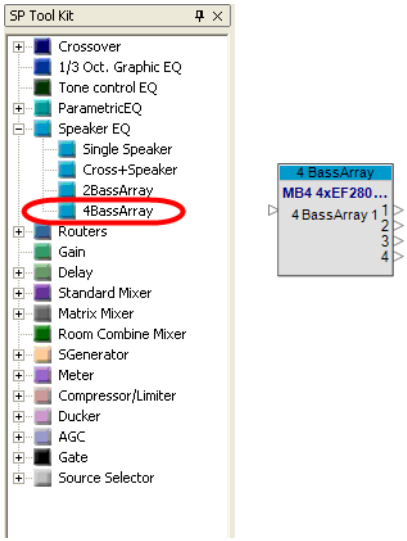


Figure 7.23 - 4 Bass Array

The 4 output bass array block is used to create four loudspeaker end-fire bass arrays using four MB4 loudspeakers. This block sets the EQ and delay needed when using this bass array. To choose a configuration, double-click on the 4 Bass Array block to open the control panel.

Figure 7.24 - 4 Bass Array control panel

MB4 4x EF280Hz	MB4 4x Endfire Bass Array, 280Hz crossover. The MB4 4x Endfire Bass Array preset provides 120 degree conical dispersion @ 160Hz. The crossover is set at 280Hz and is recommended for use with MA12, MB4 and LT Series speakers. An MB4 4x Endfire Bass array uses four MB4 loudspeakers spaced 29 inches (73.6 cm) on center from each other.
MB4 4x EF180Hz	MB4 4x Endfire Bass Array, 180Hz crossover. The MB4 4x Endfire Bass Array preset provides 120 degree conical dispersion @ 160Hz. The crossover is set at 180Hz and is recommended for use with MA12, MB4 and 02 Series speakers. An MB4 4x Endfire Bass array uses four MB4 loudspeakers spaced 29 inches (73.6 cm) on center from each other.

Routers

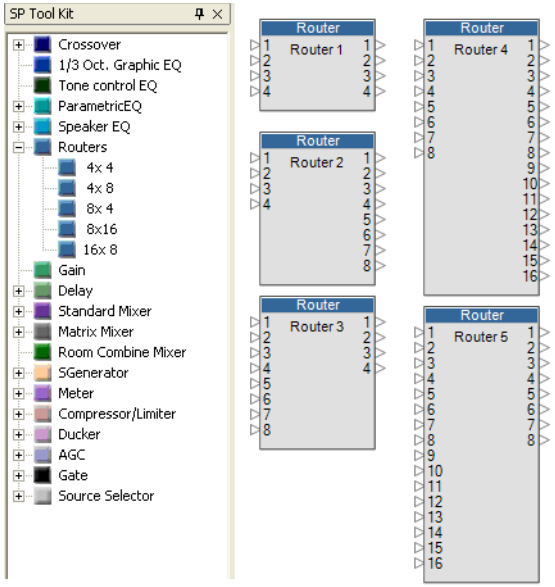


Figure 7.25 - Routers

Routers provide simple in/out routing of signals. An input signal can be routed to multiple output channels, but an output channel cannot accept more than one input signal. An output channel can also be turned off. Routers are named according to the number of input and output channels they provide. You can use 4X4, 4X8, 8X4, 8X16, and 16X8 routers. To open a router control panel, double-click on the Router block. The 4X4 Router control panel is shown below.

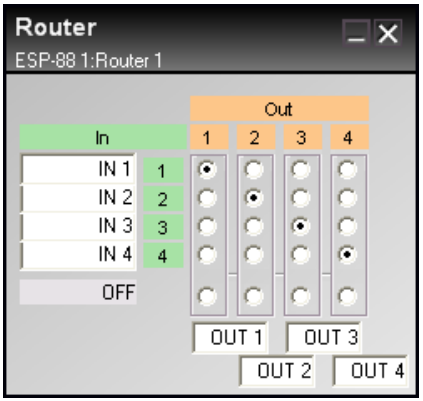


Figure 7.26 - 4X4 Router control panel

To route a given input signal to an output, press the button underneath the output number. To turn the output off, press the button in the OFF row. You can also rename any input or output channel by typing in the fields to the left and bottom of the control panel.

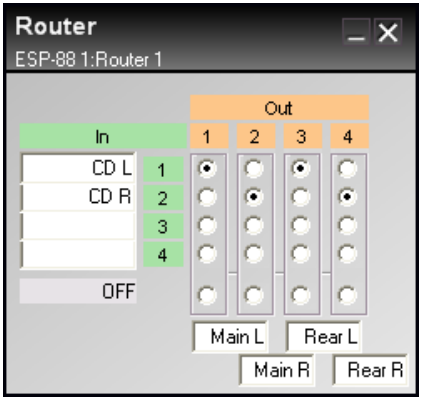


Figure 7.27 - A stereo input routed to four different outputs

Gain

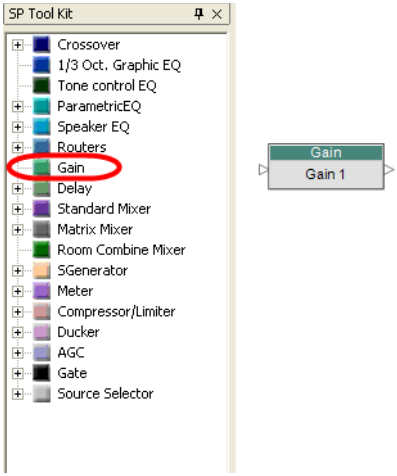


Figure 7.28 - Gain

Gain blocks control the signal level. Double-click the gain block to open the gain control panel.

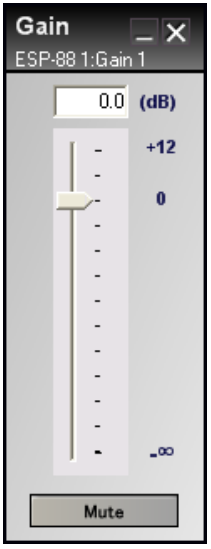


Figure 7.29 - Gain control panel

Use the slider to adjust the gain, or type a gain value into the field at the top of the control panel. Gain can be set between - infinity and + 12 dB. Press the **Mute** button to mute the signal output.

Delay

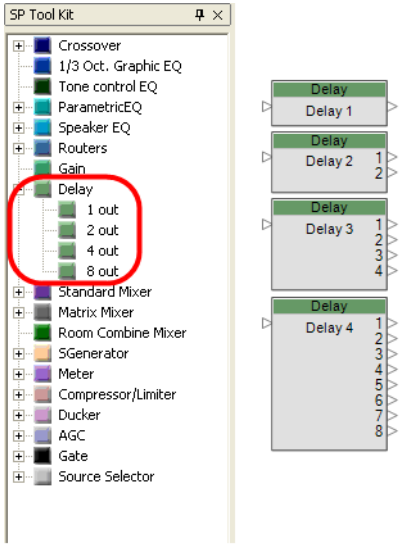


Figure 7.30 - Delay blocks

Delay blocks are available with one, two, four and eight outputs. A delay can be imparted on each output signal independently. To open a delay control panel, double-click on the delay block. A four output delay control panel is shown below.

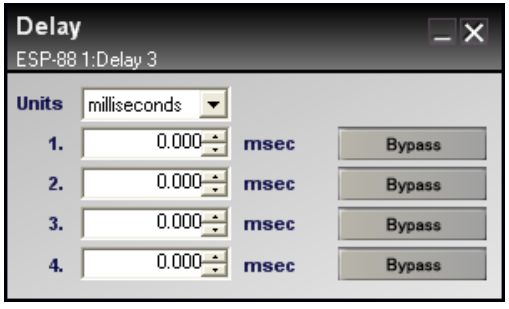


Figure 7.31 - 4 out delay control panel

Use the **Units** dropdown menu to set the delay units:

- 0 - 3000 **milliseconds**
- 0 - 144000 **samples**
- 0 - 1104.3 **meters**
- 0 - 1104300 **millimeters**
- 0 - 3623.031 **feet**
- 0 - 43476.378 **inches**.

Each output delay can be set independently. Press the **Bypass** button to bypass the delay.

Standard Mixer

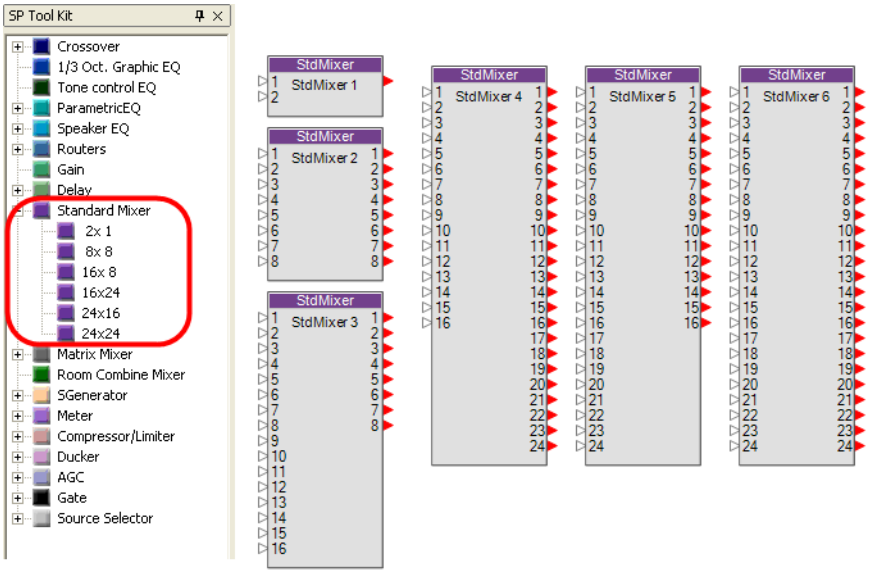


Figure 7.32 - Standard Mixers

Standard mixers are used to route input and output signals, and to adjust the input and output signal levels. Standard mixers are named according to the number of input and output channels they provide. You can use 2X1, 8X8, 16X8, 16X24, 24X16, and 24X24 standard mixers. To open a standard mixer control panel, double-click on the standard mixer block. The 8X8 standard mixer control panel is shown below.

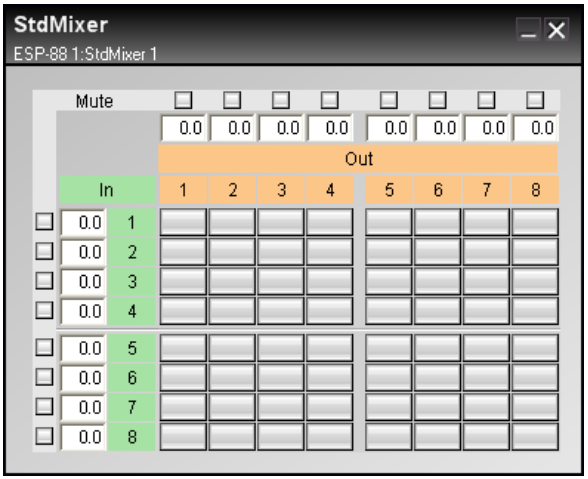


Figure 7.33 - 8X8 standard mixer control panel

Inputs are displayed in green and outputs are displayed in orange. To route a green input channel to an orange output channel, click the assign button at the intersection of the two channels. The button turns blue after being assigned. Click the button again to remove the assignment.

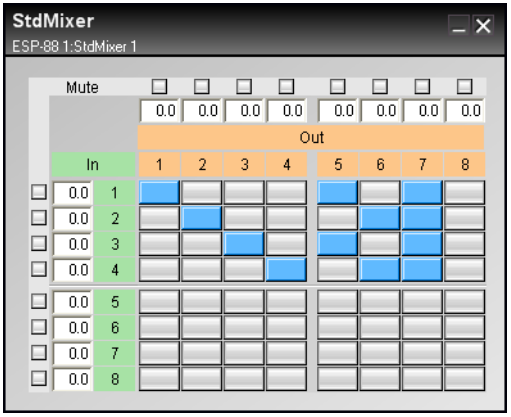


Figure 7.34 - Press the assign buttons to route inputs to outputs

Mute an input or output by pressing the **Mute** buttons to the left of the inputs, and above the outputs. The input and output level can be adjusted by typing in a gain value between -60 and 12 dB in the field next to the input/output channel number.

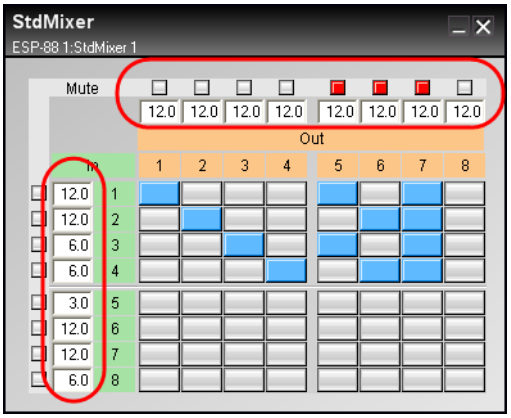


Figure 7.35 - Adjust input and output levels

Assigning several inputs to one output results in a summed output signal.

Matrix mixer

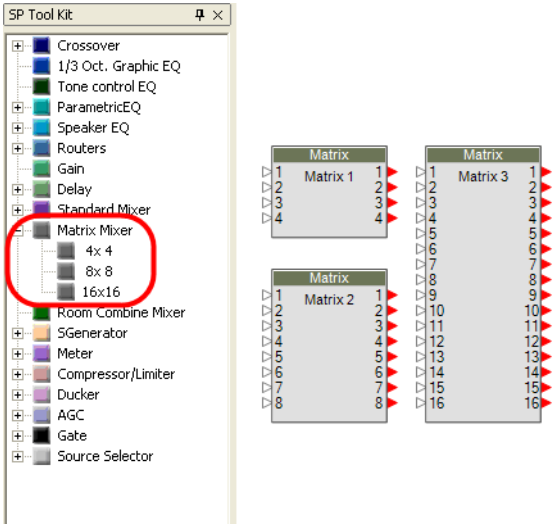


Figure 7.36 - Matrix mixers

Like the standard mixer, matrix mixers are used to route inputs to outputs, but have the added ability to adjust the signal level at each routing juncture. Matrix mixers are named according to the number of input and output channels they provide. 4X4, 8X8, and 16X16 matrix mixers are available. The 4X4 matrix mixer control panel is shown below.

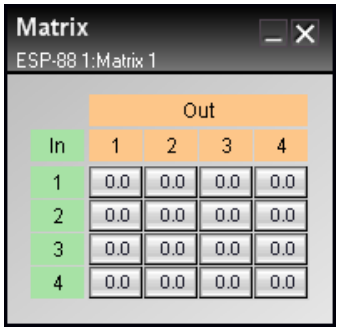


Figure 7.37 - 4X4 matrix mixer control panel

To route an input channel to an output channel, click the assign button at the intersection of the two channels. The button turns blue indicating it has been assigned. Click the button again to remove the assignment of the input to the particular output. To adjust the signal level at the routing juncture, right click on the button and adjust the gain slider. Gain can be set between - infinity and 0.0 dB.

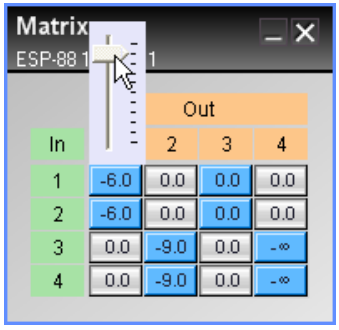


Figure 7.38 - Right click on an assign button to adjust gain

Room Combining Mixer

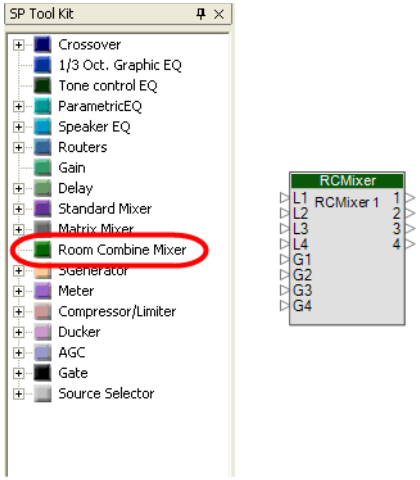


Figure 7.39 - Room combining Mixer

The room combining mixer is used to mix and route local and global inputs to one, two, three, or four separate rooms. When adjacent rooms are connected together, or “combined”, the same audio is routed to both rooms. For example, a hotel ballroom may have three “air walls” that can be used to divide the rooms into 4 smaller rooms, or many other combinations, like 2 medium sized rooms. The room combining mixer has four local inputs and four global inputs. The local inputs are located in each separate room, for example, each room might have a microphone jack input. The global inputs are for sources that span all rooms, for example, background music.

To open the room combining mixer control panel, double-click on the block.

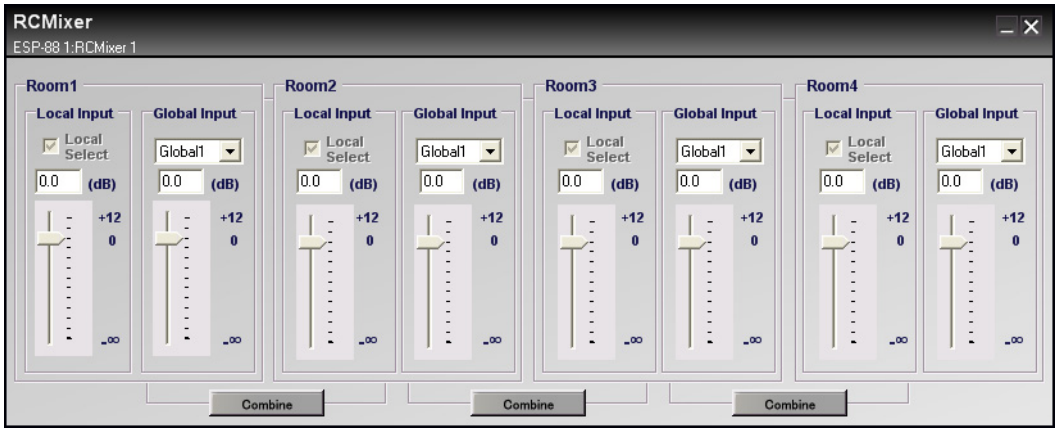


Figure 7.40 - Room combining mixer control panel

The room combining mixer control panel consists of four sections which correspond to the separate rooms in your design (you can have up to four rooms). Each section includes a local input gain slider, and a global input gain slider. Select the global input source for each room using the dropdown menu above the global gain slider.

Combining rooms

To combine rooms, press the **Combine** button located between the rooms that you want to combine.

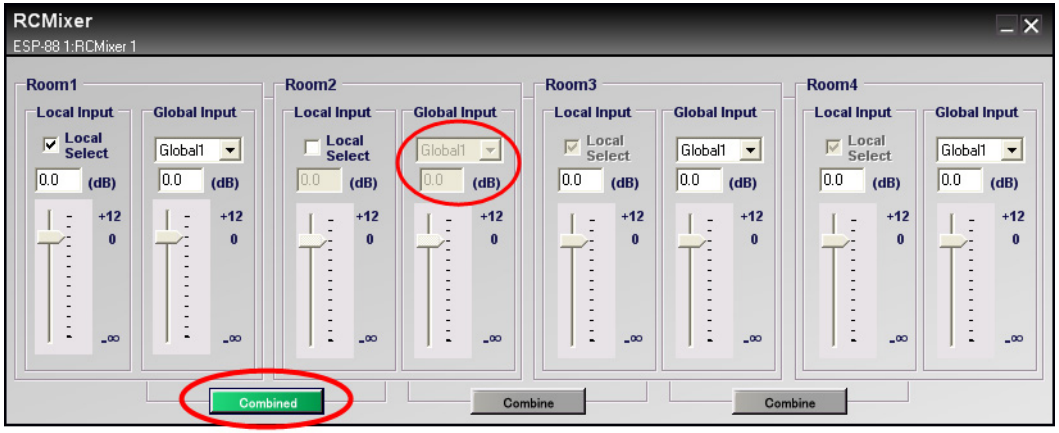


Figure 7.41 - Combining rooms 1 and 2

When the rooms are combined, only one of the local inputs is allowed. Notice that when rooms one and two are combined, the gain sliders and global input dropdown menus are disabled for room 2. Place a checkmark next to **Local Select** in the room for which you want the local input to be active. To combine more than two rooms, press the **Combine** button between the rooms you want to combine.

The output signal for each room is the mix of local input and the selected global input. If you do not want to mix in either the local or global input, lower the input gain to -infinity. The following examples show the input configurations for three different room combining scenarios:

Output for Room:		**Local input:**		**Global input:**
1	is a mix of	1	and	1, 2, 3, or 4
2	is a mix of	2	and	1, 2, 3, or 4
3	is a mix of	3	and	1, 2, 3, or 4
4	is a mix of	4	and	1, 2, 3, or 4

Figure 7.42 - Four independent rooms

Output for Room:		**Local input:**		**Global input:**
1, 2	is a mix of	1 **or** 2 	and	1, 2, 3, or 4
3	is a mix of	3	and	1, 2, 3, or 4
4	is a mix of	4	and	1, 2, 3, or 4

Figure 7.43 - Rooms 1 and 2 combined

Output for Room:		Local input:		Global input:
1, 2, 3	is a mix of	1 **or** 2 **or** 3 	and	1, 2, 3, or 4
4	is a mix of	4	and	1, 2, 3, or 4

Figure 7.44 - Rooms 1, 2, and 3 combined:

Signal Generator

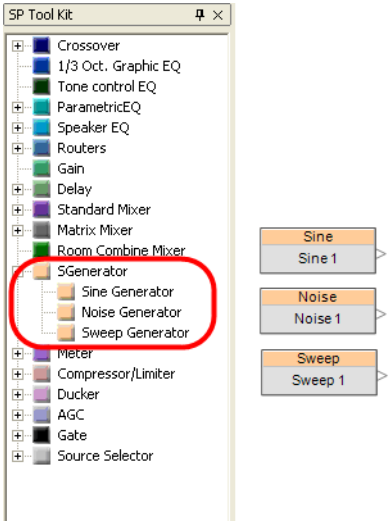


Figure 7.45 - SGenerator

ControlSpace Designer software includes three signal generator blocks: a sine wave generator, a noise generator, and a sweep generator. To open a signal generator control panel, double-click on the signal generator block.

Sine wave generator

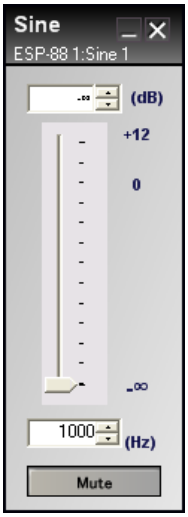


Figure 7.46 - Sine wave generator control panel

The sine wave generator produces frequencies from 20 to 20 kHz. Use the field at the bottom of the control panel to specify the output frequency. Control the signal level by using the gain slider, or by typing in a decibel value between - infinity and +12 dB in the field above the slider. Press the **Mute** button to mute the output signal.

Noise generator

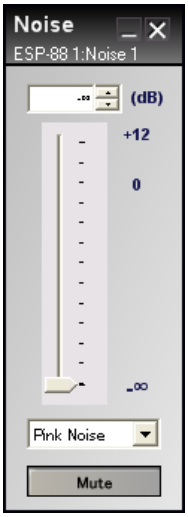


Figure 7.47 - Noise generator control panel

The noise generator will produce Pink noise or White noise. Select the type of noise from the dropdown menu at the bottom of the control panel. Control the signal level by using the gain slider, or by typing in a decibel value between - infinity and +12 dB in the field above the slider. Press the **Mute** button to mute the output signal.

Sweep generator

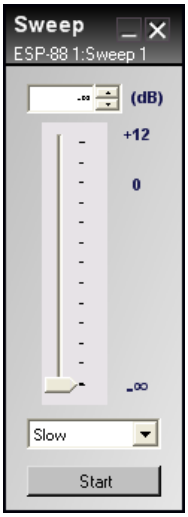


Figure 7.48 - Sweep generator control panel

The sweep generator produces a sweep sine signal from 20 Hz to 20 kHz. To start the signal, press the **Start** button at the bottom of the control panel. Press this button again to stop the sweep signal. Choose a fast or slow sweep using the dropdown menu below the gain slider. Control the signal level by using the gain slider, or by typing in a decibel value between - infinity and +12 dB in the field above the slider.

Meters

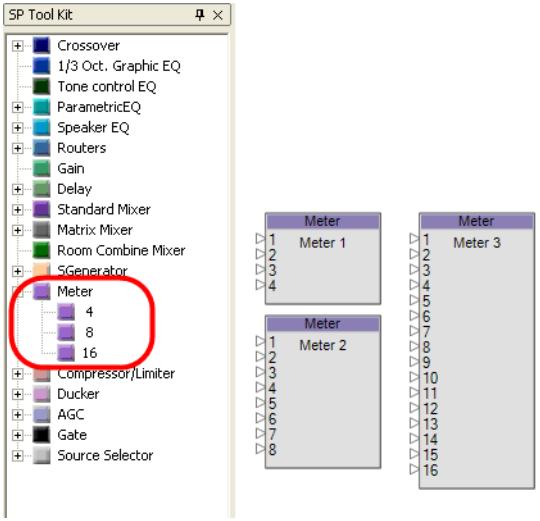


Figure 7.49 - Meters

Meter blocks display a bar level meter which displays signal level. There are three meter blocks available: 4 input, 8 input, and 16 input. The 4 input meter control panel is shown below.

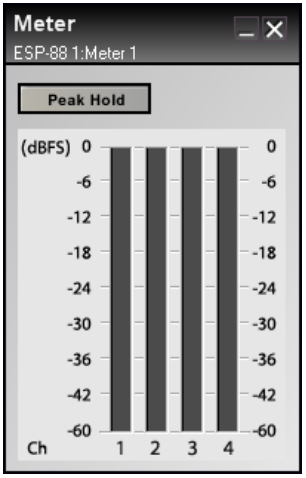


Figure 7.50 - 4 input meter control panel

The meter control panel displays signal level in dBFS. Press the **Peak Hold** button to turn on a persistent line indicating the highest signal level.

Compressor/Limiter

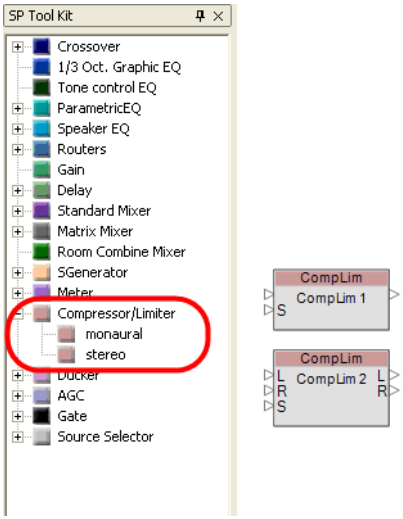


Figure 7.51 - Compressor/Limiter

The Compressor/Limiter blocks dynamically reduce the level of an input signal above a certain threshold. ControlSpace Designer software includes a monaural Compressor/Limiter with one input and a side chain input, and a stereo Compressor/Limiter with stereo inputs and a side chain input. The control panels differ only in the choice of input signal used as the trigger signal. The stereo Compressor/Limiter control panel is shown below.

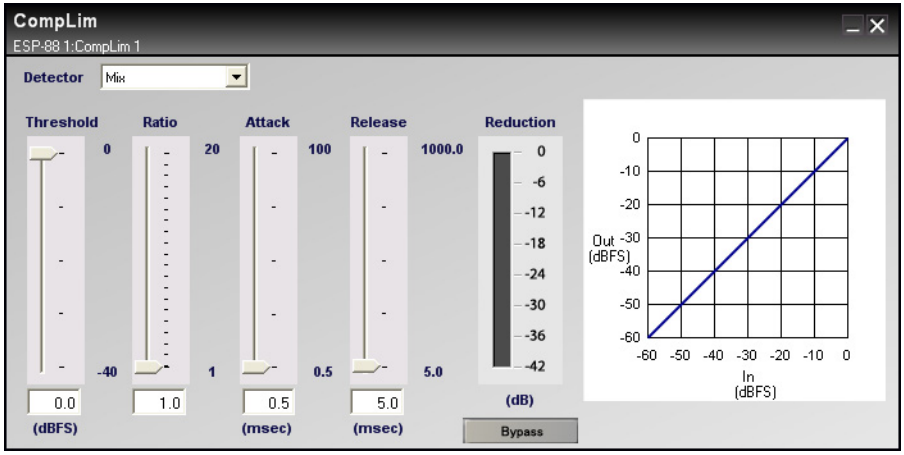


Figure 7.52 - Stereo Compressor/Limiter control panel

Use the four sliders on the left side to adjust the **Threshold**, **Ratio**, **Attack**, and **Release**. The graph on the right side of the control panel shows the input level versus the output level, and the slope of the line indicates the compression ratio. The Reduction meter shows the reduction in gain caused by compression. Press the **Bypass** button to bypass the Compressor/Limiter.

Use the **Detector** dropdown menu to choose which input acts as the trigger source. Select **Mix** in the stereo Compressor/Limiter to use both the L and R inputs as the trigger source.

Duckers

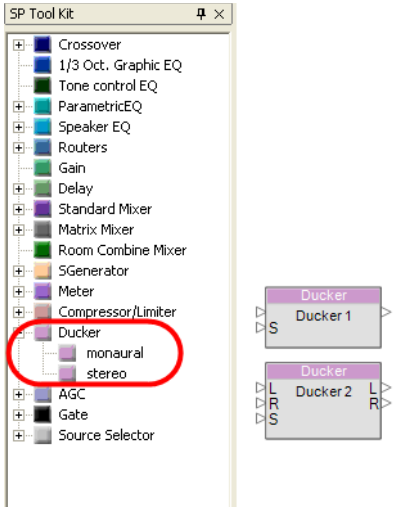


Figure 7.53 - Duckers

A ducker lowers the output volume upon the detection of a side chain input signal. A typical example is background music that is interrupted by a microphone page. When the ducker senses the microphone signal in the side chain input, it automatically lowers the background music signal level at the output. There are two duckers available in ControlSpace Designer software: monaural, which accepts one input and one side chain input, and stereo, which accepts a stereo input and a side chain input. The control panel is the same for each ducker. Double-click on a ducker block to open the control panel.

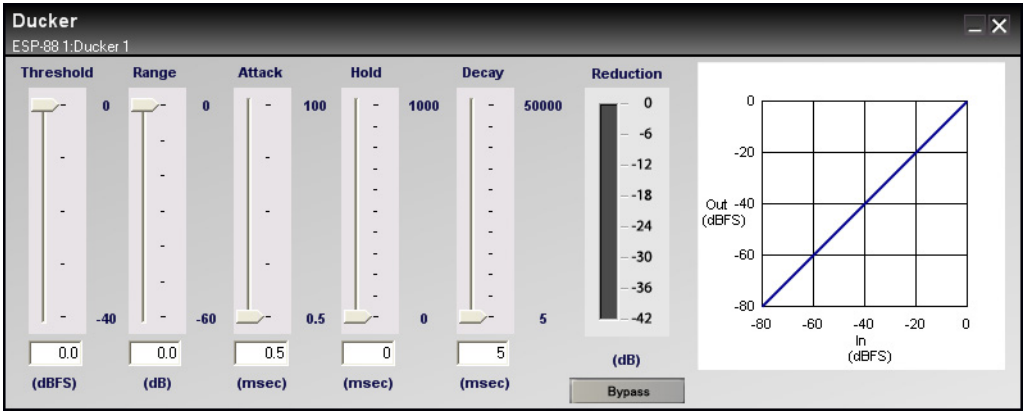


Figure 7.54 - Ducker control panel

Use the sliders on the left side to adjust the **Threshold**, **Range**, **Attack**, **Hold** and **Decay**. The **Range** setting dictates the amount of reduction in volume when the ducker is active. The graph on the right side of the control panel shows the input level versus the output level of the signal. The Reduction meter shows the reduction in gain of the output signal. Press the **Bypass** button to bypass the ducker.

Note: **The side chain input signal is not passed to the ducker output, it is only used as a trigger signal. If you want the source that is used for the trigger to be heard, you will need to mix it back in to the output after the ducker. For example, in the background music/microphone announcement example above, the microphone signal will need to be mixed back in after the ducker in order to hear the announcement.**

AGC

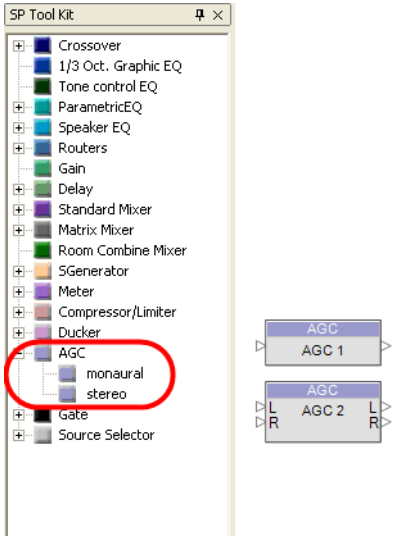


Figure 7.55 - AGC

Automatic Gain Control (AGC) combines a compressor and a gate to maintain a constant output signal level with varying input signal levels. For example, if two speakers use the same microphone, an AGC can keep the output volume at one level. Both monaural and stereo AGCs are available. The control panels differ only in the choice of input signal used as the trigger signal. To open the AGC control panel, double-click on the AGC block.

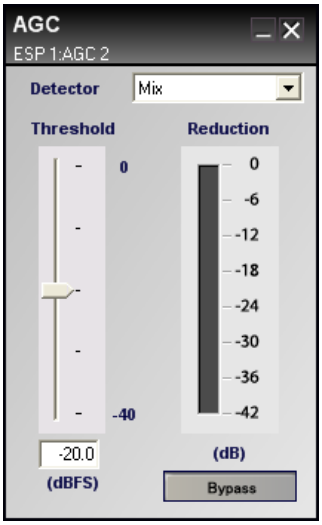


Figure 7.56 - Stereo AGC control panel

The AGC control panel includes a **Threshold** slider and Reduction meter. Use the **Threshold** slider to adjust the output level. The Reduction meter shows the reduction in gain of the output signal. In the stereo AGC control panel, use the **Detector** dropdown menu to choose which input acts as the trigger source. Select **Mix** to use both the L and R inputs as the trigger source. Press the **Bypass** button to bypass the AGC.

Gate

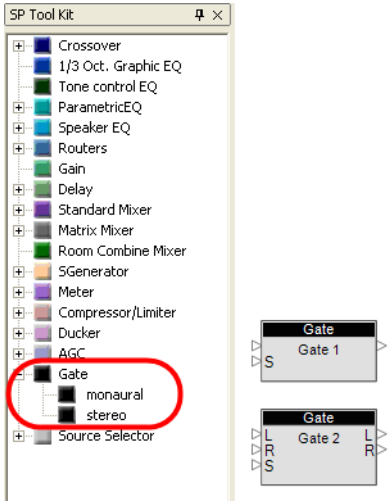


Figure 7.57 - Gate

The gate block attenuates a signal that is below a certain threshold. This is useful in situations where you want to cut out sounds below a certain volume. For example, if a microphone is located in a noisy area, you could put a gate on the signal so that sounds that are quieter than the speaker's voice are not heard. There are both monaural and stereo gates available in ControlSpace Designer software. The control panels differ only in the choice of input signal used as the trigger signal. Double-click a gate block to open the control panel.

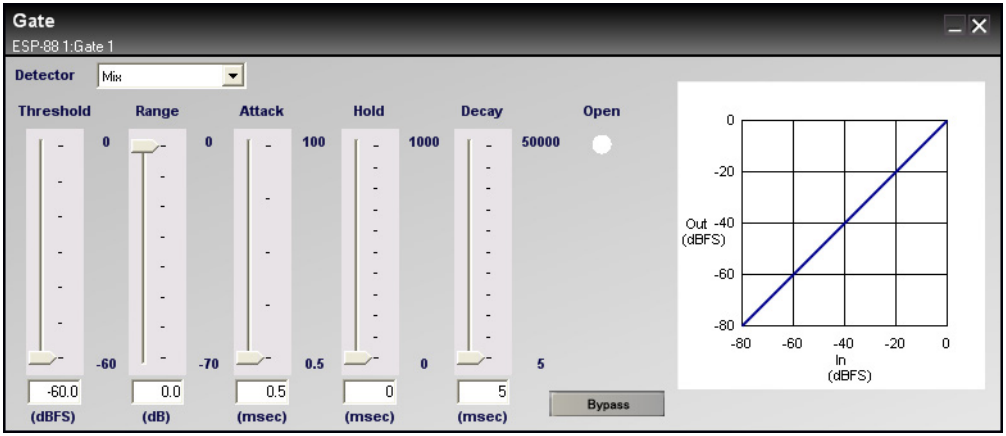


Figure 7.58 - Gate control panel

Use the four sliders on the left side to adjust the **Threshold**, **Range**, **Attack**, **Hold** and **Decay**. The graph on the right side of the control panel shows the input level versus the output level, and the line indicates the effect of the gate. Use the **Detector** dropdown menu to choose which input acts as the trigger source. Select **Mix** in the stereo gate to use both the L and R inputs as the trigger source. Press the **Bypass** button to bypass the gate.

Source Selector

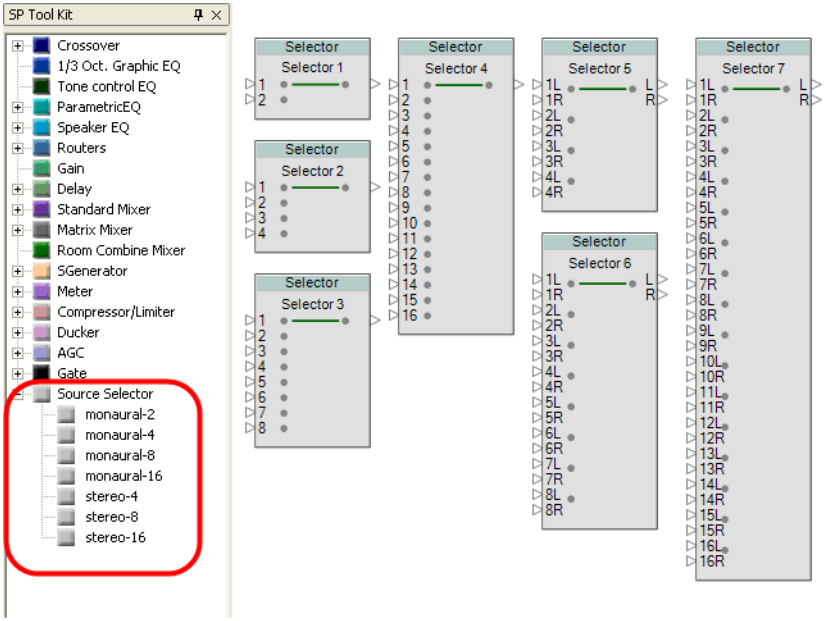


Figure 7.59 - Source Selector

Source selectors pass one of their input signals to the output channel. Both monaural and stereo source selectors are available. Four monaural source selectors are available. 4, 8 and 16 channel stereo source selectors are available. Double-click on a source selector to open the control panel. The 4 channel stereo source selector control panel is shown below.

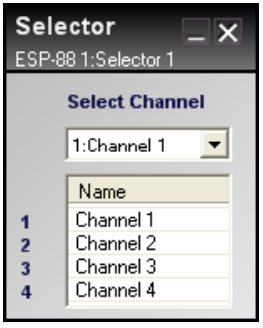


Figure 7.60 - 4 channel stereo source selector control panel

Use the dropdown menu to select an input channel. Double-click in the **Name** column to rename a channel.

Figure 7.61 - Rename inputs

Note that as you select different channels, the selector bar on the signal processing block indicates your selection.

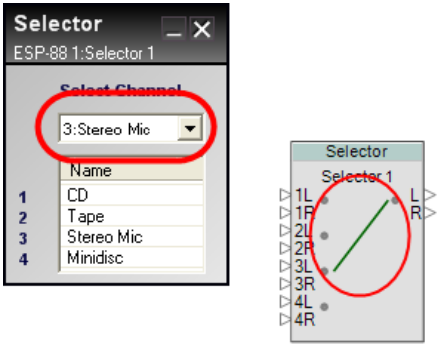


Figure 7.62 - Selector bar