SPLEX User Manual

SPLEX version 1.1.1

Contents

1 Overview

SPLEX is a multiband compressor, which means it separates the input audio signal into different frequency bands, then applies dynamic range compression (usually with different settings) to each band individually. SPLEX in particular has three frequency bands, called 'lo', 'mid', and 'hi', and features compressors that can also be used as expanders to increase rather than reduce the dynamic range.

Multiband compressors are usually used as a mastering tool late in the signal chain (as an insert in the Master section in Reason, for example), but can be placed anywhere you'd find frequency-specific compression useful. SPLEX can also be used without compression as a crossover filter, where the signal is split into bands in such a way that the recombined signal is as close to the original as possible.

Figure 1: Front panel

Figure 1 shows the front panel. At the extreme left and right are sliders for input and output gain. The inset left section controls the filter stage, and the rest of the device has controls and indicators for the compressor stages. Each frequency band has identical controls for its compressor.

Audio inputs and outputs are on the back panel, shown in Figure 2. For many applications you'll only need the main inputs and outputs located to the left. But if desired, separate outputs are available for each frequency band at the far right, and a breakout panel (with the darker background) allows you to pull the signal out and return it after the filters but before the compressors. To the right of the breakout panel are sidechain inputs for each compressor, and to the right of those are CV outputs for the gain of each compressor.

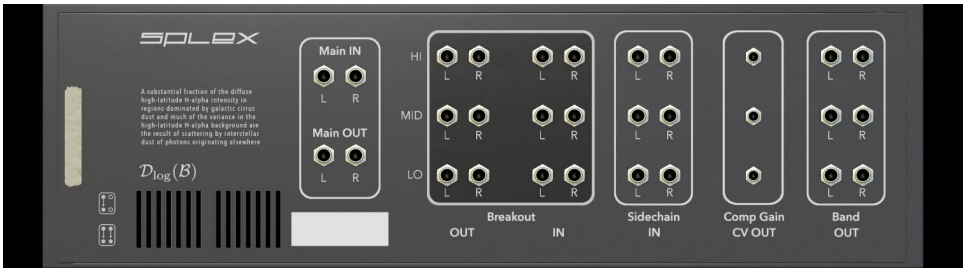

Figure 2: Back panel

2 Crossover Filters

SPLEX has a three-band crossover section (though see section 5 for ways to gain more bands). The two crossover frequencies (lo to mid, mid to hi) are adjustable with the large knobs on the left of the front panel. These are the center frequencies of the transition. Rolloff of the filters is controlled by choosing the filter type with the four-position sliders. Choices are

- BSL – this is a special filter type, constructed with combinations of complementary Bessel filters specifically designed to guarantee that the recombined output signal is in-phase with the input signal. The tradeoff is that this filter has a very slow and rather uneven rolloff. But if you're absolutely set on preserving phase at all costs, this is the filter for you.

- LR2 – is a Linkwitz-Riley filter with a rolloff of 12 dB/octave. Linkwitz-Riley filters are widely used amplitude-matched crossovers that work nicely for a variety of applications. The LR2 filter inverts the lowpass signal to bring the outputs back into phase.
- LR4 – is a Linkwitz-Riley filter with a rolloff of 24 dB/octave.
- LR8 – is a Linkwitz-Riley filter with a rolloff of 48 dB/octave.

Figure 3: Frequency section

No set of filters is perfect – experiment and find what works best for you. Linkwitz-Riley filters do somewhat affect the phase of the signal near the crossover frequencies. This is generally completely inaudible unless you're using the SPLEX as a "send" effect, mixing the SPLEX output back with the unfiltered signal. In that case, you may notice some notching at specific frequencies due to the filter stages, especially with the LR8 filter. If this is undesirable consider either using the BSL filter, or sending the "unfiltered" signal through a second SPLEX with identical filter settings but bypassed compressors.

3 Compressor/Expander

3.1 Controls

SPLEX contains three identical compression units, one for each frequency band. Each compressor can be used as an expander, and each also has an adjustable soft transition (controlled by the sharpness knob) that "fades in" the action of compression/expansion from below threshold to above it. Adjustable controls are (from left to right)

Figure 4: Compression section for a single band

- Compression ratio – turning the dial to left of center will give compression ratios less than one, in other words, expansion. The action of the compression/expansion is indicated with the "comp gain" meter, with compression going down from the center and expansion going up. To save your ears, the expander gain is limited to a maximum of +30 dB.
- Sidechain ignore – when an audio connection is made to the sidechain section of the back panel, the "sidechain active" lamp switches on and the sidechain audio is used to control the compressor gain instead of the band-filtered audio. However, you can switch back to using the band-filtered audio using this button, in which case the sidechain input is ignored.
- Threshold – sets the level above which compression/expansion is applied. However, if the sharpness parameter is low, some compression/expansion will be applied even below threshold, and not fully applied until well above threshold.
- Sharpness – without this feature, the compressor wouldn't affect signals below threshold, and fully compress signals above threshold. A low sharpness however, creates a "soft" transition where some compression is applied even when the signal is a bit below threshold, and the full compression doesn't take effect until a bit above threshold.
- Attack – how quickly the compression gain increases due to an increased signal level. Set this to a longer time to let through more punch from drums, for example.
- Release – how quickly the compression gain decreases due to a decreased signal level. Set this to a longer time to smooth out "pumping" of the sound.
- Band gain – this changes the output gain of each band *before* they are mixed back together and output from either the "main audio" jacks or the "band output" jacks on the back panel.
- Bypass – this button bypasses the compressor stage for that specific band only. Useful for auditioning whether the compressor is improving the sound (especially in combination with the solo button).
- Solo main – activating any of these causes *only* the lit channels to be recombined and sent to the main audio output sockets. They do *not* affect the individual band output audio sockets. These are convenient to use when adjusting parameters to hear what's going on with a single band.

3.2 Indicators

To the left of each compressor stage is a meter to indicate the gain reduction/increase of each compressor/expander. The meters are scaled to display the gain in a range from 0 dB in the center to ±20 dB at the top/bottom, with an adjustment to light the first lamp even for small values of gain.

The "sidechain active" lamps light as a reminder whenever a cable is connected to the sidechain inputs on the rear of the device. When the light is lit, the sidechain audio is being used to control compressor gain *unless* the sidechain ignore button is also on.

To the right of each compressor stage is another meter which shows the output audio level within each band, before being mixed back together. Meters are RMS averaged over 64 samples.

3.3 CV

Each band has a single CV output for the compressor gain. This is a unipolar output, which varies from zero when the compressor/expander is inactive, to one when the compressor/expander is at a gain expansion/reduction of ±20 dB.

4 Internal Signal Path

The overall signal path is quite linear, with the input signal splitting into three bands after the crossover filters, and mixing back into a stereo audio pair after the compressor outputs. Sidechain inputs are used only to set the compression level and otherwise do not affect the audio. The breakouts allow you to divert the output signal after the crossover filters but before the compressors, and allow you to return the signal (or any other audio) into the beginning of the compressor stages. The specific order of operations is:

Main Input sockets → Main In gain adjustment → Filter Section (splits into three bands) → Breakout Output sockets → Breakout Input sockets → Compressor Section (sidechain inputs are used for setting compression amount if connected and "sidechain ignore" button is off) → Band Output sockets → mixed into a single stereo audio pair → Main Out gain adjustment → Main Output sockets

In particular, note that the "Main Out" gain slider is only applied to the main output audio sockets, and *not* the individual band output audio sockets. Also note that using the breakout output sockets does *not* prevent audio from being sent through the rest of SPLEX. However, using the breakout input sockets *will* override any signal coming from the filter section.

5 Advanced Tricks

5.1 More bands

By chaining together two SPLEX units it is possible to create a five-band unit. For example, set the first SPLEX with a lo/mid frequency of 60 Hz, and a mid/hi frequency of 8000 Hz. The lo-band output of this first SPLEX will contain frequencies from 0-60 Hz, and the hi-band from 8000+ Hz. Then route the mid-band output into a second SPLEX with a lo/mid frequency of 300 Hz, and a mid/hi frequency of 1600 Hz. The lo-band output of the second SPLEX will then contain frequencies from 60-300 Hz, the mid-band from 300-1600 Hz, and the hi-band from 1600-8000 Hz.

You can route this using the individual band outputs (don't compress the mid band of the first SPLEX), and patch the individual band outputs into a mixer for more control. Or you can route it using the breakouts, using the mid band breakout of the first SPLEX to go to the second, then bringing the main output of the second SPLEX back to the mid band breakout input of the first SPLEX. See the next section for a note on using the breakouts.

For an example of the wiring layout inside a Combinator unit, see the following figures or download the Combi patch from the web site.

Figure 5: Front panel settings for five-band compressor

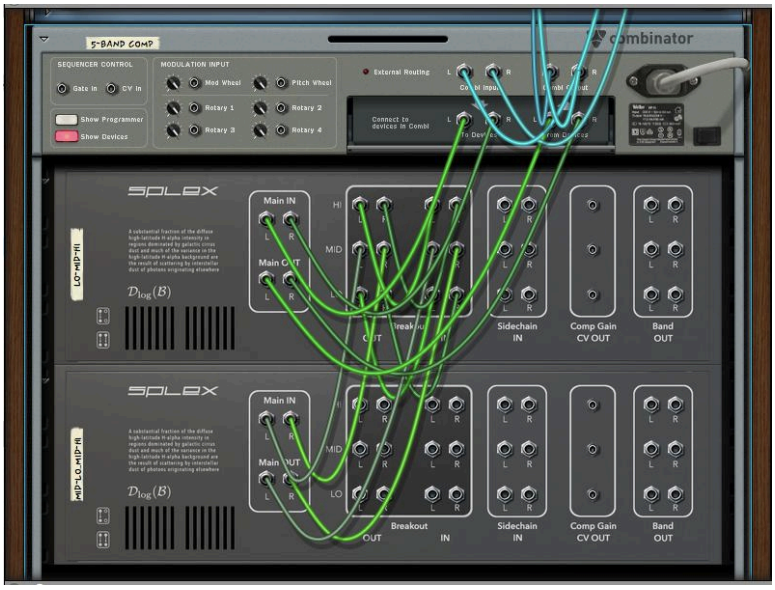

Figure 6: Rear panel wiring for five-band compressor

5.2 Breakouts and latency compensation

Reason is pretty smart about coping with feedback loops in device routing, and using tiny delays to avoid infinite processing loops. However, it can't automatically know how to deal with situations where some channels of a device are looped but others are not. Thus the recommendation is that if you use SPLEX's breakouts to apply other effects before returning to the SPLEX for compression, then you should route each of the three channels in a similar way.

For example, if you want to apply some extra pre-compression distortion to the bass frequencies, then go ahead and route the lo band through a Scream unit before returning to the SPLEX. However, even if you don't wish to have any extra processing on the other frequencies, it is recommended you use the back panel to connect ("jumper") the breakout out directly to the breakout in. This will keep the timing of each frequency band aligned.

5.3 Controlling excessive sidechain pumping/clicking

When using the sidechain inputs, if the audio being used has very large and rapid changes in loudness (like a kick drum) then, depending on compressor settings, you may hear pumping or even clicking of the compressed audio. This happens because the compressor is very rapidly switching from zero to full compression and back. All sidechaining compressors can do this to some extent, but there are a few ways to mitigate it:

- Use longer attack and release times. This is ultimately the most effective way to eliminate clicking/pumping.

- Turn the sharpness down. This may not eliminate clicks completely, but it will smear out the transition from zero to full compression.
- Filter or compress the sidechain audio input. Since the issue is caused by rapid changes in loudness, a low-pass filter or some compression can reduce these changes to a more manageable level.

A Filter Details

For a crossover it is vitally important that the filters be 'complementary', which means that when the outputs are recombined there should be no change at any frequency to the amplitude of the input signal. For realtime filters (that don't introduce a delay in the output), this requires some compromise – for SPLEX and most other crossovers this compromise is to allow small adjustments to the phase. These are usually inaudible, but SPLEX offers several filter choices to allow the user to find the best sound.

The separation into three bands is done in two stages, each stage involving a pair of complementary low-pass & high-pass filters for each stereo channel. The first stage is the higher-frequency filter, so the input is split into the 'hi' band and a 'mid'+'lo' band. Then the second stage splits the latter into the 'mid' and 'lo' bands. This order specifically ensures that the 'hi' band, where the ear is most sensitive, is only filtered once, and that the largest phase changes are concentrated in the 'lo' band where they are least audible.

The BSL crossover is actually a composite. It uses digital versions Bessel filters, which have the smoothest phase response, but Bessel low-pass & high-pass filters are not complementary. So the low-pass (or high-pass) of each stage is actually a mix of the Bessel low-pass (high-pass) filter and the complement of the high-pass (low-pass) filter. This is done in such a way that the overall combination is complementary. The trade-off is that the already low roll-off of the Bessel filter is increased, and the rolloff is not completely smooth. But the advantage is that the output is completely in phase with the input (try mixing them back together and you'll see).

The LR filters are Linkwitz-Riley filters, where each crossover is a cascade of a pair of Butterworth filters (which ensures complementarity). The overall rolloff is controlled by the order of the Butterworth filters – LR2 uses first-order Butterworths for 12 dB/octave rolloff, LR4 uses second-order Butterworths for 24 dB/octave rolloff, and LR8 uses fourth-order Butterworths for 48 dB/octave rolloff. For numerical stability, the fourth-order Butterworth filters are themselves digitally rendered as cascaded pairs of second-order filters.

B Compressor Sharpness

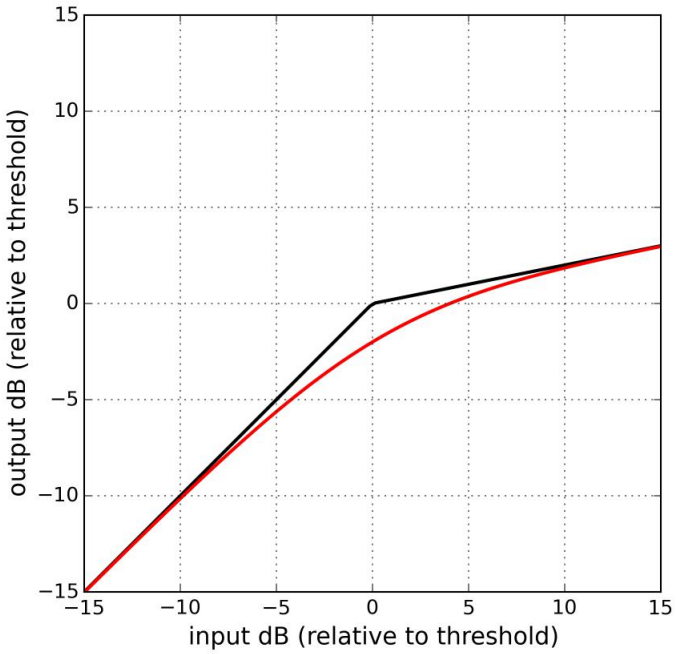

Figure 7: Black: compressor response for maximum sharpness; Red: compressor response for minimum sharpness (called “soft knee” in other devices)

Compressors normally do nothing (have a gain of unity) until the signal exceeds the threshold, and then reduce the gain for everything above threshold. So a plot of output gain vs. input gain looks like the black line in Figure B. However, especially for large amounts of compression/expansion, it is nice to “round out” the transition, so that it looks like the red curve in Figure B. This is what is controlled by SPLEX’s sharpness knobs.

C MIDI Channel/Remote Assignment

MIDI CC	Remote short name	Full name
12	freq1	lo/mid frequency
13	freq2	mid/hi frequency
14	ftype1	lo/mid filter type
15	ftype2	mid/hi filter type
16	comp1ra	lo compressor ratio
17	comp1th	lo compressor threshold
18	comp1sh	lo compressor sharpness

19	comp1at	lo compressor attack
20	comp1re	lo compressor release
21	comp1ga	lo compressor gain
–	comp1by	lo compressor bypass
–	comp1sl	lo compressor solo
–	comp1si	lo compressor sidechain ignore
25	comp2ra	mid compressor ratio
26	comp2th	mid compressor threshold
27	comp2sh	mid compressor sharpness
28	comp2at	mid compressor attack
29	comp2re	mid compressor release
30	comp2ga	mid compressor gain
–	comp2by	mid compressor bypass
–	comp2sl	mid compressor solo
–	comp2si	mid compressor sidechain ignore
41	comp3ra	hi compressor ratio
42	comp3th	hi compressor threshold
43	comp3sh	hi compressor sharpness
44	comp3at	hi compressor attack
45	comp3re	hi compressor release
46	comp3ga	hi compressor gain
–	comp3by	hi compressor bypass
–	comp3sl	hi compressor solo
–	comp3si	hi compressor sidechain ignore
53	inGain	main input gain
54	outGain	main output gain