

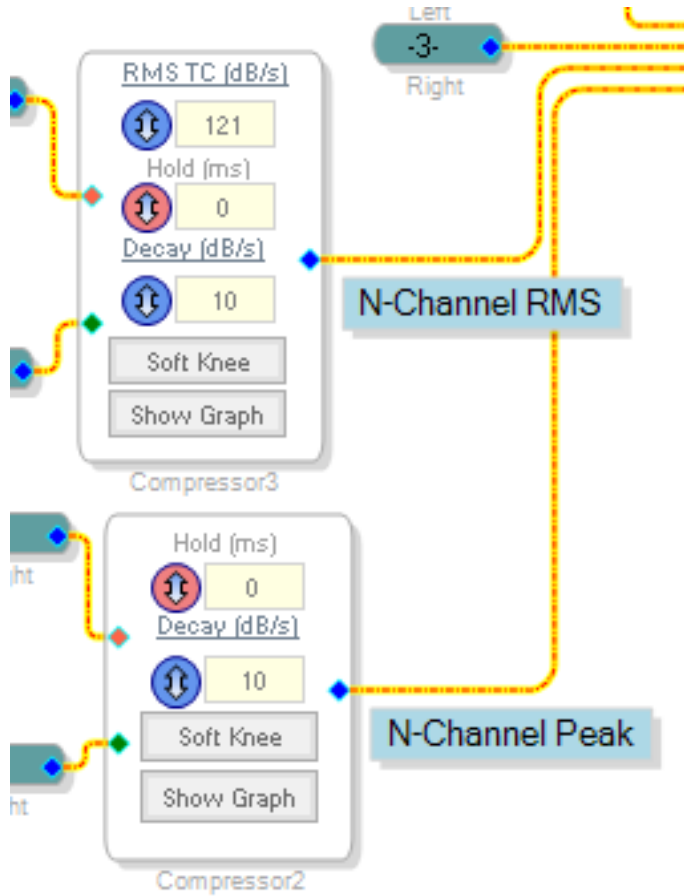
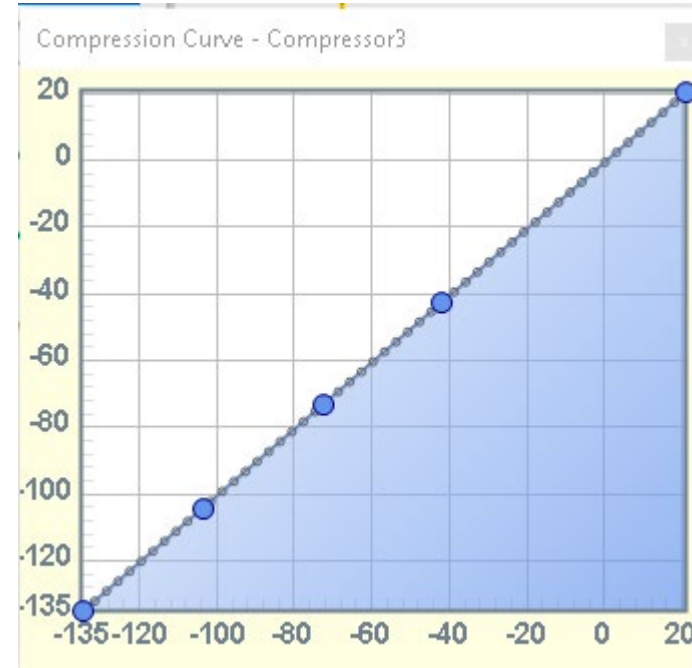
Compressor/Limiter Distortion Analysis

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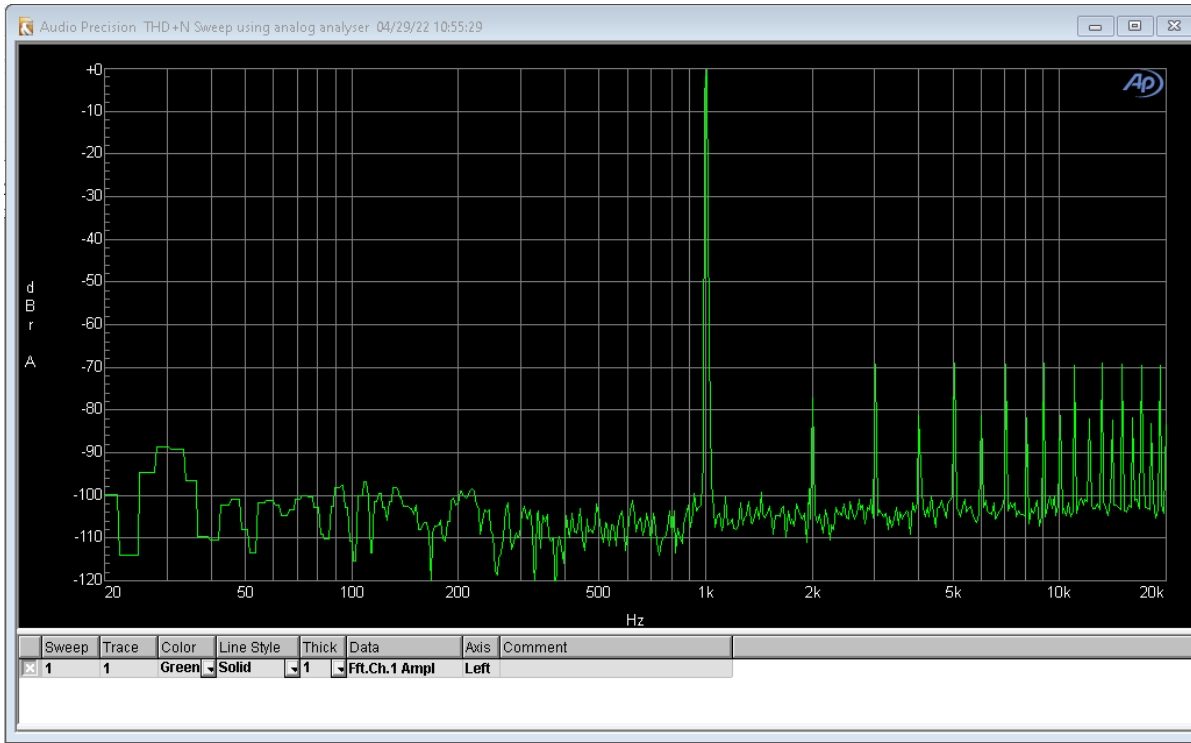


Compressor Settings are Default Settings

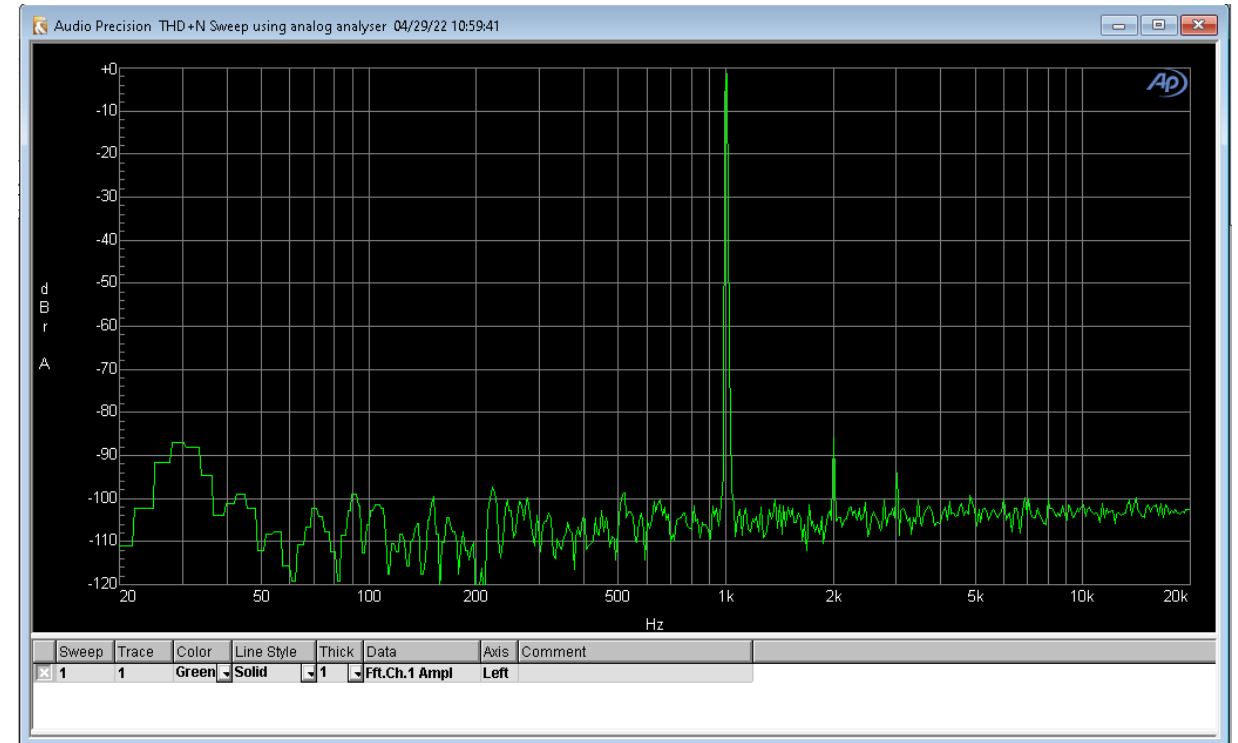


I started with default settings and default compressor curve.

Audio Precision Output Level Setting



► 0dBV



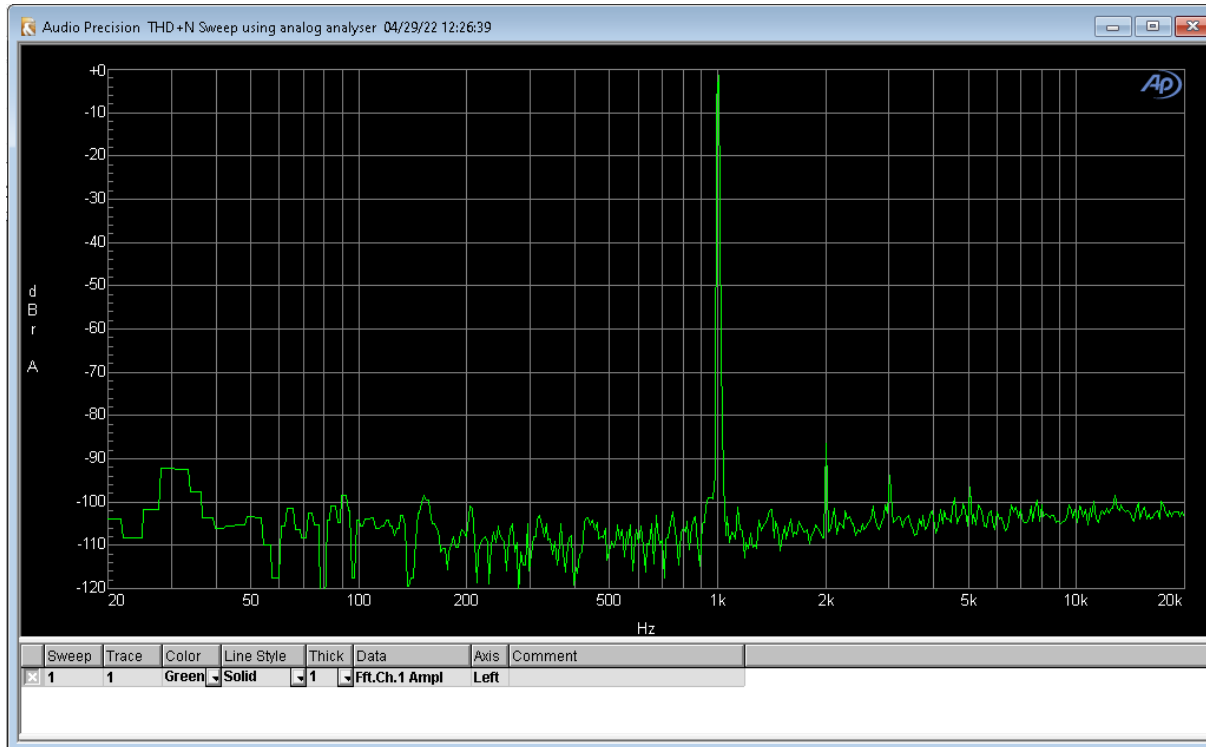
► -1dBV

The setting should be at or below -1dBV/ 0dBV is too close to clipping of the ADC and the results show high distortion from the converters.

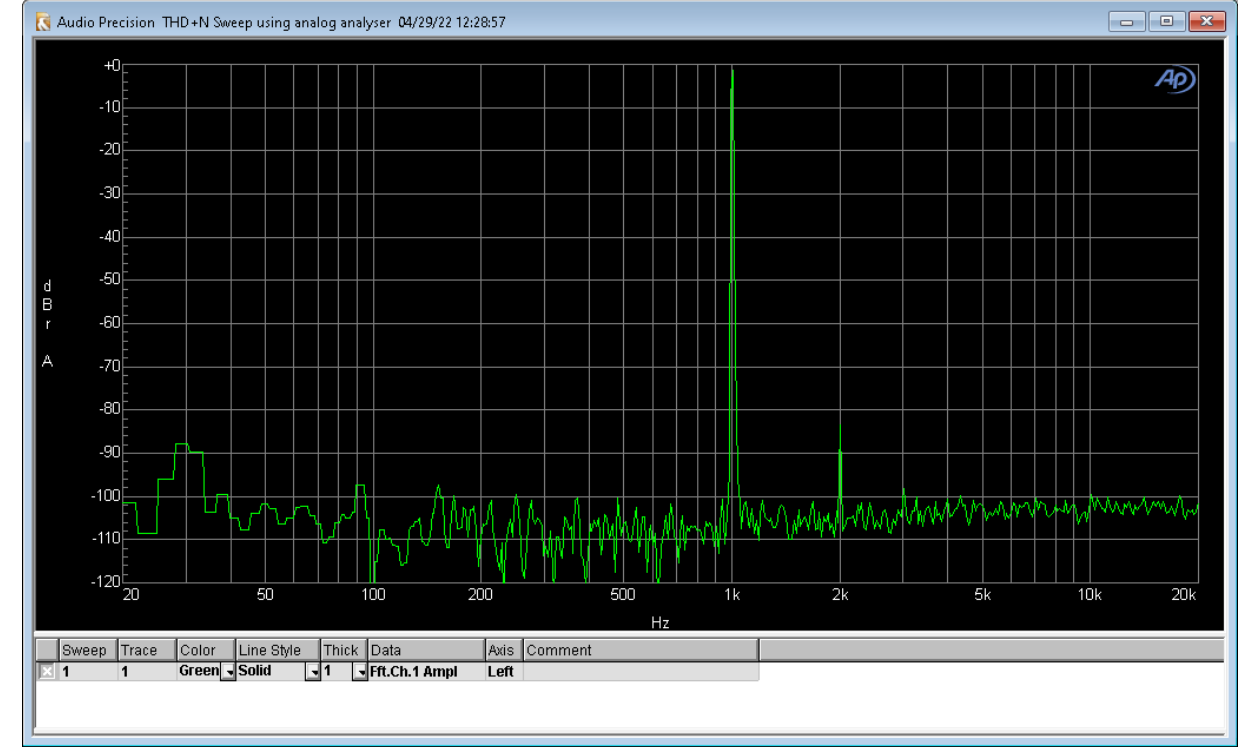
These FFTs were taken with the compressors bypassed.

Note that the SigmaStudio meters show -3dB with a 0dBV signal going into the converters which means it is a full scale 24 bit output of the ADC. When the signal generator is changed to -1dBV the meters change to -4dB so this is all as expected and correct.

-1dBV in with compressor default curve, no compression



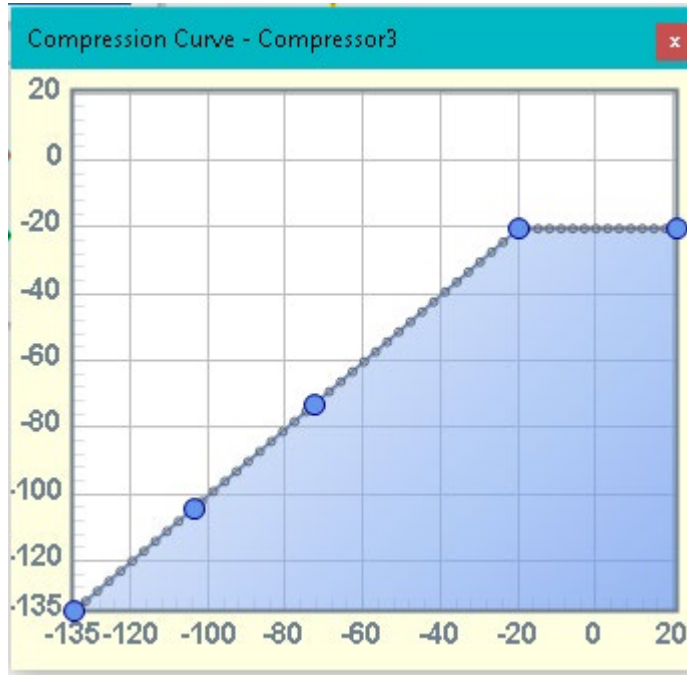
► Left Ch, RMS Compressor



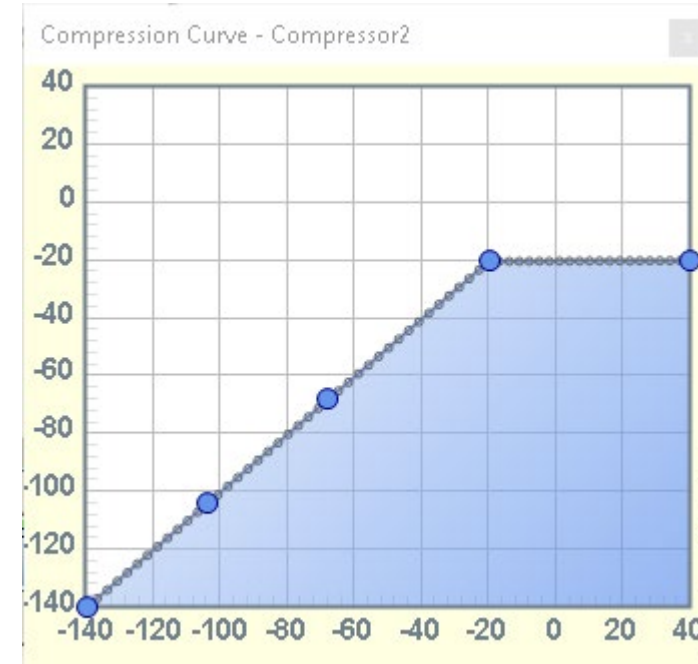
► Right Ch, Peak Compressor

These FFTs were taken with the compression curve set to flat. The left channel is the RMS N-Channel Compressor. The right channel is the Peak N-Channel Compressor.

Compressor Curve Settings



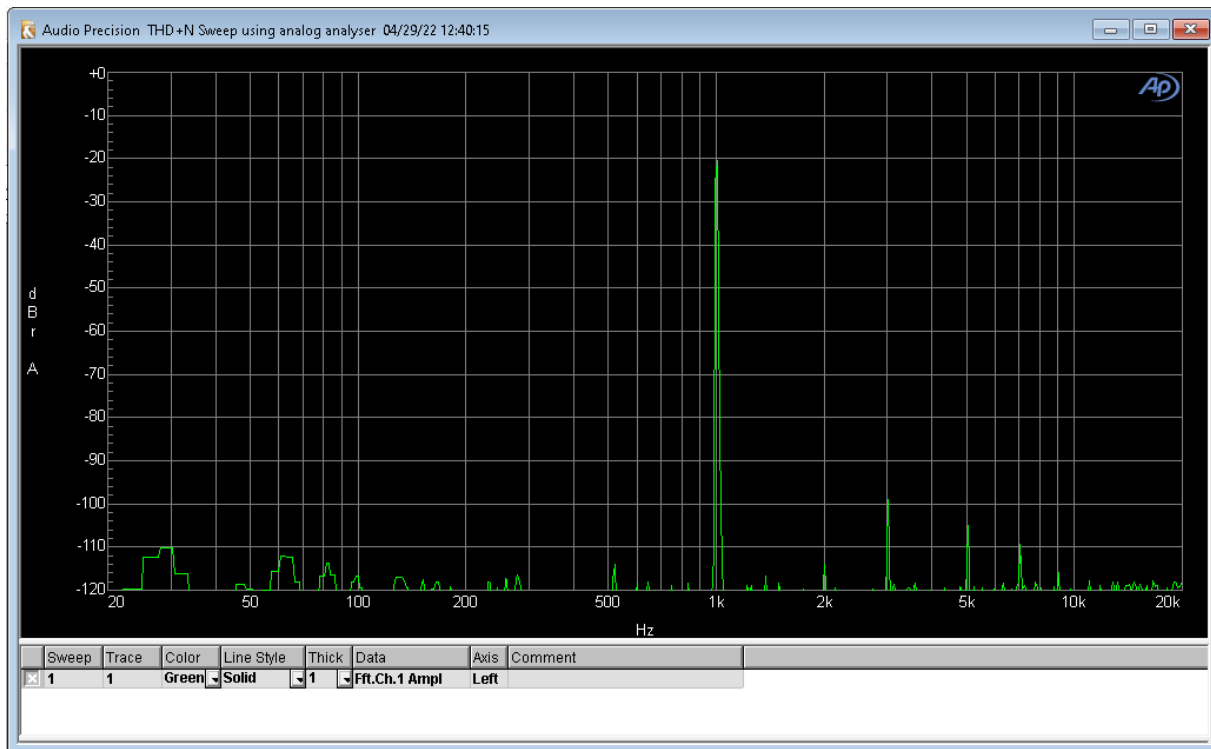
RMS



Peak

Both compressors were set to a knee point of -20dBFS and the ratio of infinite for the following test.

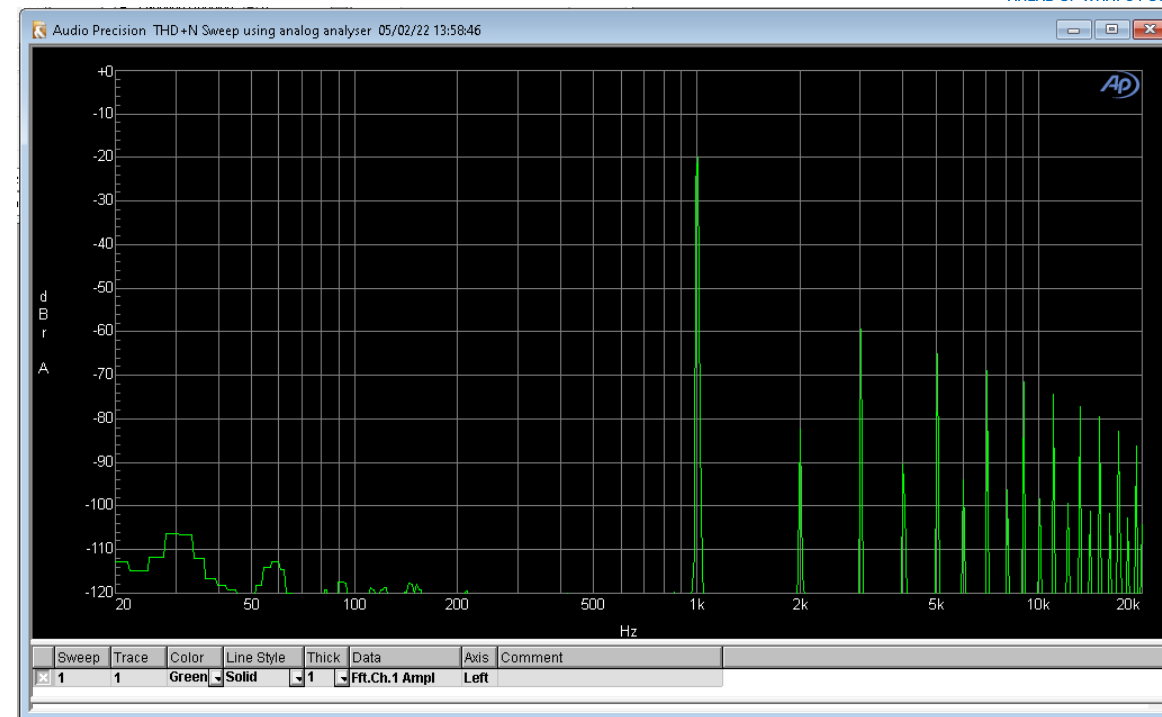
-1dBV in with compressor reducing level by -19dB



► Left Ch, RMS Compressor



The 2K THD went down more than -19dB but other peaks are visible but are WAY down below 100dB and may be caused by the DAC.

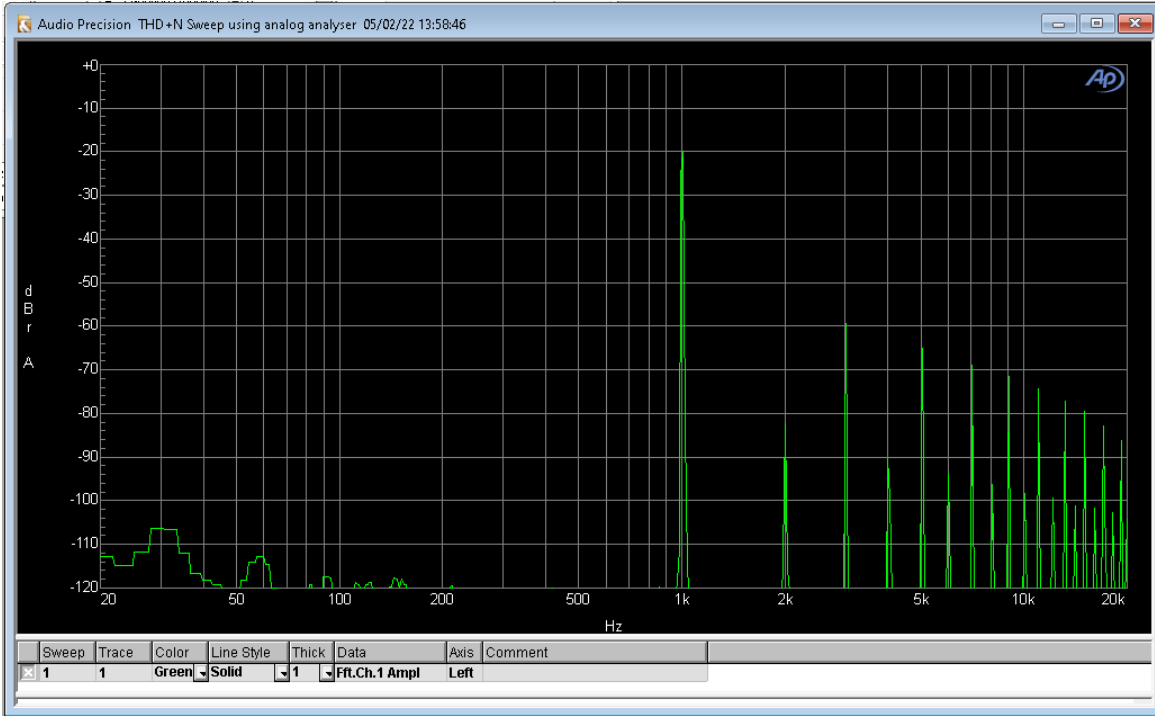


► Right Ch, Peak Compressor

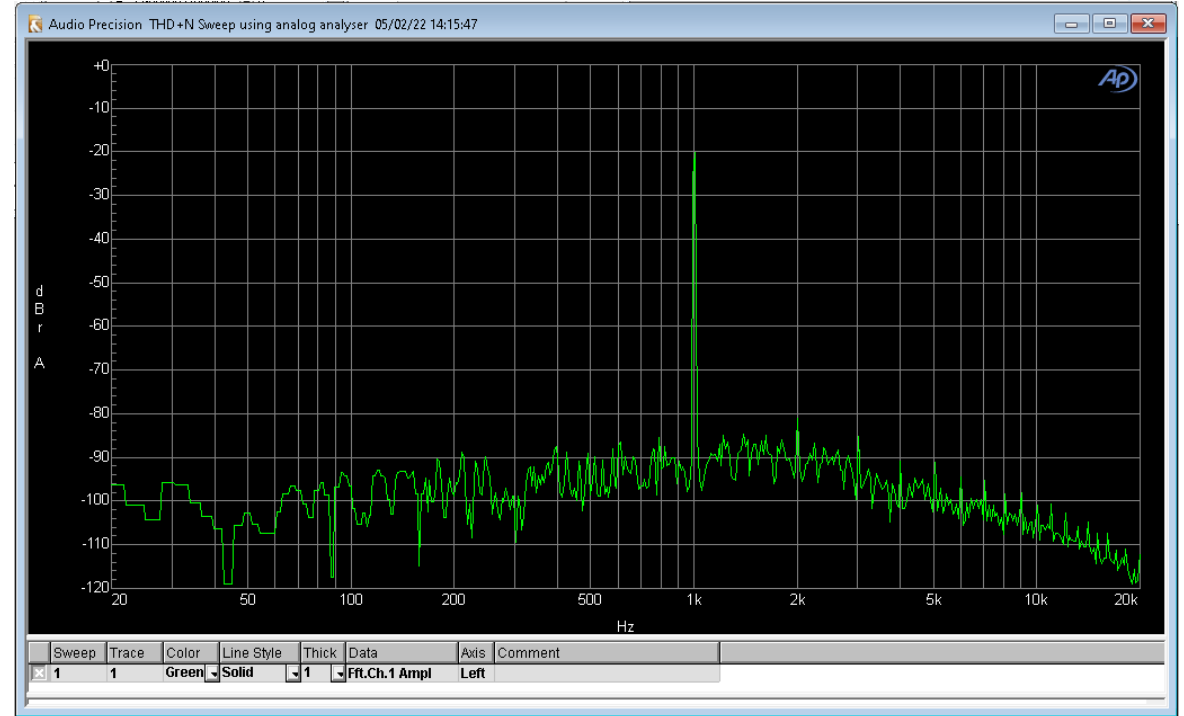


This result is much worse. What is different? The peak compressor will start compressing faster than the RMS compressor will slow down the reaction to the high level. For peak it will start right way. Then the time constants will change the sine wave during one cycle.

Setting the hold time improves the performance.



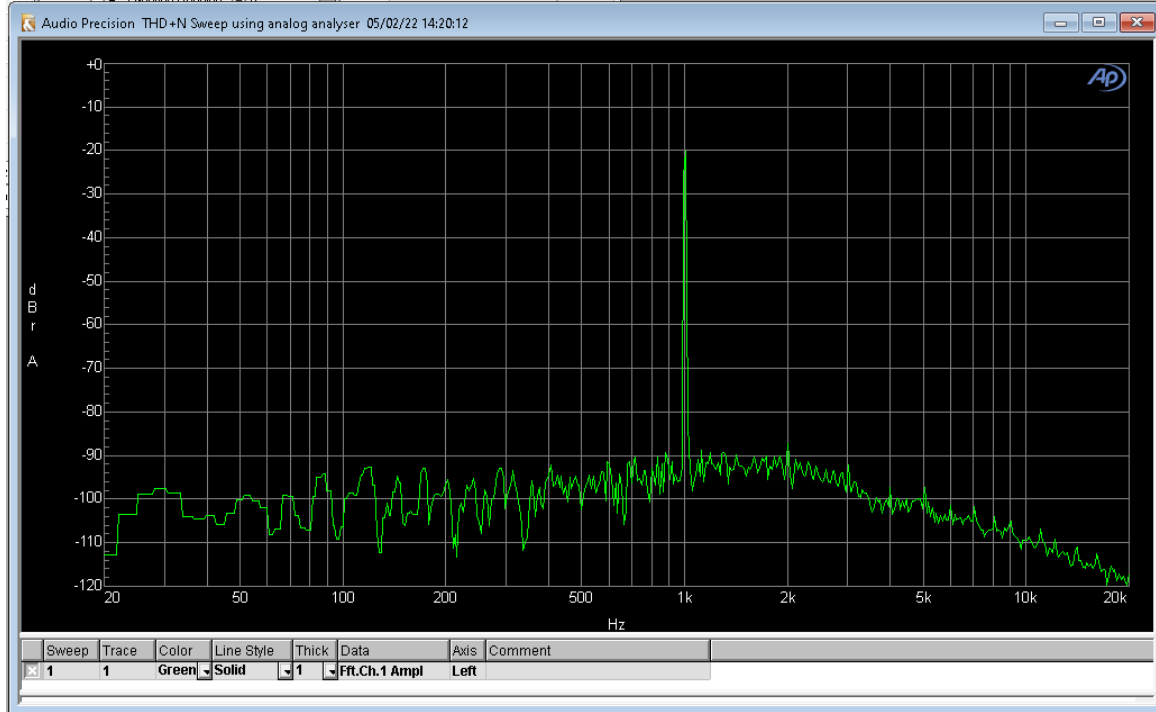
► Peak Compressor , Hold=0



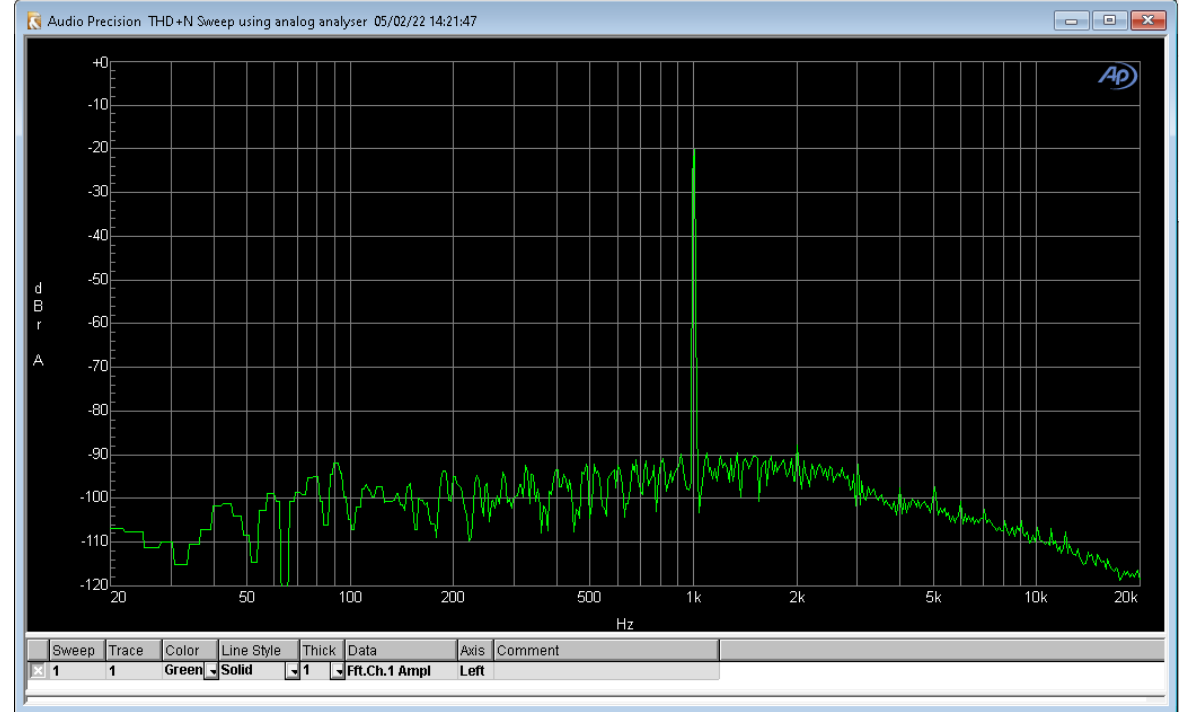
► Peak Compressor, Hold=2ms

With a 1kHz signal. The period of one cycle is 1ms. Setting the Hold time to 2ms will hold the gain change for 2ms before starting the decay. So this helps to prevent the gain from changing within one cycle of the waveform.

Setting the hold time improves the performance.



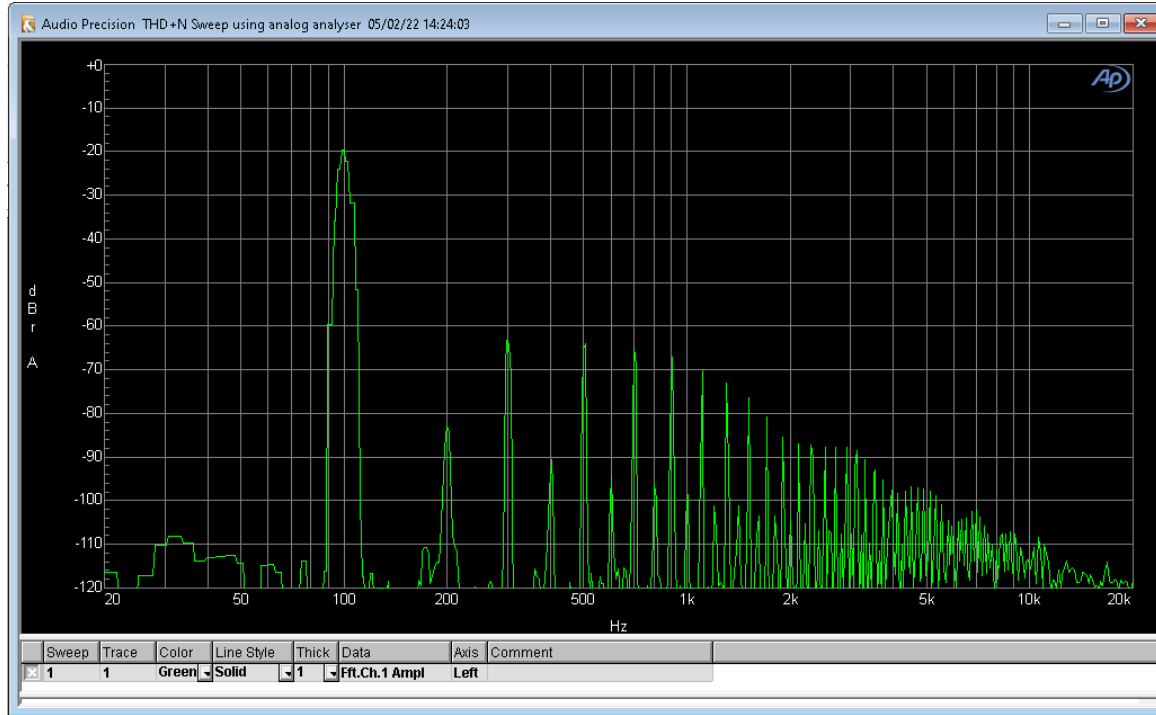
► Peak Compressor , Hold=3ms



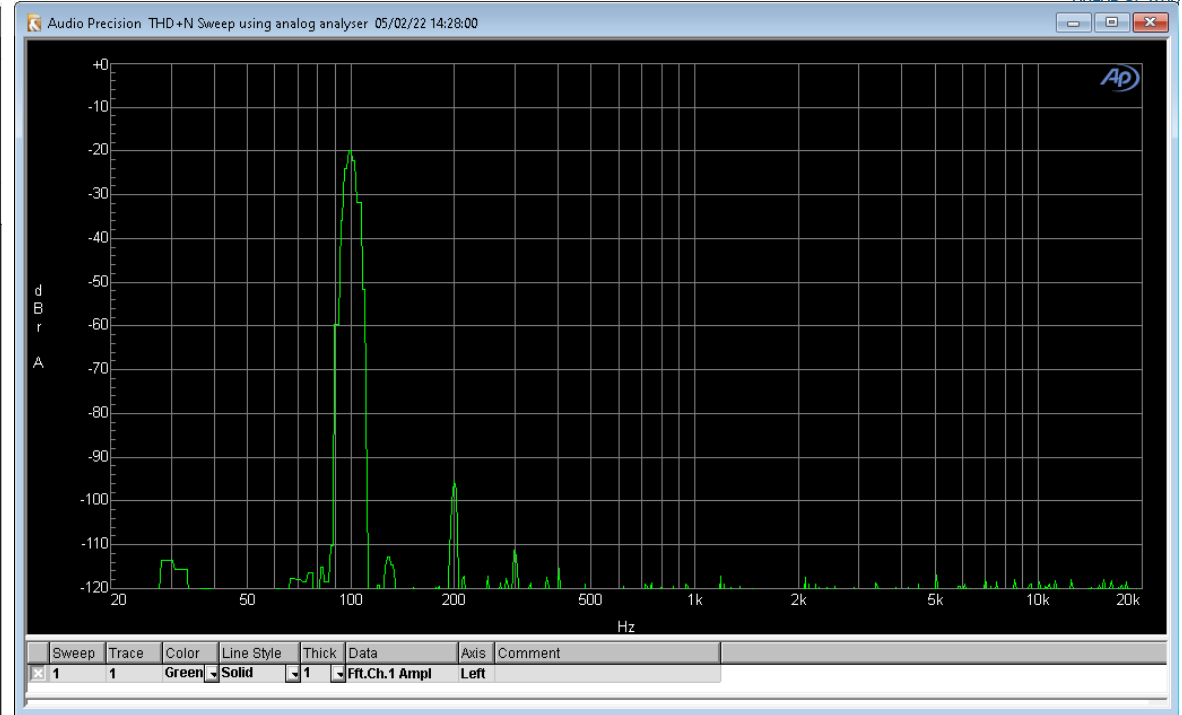
► Peak Compressor, Hold=4ms

3x the period is an improvement but 4 x the period has a minimal effect.

Lowering the frequency to 100Hz and the problem returns



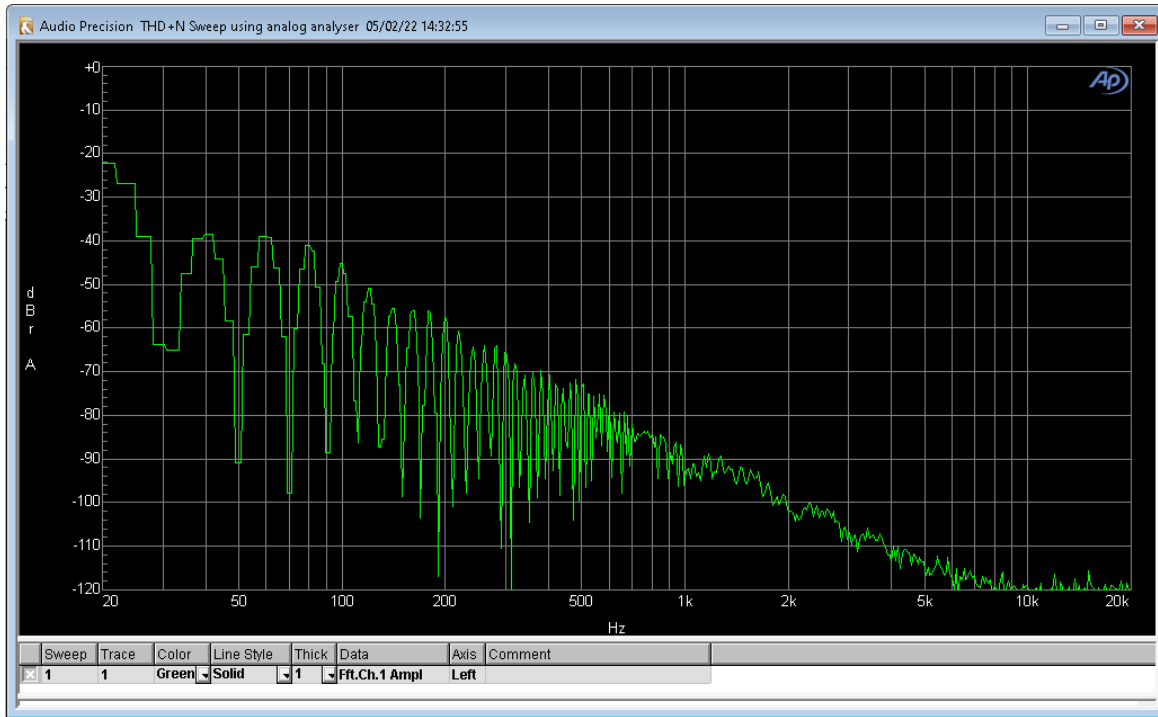
► Peak Compressor , Hold=4ms



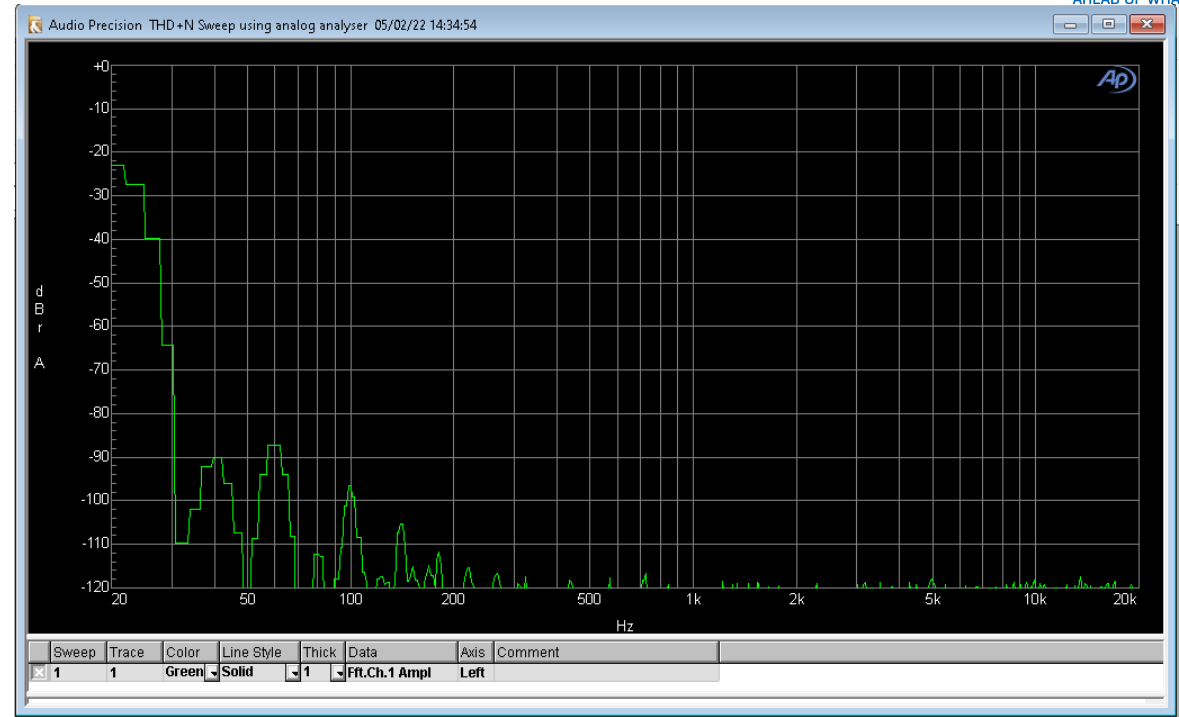
► Peak Compressor, Hold=30ms

At 100Hz the period of one cycle is 10ms so 4ms is allowing the compressor to change the gain during one period. So setting needs to be 30ms or greater.

Full bandwidth solution



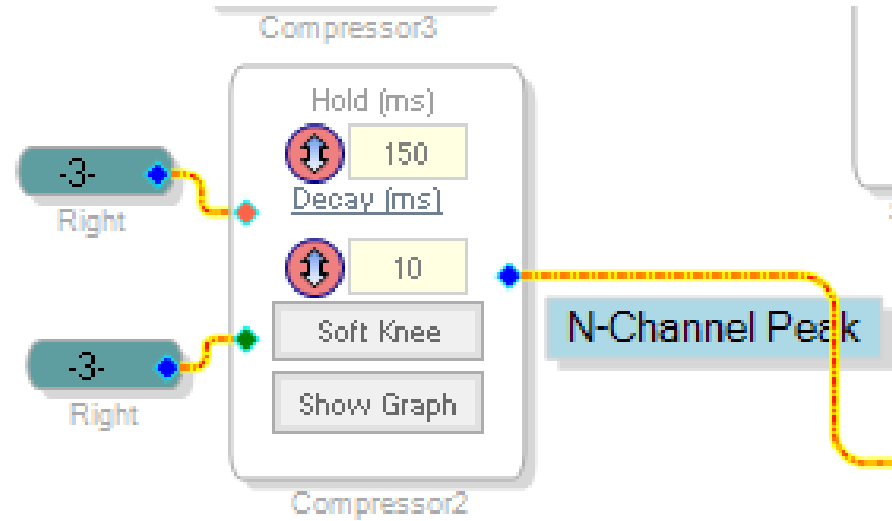
► Peak Compressor , Hold=30ms



► Peak Compressor, Hold=100ms

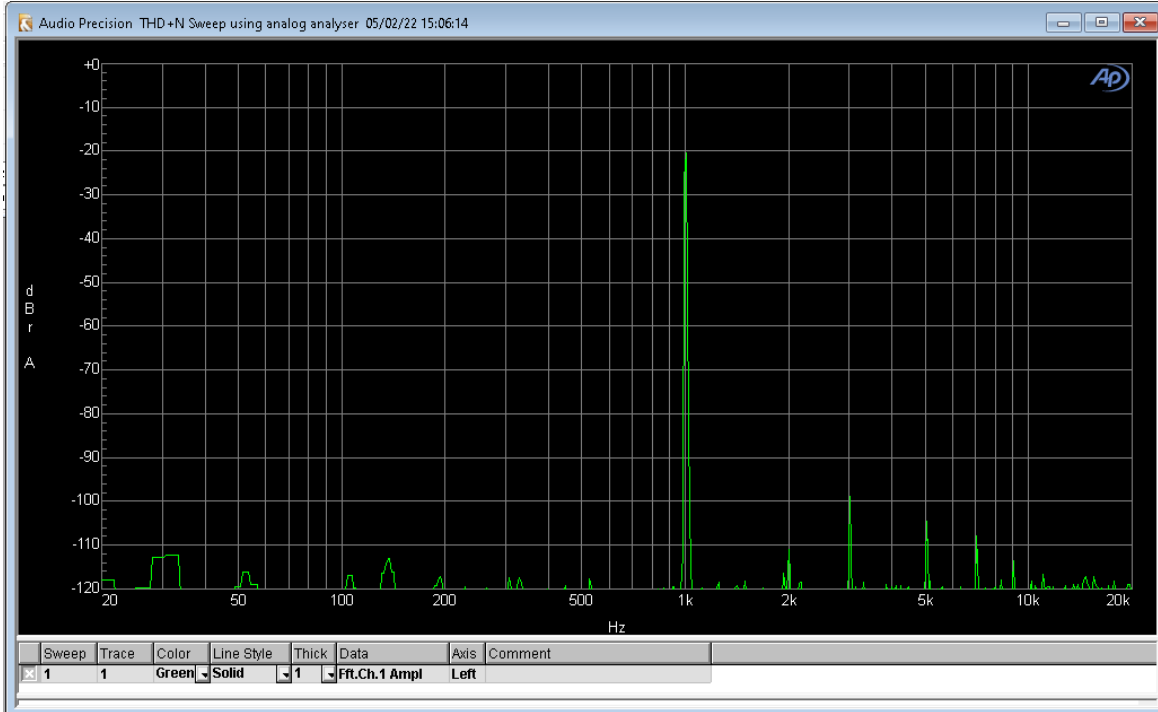
At 20Hz the period of one cycle is 50ms so 30ms is allowing the compressor to change the gain during one period. A setting of 100ms is a large improvement. Setting to 150ms at this low a frequency did not make very much difference.

Peak Compressor Settings to reduce THD down to 20Hz

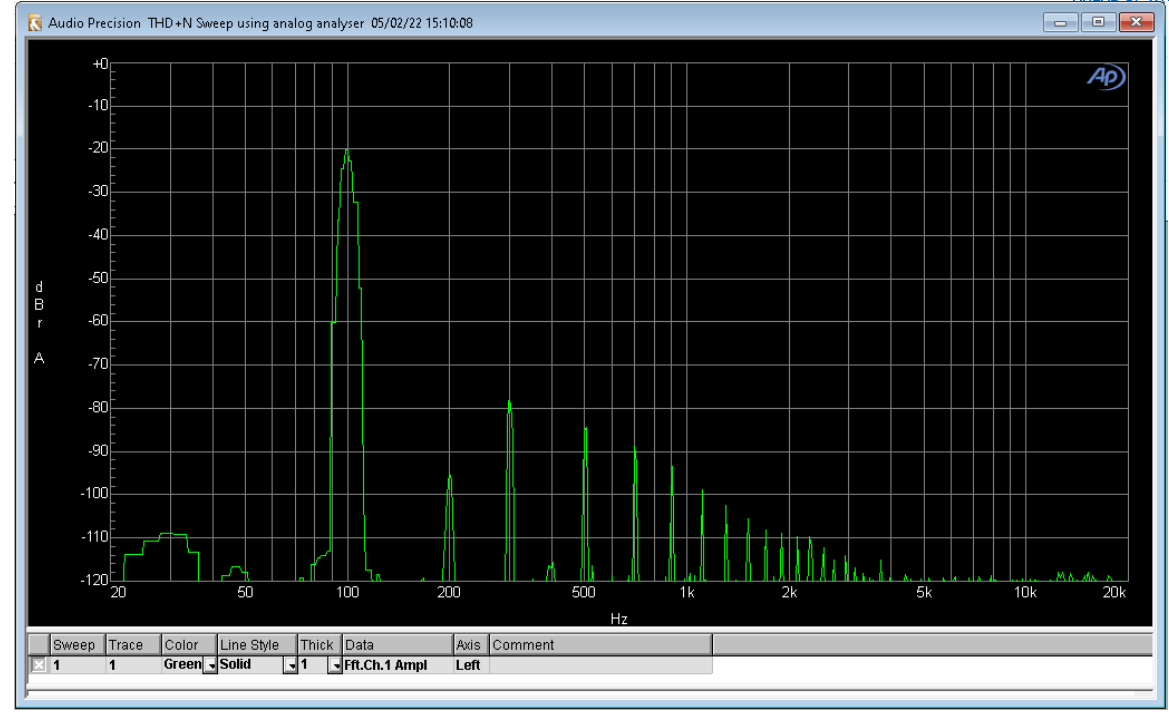


150ms hold time is long for some program material. This is good for a peak compressor for final output to protect the output from clipping the 24 bit data out to the DAC. See the next slide.

RMS Compressor Study



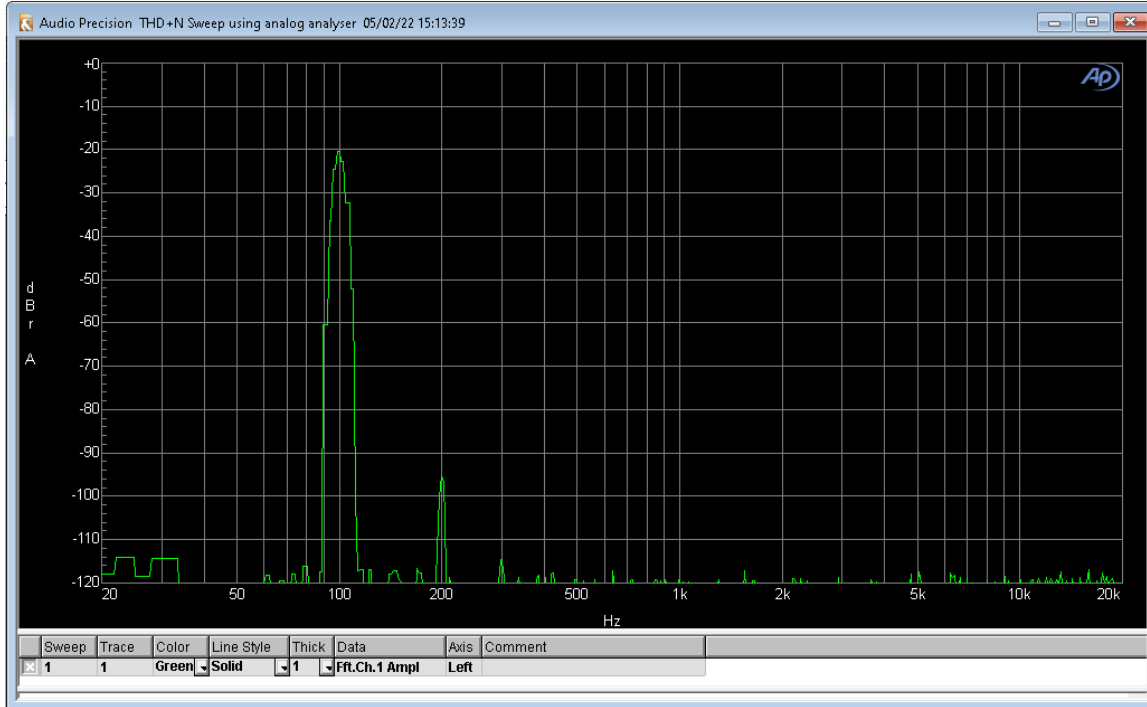
► RMS Compressor , Hold=0ms, TC=121



► RMS Compressor, Hold=0ms, TC=121

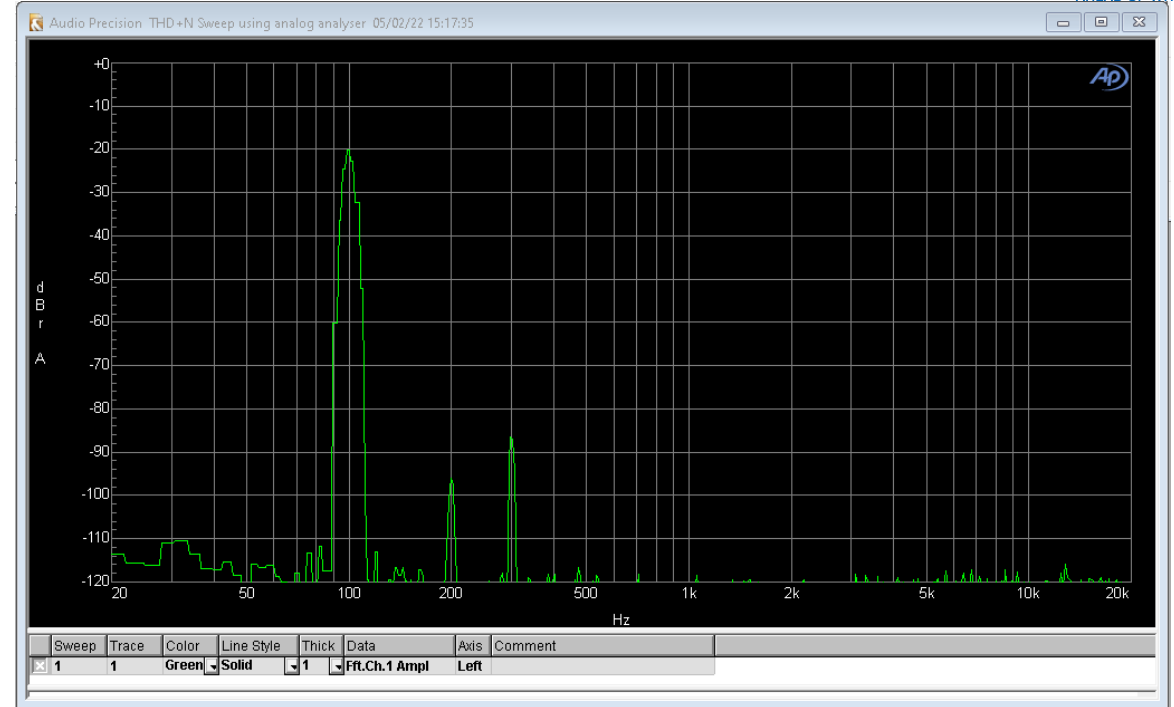
The left graph is at 1kHz and the THD is low. The right graph is at 100Hz and you can see the THD is higher. There are two ways to improve this. See next slide.

RMS Compressor Study, page 2



► RMS Compressor , Hold=5ms, TC=121

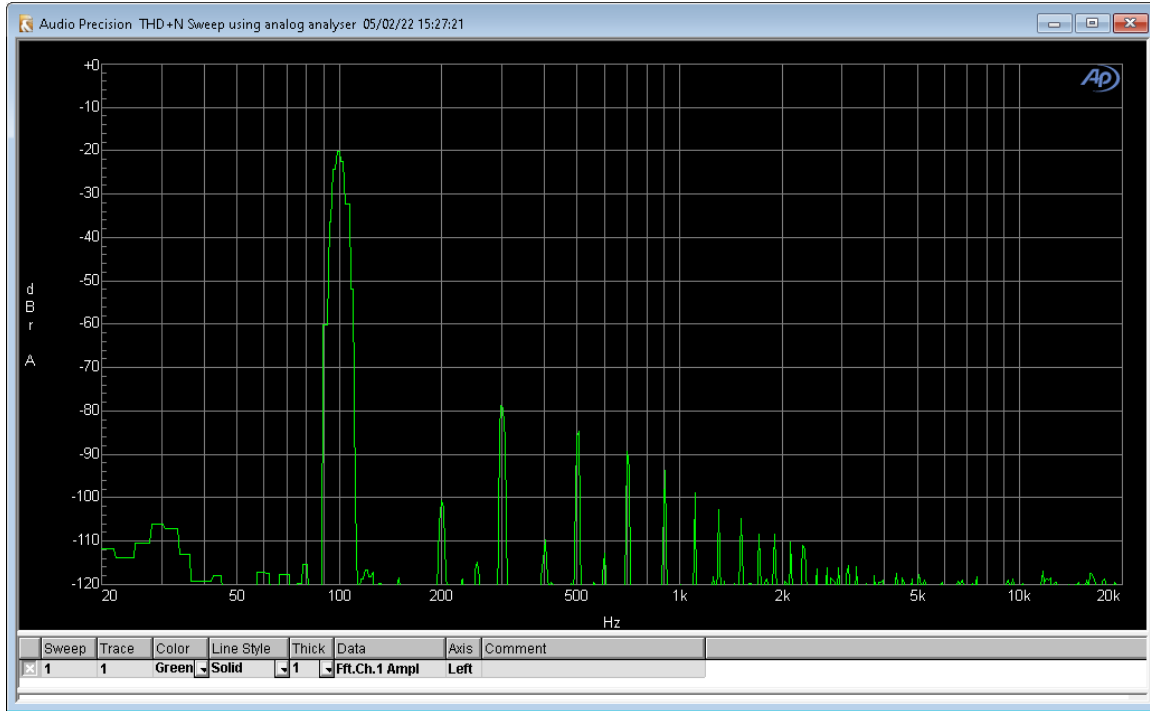
The left graph at 100Hz with a hold time of 5ms improved the THD where the period of 100Hz is 10ms, a hold time of 5ms made a difference because of the Time Constant.



► RMS Compressor, Hold=0ms, TC=10

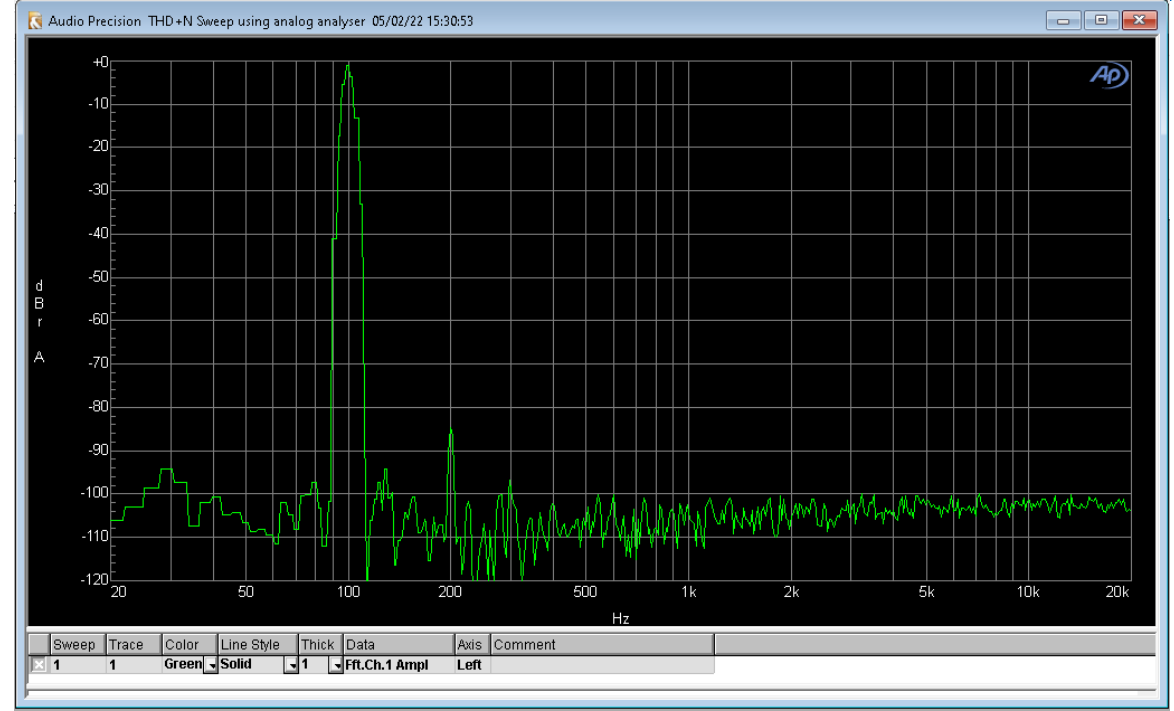
The right graph at 100Hz with a hold time of 0ms but a time constant of 10 improved the THD where the period of 100Hz made a difference because of the Time Constant.

RMS Compressor Study, page 3



► RMS Compressor , Hold=0ms, TC=121

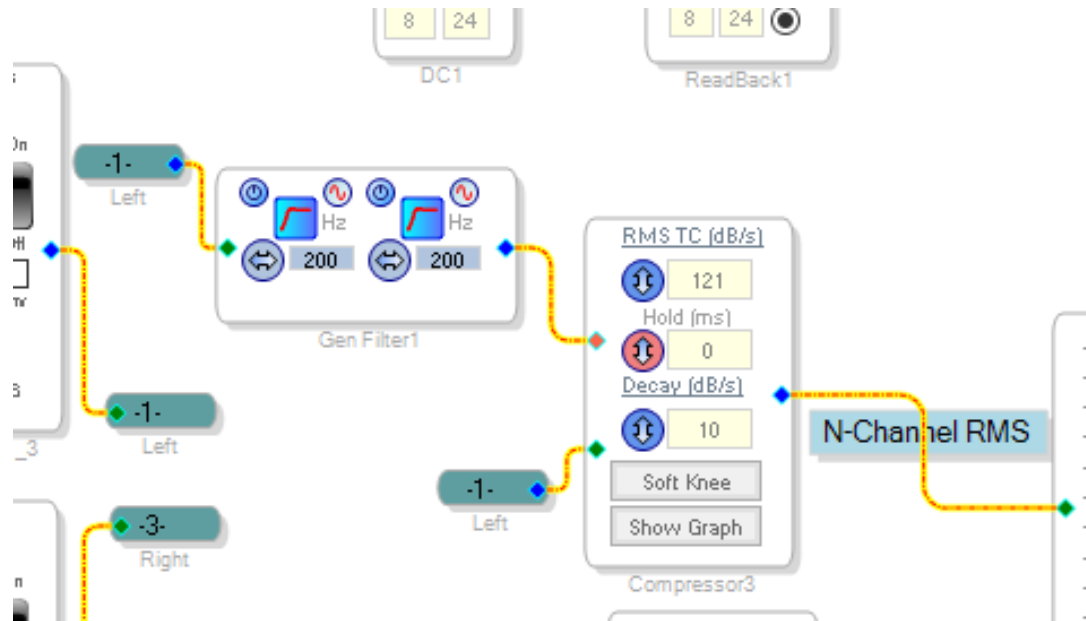
The left graph at 100Hz back to the baseline of a hold time of 0 and a Time Constant of 121. THD is back to being high.



► RMS Compressor, Hold=0ms, TC=121

The right graph at 100Hz with all the compressor settings the same but with a filter on the input to the sidechain. Filter is 24dB/Oct and set to 200Hz.

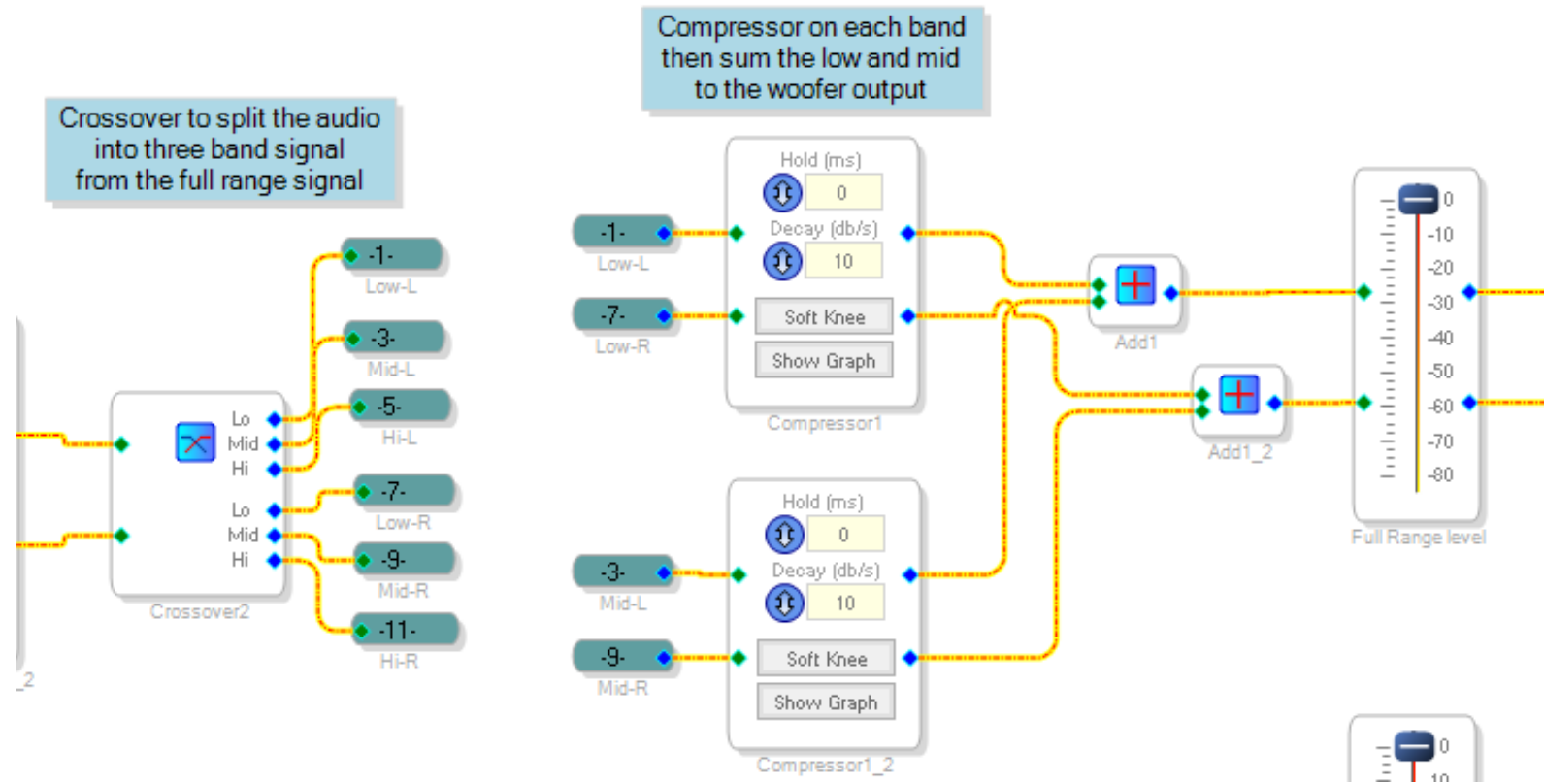
Filter added to the sidechain input.



Adding a filter to the sidechain will help to keep the compressor from reacting to the input signal at certain frequencies. In this case it is set to a high pass filter to keep the compressor from reacting to any signal below 200Hz. The result of this is that the output is not compressed and could clip the output. This is why it is desirable to have an RMS compressor with faster time constants to compress the audio in a clean and good sounding way but by filtering the sidechain you can avoid the issue of distortion at lower frequencies. This coupled with the hold time and careful settings of the RMS time constant gives a lot of flexibility to create a good sounding compressor. Then following this compressor with a much longer time constants and a peak detector in the sidechain, the low frequency signals can be controlled to prevent clipping on the output of the DSP.

This two stage approach is often done because it is almost an impossible task to find settings that will work over the entire audio frequency band. Often designers will split the audio band with a crossover to make a multi-band compressor to compress different audio bands with different time constants. A very powerful approach.

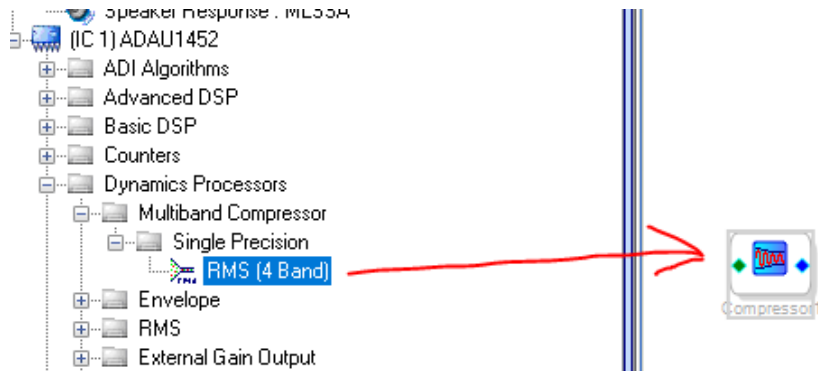
Multiband Compressor using crossover block



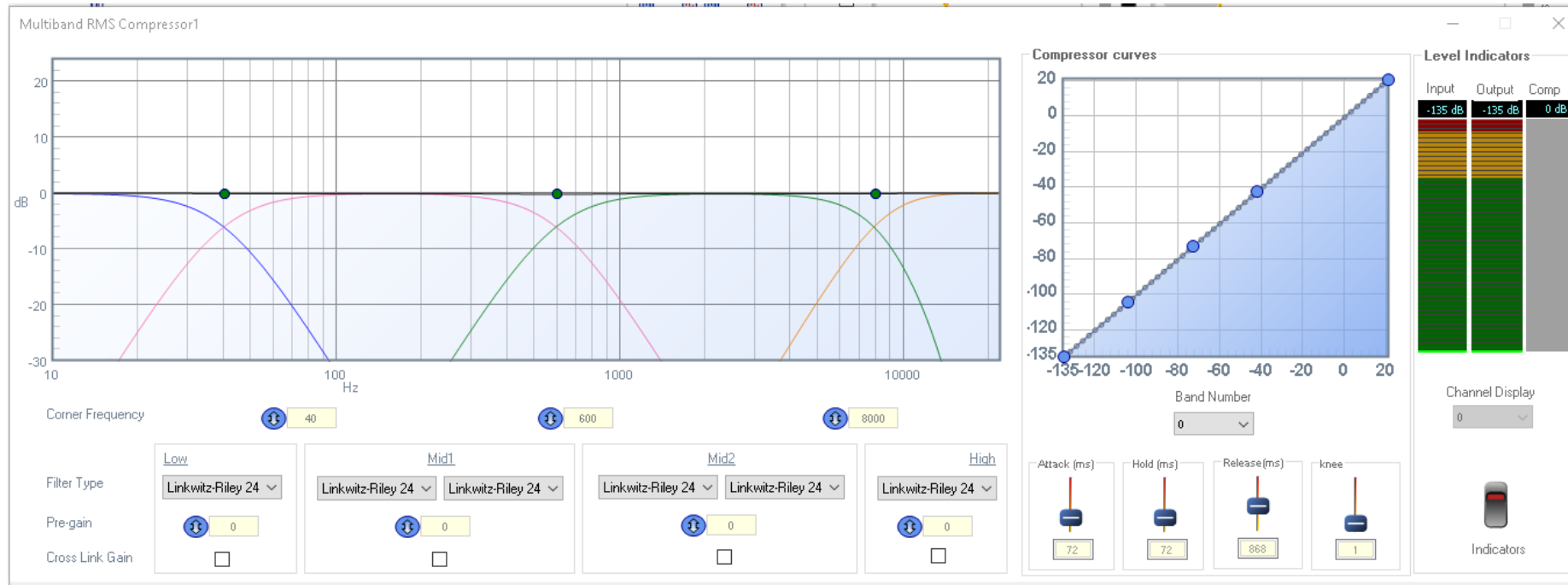
This example shows the splitting of the audio band then compressing each band on its own and summing them afterwards. This allows more control of time constants. We have done this in a block to make this easy to do.

See next slide

Multiband Compressor



Location of the Multiband compressor in the toolbox.



The Multiband compressor in the toolbox is a four band compressor.

Thank You!

I hope this helps to
understand the
usage of the
compressor settings
for any application.