The AK5388 high-performance four-channel 120dB ADC may be designed into systems achieving even higher dynamic range by employing "Mono" mode system design techniques. This "Mono" mode in principle is digitally summing the ADC channels containing the same desired analog signal while digitally attenuating the output, such that the desired signal correlated between individual channels is maintained while the uncorrelated noise due to conversion is effectively decreased by 3dB. If two channels are combined into one, the dynamic range increases theoretically by 3dB. In this manner, the AK5388's four channels may be combined into two channels at 123dB theoretical dynamic range. If even higher performance is desired this technique may be cascaded, essentially combining four channels into one digital output at 126dB theoretical performance.

This application note describes two implementations: one realized with a single AK5388 device with two output channels at 123dB performance, and another realized with two AK5388 devices featuring two output channels at 126dB theoretical performance. Also, actual measurement results will be shown for a “4-to-1” mono design implementation.

Figure 1 below shows a block diagram of the basic circuit configuring the AK5388 to provide two audio channels with 123dB theoretical dynamic range. For each audio channel, the analog input signal is split into separate AFE buffer circuits that feed the same desired signal into the L/R inputs of the ADC's. Separate buffers are recommended in order to alleviate the critical load driving requirements of the buffers imposed by the ADC inputs' capacitive load, achieving the highest THD performance. The AK5388 MONO mode performs the basic digital signal processing necessary (bit-shift attenuation and summing) and is enabled by pulling its mode control pin HIGH. At the digital output circuit there is a digital 2:1 MUX, (similar function as a 74’157), to format the two channels of audio data onto a single data output (SDTO) line. This MUX is required because 'Ch 1’ mono data is copied onto both the L and R slots of AK5388 output pin SDTO1, and ‘Ch 2’ is likewise output on SDTO2.
Figure 2 shows a block diagram extending the basic circuit to configure two AK5388 devices into two output channels with 126dB theoretical dynamic range. Note that there is additional DSP and/or logic processing required. Each AK5388 device, for its respective channel, performs the first stage of MONO mode bit-shift attenuation and summation processing, while the DSP does the second stage of this processing. Optionally, the same results may be achieved if the AK5388 MONO mode is disabled while the DSP is tasked to perform both stages of processing.
A system based on Figure 2 has been implemented at AKM Semiconductor. Figure 3 shows the FFT results illustrating the comparison of noise performance of a single unprocessed channel versus all four channels of one AK5388 device, processed into one channel. A single unprocessed channel measured -119.8 dB A-wtd dynamic range, while the "4-to-1" mono channel measured -124.4 dB. That’s a very good result, but a little off of the 126 dB theoretical value. Can your design do better?