High Performance 2007 CD-4 Demodulator

By
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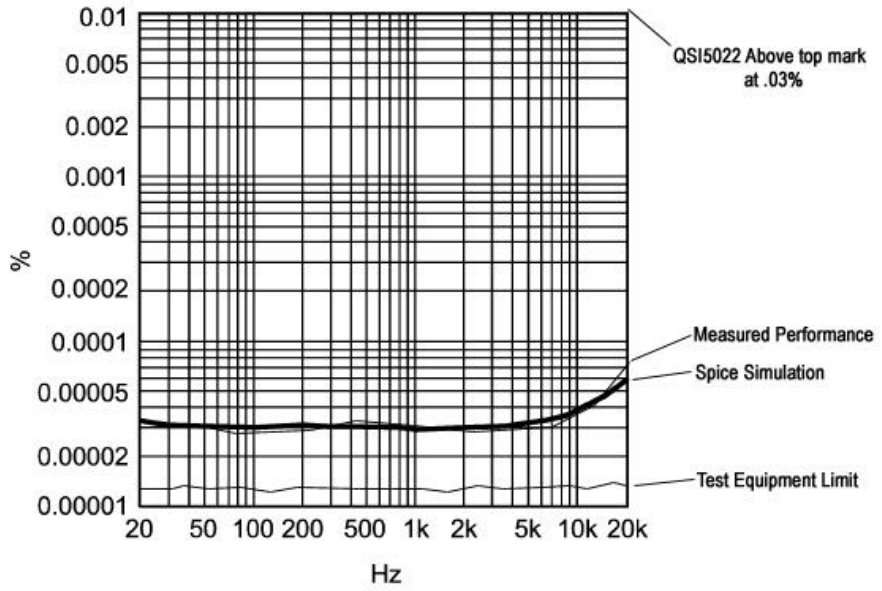
Installment II

From the first installment I indicated that IC technology had considerably advanced since 1974. During the bread boarding of the circuit for the new demodulator I have made some defining measurements on the sub-systems of the demodulator. The preamplifier performance is excellent. Figure 6 shows the predicted and measured Total Harmonic Distortion for the new preamplifier and a reference for the QSI5022 preamplifier.



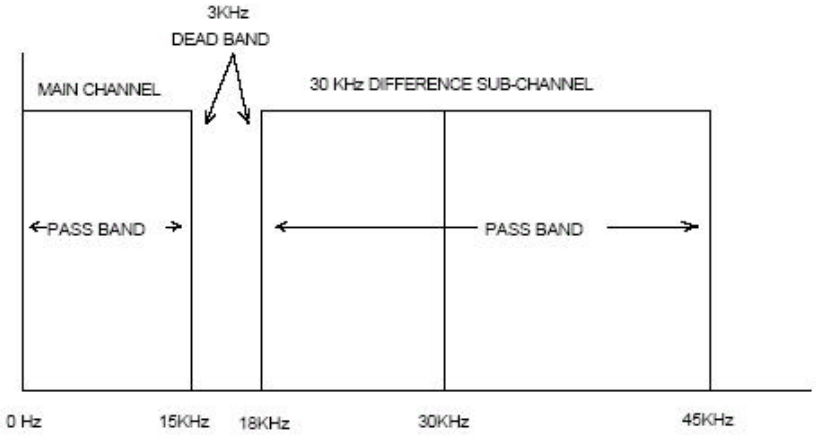
NEW CD-4 PHONO PREAMPLIFIER CHARACTERISTICS

Figure 6

The next section to describe is the main channel low pass filter. This filter serves two purposes. First it eliminates the 30 KHz carrier and it's side bands in the audio output. This may not sound significant but it is. The quality of today's audio power amplifiers is so good, that they can easily amplify signals well above 30KHz. This means that this energy would be applied to the loud speaker and could burn out the tweeter and cross over network. The filters second job is to provide the correct amount of time delay so that the main channel signals and the sub-channel signals arrive at the sum and difference matrix at the same time. This is critical for the most accurate front to back channel separation.

In the design of appropriate filters for a given system it is necessary to determine the required characteristics for proper circuit operation. This includes pass band frequency response (the frequencies wanted for correct sub-system operation), stop band frequency response(the unwanted frequencies). In addition, the pass band amplitude variation(how much unwanted level change in the pass band created by the filter) and the pass band phase variation(how much unwanted phase change in the pass band created by the filter).

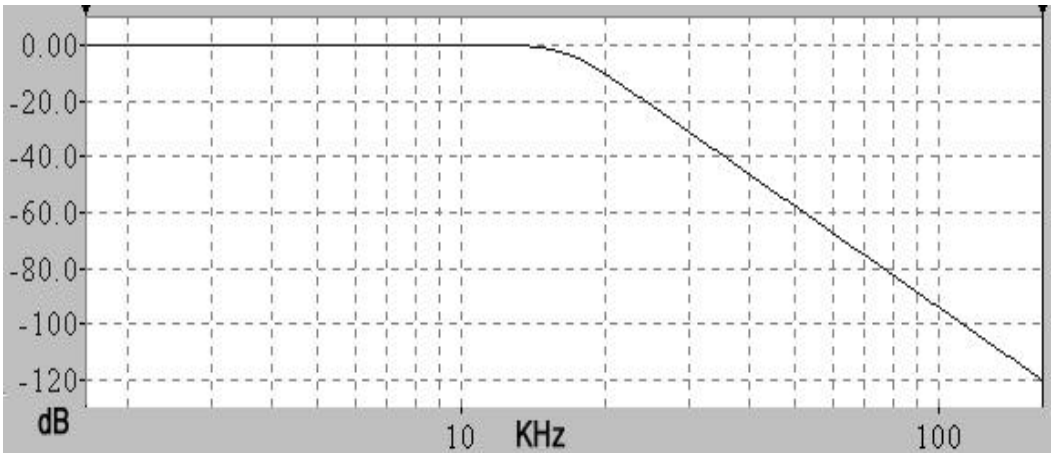
The CD-4 system puts some vary stringent requirements on the audio low pass and sub-channel band pass filters. In the 1970's, realizing the appropriate filter was a very expensive situation. This is because there is a very small 3 KHz dead band area(frequencies between the stop band of the audio filter and the stop band of the sub-channel band pass filter) Figure 7 shows the actual frequency requirements of the left channel of the CD-4 system. The right channel is identical.



ACTUAL CD-4 SPECTRUM LAYOUT LEFT CHANNEL

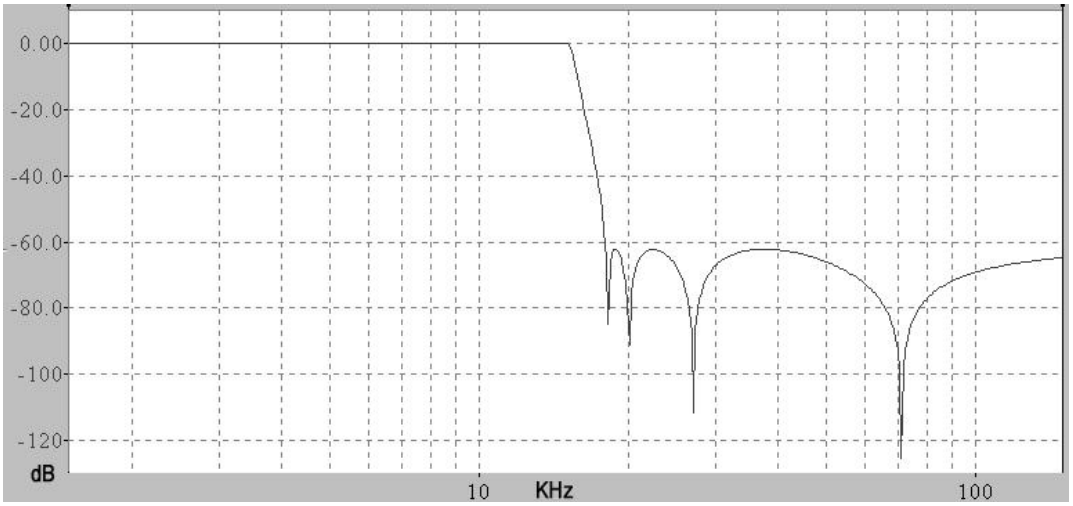
Figure 7

Filters consist of a series of what are referred to as dipoles. These dipoles consist of a fixed pass frequency and a fixed notch frequency. By using multiple dipoles(referred to as filter orders), a filter design can be realized. The problem in the CD-4 system is that with only a 3KHz dead band, the stop band slope of the filter must be very steep(from last pass frequency to first stop frequency, attenuation curve must be fast). The appropriate filter for the CD-4 audio low pass filter requires 8 poles. In 1970 the cost of this filter would have been well over $100.00. So a compromise was made and a 2 pole filter was used. This would result in some reduction in separation between 10 and 15 KHz. Figure 8 is 1970 audio LPF.



1974 QSI5022 AUDIO LOW PASS FILTER **Figure 8**

With today's high performance DSP technology, it is possible to achieve the full 8 pole filter requirement which will optimize the CD-4 performance. Figure 9 is the amplitude – frequency plot of the new CD-4 audio Low Pass Filter.



NEW CD-4 DEMODULATOR AUDIO LOW PASS FILTER **Figure 9**

This filter will improve high frequency separation performance of the demodulator. The filter input is driven from a ultra low distortion amplifier. The filter output is connected to the left channel Front-to-Back separation adjustment control.

In the next installment, I will describe the sub-channel section of the demodulator. As before, if any of you have questions, please post them. See you next installment,

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