

CMX868 Filter Coefficient Generator

Please see conditions at the end of this document

1) Introduction

To aid flexibility the CMX868 includes programmable detection of single and dual tones. This feature is particularly important where a customer wishes to use a CMX868 in a situation where non-standard tones must be detected. The CMX867 and CMX860 also include a similar programmable Tone Pair Detector (TPD) so the CMX868 Filter Coefficient Generator can be applied to these devices.

Specific details of how the TPD functions is covered in detail in the relevant Data Sheet so a thorough description will not be given in this document, however for clarity the basic functional blocks will be discussed.

The TPD consists of a pair of programmable 4th Order Infinite Impulse Response (IIR) filters to select the response bandwidth, a pair of Frequency Measurement blocks, which allow the designer to determine the resolution and response time of the measurement detector and a Level Detector. These three functional blocks in combination provide a very reliable method of detecting non-standard tones chosen by the Design Engineer. The TPD uses what is known as "coefficients" to define the filter shape and therefore what tones are detected?

Within the CMX868, 26 coefficients can be programmed into the 16bit Programming Register. These numbers describe not only which frequencies are to be detected but also over what period measurements should be taken and what amplitudes are acceptable.

The CMX868 Coefficient Generator is a Microsoft Excel spreadsheet that provides the Design Engineer a means to generate the required IIR coefficients.

The spreadsheet is self explanatory, once the "Run" button is clicked, but a quick review may be helpful.

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2) Spreadsheet

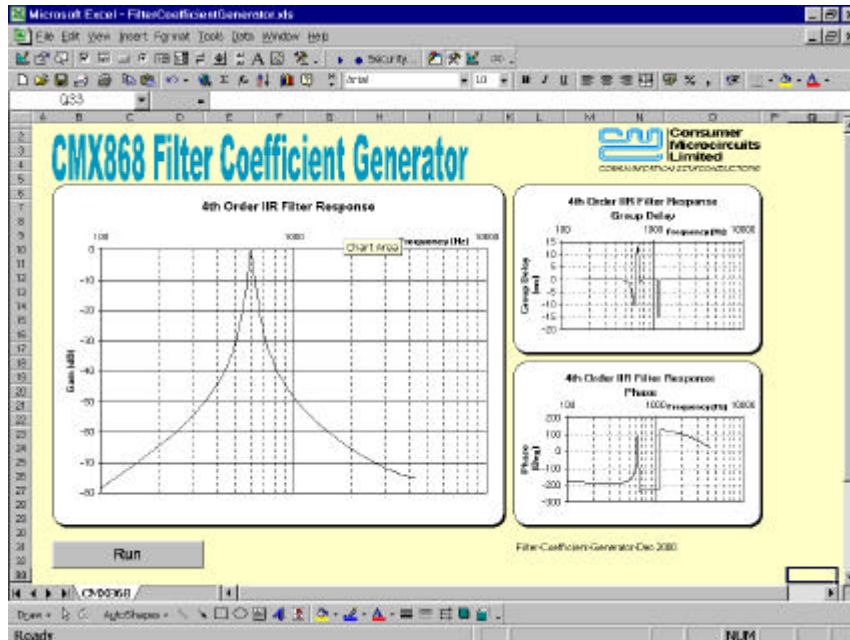


Figure 1, Filter Coefficient Generator Spreadsheet

When initially loading the Excel spreadsheet a message box may be launched asking whether macros should be enabled you, should respond "yes" to continue the loading sequence. Once open you will be presented with a spreadsheet like figure 1.

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The spreadsheet includes three auto-ranging charts, which illustrates the Gain, Phase and Group Delay of the 4th Order IIR filter. These charts, particularly the gain chart, are used when assessing the performance of a particular filter. To proceed further, the Run button should be clicked.

3) Coefficient Generator Window

CMX868 Coefficient Generator Window

Biquad A

Figures

Gain: 0

Pole Frequency: 500

Pole Q: 15

Zero Frequency: 100

Enable Zero Frequency?

Biquad B

Figures

Gain: 0

Pole Frequency: 500

Pole Q: 15

Zero Frequency: 100

Enable Zero Frequency?

Remaining Coefficients

NCycles: 30

Low Freq: 1000

High Freq: 3000

CMX868 2's Complement Coefficients

Register Word 2 or 15 = 0
Register Word 3 or 16 = 202
Register Word 4 or 17 = 32566
Register Word 5 or 18 = 7985
Register Word 6 or 19 = 17822
Register Word 7 or 20 = 0
Register Word 8 or 21 = 202
Register Word 9 or 22 = 32566
Register Word 10 or 23 = 7985
Register Word 11 or 24 = 17822
Register Word 12 or 25 = 30
Register Word 13 or 26 = 96
Register Word 14 or 27 = 288

OK DR Adjust Cancel

Figure 2, Coefficient Generator Window

Figure 2 is the main input and output window and will be where the calculated filter coefficients appear. It is divided into 4 panels.

3.1) Biquad A and Biquad B

These two panels are where the required filter shape can be defined, the edit boxes allow for the insertion of an appropriate filter gain, pole frequency, zero frequency, and Q values.

Clicking on the "Enable Zero Frequency" button allows the pole frequency to be used in the calculation and therefore define a high pass or low pass characteristic. Clicking on "Enable Zero Frequency" again will disable the zero frequency value and return the filter response back to band pass only.

Please note that the programmable TPD consists of two filter blocks (Detector 1 and 2) each containing two biquads (A and B). So for example, applications requiring two-tone detection (e.g. CAS tone 2130Hz + 2750Hz) the coefficient generator should be used once for Tone 1 and once for Tone 2.

For example

Tone 1 = Biquad A & Biquad B	Pole frequencies = 2130Hz	(Coefficients 2 to 14)
Tone 2 = Biquad A & Biquad B	Pole frequencies = 2750Hz	(Coefficients 15 to 27)

3.2) Remaining Coefficients

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The Remaining Coefficients Panel adds three final coefficients that are used to limit the response time of the detector against the accuracy of the result. The three-edit boxes are where the user enters ncy, mintime and maxtime where;

- i) ncy is an integer relating to the period of the incoming tone and required response time and,
- ii) mintime/maxtime which defines the selectivity of the detector.

Further details can be found in the relevant Data Sheet.

3.3) CMX868, 2's Complement Coefficients

This is the output panel. The values are displayed in 2's complement decimal that can be sent unchanged to the Programming Register of the CMX868. They are numbered words 2 to 14 and 15 to 27, where the numbers relate to the coefficients location in the devices programming Register. Word 1 should be set to 32769 and must not be changed.

Once the basic characteristics are entered the user clicks the Ok button. After a short delay, the resultant 2's complement coefficients will be displayed in the CMX868 2's Complement Coefficients Panel. The user will now be able to examine the filter frequency response illustrated by the charts and decide whether the required performance has been reached. If the user is not satisfied with the results the user can make fine adjustments to the coefficients by using Z-Coefficient User Fine Tweak.

4) Z-Coefficient User Fine Tweak

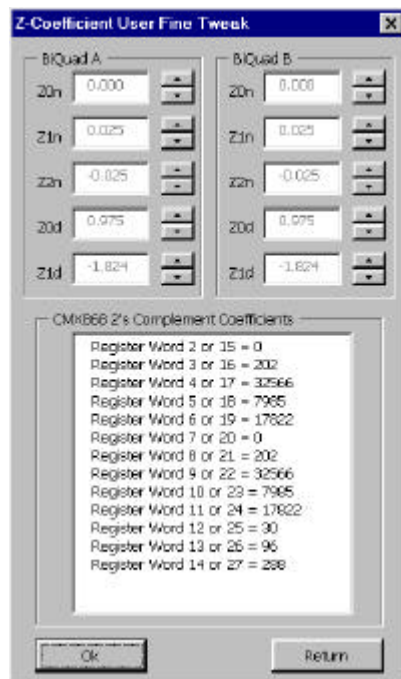


Figure 3. Z-Coefficient User Fine Tweak

The Z-Coefficient User Fine Tweak frame, which can be accessed from the Coefficient Generator Window by clicking the IIR button and allows for the direct manipulation of the coefficients 1 iteration at a time. In use there will probably be no need to alter the values by more than a few units, but more are possible if so desired.

Please note that the 2's complement values displayed in the main Z-Coefficient User Fine Tweak window are not saved upon exiting the application.

5) Notes

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When designing a filter for the CMX868 allowance must be made for the fixed receive filtering, which has the low pass characteristic shown in Figure 4.

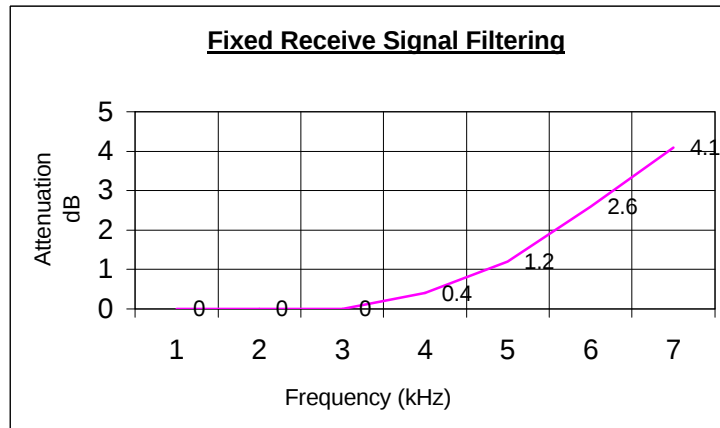


Figure 4. Fixed Receive Signal Filtering

Conditions

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