

Verasonics, Inc Doppler Process Parameter “wallFilter” Frequency Response for Weak Flow Settings

8/2016

This document describes performance of the Weak/Low-Flow wall filter coefficient sets available to the Doppler Process Object. It is titled **CDIWeakFlowFilterResponses.pdf** and is stored in the “Documentation” subfolder. It is referred to in Section 3.5.2 of the Sequence Programming Manual.

Overview

Under weak Doppler signal flow conditions, a restricted set of ensemble lengths between 20 and 60 permits six choices of appropriate matrix filter coefficients. These have an equi-ripple stop-band of -95 dB, and are optimized for detecting weak flow signals with ensemble lengths of { 20, 24, 26, 28, 30, 34, 36, 40, 44, 48, 52, 56, 60 }, not including precursor pulses. The Weak Flow / Low Flow filter names are specified by the **wallFilter** Doppler Process Object Parameter [Sequence Programming Manual, Sec. 3.5.2]. The valid settings are:

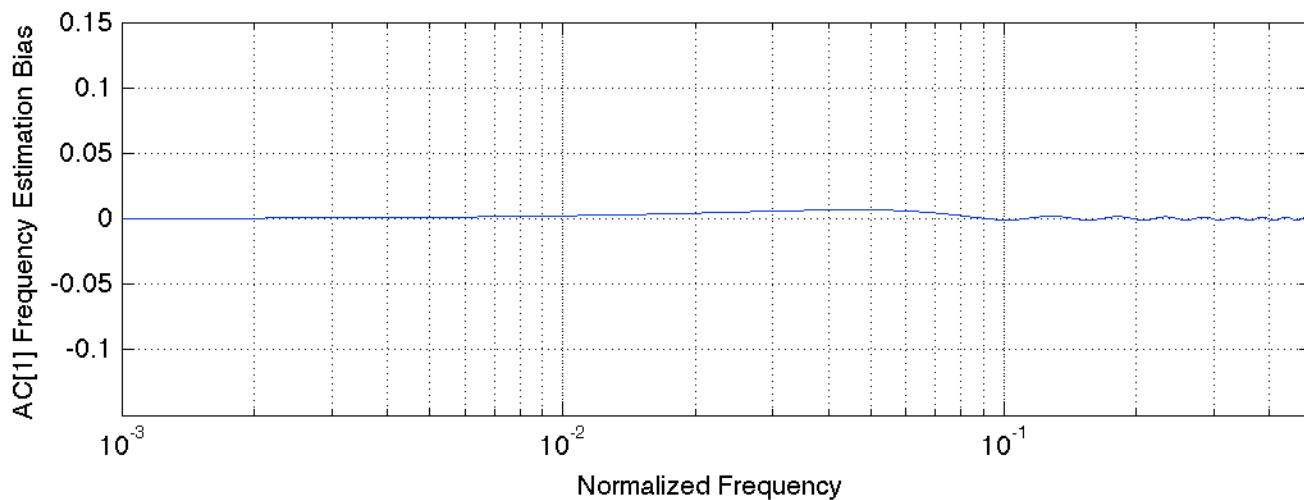
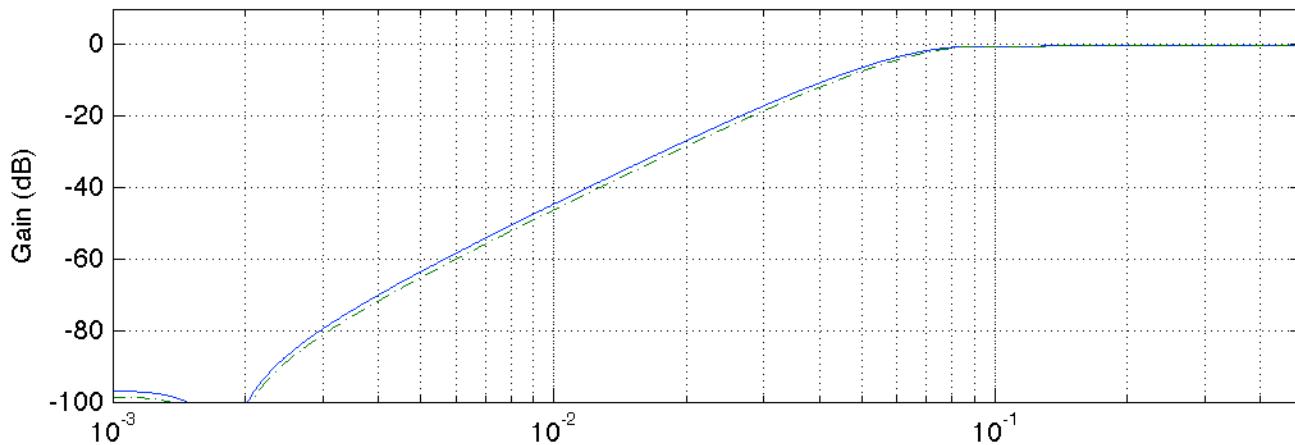
- '**WeakFlowVLow**' (lowest stopband cutoff frequency)
- '**WeakFlowLow**'
- '**WeakFlowMedLow**'
- '**WeakFlowMed**'
- '**WeakFlowMedHigh**'
- '**WeakFlowHigh**' (highest stopband cutoff frequency)

Note that at higher ensemble lengths, the Weak-Flow Matrix Filter transition band becomes steep, while the stopband is wide enough to be effective even at low cutoff settings. This allows lower-cutoff filters to use a high PRF, which generally improves detection performance of the autocorrelation processing currently implemented in the Doppler Process Object.

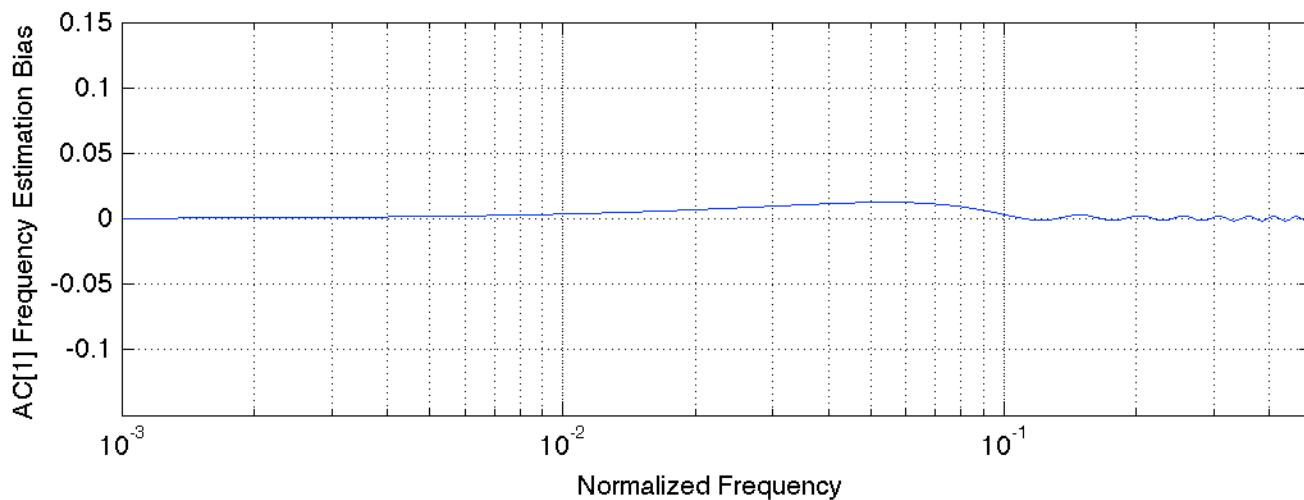
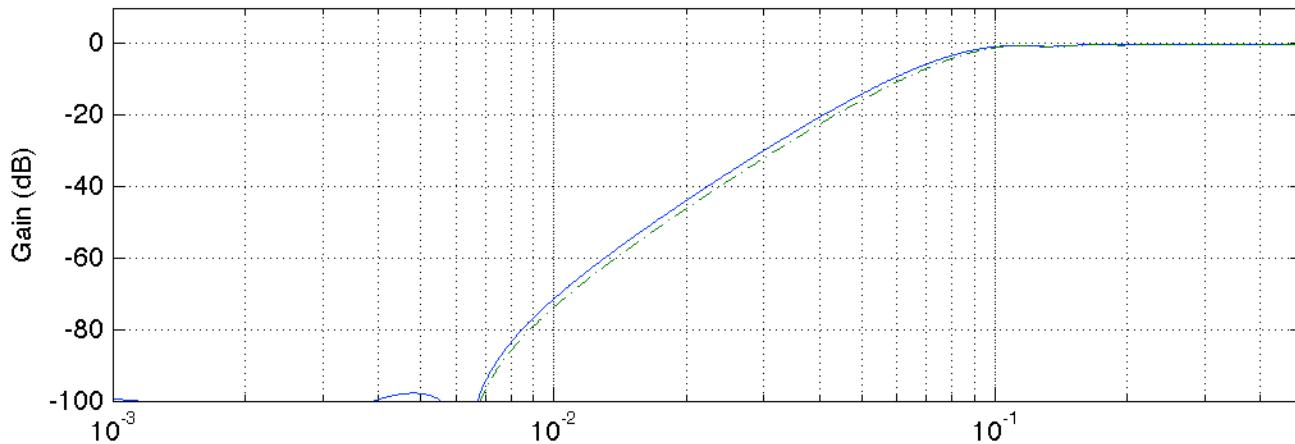
Performance

The following plots show the frequency response curves for each of the above filter specifications, at all valid ensemble lengths. The magnitude response is shown in power (solid) and lag-1 magnitude (dashed). The frequency estimation bias is also shown, based on lag-1 phase.

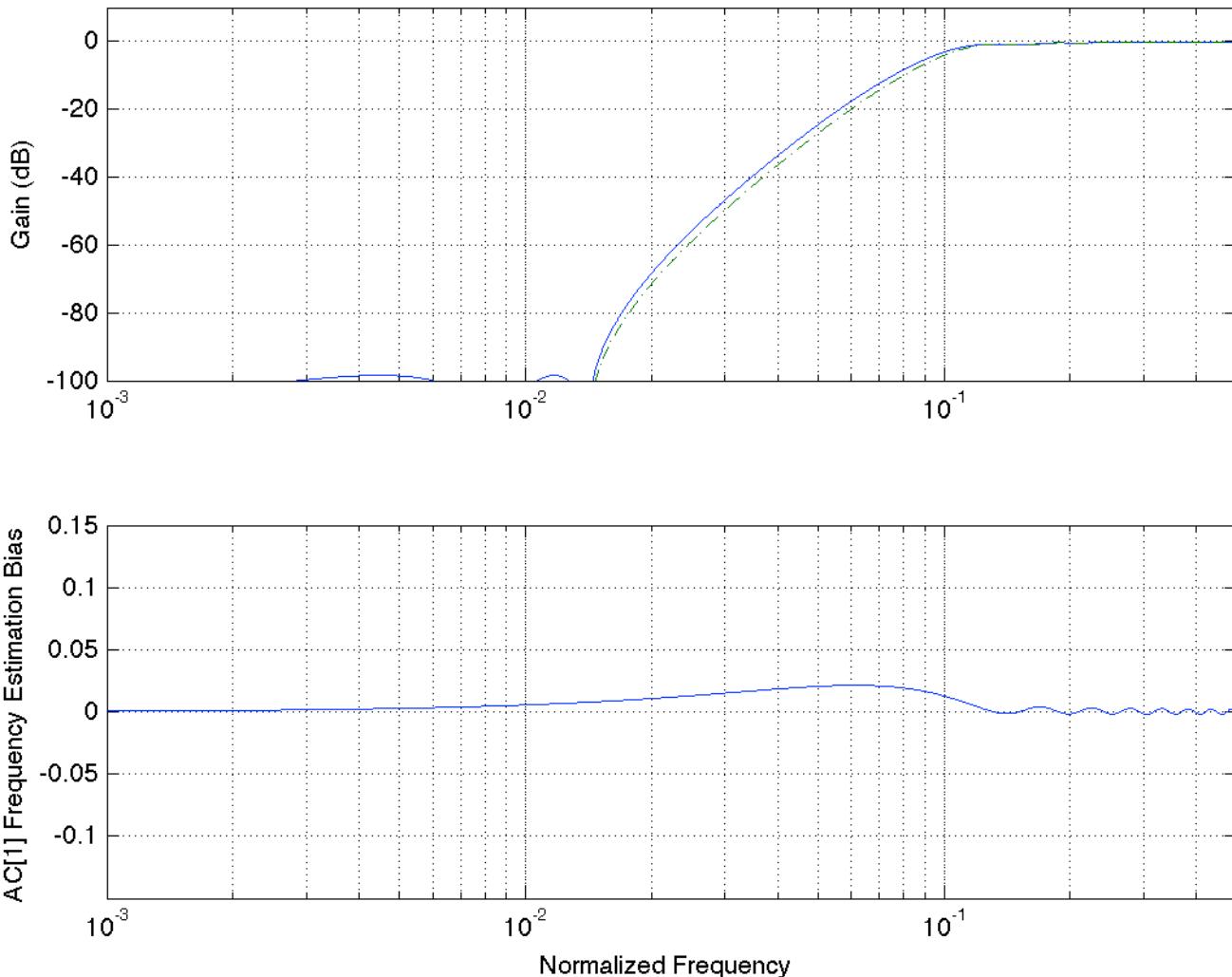
Filter: WeakFlowVLow: $N_{pri} = 20$, $N_{zeros} = 3$



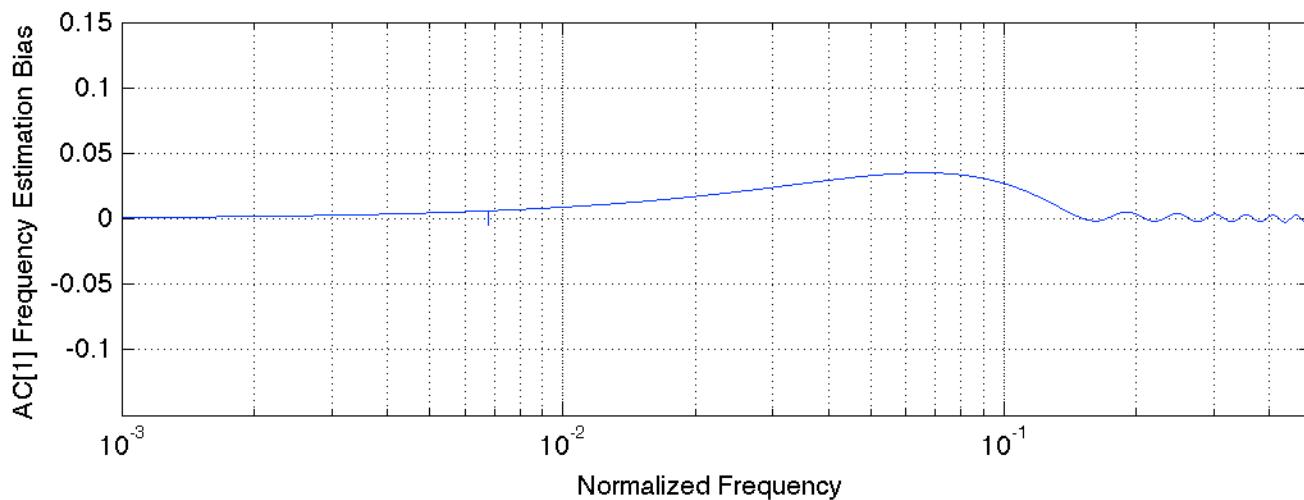
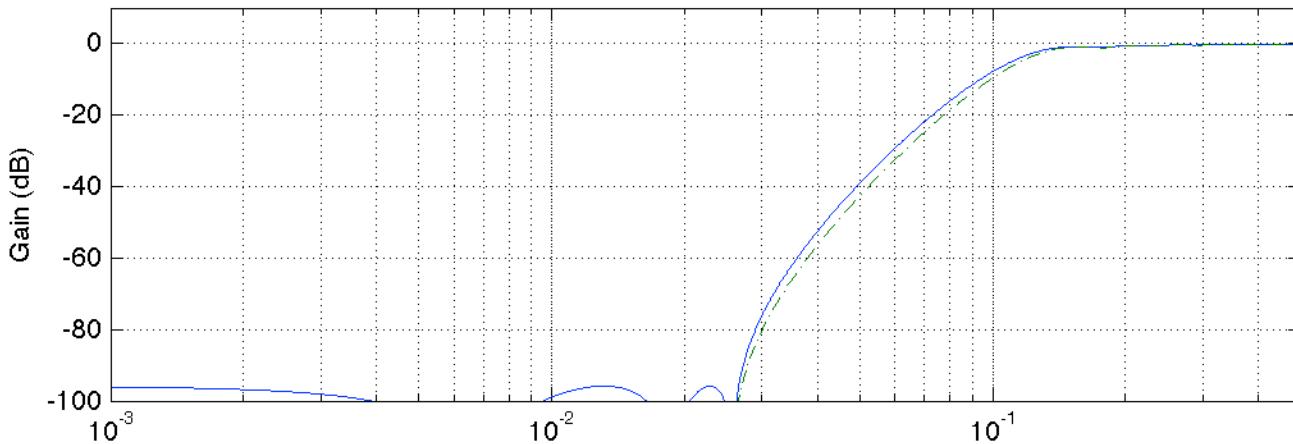
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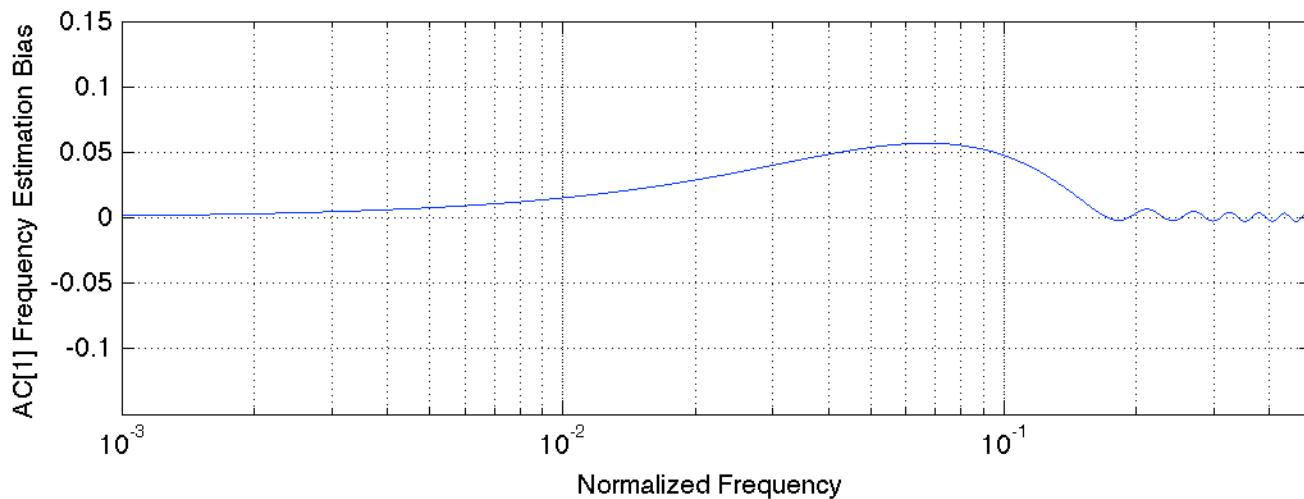
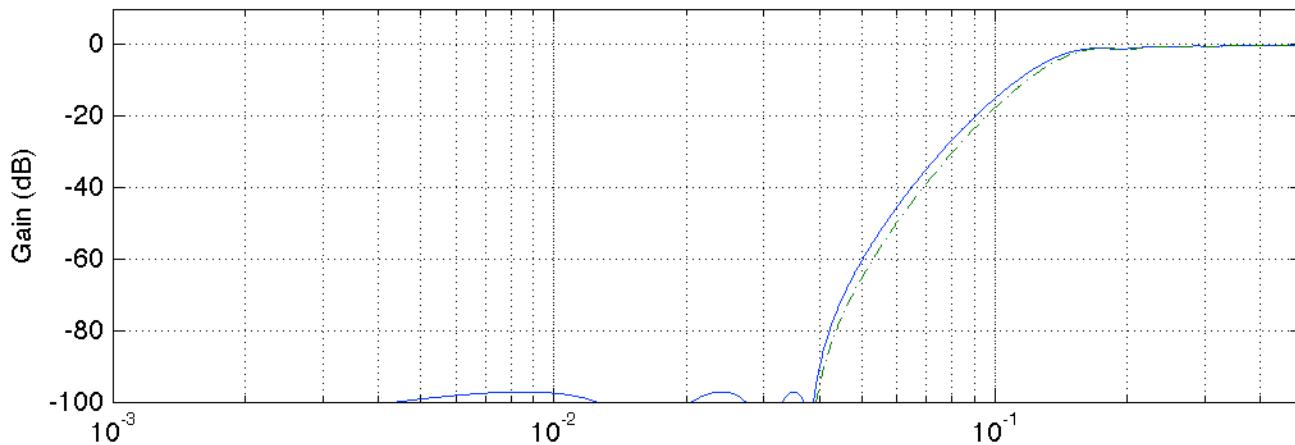
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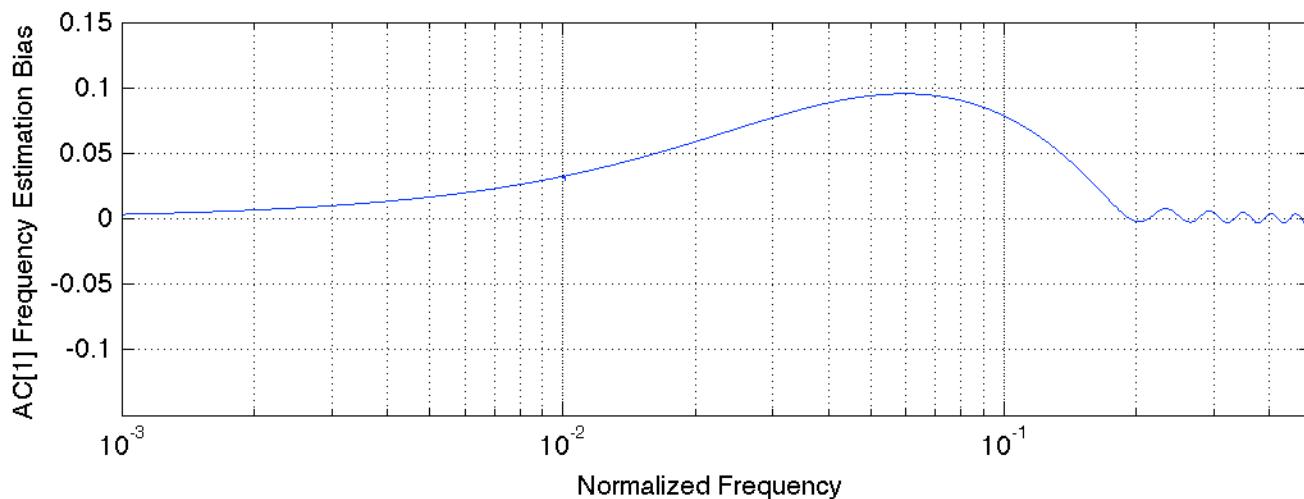
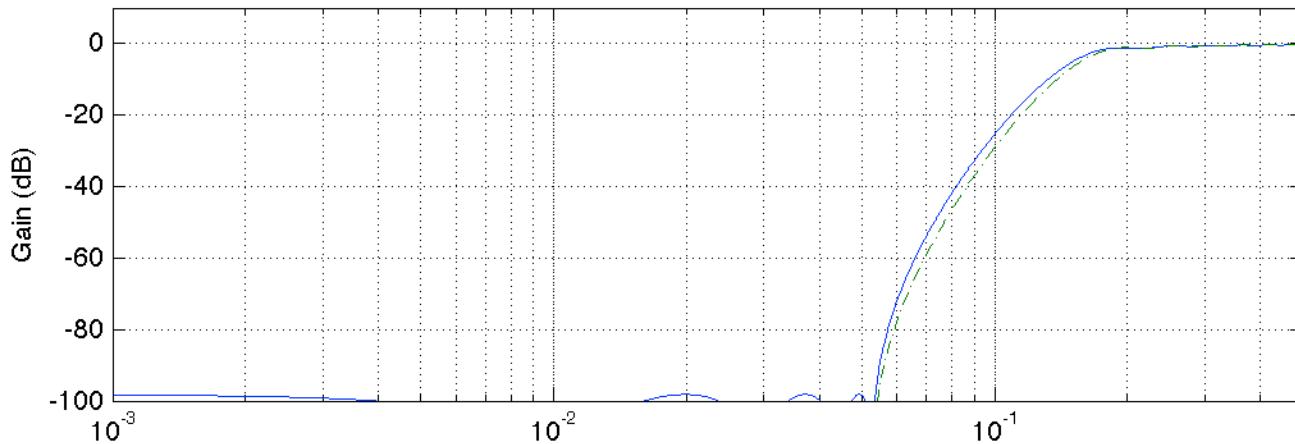
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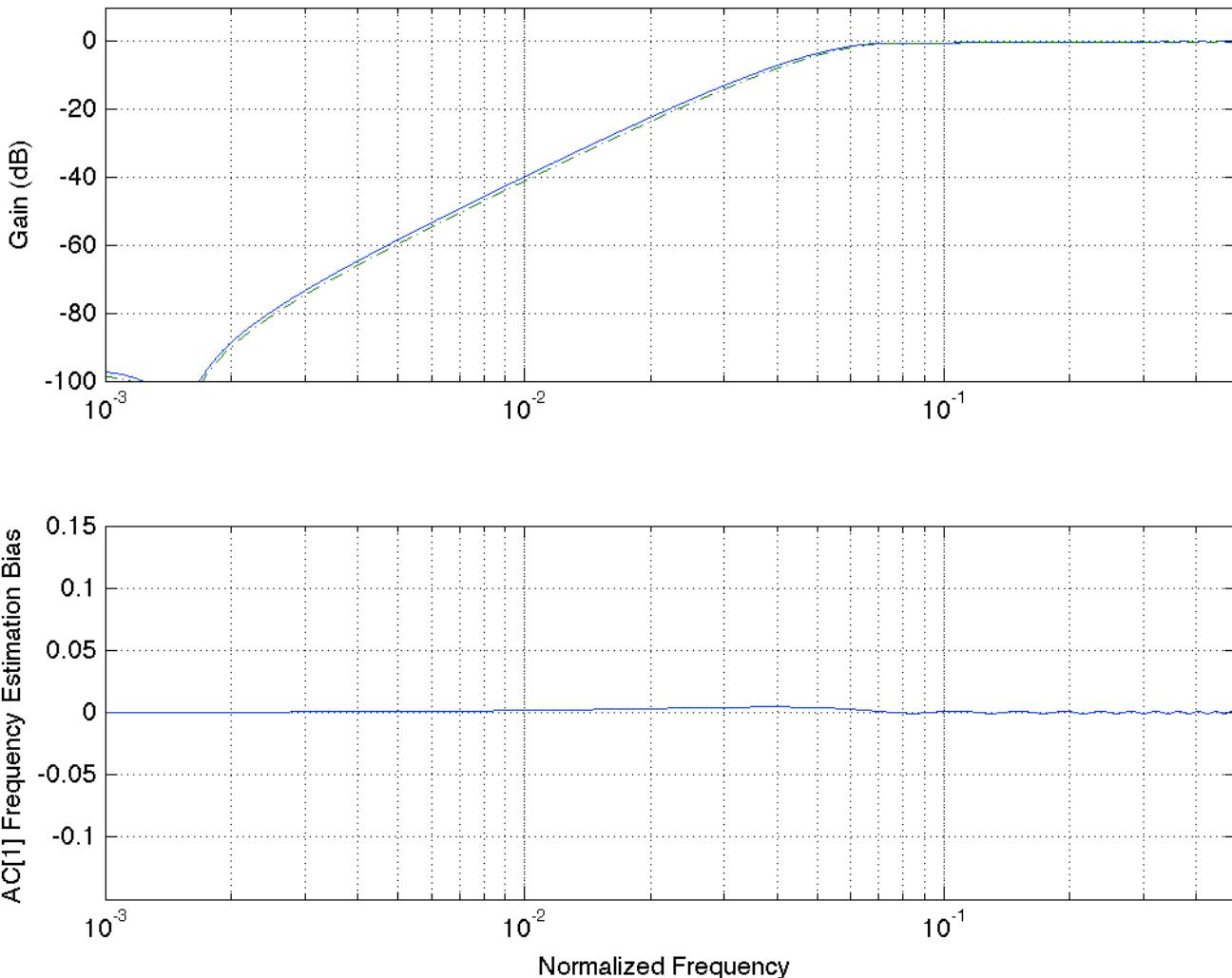
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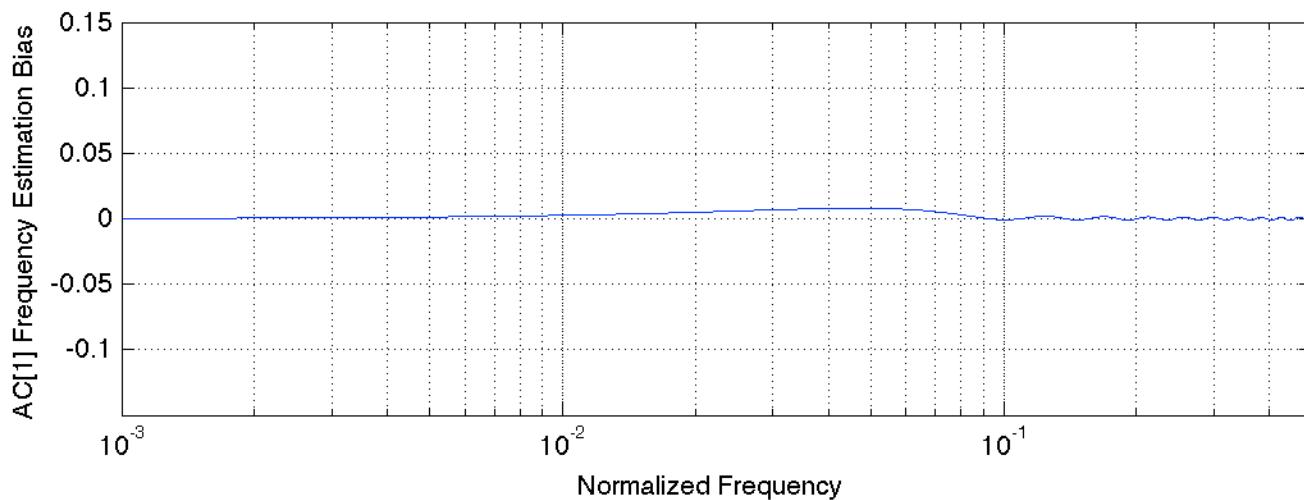
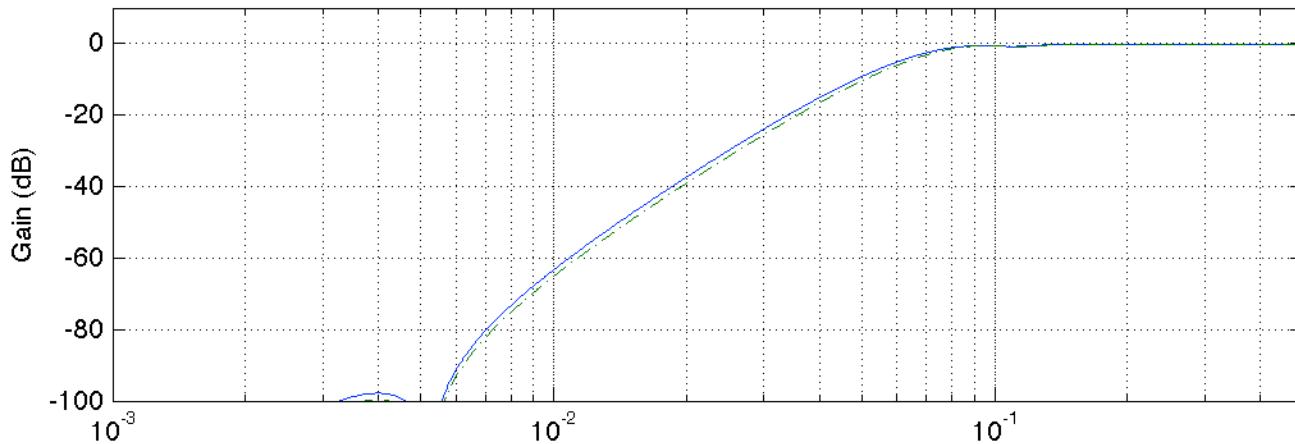
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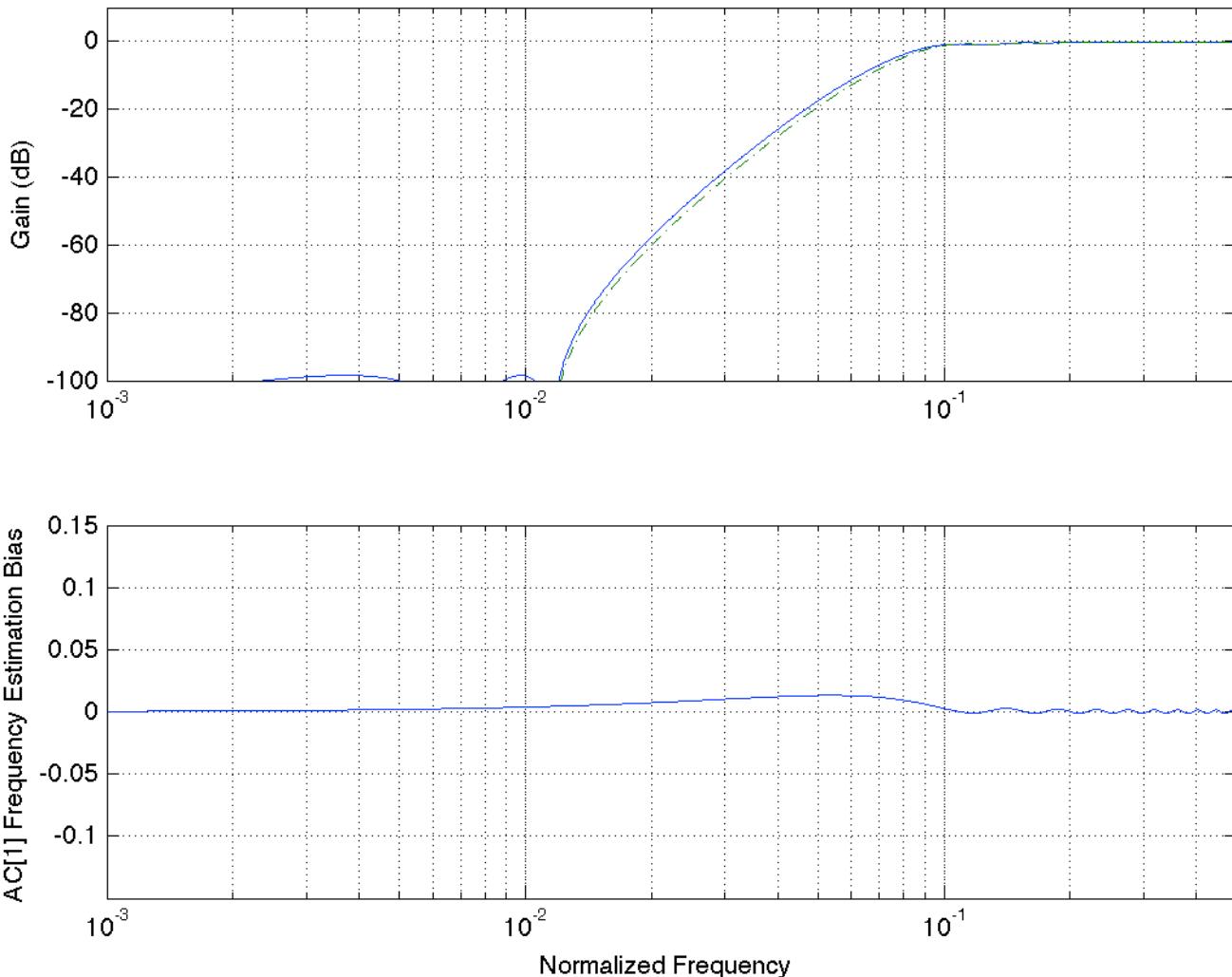
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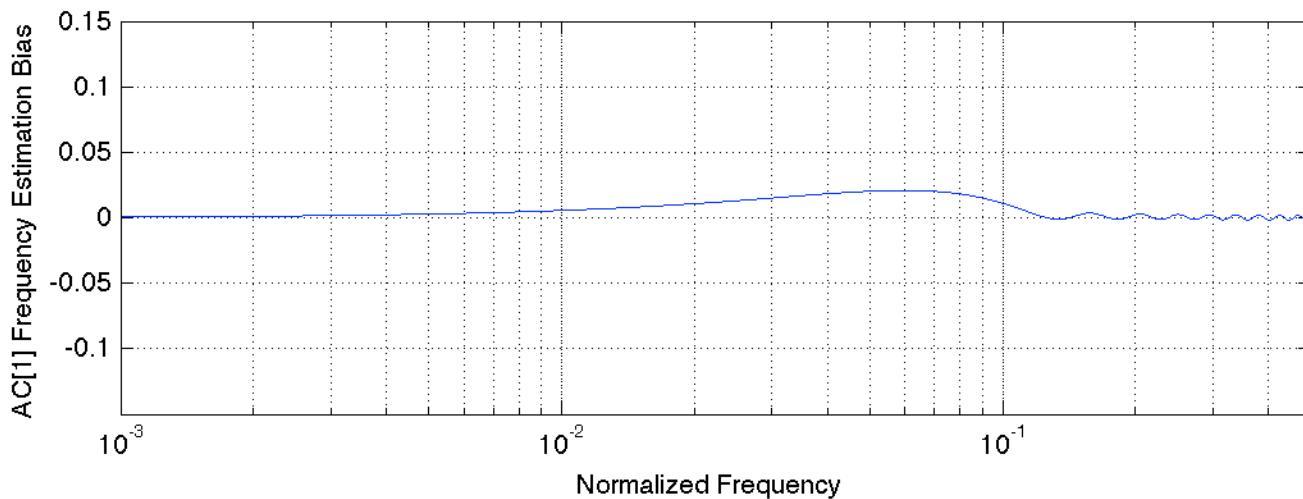
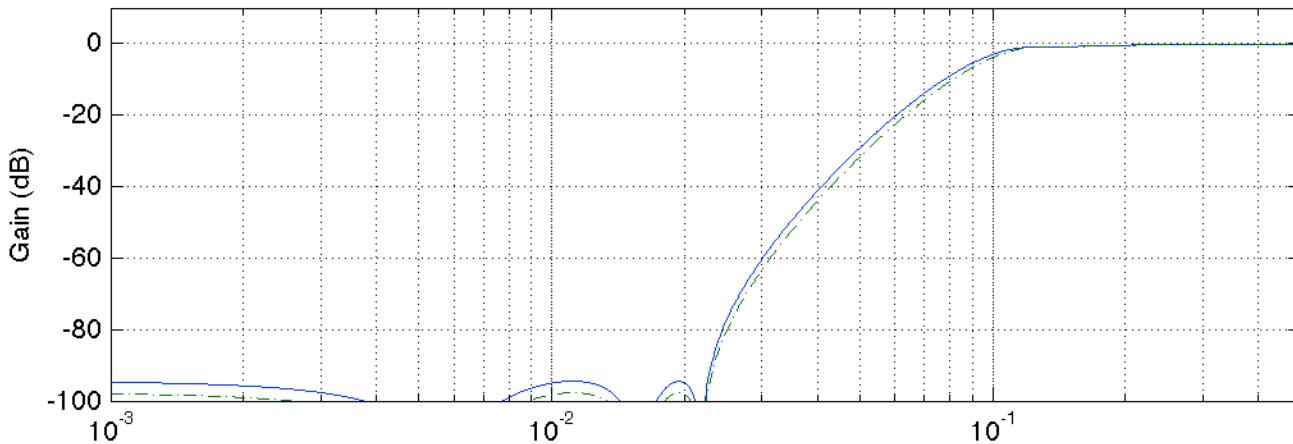
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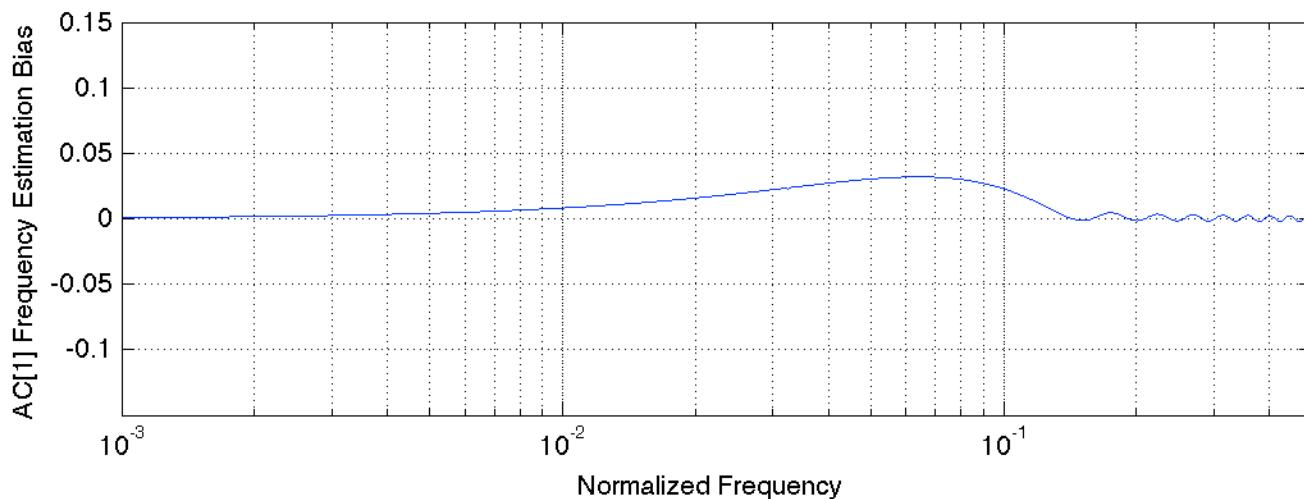
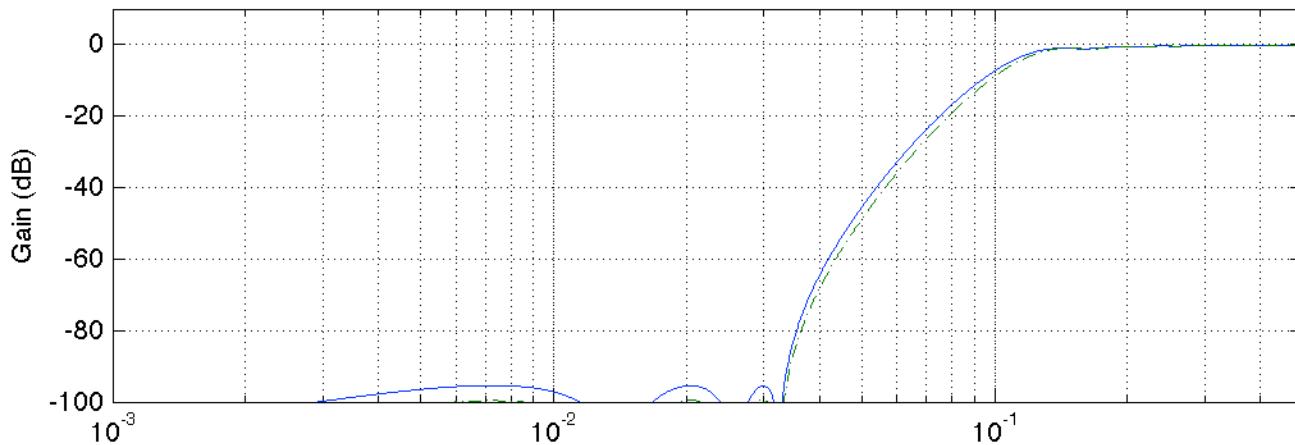
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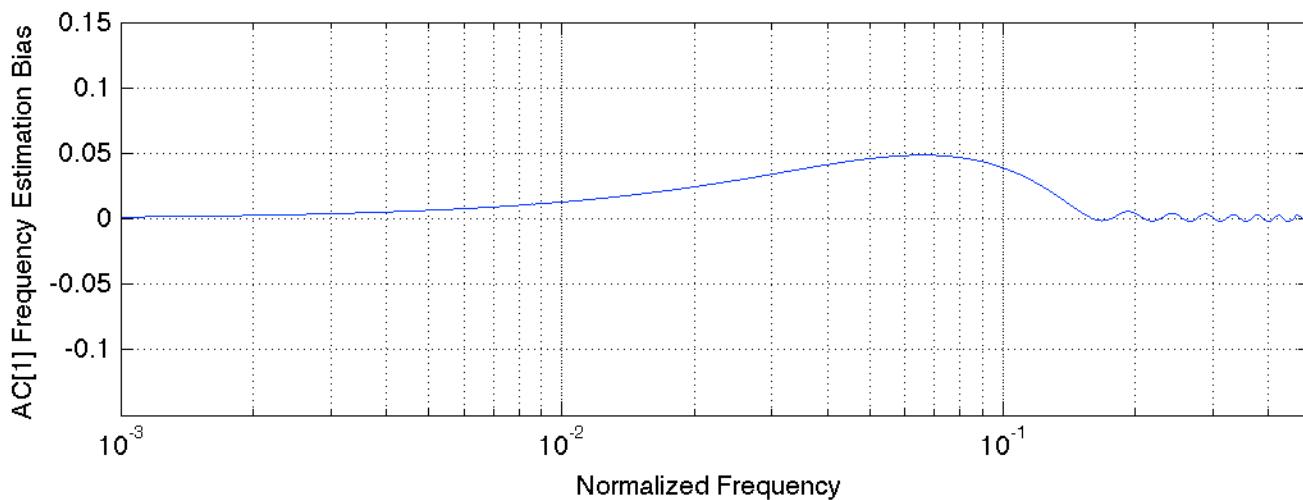
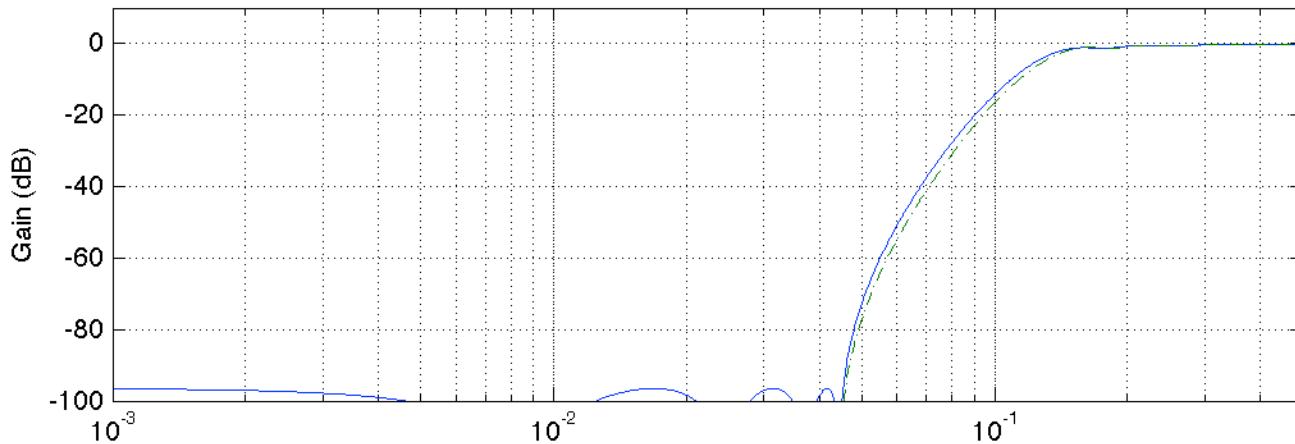
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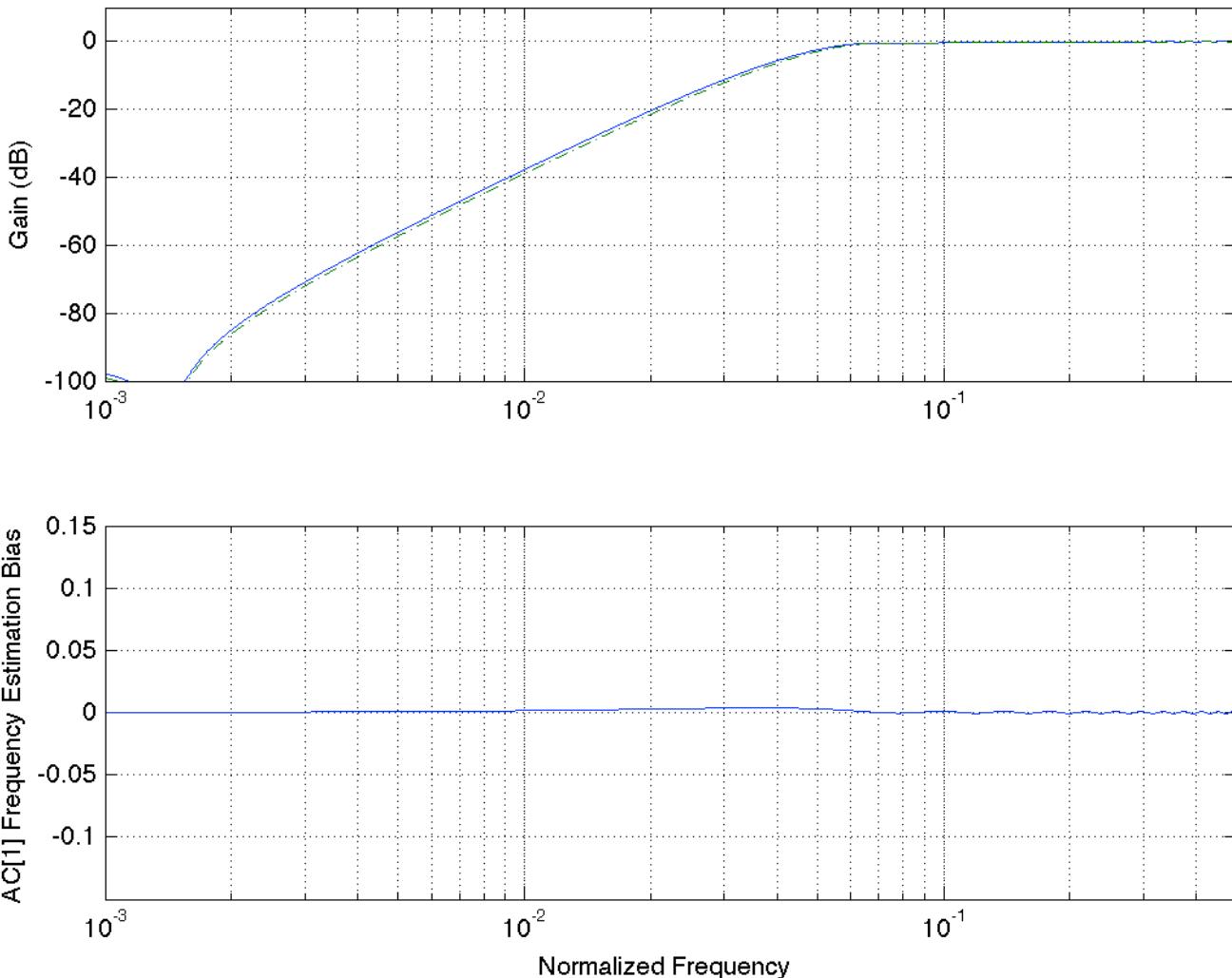
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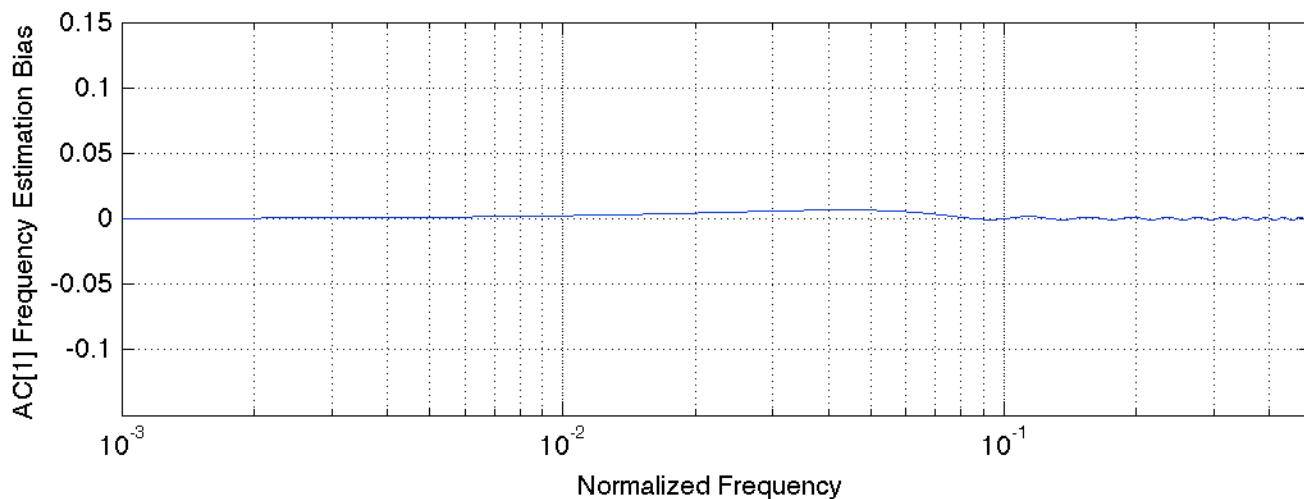
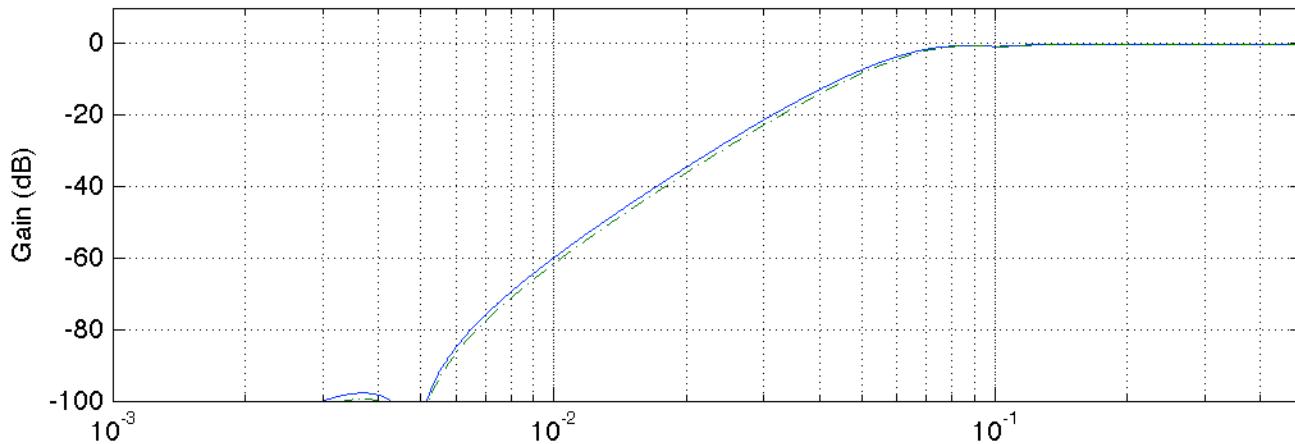
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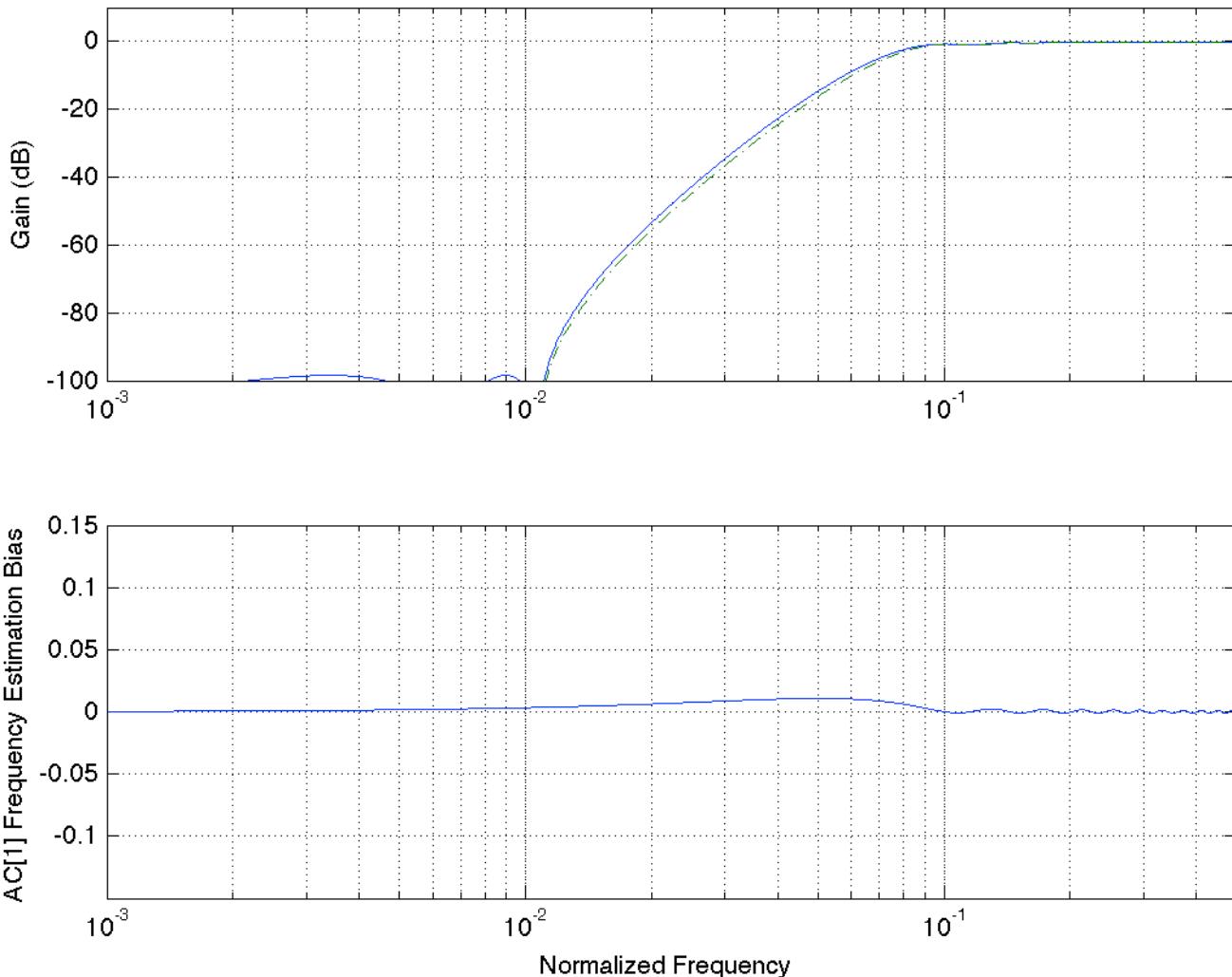
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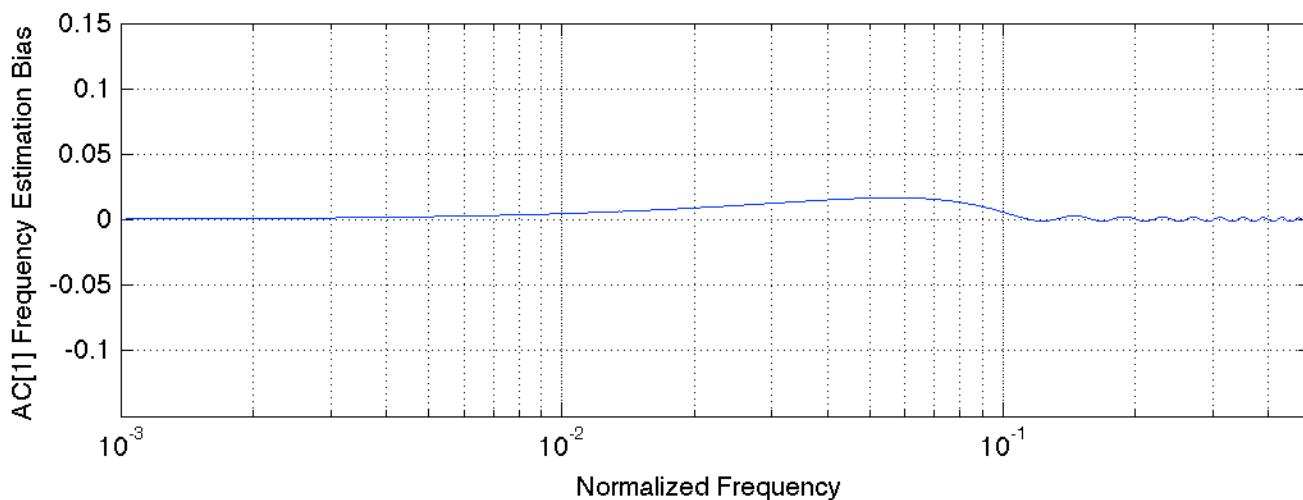
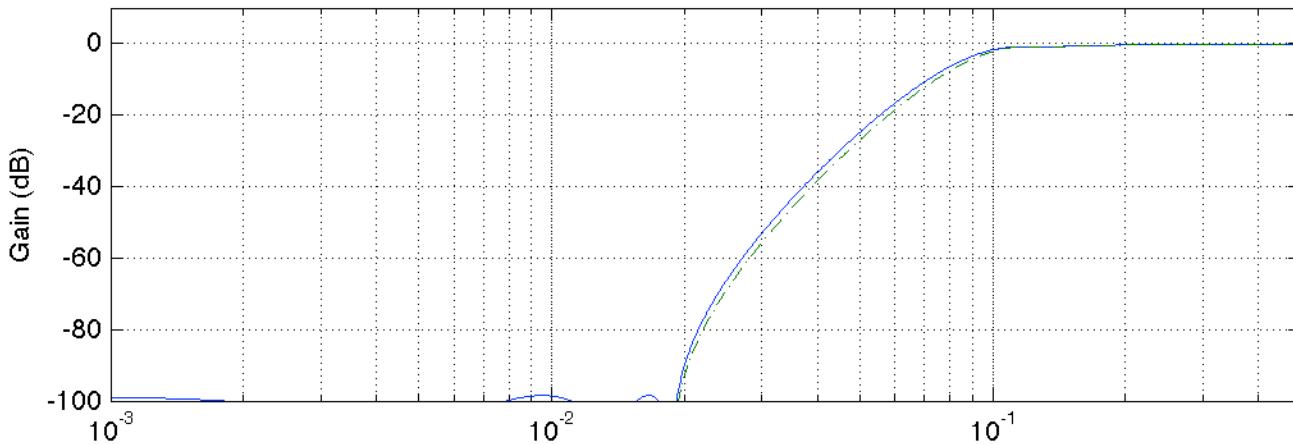
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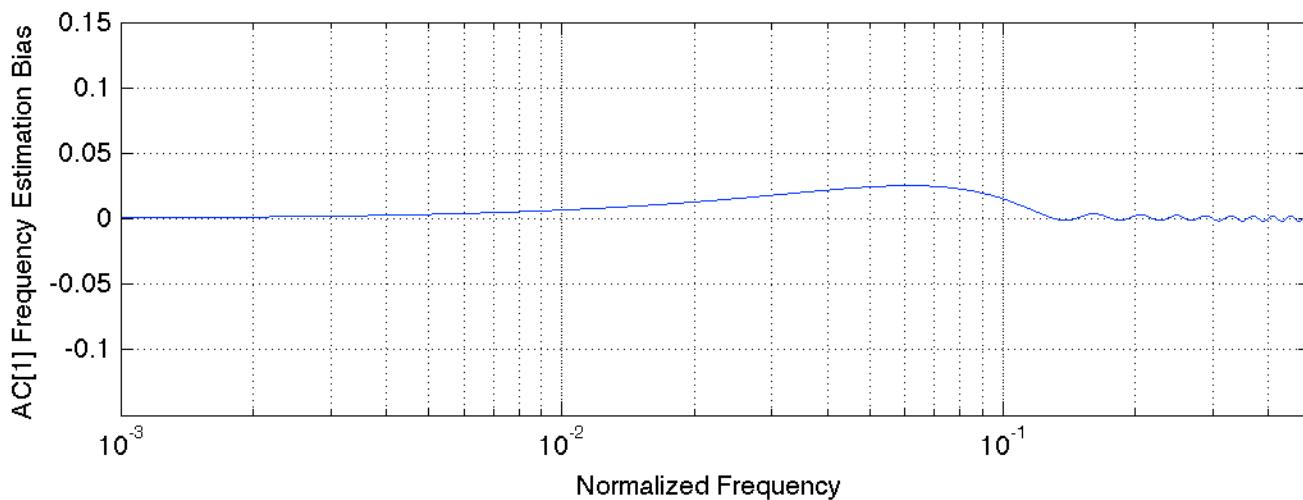
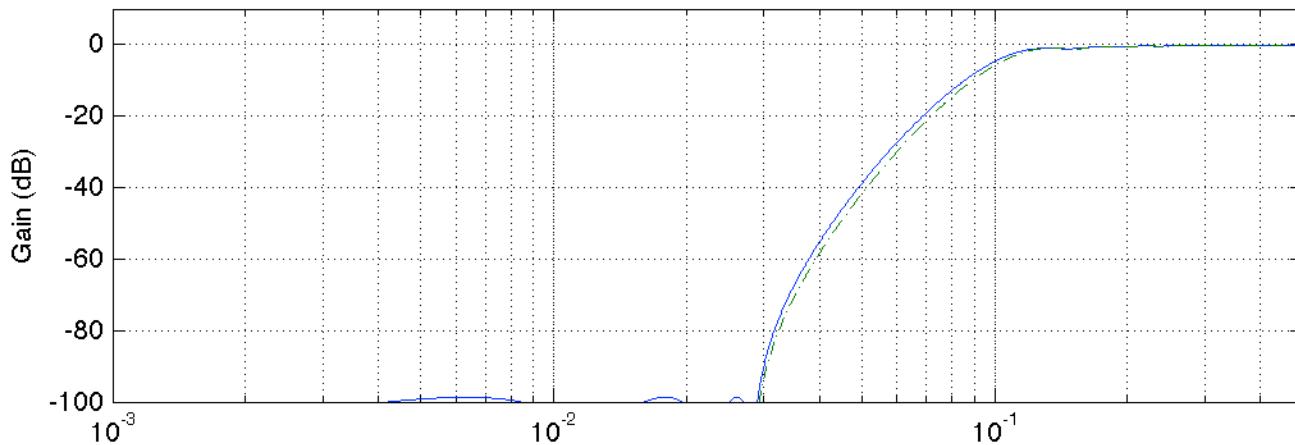
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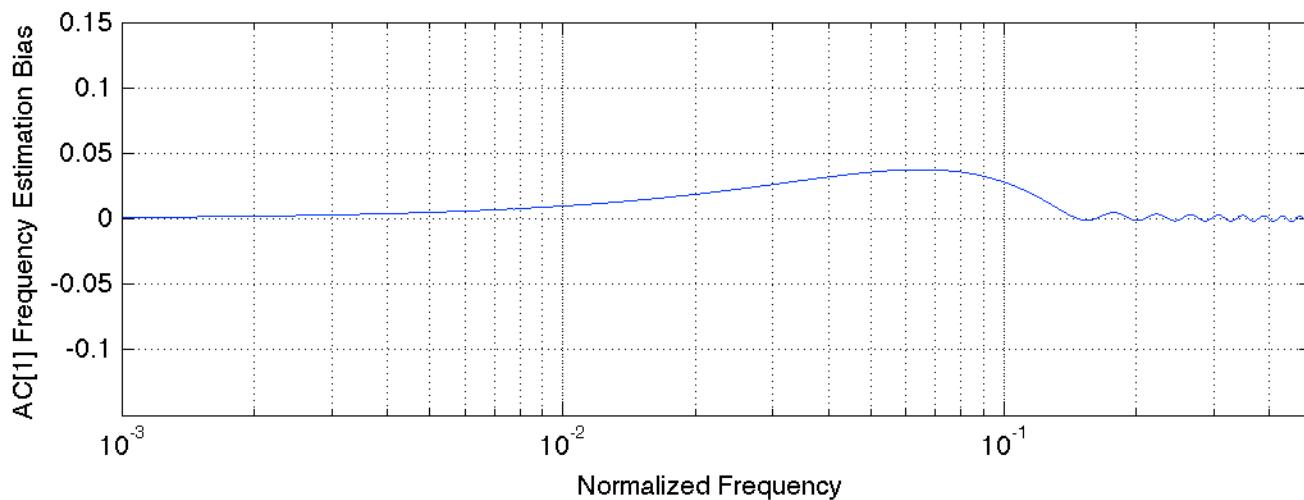
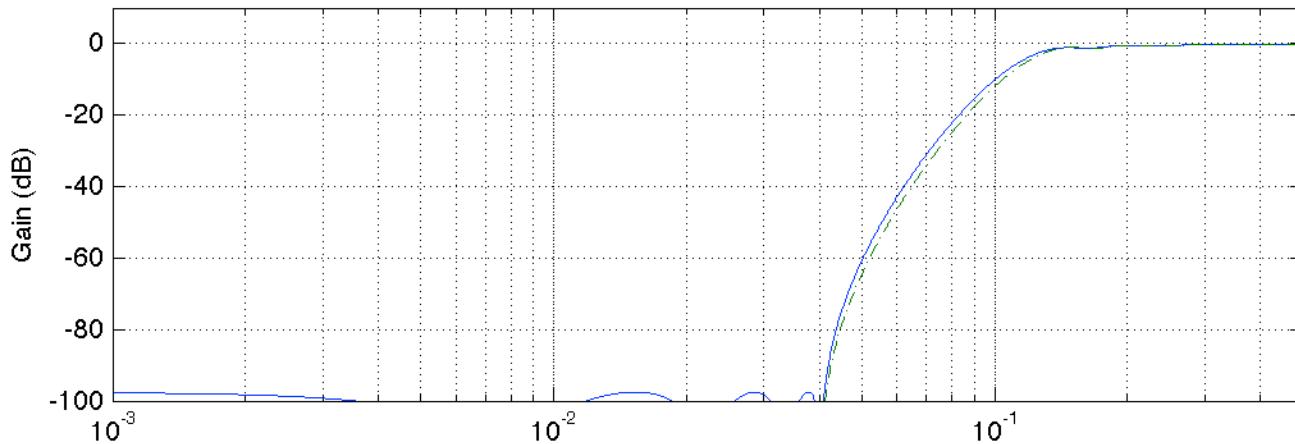
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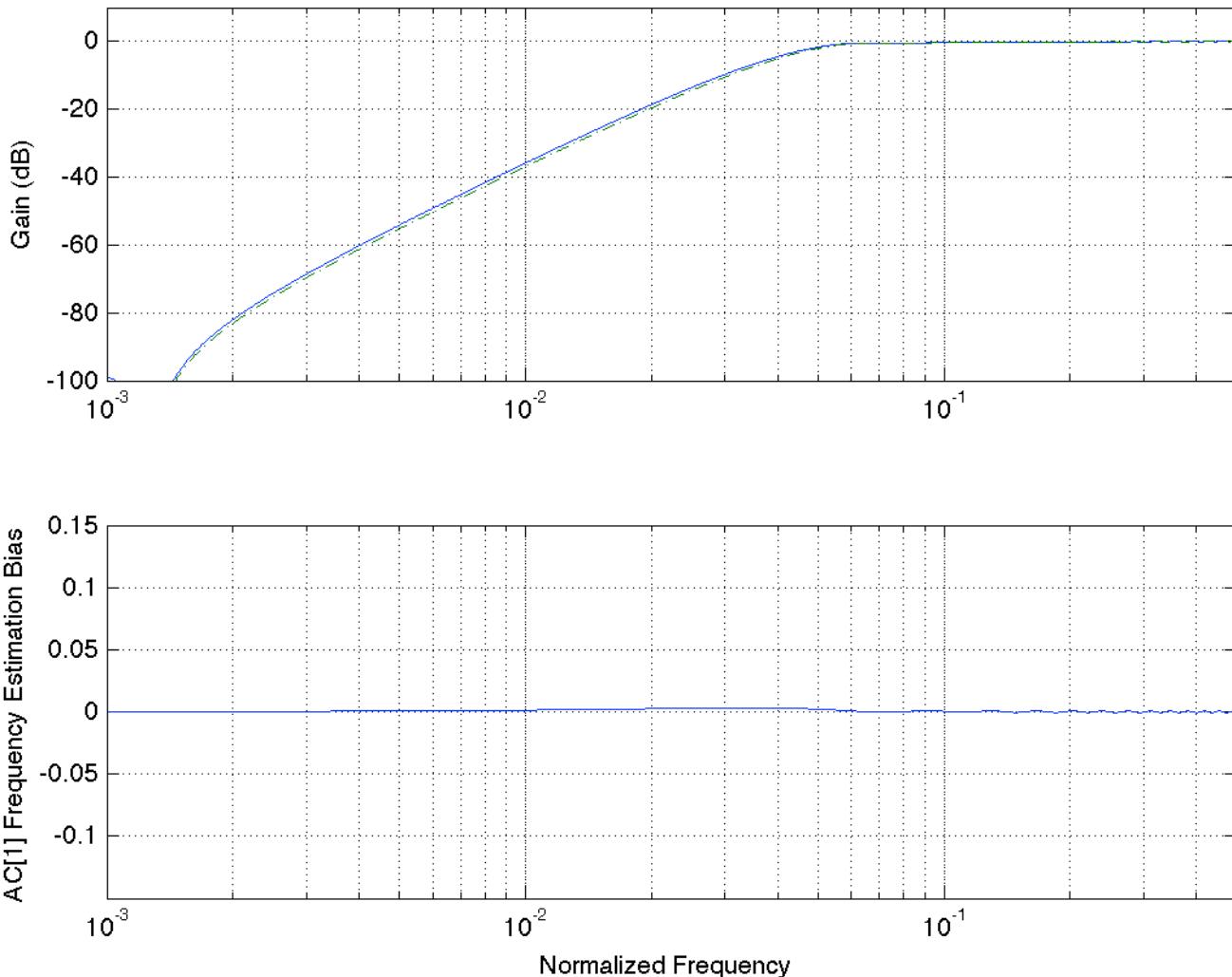
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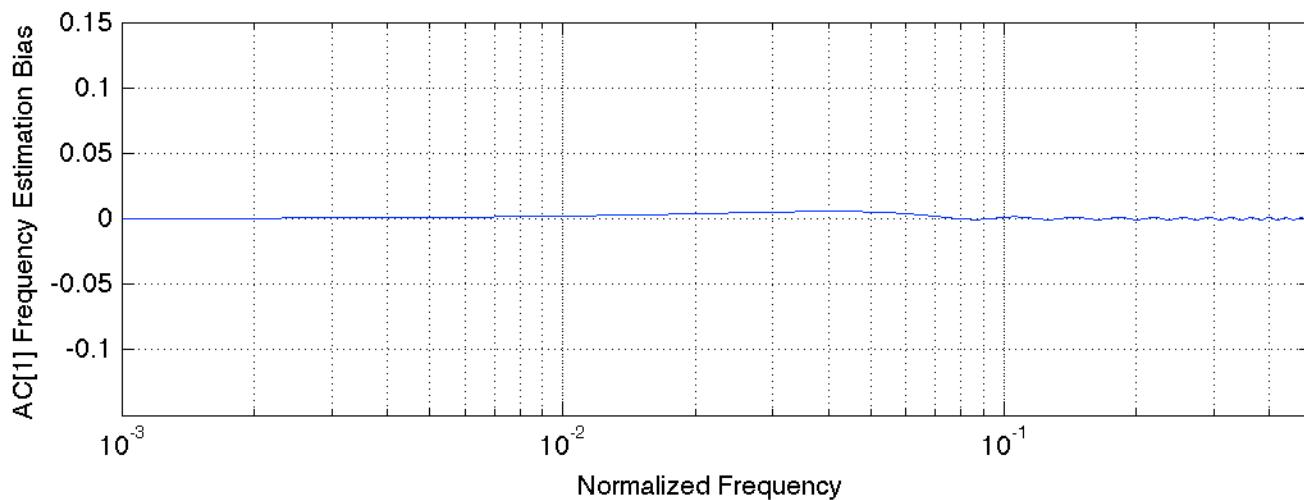
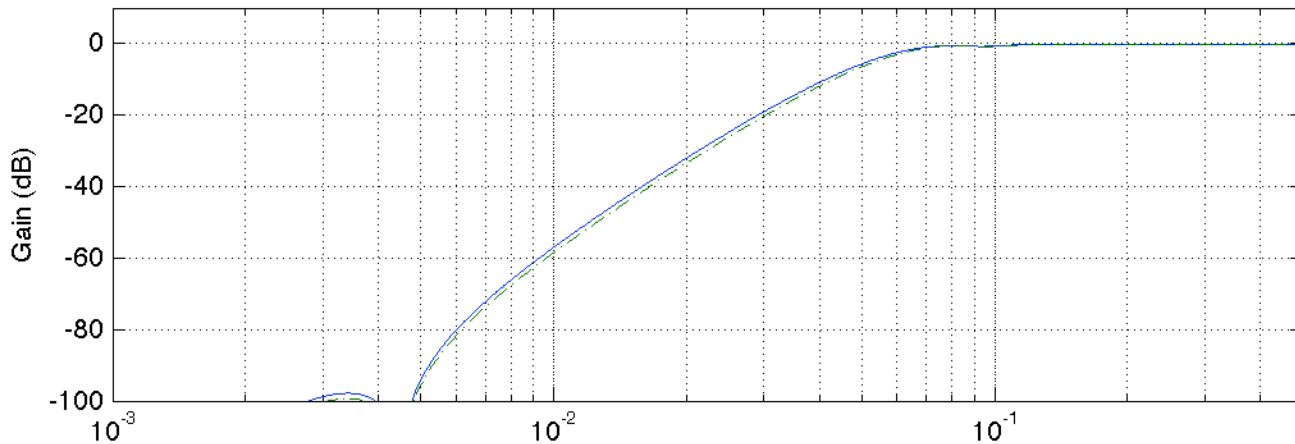
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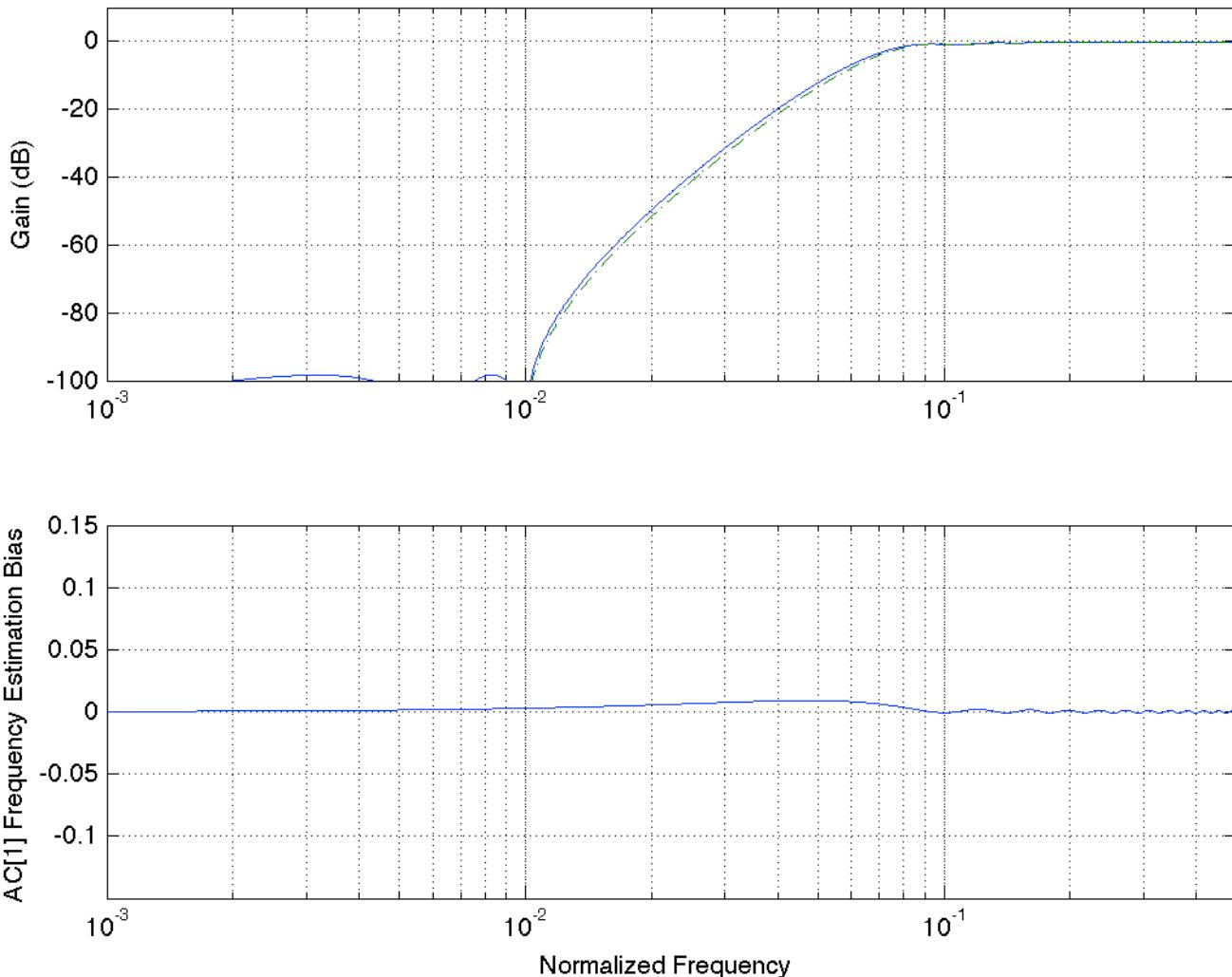
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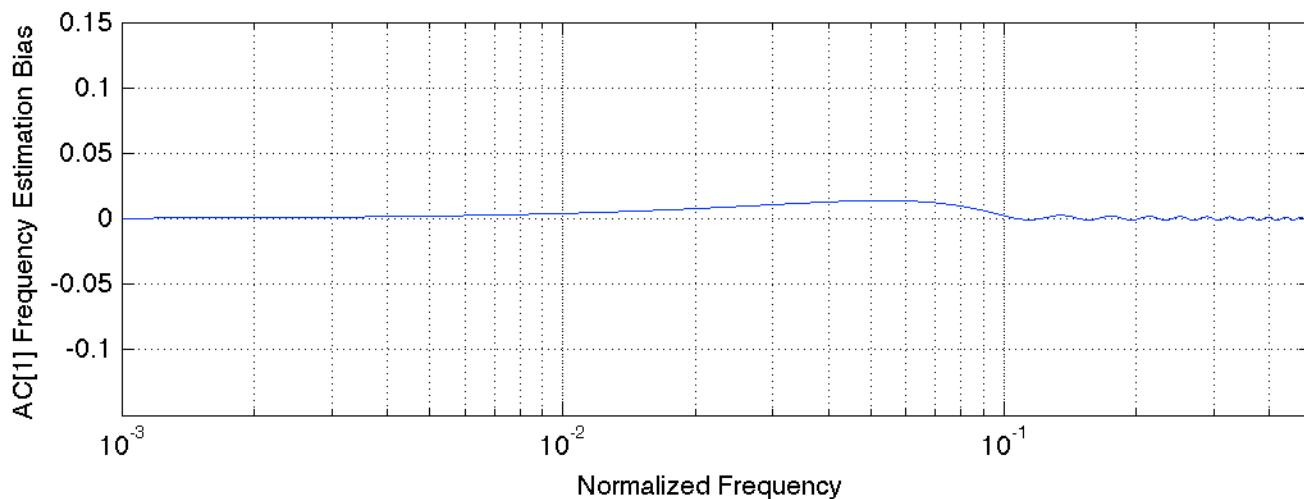
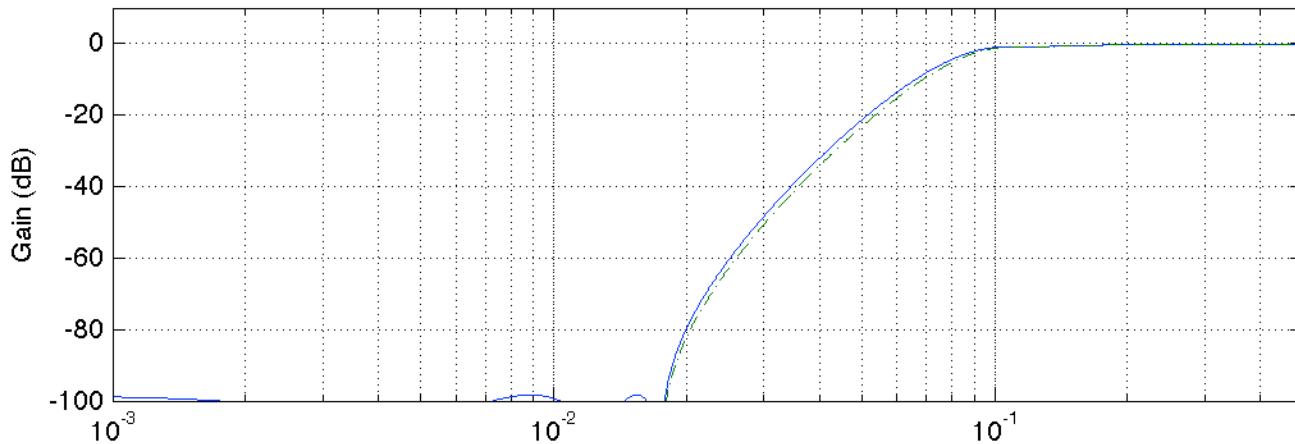
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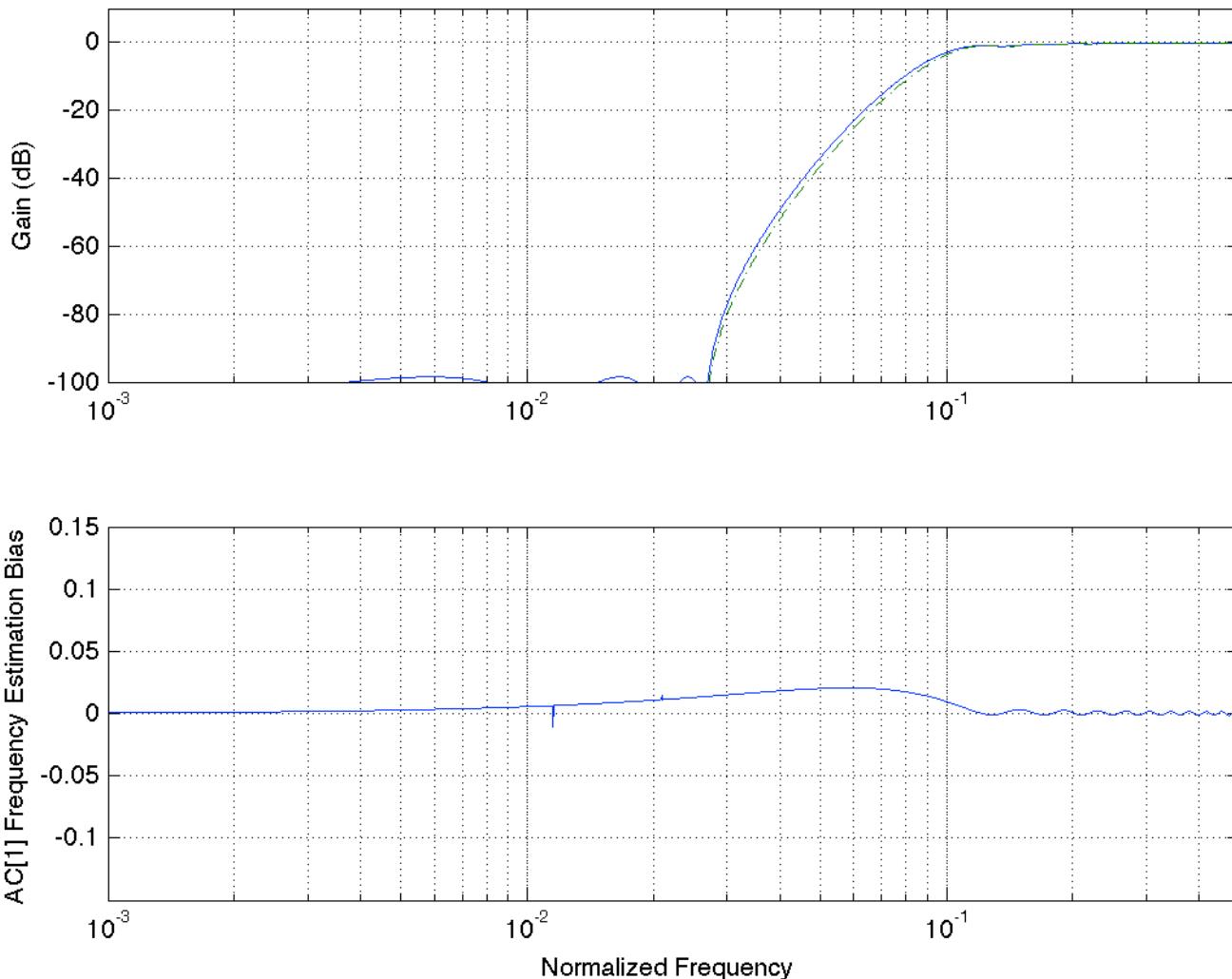
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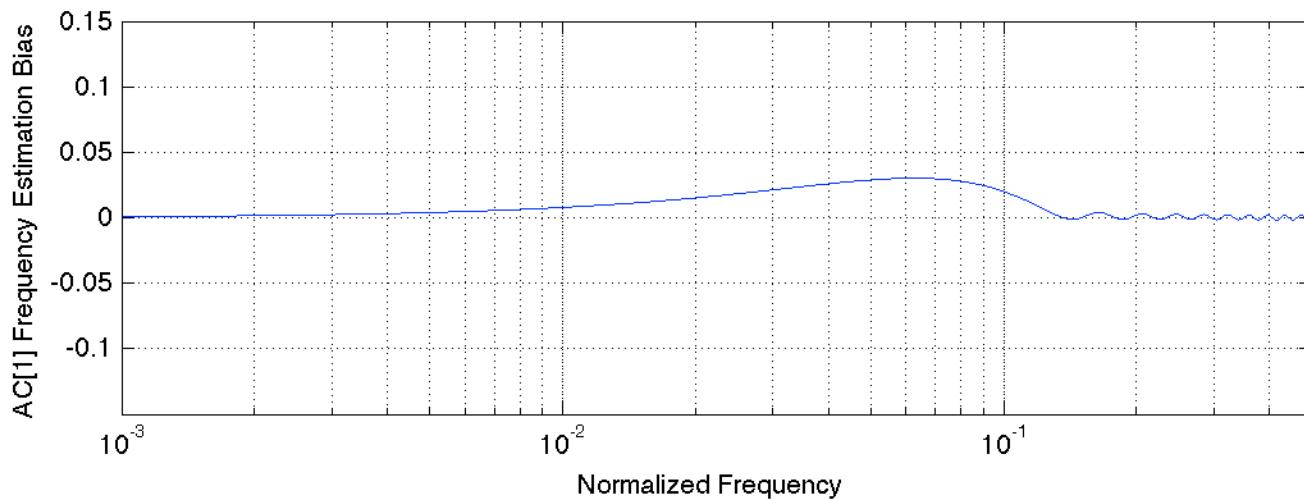
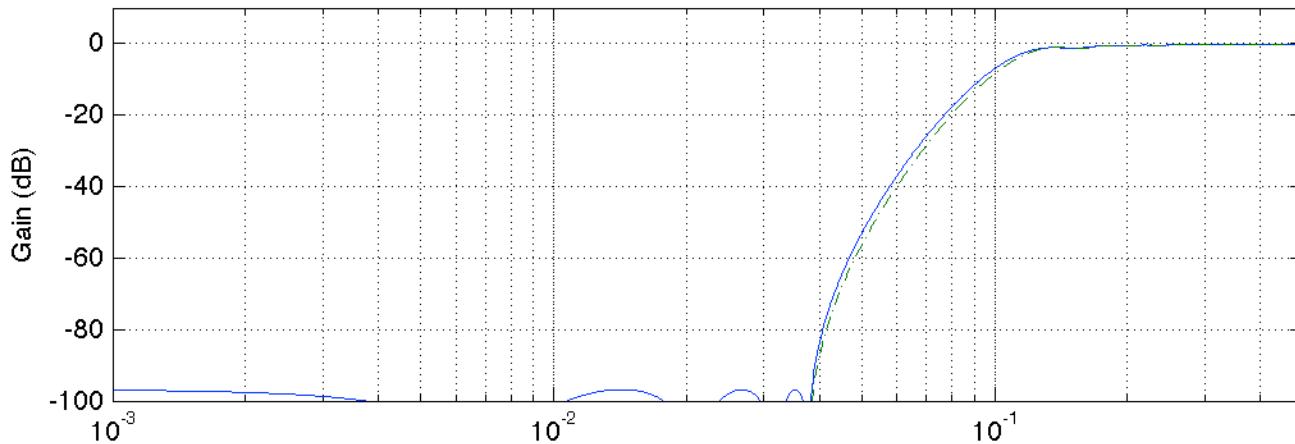
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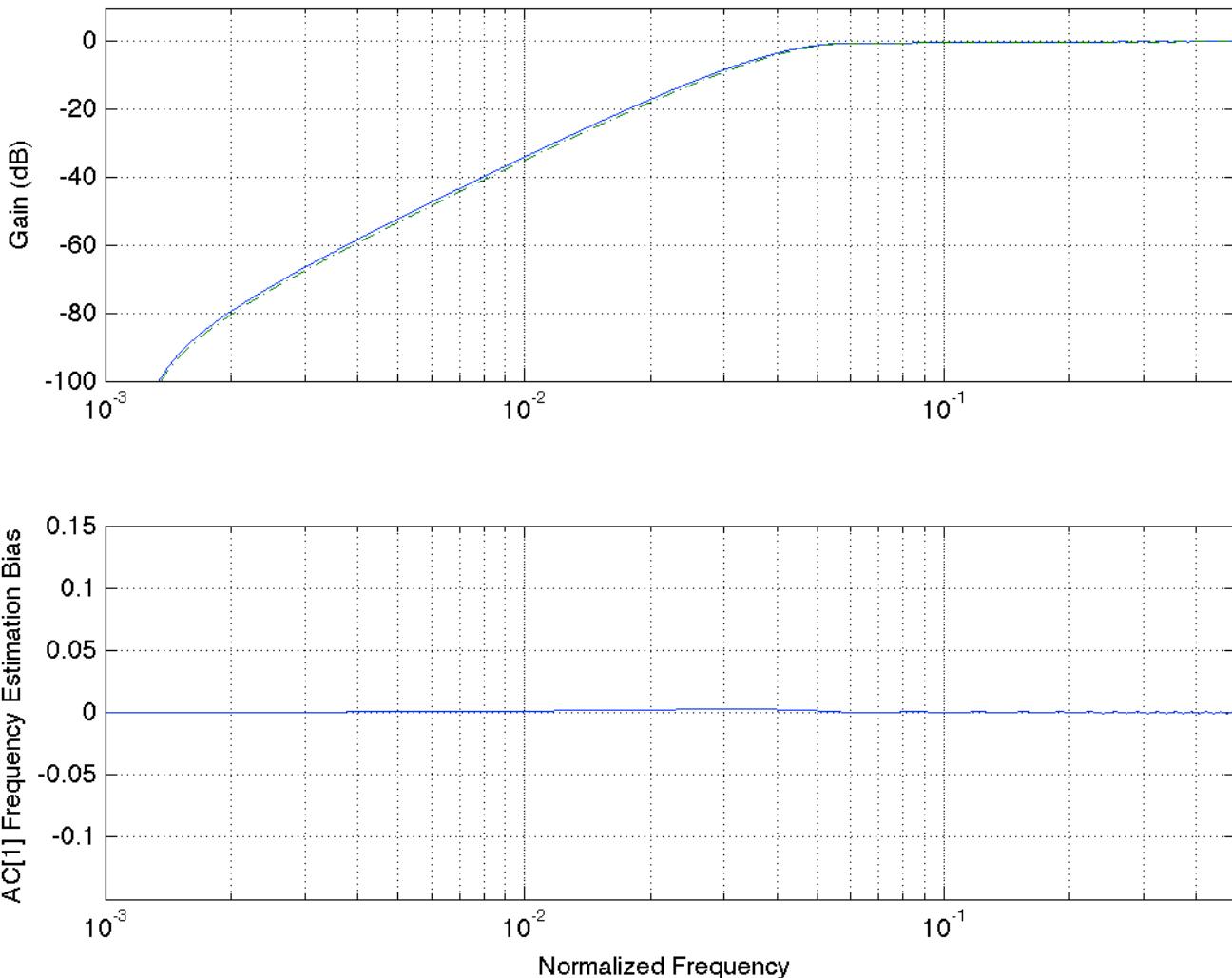
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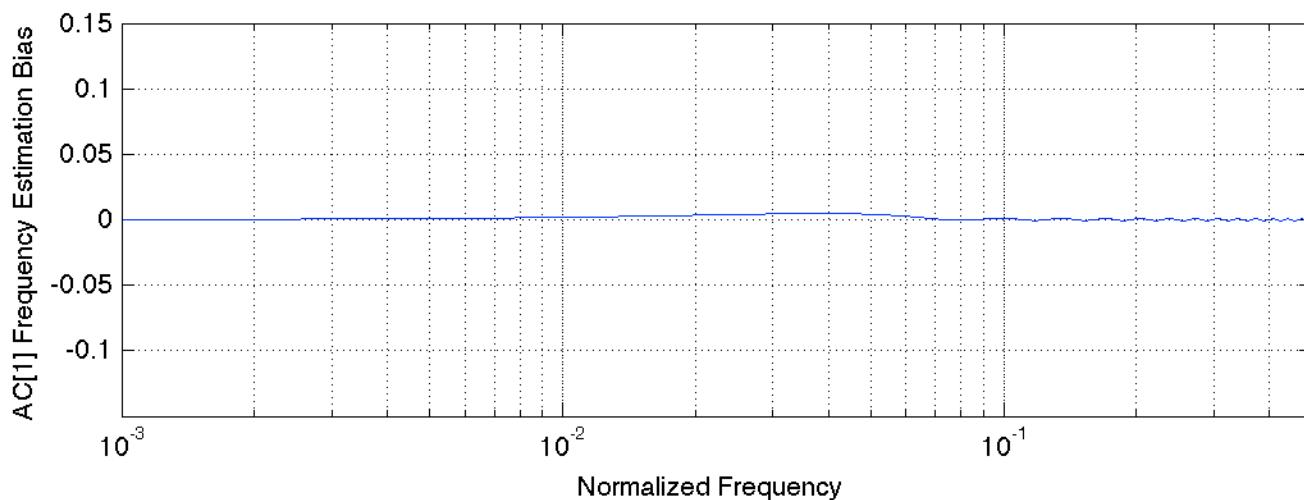
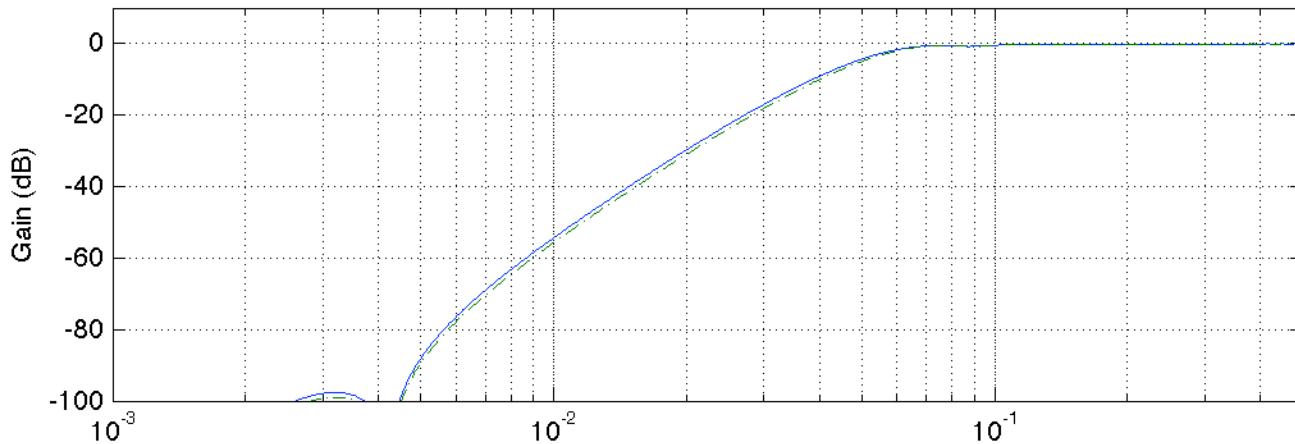
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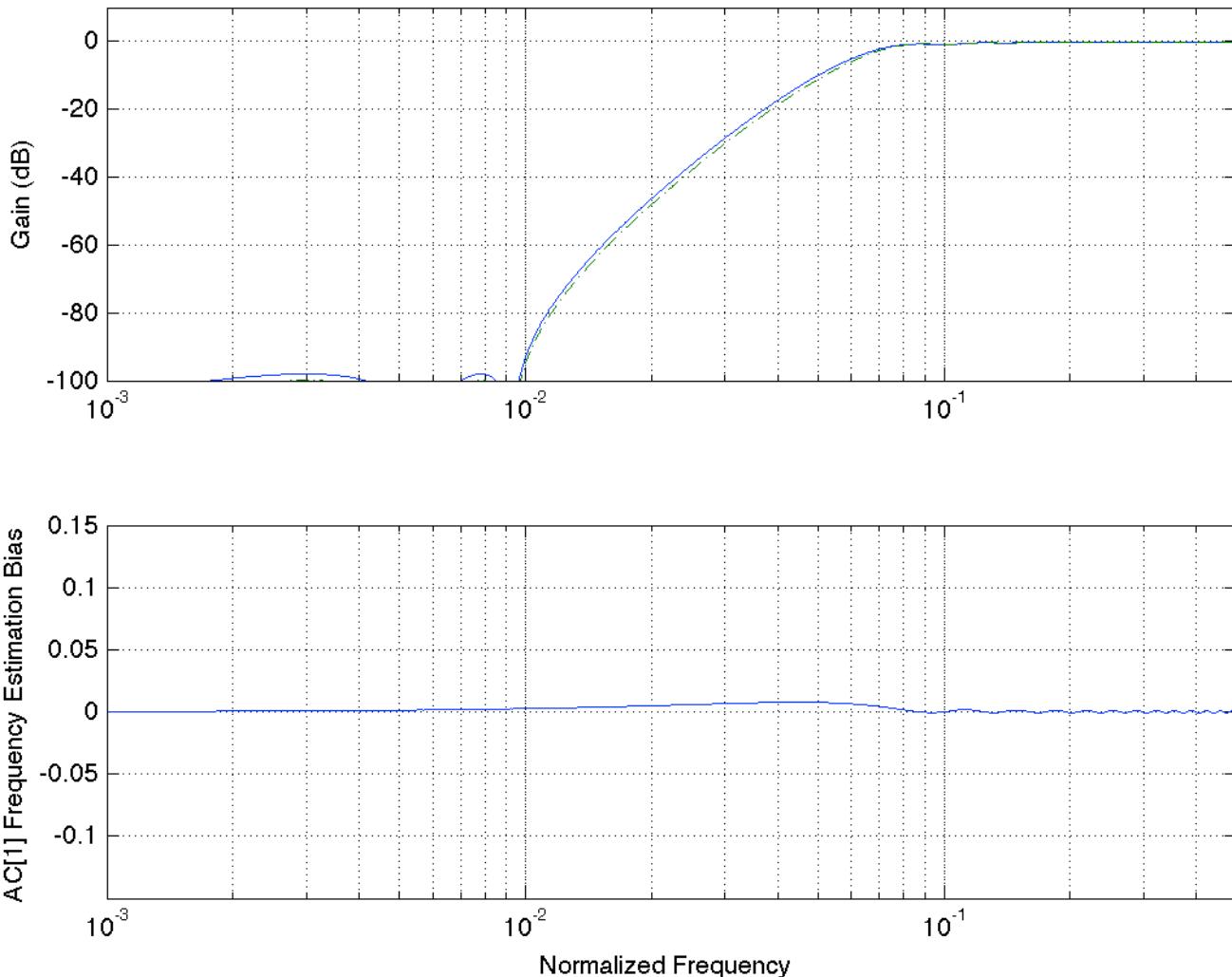
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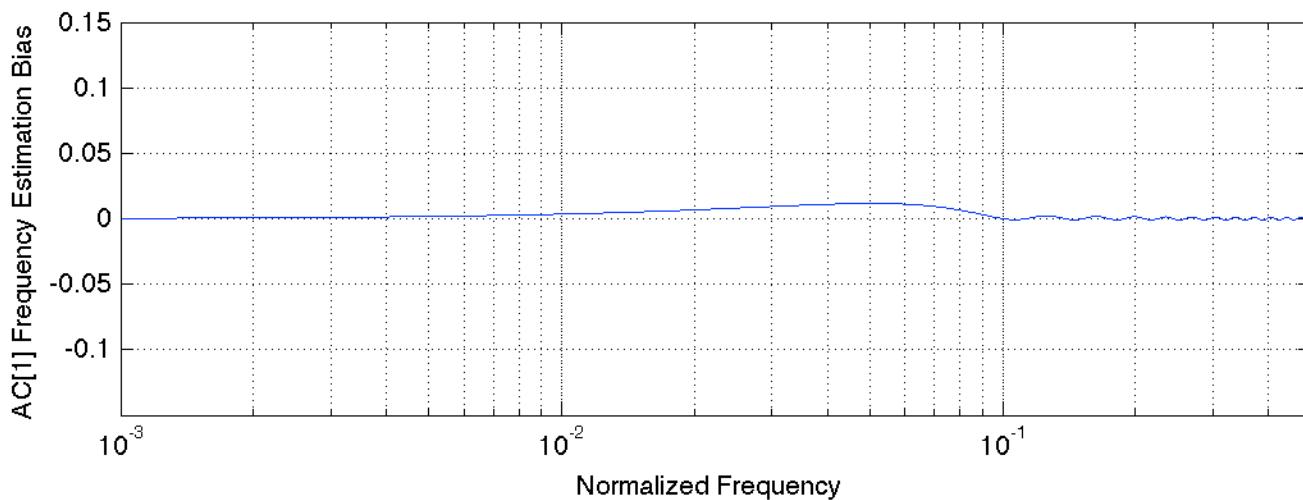
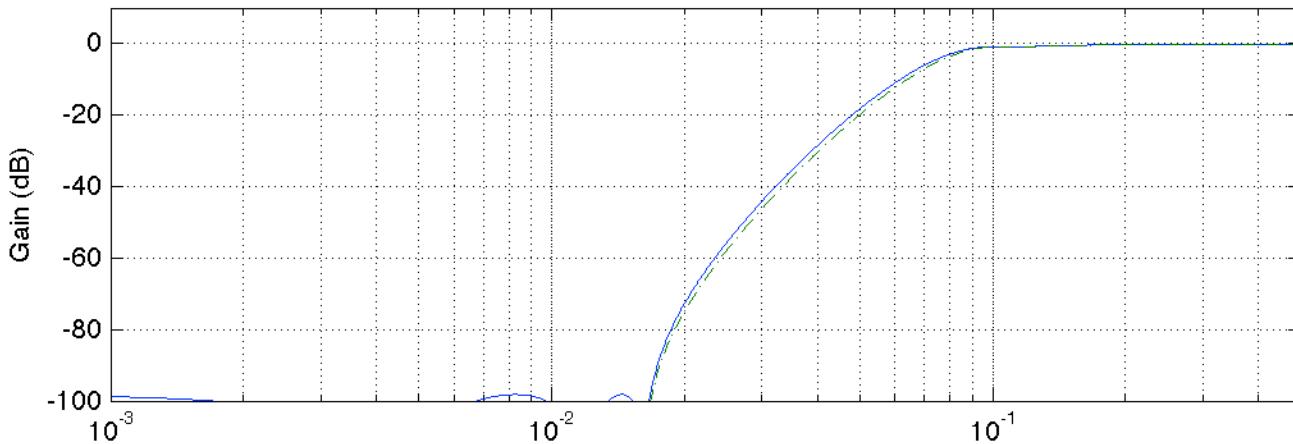
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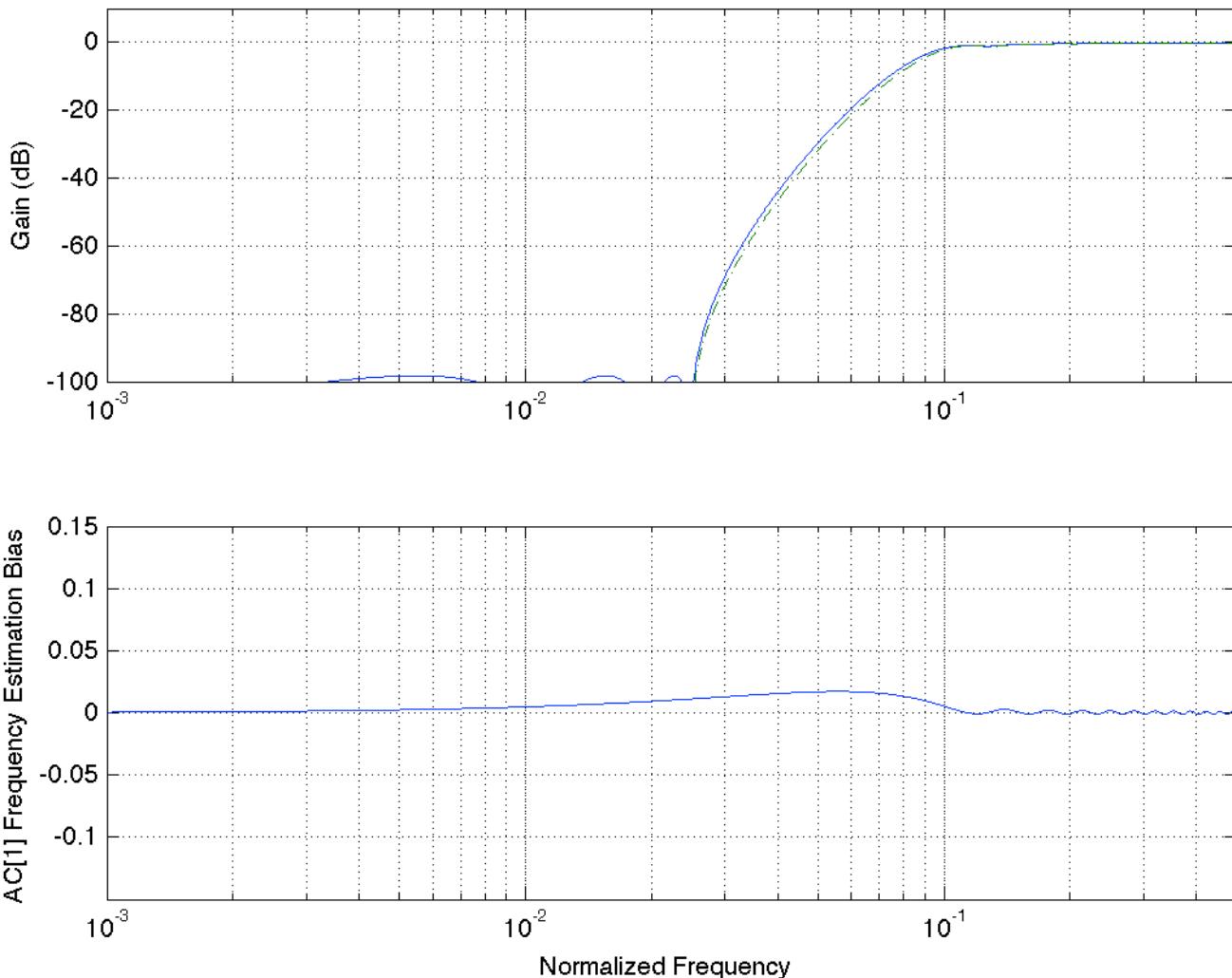
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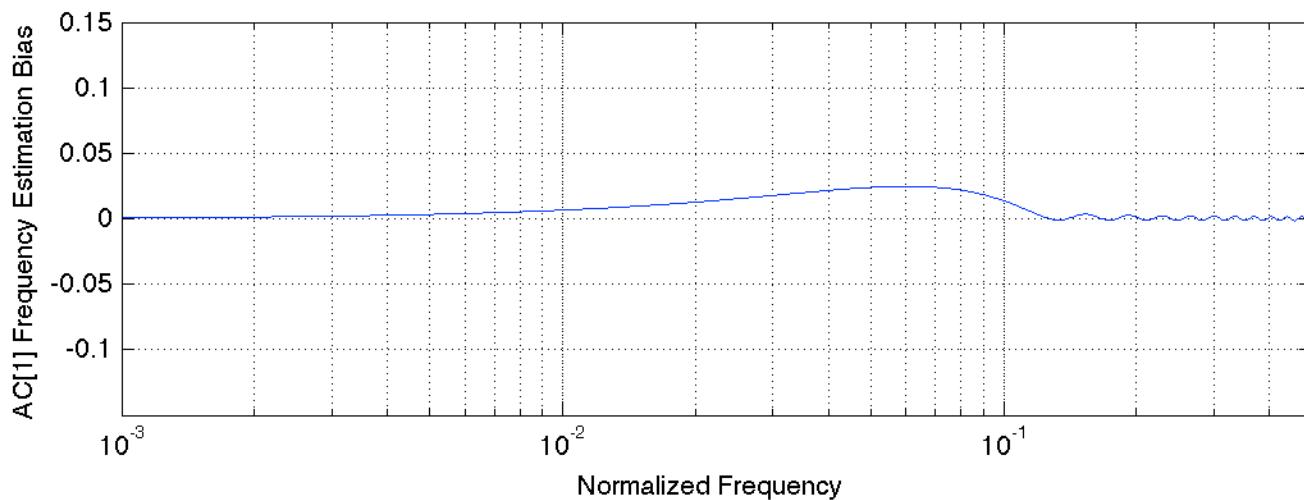
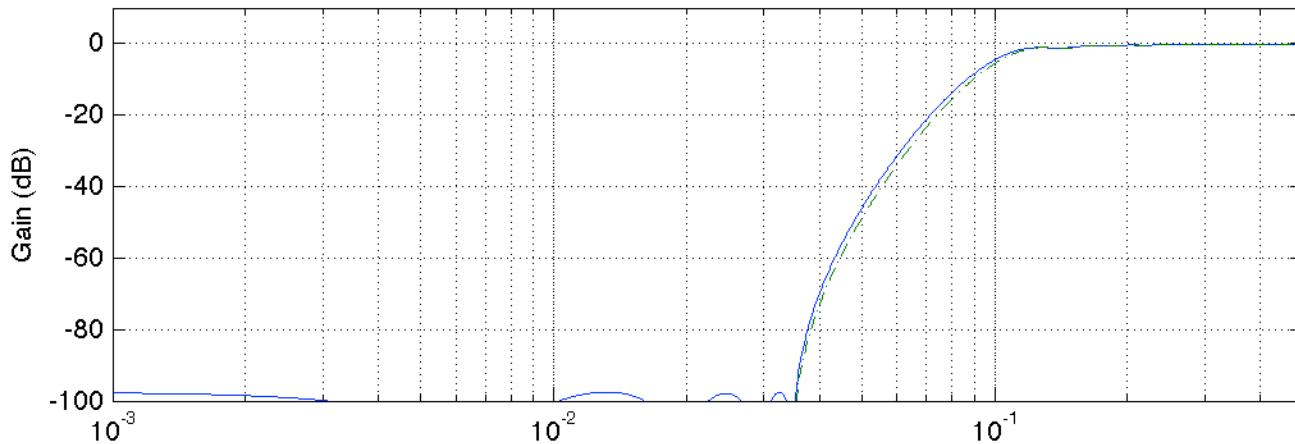
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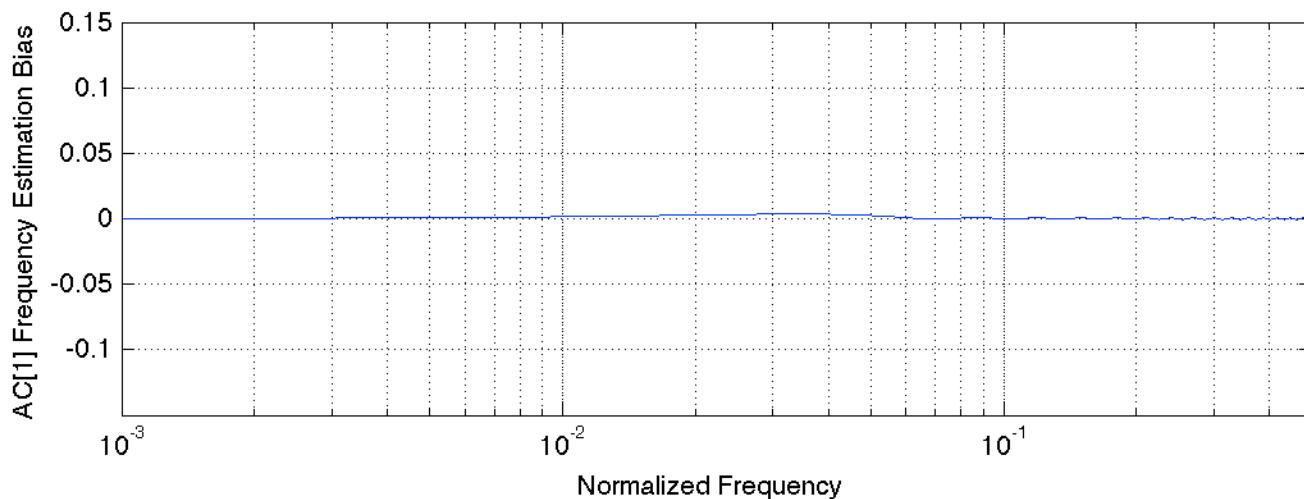
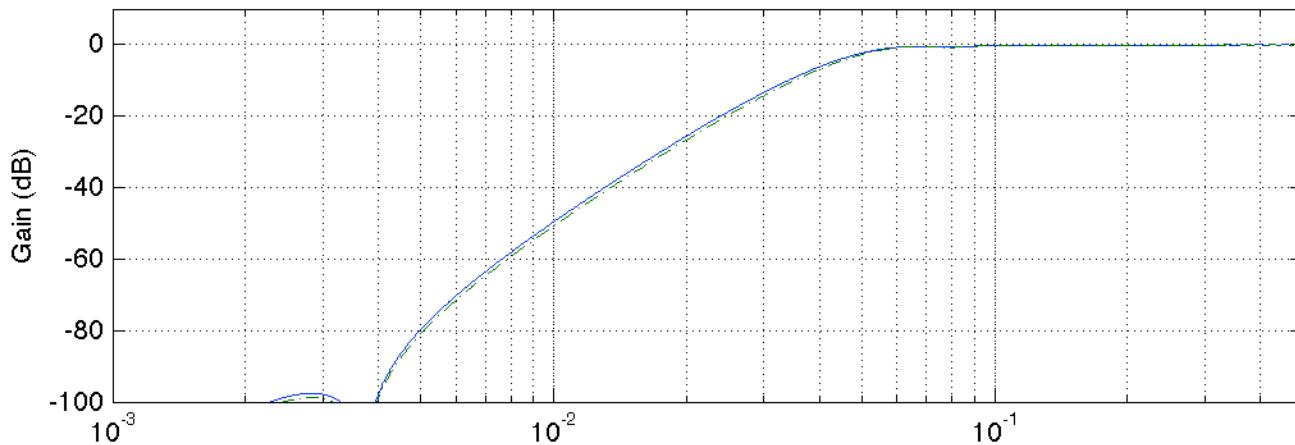
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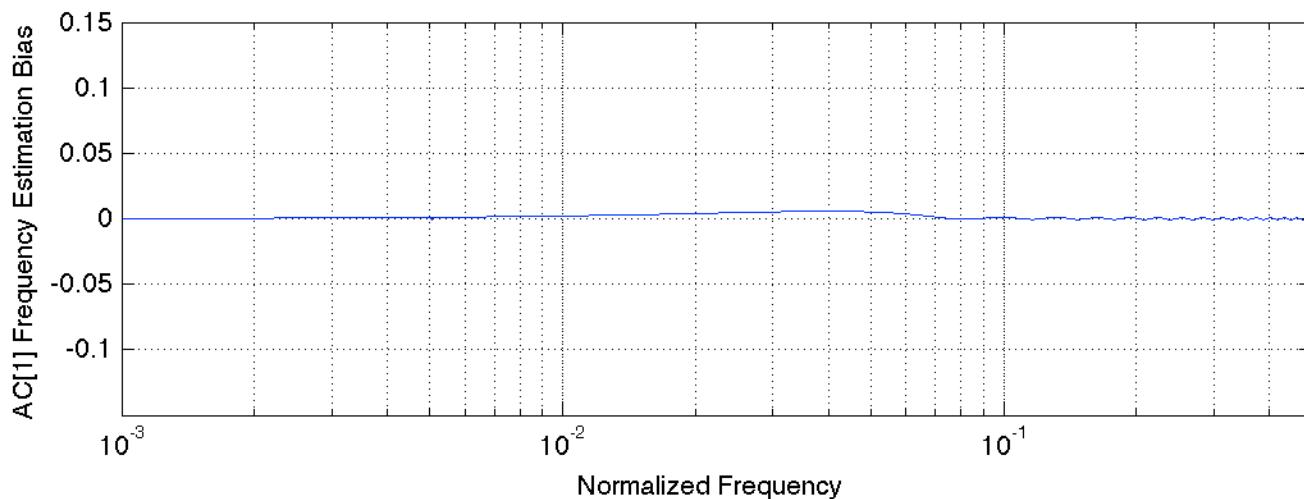
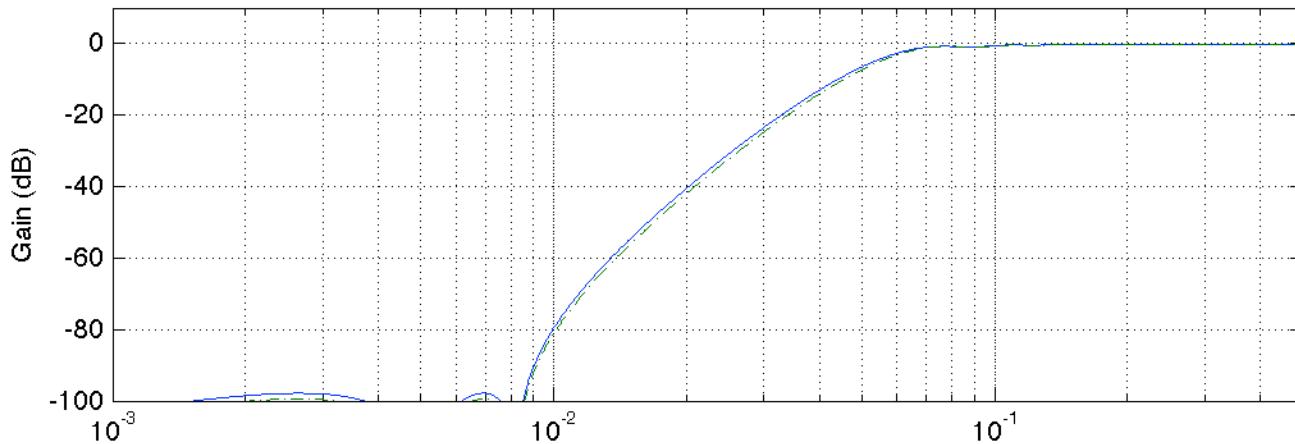
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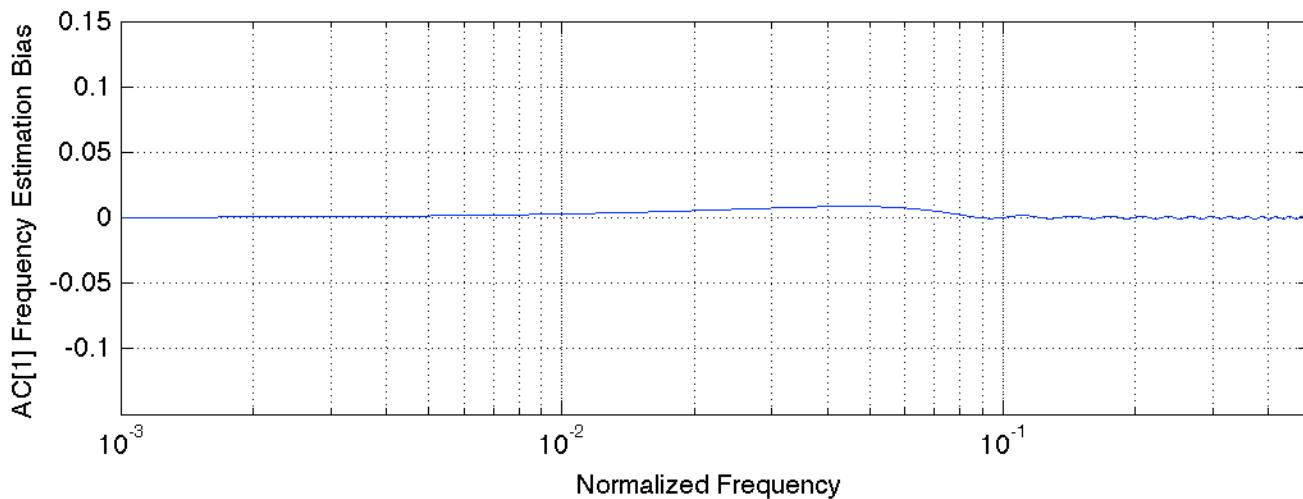
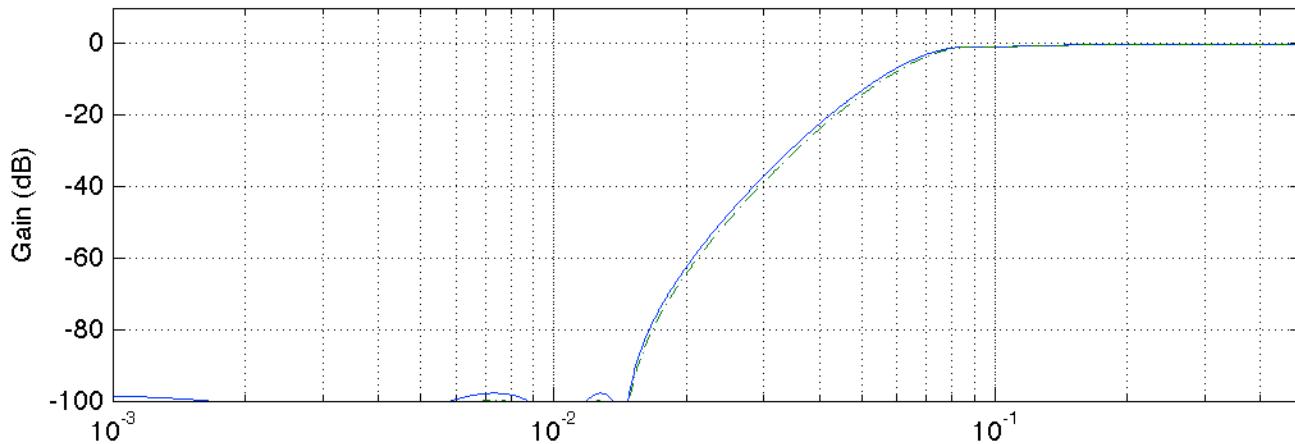
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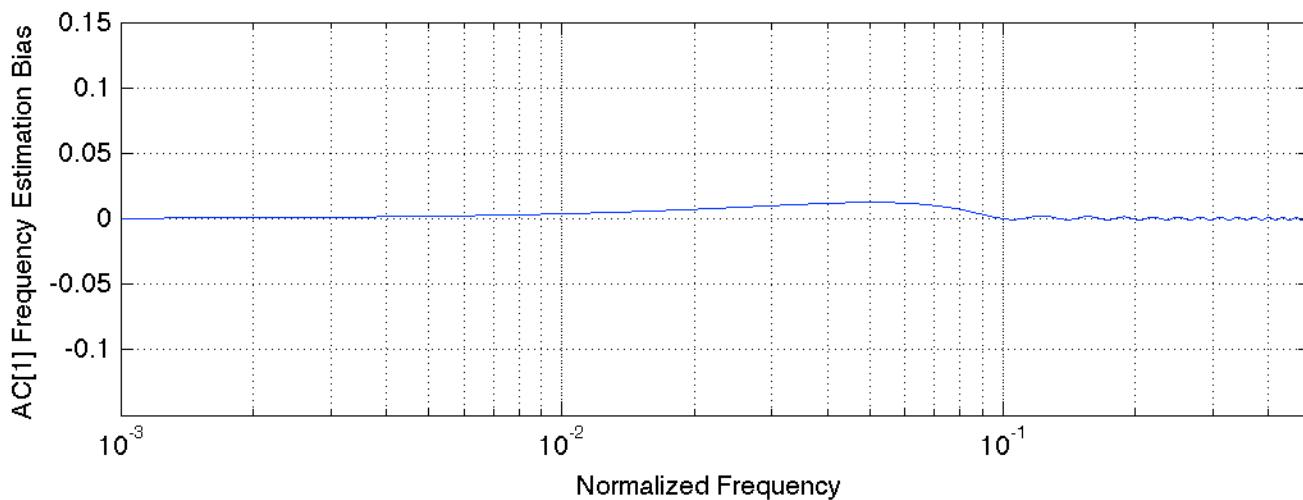
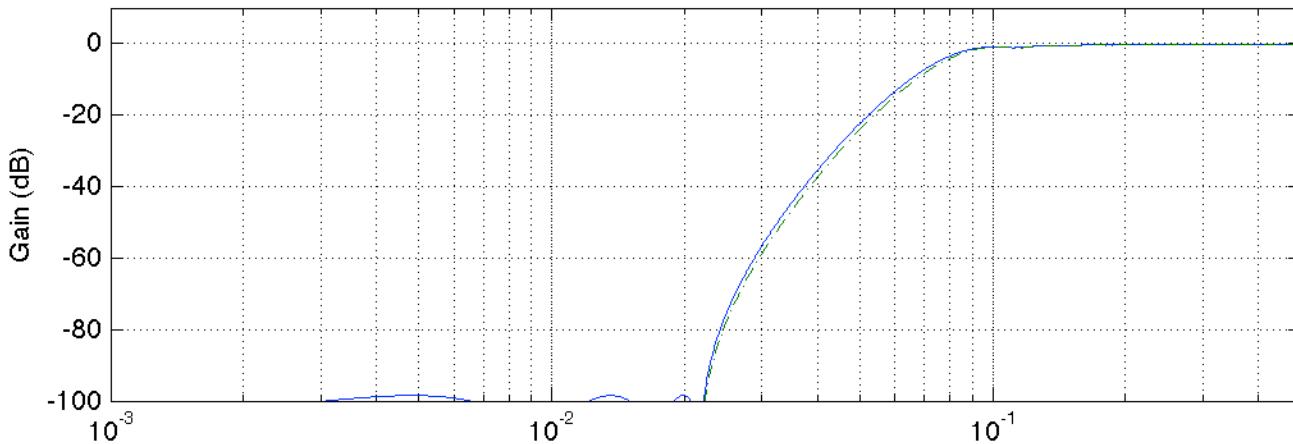
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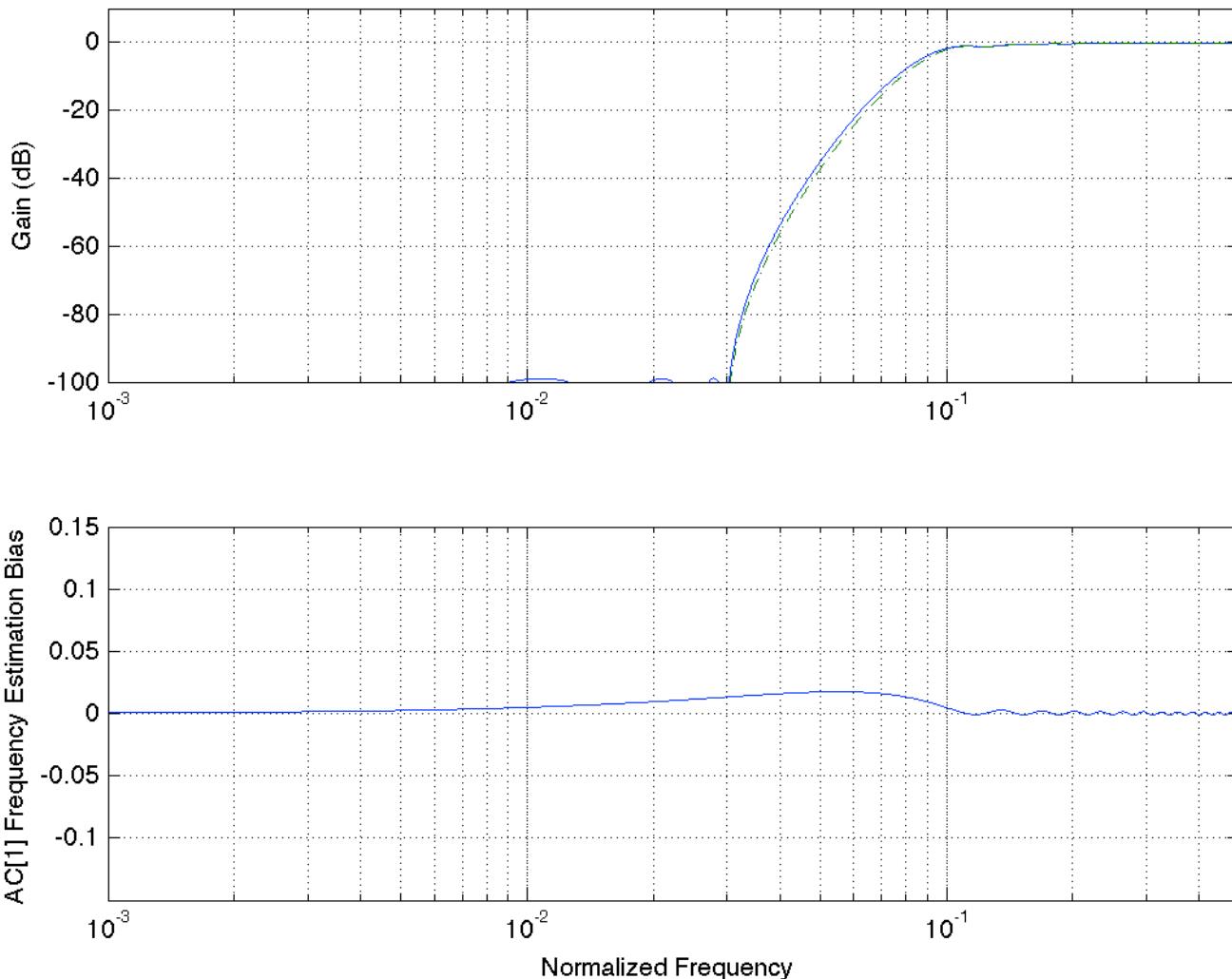
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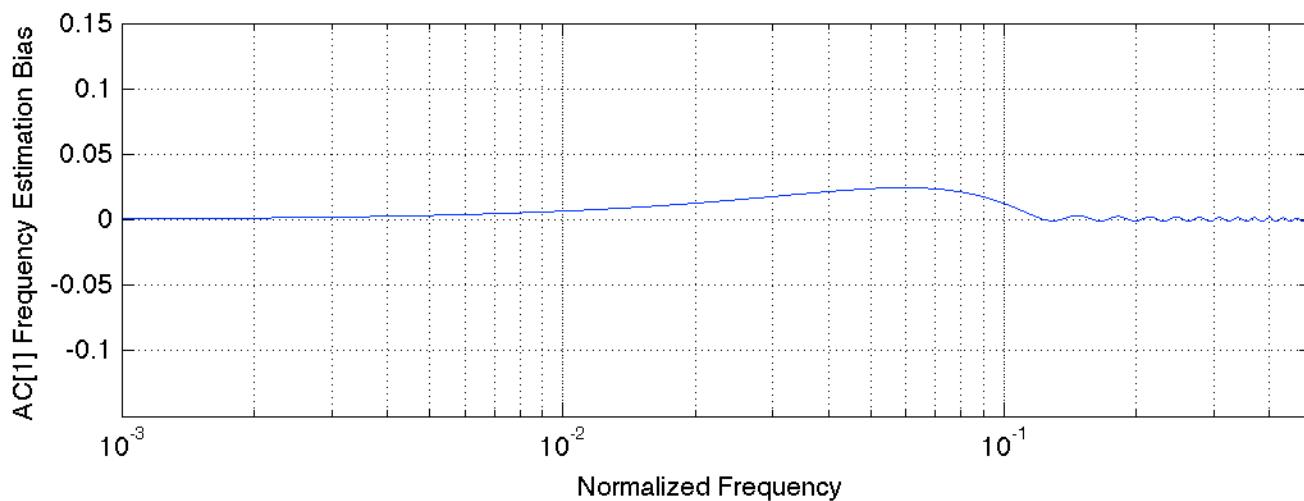
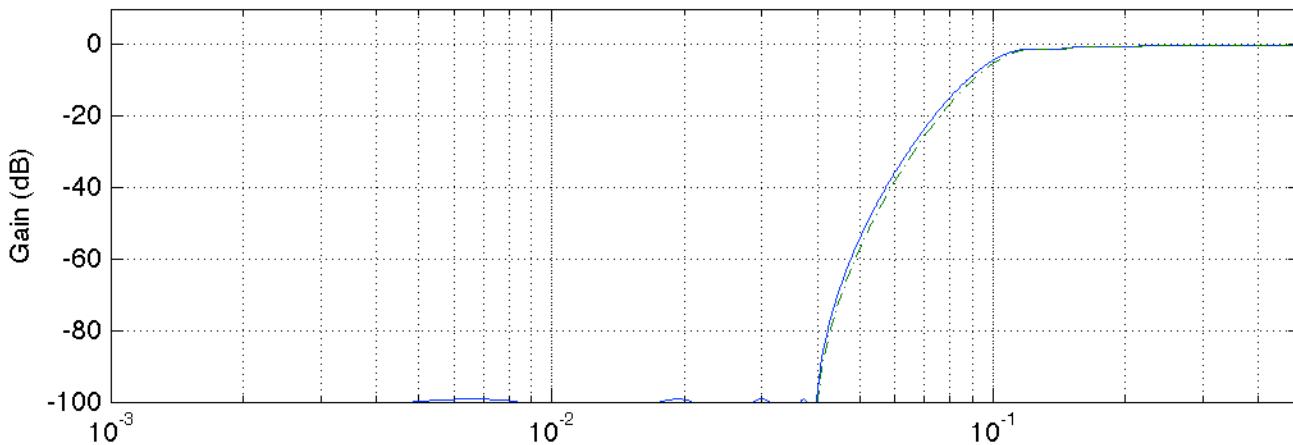
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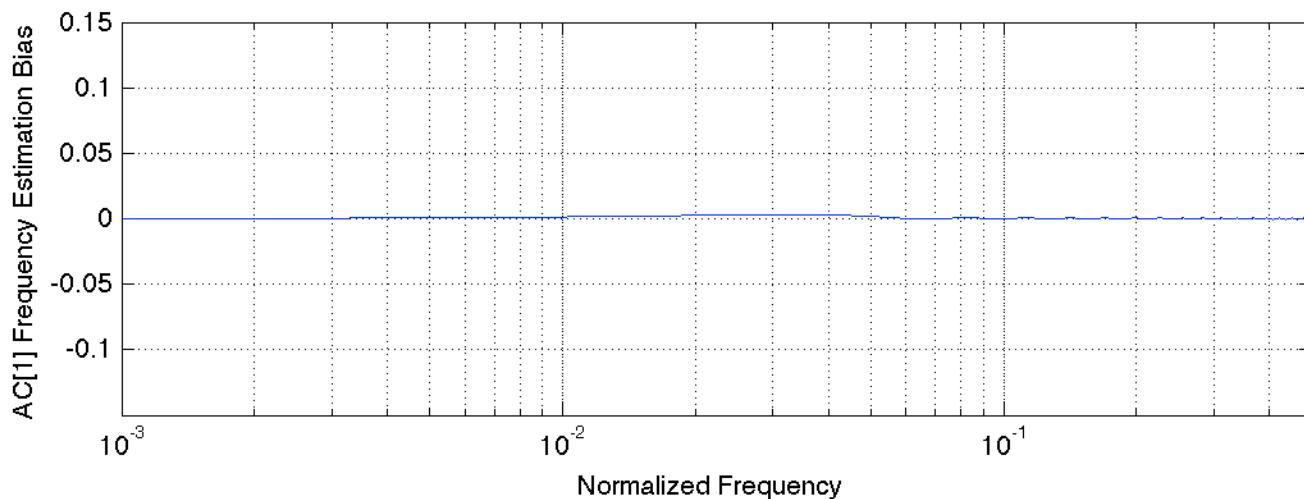
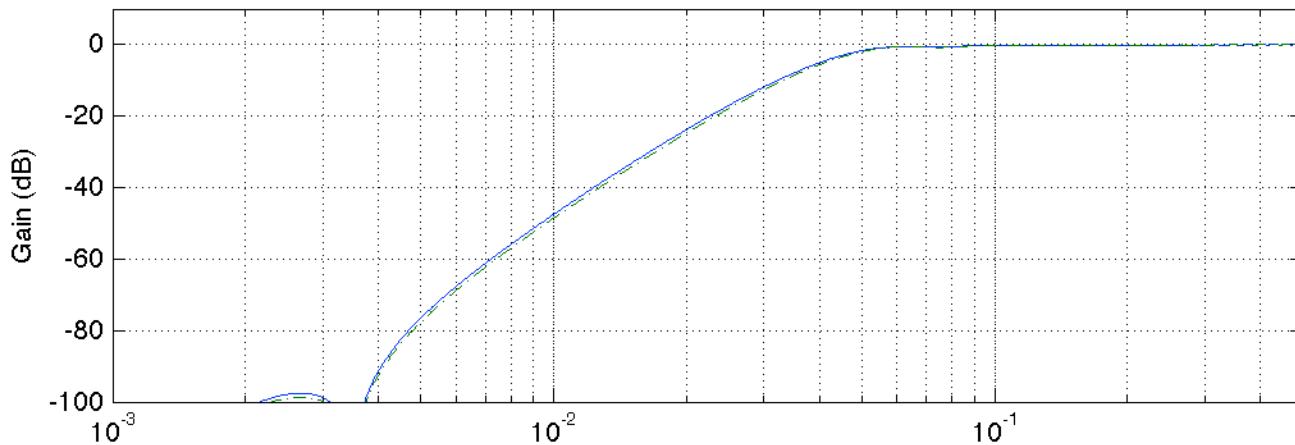
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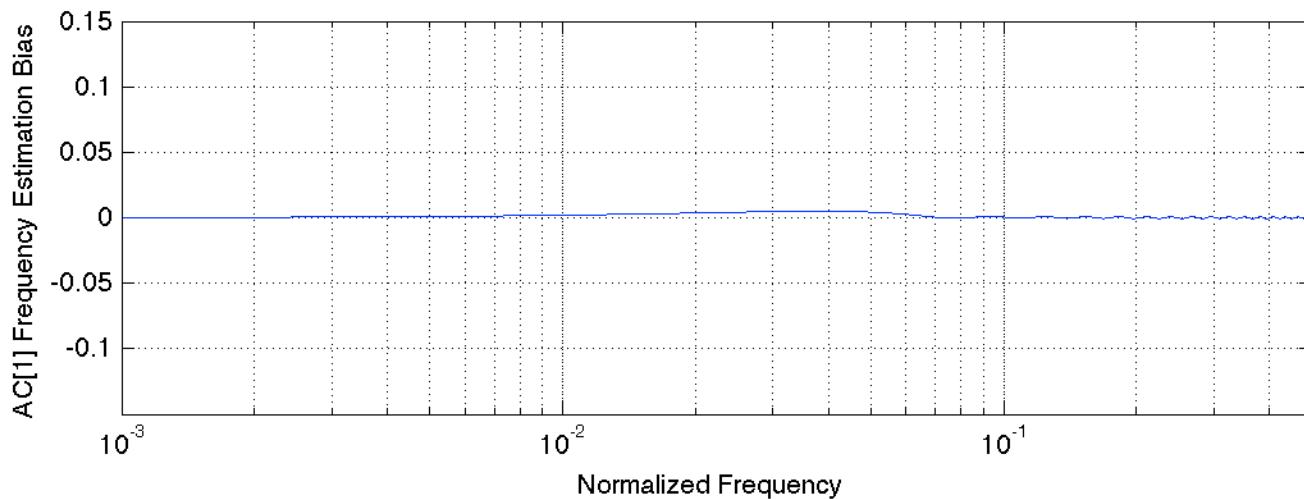
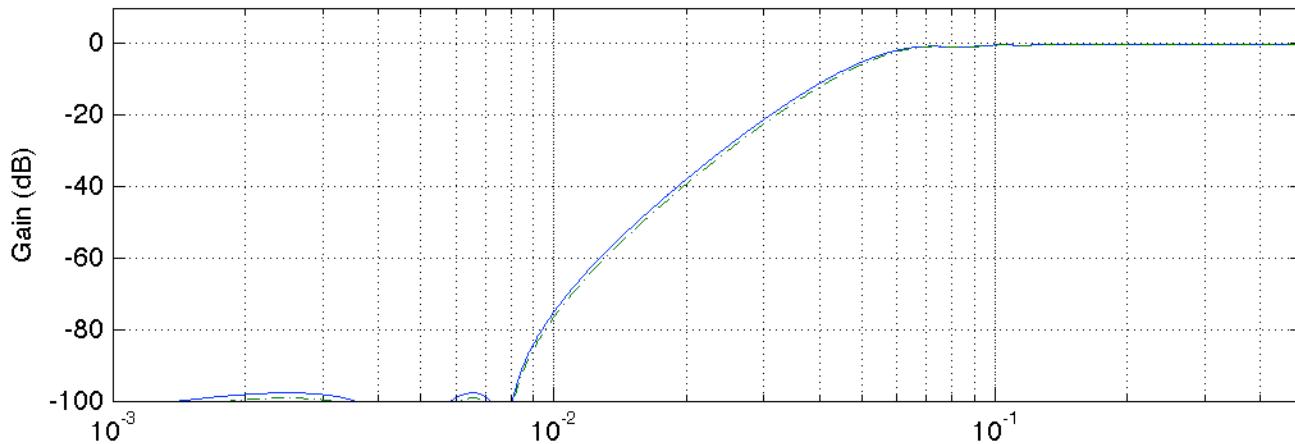
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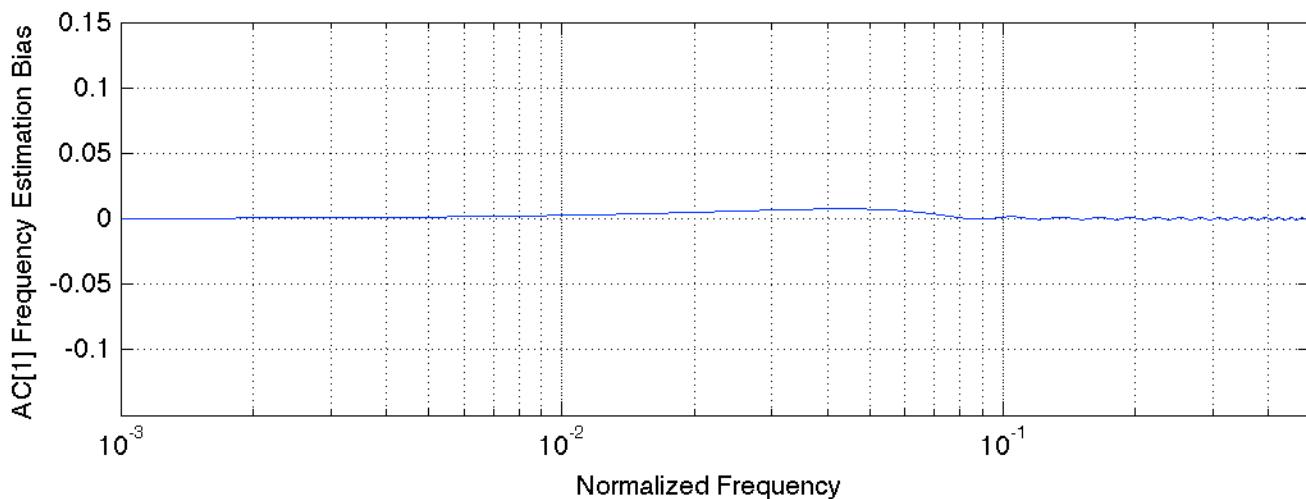
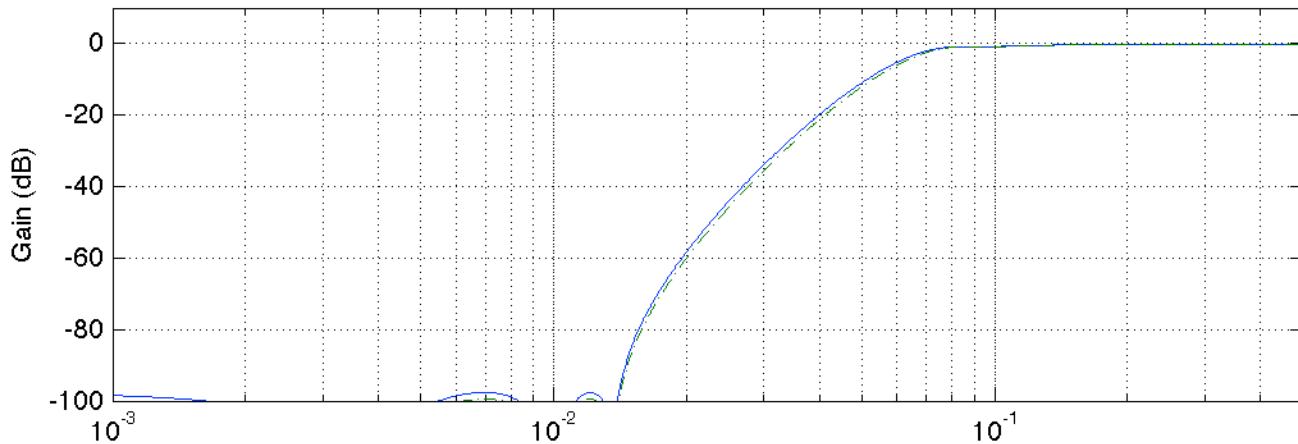
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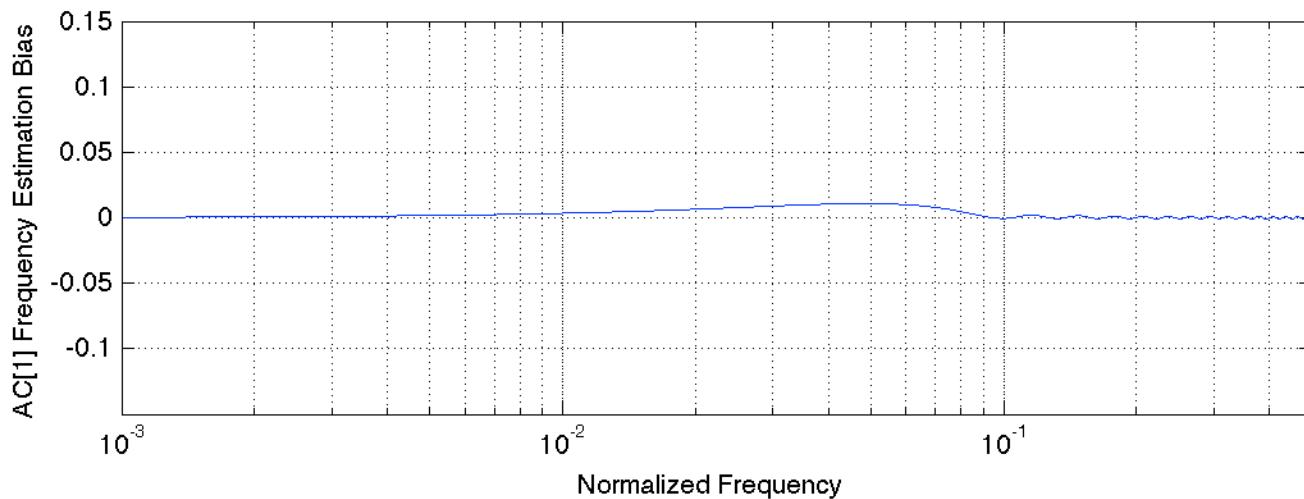
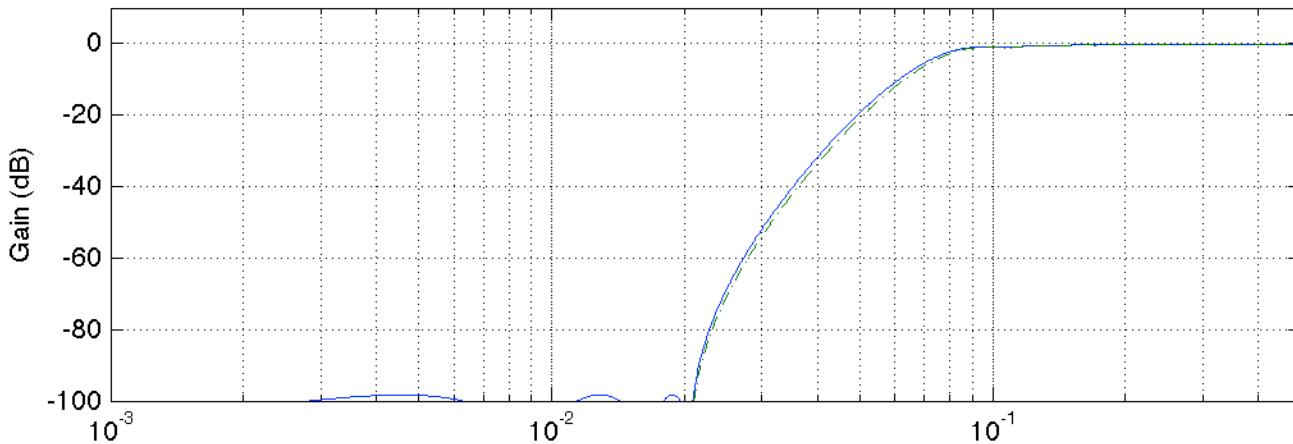
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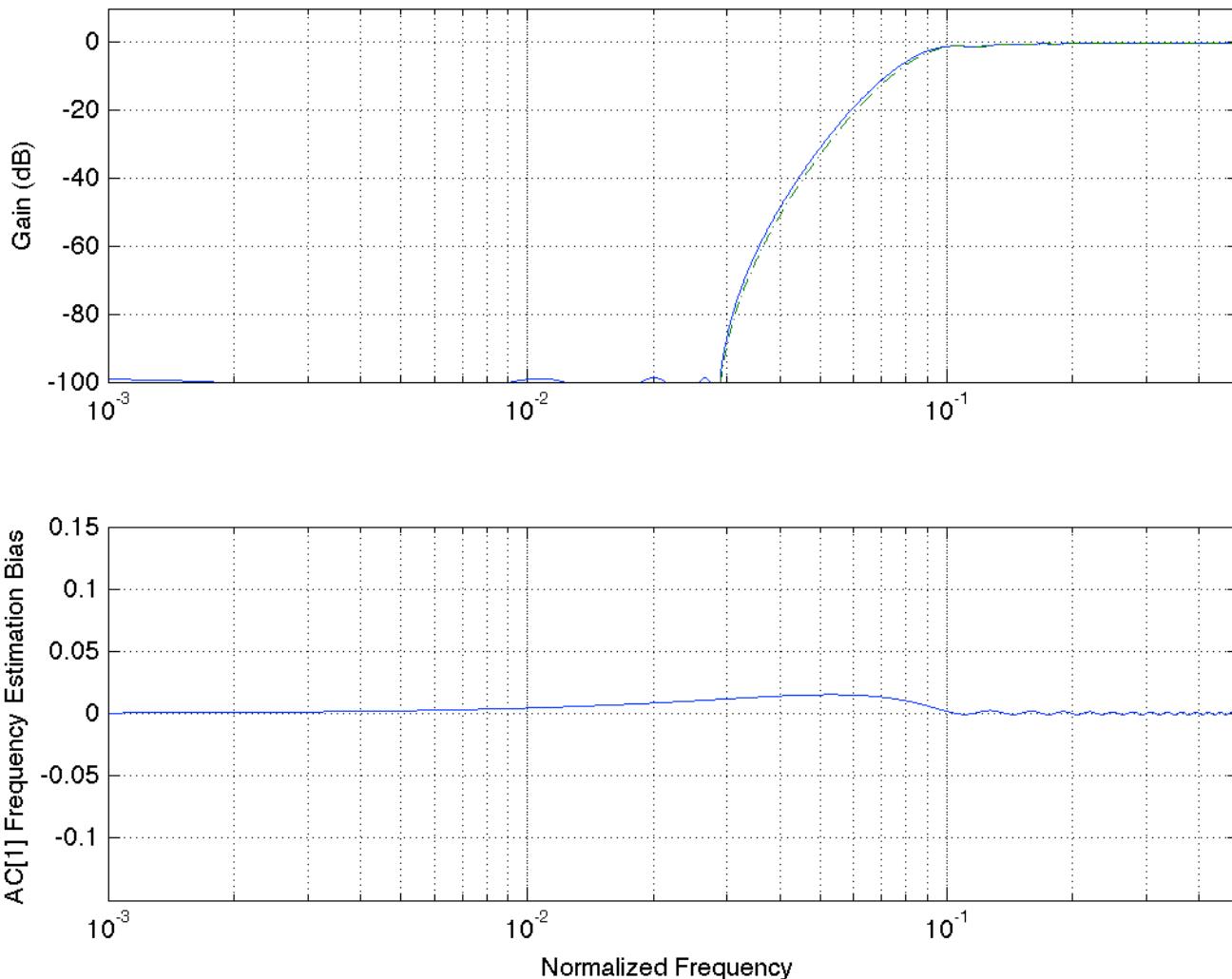
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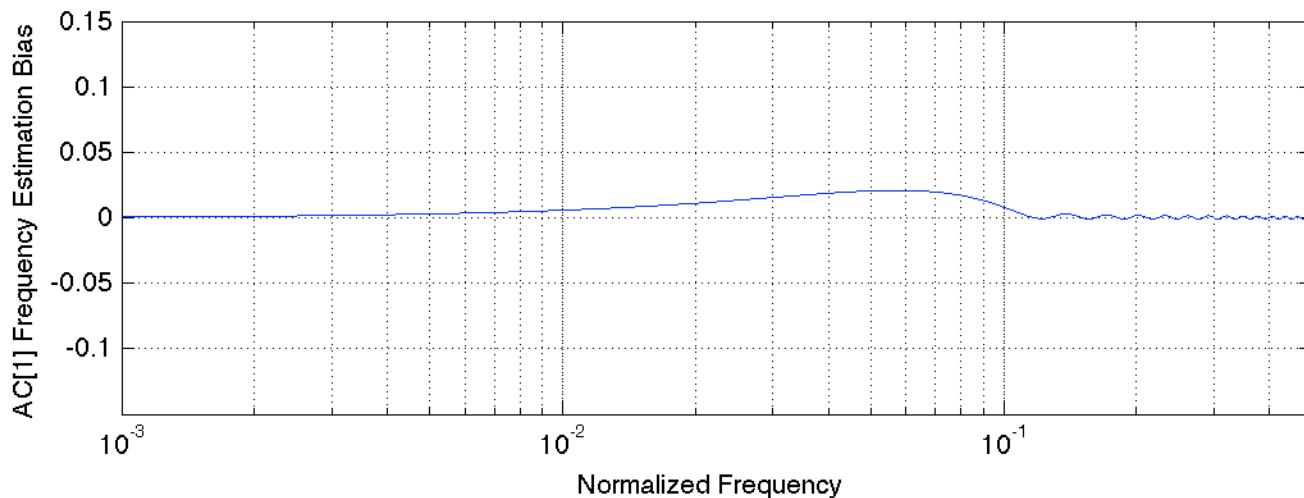
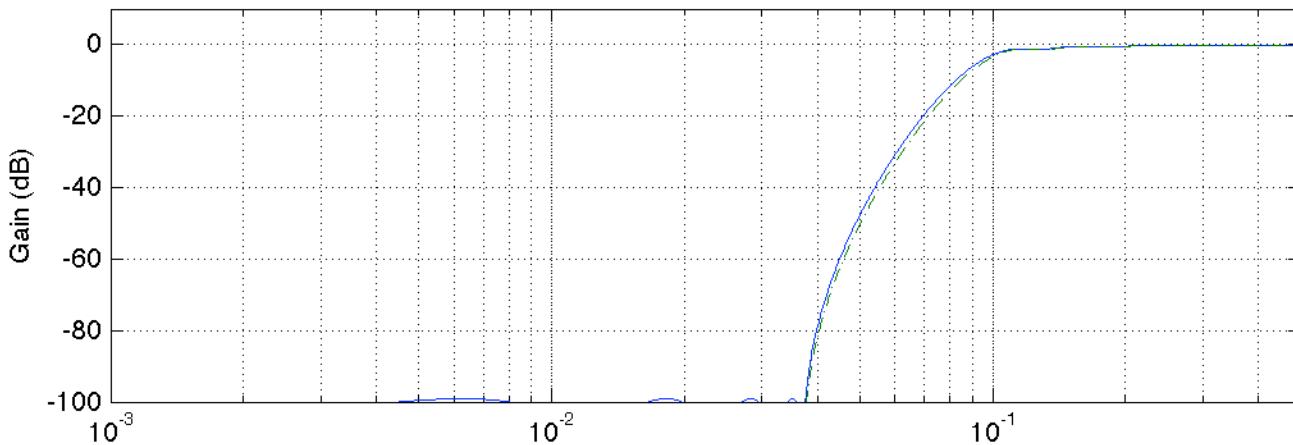
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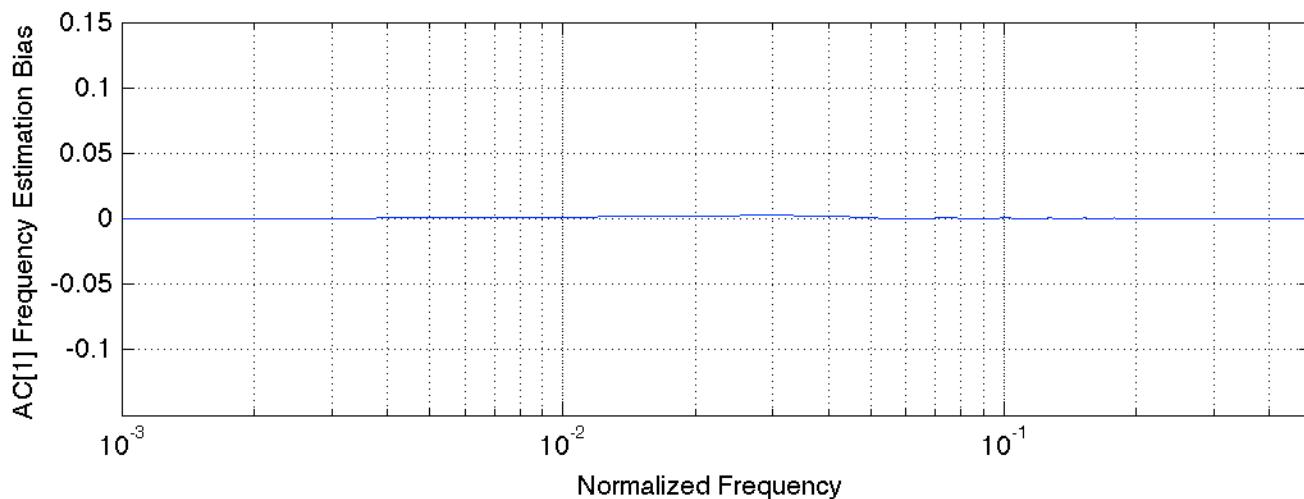
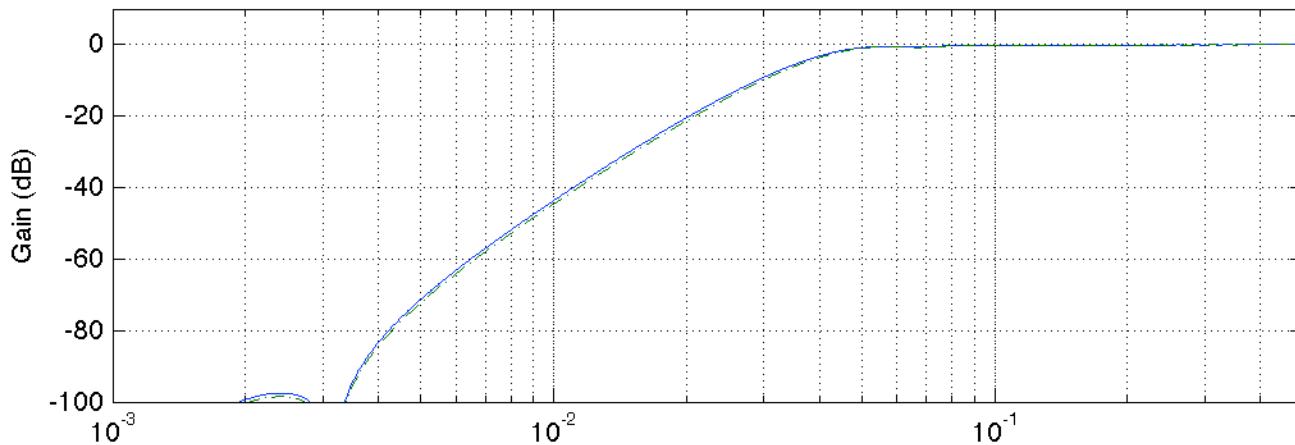
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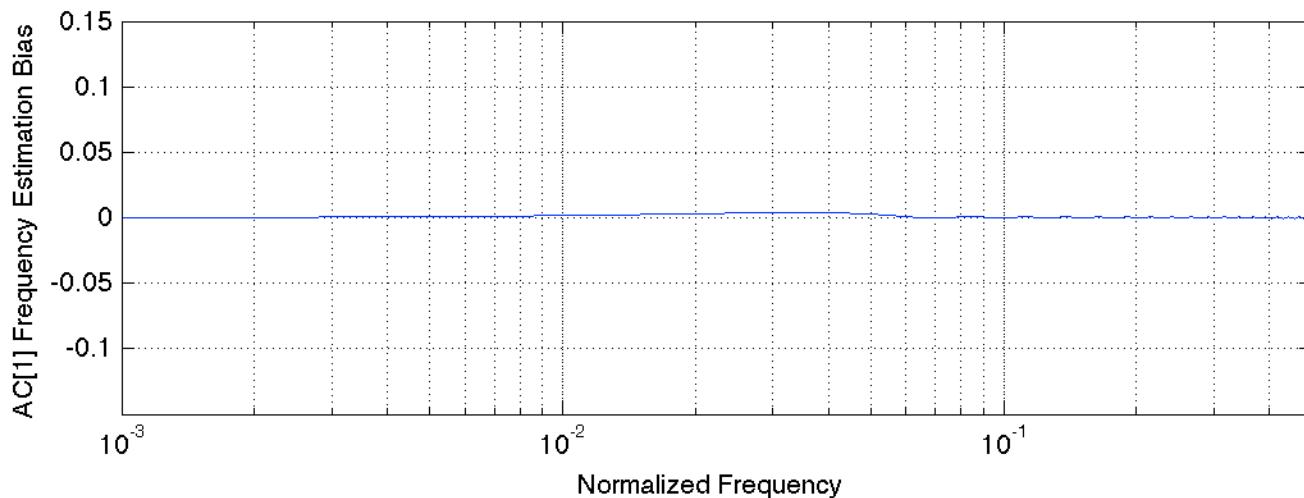
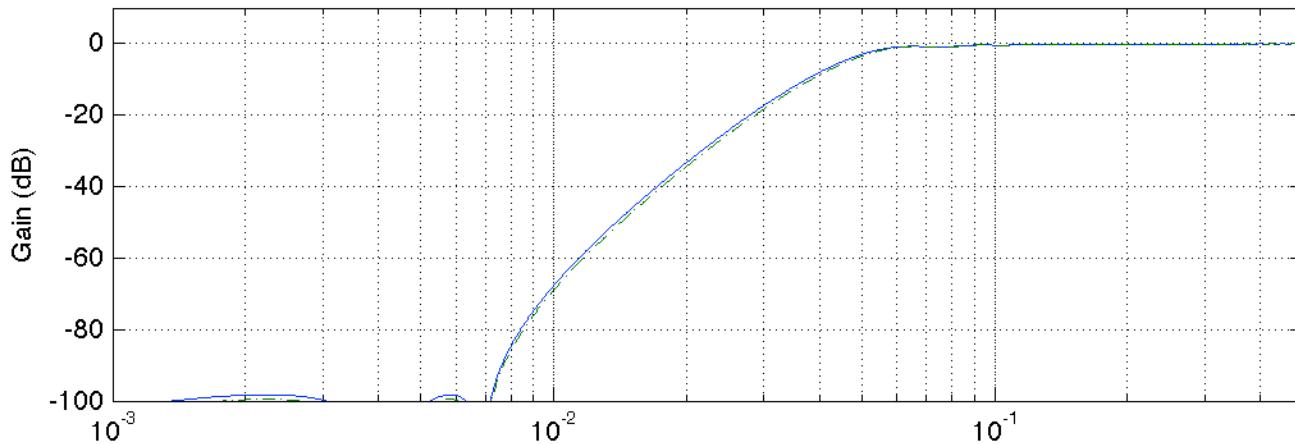
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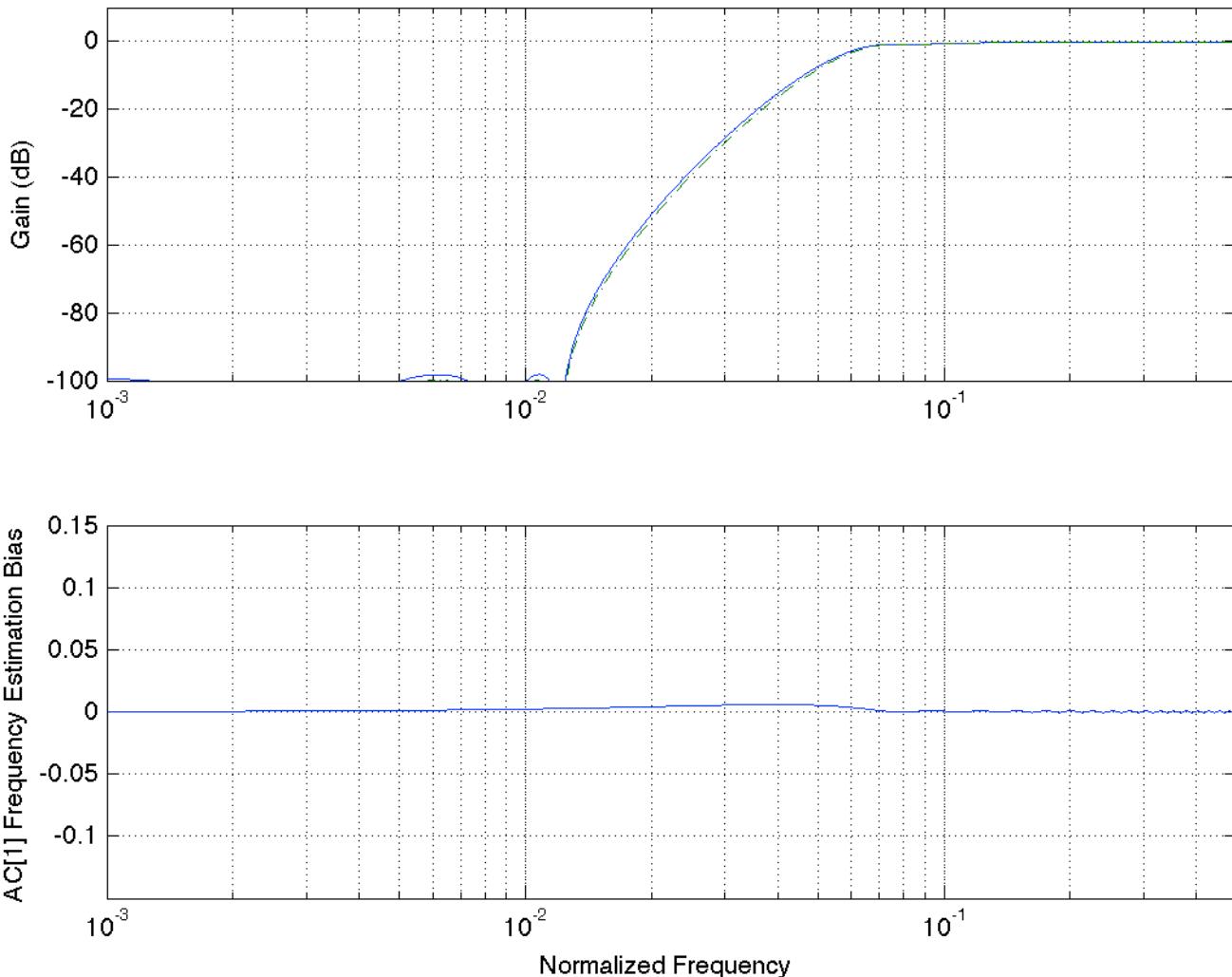
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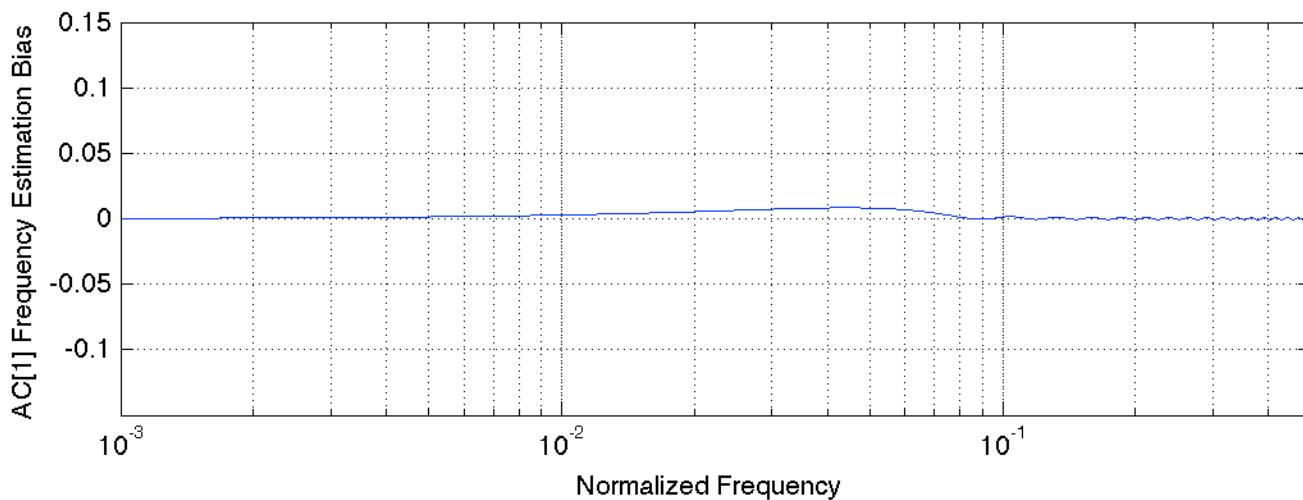
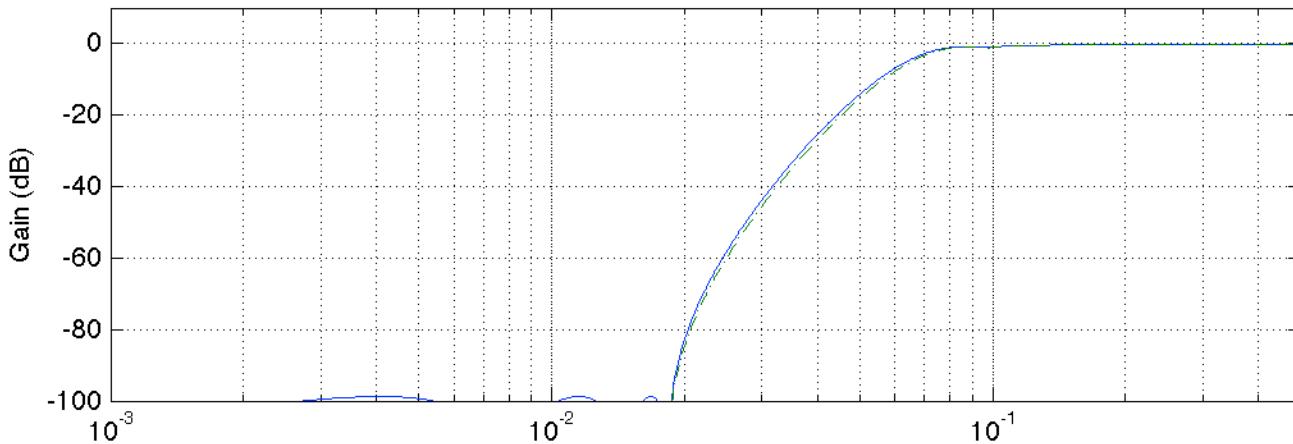
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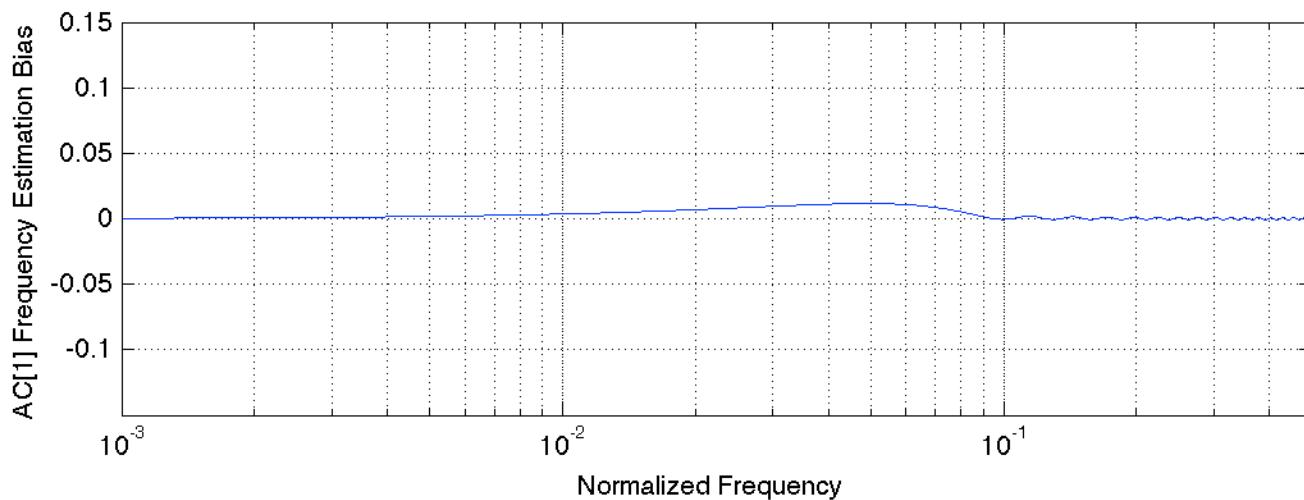
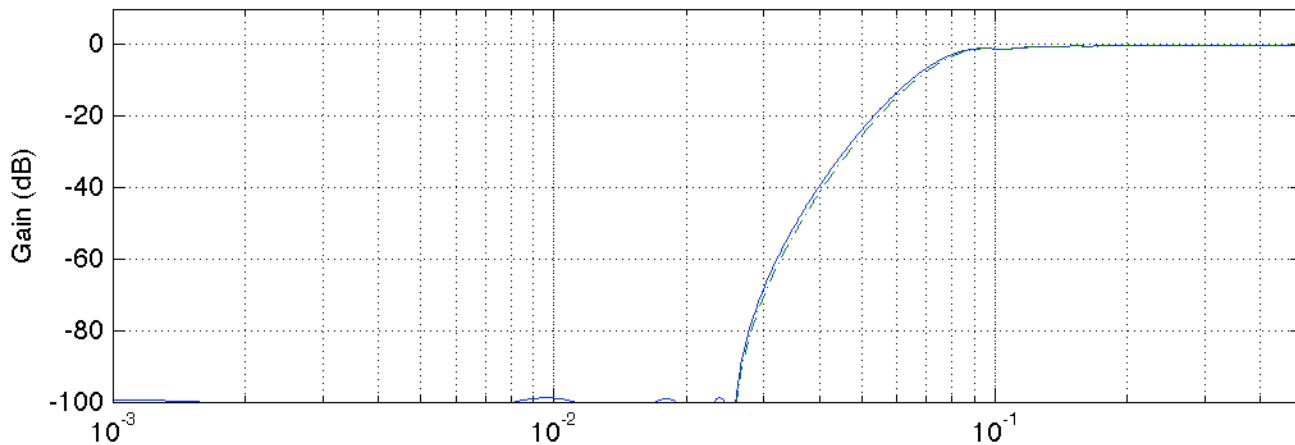
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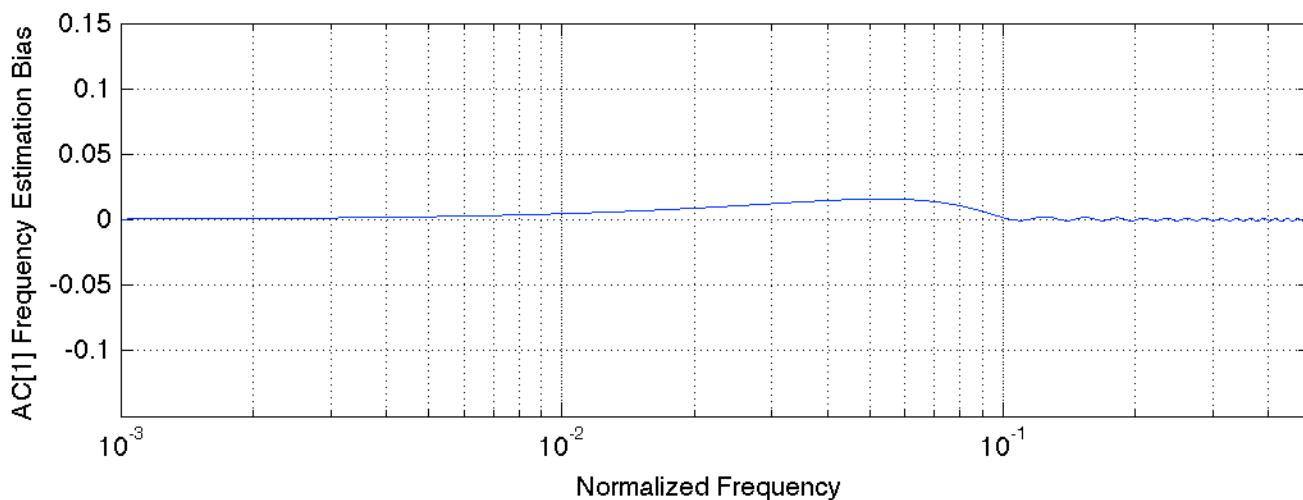
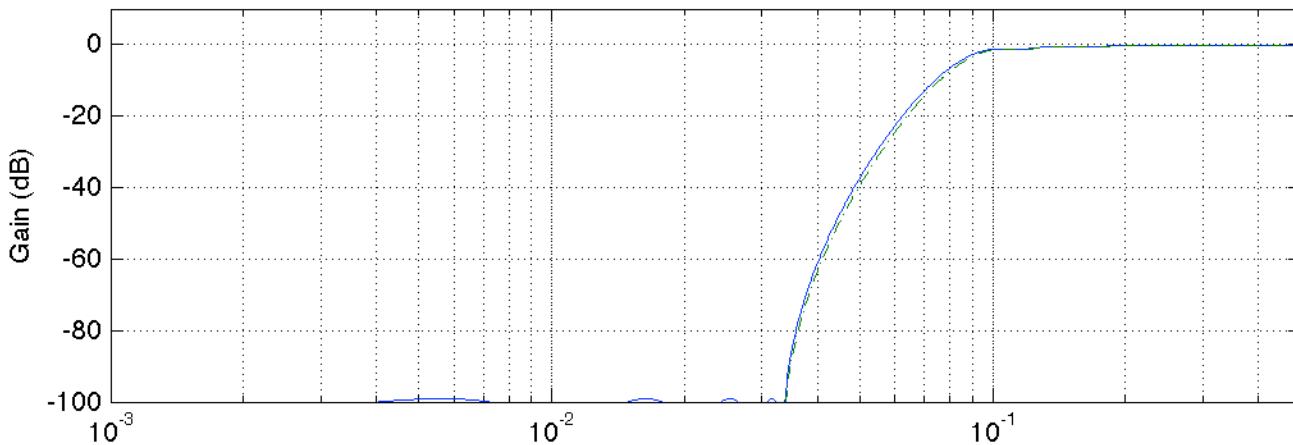
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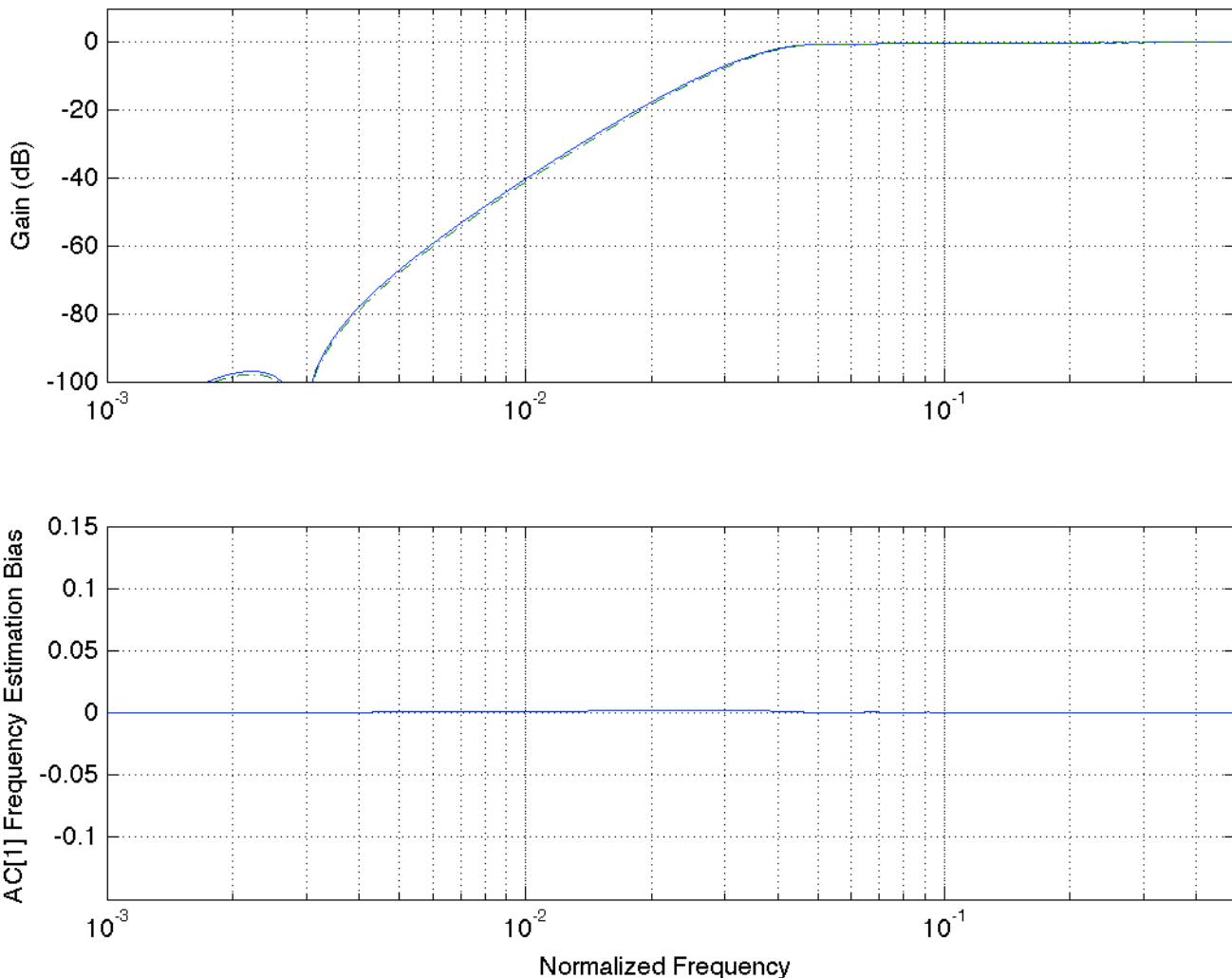
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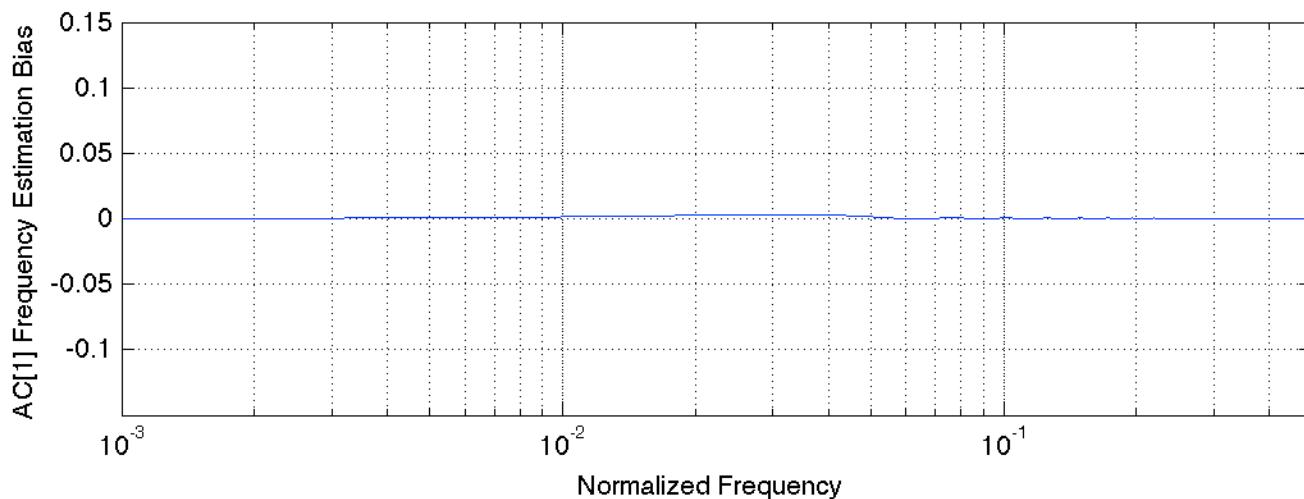
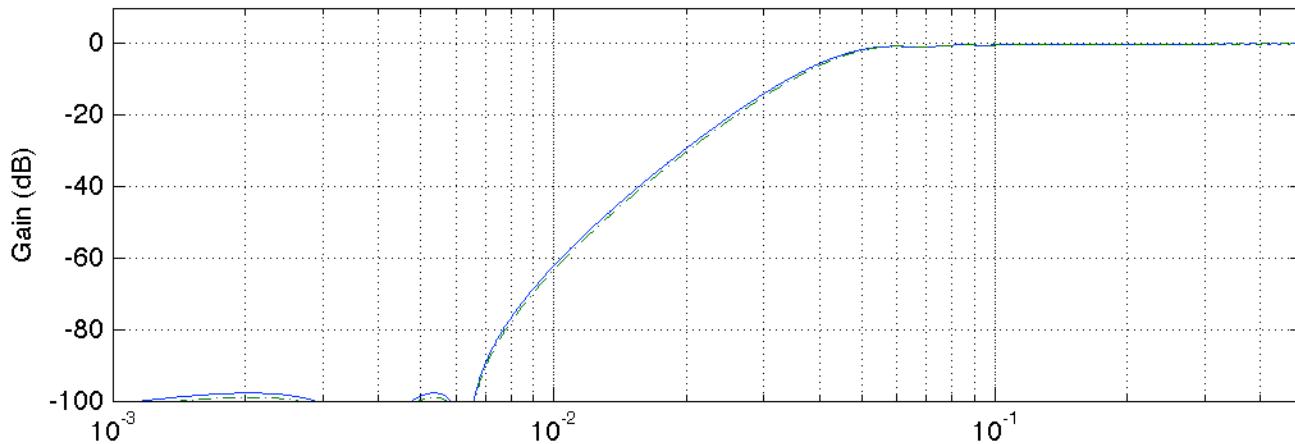
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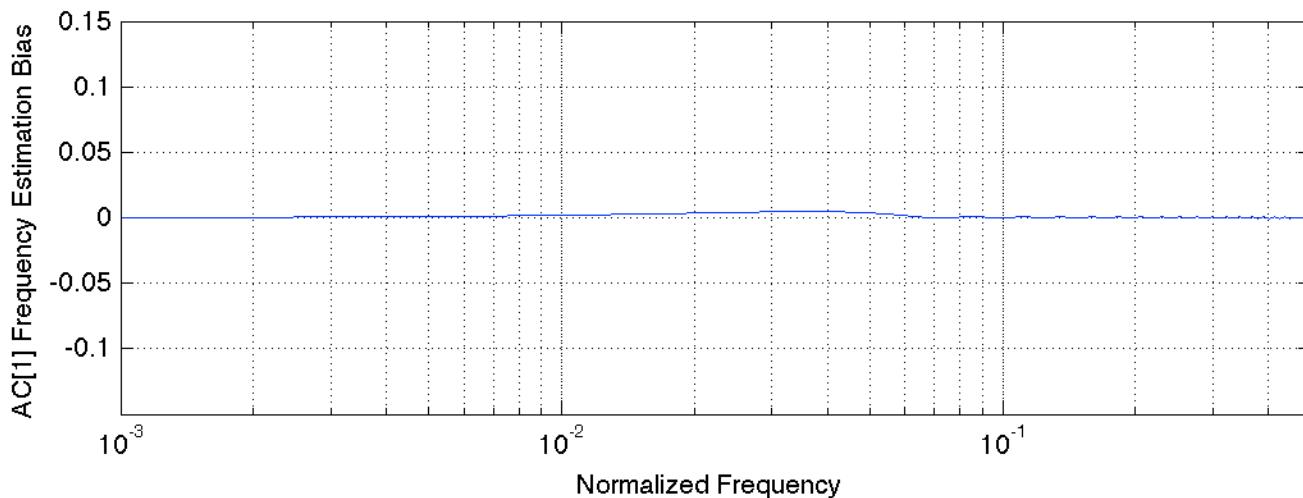
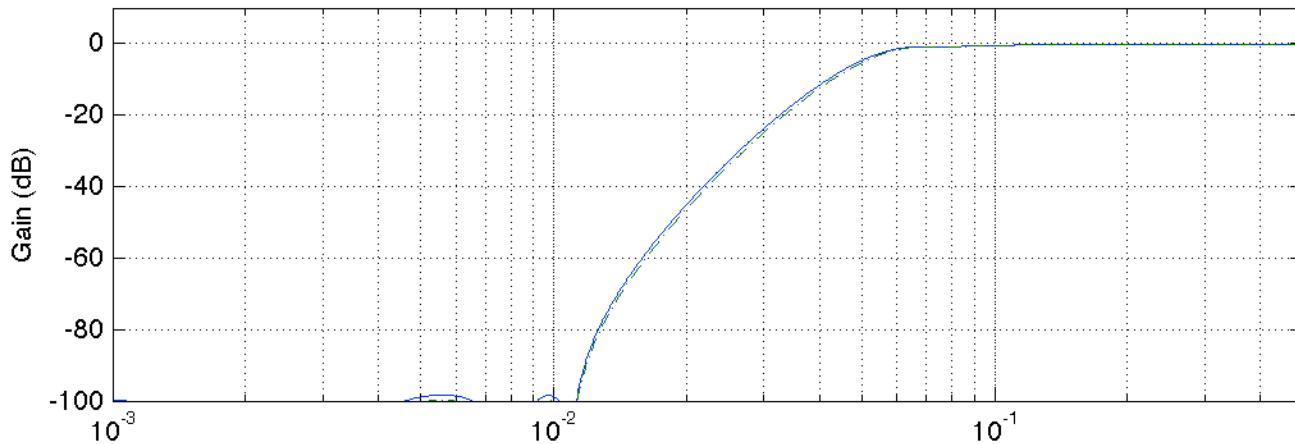
Filter: WeakFlowVLow: $N_{pri} = 44$, $N_{zeros} = 4$



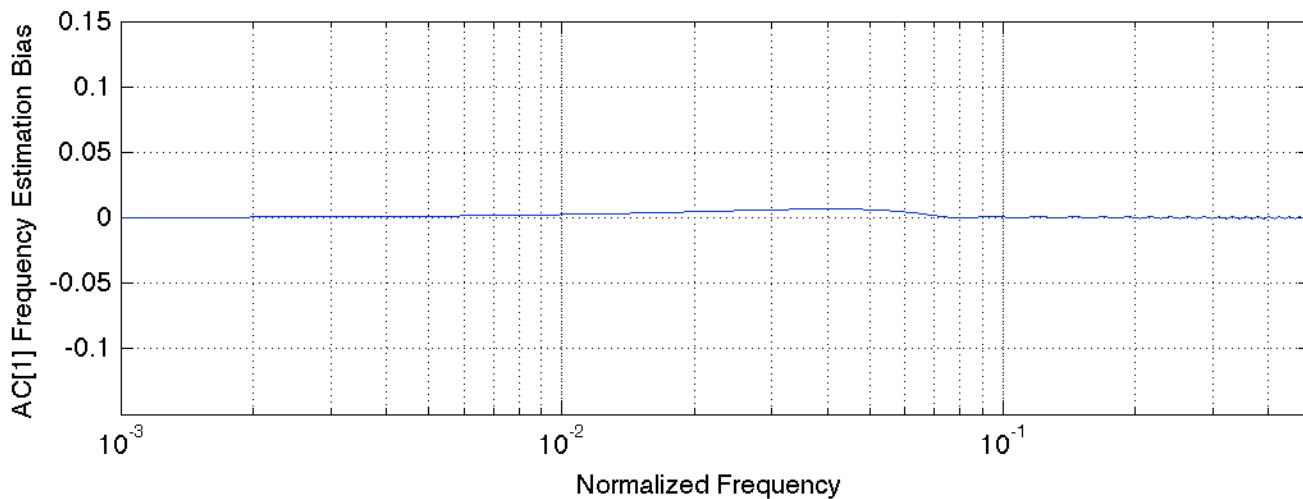
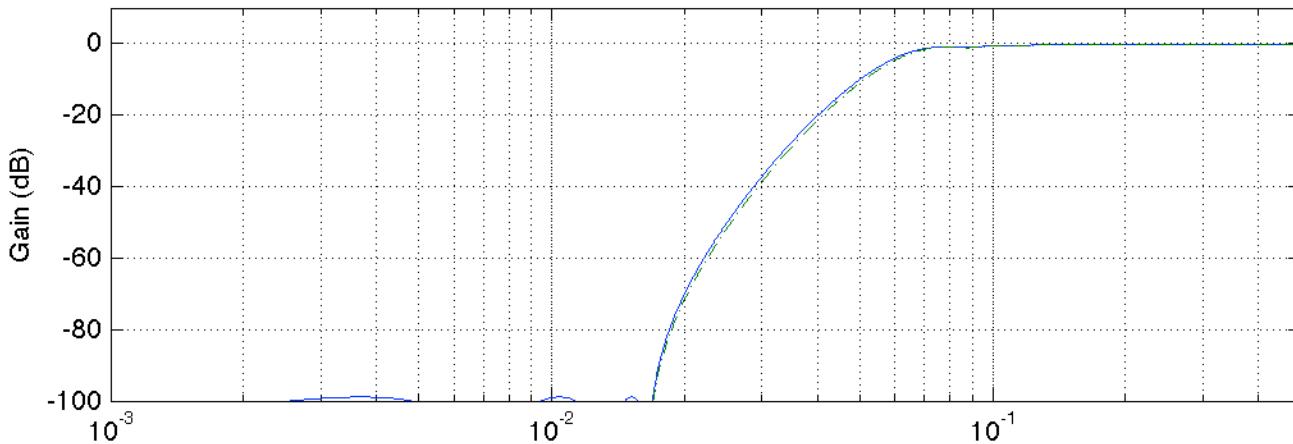
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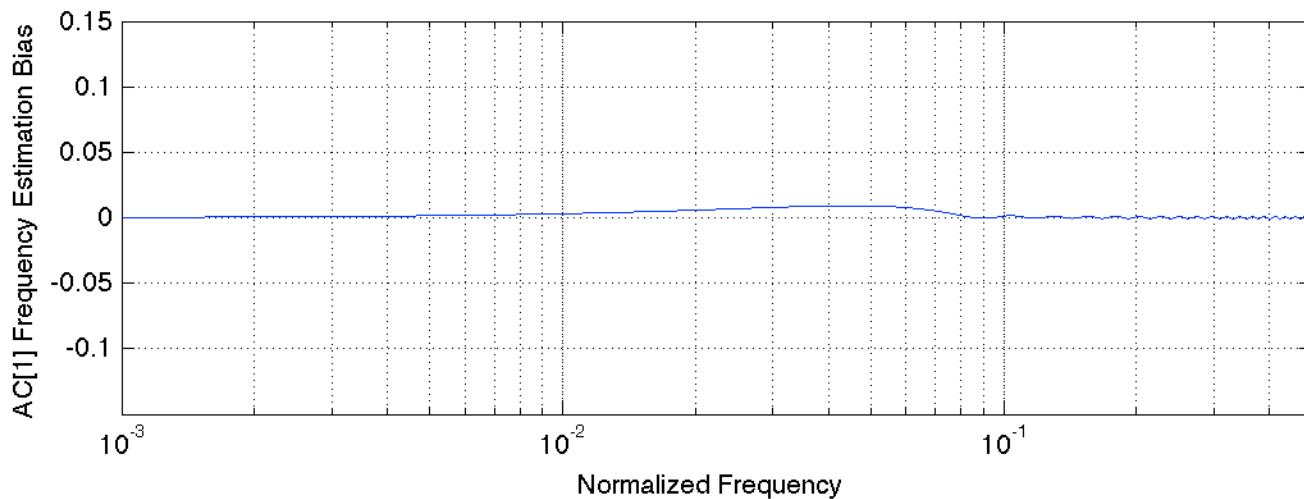
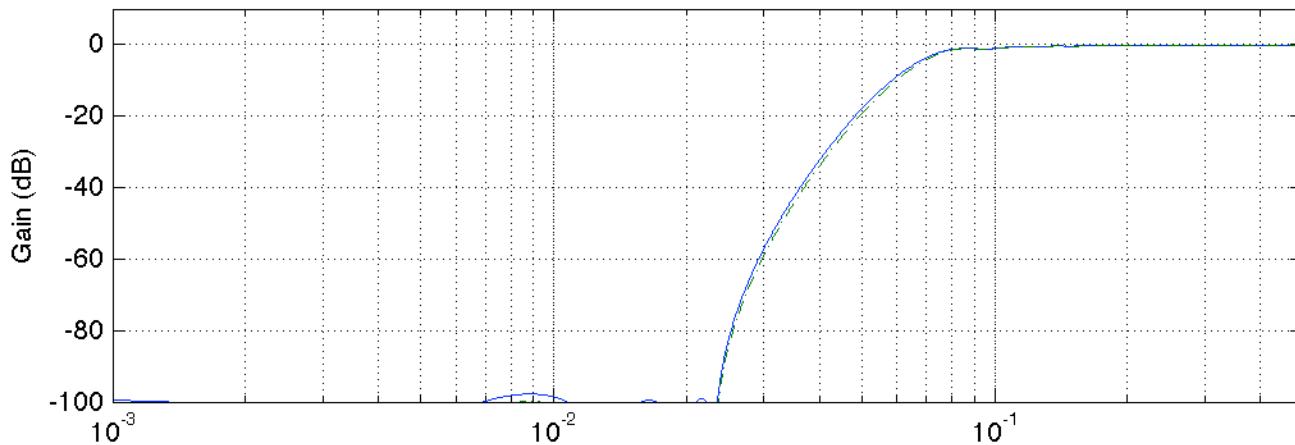
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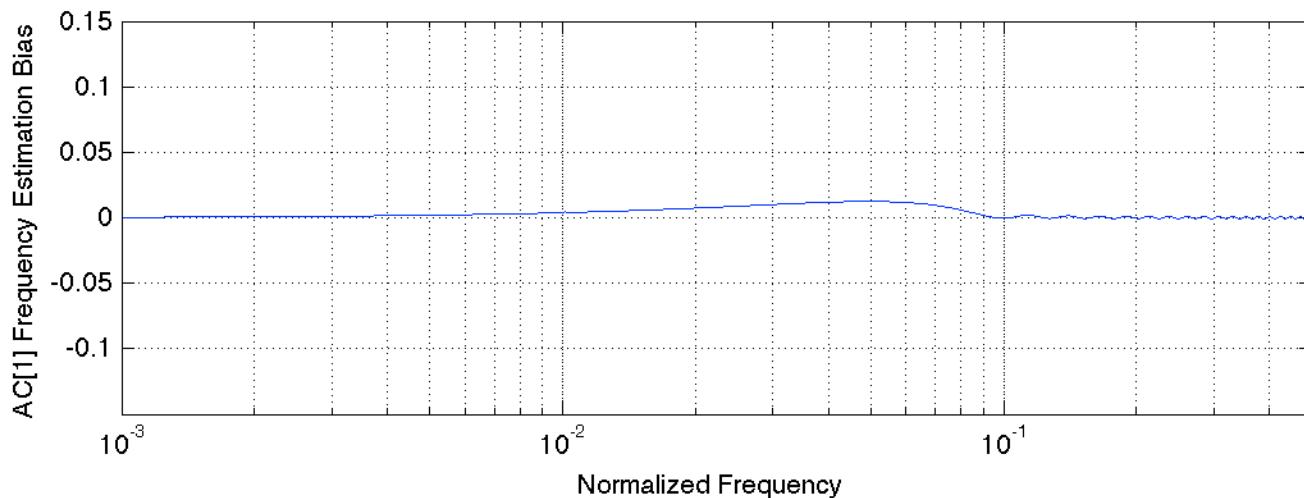
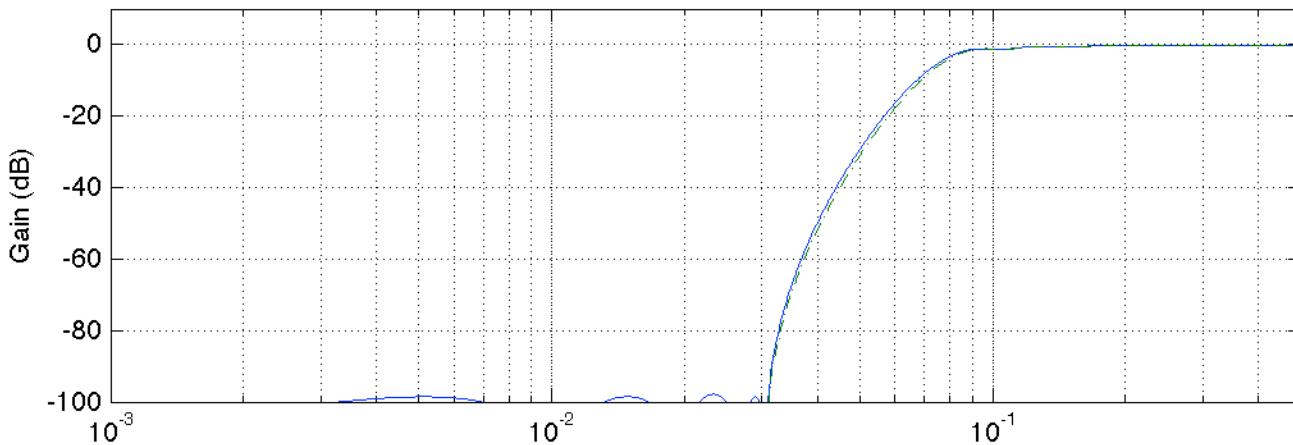
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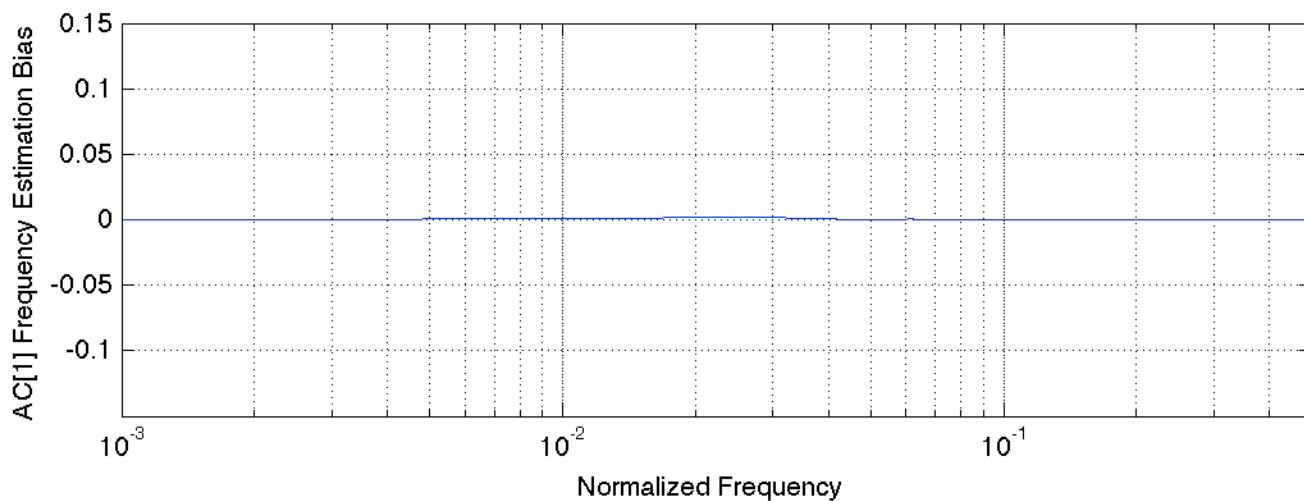
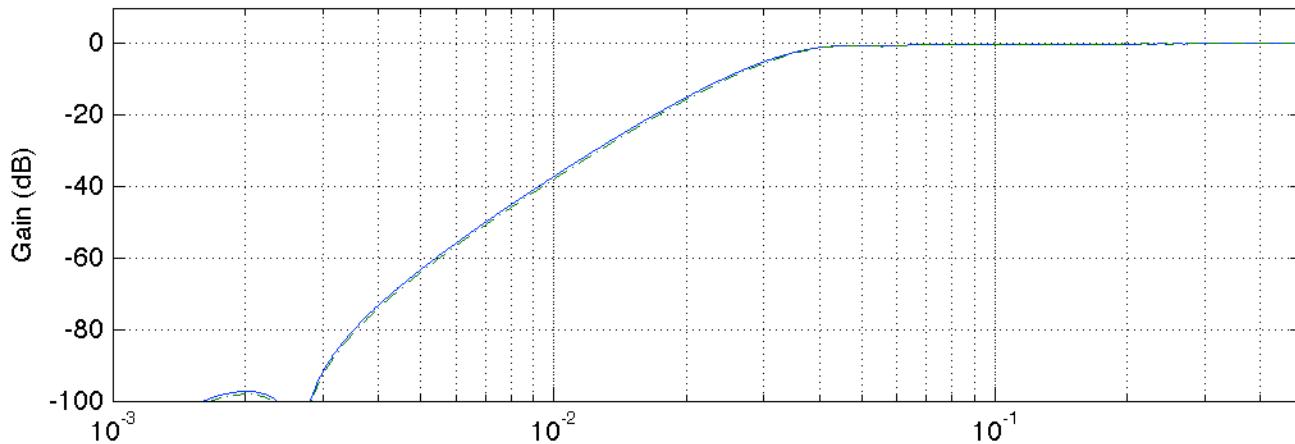
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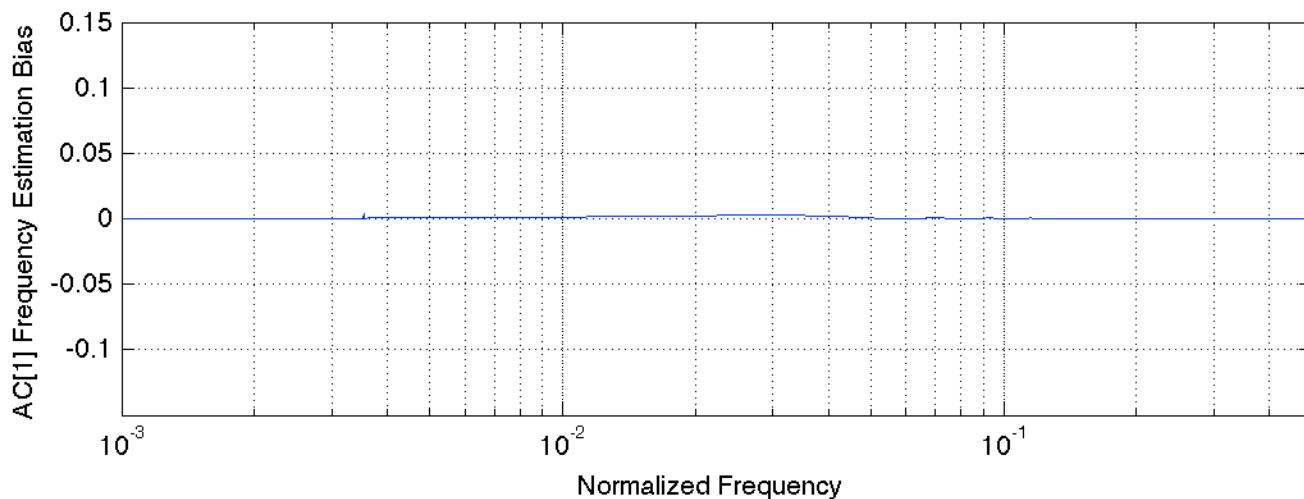
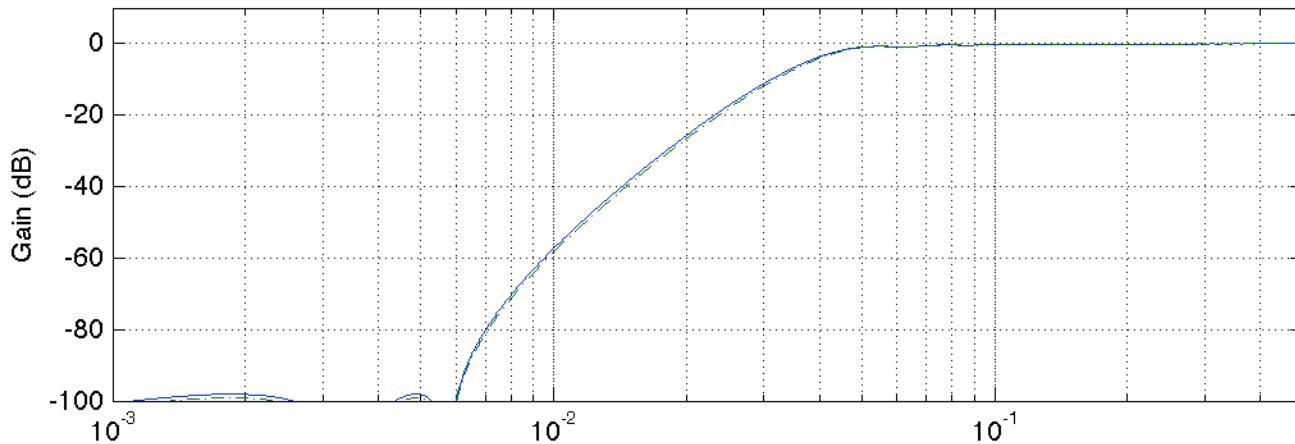
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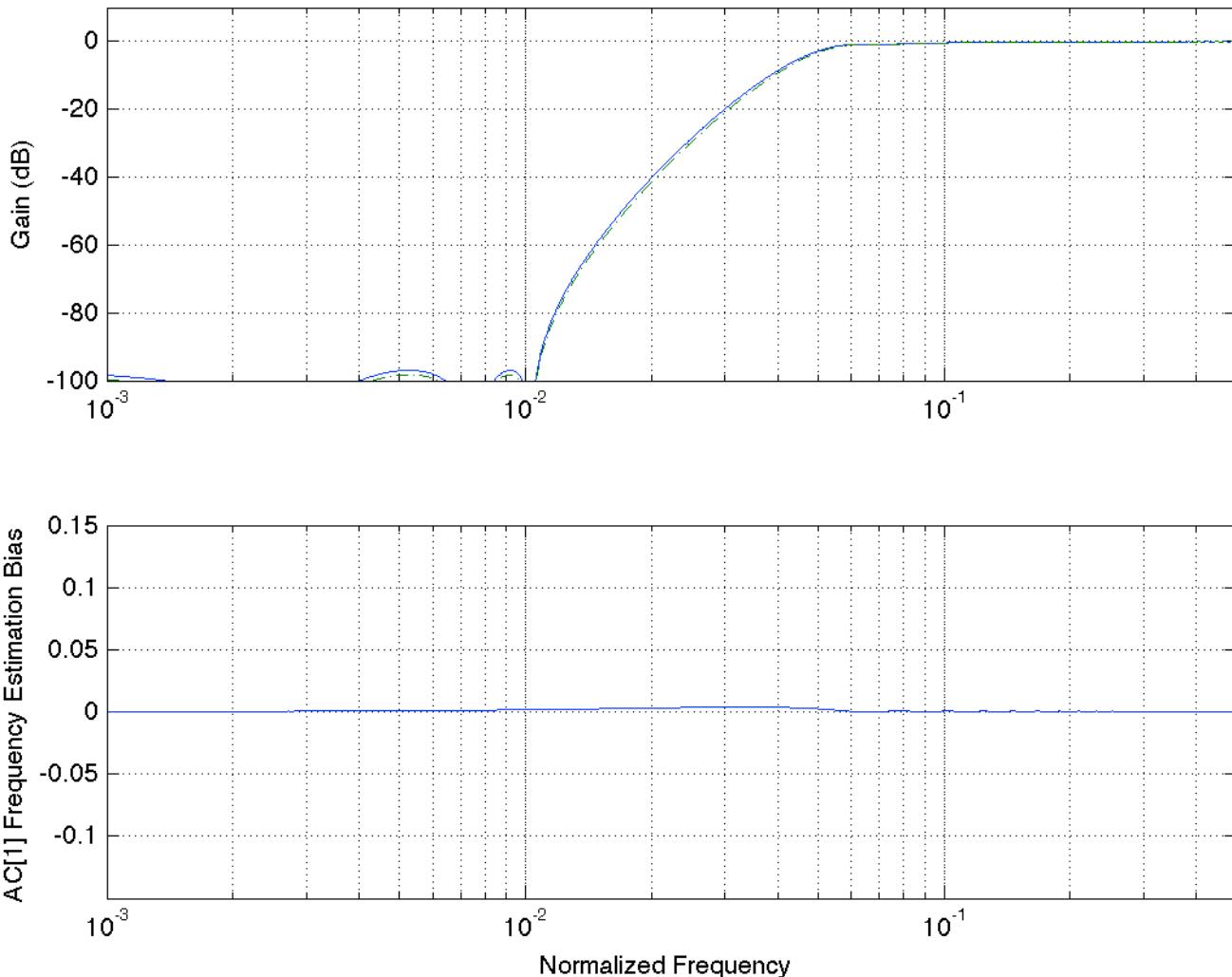
Filter: WeakFlowVLow: $N_{pri} = 48$, $N_{zeros} = 4$



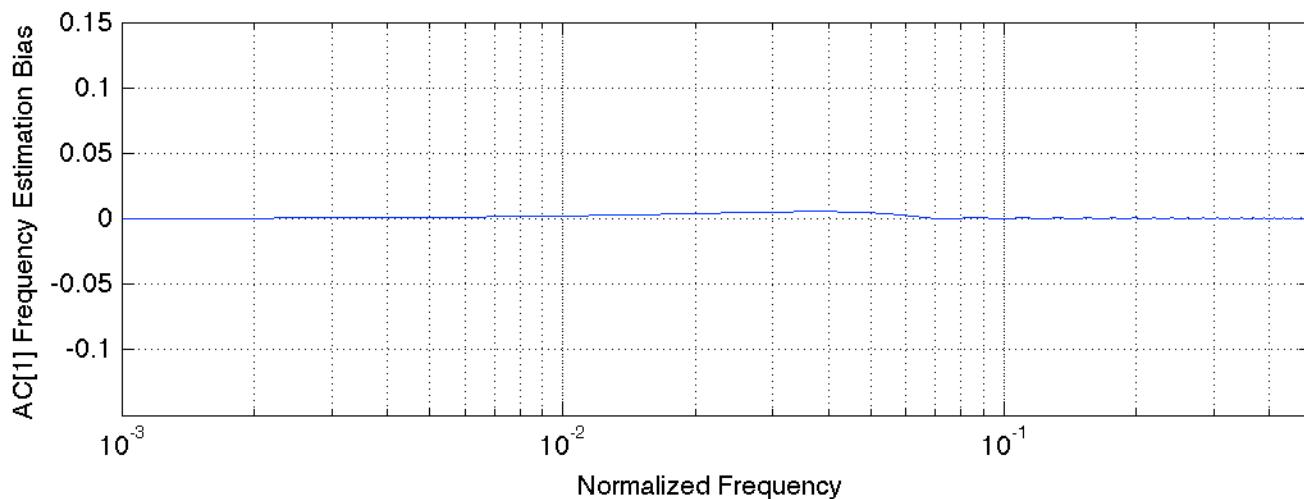
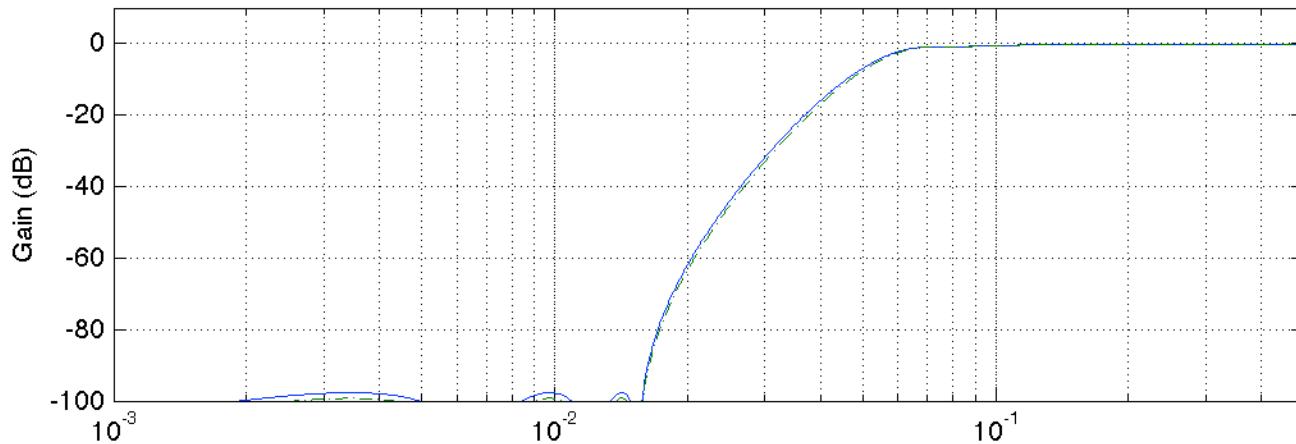
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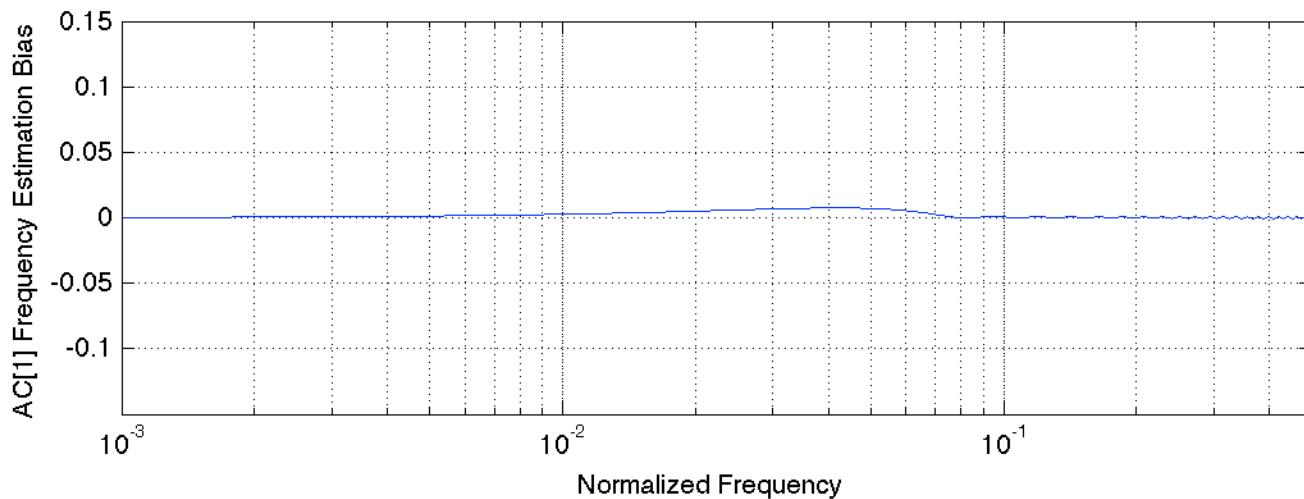
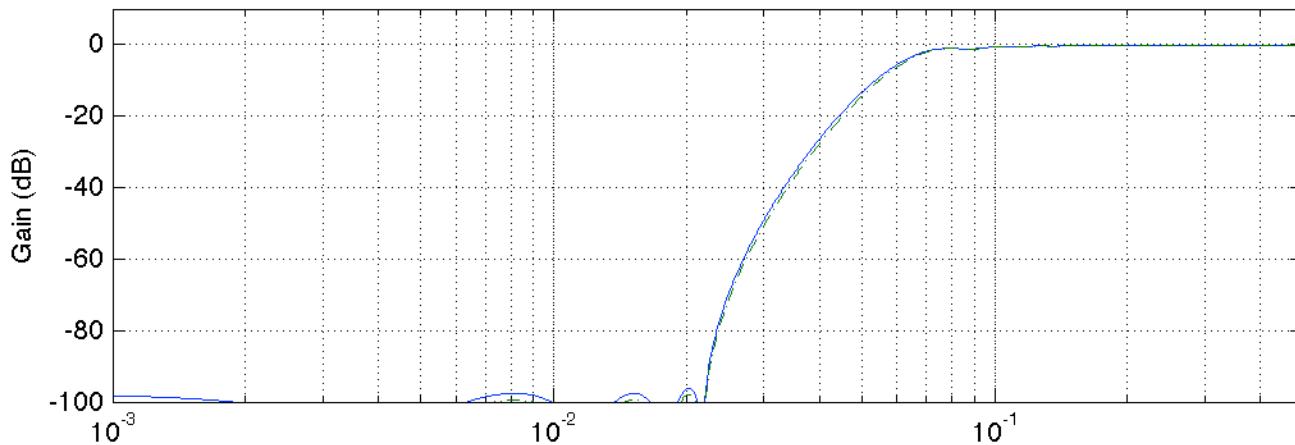
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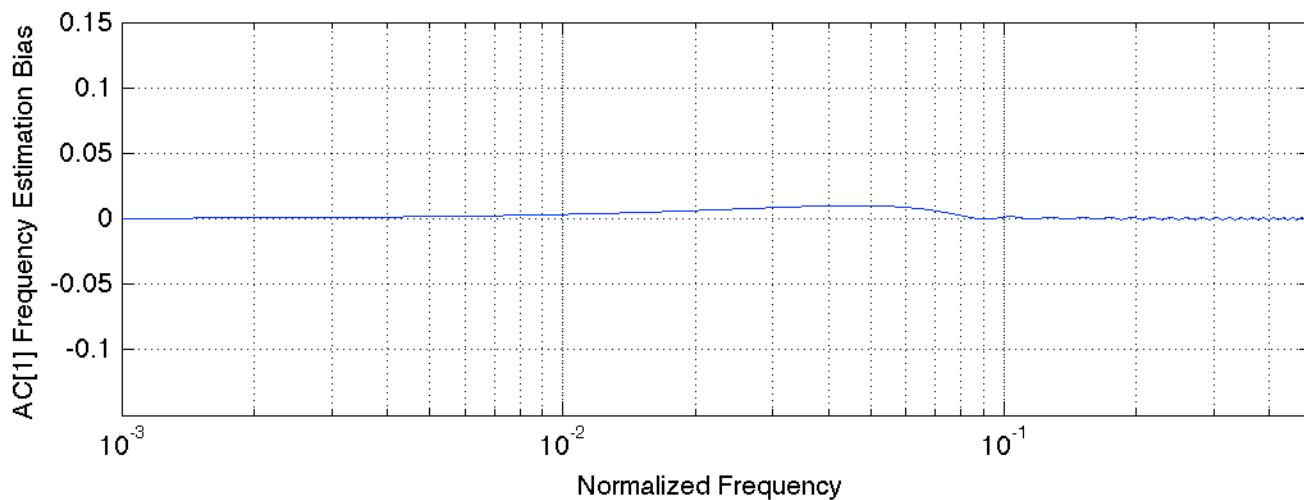
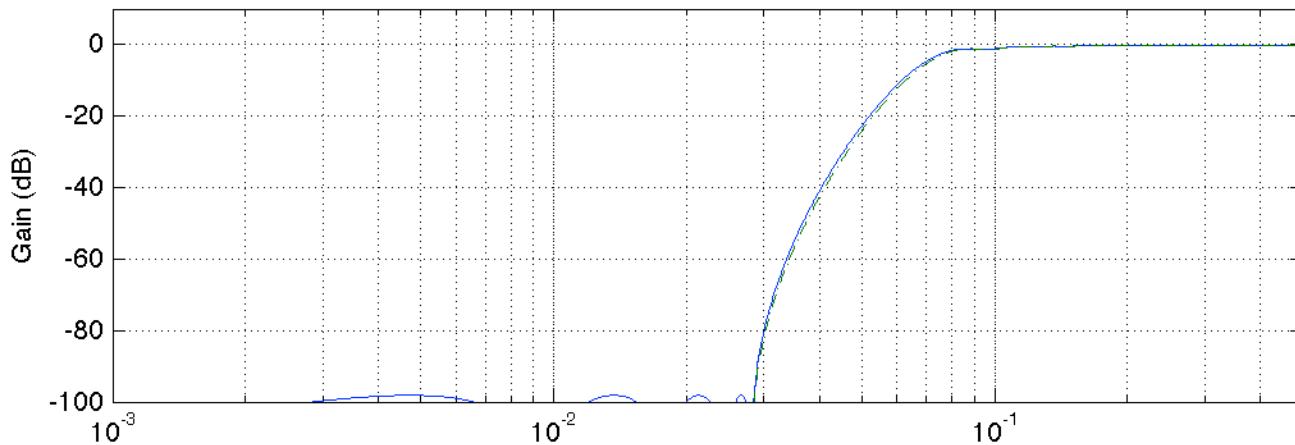
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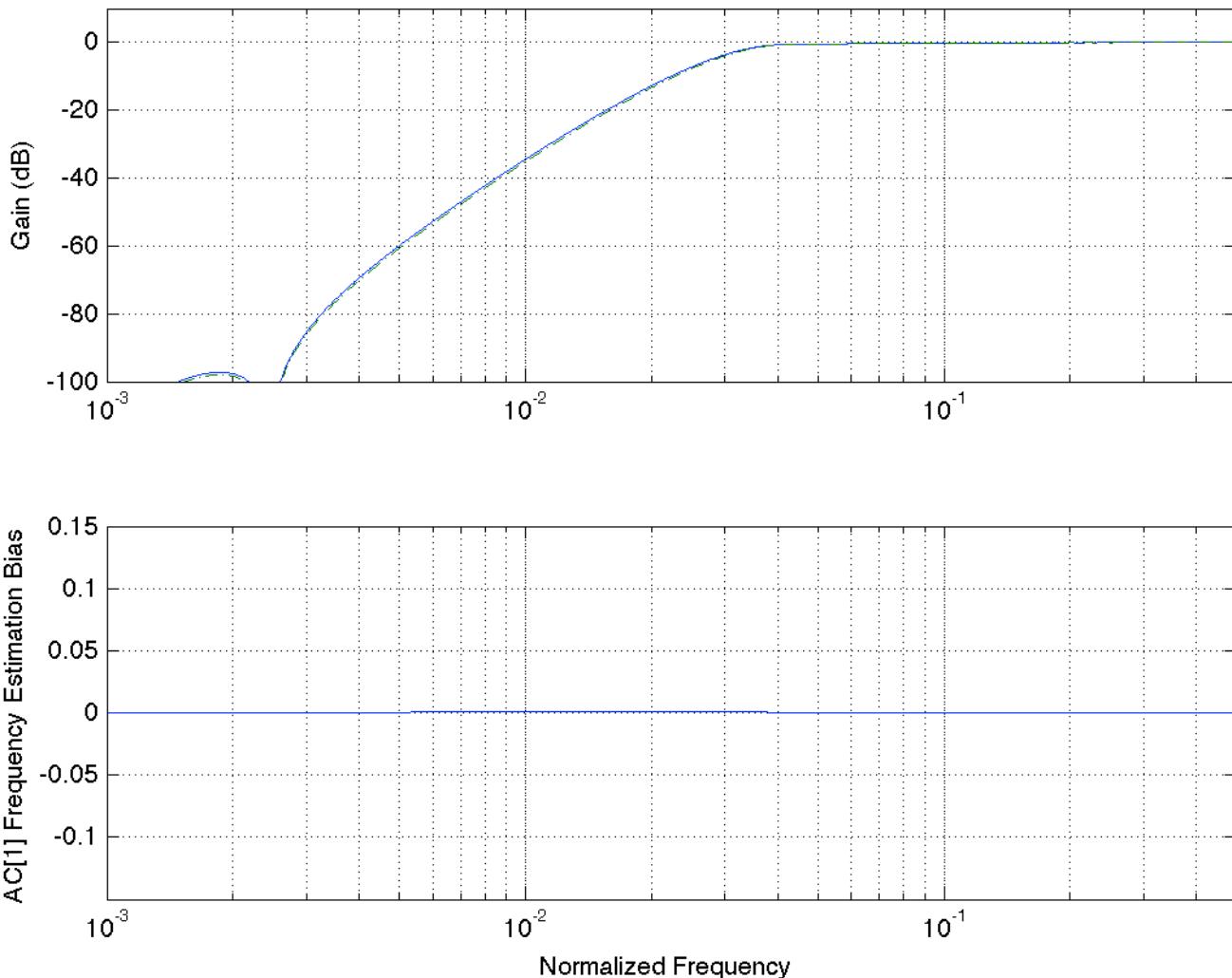
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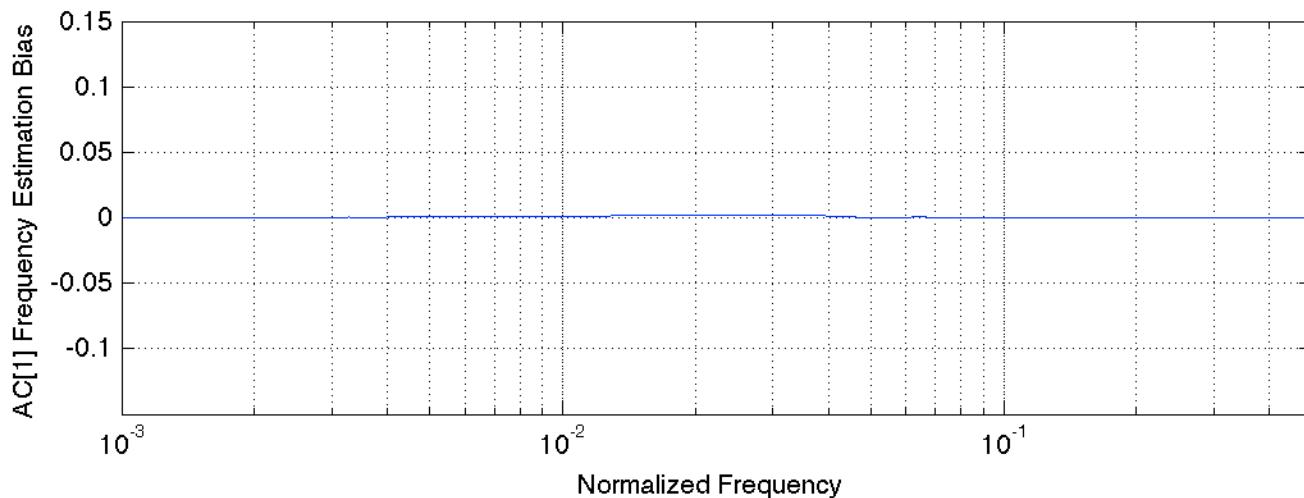
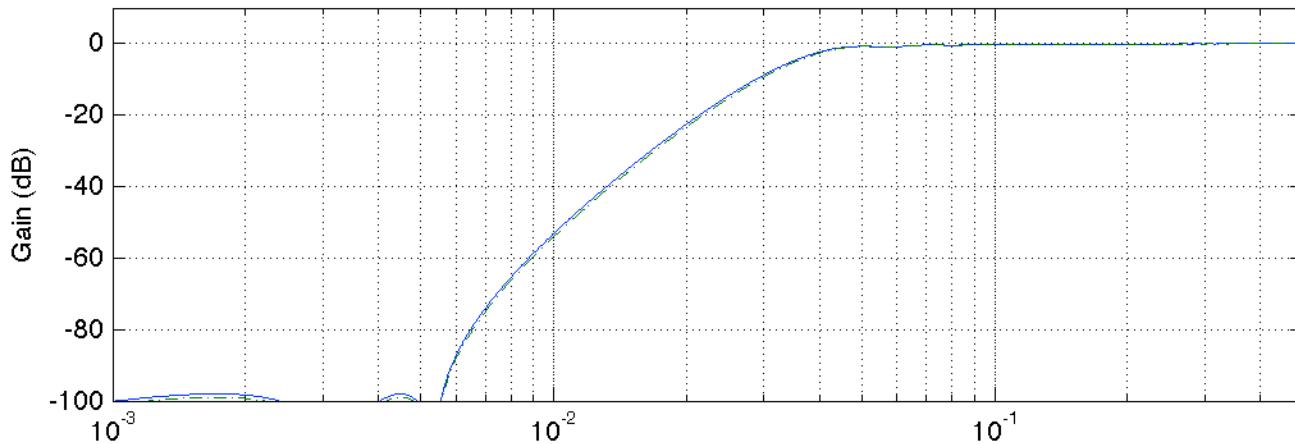
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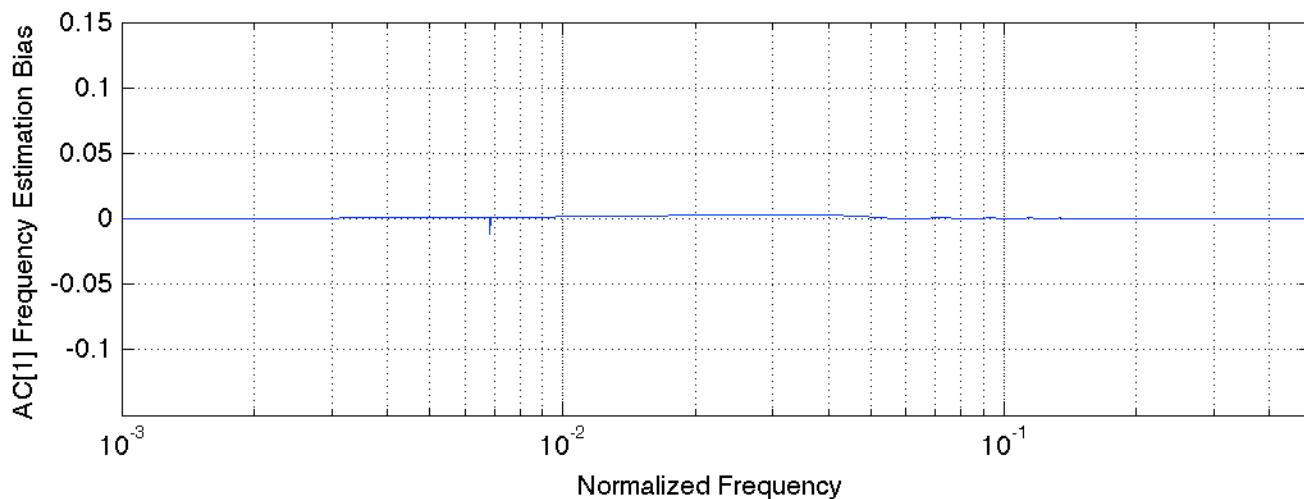
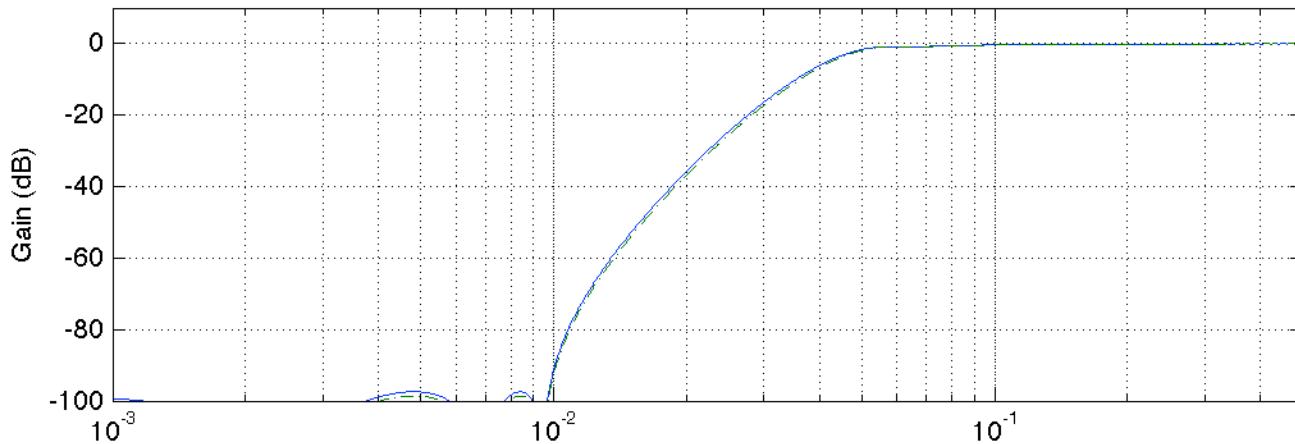
Filter: WeakFlowVLow: $N_{pri} = 52$, $N_{zeros} = 4$



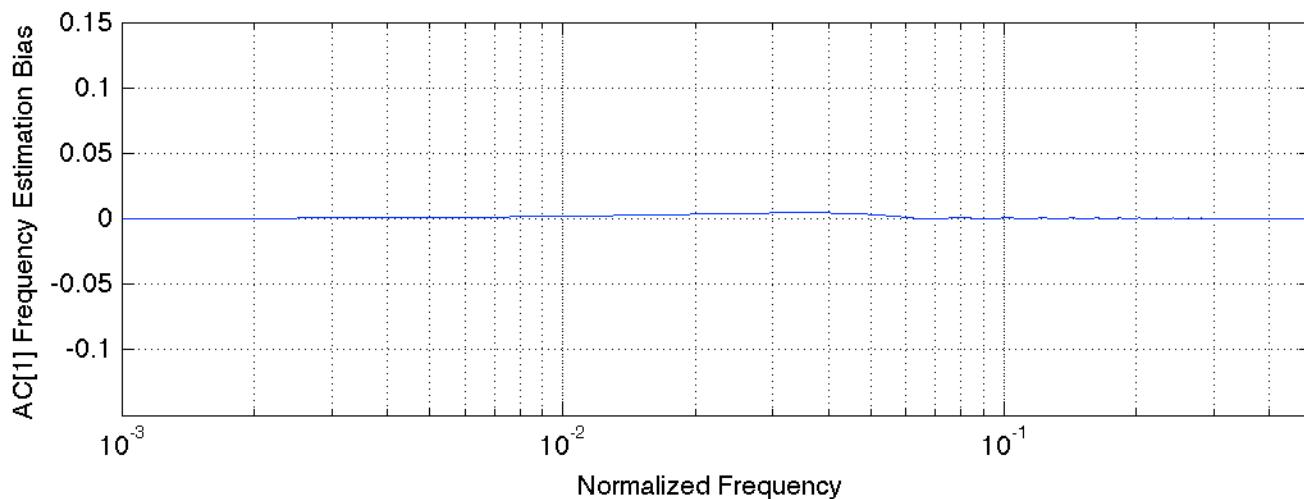
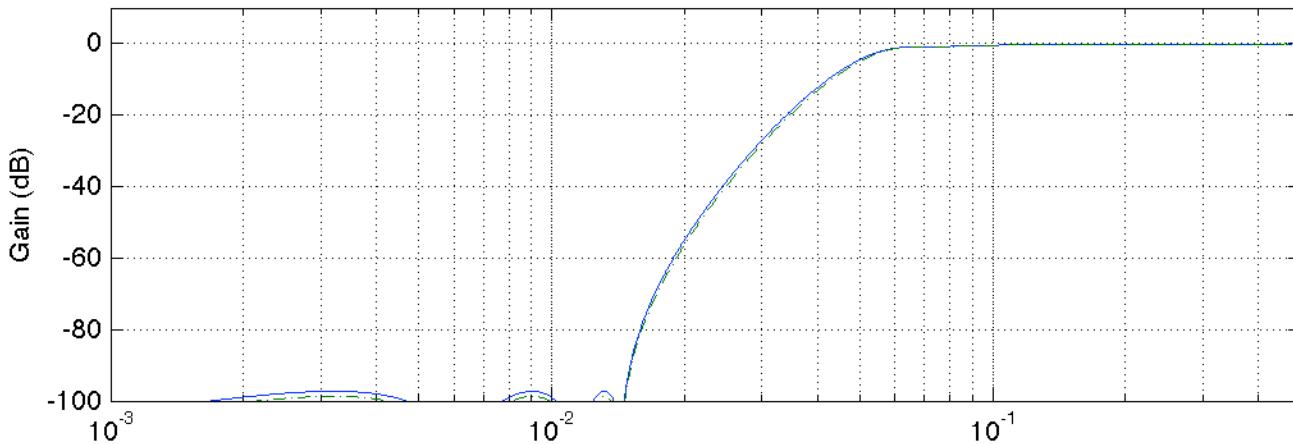
Filter: WeakFlowLow: $N_{pri} = 52$, $N_{zeros} = 5$



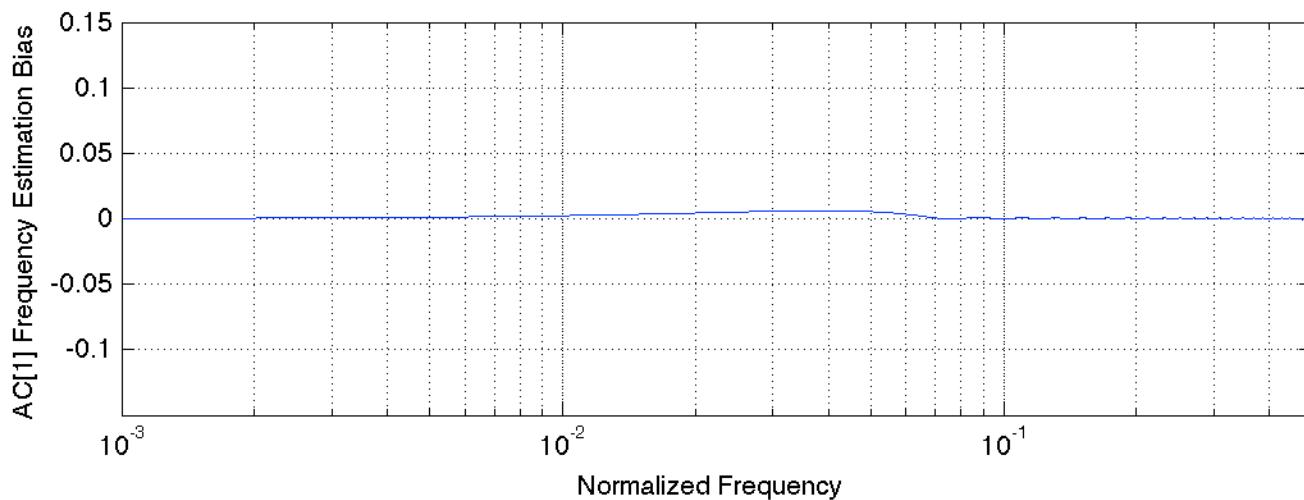
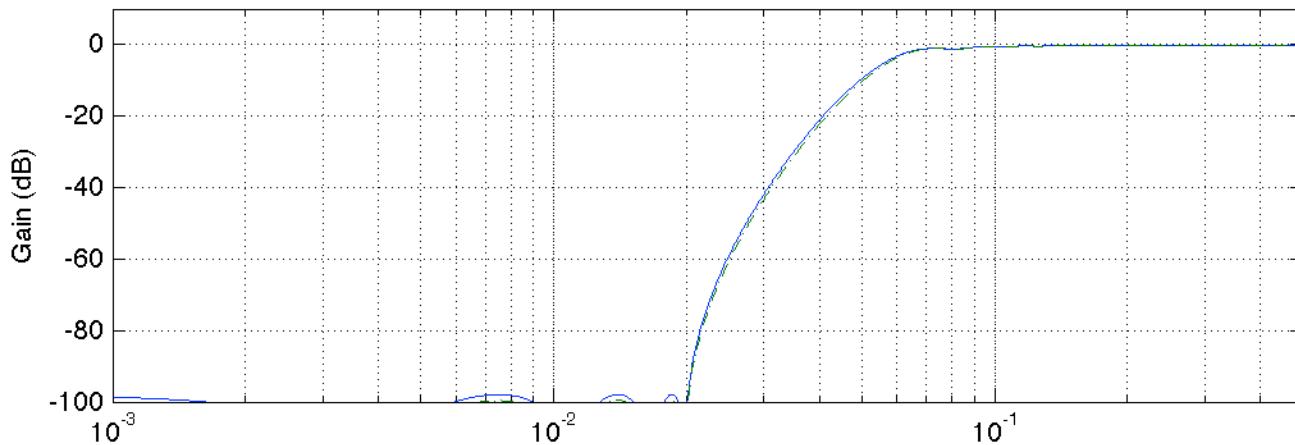
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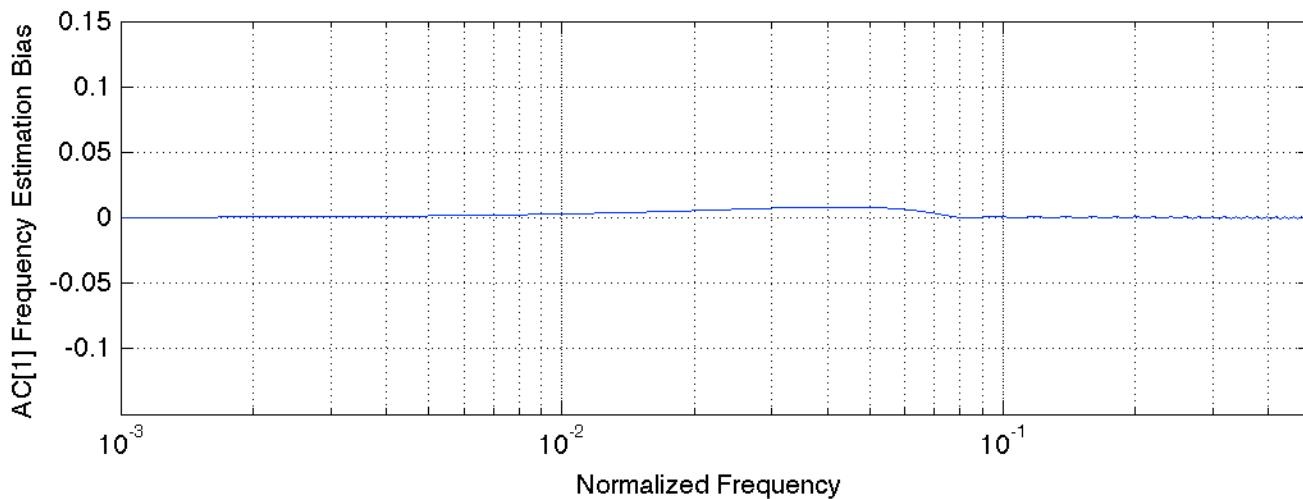
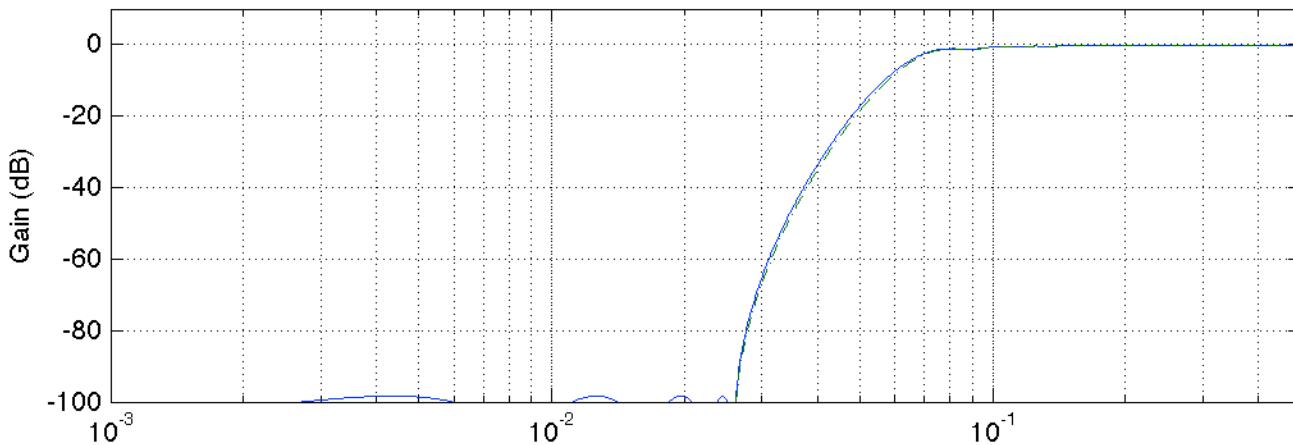
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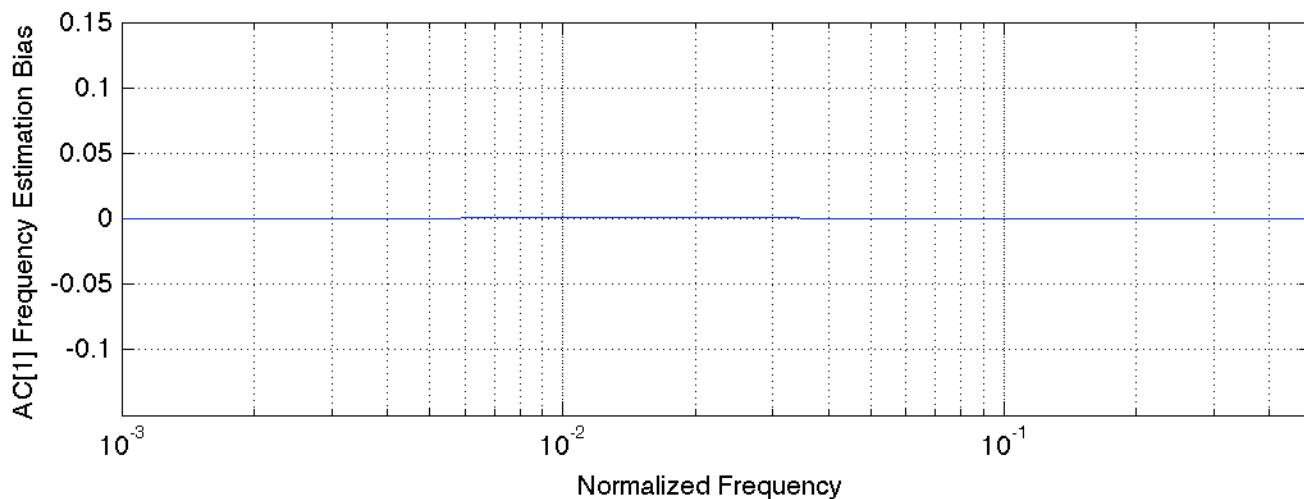
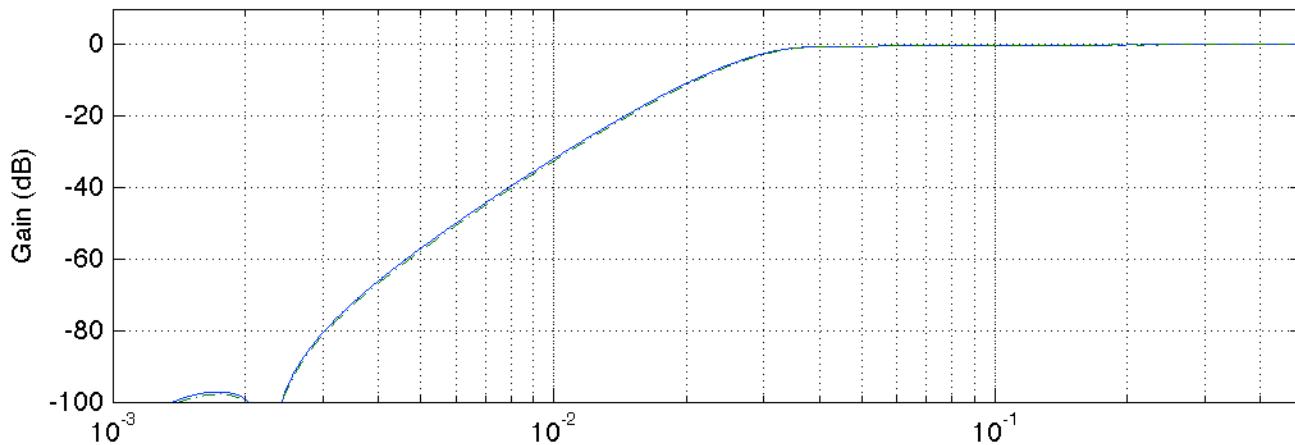
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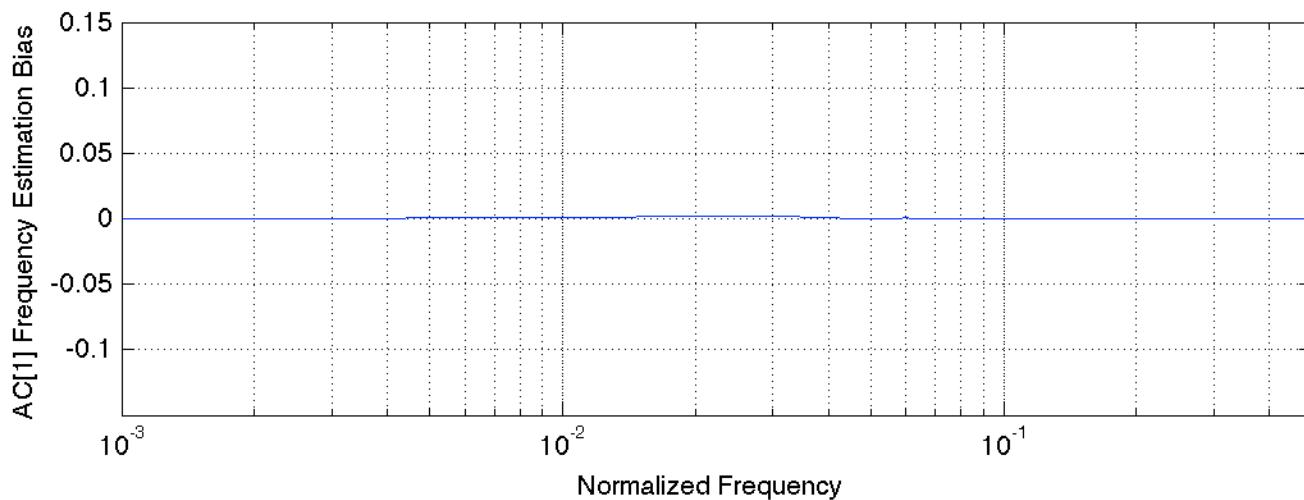
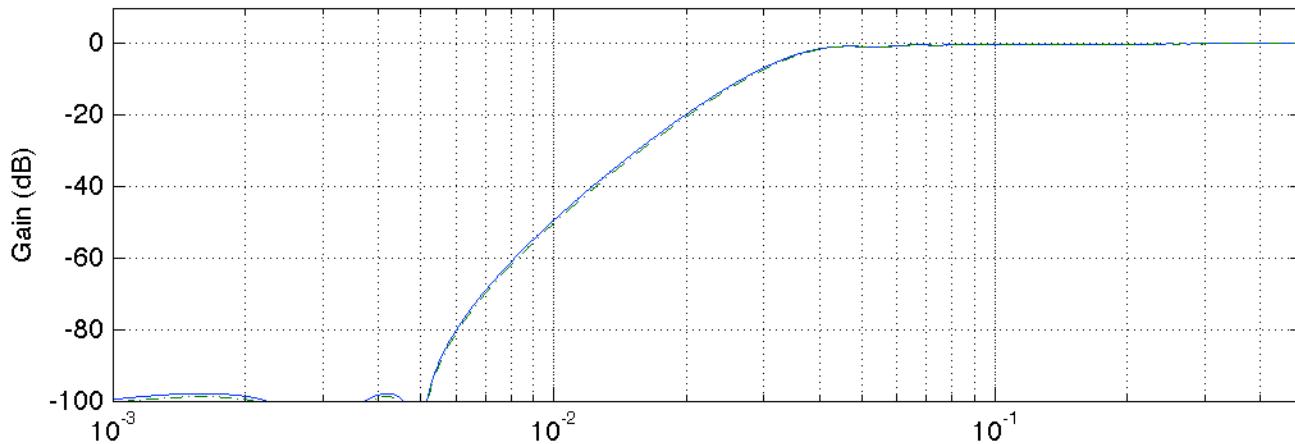
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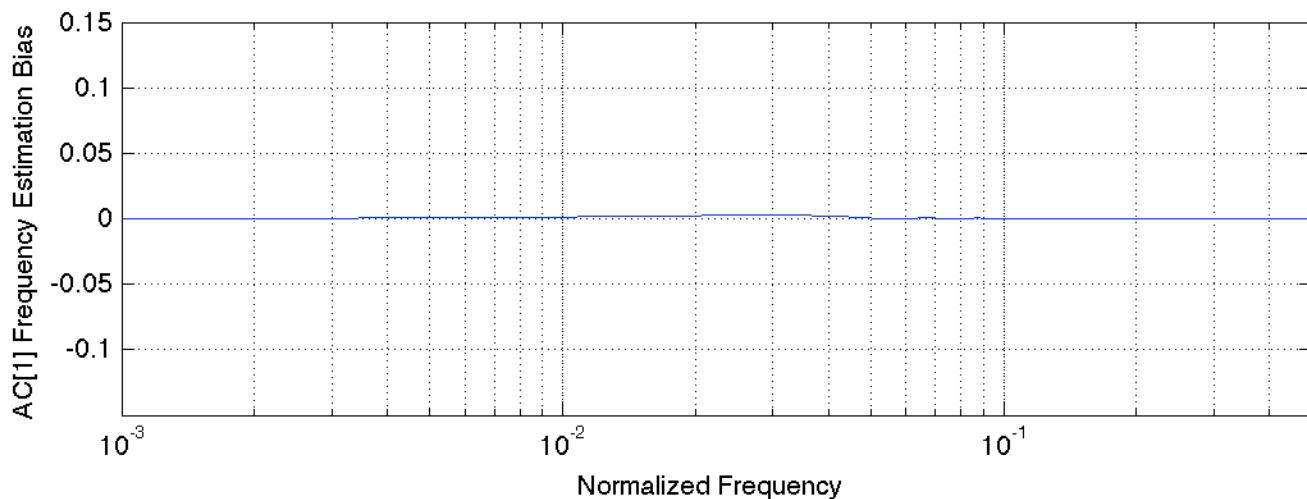
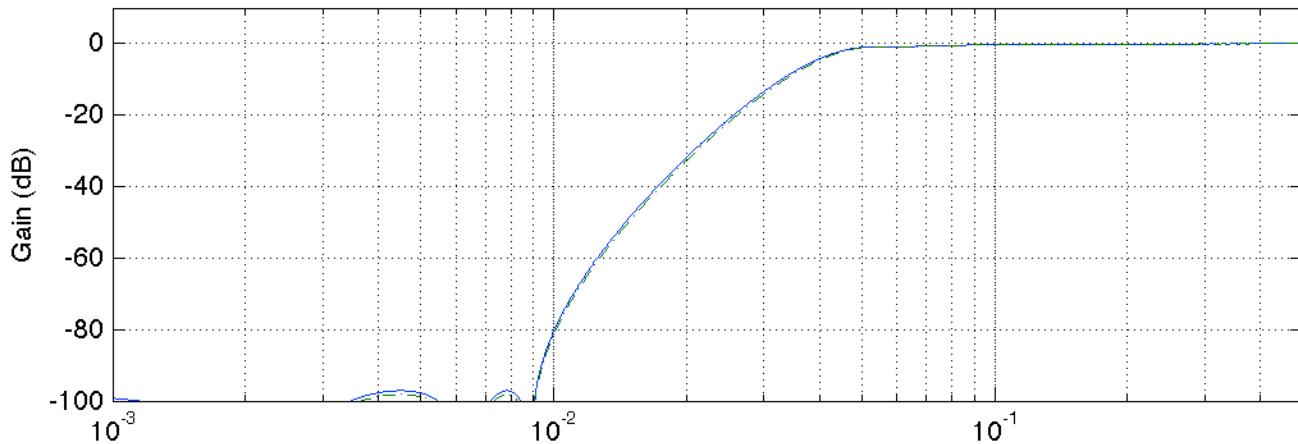
Filter: WeakFlowVLow: $N_{pri} = 56$, $N_{zeros} = 4$



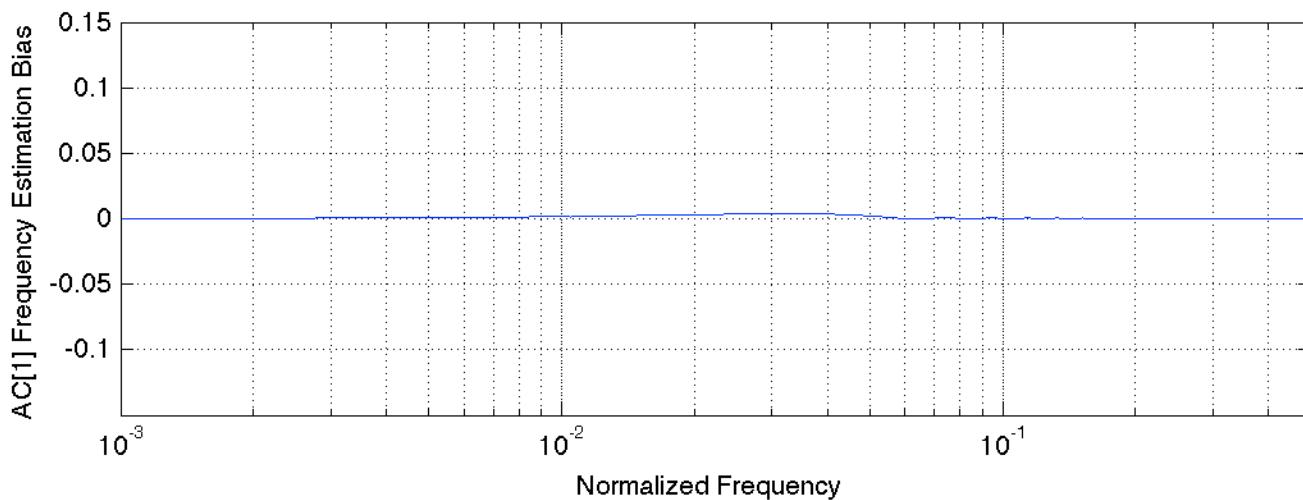
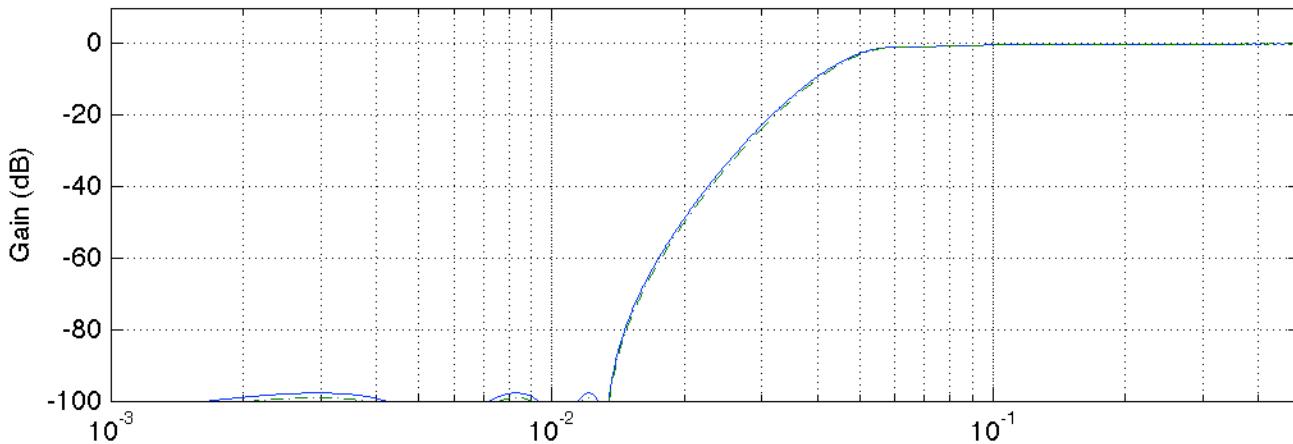
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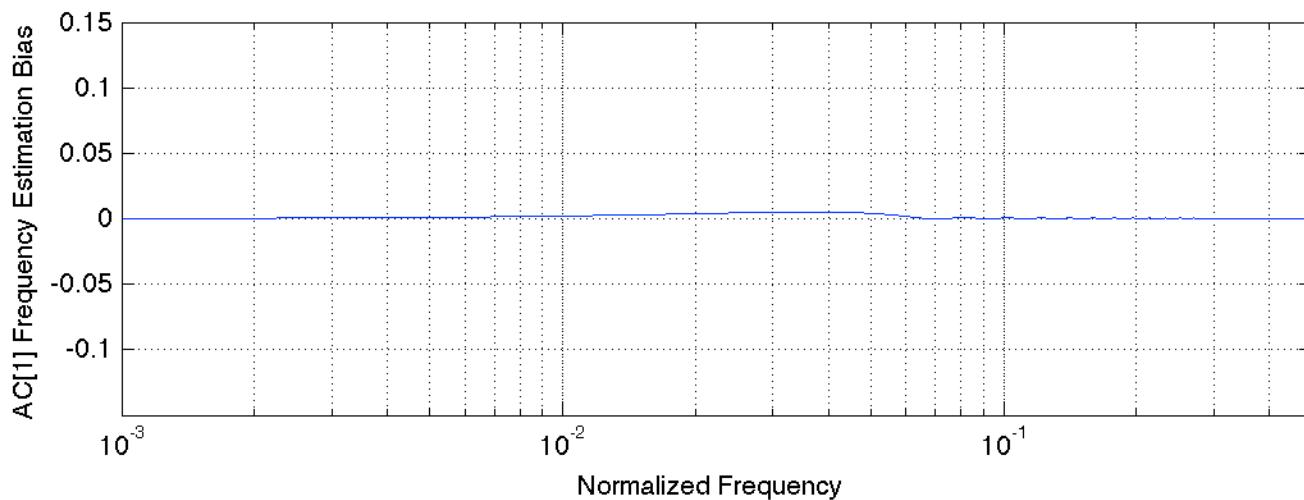
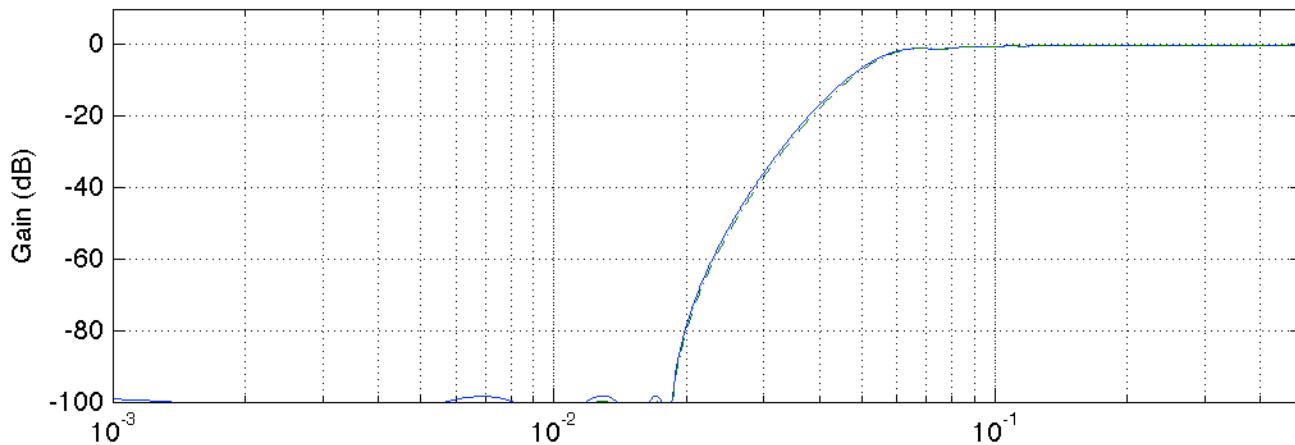
Filter: WeakFlowMedLow: $N_{pri} = 56$, $N_{zeros} = 6$



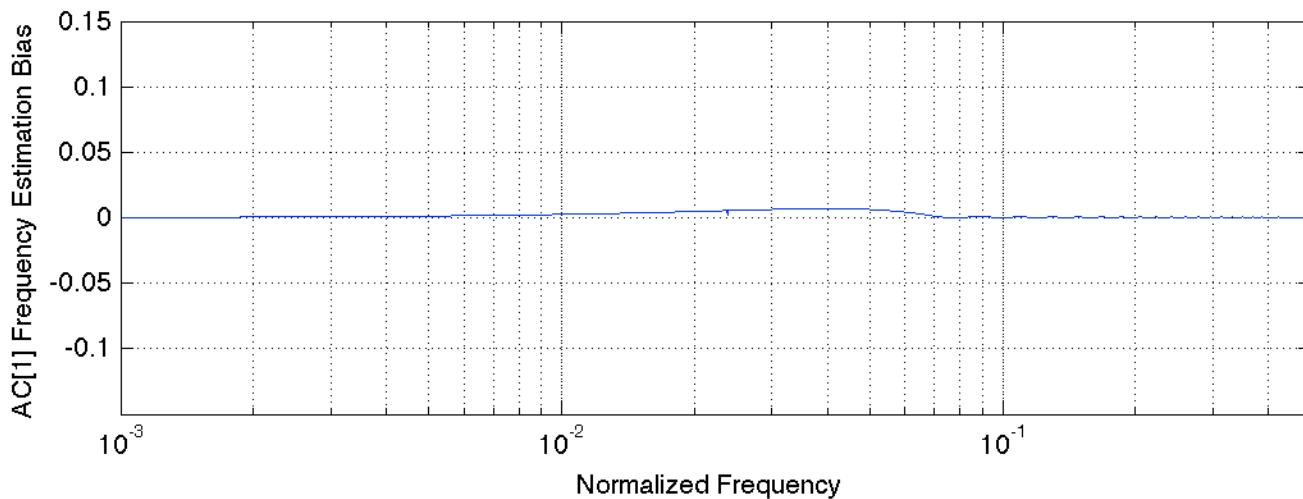
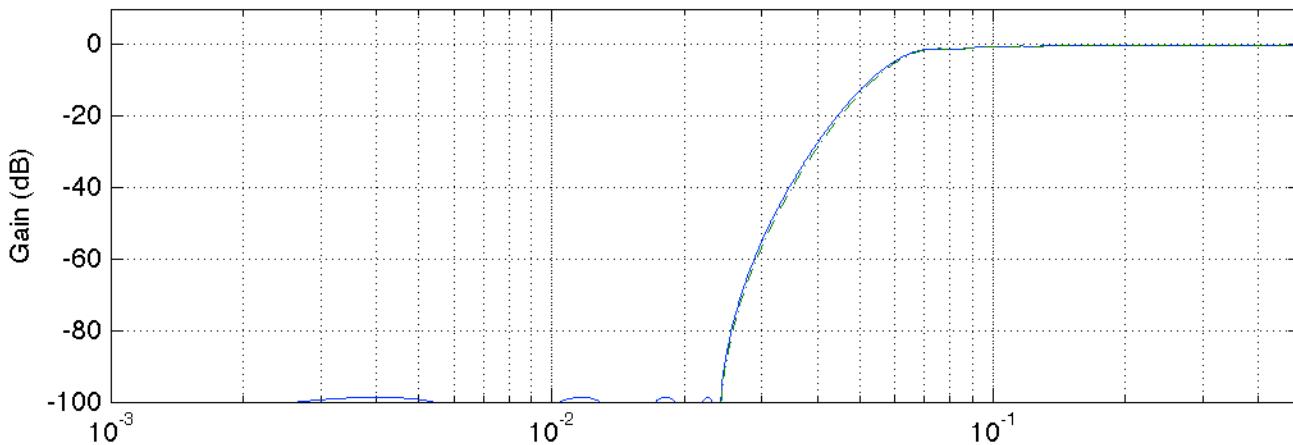
Filter: WeakFlowMed: $N_{pri}=56$, $N_{zeros}=7$



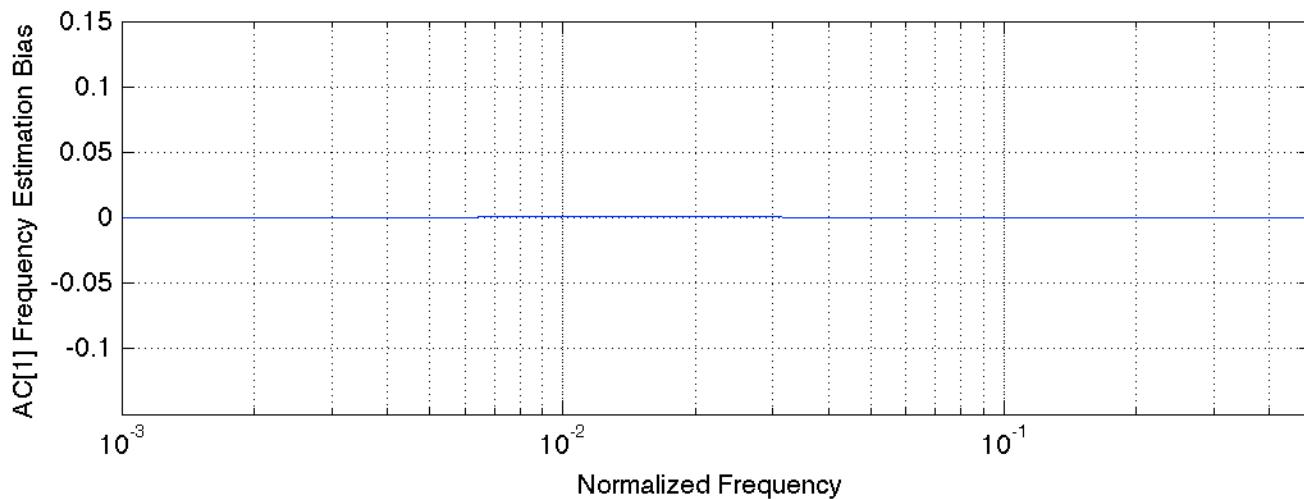
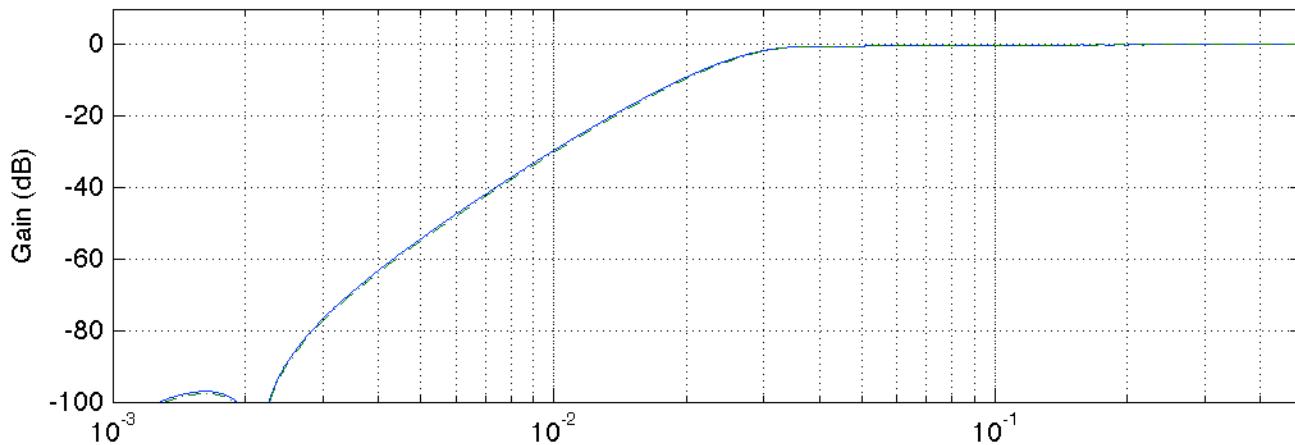
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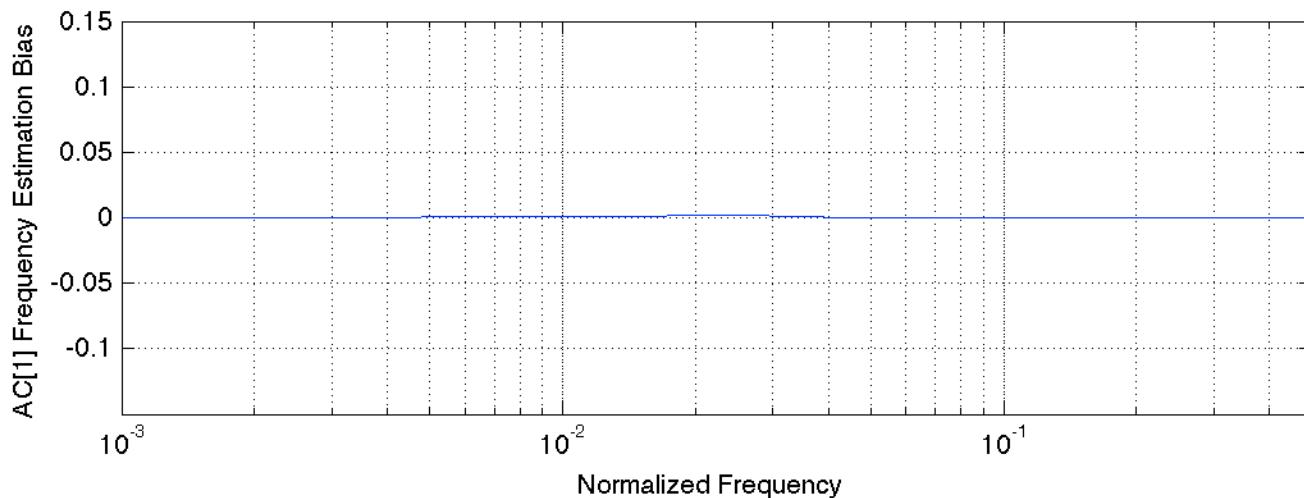
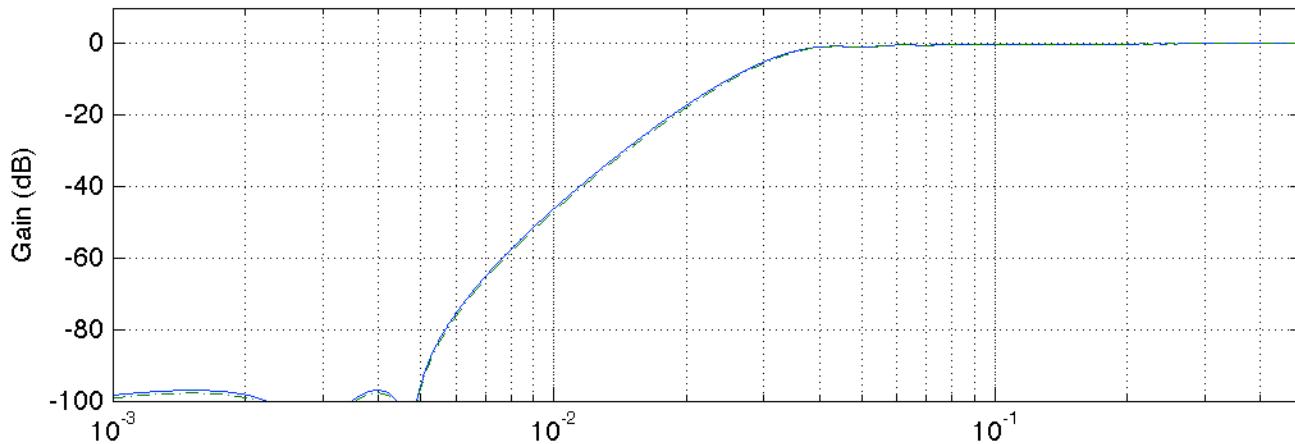
Filter: WeakFlowHigh: $N_{pri}=56$, $N_{zeros}=9$



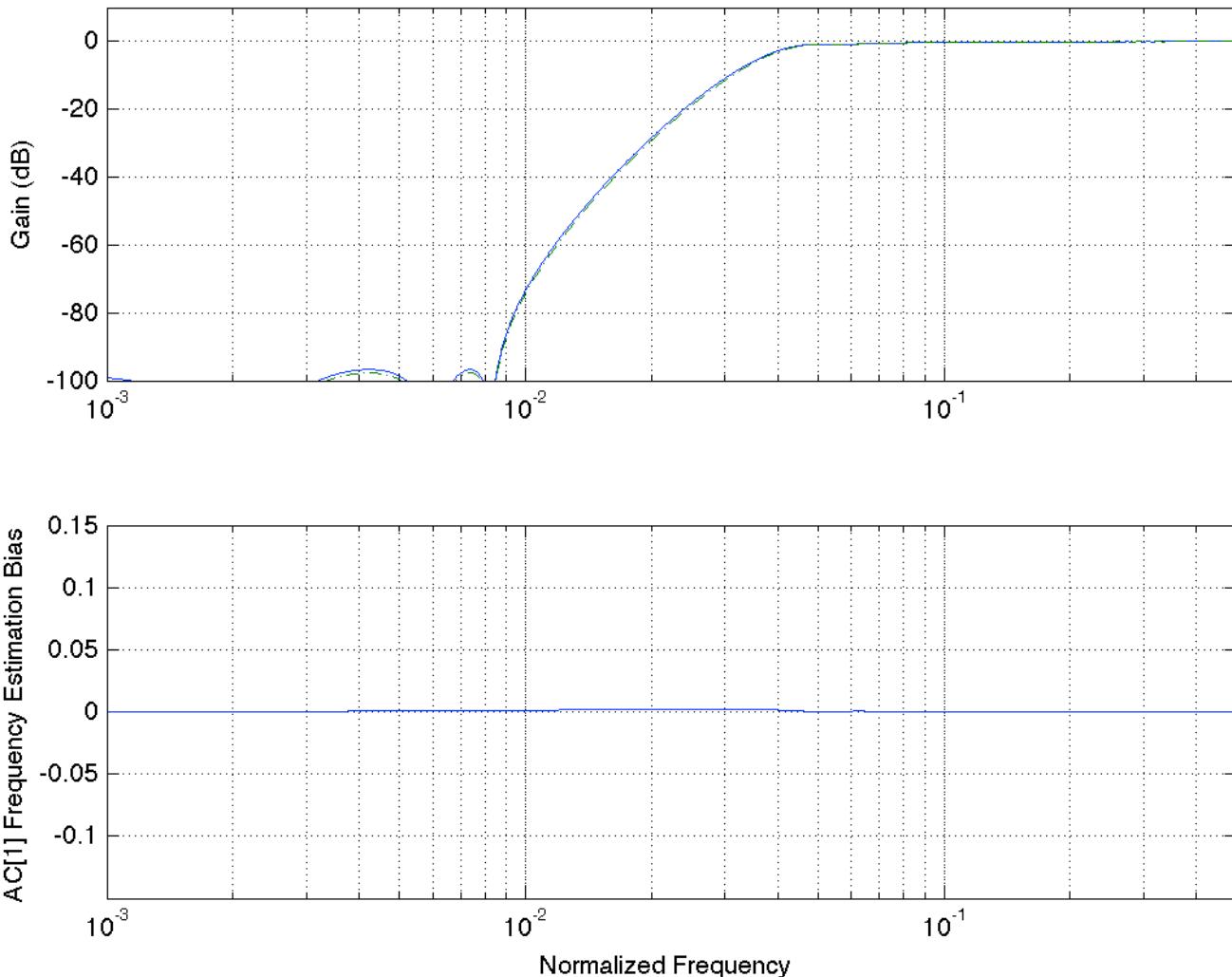
Filter: WeakFlowVLow: $N_{pri} = 60$, $N_{zeros} = 4$



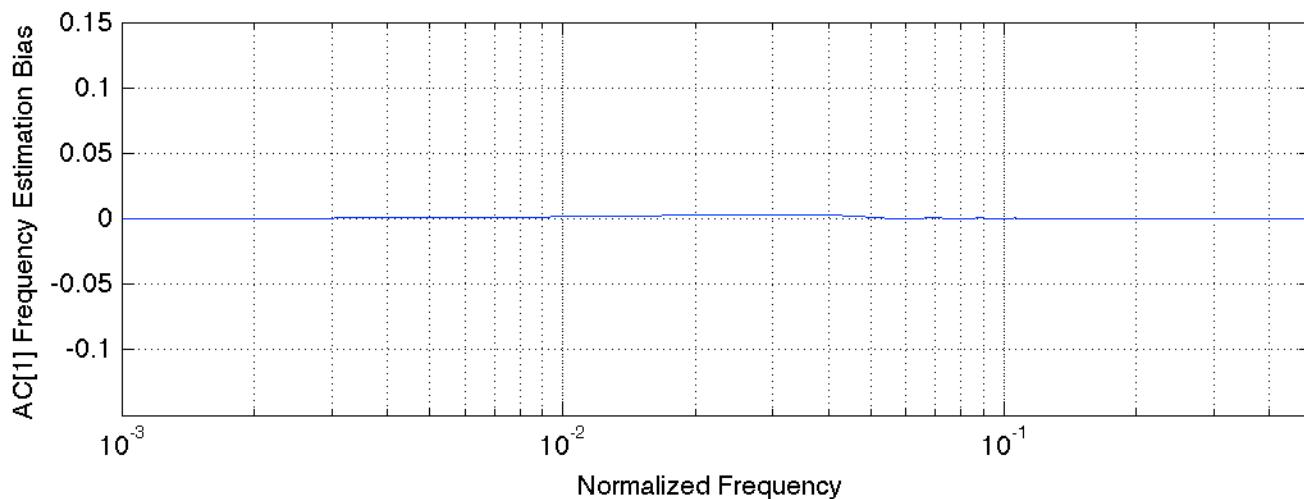
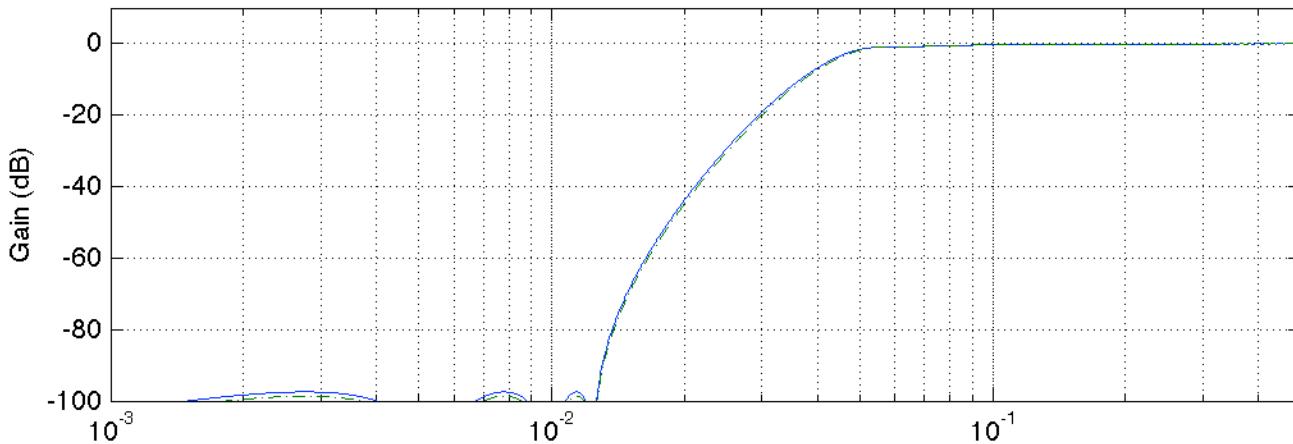
Filter: WeakFlowLow: $N_{pri}=60$, $N_{zeros}=5$



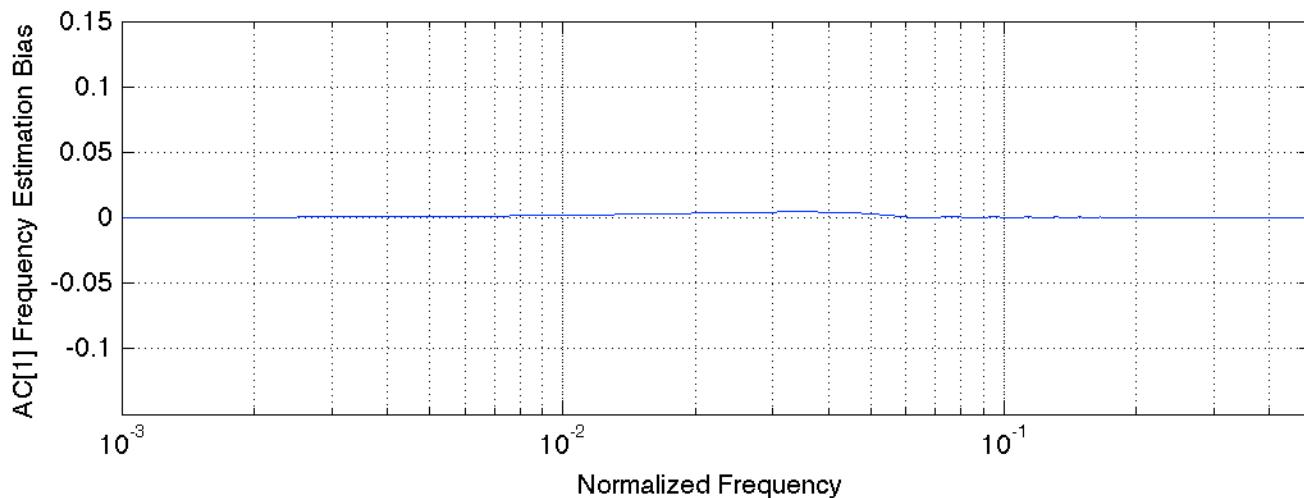
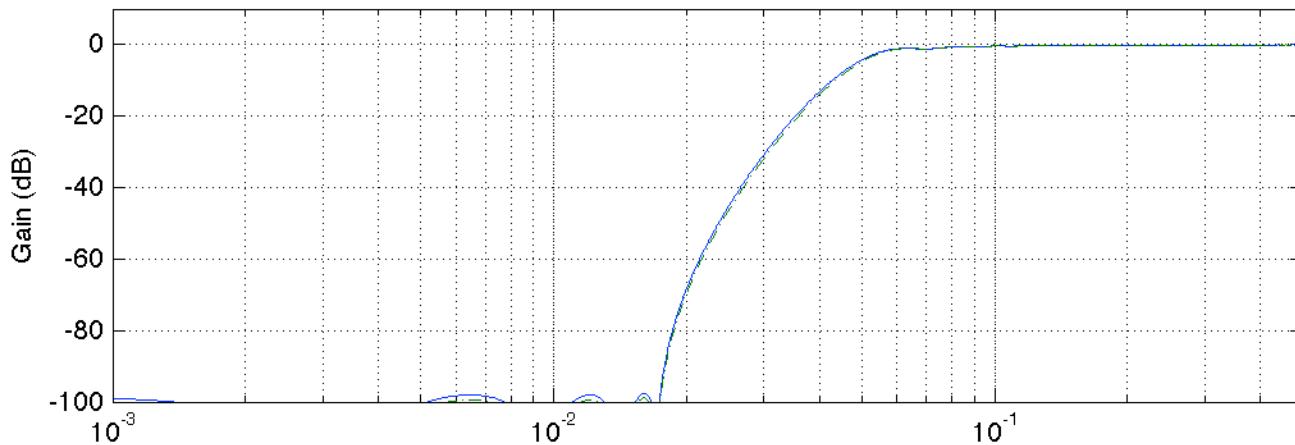
Filter: WeakFlowMedLow: $N_{pri} = 60$, $N_{zeros} = 6$



Filter: WeakFlowMed: $N_{pri}=60$, $N_{zeros}=7$



Filter: WeakFlowMedHigh: $N_{pri} = 60$, $N_{zeros} = 8$



Filter: WeakFlowHigh: $N_{pri}=60$, $N_{zeros}=9$

