ANALOG DEVICES

AN-562
APPLICATION NOTE

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Filter Specification for the Internal Filters of the ADV7190/ADV7191/ADV7192/ADV7194 Video Encoders

INTRODUCTION

This application note documents the filter specifications and detailed plots of the internal filters of the ADV7190/ADV7191, ADV7192 and ADV7194 video encoders.

All the above-mentioned devices provide two luma low-pass filters, two luma notch filters, an extended SSAF™ (Super Sub Alias Filter) luma low-pass filter, a luma CIF and a luma QCIF filter, five chroma low-pass filters, a Chroma CIF and a Chroma QCIF filter.

The SSAF filter, as can be seen in Figure 5, provides a sharp stopband attenuation that enables studio quality video playback on modern TVs, giving optimal horizontal line resolution.

Additionally, it is possible to change the response of the SSAF filter in the passband in using the programmable gain/attenuation feature or sharpness control as can be seen in Figures 6, 7 and 8. Overall, there are six programmable gain responses (Figure 7) and six programmable attenuation responses (Figure 8) in the range of –4 dB to +4 dB available. These responses can be programmed over the I²C® interface.

The tables on the following pages show the filter specifications for all the filters in 2× oversampling and 4× oversampling mode.

Figures 1–17 highlight the frequency responses in the passband and stopband.

Figures 18–31 highlight the different frequency responses in 2× oversampling and 4× oversampling.

Tables I, II, III, and IV apply to the ADV7190/ADV7191, ADV7192 and ADV7194 video encoders.

Table I. Luminance Internal Filter Specifications (2× Oversampling)

Filter Type	Filter Selection			Passband Ripple[1] (dB)	3 dB Bandwidth[2] (MHz)	Stopband Cutoff[3] (MHz)	Stopband Attenuation[4] (dB)
	MR04	MR03	MR02				
Low-Pass (NTSC)	0	0	0	0.09	4.158	6.05	–65.7
Low-Pass (PAL)	0	0	1	0.15	4.74	6.41	–81.1
Notch (NTSC)	0	1	0	0.09	2.25/5.0/6.54	8.03	–88
Notch (PAL)	0	1	1	0.095	3.07/5.8/6.24	8.02	–80.5
Extended (SSAF)	1	0	0	0.017	6.37	8.03	–87.4
CIF	1	0	1	0.012	3.0	5.09	–69.2
QCIF	1	1	0	0.118	1.5	3.74	–88.4

NOTES
[1]Passband Ripple refers to the maximum fluctuations from the 0 dB response in the passband, measured in dB. The passband is defined to have 0 (Hz) to fc (Hz) frequency limits for a low-pass filter, 0 (Hz) to f1 (Hz) and f2 (Hz) to infinity for a notch filter, where fc, f1, f2 are the –3 dB points.
[2]3 dB bandwidth refers to the –3 dB cutoff frequency.
[3]Stopband Cutoff refers to the frequency (MHz) at attenuation point (dB) referred to under Note 4.
[4]Stopband Attenuation refers to the attenuation (dB) at the frequency (MHz) referred to under Note 3.

SSAF is a trademark of Analog Devices, Inc.
I²C is a registered trademark of Philips Corporation.

Table II. Chrominance Internal Filter Specifications (2× Oversampling)

Filter Type	Filter Selection			Passband Ripple[1] (dB)	3 dB Bandwidth[2] (MHz)	Stopband Cutoff[3] (MHz)	Stopband Attenuation[4] (dB)
	MR07	MR06	MR05				
1.3 MHz Low-Pass	0	0	0	0.087	1.397	2.46	–84
0.65 MHz Low-Pass	0	0	1	Monotonic	0.653	2.41	–78.3
1.0 MHz Low-Pass	0	1	0	Monotonic	1.0	1.89	–66.6
2.0 MHz Low-Pass	0	1	1	0.0438	2.21	3.1	–65
3.0 MHz Low-Pass	1	0	0	Monotonic	3.18	5.33	–84.9
CIF	1	0	1	Monotonic	0.653	2.41	–78.3
QCIF	1	1	0	Monotonic	0.5	1.75	–33.17

Table III. Luminance Internal Filter Specifications (4× Oversampling)

Filter Type	Filter Selection			Passband Ripple[1] (dB)	3 dB Bandwidth[2] (MHz)	Stopband Cutoff[3] (MHz)	Stopband Attenuation[4] (dB)
	MR04	MR03	MR02				
Low-Pass (NTSC)	0	0	0	0.16	4.24	6.05	–75.2
Low-Pass (PAL)	0	0	1	0.1	4.81	6.41	–64.6
Notch (NTSC)	0	1	0	0.09	2.27/4.9/6.6	8.03	–87.3
Notch (PAL)	0	1	1	0.1	3.1/5.6/6.4	8.02	–79.7
Extended (SSAF)	1	0	0	0.043	6.45	8.03	–86.6
CIF	1	0	1	0.127	3.02	5.09	–62.6
QCIF	1	1	0	Monotonic	1.5	3.74	–88.2

Table IV. Chrominance Internal Filter Specifications (4× Oversampling)

Filter Type	Filter Selection			Passband Ripple[1] (dB)	3 dB Bandwidth[2] (MHz)	Stopband Cutoff[3] (MHz)	Stopband Attenuation[4] (dB)
	MR07	MR06	MR05				
1.3 MHz Low-Pass	0	0	0	0.09	1.395	2.46	–83.9
0.65 MHz Low-Pass	0	0	1	Monotonic	0.65	2.41	–71.1
1.0 MHz Low-Pass	0	1	0	Monotonic	1.0	1.89	–64.43
2.0 MHz Low-Pass	0	1	1	0.048	2.2	3.1	–65.9
3.0 MHz Low-Pass	1	0	0	Monotonic	3.2	5.3	–84.5
CIF	1	0	1	Monotonic	0.65	2.41	–71.1
QCIF	1	1	0	Monotonic	0.5	1.75	–33.1

NOTES
[1]Passband Ripple refers to the maximum fluctuations from the 0 dB response in the passband, measured in dB. The passband is defined to have 0 (Hz) to fc (Hz) frequency limits for a low-pass filter, 0 (Hz) to f1 (Hz) and f2 (Hz) to infinity for a notch filter, where fc, f1, f2 are the –3 dB points.
[2]3 dB bandwidth refers to the –3 dB cutoff frequency.
[3]Stopband Cutoff refers to the frequency (MHz) at attenuation point (dB) referred to under Note 4.
[4]Stopband Attenuation refers to the attenuation (dB) at the frequency (MHz) referred to under Note 3.

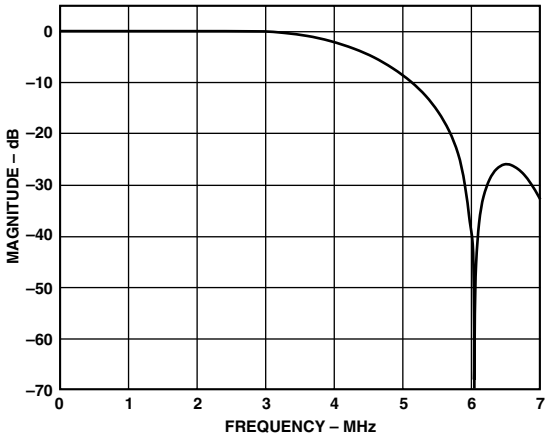

Figure 1. Luma NTSC Low-Pass Filter (4× Oversampling)

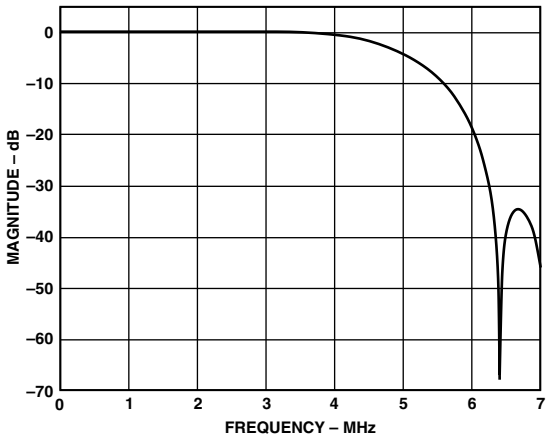

Figure 2. Luma PAL Low-Pass Filter (4× Oversampling)

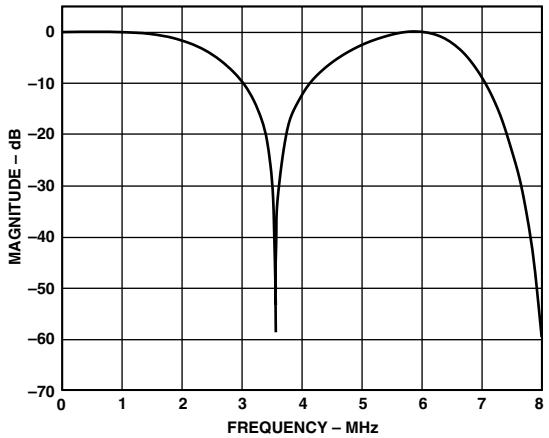

Figure 3. Luma NTSC Notch Filter (4x Oversampling)

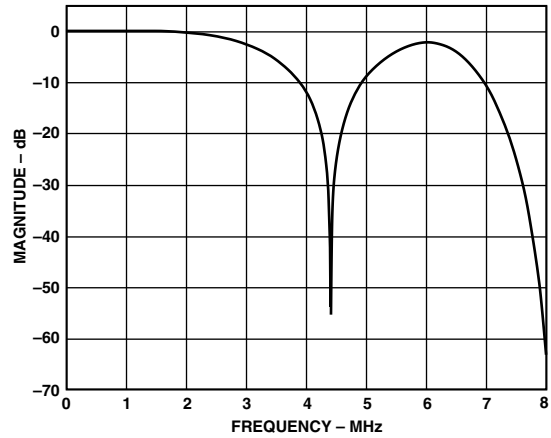

Figure 4. Luma PAL Notch Filter (4x Oversampling)

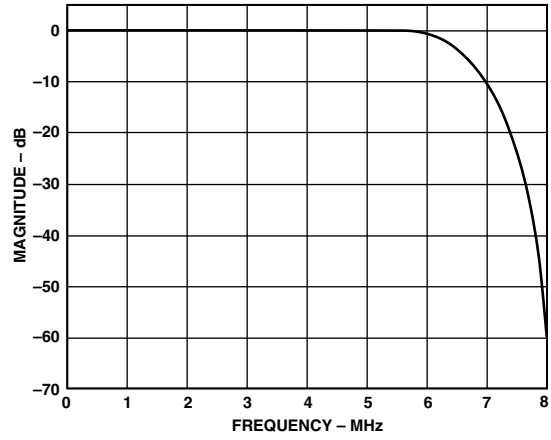

Figure 5. Extended (SSAF) Luma Filter (4x Oversampling)

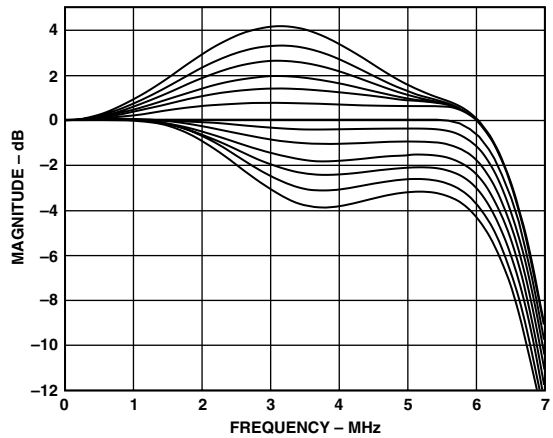

Figure 6. Extended (SSAF) Luma Filter (4x Oversampling) with Programmable Attenuation/Gain in the Passband

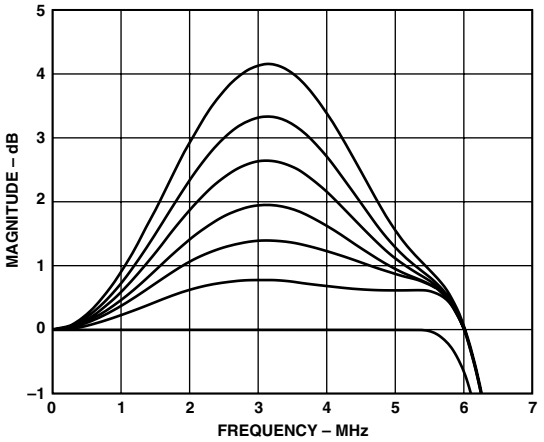

Figure 7. Extended (SSAF) Luma Filter (4x Oversampling) Zoom In on Programmable Gain in the Passband

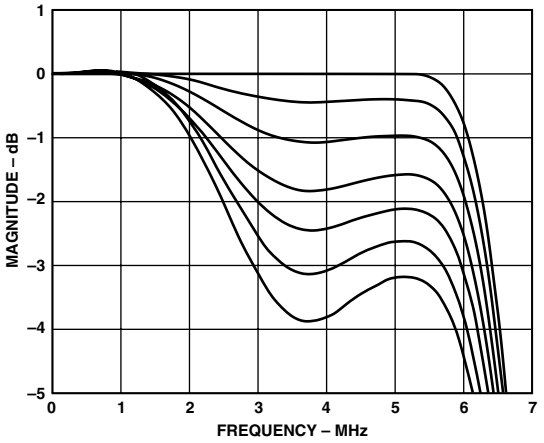

Figure 8. Extended (SSAF) Luma Filter (4x Oversampling) Zoom In on Programmable Attenuation in the Passband

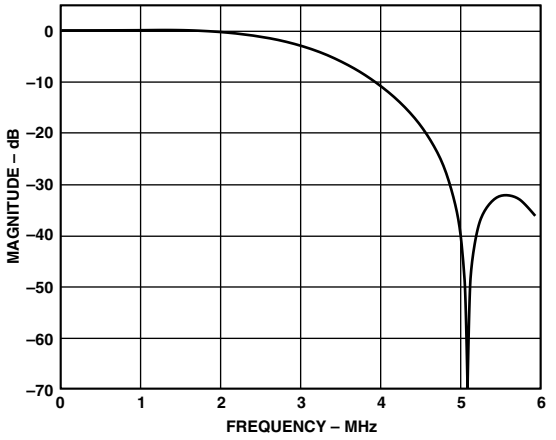

Figure 9. Luma CIF Filter (4x Oversampling)

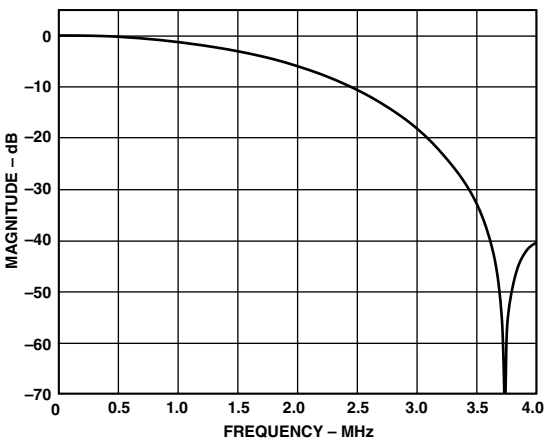

Figure 10. Luma QCIF Filter (4x Oversampling)

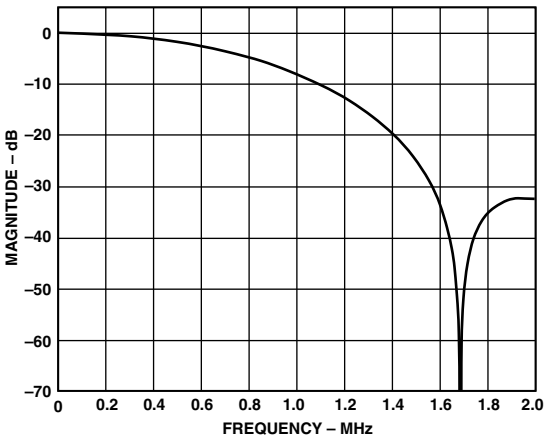

Figure 11. Chroma 0.65 MHz Low-Pass Filter

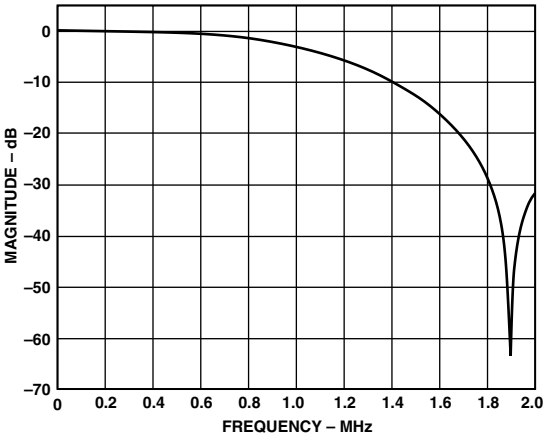

Figure 12. Chroma 1.0 MHz Low-Pass Filter (4x Oversampling)

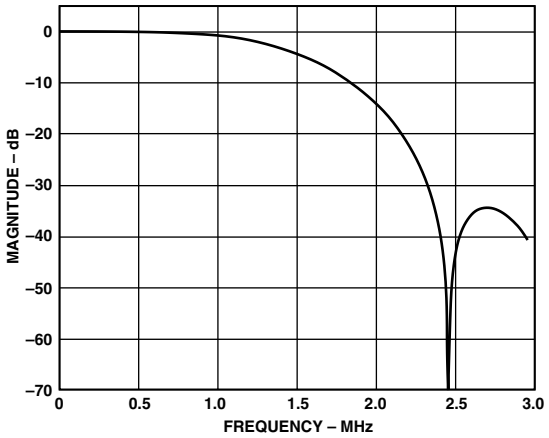

Figure 13. Chroma 1.3 MHz Low-Pass Filter (4x Oversampling)

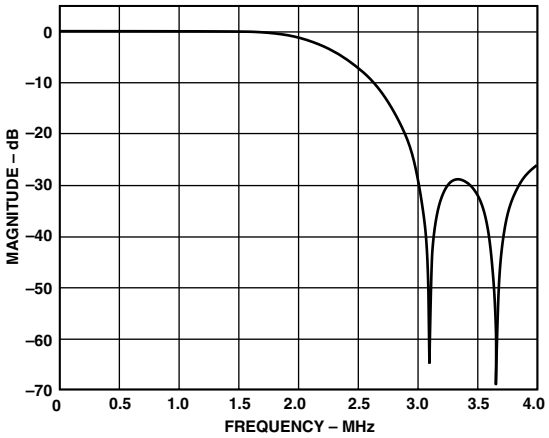

Figure 14. Chroma 2.0 MHz Low Pass Filter (4x Oversampling)

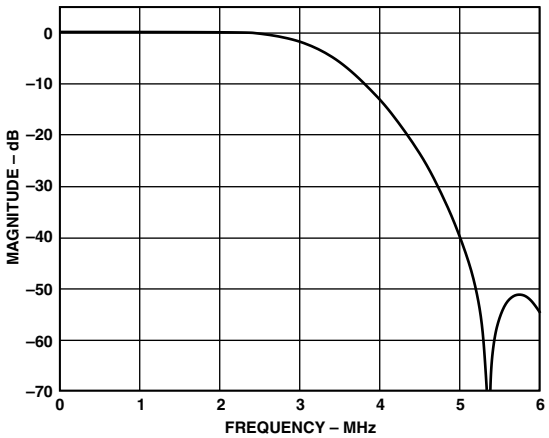

Figure 15. Chroma 3.0 MHz Filter (4x Oversampling)

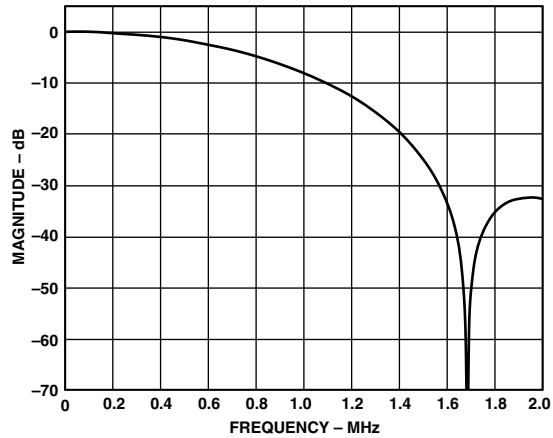

Figure 16. Chroma CIF Filter (4x Oversampling)

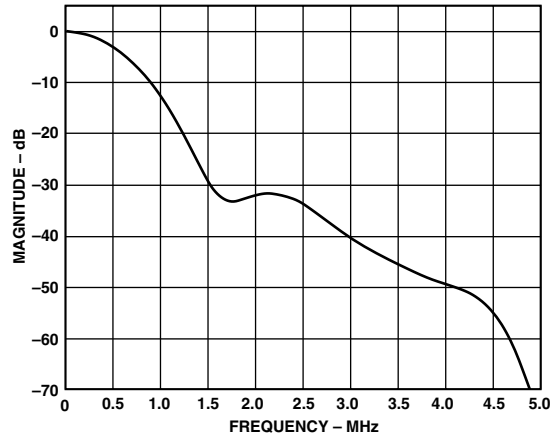

Figure 17. Chroma QCIF Chroma Filter (4x Oversampling)

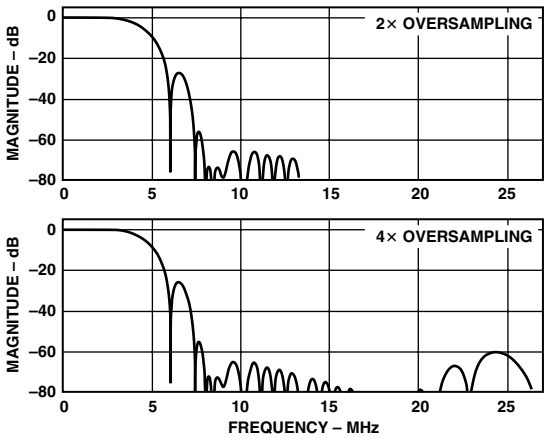

Figure 18. Luma NTSC Low-Pass Filter

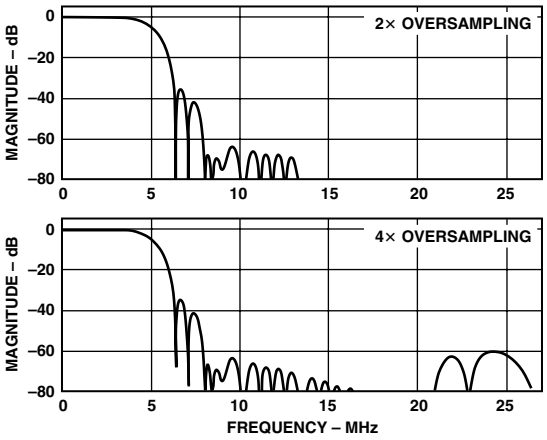

Figure 19. Luma PAL Low-Pass Filter

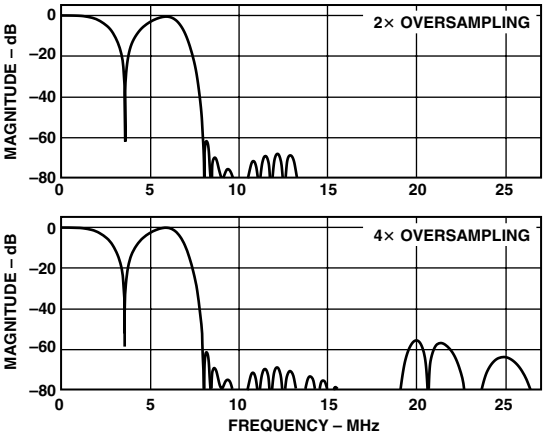

Figure 20. Luma NTSC Notch Filter

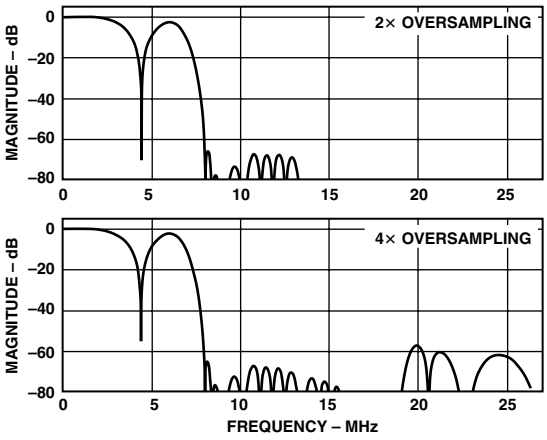

Figure 21. Luma PAL Notch Filter

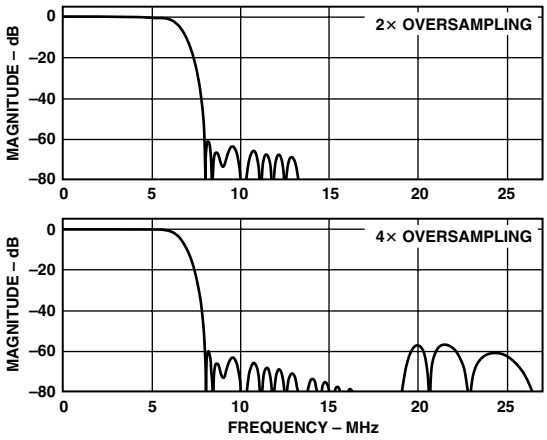

Figure 22. Extended (SSAF) Luma Filter

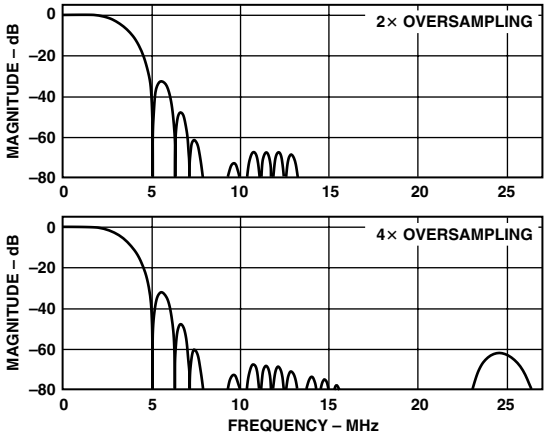

Figure 23. Luma CIF Filter

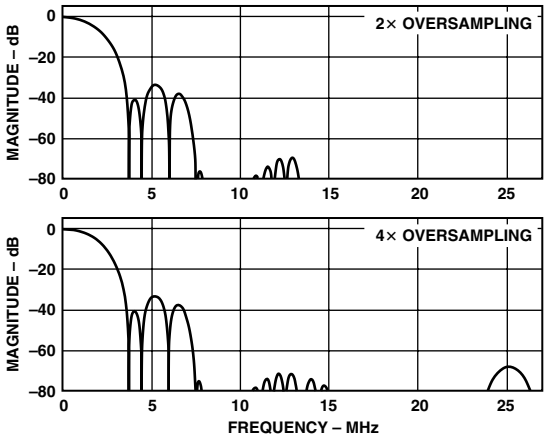

Figure 24. Luma QCIF Filter

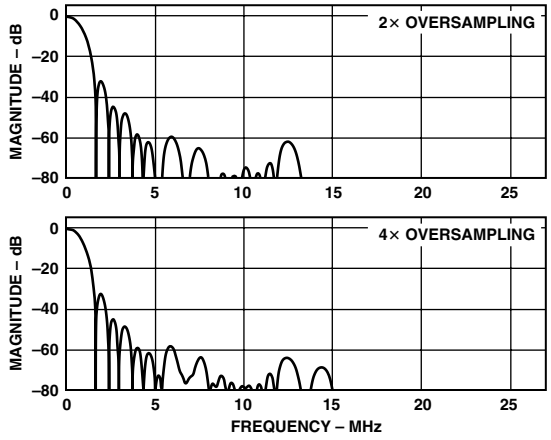

Figure 25. Chroma 0.65 MHz Filter

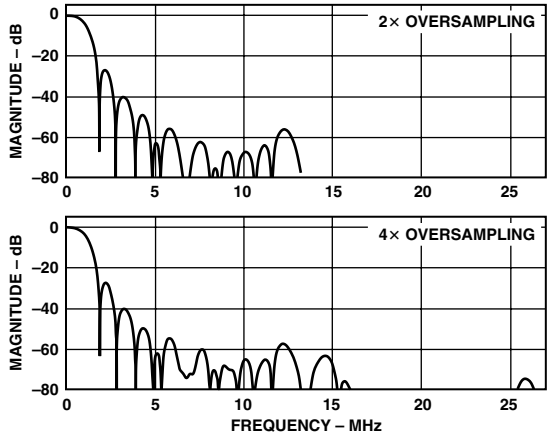

Figure 26. Chroma 1.0 MHz Filter

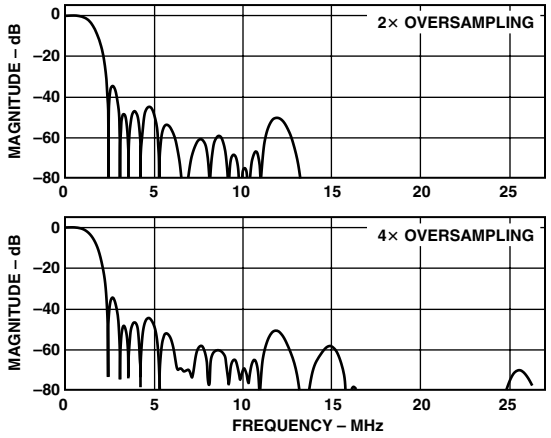

Figure 27. Chroma 1.3 MHz Filter

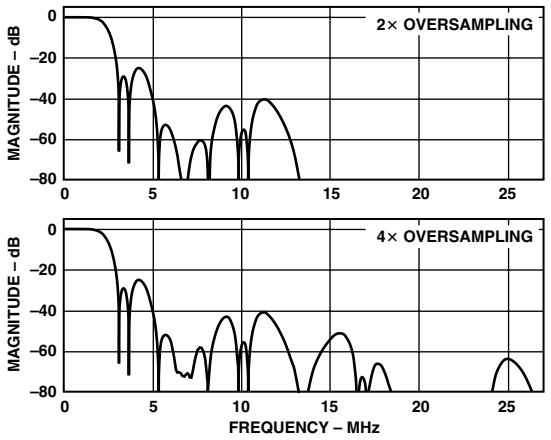

Figure 28. Chroma 2.0 MHz Filter

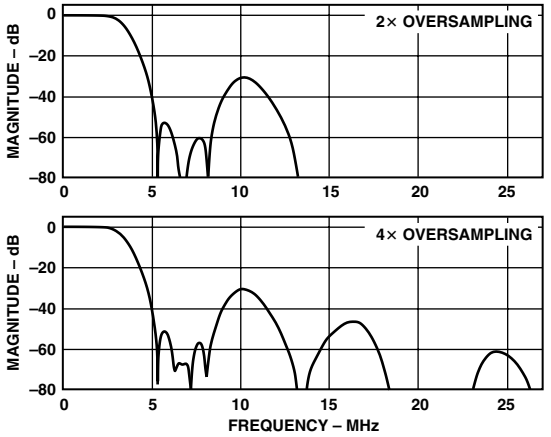

Figure 29. Chroma 3.0 MHz Filter

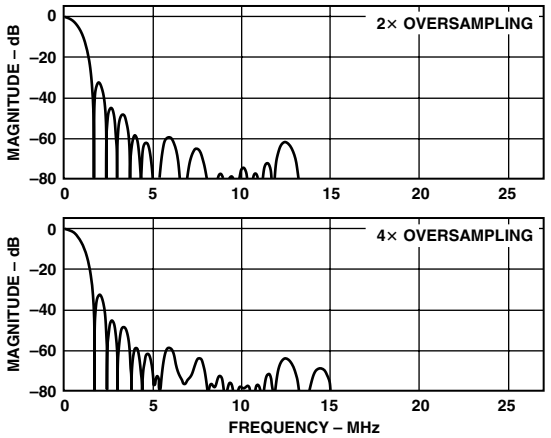

Figure 30. Chroma CIF Filter

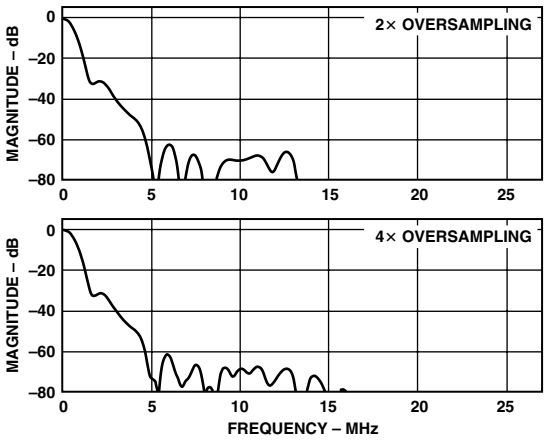

Figure 31. Chroma QCIF Filter

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