

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

¹Passband 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 f_c (Hz) frequency limits for a low-pass filter, 0 (Hz) to f₁ (Hz) and f₂ (Hz) to infinity for a notch filter, where f_c, f₁, f₂ are the -3 dB points.

²3 dB bandwidth refers to the -3 dB cutoff frequency.

³Stopband Cutoff refers to the frequency (MHz) at attenuation point (dB) referred to under Note 4.

⁴Stopband Attenuation refers to the attenuation (dB) at the frequency (MHz) referred to under Note 3.

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

¹Passband 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 f_c (Hz) frequency limits for a low-pass filter, 0 (Hz) to f_1 (Hz) and f_2 (Hz) to infinity for a notch filter, where f_c , f_1 , f_2 are the −3 dB points.

²3 dB bandwidth refers to the −3 dB cutoff frequency.

³Stopband Cutoff refers to the frequency (MHz) at attenuation point (dB) referred to under Note 4.

⁴Stopband Attenuation refers to the attenuation (dB) at the frequency (MHz) referred to under Note 3.

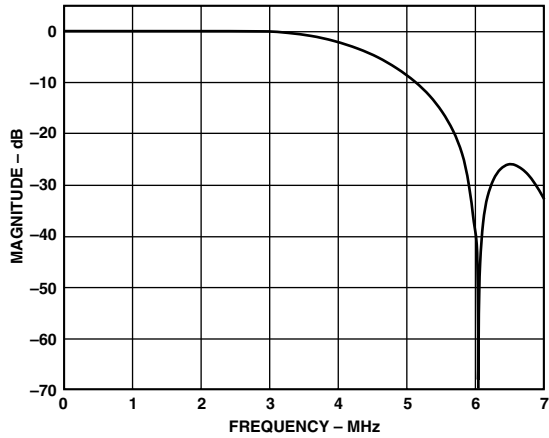


Figure 1. Luma NTSC Low-Pass Filter (4x Oversampling)

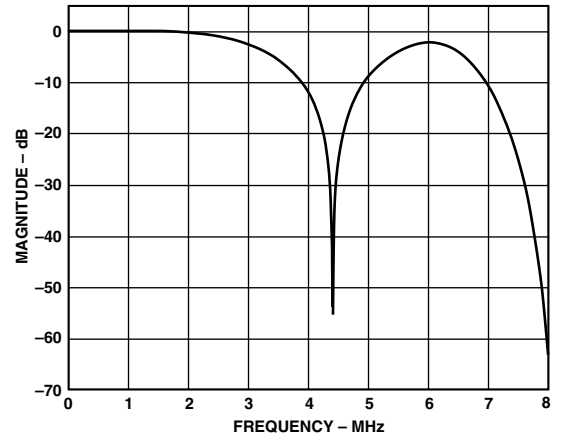


Figure 4. Luma PAL Notch Filter (4x Oversampling)

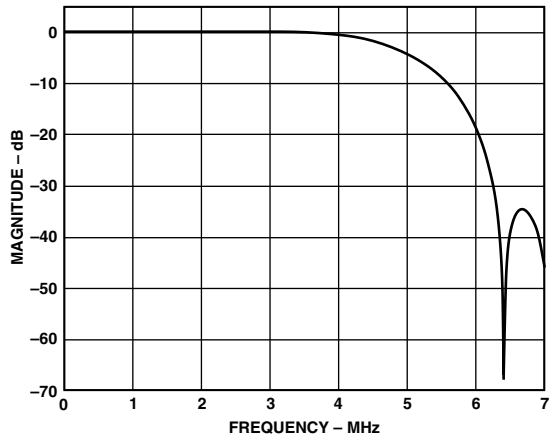


Figure 2. Luma PAL Low-Pass Filter (4x Oversampling)

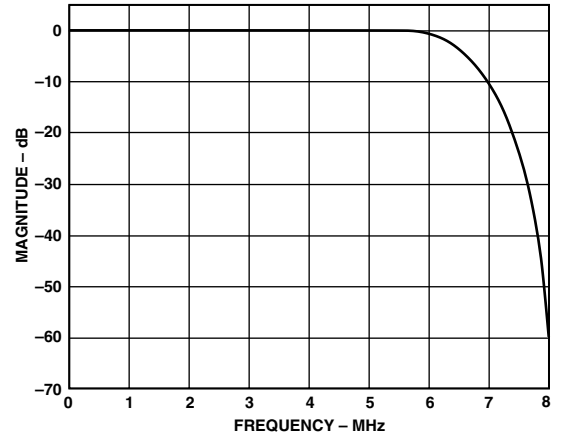


Figure 5. Extended (SSAF) Luma Filter (4x Oversampling)

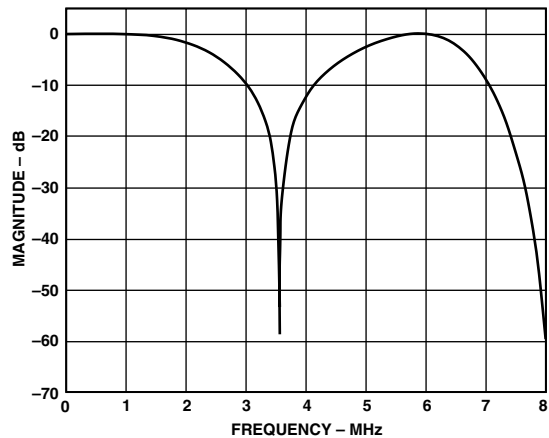


Figure 3. Luma NTSC Notch Filter (4x Oversampling)

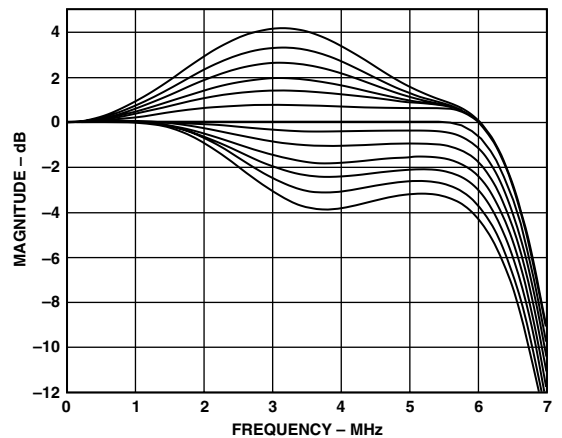


Figure 6. Extended (SSAF) Luma Filter (4x Oversampling) with Programmable Attenuation/Gain in the Passband

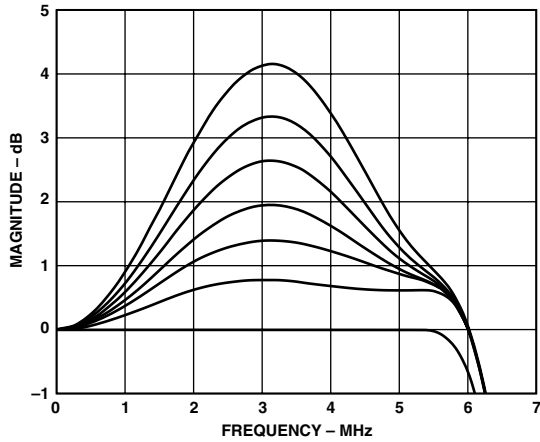


Figure 7. Extended (SSAF) Luma Filter (4x Oversampling) Zoom In on Programmable Gain in the Passband

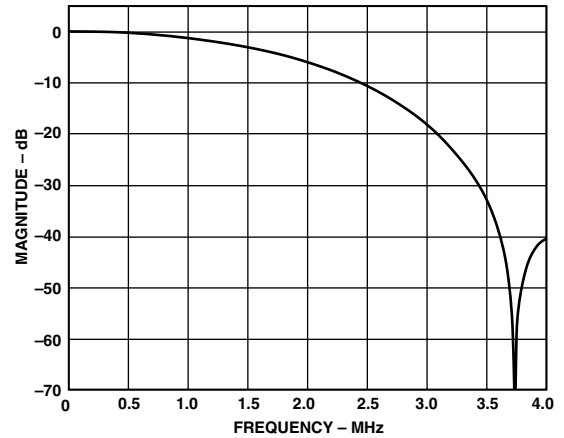


Figure 10. Luma QCIF Filter (4x Oversampling)

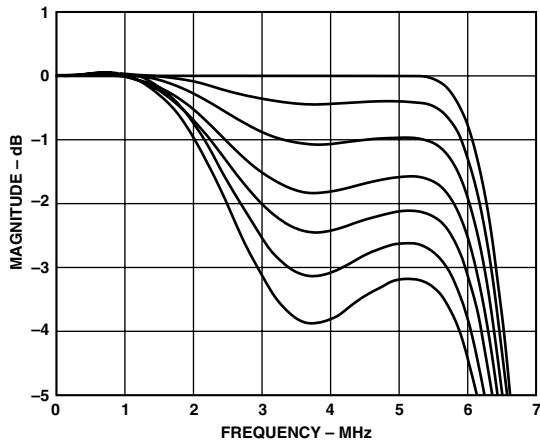


Figure 8. Extended (SSAF) Luma Filter (4x Oversampling) Zoom In on Programmable Attenuation in the Passband

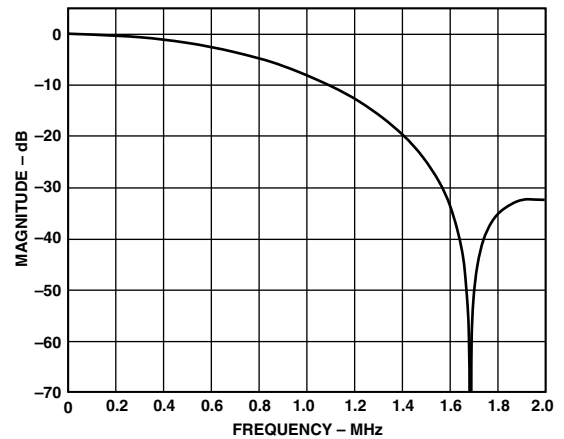


Figure 11. Chroma 0.65 MHz Low-Pass Filter

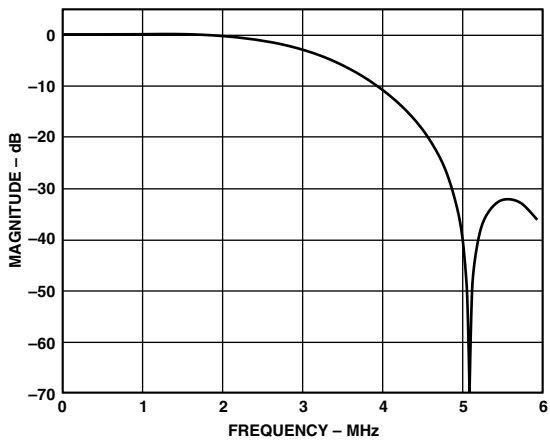


Figure 9. Luma CIF Filter (4x Oversampling)

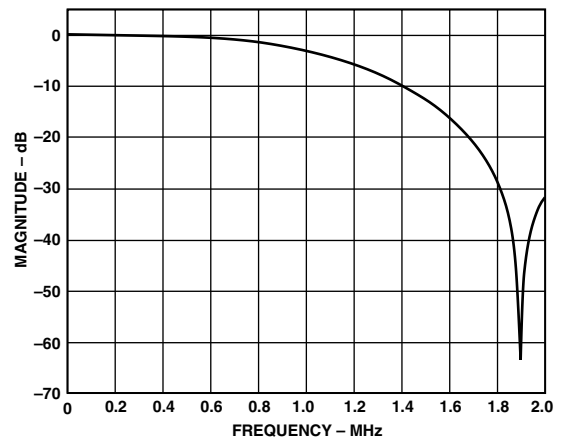


Figure 12. Chroma 1.0 MHz Low-Pass Filter (4x Oversampling)

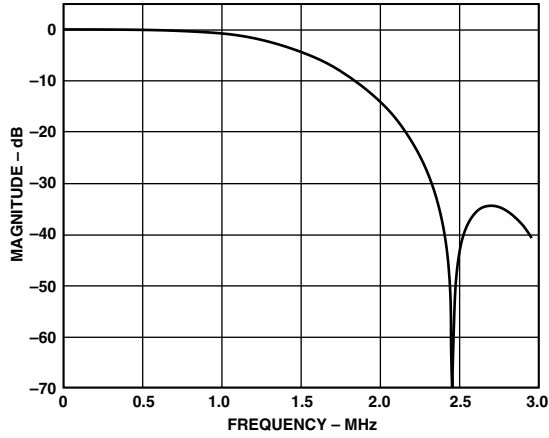


Figure 13. Chroma 1.3 MHz Low-Pass Filter (4x Oversampling)

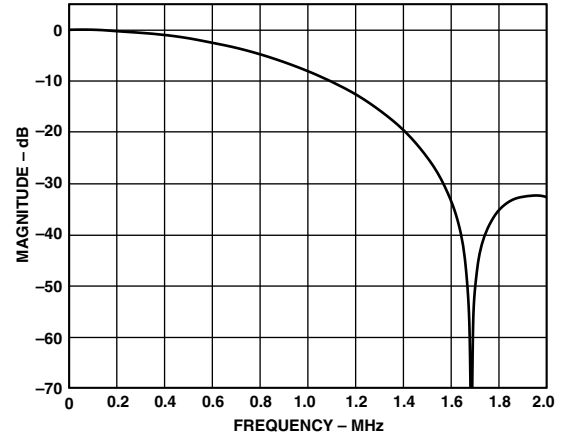


Figure 16. Chroma CIF Filter (4x Oversampling)

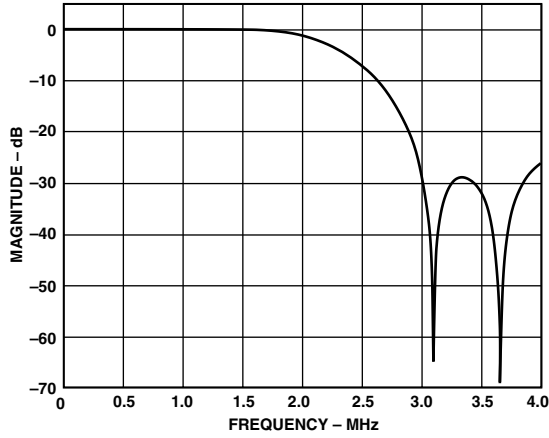


Figure 14. Chroma 2.0 MHz Low Pass Filter (4x Oversampling)

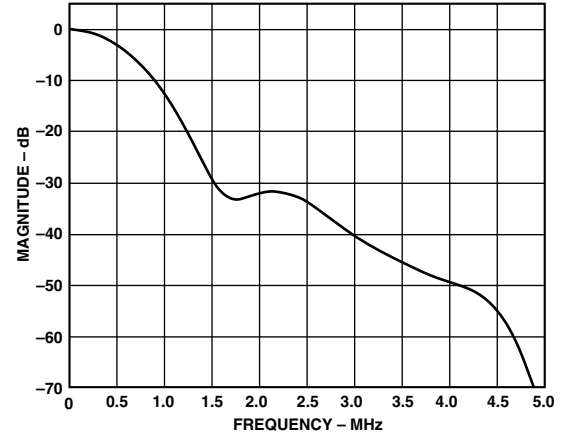


Figure 17. Chroma QCIF Chroma Filter (4x Oversampling)

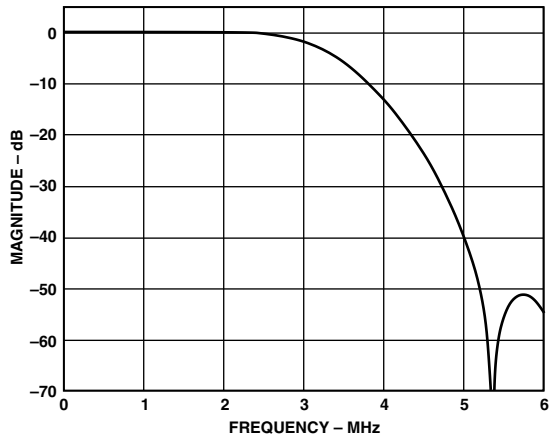


Figure 15. Chroma 3.0 MHz Filter (4x Oversampling)

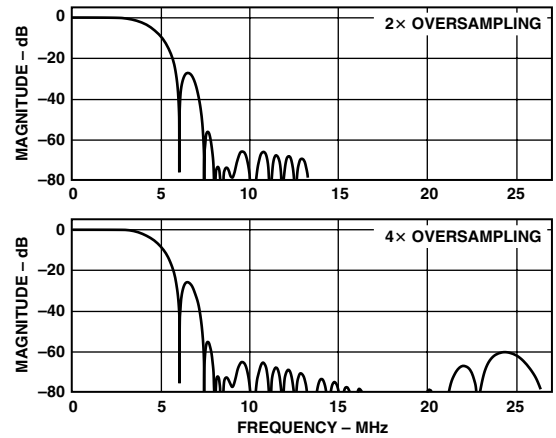


Figure 18. Luma NTSC Low-Pass Filter

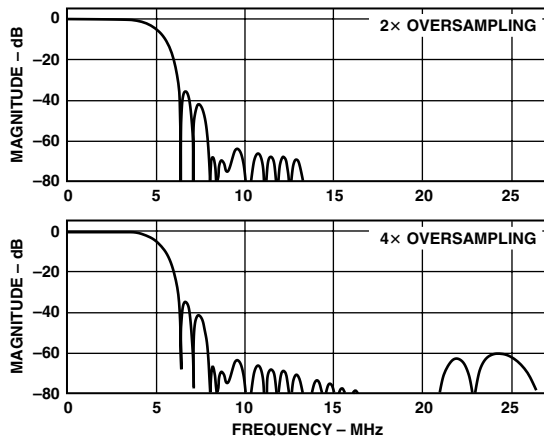


Figure 19. Luma PAL Low-Pass Filter

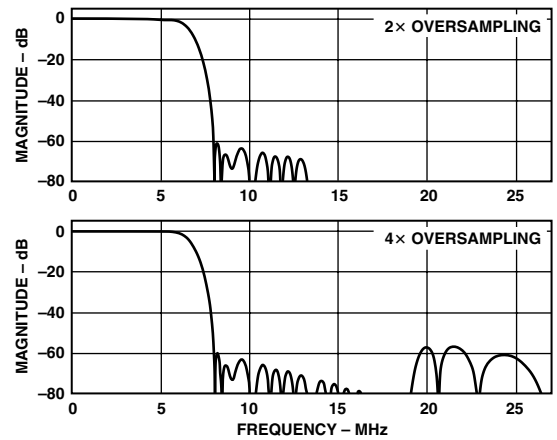


Figure 22. Extended (SSAF) Luma Filter

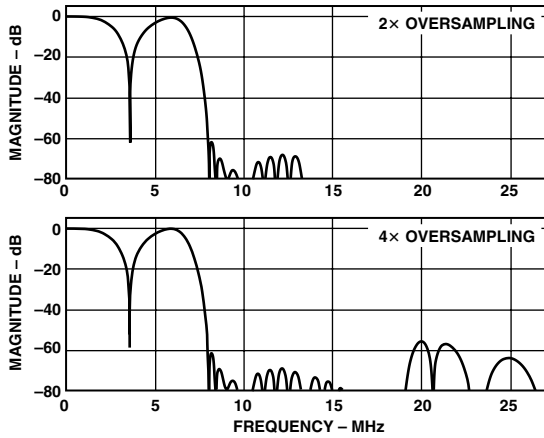


Figure 20. Luma NTSC Notch Filter

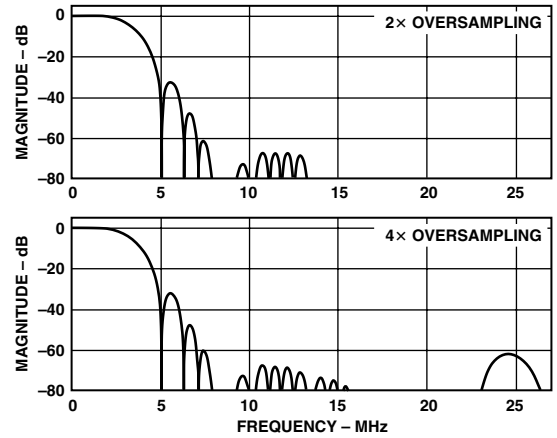


Figure 23. Luma CIF Filter

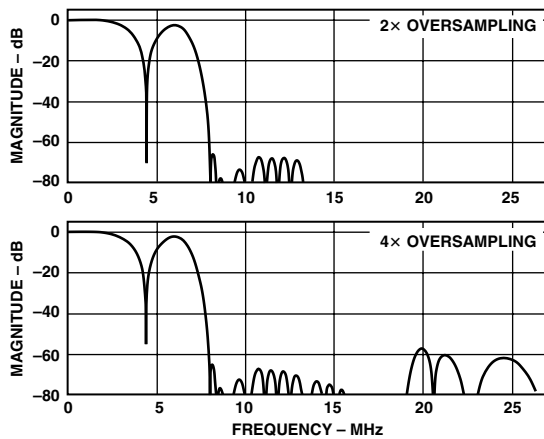


Figure 21. Luma PAL Notch Filter

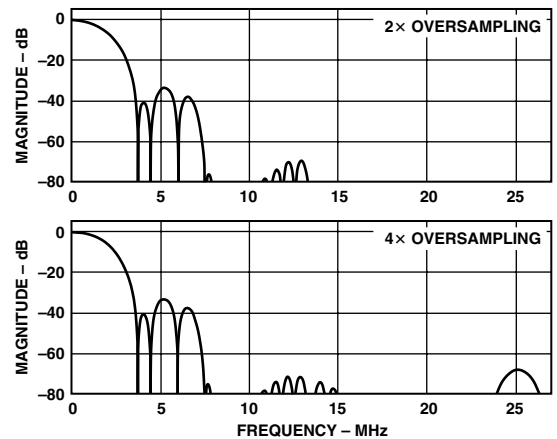


Figure 24. Luma QCIF Filter

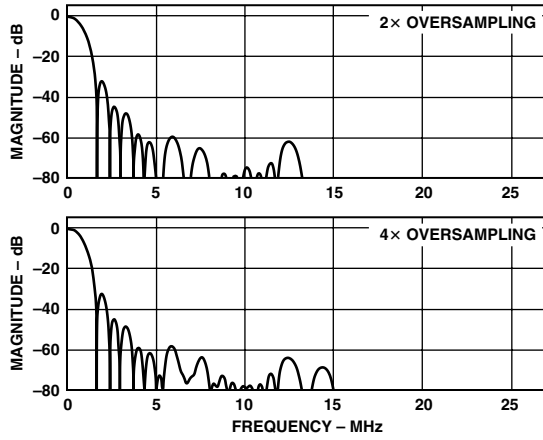


Figure 25. Chroma 0.65 MHz Filter

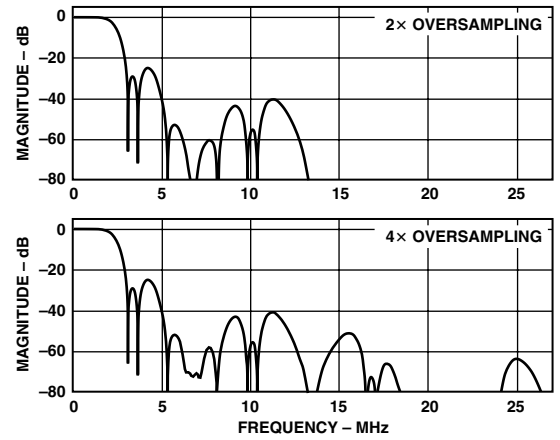


Figure 28. Chroma 2.0 MHz Filter

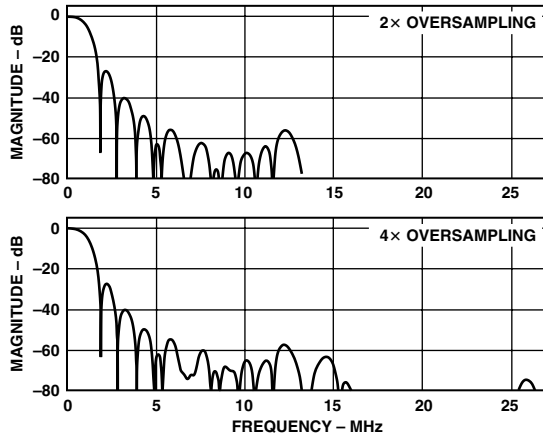


Figure 26. Chroma 1.0 MHz Filter

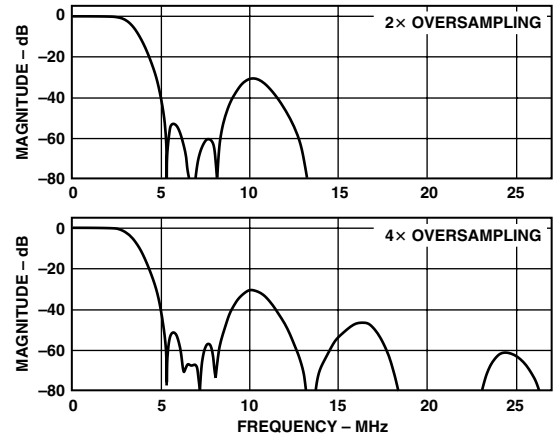


Figure 29. Chroma 3.0 MHz Filter

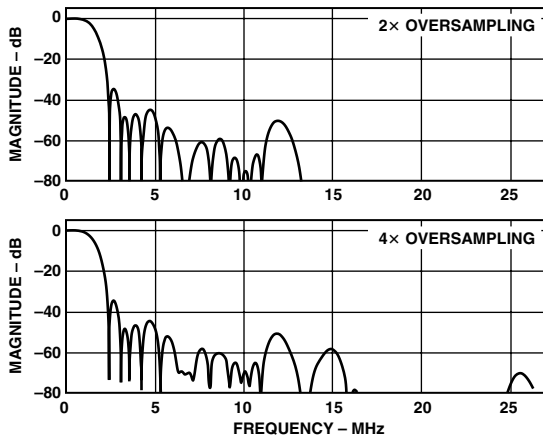


Figure 27. Chroma 1.3 MHz Filter

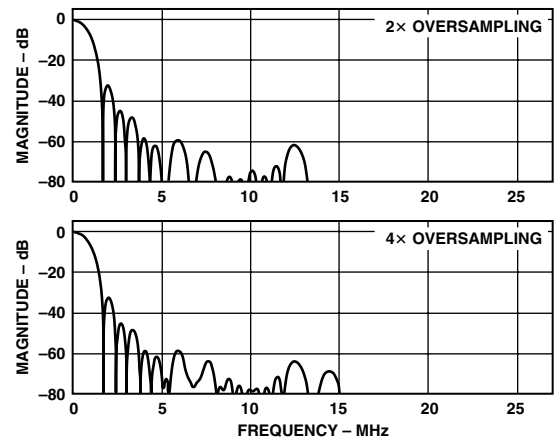


Figure 30. Chroma CIF Filter

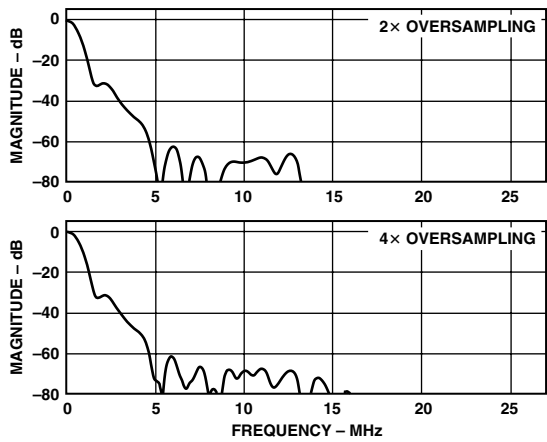


Figure 31. Chroma QCIF Filter