

# Oversampling (3B)

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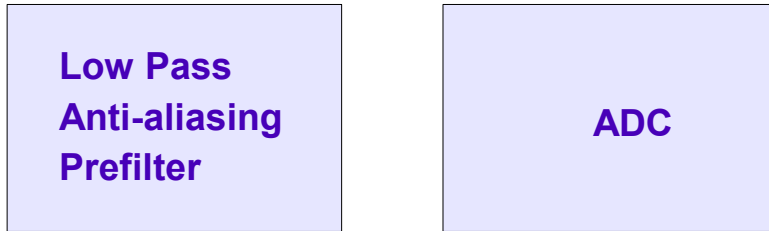
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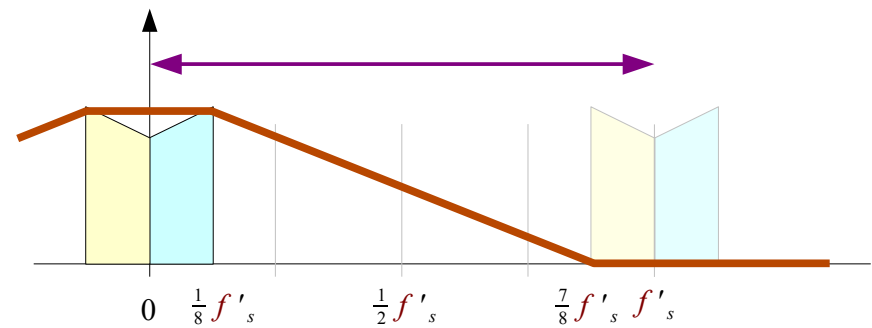
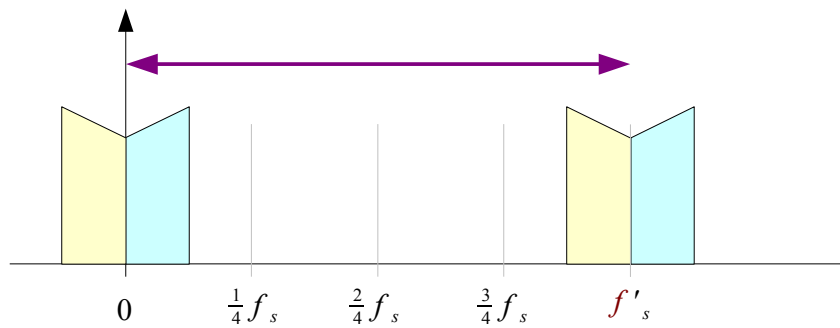
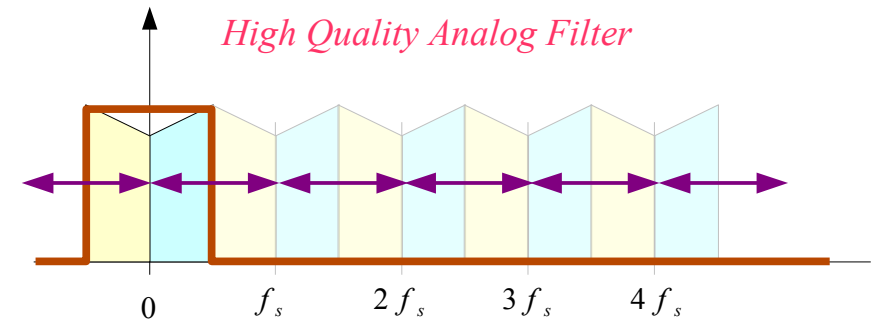
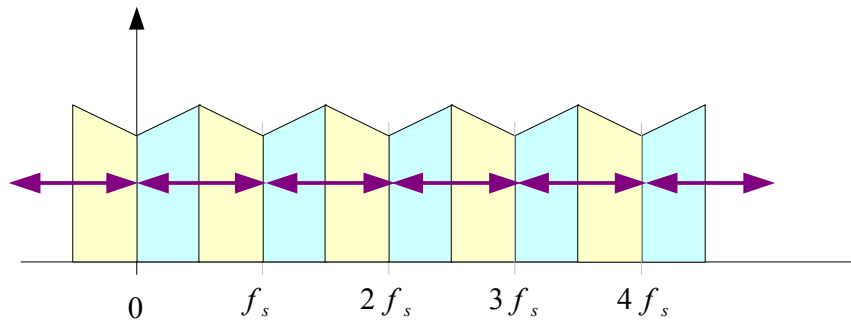
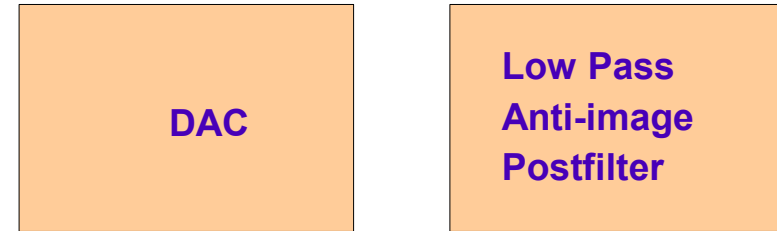
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# Band-limited Signal

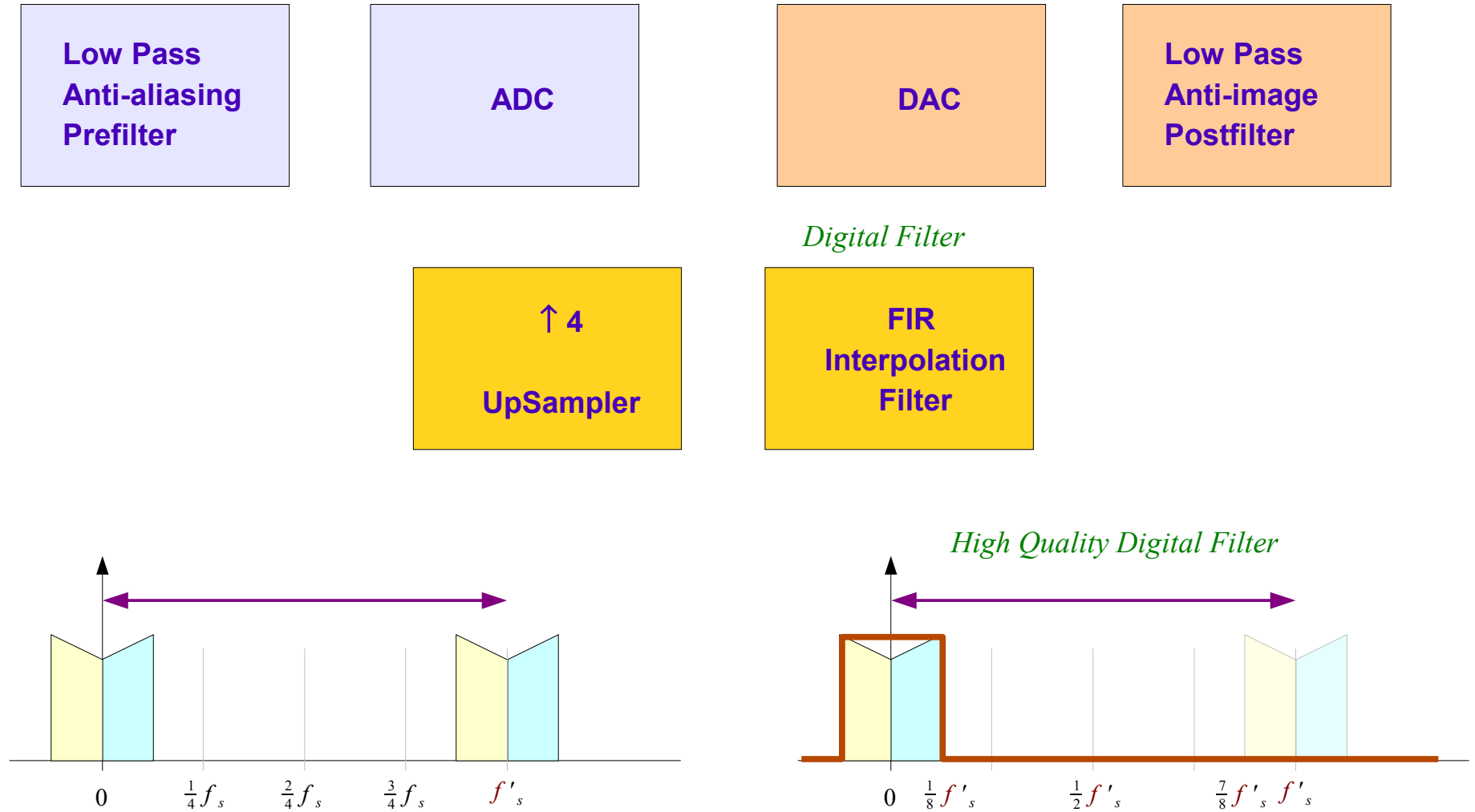
*Analog Filter*



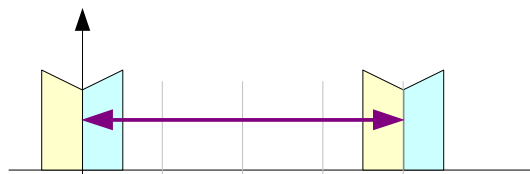
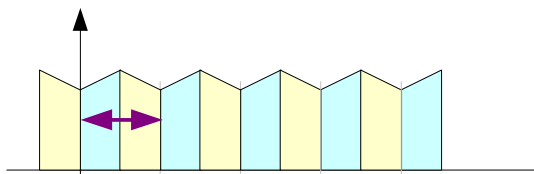
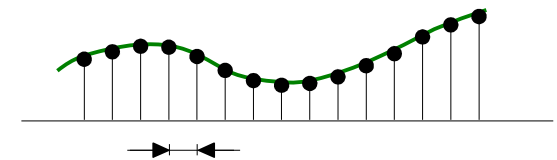
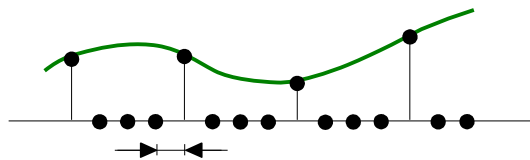
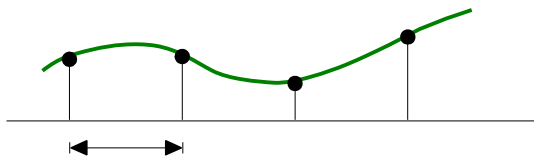
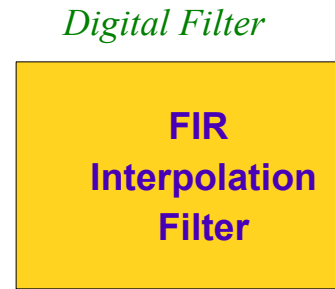
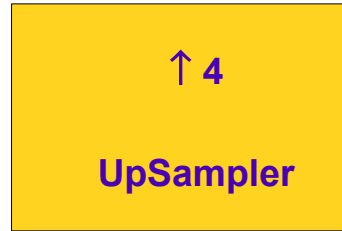
*Analog Filter*



# Band-limited Signal



# Band-limited Signal



# Band-limited Signal

Low Pass  
Anti-aliasing  
Prefilter

ADC

DAC

Low Pass  
Anti-image  
Postfilter



↑ 4

$$f_{oversampling} = 4^n \cdot f_s$$

UpSampler

FIR  
Interpolation  
Filter

$$f_s > 2 \cdot f_H$$

# Band-limited Signal

$$f_{\text{oversampling}} = 4^n \cdot f_s$$

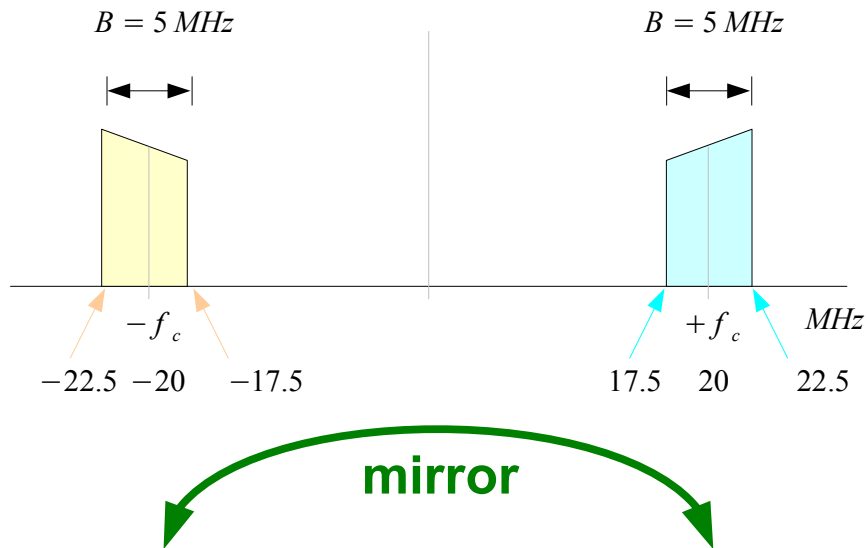
Oversampling and Decimation  
Oversample and Lowpass Filter

- Normal Averaging
- Decimation / Interpolation

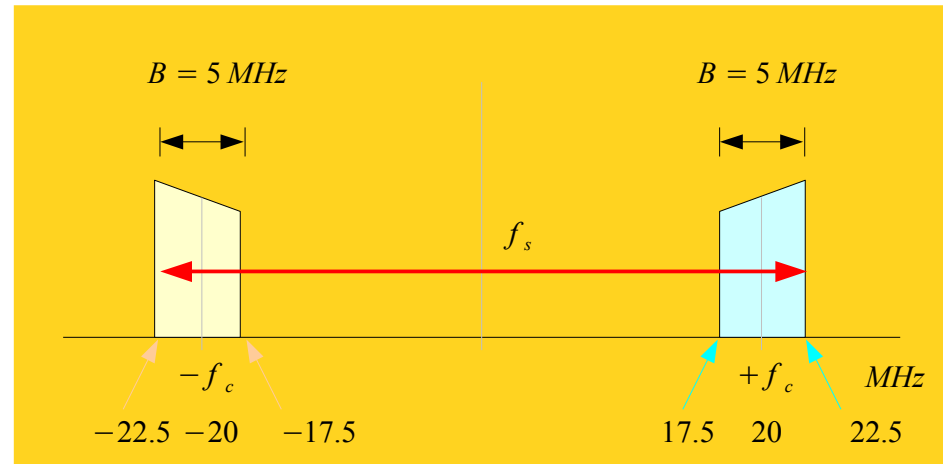


$$f_s > 2 \cdot f_H$$

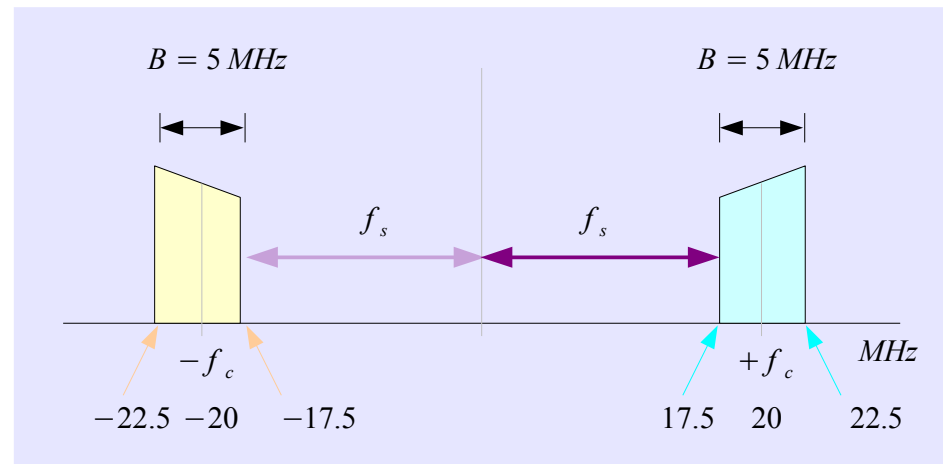
# Band-limited Signal



- Bandpass Sampling
- IF filtering
- Harmonic Sampling
- Sub-Nyquist Sampling

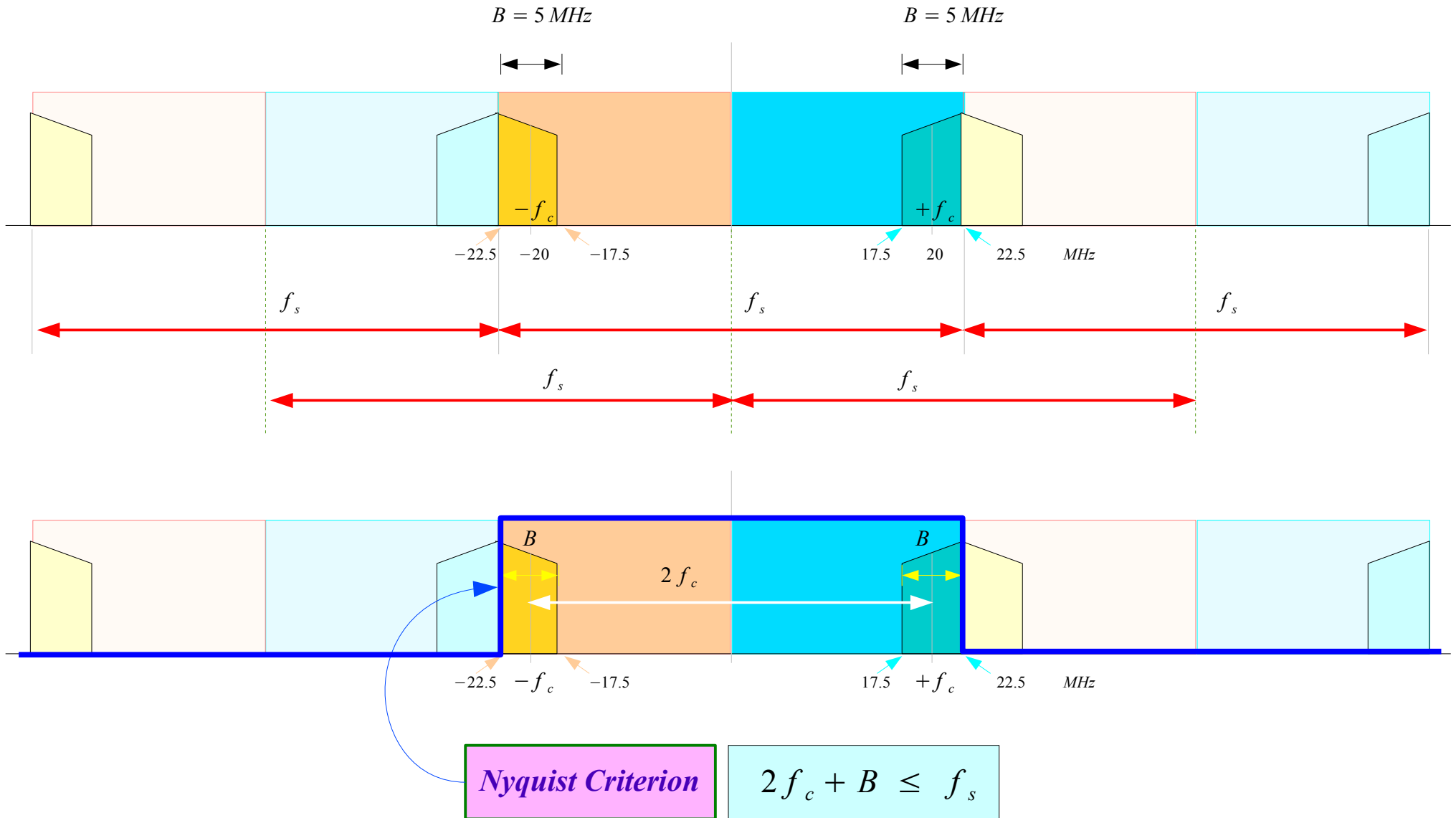


- Lowpass Sampling





# Low-pass Signal Sampling



## References

- [1] <http://en.wikipedia.org/>
- [2] J.H. McClellan, et al., Signal Processing First, Pearson Prentice Hall, 2003
- [3] A “graphical interpretation” of the DFT and FFT, by Steve Mann
- [4] R. G. Lyons, Understanding Digital Signal Processing, 1997
- [5] AVR121: Enhancing ADC resolution by oversampling
- [6] S.J. Orfanidis, Introduction to Signal Processing  
[www.ece.rutgers.edu/~orfanidi/intro2sp](http://www.ece.rutgers.edu/~orfanidi/intro2sp)