# Frequency Response

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Frequency response is the measurement of a circuit passes a AXC signal from input port to the output port. A Bode plot is the graphical representation on a mathematical solution of a transfer function of circuit that passes a signal from the input port to the output port. Note many times the terms are used interchanged. Both the frequency response and Bode plot are plotted with the X-axis (frequency) on a logarithmic scale. The Y-axis is the ratio the output signal level to the input signal level. The ratio is the gain or loss of the circuit.

The voltage gain Av = Vout / Vin with a scale V/V and is plotted on linear scale. |Av| > 1 the circuit has gain, if |Av| < 1 the circuit has loss. The output signal is inverted or 180 phase shited if the Av is a negative value.

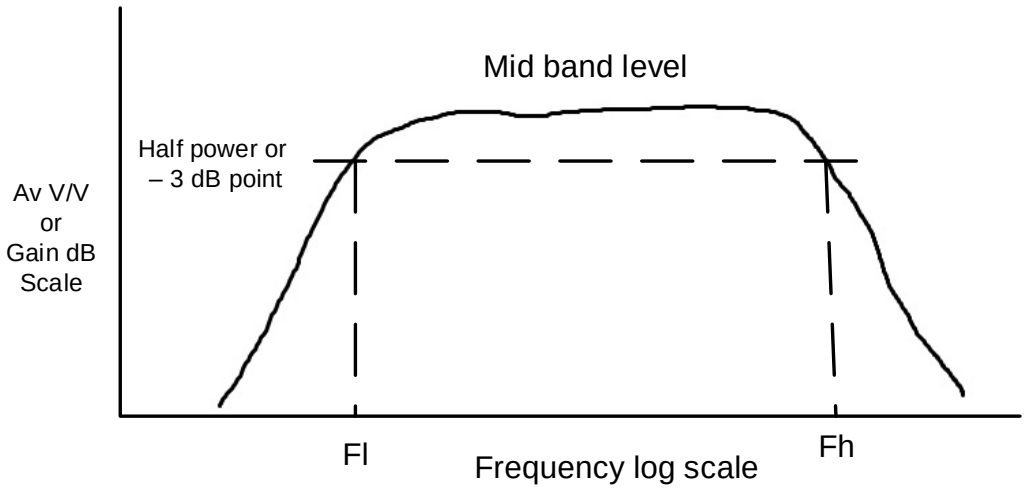
Gain in decibels have the scale factor of 20log (Vout/Vin) dB is the units and is plotted on a logarithmic scale. The phase shift is show a plot of the phase angle with 0-degree equivalent to a positive Av and 180-degree equivalent to a negative value.

If the gain in dB is positive the circuit has gain, if it is negative the circuit has loss.

Mid band signal level is between the low frequency cutoff and the high frequency cutoff. The cut off frequency are measured at a point on the plot that below the mid band level.

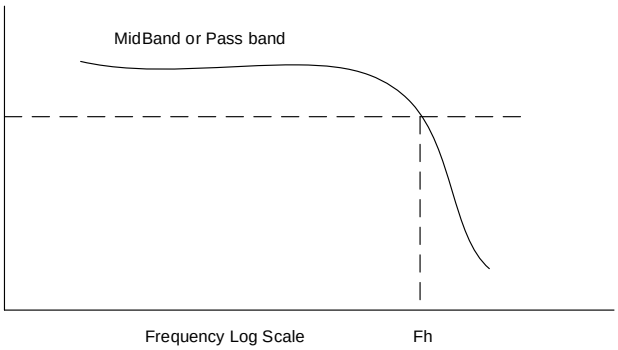
For a voltage to voltage plot it is the half power frequency = ( 1/√2)MidBand level.

For the dB plot it is 3 dB below the Midband level sometimes called the “- 3dB point”



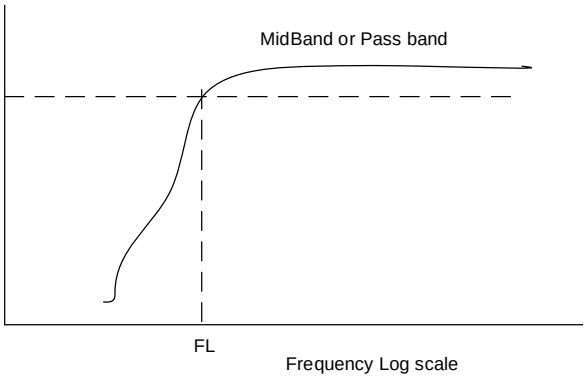
## Low Pass

A low pass filter has only a high frequency cutoff; it passes the low frequency signals.



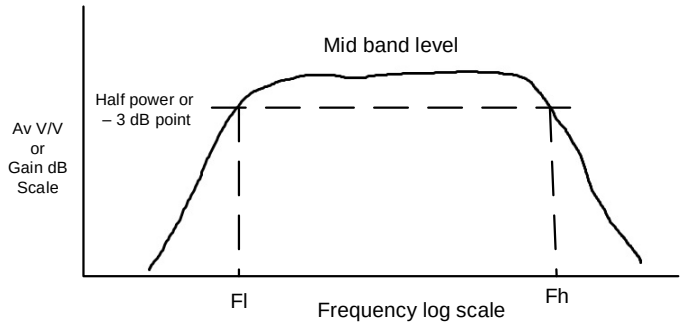

## High Pass

A high pass filter has only a low frequency cutoff; it passes the high frequency signals.




## Band Pass

A band pass filter has both a low frequency cutoff $F_L$ and high frequency cutoff $F_H$. The pass band is called the bandwidth $BW = F_H - F_L$.



**Gain Bandwidth product**

An operation amplifier has term called GB gain bandwidth product, which is gain of the amplifier multiplied by its bandwidth. An OpAmp with a GB of 1 MHz has a bandwidth of 1 MHz if the |Av| = 1. If IAv| = 100 the bandwidth = 10 kHz.