

GLOSSARY

ATTENUATION - Loss of a signal in transmission through a filter, typically referring to signal amplitude or signal power. Usually measured in decibels (dB).

BAND REJECT FILTER - A filter that rejects one band of frequencies and passes both higher and lower frequencies. Sometimes called a notch or band-stop filter.

BANDPASS FILTER - A filter that passes one band of frequencies and rejects both higher and lower frequencies.

BANDWIDTH - The width of the passband of a bandpass filter. This is usually expressed as the frequency difference between lower and upper relative 3dB points.

BESSEL FUNCTION - A mathematical function used to maximally yield constant time delay in a filter without consideration for amplitude response. This function is very close to a Gaussian Function.

BUTTERWORTH FUNCTION - A mathematical function used to maximally yield constant amplitude response in a filter without consideration for time delay, or phase response.

CENTER FREQUENCY (Fc) - The arithmetic mean frequency. This is normally calculated using 3dB relative band edges (F1 & F2).

$$F_c = \frac{F_1 + F_2}{2}$$

Where F1 & F2 are lower and upper frequencies respectively, at which a particular signal attenuation occurs, usually taken as 3dB relative attenuation - an important parameter of bandpass and band reject filters.

CHEBYSHEV FUNCTION - A mathematical function that produces a curve that ripples within certain bounds (see ripple). This produces a squarer amplitude response than a Butterworth function but with less desirable phase and time delay characteristics. There is a whole family of Chebyshev functions (0.1dB ripple, 0.5dB ripple, etc.)

CUT-OFF FREQUENCY (Fco) - The upper passband edge in lowpass filters or the lower passband edge in highpass filters closest to the stop band. Lark normally uses the point at which the VSWR equals 1.5/1.

DECIBEL (dB) - A unit used to express the ratio between two amounts of power P1 and P2 existing at two points. By definition:

$$dB = 10 \log_{10} \frac{P_1}{P_2}$$

It can also be used to express voltage and current ratios but only when the voltage or current is measured at places having identical impedance.

DISSIPATION - Energy losses in a filter due to resistive or core losses.

DISTORTION - Generally speaking, the modification of signals which produce an undesirable end effect. These modifications can relate to phase, amplitude, delay, etc. The distortion of a sine wave is usually defined as the percentage of signal power remaining after the fundamental sine wave component has been removed.

ELLIPTIC FUNCTION - A mathematical function used to yield the squarest possible amplitude filter response with a given number of circuit elements. The elliptic function has a Chebyshev response in both the passband and the stopband. The elliptic function filter has a poorer phase response and transient response than any of the classical transfer functions.

GROUP DELAY - The group/time delay of the envelope of an amplitude modulated signal as it passes through a filter. Sometimes called time delay or envelope delay. Group delay is proportional to the slope of the phase shift responses versus frequency curve. Group delay distortion occurs when the delay is not constant at all frequencies in the passband area.

GAUSSIAN FUNCTION - a mathematical function used to design a filter which passes a step function with zero overshoot with maximum rise time. This function is very close to a Bessel Function.

HIGHPASS FILTER - A filter which passes high frequencies and rejects low frequencies.

INPUT IMPEDANCE - The impedance measured at the input terminal of a filter when it is properly terminated at its output terminal.

INSERTION LOSS - The loss of signal caused by a filter being inserted in a circuit. It has many different definitions and is usually measured in dB. In general, it is the ratio of voltage to the load (at peak frequency response) with the filter in the circuit, to the voltage in the load if a perfect lossless matching transformer replaced the filter. When a filter is inserted between two circuits whose impedance differs widely, it is sometimes more practical to specify insertion loss some other way.

LINEAR PHASE FILTER - A filter that exhibits a constant change in degrees per unit of frequency. The resultant plot of frequency versus phase is a straight line. This type of filter ideally displays a constant delay in its passband.

LOAD IMPEDANCE - The impedance that normally must be connected to the output terminal of the filter in order to meet filter specifications. The filter will drive this load.

LOWPASS FILTER - A filter which passes low frequencies and rejects high frequencies.

GLOSSARY

OVERSHOOT - The amount, in percent, by which a signal exceeds its steady-state output on its initial rise.

PASSBAND - The frequency range in which a filter is intended to pass signals.

PASSBAND RIPPLE - Variations of attenuation within the passband of a filter.

PHASE SHIFT - The changing of phase of a signal, as it passes through a filter. A delay in time of the signal, is referred to as phase lag. In normal networks, phase lag increases with frequency, producing a positive envelope delay (see envelope delay).

Q - The figure of merit of a capacitor or inductor. The ratio of its reactance to its equivalent series resistance. Also, in bandpass filters, "loaded Q" is a term used to define the percentage of 3dB bandwidth.

$$\text{LOADED Q} = \frac{\text{Center Frequency (Fc)}}{3\text{dB Bandwidth}}$$

RELATIVE ATTENUATION - Attenuation measured with the point of minimum attenuation taken as zero dB, or relative attenuation = attenuation minus insertion loss.

RESPONSE - The ratio of the input signal compared to the output signal. The term is used to describe how a filter reacts to input signal (for amplitude response and phase response).

RETURN LOSS - The ratio, in dB, of maximum power sent down a transmission line to the power returned toward the source. Also equal to 20 times the log of the reciprocal of the reflection coefficient. If return loss is infinite all power is absorbed in the circuit.

RINGING - The tendency of a filter to oscillate for a time when a transient waveform is applied to it.

RIPPLE - Generally referring to the wavelike variations in the amplitude response of a filter. Chebychev and elliptic function filters ideally have equi-ripple characteristics, which means that the difference in peaks and valleys of the amplitude response in the passband, are always the same. Butterworth, Gaussian, and Bessel functions do not have any ripple. Ripple is usually measured in dB.

RISE TIME - The length of time it takes a step-function, at the output of a filter, to move from 10% to 90% of its steady state value on the initial rise.

SHAPE FACTOR - An important parameter of all filters:

$$\text{BANDPASS: SF} = \frac{\text{Attenuation Bandwidth}}{3\text{dB Bandwidth}}$$

$$\text{BANDSTOP: SF} = \frac{3\text{dB Bandwidth}}{\text{Attenuation Bandwidth}}$$

$$\text{LOWPASS: SF} = \frac{\text{Attenuation Frequency}}{F_{co}}$$

$$\text{HIGHPASS: SF} = \frac{F_{co}}{\text{Attenuation Bandwidth}}$$

SOURCE IMPEDANCE - The output impedance of the circuit that drives the filter. The impedance of the circuit the filter must work from or be tested in.

STEP FUNCTION - A signal change in amplitude, from one level to another, which occurs in zero time. Usually refers to a rectangular front waveform, used in testing transient response.

STOPBAND - The area of frequency where it is desirable to reject or attenuate all signals, as much as is practical.

TIME DELAY - The amount of time it takes for certain signals to pass through a filter.

TRANSIENT RESPONSE - The response of a lowpass filter to a step function or very low frequency square wave. If a sudden voltage rise is applied to a lowpass filter, the output will respond sometime later. Transient response can also apply to a bandpass filter responding to a sudden burst of signal within its passband.

VOLTAGE STANDING WAVE RATIO (VSWR) - The ratio between the peak and valley of standing waves on a transmission time.