Tips on Navigating Cavity Filter Types, Performance, and Features

Cavity filters are a type of resonant filter used for either passing desired RF signals within a specified frequency range or rejecting RF signals within a range of frequencies. The resonant cavity within these filters can be constructed from durable materials, such as highly conductive and dimensionally stable metals, to reliably perform for years in harsh environments. Along with the ability to provide high quality filtering for high powered signals, these filters are ideally suited for telecommunications applications from tens of megahertz to a gigahertz. These filters are often used between an antenna and receiver to block out unwanted signals, or between an antenna and transmitter to prevent spurs or distortions from transmitting. When evaluating cavity filters, specifically for telecommunications purposes, there are several key features worth noting. Following is a list of these key features with a brief explanation.

**Bandpass Cavity Filter**
A bandpass filter is a type of frequency selective attenuator, which means that signals passing through the filter will exit the filter with less power at certain frequencies. A bandpass filter will dampen all signals except for a narrow range of frequencies at the center frequency. These filters are useful for blocking out all other frequencies except for the desired telecommunication channels from reaching a receiver.

![Figure 1: The frequency response of a bandpass filter.](image1)

**Notch Cavity Filter**
A Notch filter is also a frequency selective attenuator, like a bandpass filter; except the notch filters only block a small range of frequencies, and pass all other frequencies within a wide, but finite bandwidth.
Pass-Reject Cavity Filter
A pass-reject filter is also a frequency selective attenuator, but it has attributes of both a pass filter and a notch filter. This filter will have the least amount of insertion loss at the tuned pass frequency, the most attenuation at the tuned notch frequency, and a moderate amount of loss at all other frequencies.
**Frequency or Tuning Range**
The frequency range for a specific cavity filter is the minimum and maximum frequency that the cavity can resonate. Because the resonant frequency of the cavity depends upon the cavity dimensions, there is a limited frequency range that the cavity filter will operate best. The cavity can be tuned and operate anywhere within the frequency range.

**Insertion Loss or Attenuation**
Insertion loss or attenuation is the signal power at the configured pass frequency that is lost within the cavity. For a notch filter, it is the amount of signal power outside of the notch frequency that is lost. This parameter is usually represented in decibels referenced to a watt, or dB.

**Connector Type**
Different types of coaxial connectors can be installed on a cavity filter. Typically, these filters come standard with N-type RF connectors, though UHF connectors can also be installed. In some cases DIN 7-16 RF connectors may also be desired. These connectors must exactly match the connectors attached to the telecommunications cable used to connect the cavity filter to other components.

**Impedance**
The impedance of a cavity filter is the impedance seen at the cavity filters RF ports. Typically, 50 Ohms is used, though 75 Ohms is also common for some applications and may be requested.

**VSWR**
The voltage standing wave ratio is a measure of how well an RF device is impedance-matched to the transmission lines used to connect it to other devices. A VSWR of 1:1 is a perfect match with all of the power from a source being delivered to the filter. Any VSWR beyond 1:1 means there is some energy reflected from the input of the filter. Hence, the closer the VSWR of the cavity filter to 1:1, the better.

**Number of Cavities**
Some cavity filters may be available as single, dual, or even triple cavity filters. This means that there is more than one resonant cavity used to make the filter. More resonant cavities enables much greater attenuation in the undesired block frequency bands for both bandpass and notch cavity filters. Additional cavities do come with a trade-off in performance, as the additional cavities often lead to greater insertion loss in the desired pass frequencies.

**Power Handling**
The power handling of a cavity filter describes the maximum signal power that the filter can pass and still operate normally, or not suffer physical damage.

**Temperature Range**
The temperature range is the operating range in which the cavity filter will perform as described. If the cavity filter experiences temperatures beyond the prescribed range, the performance of the filter may suffer, and the filter may even be damaged.

**“Q”**
A figure of merit that describes the amount of bandwidth the cavity can pass, the insertion loss, and the sharpness of the curve of attenuation above and below the tuned pass frequency.