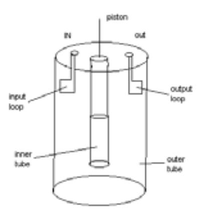
TECHNICAL BULLETIN N.2 October 2016

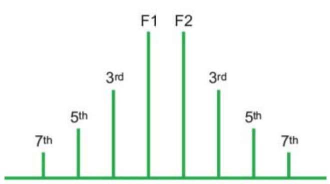
This month:

Cavity Filters and Combiners

The Band-Pass Cavity filter is a device that allows only one frequency to pass and cuts out all the other frequencies. Depending on the size of the cavity (Q factor), the band-pass filter can give a different isolation and a different insertion loss. In fact, the higher Q factor a cavity has, the sharpest curve it performs with the lowest insertion loss. As you can see in this simple schematic, the RF signal enters the Input of the Cavity and it is picked up by the output loop. The length of the inner tube determines the operating frequency.

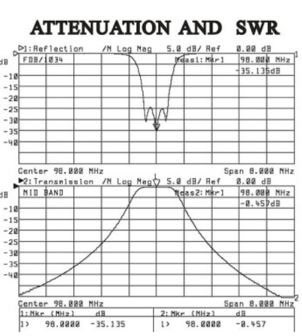


As you can see from the drawing, **there is no direct connection between the input connector and the output connector**. In the previous bulletin we stated that the Isolation Transformer was protecting the transmitter from anything coming from the AC Line because there was no electrical continuity between the input and the output of the Transformer. Now, in the same way, we can state that the Band-Pass cavity provides electrical isolation between the antenna and the transmitter. This means that **whatever comes down from the antenna (static, lightening etc.) stops inside the Cavity and will not reach the transmitter**. We like to imagine the cavity like a big fuse that protects the transmitter.
This is an aspect of the cavity that has never been properly pointed out, but that we like to emphasize. Now, imagine a sudden increase in the antenna SWR; usually this will reflect in an increase of the transmitter SWR and sometimes if the SWR is too high the mos-fets can fail.
With the use of a Cavity this will not happen because the input loop of the cavity will still show the transmitter good impedance even if the antenna is bad. In my experience of more than 40 years in the field, I have seen antennas totally gone and transmitters still working, with the cavity super hot, acting like a dummy load! This is another performance of the Cavity to be considered.
The main function of a Band-Pass Cavity is to clean the emission and avoid any kind of inter-modulation when more frequencies are present in a close area.



This second drawing shows what happens when 2 frequencies (F1 and F2) are transmitting without any filter. All the inter-modulation products are present and, depending on the vicinity of the 2 transmitters, they can be of different amplitude. A simple example: If we have a frequency of 98.1 MHz and a frequency of 101.1 MHz (a frequency distance of 3 MHz), there will be inter-modulation products every 3 MHz over 101.1 (104.1-107.1-110.1 etc.) and under 98.1 (95.1-92.1-89.1 etc.).
If we apply a band-pass filter at 98.1 MHz, we will eliminate all the inter-modulation products below 98.1MHz. However, those above 101.1 MHz will remain. If we install a Cavity also on 101.1 MHz, then everything will disappear and only the two main carriers will appear on the screen of a spectrum analyzer.

The Q factor in a Cavity is very important and it is strictly connected to the physical dimension of the cavity. However, also if we have a very good Q factor, we still need to have a good attenuation for all the unwanted frequencies. Here at Nicom, we decided not to produce single Cavities, but Double and Triple. The reason is that in this way we still keep the insertion loss very reasonable, but we highly increase the steepness of the curve. This allows us to better separate the unwanted signals from our main carrier and also gives us a better start for building Diplexers and Triplexers.



Here are some images of a 2 cell Cavity for 800W max power and a 3 cell Cavity for 2 KW max power. In the drawing you can see the typical curve of a Band-Pass Cavity and the SWR curve.
Depending on the Cavity model the typical insertion loss can go from 0.35dB to a max of 0.65 dB.

Low power cavities come with N type connector.
Medium and high power cavities come with 7/8 EIA flange.
Nicom highly recommends the use of a Band-Pass Cavity .

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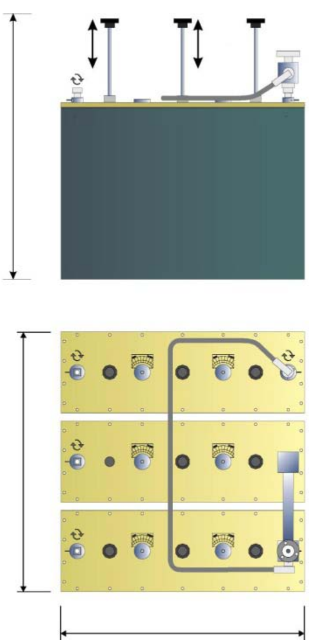
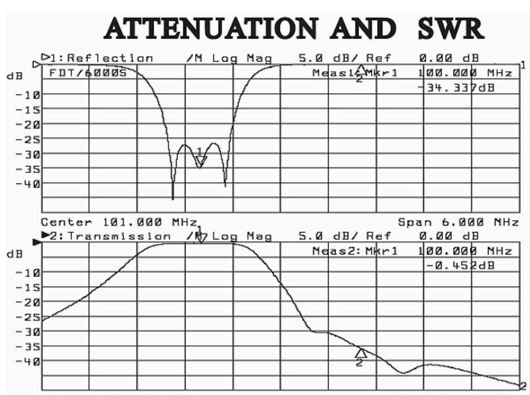
Diplexers and Triplexers

One of the purposes of manufacturing broadband antennas is to have more frequencies broadcasted by the same radiating system. Diplexers and Triplexers have been conceived just for this purpose. **These devices combine 2 or3 frequencies into the same radiating system**. In today's market where tower space has become an issue and/or is very expensive, the chance of combining more frequencies into one antenna system can be the better choice. Technically every Cavity is tuned on a specific frequency and the 2 or 3 cavities are connected together through a line of a specific length that mostly depends on the frequencies. If the spacing between frequencies is higher than 3 MHz, it is possible to build combiners with 2 cell cavities. If one or more frequency is closer than 3 MHz, then we need to use the 3 cell cavity. With these last cavities it is possible to reach a spacing of 1.5 MHz.
Isolation between channels is strictly related to the frequency spacing; it can vary from a minimum of 25dB up to 50dB or more.
Diplexers and Triplexers are tuned at the factory on specific frequencies and cannot be re-tuned in the field. Only very skilled technicians with proper test equipment can re-tune this type of device.
Diplexers and triplexers, besides combining frequencies, also offer the same transmitter protection that a single cavity does.
The correct installation of this type of device is very critical to the overall set up; the unit is tuned at the factory on a dummy load but when connected to an antenna the tuning could be slightly different. We always recommend to our customer to contact our engineer before installing the device so that they can be assisted in this first installation. Once everything is correctly in place Diplexers and Triplexers usually don't require any particular care.





These drawings show the typical configuration of a Ttriplexer where 2 of the cavities are connected through a rigid line while the 3rd one is connected with a ½ inch cable.
The 3 studs can be regulated by moving them up and down to center the desired frequency. Between the studs there are 2 rotating knobs that adjust the coupling between the cells. Input and output connectors can be rotated to find the best impedance match.
The picture above is showing the typical network analyzer reading of a diplexer tuned at about 3 MHz spacing. You can see channel one with an insertion loss of 0.452 dB and a separation to channel 2 of 34.337 dB.
Nicom provides a test report and visual representation of the network analyzer for every unit sold.
Due to the dimensions of the cavities and to better protect the device we prefer to ship them on a pallet in most cases.
For further information, pricing and delivery you can contact our sales person at NicomUsa.