

OCI VHF and UHF Band-pass Filters

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Good front-end receiver filtering is of primary importance for VHF/UHF repeater installations where the repeater is located on a mountaintop, a high-rise building, or other site where many radio services coexist. It's also important for amateurs who live near, or operate portable from, locations

hosting multiple radio services.

With many transmitters physically close by, a receiver can overload, often with the result of intermodulation distortion (IMD) products, broadband noise, and other interference heard in the speaker. Third-order IMD can occur when two strong signals appear at a receiver's antenna jack with frequencies equally spaced in relation to the receiver's tuned frequency.

Example: a repeater with a receive input frequency of 447.1 MHz is susceptible to two strong signals at 457.1 and 467.1 MHz (business or municipal service, at 10 MHz spacing). Second-order IMD can occur when two strong signals appear at the antenna jack that add up in frequency to the receiver's tuned frequency. For example, 100 MHz (from the FM broadcast band) and 47.690 MHz (business repeater) add up to 147.690 MHz.

Table 3
OCI VHF and UHF Band-pass Filters

Model 146-4 (VHF)	Manufacturer's Claimed Specifications	Measured in the ARRL Lab
Passband: 144 – 148 MHz.		As specified. See Figure 14.
Insertion loss: <0.6 dB @ 146 MHz; <1.0 dB @ 144 and 148 MHz.		As specified.
SWR: <1.2:1 @ 146 MHz; <1.4:1 @ 144 and 148 MHz.		As specified.
Power rating: 160 W.		As specified.
Connectors: Type N (UHF connectors available).		
Size (H x W x D, including protrusions): 3.7 x 7.9 x 2.7 inches. Weight, 2 lbs.		
Price: \$159.		
Model 445-10 (UHF)	Manufacturer's Claimed Specifications	Measured in the ARRL Lab
Passband: 440 – 450 MHz.		As specified. See Figure 15.
Insertion loss: 0.3 dB @ 445 MHz; 0.6 dB @ 440 and 450 MHz.		As specified.
SWR: <1.2:1 @ 445 MHz; <1.4:1 @ 440 and 450 MHz.		As specified.
Power rating: 200 W.		Tested at 50 W.
Connectors: Type N.		
Size (H x W x D, including protrusions): 9 x 10 x 2.8 inches. Weight, 5.4 lbs.		
Price: \$219.		

Table 4
Third-Order Intermodulation Distortion Dynamic Range (3 IMD DR) Tests

OCI 146-4 2-Meter Filter and Icom IC-2AT		
Spacing (MHz)	3 IMD DR without Filter (dB)	3 IMD DR with Filter (dB)
2	65	67
5	68	97
10	73	128
OCI 445-10 70-cm Filter and Icom IC-4AT		
Spacing (MHz)	3 IMD DR without Filter (dB)	3 IMD DR with Filter (dB)
2	61	62
5	63	64
10	69	82
15	75	87
20	78	123

Bottom Line

The OCI VHF and UHF band-pass filters offer low insertion loss and high out-of-band rejection, improving receiver performance in RF-dense environments.



Figure 12 — The OCI model 146-4 band-pass filter for 2 meters.



Figure 13 — The OCI model 445-10 band-pass filter for 70 centimeters.

A solution to such a problem is to move the receiver, or move the repeater entirely to another location, which may not be practical or cost effective. The best method is to use a band-pass filter at the receiver antenna jack, provided the offending signals are not within the amateur bands. Olds Communications (OCI) offers a solution in the form of two band-pass filters — model 146-4 for 2 meters (see Figure 12) and model 445-10 for 70 centimeters (see Figure 13).

In the Lab

Tables 3 and 4 and Figures 14 and 15 show the results of filter testing in the ARRL Lab. Laboratory measurements indicate the OCI filters reject out-of-band signals significantly. They have low in-band insertion loss, so they won't have much effect on receiver sensitivity. Note that they are both designed to handle power (160 W for the 2-meter version and 200 W for the 70-centimeter version), so they can be placed in a transceiver's antenna feed line without the need for external switching between transmit and receive. I tested the 2-meter version at full power without issues. I didn't have a 200 W amplifier available for 70 centimeters, but that filter easily handled 50 W from a typical FM mobile transceiver.

In addition to sweeping the passband and measuring insertion loss, I mea-

sured the third-order IMD dynamic range of a pair of old Icom handheld transceivers (1980s vintage) with and without the filters. I chose these transceivers because each had room for improvement regarding this parameter and were in "like new" condition. As you can see, there is little difference in

dynamic range when the test signals are inside the filter passband (2 MHz spacing on 2 meters; 2 and 5 MHz on 70 centimeters). Once the offending test signals are outside the passband (wider spacings), IMD dynamic range improves — dramatically so at the widest spacing.



Figure 16 — Mike Gruber, W1MG, listening on 2 meters at West Peak in Meriden, Connecticut.

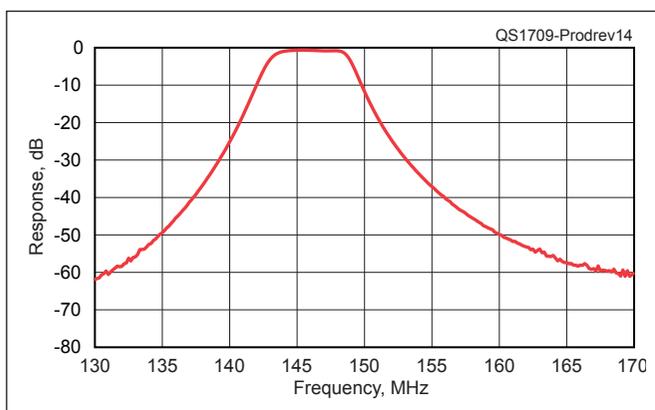


Figure 14 — Swept frequency response of the 146-4 from 130 to 170 MHz.

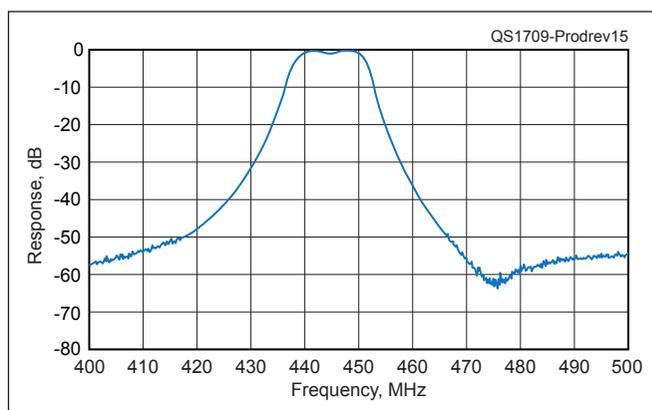


Figure 15 — Swept frequency response of the 445-10 from 400 to 500 MHz.

In the Field

To confirm the Lab observations, I tried the OCI filters in an RF-dense environment where many transmission facilities are located — West Peak, in Meriden, Connecticut, about 15 miles southwest of ARRL HQ. In addition to being a scenic location overlooking southern Connecticut, it is also scenic to the radio engineer with its many towers, bristling with antennas. When visiting the location in my previous career in the commercial telecommunications field, any amateur handheld or mobile transceiver that I brought to the site would overload, degrading reception.

At West Peak, ARRL RFI expert Mike Gruber, W1MG, and I tried listening

on various handheld transceivers, including the 35-year-old Icom IC-2AT 2-meter handheld that I had tested in the Lab (see Figure 16). Without the OCI filter, I tuned around and listened for a while, but could not hear a single signal on the band. I didn't hear any intermodulation or spurious signals either. Perplexed, I then tried my modern FM mobile transceiver and quickly noticed that the S-meter was pinned without a discrete signal received. After placing the OCI filter in line, the S-meter settled to S-1, and I could clearly hear amateur repeaters. Reception also dramatically improved when using the OCI filter with the handheld transceivers.

The results showed that while no

receive intermodulation was occurring, wideband noise generated somewhere on the peak, possibly transmit phase noise from one of the FM broadcast transmitters, was overloading the 2-meter receiver. The OCI filter took care of this problem nicely.

However scenic West Peak was that day, Copperhead snakes were afoot and swarms of biting insects pestered us unmercifully. We reluctantly retreated before trying the 70-centimeter filter.

Manufacturer: Olds Communications, 3780 Murray Dr., Armstrong, BC V0E 1B4 Canada; www.ocicom.com. Available at Ham Radio Outlet. Price: VHF version, \$159; UHF version, \$219.