Low Band Systems HF Triplexer and Band-pass Filters

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I've been experimenting with single-operator, two radio (SO2R) contest operating. The basic idea is to call CQ and run stations with one radio, while hunting for multipliers and contacts on a different band with the other radio. (Some really proficient operators are CQing and running CW pileups on two bands at once, but let's just say I'll need to practice a lot more to try that.) I have a small multiband beam and some inverted-V antennas for my main radio, and I've been using a multiband vertical and 40-meter inverted V for the second radio. That worked okay when we had more sunspots and better high-band propagation, but with current conditions, I really wanted a beam for the second radio.

In the June 2010 issue of *QST*, Gary Gordon, K6KV, described an HF triplexer he designed to allow his club to share a single triband Yagi among several stations at ARRL Field Day.[3] With the triplexer and band-pass filters, the 20-, 15-, and 10-meter stations — all with typical 100 W transceivers — could use the tribander at the same time without risk of damage to the radios. Soon, there were several commercially made triplexers, and these devices have proved popular at Field Day, the World Radiosport Team Championship, and low-power SO2R and multioperator contest stations.

A New Player in the US Market

Recently, DX Engineering introduced a line of "HF multiplexers" and band-pass filters from Low Band Systems (LBS). Based in Russia, LBS builds a variety of devices for sharing a multiband antenna among several transceivers. Although these devices are new to the US market, LBS owner Andrei Fedorischev, RA6LBS, developed a triplexer system in 2009 for use by the Russian teams at the 2010 World Radiosport Team Championship. For this review, we'll look at a triplexer for 20, 15, and 10 meters that is rated for 200 W (see Figure 9). They also offer quadplexers (40/20/15/10 meters) and diplexers (80/40 or 160/80 meters). Other models are rated for 500 W and even 1,500 W.

I wasn't sure about the power rating, but an e-mail to DX Engineering assured me that it's 200 W *per port*, simultaneously. They did suggest the 500 W version to provide some headroom if you really want to run 200 W on each port with a high-duty-cycle mode such as RTTY.

The triplexer alone does not provide enough isolation among bands. You must use band-pass filters in conjunction with the triplexer to prevent receiver damage and minimize interstation interference. Low Band Systems also makes band-pass filters rated at 200, 500, and 1,500 W. The 200 W and 500 W models are available for 160, 80, 40, 30, 20, 17, 15, 12, and 10 meters. The 1,500 W models are available for 160, 80, 40, 20, 15, and 10 meters. For this review, we will look at 200 W band-pass filters for 20, 15, and 10 meters (see Figure 10).

Bottom Line

The Low Band Systems triplexer and band-pass filters can make one multiband antenna do double or triple duty, while protecting transceivers from damage and minimizing interstation interference.

Testing

The triplexer and band-pass filters each came with an instruction sheet that included specifications and a

[3]G. Gordon, K6KV, "HF Yagi Triplexer Especially for ARRL Field Day," *QST*, Jun. 2010, pp. 37 – 40.

Figure 9 — Low Band Systems 200 W triplexer for 14, 21, and 28 MHz.

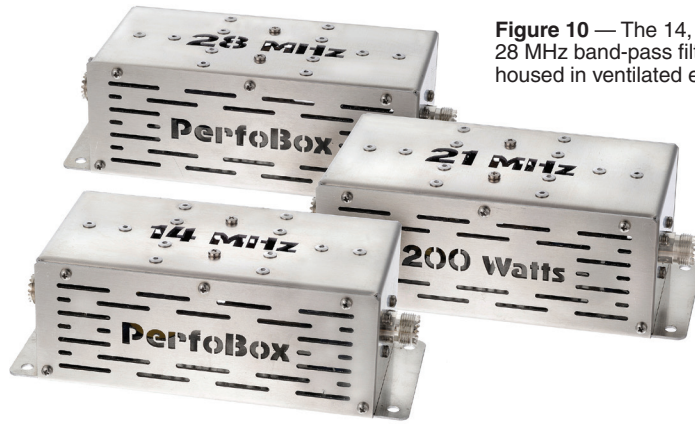

Figure 10 — The 14, 21, and 28 MHz band-pass filters are housed in ventilated enclosures.

Table 7
Low Band Systems Model PB-TP200 14/21/28 MHz Triplexer

Manufacturer's Specifications	Measured in the ARRL Lab
Insertion loss: 0.2 dB typical.	14 MHz, 0.1 dB; 21 MHz, 0.2 dB; 28 MHz, 0.2 dB.
Attenuation to adjacent band: 35 dB nominal.	See Figure 11.
Power handling: 200 W ICAS.*	Tested at 100 W.
Size (HWD): 2.8 × 8 × 4.9 inches; weight: 1.2 lbs.	
Price: $190.	
*Intermittent Continuous and Amateur Service	

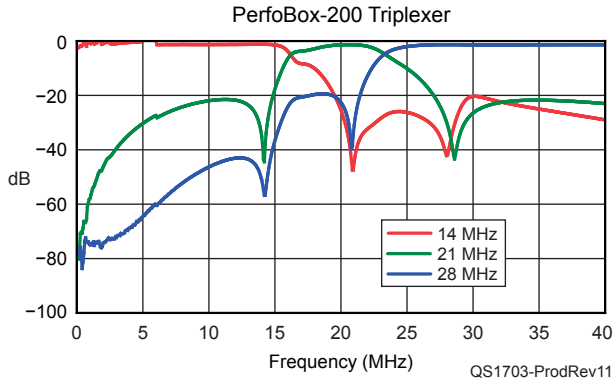

Figure 11 — Swept frequency response of the Low Band Systems 200 W triplexer on the 14, 21, and 28 MHz bands.

Table 8
Low Band Systems PB-F200 Series Band-pass Filters

Manufacturer's Specifications	Measured in the ARRL Lab
Insertion loss: 0.6 dB maximum.	14 MHz, 0.3 dB; 21 MHz, 0.5 dB; 28 MHz, 0.5 dB
Rejection: 60 dB band to band typical.	See Figure 12.
Power handling: 200 W ICAS.*	Tested at 100 W.
Size (HWD): 2.6 × 7.5 × 3.3 inches, weight 0.95 lbs.	
Price: $120 each.	
*Intermittent Continuous and Amateur Service	

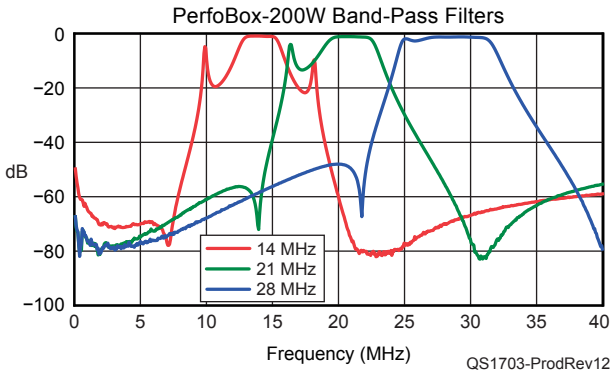

Figure 12 — Swept frequency response of the Low Band Systems 200 W band-pass filters on the 14, 21, and 28 MHz bands.

swept frequency response plot. After comparing serial numbers on the devices and instruction sheets, I realized that the frequency response plots were for the actual devices we received rather than "typical" or expected performance. Wow!

ARRL Senior Test Engineer Bob Allison, WB1GCM, tested the triplexer and band-pass filters in the ARRL Lab. First, he measured insertion loss. For the triplexer, this test was conducted with 50 Ω terminations on the unused ports. Then he measured isolation among the three bands, again with 50 Ω terminations on the unused ports. Test results for the triplexer are shown in Figure 11 and Table 7.

As you can see from the swept frequency response plots in Figure 11, each triplexer port passes the band of interest and attenuates the other two bands. For example, as a signal is swept across the 15-meter band (21.0 to 21.45 MHz) input and measured at the antenna output, rejection at 14 MHz is about 35 dB across the band. Rejection at 28 MHz ranges from 31 dB at the low end to about 33 dB at 29 MHz and 28 dB at 29.7 MHz. The triplexer, itself, provides at least 30 dB of rejection on the other bands with two exceptions — the 28 MHz section showed 20 dB of rejection at the high end of the 21 MHz band (31 dB at the low end), and the 14 MHz section showed 20 dB rejection at the high end of the 28 MHz band (42 dB at the low end).

Test results for the band-pass filters are shown in Figure 12 and Table 8. Rejection of the other two bands is typically 50 to 60 dB, and in some cases, much higher. Impressive performance!

How much power can the receiver in a modern transceiver handle safely? ARRL Lab receiver test levels generally don't exceed +10 dBm (10 mW). The triplexers reviewed

here, used in conjunction with the matching band-pass filters, typically provide 80 to 90 dB or more of attenuation, depending on the frequency combination. With 100 W (+50 dBm) transmitters, around 1 μW (–30 dBm) or less reaches the receiver input.

When terminated with a 50 Ω load, the triplexer and filters presented an SWR of 1.2:1 or less across all three bands. That was especially surprising on 10 meters, which is fairly wide. The band-pass filters that I normally use present a fairly high SWR above 28.8 MHz.

On the Air

The Low Band Systems triplexer and band-pass filters are housed in rugged, ventilated aluminum enclosures. Here's an interesting touch: Labels are actually cut out of the enclosures as part of the ventilation. For example, 14 MHZ is cut out of the top of the 20-meter filter, and 14, 21, and 28 labels are cut out of the triplexer above their respective connectors. You won't have to worry about these labels wearing off.

Antenna connections are all SO-239 jacks. Connect the antenna to the triplexer's common connector, connect one side of each filter to the appropriate jack on the triplexer, and connect the other end of the filters to your transceivers or antenna switch. The filters are big enough that you can't connect all three of them to the triplexer with double-male barrel connectors. For this review, I ended up using barrel connectors for the end filters (14 and 28 MHz) and a short cable for the 21 MHz filter in the center. The enclosures all have flanges, so for a more permanent installation, I would probably mount everything to a board and run short cables. No power supply or adjustments are required — just hook up the cables and go.

With the triplexer hooked up to my multiband antenna feed line and the filters connected to my antenna switch, the effect is the same as having separate antennas for each band. For example, I could call CQ on 20 meters and tune around and work stations on 15 or 10 meters with no indication the other radio was transmitting. When operating at the low end of 20 meters, I did hear the second harmonic of my signal on 10 meters, but it was only S-9 + 20 dB and no more bothersome than other strong signals on the band. In fact, the harmonic signal was weaker and less bothersome than when I used separate antennas for the two bands.

Manufacturer: Low Band Systems, Volgodonsk, 347382 Russian Federation; **lowbandsystems.com**. US Distributor: DX Engineering, 1200 Southeast Ave., Talmadge, OH 44278; **www.dxengineering.com**; tel. 800-777-0703.