

DUPLEXERS, CABLES AND ANTENNA SPACING

Duplexers

A duplexer is a device that allows two radios or a receiver and a transmitter to simultaneously operate in the same frequency band with a single antenna and transmission line. The duplexer "isolates" the "receiver" radio from the "transmitter" radio in the Radius "2-mobile" repeater. Without this isolation, the ability of the "receiver" radio to detect weak signals would be severely degraded by the output signal of the "transmitter" radio. Isolation also may be obtained by using separate antennas with proper spacing, or distance, between the antennas. It will be shown later that less vertical spacing is needed for a given isolation of land mobile antennas than may be obtained easily with horizontal spacing.

There are two basic types of duplexers: the bandpass and the bandreject.

The bandpass duplexer has two filters connected together such that each filter will "pass", or appear transparent to, a narrow segment of frequencies; the filters are tuned to different frequencies. Any signal within the segment will be transferred from or to the antenna while frequencies outside of the segment will be "blocked".

The bandreject duplexer has two filters connected together such that each filter rejects, or "blocks", a narrow segment of frequencies. Again, the filters are tuned to different frequencies but any signal outside of the segment will be transferred from or to the antenna while frequencies within the segment will be "blocked".

The choice of which duplexer configuration to purchase may be dictated by the particular application. If several radios and a Radius "2-mobile" repeater are to operate at a given location, the bandpass duplexer might provide additional rejection to the signals from the other radios.

The basic specifications for a VHF or a UHF duplexer are:

Impedance:	50 Ohms
Isolation:	70 dB minimum

The term "isolation" may be referred to as "Receiver (or RX) Isolation at the Transmitter Frequency" and "Transmitter (or TX) Noise Suppression at the Receiver Frequency" by the manufacturer of the duplexer.

Power handling:	50 Watts minimum (M100/M200)
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Power Handling:	125 Watts minimum (M400)
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Power handling may be called "Continuous Power Input" by the manufacturer. If a Lowband repeater is being assembled with the M100/M200 series Radius radios, the power handling capability would have to be increased to 100 Watts.

Insertion loss:	3 dB maximum
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Less insertion loss of the duplexer means the "receiver" radio will be able to discern weaker signals and the "transmitter" radio will deliver more power output to the antenna. The 3 dB specification will result in coverage range being reduced approximately 30%. Typical insertion losses quoted in catalog sheets are 1.5 dB.

Frequency spacing:	3 MHz minimum
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"Frequency spacing" is the frequency difference between the operating frequencies of the receiver and the transmitter. Frequency spacing less than 3 MHz can be achieved but the physical size of the duplexer increases dramatically. If a VHF repeater is being assembled, be aware of the minimum frequency spacing that a duplexer can provide when choosing the operating frequencies for the repeater. Also, note that the spacing in the 450 MHz to 470 MHz UHF band is 5 MHz and the spacing in the 470 MHz to 476 MHz band is 3 MHz.

If the proper equipment necessary to tune a duplexer is not available, then the duplexer must be pretuned by the manufacturer. Be ready to provide the exact receiver and transmitter frequencies at the time of purchase. Also indicate whether the duplexer will be used in a mobile or a fixed (base station) application.

Connector Type:	N (female)
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The type BNC connector may be used on the receiver and transmitter inputs but must be avoided for the antenna. The BNC is prone to mechanical movement which can generate noise when the transmitter is operating. Type UHF connectors will suffice for VHF but should be avoided for UHF (so why is it called a "UHF" connector?). The mini-UHF connector, if available for the duplexer, is very good. Other connectors, such as the SMA and the TNC, are very good but may be more expensive, fragile and rather difficult to assemble in the field. The best general performance comes from the type N.

Coaxial Cabling

The coaxial cables that connect the radios to the duplexer can be fabricated from RG58A/U (the