



Where tower space permits, an effective alternative to a duplexer is two separate antennas and feedlines - one for the transmitter, the other for the receiver - with adequate physical separation between. The physical antenna separation creates the electrical isolation otherwise provided by the duplexer.

How much isolation is necessary? Consult the radio manufacturer's duplex isolation curves to determine the amount of transmitter noise suppression and receiver isolation required for good performance with minimal desensitization and intermodulation problems.

#### **A NOTE OF CAUTION**

A note of caution on the use of inexpensive, low-power helical duplexers for repeater operation.

First-quality transmitters designed and manufactured with care regarding circuit layout, interstage shielding, and spurious frequency suppression, generally interface satisfactorily with this duplexer design.

However, transmitters designed to less stringent performance standards frequently emit considerable wideband noise on either side of the carrier frequency. Due to the steep skirts characteristic of the helical duplexer response curve, some of the wideband noise may fall outside the filter's notch bandwidth, thereby entering the repeater's receiver and causing desensitization. This problem is usually wrongly blamed upon a "faulty" duplexer when, in reality, the filter is performing to factory specs. The problem really lies in the transmitter's inadequate design or improper tuning.

If the problem cannot be cured within the transmitter, the only solution is to resort to a larger, more expensive TEM cavity resonator style of duplexer with the Q and attenuation characteristics needed to prevent the wideband noise from entering the receiver.

The cost and construction of duplexers varies with the transmit-receive frequency separation (offset) required, power handling capability, and ambient RF environmental constraints. For applications in which the offsets are relatively wide (about 4.5 MHz or more), duplexers can be constructed using band pass cavities. The inherent advantage of this design is that unwanted signal rejection occurs for all frequencies outside the intended pass bands, not just at the duplexer's own transmit frequency. This duplexer design is preferred for high ambient RF environments - such as crowded, leased tower sites or urban building rooftops - where it provides strong defense against unwanted signals from nearby antennas.

Where the frequency offsets are closer (between about 0.5 MHz and 4.5 MHz) band reject cavities can be used to build a duplexer. This cavity style offers the benefits of high isolation and low insertion loss, but the resulting duplexer generally lacks attenuation at frequencies other than the transmit and receive frequencies specified. Consequently, this design should not be used where high ambient RF levels exist, unless other auxiliary filtering is considered.

The number of cavities of either type required for duplexer construction varies with the level of port-to-port isolation required. Both types of cavities may be cascaded for greater duplexer isolation.



#### **FILTER TUNING**

A good rule-of-thumb to remember when tuning any RF filter of the types described above: Never tune the unit under full power. Always rely upon small-signal methods using service monitors, frequency generators, calibrated receivers, etc. The reason: during the tune-up process, off-resonance conditions occur when the tuning screws are adjusted for their optimum setting. At resonance, the reactive components increase sharply, as does the corresponding voltage drop across insulating parts. High voltage drops may lead to arcing, which can leave permanent carbon traces across internal insulating material. Leakage across these traces causes instability in the filter's tuning, and noisy duplex operation. In designs employing moving finger stock for ground contact, arcing and pitting will occur when the finger stock position is changed in the presence of power, resulting in the same deteriorated performance. Damage of this nature is generally ruinous to the filter.

Celwave will tune your new or used duplexer for you, and supply tuning instructions upon request. Consult your Celwave Applications Engineer for details.