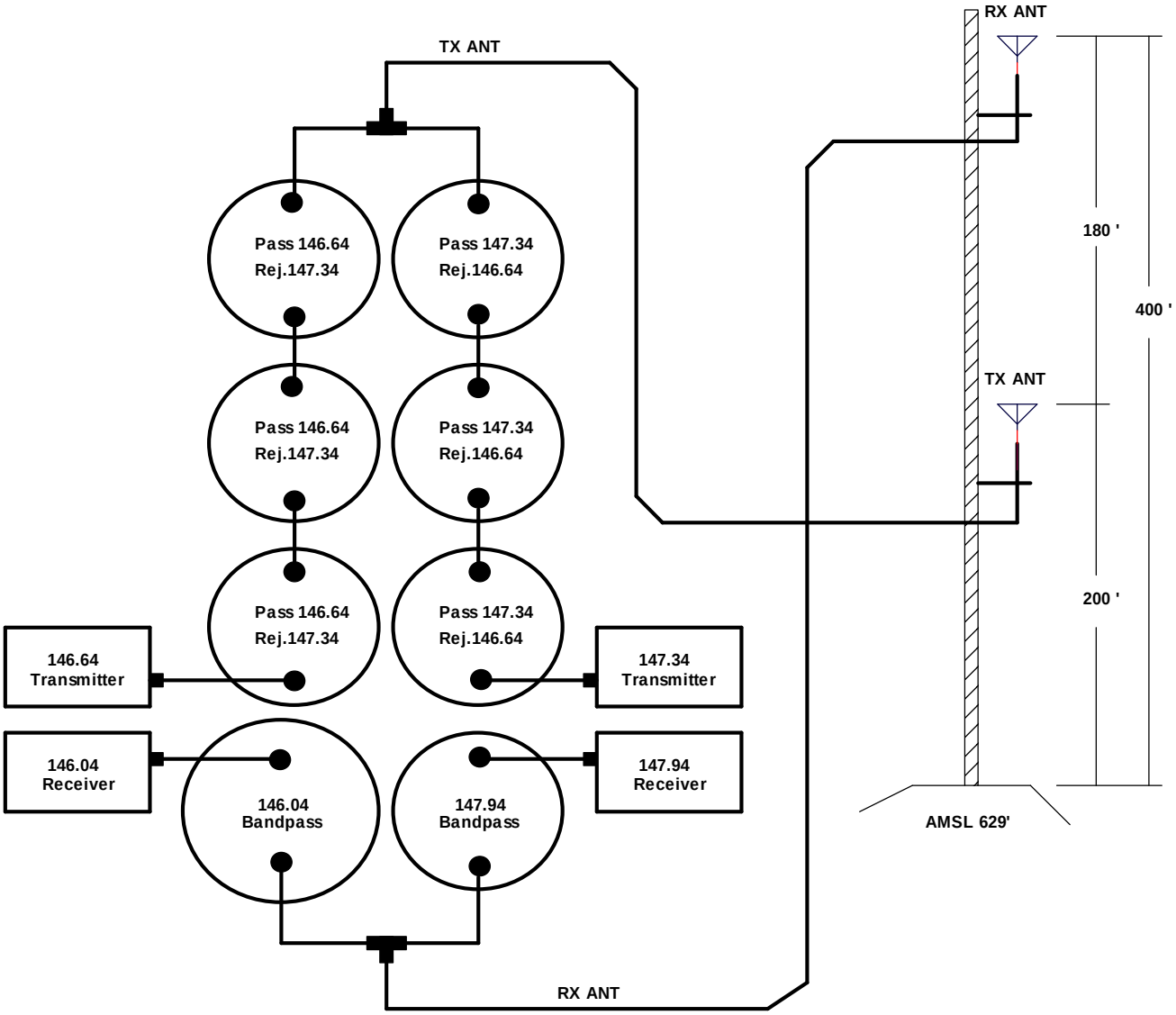
Multiplexing the 146.04/64 and 147.34/94 Repeaters

Jim Rogers (N5VGQ) ask the question; could two repeaters operate on the same antennas used by the 146.04/64 repeater at the same time. The 146.04/64 repeater uses two antennas and no duplexers to accomplish the required isolation between the repeater receiver and transmitter.

Using a single antenna with multiple microwave radios is accomplished by using a combination of Bandpass filters and circulators. The frequency split between a microwave radio receiver and transmitter is 60 – 90 MHz, not 600 kHz as seen with 2-meter amateur repeaters. With a frequency separation of 600 kHz, Bandpass filters will not provide enough isolation and circulators for 2-meters would be like buying gold.

Searching through my library of amateur books and the internet, no information was found on the subject.

After some serious head scratching, I came up with the following filter configuration:



How it Works

The trick is to make antennas see each repeater at the same time without any signal loss and not interfere with each other.

The 180 feet of vertical separation between antennas provides a minimum of 145 dB of between the repeater transmitter and receivers which is better than the best duplexers you could purchase.

The "T" connecters attached to the TX and RX antennas would normally act as a splitter and divide the signal by half. You don't want the receivers to see only half of receive signal level and/or the transmitter power to be reduced by one-half. To eliminate this problem at the receivers, I used two Bandpass cavities. Each cavity is tuned to the individual receive frequency and provides 30 dB of rejection to opposing receive port. The high impedance rejection makes the connector look like a two-port device and no signal loss occurs. The same process occurs at the transmitter "T" end, each cavity is tuned to reject the opposing frequency. The transmitter power levels are much greater than the receive signals, so additional rejection is required to prevent any transmit power from reaching the other transmitter.

Verification Test

Transmit 146.04/64

Rejection: 90 dB Min.
Opposing Port Isolation: 91.2 dB Min
Opposing Port Power Level: 0.06 Microwatts (-42.2 dBm) (80W applied to 147.94 port)
Insertion Loss: 1.2 dB Max.
Input Port Return Loss: 23.8 dB (VSWR 1.12)

Transmit 147.34/94

Rejection: 89.2 dB Min.
Opposing Port Isolation: 91.4 dB Min
Opposing Port Power Level: 0.063 Microwatts (-42.0 dBm) (80W applied to 146.64 port)
Insertion Loss: 1.21 dB Max.
Input Port Return Loss: 23.2 dB (VSWR 1.11)

Receive 146.04/64

Insertion Loss: 0.58 dBm Max. (Measured level was -100 dBm)
Output Port Return Loss: 21.6 dB (VSWR 1.13)

Receive 147.34/94

Insertion Loss: 0.55 dBm Max. (Measured level was -100 dBm)
Output Port Return Loss: 22.3 dB (VSWR 1.12)

Special thanks go to Jim Rogers (N5VGQ), he supplied all of the cavities, cables, temporary 146.04/64 repeater, power supply, radio cabinet and installation.

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