Build a voice repeater

Bench guide / Two-radio analog FM amateur repeater / Single antenna, separate receive and transmit frequencies

A repeater listens on one frequency and simultaneously retransmits what it hears on another. A handheld listens to the repeater output and transmits on its input. The station below uses a UHF amateur pair, a separate receiver and transmitter, and one shared antenna.

Choose the pair and the site

Work with your area's amateur frequency coordinator before picking a pair for an on-air installation. Record both frequencies, the access tone if used, the call sign, and the control operator. Confirm site permission, power, grounding, antenna clearance and a practical way to shut down the transmitter.

Parts and what each one does

Part	What to select or confirm
Receiver	Radio with accessible receive audio and carrier-detect output.
Transmitter	Radio rated for the power and duty cycle you plan to use.
Controller	Compatible audio levels, carrier detect, push-to-talk, ID and timeout.
Duplexer	Correct band, frequency split, power rating and site isolation needs.
Antenna and feed line	50-ohm antenna, coax, short shielded jumpers and proper connectors.
Power and cooling	Fused supply sized for simultaneous TX/RX current and ventilation.
Bench equipment	Power meter, rated 50-ohm dummy load, test handheld and RF test gear.

Write down the station settings

Repeater RX / handheld TX _____ MHz Access tone _____
Repeater TX / handheld RX _____ MHz Call sign _____

Using a GMRS repeater

For GMRS, choose eligible FCC-certified GMRS transmitting equipment and operate under a GMRS license. Example: for the 675 pair, set station transmit to 462.6750 MHz and station receive to 467.6750 MHz. Match the duplexer and feed line to the unit's antenna ports, and program the handheld for +5.000 MHz. GMRS has its own identification rules. FRS and MURS are direct-use services and do not provide repeater channels.

References: 47 CFR §§ 97.109, 97.119, 97.205, 95.1751, 95.1761 and 95.1763. Practical equipment reference: Repeater-Builder, The Repeater Builder's Parts List and Check List (repeater-builder.com/rbtip/checklist.html).

Wire the station on the bench

Use the accessory connector and duplexer documentation for the specific equipment on your bench.

Trace the signal

RECEIVE PATH

Antenna → duplexer COMMON → RX branch → receiver

CONTROL AND AUDIO

Receiver audio + carrier detect → controller → transmit audio + push-to-talk

Transmit path: transmitter → TX branch → duplexer COMMON → antenna

1. Program the radios before making cables

Set the receiver to the repeater input and the transmitter to its output. Set channel width and tone handling to the local operating plan. Turn off unneeded microphone features, auto-power-off and scanning. Keep the transmitter off while connecting RF cables.

2. Connect the low-level signals

Use the radio manuals to identify receive audio out, carrier-operated relay/squelch (COR or COS), transmit audio in, push-to-talk (PTT), and the signal return. Match the controller's active-high or active-low settings. Use an isolated keying interface if required. Do not wire a powered speaker output directly to a microphone-level input.

3. Test control on a dummy load

Connect the transmitter through an appropriate wattmeter to a 50-ohm dummy load rated for the power and test duration. Feed the receiver a test signal separately. Check that an authorized tone opens the controller, audio passes once, and PTT releases when the programmed hang time expires. Test the timeout and call-sign ID.

4. Bring the duplexer into the system

Identify COMMON, RX and TX by their labels and tuning record. Use the actual station frequencies and the manufacturer's procedure to tune both branches and verify insertion loss and rejection. A club or radio shop with the right test fixtures can do this step. Label the jumpers before final assembly.

Reference: Repeater-Builder, Technical Information Page (repeater-builder.com). Follow the accessory pinout, audio-level specifications, duplexer tuning instructions and duty-cycle rating supplied with your exact equipment.

Test the repeater before field use

Acceptance sheet / Check both directions and repeat the tests after connecting the site feed line.

Check what changes when the transmitter keys

1. Establish a receiver baseline. On a service bench, apply a weak, repeatable signal at the station receive frequency through a protected test arrangement. With the station transmitter off, reduce the signal until it is just intelligible. Record the level or the service monitor's measured sensitivity.

2. Key the station transmitter into a properly rated load through the duplexer and repeat the same receive test. A marked drop in receive performance only while transmitting is called desense. Use a correctly isolated and attenuated injection port so transmitter power cannot reach the signal generator. Have a qualified bench operator perform this measurement if the fixture or ratings are uncertain.

3. If sensitivity drops, inspect the duplexer tune, jumper shielding, connectors, power-supply noise and cable routing. Correct one item at a time and repeat the comparison. Verify audio deviation with a service monitor set for the channel plan before putting the station on the air.

At the site

Inspect and secure the feed line, weather seals and grounding. Measure the antenna system before connecting it. Begin on low power, identify the station, and have a second licensed operator make a short test from a known location. Check both talk-in and talk-out. Monitor temperature and current during a representative duty cycle.

Record the commissioning check

Check	Result or measurement
Output power / received audio	_____
RX sensitivity, TX off / TX on	_____
Site antenna SWR / test frequency	_____
ID heard / timeout releases / shutdown works	_____
Location, date, operator and test station	_____

Leave the control operator a copy of the settings, a labeled cable diagram, the shutdown method and a contact number for interference reports.

Operating references: FCC amateur station control, identification and repeater rules (47 CFR §§ 97.109, 97.119 and 97.205). Use the local coordination plan and verify any band- or location-specific limits.