

Amateur Radio Emergency Communications

Portable VHF and Cross-band Repeaters

Jim ZL1AVR

Because VHF handheld radios have such a limited range - particularly in wet bush, it is usually necessary to install a repeater or repeaters to provide coverage over the proposed search area. In some instances a permanent fixed repeater or a remotely switched cross-band repeater may be available to link the field parties with base, but even then, a portable repeater may be required at a suitable location to cover any 'shadow' areas.

There are two distinct types of repeater currently in use for Search and Rescue. These are the portable VHF repeater and the lightweight cross-band repeater. The object of this paper is to compare the advantages and disadvantages of each type of repeater but without getting involved in too much technical detail.

1. **Description**

- a) The VHF repeaters usually contain of 2 handheld radios connected together in a box which contains filters, duplexer, power supply and a small amount of switching circuitry. There is also a length of coaxial cable, an aerial and a set of poles.
- b) The Cross-band repeater usually consists of a small dual-band handheld radio mounted in a box which fits on top of the aerial poles. The aerial is screwed directly into the top of this small box. The power supply is normally carried separately and plugged into the box at the top of the poles.

2. **Size and Weight**

- a) The entire VHF repeater package weighs in the vicinity of 14kgs and requires 2 or 3 people to carry it to its location. This type of repeater is best located on a site not too far from vehicle access.
- b) The package for the cross-band pole-top repeater weighs about 5.5 kilograms and can be carried and set up by one person.

3. **Performance**

No definitive tests or comparisons have been done as far as I am aware, but power output to the aerial is mostly about 3 watts in each case. Performance depends on so many factors - siting of the repeater, the type of aerial used, the voltage supplied to the repeater, and the level of power selected.

In all cases, the frequencies available for use are limited by the type of aerial used. There are few aeriels which will operate on both the old CD band and the newer ES Band so that care in the selection of aeriels and frequencies is important.

- a) Because VHF repeaters require filters, there will be insertion losses. These will vary according to their level of adjustment and the ambient temperature. There will also be losses in the coaxial cable - depending on the type and length of the cable used.
- b) Cross-band repeaters do not require filters and use only a few centimetres of coaxial cable, therefore should have very little reduction in performance.

4. Reliability

The reliability of any radio equipment is dependant largely on the standard of maintenance that the equipment has received. The component count should also be taken into account - the more complex the equipment, the more chance of a breakdown occurring.

- a) The coaxial cable of VHF repeaters should be checked after each use. Special care must be taken that the unit is switched off and that all leads are connected **before** switching on the mains power to the charger, otherwise an 'error' condition may occur and the battery is not charged. Aerial and battery connections should also be checked from time to time. Internal connections and settings should be confirmed at regular intervals. Re-adjustment of the filters may be required after some period of time.
- b) The DC lead of cross-band repeaters should be checked from time to time. Aerial and other connections and settings should also be confirmed before the equipment is sent into the field.

5. Ease of use in the Field

It is essential of course that the field parties are instructed as to the correct channel to be used and that Base has sufficient equipment to cover those channels.

- a) If a VHF repeater is being used, instruction must also be given on the use of the 'Talk Around' function of the ICOM handhelds in the event that access to the repeater is lost. This leaves open the option for simplex operation. Problems have been experienced in using the 'Talk Around' function in the field. Search Teams are usually well trained in search techniques, but do not always have experienced radio operators with them. It is usually preferred to monitor the repeater input frequency at Base or nominate an alternative simplex channel..
- b) When a cross-band repeater has been installed and field operators move outside the coverage area, no other action need be taken by them as Base may copy them directly on the simplex VHF channel being used as the input frequency of the cross-band repeater. It is possible to set up more than one cross-band repeater on the same simplex VHF channel, but an additional UHF transceiver will be required at base for each repeater operating. A disadvantage with using cross-band repeaters is that the stations in the field are not always able to hear each other and rely on the Base operator to keep them informed.

6. Base Requirements

It is considered that the minimum requirement at Base is for 2 masts at least 7 metres tall and at least 2 base radios, plus a selection of aerials.

- a) If a VHF repeater has been installed, then one of the base sets should operate on the repeater frequency. It may be possible to monitor the reverse frequency of the repeater with the other radio, but there could well be cross-modulation and de-sensing problems, in which case the 2nd set would be held as a spare or used as a separate simplex channel .
- b) A VHF transceiver and a UHF radio would be required when a cross-band repeater is used. The VHF equipment would monitor the SAR simplex channel and the UHF radio would be used for the up-link to the repeater. If a dual band transceiver is used, the volume on the VHF side should be turned down to avoid feed-back, but care must be taken to monitor both frequencies by watching the S-meter readings..

7. Capital Costs

These costings are only approximate and may vary depending on the specifications and source of materials, but give some indication for comparison.

- a) A standard VHF Repeater complete with filters aerial, coaxial cable and poles would cost in the vicinity of about \$5,000.
- b) Pole top repeaters are not available commercially as a complete package, but may be assembled quite readily. The estimated cost of materials is less than \$1,000. Be sure to use a dual-band hand-held transceiver that retains 'repeater mode' while changing power sources and does not produce distorted audio when set up as a repeater.

Conclusion:

There is a place in Search and Rescue for both types of repeater. The VHF repeater could be installed in a situation accessible by road or close to Base (channel 3 or 4). If there is any doubt that this would cover the entire search area, consideration should be given to installing a cross-band repeater on a suitable site (channel 10). If there is no suitable site near to road access, then the lightweight pole-top cross-band repeater could easily be carried and set up on the best site in, or near the search area.

Channel 10 (CD12B) has been suggested because of its' proximity to the VHF Amateur Band and better compatibility with amateur transceivers and aerials. When (or if) the old CD band is no longer available to us, we will have to go back to the drawing board!

