

# The Elecraft<sup>®</sup> K3

## Design, Configuration, and Operation

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**All you ever wanted to know but were afraid to ask!**

## 5.14 Diversity Reception

Diversity reception uses two identical receivers with two different antennas to "smooth out" signal fading.

Effective diversity reception requires two receivers, each fed by a different antenna. To be effective, the two antennas may have the same or different directivity but be widely separated from each other, or may be close together but have different horizontal and vertical polarization. For example, on 160 meters a good combination is the transmit antenna, say a vertical, plus a Beverage or receiving loop. Diversity reception can improve signal copy by reducing fading. When you use two different antennas, QSB fading generally affects each of them differently. By listening to the two signals from the two antennas we can "smooth" out the fading effects. In Figure 5-31 we see the Main receiver feeding audio to the left headphone and the Sub to the right. When the two receivers are closely matched with minimal difference in phase delays in each, as they are in the K3, we can have an effective diversity receiver. As the signals received by the two different antennas change, we perceive the signal "moving" around in our head. This can sometimes greatly improve copyability.

Achieving good results with diversity reception depends on many factors, including the combination of antennas used, the propagation at any given time, and current noise conditions including polarization of the noise. What is especially effective at one time may not be so at another.

When diversity reception is activated, the Sub receiver is linked to and controlled by VFO A. VFO B remains independent and can be used to set the transmit frequency for split operation as described below.

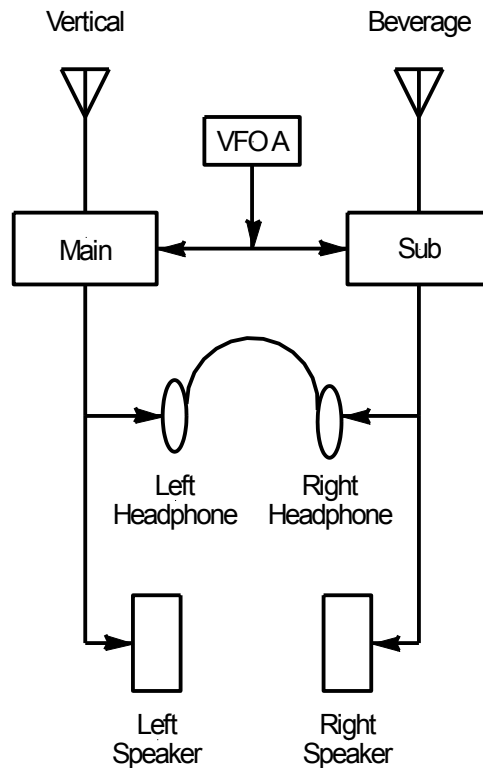


Figure 5-31. Diversity reception.

## Roofing Filters for Diversity Reception

The roofing filters in the two receivers should be as nearly identical as possible for diversity reception. Five-pole filters are delivered with an offset, for example, -0.87 kHz for the one in the Main receiver and -0.85 kHz for the Sub. When you configure the crystal filters as we showed in Chapter 2, these offsets are entered. You can make the offsets identical for diversity reception by splitting the difference. In this case you would make the Main and Sub receiver's offset -0.86. Eight-pole filters are close enough to zero offset that you do not have to enter any offsets in the configuration.

## Activating Diversity Reception

Holding **SUB** two seconds or more activates the diversity reception feature. This does the following:

1. Sets the Sub receiver to the same frequency as the Main.
2. Matches the Sub's filter bandwidth to the Main's.
3. Switches the Sub receiver to the AUX antenna input.
4. The kHz decimal point in the VFO A display flashes to indicate diversity mode is active.
5. VFO B is free to be used for split operation with the transmitter (see Chapter 3).

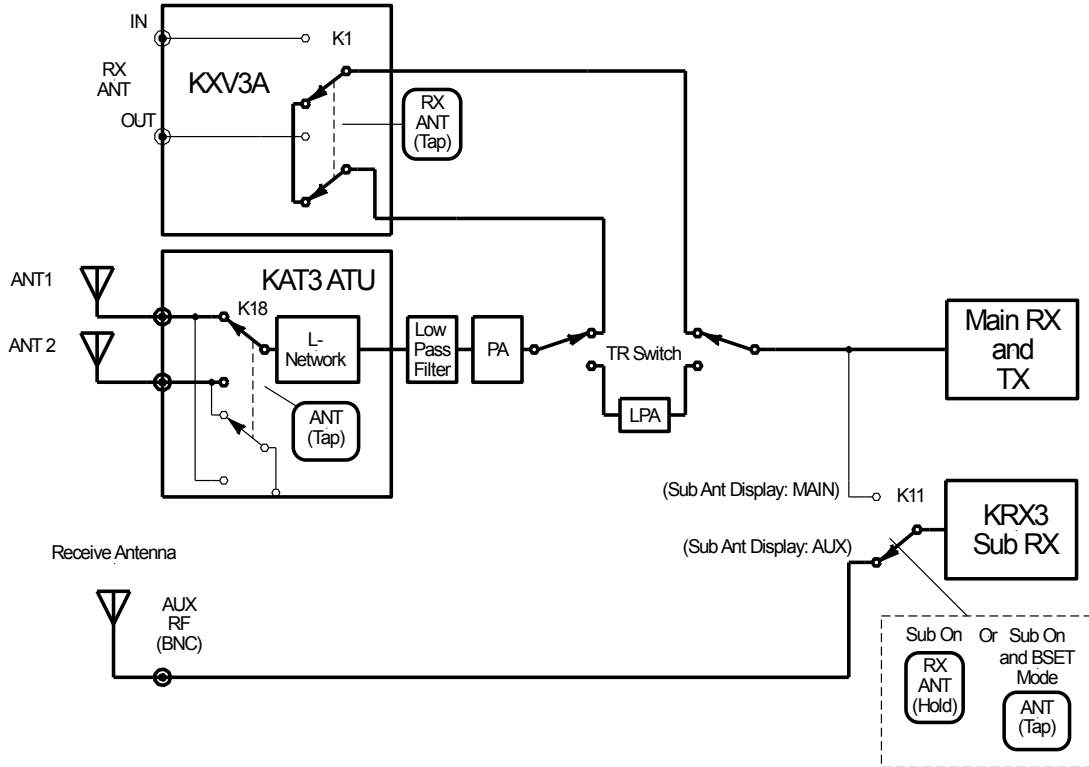
Note that the outputs of the diversity receivers are not connected to each other electrically. There can be time offsets between the RF path to the two antennas, resulting in phase differences between the two audio signals. Your brain can combine these time-offset signals and get good copy from them with one in each ear, but combining them in an electrical circuit will often yield nasty phase cancellation.

## 5.14.1 Diversity Antenna Selections

When diversity reception is activated, the Main and Sub receivers must be connected to different antennas. Thus, the Sub receiver is automatically switched to the auxiliary (AUX) antenna position. When `CONFIG:KRX3 Ant=bnc`, this will be the antenna connected to the AUX RF (BNC) as shown in Figure 5-32 – Figure 5-34. When `CONFIG:KRX3 Ant=Atu`, the Sub's antenna will be ANT1 or ANT2, whichever one the Main receiver is not using. This configuration is shown in Figure 5-36.

### Sub Receiver Connected to the AUX RF BNC

Figure 5-32 shows the Sub receiver antenna input connected to the Aux RF BNC connector, allowing the Sub receiver to use a separate receive antenna while the Main receiver uses ANT1 or ANT 2. This is the best configuration for diversity operation.



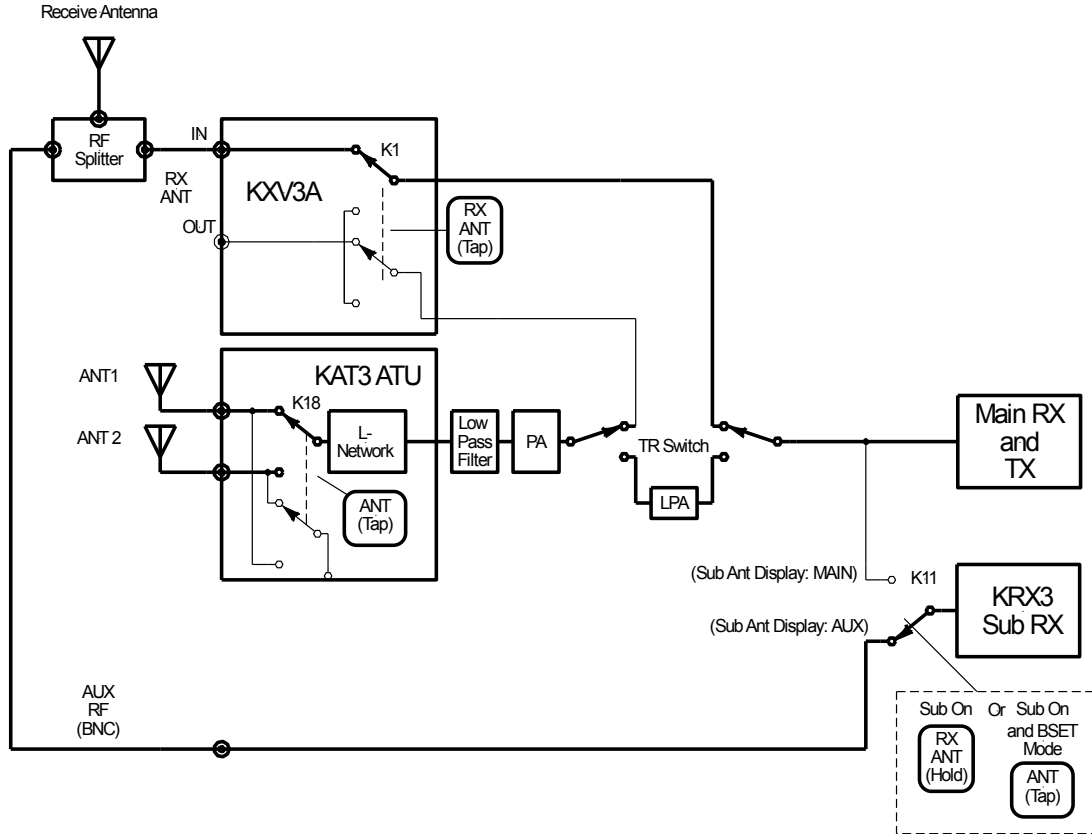
- Main on ANT1, Sub on receive antenna, diversity mode**
1. **CONFIG:KRX3 Ant=bnc**
  2. Hold **SUB** more than 2 seconds to turn diversity mode on.
  3. Tap **ANT** to select ANT1 for Main antenna.
  4. Tap **SUB** to turn diversity mode off when finished.

**Figure 5-32. Main = ANT1, Sub = RX Ant (diversity antenna)**

**Exercise**  
 What sequence of keys do you use and what is displayed on the K3 front panel when you set up the configuration shown in Figure 5-32 in diversity mode.  
 — ● ● ● —  
 Hold **SUB** more than 2 seconds to turn diversity mode on. **DIVRSTY** shows momentarily on VFO B and the kHz decimal point in VFO A flashes.  
 Tap **ANT**: Display shows ANT1.

### Using a Receive Antenna on the Main Receiver

A disadvantage of the configuration in Figure 5-32 is that you may want to use the receive antenna on the Main receiver at times while not using diversity or the Sub receiver. This dilemma may be solved by adding a splitter<sup>41</sup> (or a Y-cable, although the splitter is better) as shown in Figure 5-33. We see the Main can use the receive antenna for "normal" non-diversity mode reception. To use diversity, the Main receiver can be changed to ANT1 and diversity mode activated. See Figure 5-34.



**Main on receive antenna, Sub on receive antenna, no diversity**

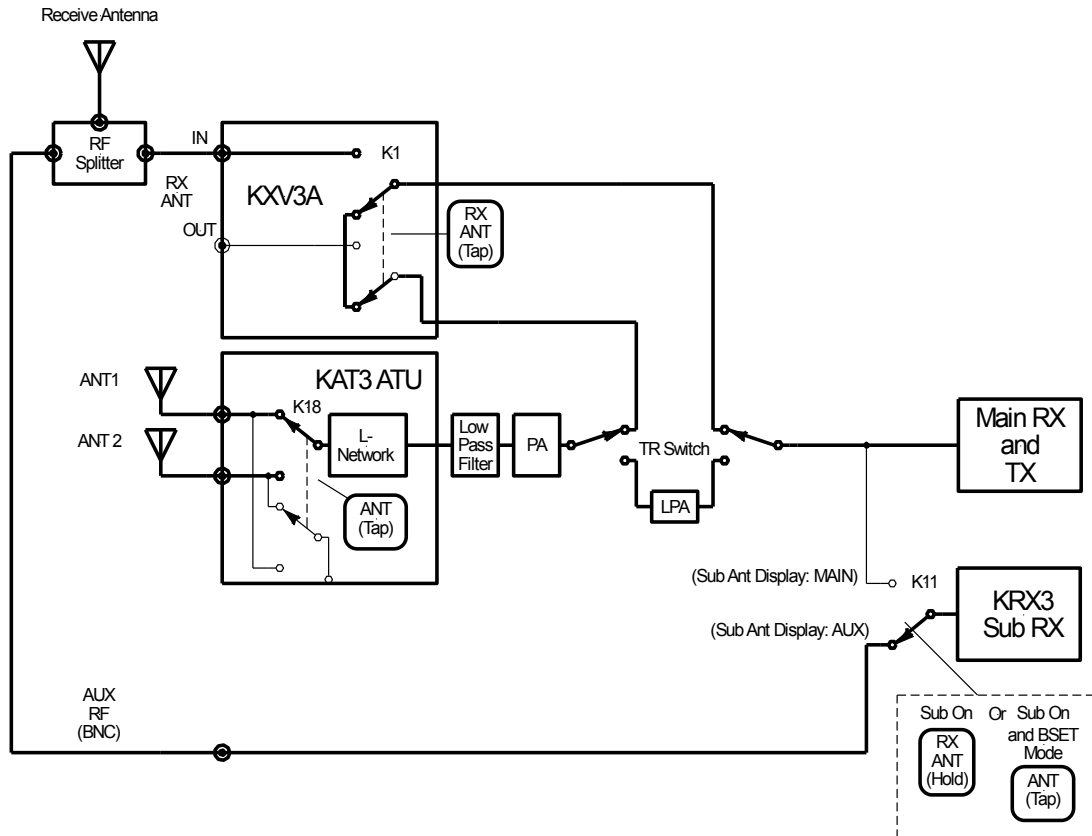
1. **CONFIG:KRX3 Ant=bnc**
2. Tap **SUB** to turn Sub receiver off if it is on.
3. Tap **ANT** to select ANT1 for the transmit antenna.
4. Tap **RX ANT** so that the RX icon is displayed.

Figure 5-33. Main = receive antenna, Sub = receive antenna.

<sup>41</sup> A splitter is a transformer coupling device that can share a signal between two receivers. By design of the transformer turns ratios, the 6 dB loss seen when simply paralleling the receivers with a Y-cable can be compensated for. Mini-Circuits Laboratories (<http://www.minicircuits.com/>) ZFSC-2-1-75 is a very good choice that provides some isolation between the outputs.

### Diversity Reception Activated

Figure 5-34 shows a common configuration for diversity reception where the Main receiver uses the TX antenna on ANT1 and the Sub receiver uses the receive antenna. This configuration gives you the flexibility of using diversity or using the receive antenna on the Main as shown in Figure 5-33.



- Main on ANT1, Sub on receive antenna, diversity mode**
1. **CONFIG:KRX3 Ant=bnc**
  2. Hold **SUB** more than 2 seconds to turn diversity mode on.
  3. Tap **ANT** to select ANT1 for Main antenna.
  4. Tap **SUB** to turn diversity mode off when finished.

Figure 5-34. Main = ANT1, Sub = AUX RF (BNC)

**Exercise**  
 What key do you use and what is displayed on the K3 front panel when you activate diversity mode?  
 — ● ● ● —  
 Long hold (~2 sec.) **SUB**: Display shows **DIVRSTY** (momentarily in the VFO B display area) and the kHz decimal point in VFO A flashes.

## Diversity Reception

### Exercise

Assuming your K3 is set up like Figure 5-34, what sequence of keys do you use to turn the Sub receiver off and switch the Main receiver to the receive antenna? What is displayed on the K3 front panel?

— ● ● ● —

Tap **SUB**: **SUB** icon goes out.

Tap **RX ANT**: Until the RX icon is displayed.

### Exercise

Assume you are operating normally using a receive antenna on the Main receiver as shown in Figure 5-33. What sequence of keys do you use and what is displayed on the K3 front panel when you switch to diversity reception (Figure 5-34).

— ● ● ● —

Tap **RX ANT**. The RX icon goes out.

Tap **ANT** until ANT1 is displayed.

Hold **SUB** until **DIVERSITY** mode is entered and the kHz decimal point in VFO A flashes.

### Exercise

Assume you are operating in diversity mode as shown Figure 5-34. What sequence of keys do you use and what is displayed on the K3 front panel when you switch back to normal operation (Figure 5-33).

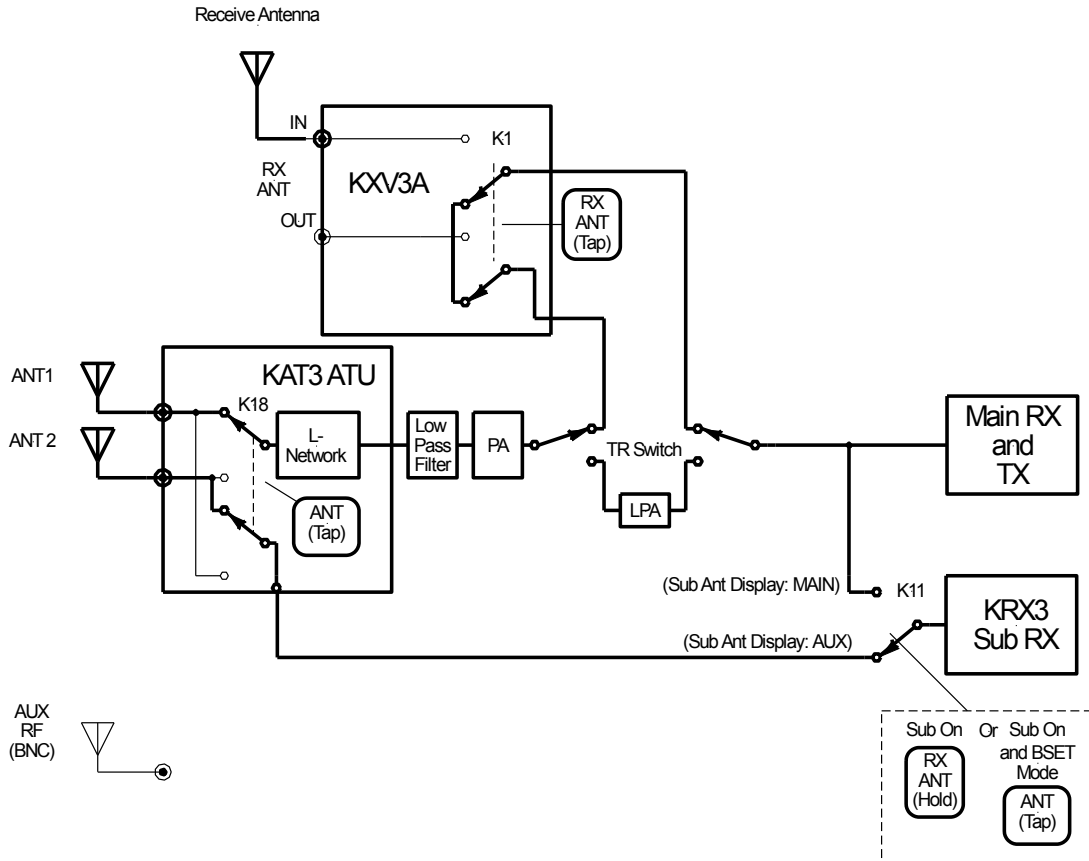
— ● ● ● —

Tap **SUB** to leave diversity mode.

Tap **RX ANT** to switch the Main to the receive antenna. The RX icon appears.

### Sub Receiver Connected to ATU

You can use the diversity reception feature when the Sub receiver is connected to ANT 2 and the Main receiver is connected to ANT1, as shown in Figure 5-35, or to the Receive Antenna as shown in Figure 5-36. In each case the K3 will transmit on the antenna selected by relay K18, i. e. ANT1. This rather limits your antenna choices for ANT1 and ANT 2. Further, if ANT 2 is a receive antenna with preamplifiers, you run the danger of accidentally transmitting on it. For effective diversity operation, it is better to connect the Sub receiver to the auxiliary RF BNC.

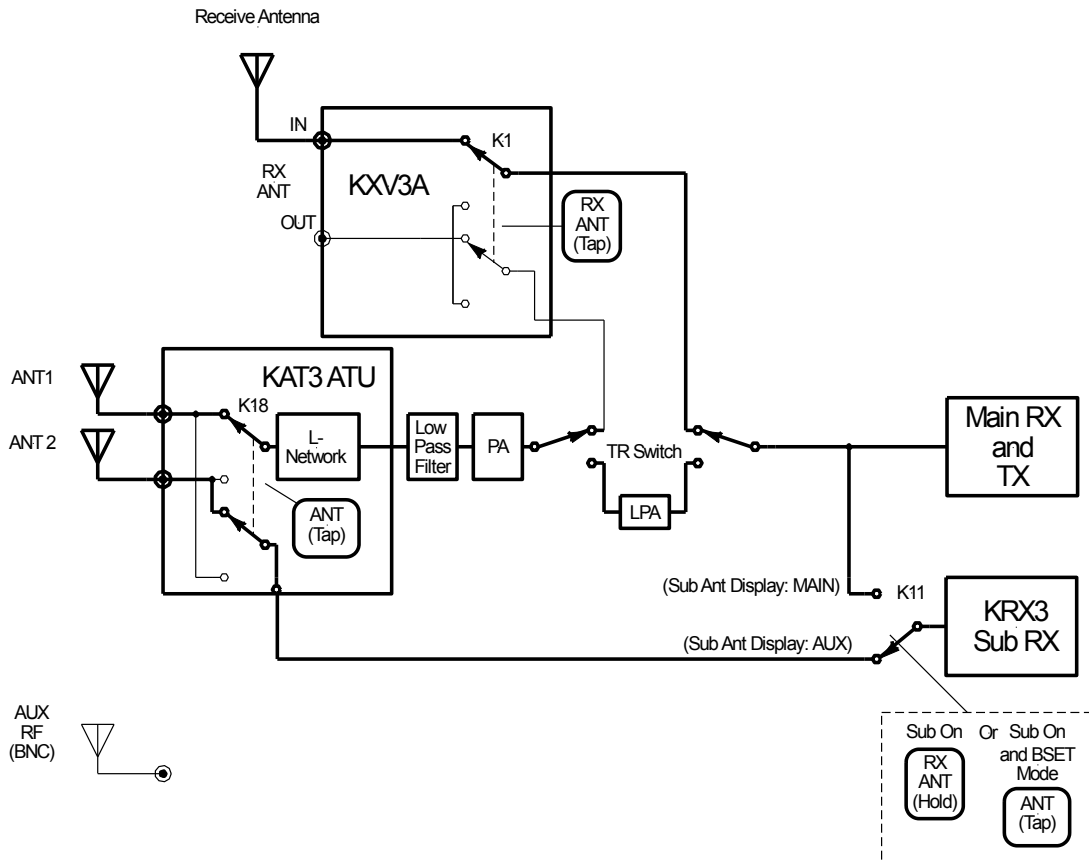


- Main on receive antenna, Sub on ANT2**
1. **CONFIG:KRX3 Ant=Atu**
  2. Hold **SUB** more than 2 seconds to turn diversity mode on.
  3. Tap **ANT** to select ANT1 for Main antenna.
  4. Tap **SUB** to turn diversity mode off when finished using diversity reception.

Figure 5-35. Main = ANT1, Sub = ANT 2.



## Diversity Reception



### Main on receive antenna, Sub on ANT2

5. **CONFIG:KRX3 Ant=Atu**
6. Hold **SUB** more than 2 seconds to turn diversity mode on.
7. Tap **ANT** to select ANT1 for Main antenna.
8. Tap **RX ANT** to select the receive antenna for the Main receiver.
9. Tap **SUB** to turn diversity mode off when finished using diversity reception.

**Figure 5-36. Main = RX ANT IN, Sub = ANT 2.**

### **Operating Split in Diversity Mode**

You can operate split when in diversity reception. Because both receivers are tuned by VFO A, you must revert to the operating techniques needed for a single receiver radio. You will be listening to the DX station on VFO A and searching for the station that has successfully broken through the pile-up with VFO B, which can be tuned independently of VFO A. VFO B controls the transmit frequency in split operation.

3. Tune into the DX station with VFO A.
4. Tap **A→B** to transfer VFO A to VFO B.
5. Start up diversity reception by holding **SUB** for more than two seconds.
6. Hold **SPLIT** to enter split mode. Now you will be transmitting on VFO B.
7. When you hear the DX station go back to a station in the pile-up, hold the **REV** switch to reverse VFO A and VFO B temporarily. Quickly search through the pile-up using VFO A to find the station going back to the DX. When you find it, release **REV** and get ready to call the DX on the next over.
8. You may also hold **B SET** to enter *b sEt* mode. You will hear the Main receiver in the left ear and the Sub in the right ear. This temporarily overrides diversity mode allowing you to hear the DX station and the pileup frequencies.