

# ANC-4

## ANTENNA NOISE CANCELLER for Reducing Locally-Generated Noise

Instruction Manual

Revision 2.0 May 2, 2000



## WARRANTY

### **TIMEWAVE TECHNOLOGY INC. LIMITED ONE YEAR WARRANTY**

#### **WHO IS COVERED**

This warranty is extended only to the original purchaser of the ANC-4.

#### **WHAT WE WILL DO**

If your ANC-4 fails in normal use because of a defect in workmanship or materials within one year of the date of purchase, we will repair or replace (at our option) the equipment at our factory without charge to you. Timewave will pay for the return of the warranty-repaired unit to you.

#### **WHAT YOU MUST DO**

First, double check your connections and operating procedure. If you're certain that the unit is faulty, notify Timewave Customer Service immediately. If Timewave is unable to resolve the problem by telephone or email, we will give you an RMA number and ask you to return the unit. You must pay all shipping and insurance charges for returning the unit to our factory.

#### **WHAT IS NOT COVERED**

We cannot be responsible for damage caused by accidents, abuse, misuse, improper installation, or unauthorized attempts to repair the unit.

#### **SERVICE WARRANTY**

Timewave service work performed in connection with this warranty is warranted to be free from defects in materials and workmanship for 30 days from the date of repair. All other terms of the limited warranty apply to the service warranty.

#### **HOW TO CONTACT TIMEWAVE**

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**TIMEWAVE MAKES NO OTHER WARRANTY, EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.**

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## SECTION 1

### BRIEF DESCRIPTION

The ANC-4 is an rf device which is designed to provide cancellation of locally generated noise from signals received by a primary antenna. This unit is employed right at the antenna connector of the receiver or transceiver to cancel locally generated noise, such as power line noise, computer noise, TV-generated interference, etc., before it gets into the receiver and affects the receiver AGC circuits. This will allow the reception of signals well below the noise level induced by the local interference.

To cancel locally generated interference, the interference signal must be detected and its phase and magnitude adjusted so that it matches the offending interference, but is 180 degrees out of phase, effectively cancelling the interference. This scheme is particularly effective at reducing local power line noise or other locally generated noise types.

This unit may be used with any receiver or transceiver with rf power output of 250 Watts PEP or less. An rf detector built into the unit automatically bypasses the network whenever transmit rf is detected. The unit is NOT designed to be used at the output of a high power linear power amplifier, but must be installed at the lower rf level of the transceiver, if transmitting is anticipated. In other words, if you use a linear amplifier, place the ANC-4 between the transceiver and the linear amplifier.

Controls are provided on the front panel to allow adjustment of both the phase and magnitude of the local interference, providing extremely deep cancellation of the offending interference.

The unit connects between the main station antenna and the receiver antenna connector. The DC power mating connector for the ANC-4 is supplied with each unit. UHF (SO-239, which mates with a PL-259 plug) connectors are used for the outside antenna and the output to the receiver. A short wire antenna and a short collapsible whip are supplied with each unit to act as a noise pickup antenna. These will generally be satisfactory for eliminating noises generated around the operating position or in the house, but are generally not large enough to eliminate noises generated outside the home, such as power line noise. For noises generated outside the home, we recommend that you mount a small noise dipole (6 feet of wire each side of center) outside perhaps down in the shrubs or some other area a foot or two above ground, and broadside to the noise source, such as parallel to power lines. Feed the noise probe at the center with coaxial cable, shielded wire or even lampcord and connect it to the NOISE ANTENNA connector J1, located on the rear of the ANC-4, using an RCA plug. (Connect the center conductor of shielded wire or one side of the lampcord to the center pin of the RCA phono plug, and the shield or other dies of the lampcord to the ground side of the RCA plug.) If you use the whip supplied with the unit, it may be mounted through a hole in the top over and screwed onto a threaded stud. DO NOT OVERTIGHTEN. The short wire antenna supplied connects to an RCA jack on the rear panel of the unit. Any noise antenna that works, including combinations of horizontal and vertically polarized antennas, may be used.

The ANC-4 can be used to cancel ignition noise, alternator whine or other noise types found in an automobile. To provide sufficient noise signal to the unit, it may be necessary to run a wire from the NOISE ANTENNA connector into the engine compartment to act as a noise

pickup. It will probably be necessary to readjust the NOISE PHASE and NOISE GAIN controls when changing from one band to another, but the settings should hold over an entire Amateur band.

The ANC-4 may be used as an active antenna by plugging the noise antenna (or a longer wire antenna) into the noise antenna jack and using the NOISE GAIN control to increase the antenna output. See Section 5 ACTIVE ANTENNA. The unit may also be used as a diversity combiner to null interfering signals. See Section 5.

## SECTION 2

### QUICK OPERATION

This section lets you get “on the air” with the ANC-4 as quickly and as simply as possible. Refer to the Connection Diagram Figure 3. See the following sections of this manual for more detailed information. Refer to Figures 1 and 2 for location of front and rear panel connectors and controls.

#### CONNECT POWER

The ANC-4 operates from a nominal +12VDC power source. Plug an AC to 12VDC adapter into the ANC’s DC IN (J4) jack on the rear panel. The unit is protected for reverse polarity, so no damage will result if the correct polarity is not observed, but the unit will not operate. If you solder on your own power plug, be sure to check for the correct polarity - center terminal is positive - before connecting to the ANC-4. Use the Timewave ANC-1 or similar AC-to-DC adapter with at least 300 mA current capacity. The power input mating connector is coaxial, 2.1mm ID and 5.0 to 5.5mm OD, center positive. A mating plug is included with the unit. (Older JPS ANC-4 units use a 2.5 mm ID power connector).

#### CONNECT NOISE ANTENNA

Connect the Noise Antenna, using either the short wire antenna or the collapsible whip antenna (both supplied with the unit) or your own noise antenna, to the unit. **NOTE: The two noise antennas supplied with the unit are likely to be effective only for noise generated within the operating area or room and will not be adequate for reducing power line or other noises generated outside the home. See Section 3 for outside noise antenna suggestions.** The whip mounts through the hole in the top of the case and screws onto a terminal on the internal printed circuit board. The wire antenna comes with an RCA phono plug and plugs into the phono jack (J1) on the rear of the unit. This jack is also used to connect your own noise antenna, if desired. The RCA phono connector provided with the wire antenna may be used to connect your own outside noise antenna by unsoldering the wire and connecting the coax center conductor to the center pin of the RCA connector and the coax shield to the outside of the RCA connector. Use the shortest length for the noise antenna that will provide a good null with the NOISE GAIN control in its mid range.

#### CONNECT OUTSIDE ANTENNA

Using a UHF connector, connect the outside antenna to the MAIN ANT connector (J3) on the rear of the unit.

#### CONNECT UNIT TO RECEIVER ANTENNA CONNECTOR

Using a UHF connector and coaxial cable, connect the unit from the RADIO connector (J2) on the rear of the unit to the receiver or transceiver rf input or ANTENNA connector.

#### CONNECT TO STATION GROUND

Connect the rear panel ground connector to your station ground. This will reduce the effect of hand capacitance on the settings as you null out the local noise.

#### TURN ON POWER

Turn on the ANC-4’s POWER switch. The yellow LED next to the switch should be illuminated.

#### CONTROL SETTINGS

Set the NOISE PHASE control to the full CCW position. Set the PHASE RANGE pushbutton in the “IN” (“A”) position. Set the FREQ RANGE pushbutton in the “IN” (LO) position. Turn the NOISE GAIN control fully CCW to ZERO.

#### TUNE IN NOISE ON THE RECEIVER

Tune your receiver to a frequency in the 3 to 4 MHz band (80 Meters). Find a spot where you hear only the noise level. If the noise is generated

locally, such as close-by power lines, computers, TV, etc., you should be able to adjust the NOISE PHASE and NOISE GAIN controls to reduce the noise level considerably. If the noise you receive is not generated locally, the unit will probably have little effect on your noise level.

## **ADJUSTING FOR MINIMUM NOISE**

Turn the NOISE GAIN control slowly CW (clockwise) while observing the receiver "S" meter. Note when the noise level changes, either increase or decrease. Now adjust the NOISE PHASE control until you see the "S" meter dip. If you do not see a dip or rise in the "S" meter reading, try changing the PHASE RANGE pushbutton to the "OUT" ("B") position and readjust the NOISE PHASE control. One position of the PHASE RANGE pushbutton provides a NOISE PHASE range from 0 to 180 degrees, while the other position provides a NOISE PHASE range from 180 to 360 degrees. One of the settings of the PHASE RANGE button will provide the proper phase so that a good null can be attained. Readjust the NOISE GAIN and NOISE PHASE controls alternately until the local noise has been cancelled. If you cannot obtain a null, follow the procedure given in the following paragraphs to determine if adequate noise is being picked up by the noise antenna. If you obtain a null of the noise, but it is not as deep as you believe it should be, try changing the polarity of the noise antenna to agree with the polarity of your main station antenna. Although the vertical whip may do a good job of cancelling the noise regardless of the main antenna polarity, better performance (deeper nulls) can be obtained in some cases when the main antenna and the noise antenna have the same polarity. When a null has been reached, you now hear the noise level you would have if no local noise was present, because you have just cancelled the locally-generated noise. Now you will hear signals that you didn't know were there before. Or you'll get good copy on signals that you couldn't quite hear because they were in the noise level.

If your receiver does not have an "S" meter, listen carefully to the noise level. When you hear the noise level increase with noise from the noise antenna, switch to the NOISE PHASE control and listen for the null in the noise. Switch between the NOISE PHASE and NOISE GAIN controls to attain the local noise null. The null obtained is normally good for most of, if not the entire band in which you're listening. If you go to a new frequency, you will probably have to readjust the settings on the NOISE PHASE and NOISE GAIN controls to recancel the local noise. If you cannot obtain a satisfactory null in the noise, make the following check to determine if adequate noise is being picked up by the noise antenna.

- (1) Turn both NOISE PHASE and NOISE GAIN controls fully CCW.
- (2) Note the S meter reading on noise received from the main antenna. Also listen to the character of the noise.
- (3) Disconnect the main antenna and increase the NOISE GAIN in a CW direction until the S meter reads the same as it did with noise from the main antenna. Listen to the noise to be sure it sounds the same as it did in step 2 above. If you cannot get the S meter reading high enough to equal the reading taken in step 2, the noise antenna length must be increased to pick up enough noise to properly cancel that received by the main antenna.
- (4) If the character of the noise is not the same in step 3 as it was in step 2, you may need to place an outside noise dipole to pick up the noise. Feed the output from this outside probe through shielded wire or coaxial cable to the NOISE ANT connector on the rear of the ANC-4.



**HIGH FREQ  
OPERATION  
(Over 20 MHz)**

For operation at frequencies above 20 MHz, the FREQ RANGE pushbutton should be in the "OUT" (HI) position. This centers the network so that it will operate properly at these higher frequencies. If you have trouble getting a good null at high frequencies, try placing the FREQ RANGE switch in the LO position and readjust the NOISE PHASE and NOISE GAIN controls. All other adjustments should be made as noted above to cancel the local noise. The unit will cancel local noise down to about 100 KHz and up to about 80 MHz.

**REDUCING HANG  
TIME FOR BREAK-  
IN CW OR AMTOR/  
FACTOR USE**

To reduce the Time to Return to Receive Mode When RF is Not Present, parallel resistor R29 with 22k, 1/4W. This can easily be done internally by changing jumper J1 (DELAY) from position 1-2 (NORMAL), to position 2-3 (FAST). This will decrease the relay hang time from 500 msec to approximately 7 msec.

**BROADCAST  
STATION NOTCH**

If a local broadcast station overloads the NOISE ANTENNA amplifiers, it can be sharply attenuated with a tunable trap, C27 and L2. To activate the trap, connect the jumper JP2 to position 1-2. By adjusting the variable capacitor, station frequencies in the 1000 to 1600 kHz range can be trapped. To trap a station with a frequency between 800 kHz and 1000 kHz, install a 22 pF capacitor between E1 and E2 on the printed circuit board. If the offending station has a frequency below 800 kHz, install a 47 pF capacitor between E1 and E2. To deactivate the tunable trap, place the jumper JP2 in position 2-3.

**BROADCAST BAND  
FILTER**

To attenuate signals from local broadcast stations that are picked up by the external noise antenna, place Jumper JP3 for the BCB Filter in position 1-2. This places a high pass filter with at least 50 dB attenuation in the stop band in series with the noise antenna. If one particular station is so strong that it still comes in despite the high pass filter, use the BCB TRAP to notch it out. See paragraph above. To deactivate the BCB Filter, place jumper JP3 in position 2-3.

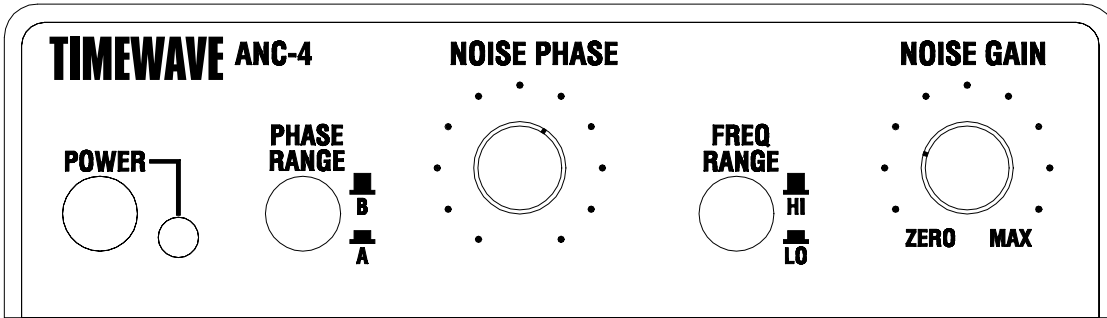


Figure 1  
Front Panel Controls

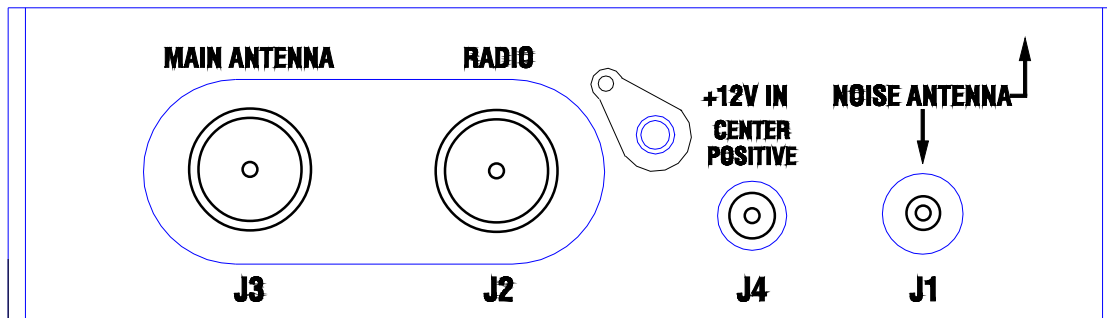


Figure 2  
Rear Panel Controls

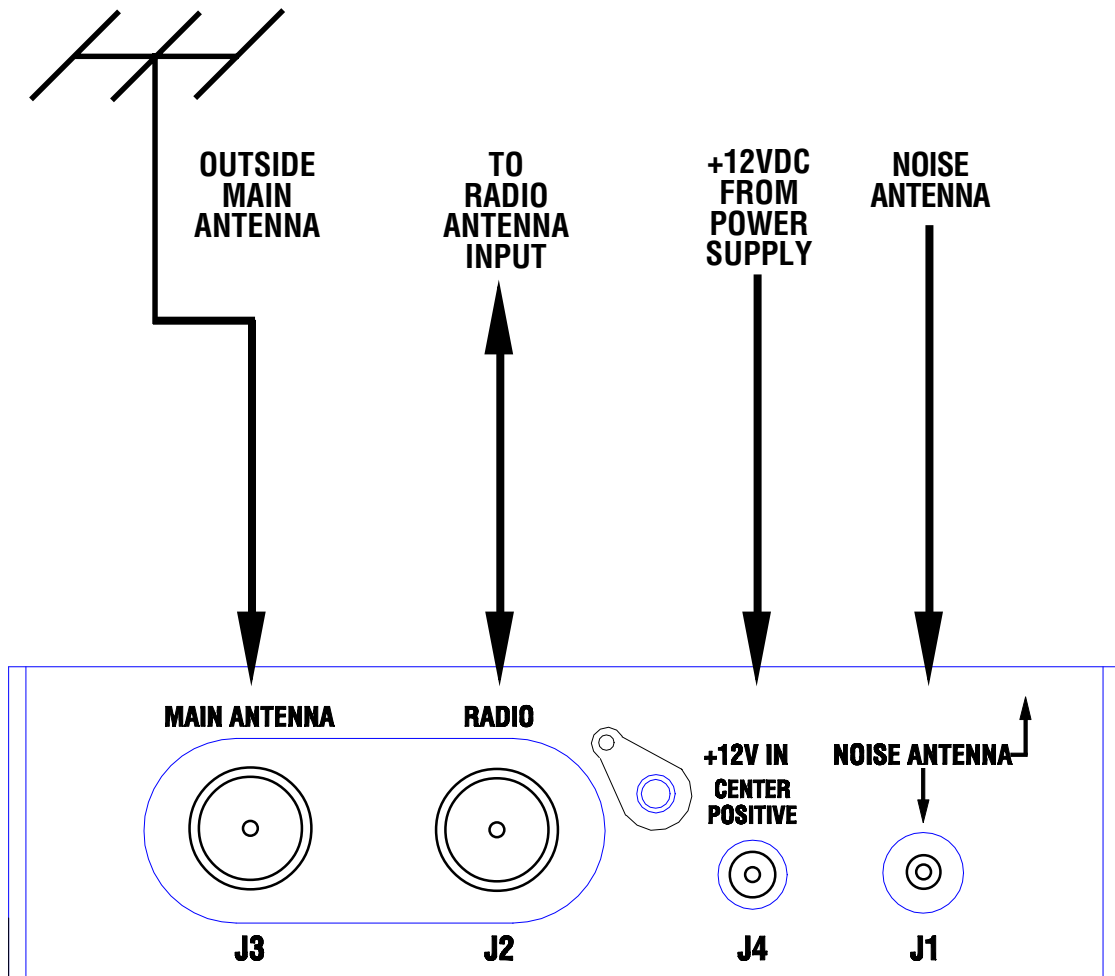


Figure 3  
Connection Diagram

## SECTION 3

### CONNECTIONS

This section gives detailed information on the connections to the ANC-4. The unit is quite simple to connect and use, but for best results, follow the guidelines in this manual. See Figure 2 for Rear Panel Connections.

#### POWER REQUIREMENTS

The ANC-4 operates from +11VDC to +16VDC and requires about 300 mA. Power can be supplied from any filtered DC source. An AC to 12VDC adapter is available from JPS Communications at slight additional cost.

#### VEHICULAR OPERATION

The ANC-4 may be operated directly from the power system of any 12VDC negative ground vehicle.

#### MAIN ANTENNA INPUT

The MAIN ANT input (J3) connector is a UHF (SO-239) type for use with coaxial rf cables, such as RG-8 or RG-58. This connector serves as the rf input from the outside or station antenna system.

#### RADIO INPUT

The RADIO (J2) connector is also a UHF (SO-239) type for use with coaxial rf cables, such as RG-8 or RG-58. This connector provides the output from the antenna to the receiver. When the ANC-4 power is off, the MAIN ANT is bypassed directly to the RADIO connector.

#### NOISE ANTENNA

The NOISE ANTENNA connector on the rear panel (J1) is an RCA phono jack for connecting the short wire noise antenna or your own noise antenna to the ANC-4. A hole in the top cover of the unit allows the short collapsible whip noise antenna to be screwed into a threaded adapter on the pc board inside the unit. This antenna picks up locally generated noise to the exclusion of desired long distance signals, and is used as a reference signal which can be varied in magnitude and phase for cancellation of the local noise. Keep in mind when selecting which noise antenna to use that you may get deeper noise nulls by having the same polarization on both the noise antenna and the main antenna. In either case, the noise antenna should be kept as short as possible to provide a good noise null with the NOISE GAIN control in its mid range.

**If sufficient noise cannot be picked up by the noise antenna supplied with the unit, it may be necessary to install a noise dipole or noise probe outside to more clearly pick up the noise.** A noise dipole of 3 to 6 feet either side of center, fed with shielded wire or coaxial cable, will generally suffice. The dipole should be turned broadside (parallel) to the noise source and should be located 2 to 4 feet above ground, perhaps in shrubs around the house, but where it can "see" the power lines or other noise source. This will prevent it from receiving much if any of the desired signal. After installation, perform the test in the SECTION 2, ADJUSTING FOR MINIMUM NOISE to be sure that adequate noise pickup is available from the noise antenna. It is most desirable to have the matching noise level occur when the NOISE GAIN control is somewhere in its middle range. Otherwise, the null may be obscured if it occurs too close to either end of the control.

## **SECTION 4**

### **CONTROLS & INDICATORS**

This section explains the operation of the ANC-4 controls. See Figure 1 for the location of Front Panel Controls.

#### **NOISE PHASE CONTROL**

The NOISE PHASE control adjusts the phase angle of the signal from the noise antenna to 180 degrees for maximum cancellation of the local noise.

#### **PHASE RANGE PUSHBUTTON**

The PHASE RANGE pushbutton provides two different networks to allow greater range of adjustment of the NOISE PHASE control to achieve the deepest null of local noise interference. When the button is pushed in, the phase network is in the “A” position, which is used for most situations. When the button is out, the phase network is in the “B” position. No position on this switch is more “right” than the other. The proper or “right” position is that which gives the best null. The FREQ RANGE button can be used in conjunction with this pushbutton to give even greater phase nulling range at low frequencies by placing it in the HI position.

#### **FREQ RANGE PUSHBUTTON**

The FREQ RANGE pushbutton extends the frequency range over which the NOISE PHASE and NOISE GAIN controls are effective. In the “IN” position (LO), the network is set for frequencies below 20 MHz. In the “OUT” position (HI), the network is set for frequencies above 20 MHz. Note that the HI position is also usable for low frequencies and may be required if a satisfactory phase null cannot be obtained with the switch in the LO position.

#### **NOISE GAIN**

The NOISE GAIN control adjusts the level of the signal picked up by the noise antenna so that the magnitude of the offending interference can be cancelled. When the ANC-4 is used as an active antenna, this control adjusts the gain of the antenna.

## SECTION 5

### OPERATION

This section describes the operating procedure for best results with the ANC-4.

#### LOCAL NOISE

When the unit is connected as shown in Figure 3, locally generated noise can be cancelled, in many cases completely. The controls and switches should be manipulated as follows: (Refer to Figure 1).

1. Use your receiver "S" meter as a noise level indicator.
2. Set the NOISE PHASE control initially fully CCW and turn the NOISE GAIN control fully CCW. Set the PHASE RANGE pushbutton "IN" to the A position, and the FREQ RANGE pushbutton "IN" to the LO position for frequencies below 20 MHz, or release it to the "OUT" or HIGH position for frequencies above 20 MHz. (See "adjusting for Minimum Noise" in Section 3 for further discussion.)
3. Slowly increase the NOISE GAIN control clockwise until a change, increase or decrease, in the "S" meter reading is just noted.
4. Now adjust the NOISE PHASE control until a null is noted on the "S" meter.
5. Alternately adjust the NOISE GAIN and NOISE PHASE controls until the best null is obtained. If interaction due to hand capacitance is noted, ground the case of the ANC-4 to your system ground.
6. If a good null cannot be obtained with the PHASE RANGE pushbutton in the A (in) position, release the pushbutton to the B position and readjust. A null should be obtained in one of the two PHASE RANGE switch positions. Remember that the "right" switch position is that which gives the best null.
7. For the deepest noise nulls, it may be necessary to change the noise antenna polarity (horizontal or vertical) to be the same as that of the main antenna.
8. When changing bands, it will probably be necessary to readjust the network to reduce the noise on the new band. Normally, the adjustment will hold over a frequency range of several kilohertz without requiring readjustment. So if you adjust the noise cancellation in any one ham band, it will generally hold throughout that band. However, different noise sources may be present in different parts of the same band, so that some readjustment may be required if this occurs.
9. If a null cannot be obtained using the noise antennas supplied with the unit, you may have to install an external noise antenna. SECTION 2, ADJUSTING FOR MINIMUM NOISE provides a test which will determine if adequate noise is being provided by the noise antenna. SECTION 3, NOISE ANTENNA gives some hints for an external noise antenna and where it should be physically located.

#### ACTIVE ANTENNA

The ANC-4 can be used as an active antenna by using the whip antenna provided with the unit (See Figure 2). The NOISE GAIN control can then be used to provide amplification of the signals received by the antenna.

## GENERAL OPERATING HINTS

For active antenna use, do not connect an antenna to the MAIN ANTENNA connector.

As an alternative, a wire antenna can be connected to the rear panel NOISE ANTENNA connector, J1. Best results will be obtained by using the longest practical length of wire for this antenna.

When used as an active antenna, set the NOISE PHASE control fully clockwise for best results. Set the FREQ RANGE pushbutton to agree with the frequency band in which you are operating. The position of the PHASE RANGE pushbutton is not important.

Following are some helpful hints for operating with the ANC-4:

- **To prevent damage to the ANC-4 when an antenna tuner is used, simply turn off the power on the ANC-4 until the tuning process is complete.**
- If the PHASE GAIN control is too close to either the CCW or CW end, merely adjust the noise antenna length to center the control. In other words, keep the noise antenna length to the minimum required to get a good null while keeping the NOISE GAIN control in its mid range.
- If you use an antenna tuner, wait until the antenna has been properly matched before adjusting the ANC-4 for local noise null.
- If the local noise is not stronger in the noise antenna than it is in the main antenna, adjusting for a null will likely reduce the desired signal as well. It is desirable to have the noise antenna as close to the noise source as possible for best performance, so an external noise antenna may be required.
- **DO NOT** connect the noise antenna to a high gain outside antenna unless a series attenuator is used. Unless the signal is attenuated, the received signals will overload the internal amplifier and will cause intermodulation distortion. The loss in signal strength through the attenuator can be made up by adjusting the NOISE GAIN control.
- You will likely find that the ANC-4 will make operation of a DSP noise reducer, such as the Timewave DSP-599zx., much more effective because the ANC-4 will eliminate noise before it gets into the receiver and affects the receiver AGC circuits.
- If you are situated close to an AM broadcast station, you may need to trap the BC signal to prevent overload of the noise amplifier in the ANC-4. A tunable trap is included on the pc board to eliminate BC station interference. See Section 2, BROADCAST BAND NOTCH for further information. If more than one station is involved, merely place jumper JP3 in position 1-2. This engages a highpass filter which attenuates the broadcast band by at least 50 dB.
- **NOTE:** If the NOISE GAIN is set too high, the ANC-4 will introduce noise instead of removing it. Noise cancellation is dependent upon a good balance between the NOISE PHASE and NOISE GAIN controls.
- If two antennas are available and located with space diversity, you can use the ANC-4 to null interfering stations as shown in figure below.
- In order to obtain the best noise null, it may be necessary to change the noise antenna polarization (horizontal or vertical) to be the same as that of the main station antenna.

## SECTION 6

### TECHNICAL INFORMATION

#### SPECIFICATIONS

Operating Frequency Range	500 kHz to 80 MHz (usable down to 100 kHz)
Signal Loss, Main Ant. to Radio	6 dB
Rf Input Level, Main Antenna	3 Vrms maximum
Maximum Transmit Rf Power Through Unit	250 W PEP or Average
Time to Switch to Bypass When Transmit Rf is Detected	7 mSec, typical
Time to Return to Receive Mode When Rf is Not Present	Approx. 500 msec or 7 msec, typical intentionally selectable, (hang time)
Typical Local Noise Types	Power Line Noise, Computer Noise, TV Noise, etc.
Noise Cancellation	Typically 40 dB or greater
Front Panel	POWER switch, POWER LED, PHASE RANGE switch, NOISE PHASE control, FREQ RANGE switch, NOISE GAIN control.
Rear Panel	Power Input, Noise Antenna Input, Main Antenna Input, Radio Output
Input Power	+11 VDC to +16 VDC @ 150 mA, reverse polarity protected
Size	1.7"H x 6"W x 4.3"D (4.3cm x 15.2cm x 10.9cm)
Weight	2 pounds (.91 kG)
Temperature Ranges	Operating: -20°C to +55°C Storage: -40°C to +85°C
Humidity	Up to 95% @ +55°C



## SECTION 7

### TROUBLE-SHOOTING

#### Symptom

POWER ON LED does not light.

Unit comes on, but no signals heard

Noise received cannot be nulled

Service Department.  
Noise received cannot be nulled.

#### Possible Fault

Check AC power source, polarity and power line connections. Check for proper seating of plug in DC power jack

Check all antenna connections on rear panel. Make sure cables go to correct connectors in Receiver

Received noise may not be locally generated. Follow nulling instructions carefully. Make sure you try both settings of PHASE RANGE switch and the FREQ RANGE switch when nulling if difficulty is noted. If frequency is above 20 MHz, set the FREQ RANGE switch to the HI position. NOISE GAIN control may be set too high initially. The noise antenna length may be too great, particularly if the noise is severe. Shorten the noise antenna length until a satisfactory null can be obtained with the NOISE GAIN control in its mid range. Change the noise antenna polarization (horizontal or vertical) to agree with that of the main station antenna. If you can approximate the location of the noise source, place a short external noise antenna as close to the source as you can, or use a short dipole facing toward the noise source as a noise antenna. **NOTE: The short whip and short wire noise antennas supplied with the unit are not adequate to cancel local power line noise or other noise generated outside the home. You will need to install an outside antenna. See Section 3, NOISE ANTENNA for suggestions on antenna size and location.** If problem persists, contact Timewave Customer

Noise received on noise antenna is too low. Noise received on noise antenna is different from that received by main antenna. To determine if this is the case, perform the following procedure:

(1) Connect up the unit as described in the manual. Turn the unit power on.

(2) Turn both the NOISE PHASE and NOISE GAIN controls fully CCW.

(3) Now with the main antenna connected, note the S meter reading and listen to the character of the noise (is it a "buzz" or a "crackle", etc.?)

(4) Disconnect the main antenna from the ANC-4.

(5) Turn the NOISE GAIN control CW until it is somewhere in its mid-range and observe the S meter reading. Is it as high as the reading obtained in step 3? Is the character of the noise the same as

that heard in step 3? If the answer to both questions is "YES", you should be able to arrive at a satisfactory null of the noise. (Hint: When you reach the same S meter reading as before, leave the GAIN where it is, reconnect the main antenna and try to null with just the NOISE PHASE control. You may have to alternate between PHASE and GAIN a few times to get the deepest null.) If the answer to either question is "NO", then a null probably cannot be achieved.

(6) If the noise sounds the same in steps 3 and 5, but you can't get a high enough S meter reading from the noise antenna alone, you need a longer noise antenna or need to locate the noise antenna closer to the noise source.

(7) If you can get a similar S meter reading, but the noise sounds different in step 5 from what it sounds like in step 3, your noise antenna is picking up noise that is not being heard by the main antenna and the noise antenna must be relocated so that it DOES pick up the noise appearing on the main antenna. (For instance, your outside antenna may be receiving noise from power lines, while the indoor noise antenna may be picking up noise from a nearby computer, noise which is not heard by your main antenna). In most cases, a simple short dipole can be placed outside in shrubs or some other low area, but in view of the noise source, if possible. The noise antenna is then fed to the ANC-4 NOISE ANTENNA jack (rear of the unit) with shielded wire. Repeating the above tests will let you determine if you will be able to null the main antenna noise or not. Some adjustment of noise antenna length or

## SECTION 8

### GENERAL THEORY OF OPERATION (See Figure 5)

position may improve the null.

Figure 6 is a block diagram of the ANC-4 showing the elements that are used to cancel locally generated noise from the signal received by the station main antenna system.

The station antenna picks up noise, both locally and remotely generated, as well as desired signals and passes everything directly to the receiver. If the noise level is strong enough, it will take over the receiver AGC system and reduce the receiver gain for weaker desired signals, masking them. The detected audio output then contains mostly noise information unless the desired signal is of sufficient strength to overcome the noise signal amplitude. This reduces the number of signals actually heard by the operator to those stronger than the received noise level. When the noise level from local sources, such as power lines, computers, etc., is strong enough to give high "S" meter readings on the receiver, the number of intelligible signals received by the operator is greatly reduced when compared to what could be heard if the local noise level could be overcome. Now DSP noise reduction devices can allow the operator to improve the intelligibility of signals close to or in the noise level, but cannot "dig out" those signals which have been masked by the local noise. The ANC-4 provides a means to allow the operator to cancel the local noise and let him hear those signals previously masked by that noise.

The signal from the MAIN antenna is combined in a special network with a signal from the NOISE antenna. The MAIN antenna signal contains desired information as well as noise. The NOISE antenna signal, which contains mostly the local noise, is amplified and passed through a phase shift network so that its phase can be adjusted to 180 degrees compared to the MAIN antenna signal. Front panel controls, NOISE PHASE and NOISE GAIN, let the operator adjust the NOISE antenna phase and gain to just equal the noise signal magnitude picked up by the MAIN antenna, but shifted 180 degrees in phase. Two phase shift networks (PHASE) are incorporated to give maximum flexibility and cover most local noise situations. A switch (FREQ RANGE) is also provided to tailor the noise cancellation network for operation at frequencies above 20 MHz. The HI range on this switch is also usable at low frequencies and provides an additional phase shift network which may be required if a satisfactory phase null cannot be obtained with either PHASE switch position. The combined signals, with the local noise cancelled, are passed on to the receiver via the RADIO connector on the rear panel. The networks in the ANC-4 allow cancellation of local noise up to an operating frequency of about 80 MHz or so.

$$\text{Desired Signal} + \text{Atmospheric Noise} + \text{Local Noise} - \text{Local Noise} = \\ \text{Desired Signal} + \text{Atmospheric Noise}$$

When properly adjusted, 50 dB reduction of the locally generated noise is possible, leaving only the normal atmospheric noise level existing on the band. (Observing the "S" meter readings before and after local noise cancellation will make this apparent.) Signals that were masked by the local noise can now be heard. Now that the local noise has been removed from the received signal, a DSP noise reducer is much more effective when operating at the audio end of things. Just by eliminating or reducing noise, listening fatigue can be greatly reduced.

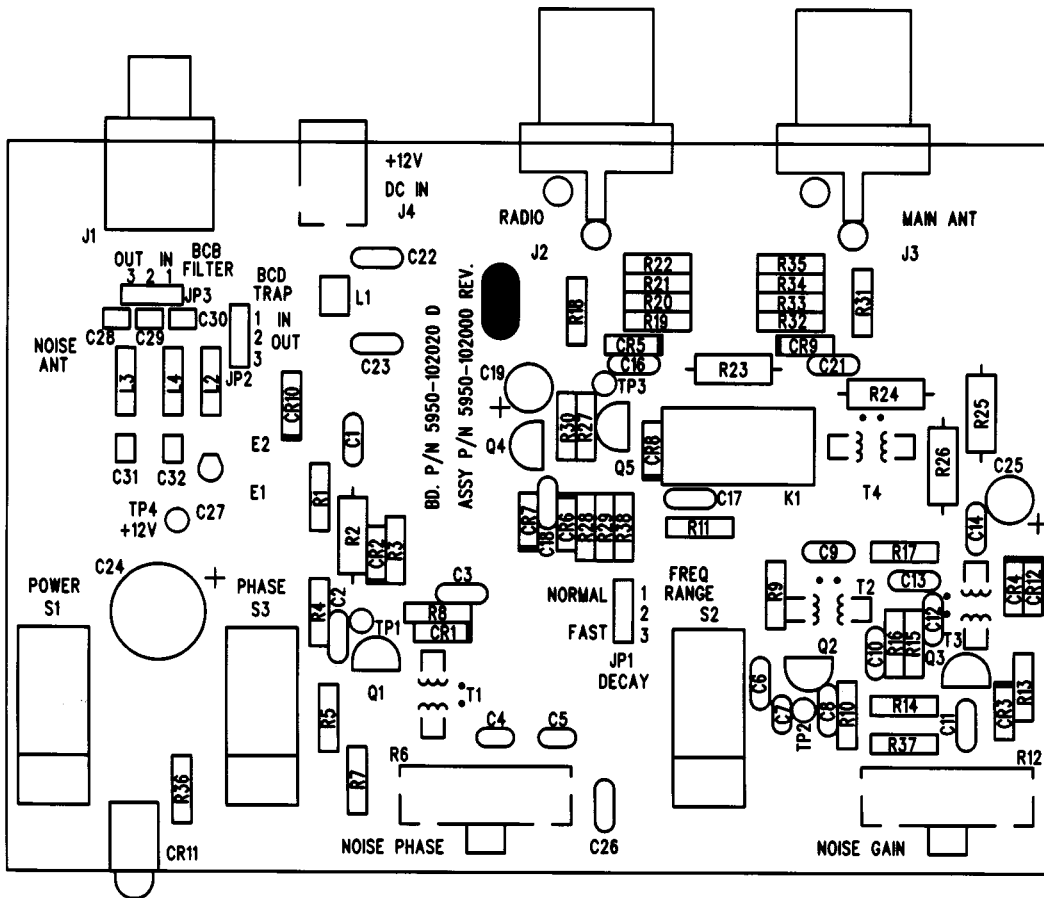


Figure 4  
Printed Circuit Board Parts Placement

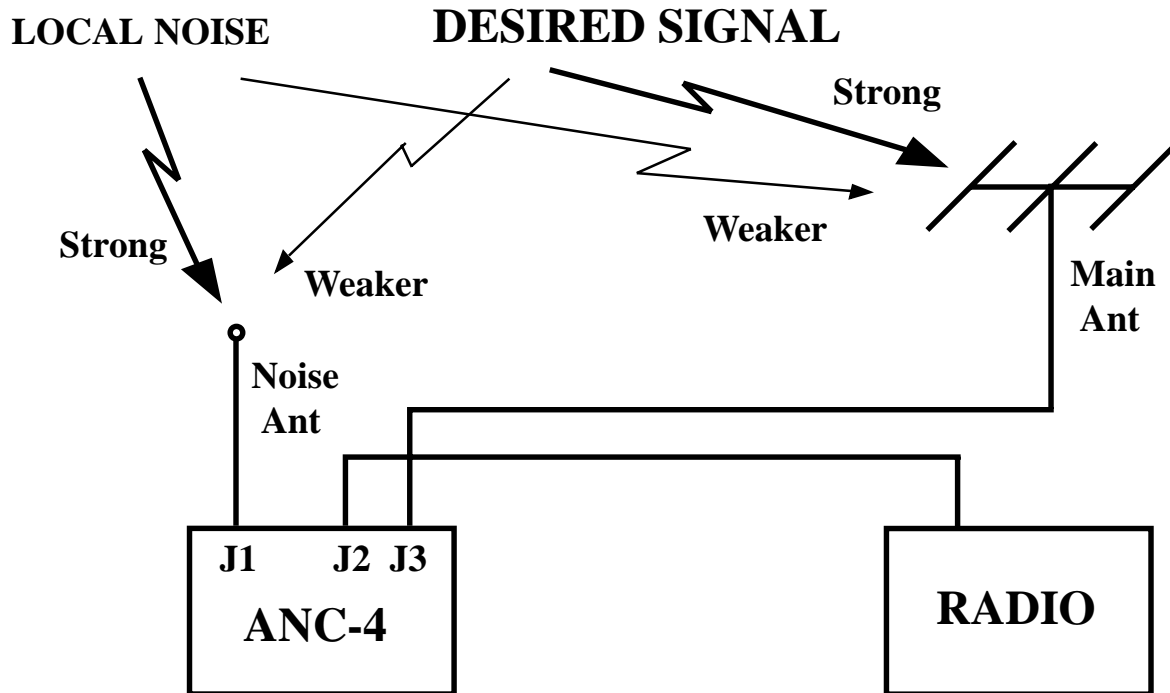
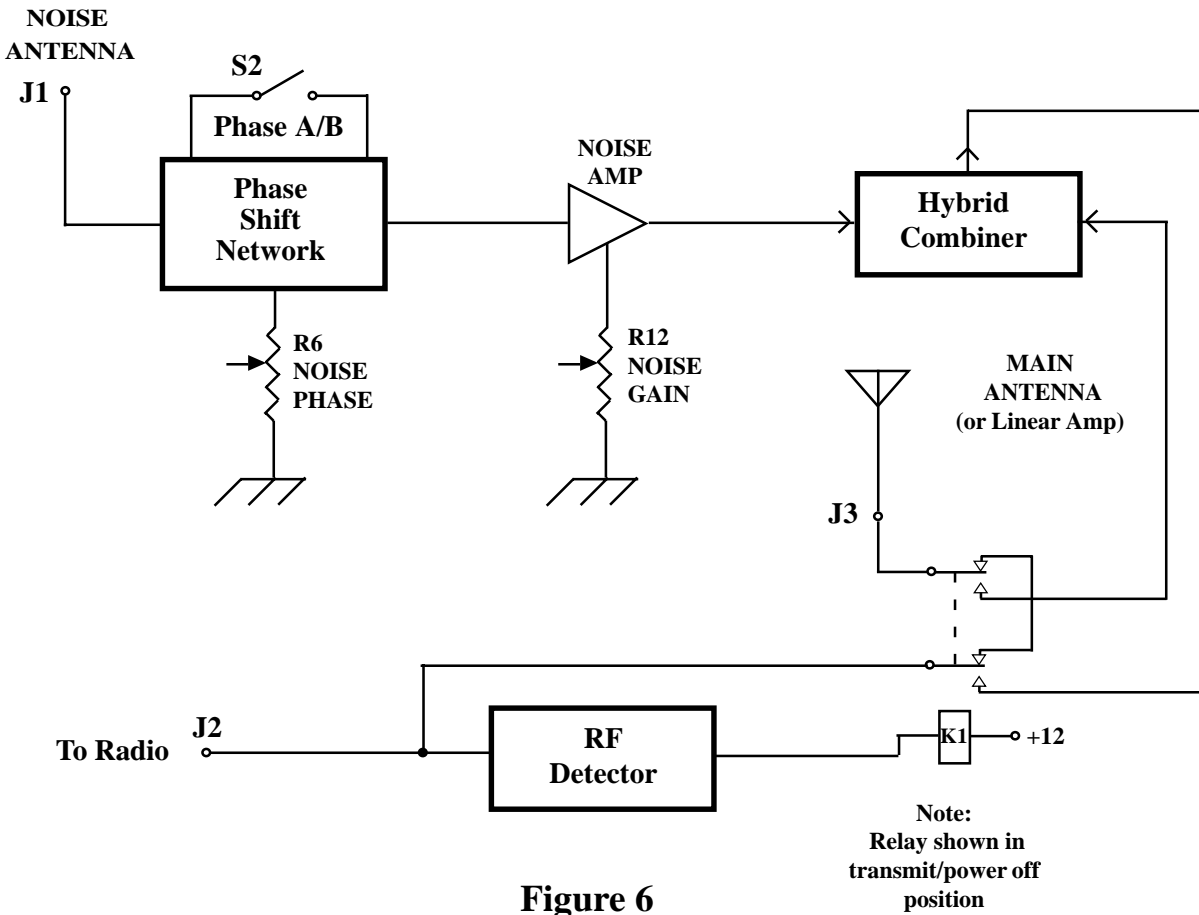


Figure 5  
Principle of Operation



**Figure 6**  
**Block Diagram**

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