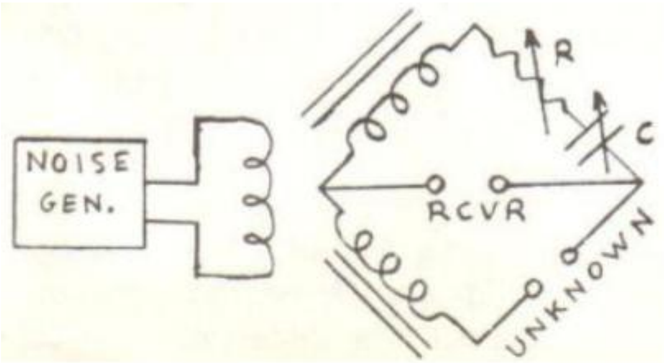
RX-100 Noise Bridge
Original Operators Manual

After the original document, offered by OZ6YM, Palle A. Andersen

Operator’s Manual

R-X Noise Bridge

General description.
The R-X Noise Bridge containes a wideband noise generator and an r-f impedans bridge. Two arms of the bridge are driven equally by the noise generator through a broadbanf ferrite transformer. A third leg of the bridge has a calibrated variable resistor R and a calibrated variable capasitor C in series. The antenna or other “Unknown” circuit to be measured is connected as the fourth leg of the bridge, A short-wave receiver is used as a detector.



When R and C are adjusted for a null (minimum noise out of the receiver) their dial settings can be read to find the resistance and the resistance of the unknown. A capacitor is in series with the unknown so that, if the unknown is a pure resistance capacitor C is at half scale for balance.
Thus both capacitive and inductive impedances can be measured. By tuning the receiver, the R and X of the unknown can be found of different frequencies.

The useful range of the Noise Bridge is 1 – 100 MHz. It measure R = 0 – 250 Ohms and C = +/- 70 pF.

Antenna Resonance.
Connect the antenna to the “Unknown” terminal (through any convenient length of line), and a 9 Volt transistor battery to the clips provided.

Tune the receiver to the expected resonant frequency of the antenna and turn the Noise Bridge ON. A loud noise will be heard. Adjust the R and X controle for NULL; the controls interact and must be adjusted alternately until a deep NULL is obtained.

If the reading is an the XL side of ZERO, the receiver is tuned to a frequency ABOVE resonance. If the X reading is on the XC side of ZERO, the receiver is tuned BELOW resonance. Using the X reading as a guide,retune the receiver and readjust the R and X dials for NULL. With this procedure it is easy to find the resonant frequency of an antenna.

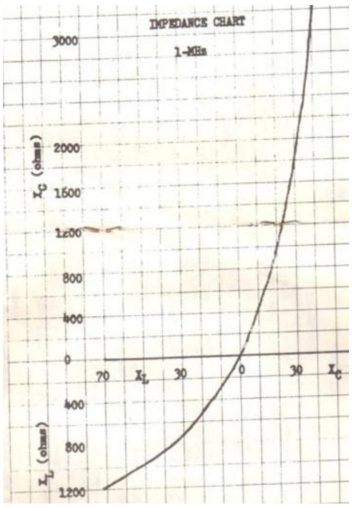
At the resonant frequency (X = 0) the R reading is the antenna resistance at the measurement point. If the measurement is made at a current loop (the center of a dipole antenna, for example) the indicated resistance is effectively the antenna radiation resistance.

Sometimes it is not possible to make the measurements at the antenna. Instead the R-X Noise Bridge can be connected to the antenna's coax feedline. There are two ways to do this:

1. If the feedline is an electrical half wave long, or some multiply of a half wave, then the readings taken at the end of the feedline are exactly the same as though the were taken at trhe antenna. Of course there is just one frequency where the feedline is a half wave long so all measurements must be taken at this frequency.

2. If the feedline length is known, readings taken at the end of the feedline at any frequency can be converted using the SMITH CHART to find the antenna resistance and reactance. The procedure is described in detail in the ARRL Antenna Book (13^{th} edition, 1974).

Antenna OFF-Resonance.
With the antenna connected as the "Unknown" its resistance and reactance of resonance can be found. At frequencies lower than resonance an antenna appears as a capacitor and a resistor in series. The resiatance is read directly from the R dial.
The reactance is found from the X dial reading and the impedance chart. The chart gives reactance in Ohms for a measured frequency of 1 MHz. To find the reactance at higher frequency, devide the tabulated values by the frequency in MHz.



Series Tuned Circuits.
To find the resonant frequency of a series tuned circuit, connect it across the "Unknown" terminals. Set the R control to minimum resistance (most tuned circuits used in communications work have a very low series resistance). Set the X control to ZERO. Tune the receiver for a nul. The X control can be used as described above to determine whether resonance is above or below the frequency to which the receiver is tuned.

Parallel Tuned Circuits.
A coupling link of two turns or so should be connected to the "Unknown" terminal. The link is then brought close to the tuned circuit and the procedure described above is used to find the resonant frequency.

If the tuned circuit uses a toroid inductor, the link must thread through the toroid core.

Measurement of Inductance and Capasitance.
The R-X Noise Bridge can be used to find the values of unknown capacitors and inductors. To do this, a standard capacitor (100 pF MICA) and a standard inductor (5 microhenry) are used.

To measure the inductance of a coil connect it in series with the standard capacitor and find the resonant frequency. To measure a capacitor, connect it in series with the standard inductor and find the resonant frequency.

$$L = \frac{25{,}330}{f^2C} \qquad C = \frac{25{,}330}{f^2L}$$

where f = resonant frequency in MHz
L = inductance in micro Henrys
C = capacitance in pico Farads

With the resonant frequency known and either the standard capacitor or standard inductor in use, an unknown inductor or unknown capasitor value can be calculated.
The L/C/F calculator (available for $2 from the American Radio Relay League) finds the answears without the need of arithmetic calculations.

Transmission Lines.
The length of a quarte wave line is:

$$L_{(feet)} = \frac{246}{f} V$$

where: f = frequency in MHz
V = velocity factor of the line.

V is approximately 0.66 for coaxial cables, 0.8 for foam dialectric coaxial cables, and 0.82 for twin-lead cables.

To find the frequency at witch a given line is an electrical quarter wavwe, connect it to the “Unknown” terminal. Leave the other end of the line OPEN. Set the R dial at ZERO. Tune the receiver to the expected frequency. If the line is an exact electrical quarter wave, the NULL will be at X = 0. If the receiver is tuned too high, the NULL will be on the XL side of ZERO.

If it is desired to prune the line to resonance at a given frequency, the line should be disconnected from the R-X Bridge. Short the “Unknown” terminal and adjust the X control for a NULL with the receiver at the desired frequency (the NULL will be at X = 0, but this method allows a precise setting to be made). Reconnect the line and do not readjust the X control. Find the quarter wave frequency by tuning the receiver to NULL. Prune the line slightly, retune the receiver, and repeat the procedure until the desired frequency is reached.

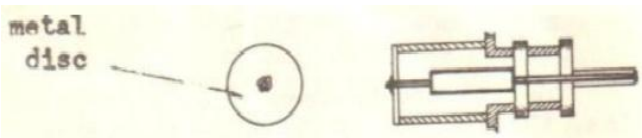
The length of a half wave line is:

$$L_{(feet)} = \frac{492}{f} V$$

To find the frequency for a half wave line, the far end of the line should be short-circuited (instead of OPEN-circuited as for quarter wave lines). Then follow the same procedure as described for quarter wave lines.

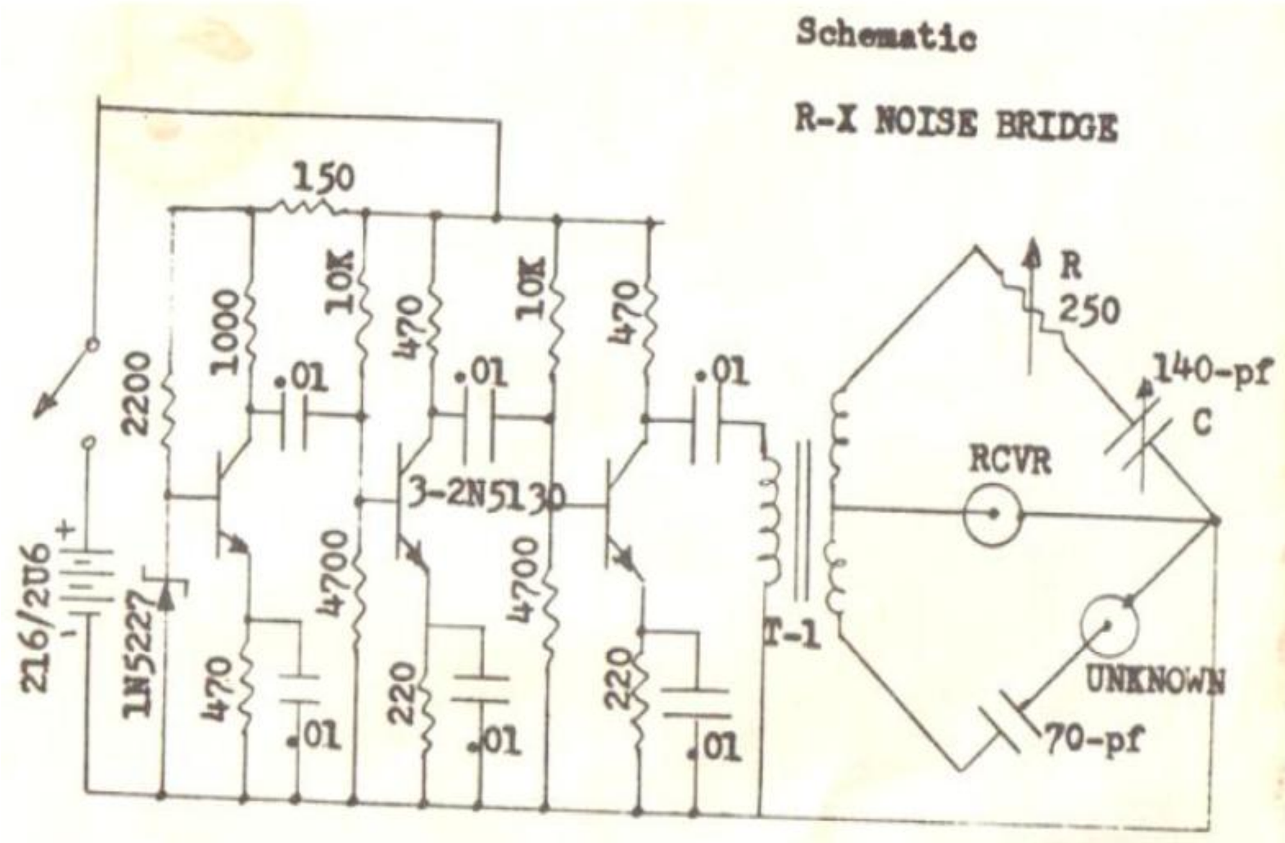
Calibration.
The R-X Noise Bridge has wide range controls (0 – 250 Ohms and 170 pF) to take care of the many uses to which it may be put. Because of this, and because of variations in bridge components, the dials cannot be read as precisely as desired for some measurements. To find the procise settings for a given antenna resistance and to check the calibration of the bridge, resistors of known values can be connected to the “Unknown” terminal. ¼ Watt or ½ Watt carbon resistors are suitable for this purpose. They should be mounted in a PL-259 coaxial plug as shown below. The is then mated with the “Unknown” receptacle of the Noise Bridge.

Resistors connected to the “Unknown” terminal by banana plugs or other open wiring methods invariably will give incorrect X readings because of lead inductance.



Impedance Chart.
Refer to the schematic diagram here under. R and C are the panel controls labeled R and X. C = 70 pF at a dial reading of X = 0. There is a 70 pF capasitor in series with the unknown. If the unknown series resistance and reactance are RU and XU then at NULL

$$R = R_U \quad \text{and} \quad X_C = X_U + X_{(70\text{-pf})}$$



TRAP Dipoles.
The noise bridge will give a NULL on each band that the trap dipole resonates. Start with the highest frequency band and measure the resistance and reactance as described for dipole. Adjust the center (or lower) section if necessary to resonate. Then repeat the procedure on the next lover band.The method works with either horizontal or vertical trap antennas.

Beam Antennas.
Connect the noise bridge to the driven element. Tune your receiver to the operating frequency and read the resistance and reactance. Adjust the element to resonance if needed.

With the noise bridge still connected to the driven element NULLs will be found at the resonant frequencies of the parasitic elements bercause of there close coupling to the driven element. The correct frequencies for these NULLs depends on the exact design of the beam. As an example ARRL Antenna Book has directors resonant at .980 and reflectors at 1.025 of the driven element resonant frequency.

The impedance chart shows this last relationship with reactance values given for f = 1 MHz. To find the reactance at higher frequencies devide the tabulated values by the frequency in MHz.

Warranty Policy.
Palomar Engineers warrents this equipment against defects in material and workmanship for a period of one year from the date of original purchase.

Do not ship to the factory without prior autorisation. First write and describe the difficulty. Many times we can diagnose and correct problems by mail.

This warranty is limited to replacing or repairing the defective parts and is not valid if the equipment has been tampered with, misused or damaged.