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Emtron's ENB-2 Noise Bridge

One of the most underrated yet valuable pieces of test equipment available to amateur radio operators is the RF noise bridge. It can help optimise your antenna installation

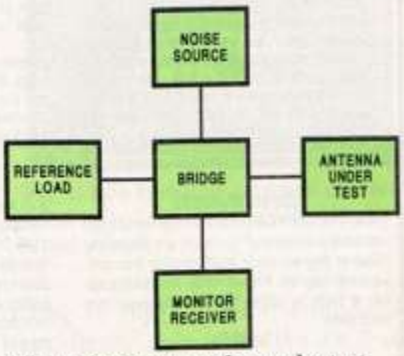

Fig.1: this diagram shows the test set-up involving a noise bridge. It allows you to check the resonance of an antenna.

This ingenious device, when used with a monitor receiver, is capable of not only locating the resonant frequency of an antenna but is also capable of determining if an existing antenna is the correct length for the frequency at which resonance is desired.

Basically, the bridge consists of a wideband noise generator and an RF impedance bridge. Fig.1 shows the basic test set-up when using a noise bridge. The most commonly used configuration for the noise generator is to use either a zener diode, or reverse biased base-emitter junction of a silicon transistor, under low current conditions. This circuit arrangement generates wideband noise. Commonly used designs modulate the noise with a square wave generator at a 50% duty cycle and a frequency of 1kHz. This has the affect of making a null in the noise generated more noticeable in the monitor receiver.

The modulated noise is then followed by two or three stages of amplification using AC coupling, until a level sufficient to produce an S9 signal on the monitor receiver is achieved. This normally equates to several millivolts of output. Fig.2 shows the complete circuit of a typical noise bridge design, as originally published in the ARRL Handbook. It uses a zener diode as the noise source and the 555 time generates the modulating square wave.

The bridge part of the circuit consists of a trifilar wound transformer, a potentiometer, variable capacitor, and a fixed value capacitor, arranged as a Wheatstone bridge. One winding of the transformer is used to couple noise into the bridge, while the remaining two windings are arranged so that they each form one arm of the bridge circuit. The potentiometer and variable capacitor form the third leg of the bridge, in effect the resistance and reactance tuning controls. The antenna under measurement and a fixed capacitor (selected according to the frequency bands of operation) form the fourth, "unknown" leg of the bridge.

The entire arrangement is normally

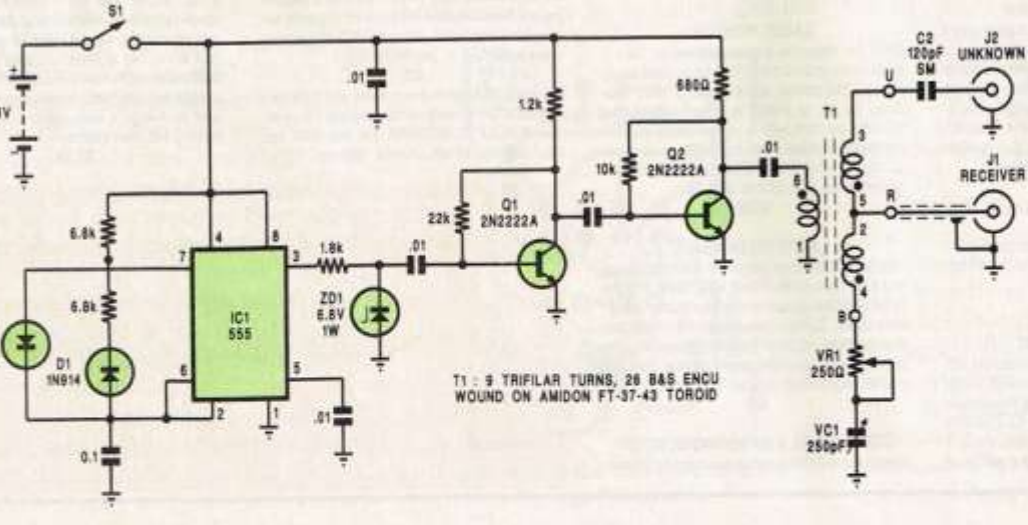

Fig.2: the circuit uses a zener diode as the noise source & a 555 timer to generate the modulating square wave. The bridge part of the circuit consists of a trifilar wound transformer, a potentiometer, a variable capacitor, & a fixed value capacitor.

built into a metal box, having two coax connection sockets on the rear panel, one for the monitor receiver, the other for the antenna under test. The two reactance controls are mounted on the front panel. The circuit is easily powered by a 9V battery and as the current drain is only around 20mA or so, battery life is quite reasonable, considering the intermittent use of such a device.

The two front panel controls are "resistance" and "reactance". The resistance control has a range of 0 to 250Ω in most designs, whilst the "reactance" range runs from -j150Ω (capacitive reactance) to +j150Ω (inductive reactance).

Tuning an antenna

To tune an antenna, the operator connects the antenna of unknown resonant frequency to the "unknown" socket, and the monitor receiver to the "receiver" socket through any length of coaxial cable. The monitor receiver is then tuned to the frequency at which antenna resonance is desired.

By adjusting both controls for minimum signal in the monitor receiver, it can be determined from the position of the reactance control on the front panel of the noise bridge if the antenna requires inductive or capacitive reactance to tune it to resonance.

If the reactance control tunes to the "X_L" side of the scale, the antenna is too long. If the reactance control indicates "X_C", the antenna is too short to resonate at the nominated frequency. The "R" control indicates the feedpoint resistance.

Since it gives this detailed information, the RF noise bridge is a more versatile device than an SWR meter for checking antennas. An SWR meter can show a ratio of 2:1 but an RF noise bridge can tell the amateur operator that the impedance causing the SWR is 25Ω or 100Ω. The SWR meter cannot tell if an antenna is above or below resonance, but the noise bridge can be used to determine this parameter.

So this is the basic theory and operation of an RF noise bridge. But where can this magic device be purchased?

Fortunately, we have a manufacturer right in our own backyard. Local company Emona Electronics Pty Ltd, based in Sydney, produce a unit capable of operation on the HF bands from 10m to 160m, the ENB-2 noise bridge.

Although the Emtron ENB-1 noise bridge is a simple instrument, it can be a great help in tuning & measuring antennas.

The unit is housed in a sturdy box with an aluminium base and a steel lid finished in hammertone enamel. Both resistance and reactance controls are located symmetrically on the front panel, whilst SO-239 coax sockets are used for the "unknown" and "receiver" connections. The unit is powered by an internal 9 volt battery, the ON/OFF switch function being provided by the switched "resistance" control.

Unlike designs seen in amateur magazines, this unit does not modulate the zener noise source, and has an additional "expand" pushbutton control. This function gives greater resolution in the lower HF band. The unit is accompanied by a 12-page booklet, which explains the versatility of the unit. Apart from instructions on how to tune a random length antenna, the booklet also covers detailed theory behind measuring quarter wavlength feedlines (useful when making stub filters), measuring unknown inductors and capacitors, checking trap dipole antennas, testing a balun, correctly setting the controls of an antenna tuner without RF excitation, and checking Yagi antennas.

In order to check the ease of operation of the bridge, we connected it to our lab monitor receiver, a Yaesu FRG-7700. The "unknown" terminal was connected to a halfwave dipole, originally designed for listening to the 8.8MHz HF aviation frequency as used by international aircraft inbound to Australia from the USA.

When this was measured, the bridge produced a null in the monitor receiver at 7.8MHz, and the reactance control showed inductive reactance at 8.8MHz, indicating that the antenna was too long for the original desired frequency. No doubt if I had climbed up on the roof and trimmed the antenna, better results could then have been obtained at 8.8MHz.

The whole point of the exercise was to demonstrate the ability of the noise bridge to do in practice what was claimed in theory.

Apart from the somewhat unique mounting arrangement for the internal battery (glued to the chassis!), the ENB-2 noise bridge is well made and performed exactly as claimed. The mathematical information supplied with the unit, explaining some of the more complex operations of the unit, indicate that the designer has firm ideas about the needs of the market, and as such he has gone to extreme pains to explain all possible applications in detail.

Considering that the price of the bridge is only $129 including sales tax, it is no wonder the unit enjoys strong popularity amongst HF operators.

Emona Electronics has a range of equipment for the amateur including the matching ETP-1 receiver antenna tuner and amplifier. It sells for $179 including tax. You can see the full range at Emona Electronics Pty Ltd, 94 Wentworth Ave, Haymarket, NSW 2000. Phone (02) 211 0988. **SC**