

### RESISTOR $\Omega$ REFRESHER

Multiply both digits of first 2 bands by 3rd Band:

black	0	0	X 1
brown	1	1	X 10
red	2	2	X 100
orange	3	3	X 1000
yellow	4	4	X 10,000
green	5	5	X 100,000
blue	6	6	X 1,000,000
violet	7	7	
gray	8	8	
white	9	9	
gold	--	--	X 0.1

✓ Examples ...

red-red-gold = 2.2  $\Omega$   
red-red-black = 22  $\Omega$   
red-red-brown = 220  $\Omega$   
red-red-red = 2200  $\Omega$  (2.2K)  
red-red-orange = 22K  
4th Band = mfr's tolerance.  
Gold = 5% Silver = 10%

### Some Ham Band Highlights

✓ WARC Bands  
10.100 - 10.150  
18.068 - 18.168  
24.890 - 24.990

✓ National Calling Frequencies (Simplex):

29.600 FM  
50.110 SSB DX  
50.200 USA SSB  
51.700 Packet  
52.525 FM  
144.20 SSB  
146.52 FM  
222.10 CW-SSB  
223.50 FM  
432.10 CW  
446.00 FM

✓ Easy QRP CW  
7.040  
10.106  
14.060

✓ Easy Space to Earth  
29.357 RS-10 Series  
Satellite CW beacon  
145.55 FM SAREX & MIR  
space-earth downlinks

### MAKE your Antennas!

1/4 Wavelength (in FEET)  
=  $234 \div \text{FREQ in MHz}$   
\*use 238 for radials  
\* FOR VHF, you can use 2808  
to get 1/4  $\lambda$  in INCHES !!!

### MOLDED $\mu\text{H}$ INDUCTORS

look very much like resistors, but don't "resist" much - just check them out on your meter to read less than 1-2  $\Omega$ , much lower than resistors in your kit. Values are in  $\mu\text{H}$  (microhenries), to 1000  $\mu\text{H}$  per resistor code, with 3rd silver band = X .01.

✓ Examples:

red-red-silver (22X.01) = 0.22  $\mu\text{H}$   
red-red-gold (X 0.1) = 2.2  $\mu\text{H}$   
red-red-black (X 1) = 22  $\mu\text{H}$   
red-red-brown (X 10) = 220  $\mu\text{H}$   
brown-black-red = 1000  $\mu\text{H}$

### ALL ABOUT THOSE Disc Cap Numbers!

101 = 100 pF  
102 = .001  $\mu\text{F}$   
103 = .01  $\mu\text{F}$   
104 = .1  $\mu\text{F}$

✓ Want more?

221 = 220 pF  
222 = .0022  $\mu\text{F}$   
223 = .022  $\mu\text{F}$   
331 = 330 pF  
332 = .0033  $\mu\text{F}$   
471 = 470 pF  
472 = .0047  $\mu\text{F}$   
473 = .047  $\mu\text{F}$   
474 = ?  
Got the idea ?!?

### FOR SURE!

We ALL know this ...

$E \text{ volts} = I \text{ amps} \times R \text{ ohms}$

$R = E / I$

$I = E / R$

$P \text{ watts} = E \times I$

### They used to make BULLETS

by dropping melted lead way down into cold water. That's how some folks make excellent cold solder joints ... by melting solder with the iron so it blobs onto the board, looking like deformed buckshot.

PLEASE ...

heat the connection itself so IT does all the melting, forming a shiny cone, not a dirty blob!

### A Super SOLDER BRIDGE

is built with that extra solder clinging to the iron's tip that we didn't need anyway. Just jiggle the soldering iron, and we can build nifty bridges across 2, 3, 4 or more PC-board soldering points, especially DIP IC's or sockets. Don't try it: you'll hate it!

74303

## No. 1051 T-KIT Module Board

### TRANSMATCH TUNING BRIDGE

with Modulated Broadband Noise Pulses and Self-Test Provision.

For 1.8 to 50 MHz. Useful to 150 MHz.

# TOKIT

by TEN-TEC

## INSTRUCTION MANUAL

**TOKIT**, A Division of TEN-TEC, Inc.

1185 Dolly Parton Parkway • Sevierville, TN 37862-3710

Information • 1-865-453-7172

Fax • 1-865-428-4483

Orders • 1-800-833-7373 (credit card orders only)

**America's Best!**

**T-KIT Model 1051 Tuning Bridge  
APPLICATION NOTES**

## **T-KIT Limited WARRANTY**

*Please read carefully BEFORE building your kit.*

This Limited Warranty applies solely to KITS sold by TEN-TEC, Inc. under the trade name "T-KIT." The terms of this Warranty do not apply to other products of any kind manufactured by TEN-TEC, Inc., nor shall any other warranties published by TEN-TEC, Inc., or any TEN-TEC customer service policies for its manufactured products, be construed as applicable to T-KIT products.

1. All components and hardware supplied as parts of a kit are warranted to be free from manufacturing defect for one year from date of purchase.
2. The original purchaser has the option of examining the kit and manual for 30 days. If you choose within this period not to construct the kit, you may return the entire unassembled kit at your own expense for full credit toward any other TEN-TEC product, or a refund, less original shipping/handling charges.
3. This warranty is voided if acid-core solder is used in construction. **USE ROSIN-CORE SOLDER ONLY**, of a grade designed for electronic PC-board assembly. **WARNING: solder contain LEAD, which is known to cause birth defects or other reproductive harm. Avoid breathing solder fumes, which may cause pulmonary irritation or damage. After handling any solder, wash hands with soap and water before eating.**
4. TEN-TEC, Inc. warrants this device to function as described in its documentation provided that it is assembled and used correctly in accord with all printed directions. It is your responsibility to follow all directions in the instruction manual, to identify components correctly and to use good workmanship and proper tools in constructing this kit.
5. We do not accept the return of partially-assembled kits for repair or refund.
6. If you believe a kit part is missing, do a thorough sorting of all parts, checking each off on the parts list in the manual. Check all bags, envelopes or boxes carefully. Simply call, fax, or write, and we will promptly replace any missing part. Even if you find an exact replacement parts locally, please notify us so we may assist other customers.
7. If your kit does not work after final assembly, please follow these three steps in order:
  - A. Double-check EVERY step in the assembly manual and any troubleshooting tips provided.
  - B. Ask an experienced ham or hobbyist friend review to your work. A fresh set of eyes can catch a detail which you may have overlooked.
  - C. If necessary, you are welcome to ask for T-KIT Technical Assistance at 453-7172. (Technical Assistance for T-KITS is available ONLY through THIS number.)
8. **Factory Inspection or Service.** If you wish to return a kit for professional inspection or repair, there is a minimum charge of \$20.00, payable by cash, check, money order or credit card charge authorization. There is no need to call or write for authorization; simply send your kit with a note explaining the problem, and provide authorization to make repairs at prevailing hourly shop rates. To minimize extra cost to you we reserve the right simply to send you replacement parts with notes on how to solve your problem. If we find that a part was defective in manufacture, there will be NO CHARGE to repair your kit unit. Our technicians will make the determination whether a part was defective in manufacture or was damaged during installation.
9. TEN-TEC, Inc. reserves the right to revise this Limited Warranty, to change or discontinue any kit product or revise its instruction manual with no liability to previous purchasers. However, if you complete the Kit Registration form supplied with all kits, you will receive periodic technical news from us, including tips, special offers on upgrades. Individual kit manuals may contain Warranty extensions or limitations for that specific kit product.
10. TEN-TEC, Inc., is not liable for any consequences from use or abuse of any T-KIT or part contained therein.

**T-KITS BY TEN-TEC**

A division of TEN-TEC, Inc. • 1185 Dolly Parton Parkway • Sevierville, Tennessee 37862



## T-KIT TECHNICAL UPDATE

TEN-TEC is no longer using 2N-6514 Transistors (TT-25054). We are now using 2N-4124 (TT-25258). Please make appropriate notes in the manual.

Thanks for your confidence in T-KIT by TEN-TEC

Part No. 74334

T-KIT Manual No. 7430  
Price: \$5.00

## Kit Assembly and Instruction Manual for T-KIT Model No. 1051

# Tuning Bridge

### Table of Contents

Introduction .....	4
Circuit Description .....	5
Schematic Diagram .....	6
Kit Parts List .....	7
Circuit Board X-Ray View .....	8
Construction Steps .....	9-11
The Noise Pulses: What to Expect to Hear .....	11
First Tests and Adjustments .....	12-14
How to Use the Tuning Bridge .....	15-17
Building Your Own "R-X" Noise Bridge .....	18-19
Troubleshooting Guide .....	20
Conclusion .....	21
T-KIT Limited Warranty .....	<i>inside back cover</i>

**IMPORTANT: Please read Warranty Terms  
BEFORE starting kit assembly.**

... a quality electronics kit project from  
**T-KIT**

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## Introduction

The T-KIT 1051 Transmatch Tuning Bridge is a streamlined, easy-to-use "R-X Noise Bridge" specifically designed to permit adjustment of antenna tuners without applying transmit power. This capability lets you experiment all you wish with various antennas, bands, and tuner adjustments, with no risk to the transmitter, no on-the-air QRM, and no TVI or RFI.

There is considerable literature on the use of *adjustable* noise bridges for measuring and pruning antennas and feedlines. Several such noise bridges are available for \$60 to \$90, and ARRL antenna handbooks regularly include a standard circuit for constructing and calibrating your own. The procedure is likely to appear complicated and formula-intense to many hams.

The 1051 Tuning Bridge differs from these instruments *only* in its single-minded application: its purpose is to give you an **easy** yes/no indication as to how well your antenna tuner can match a particular antenna to your transceiver's typical 50-ohm requirements on a particular band. However, the basic 1051 Module Board also may be adapted easily to be the foundation for a commercial-quality R-X noise bridge, using your own linear potentiometer, variable capacitor and calibration.

In this booklet, the terms antenna tuner, antenna coupler, antenna matcher and transmatch are used synonymously.

## About the Circuit Design

Your economical 1051 Tuning Bridge actually includes several practical features not always found in costlier units:

- pulsing noise signal rather than steady hiss
- internal adjustment for most useful noise level
- Modulation of noise signal for AM-mode
- improved, preassembled trifilar bridge transformer
- built-in self-testing of bridge circuit
- a clear and easy noise bridge user's manual!

The "bridge" itself consists of balun transformer T1 plus a network consisting of R12 (normally set to 50 ohms), the 50-ohm input of your transceiver, plus ONE variable element: the combination of your antenna tuner and antenna. (In a variable noise bridge instrument, R12 would be a front panel control in series with a variable capacitor, and there would be a fixed-value capacitor in series with the antenna tuner.)

## Circuit Description

U1 is a 556 dual timer (two in one 14 pin DIP package). The first half generates pulses while the second half produces a steady square wave at about 700 Hz. The pulses from pin 5 blink the LED through current-limiting resistor R7 and are applied to the base of Q1 through R4. Q1 serves as a switch which applies the 700 Hz audio to zener diode D1, which works as the broadband noise generator. The modulated noise pulses are fed to the base of Q2 through C6. Q2 and Q3 form a high gain broadband amplifier in a maximized collector feedback configuration, boosting the D3 noise pulses by about 40 dB at C8/T1 up through 30 MHz. It is normal for Q3 and R11 to run quite warm in this high-gain circuit.

"Leg 1" of the bridge is formed by R12, normally set to 50 ohms. Leg 2 of the bridge is formed by your antenna tuner and antenna, OR by the R13/SW1 test circuit.

When Leg 1 and Leg 2 are NOT equal, very loud pulses are heard in the receiver/transceiver. When the two legs of the bridge are made equal (by adjusting the antenna tuner), the noise pulses are nulled almost to the point of being inaudible.

R13 with SW1 forms a simple self-test circuit, permitting easy demonstrations to yourself or others of what kind of null of the noise pulses is possible with "perfect" resistance balance.

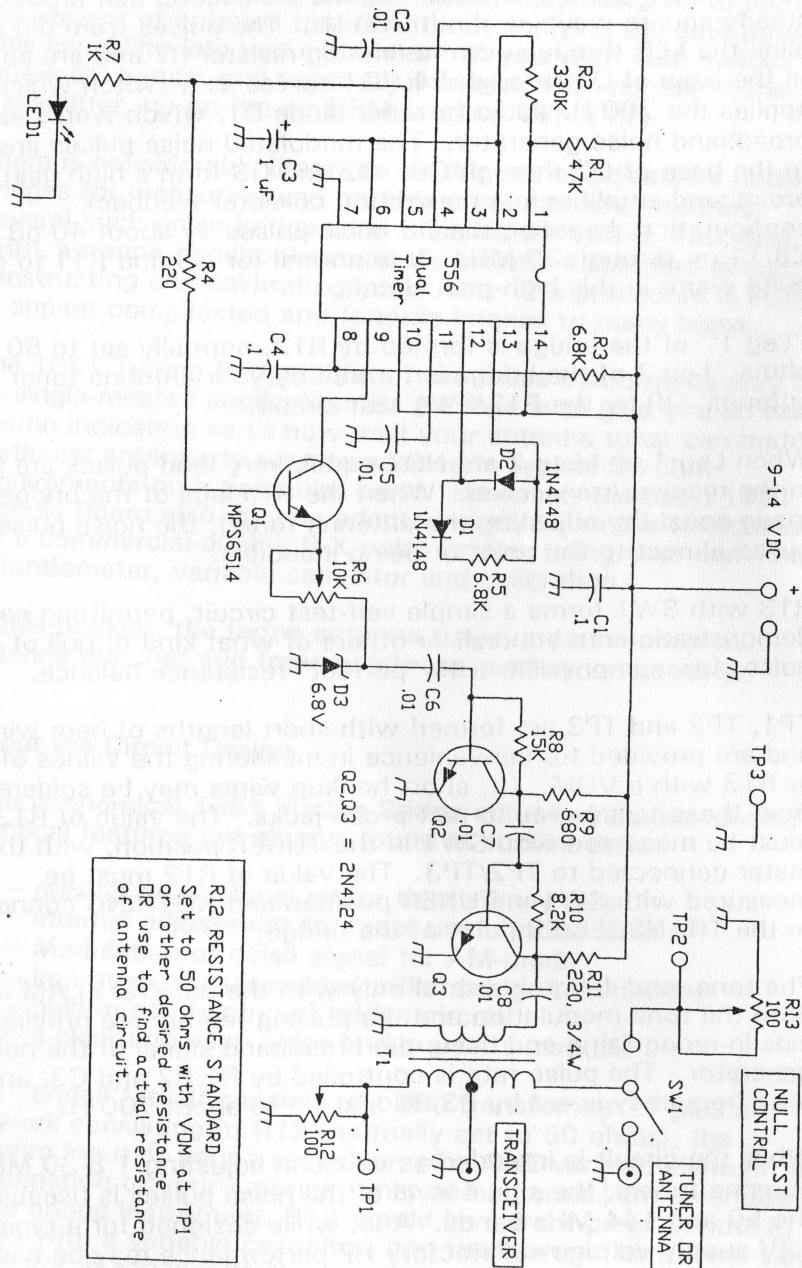
TP1, TP2 and TP3 are formed with short lengths of bare wire and are provided for convenience in measuring the values of R12 or R13 with a VOM. Or, short hookup wires may be soldered from these test points to test probe jacks. The value of R13 must be measured with SW1 in the TUNER position, with the meter connected to TP2/TP3. The value of R12 must be measured with SW1 in TUNER position and NOTHING connected to the TRANSCEIVER point of the bridge.

The tone modulation is useful only with the receiver in AM mode. Both the tone modulation and the pulsing feature are provided as aids in recognizing and using the broadband signal of the noise generator. The pulse rate is controlled by R1, R2 and C3, and the tone frequency is set by R3, R5 and C5 to about 700 Hz.

While the circuit is intended as an aid in adjusting 1.8-30 MHz antenna tuners, the signal level of the noise pulses is useable in the 50 and 144 MHz bands. And, while designed for a typical 12V supply voltage satisfactory HF performance may be had with a 9V battery.



T-KIT Model No. 1051 Schematic:



# T-KIT 1051 Tuning Bridge KIT PARTS LIST

Please check and organize all parts before starting construction.  
See T-KIT Warranty if you suspect any parts are missing.

Quantity	Description and Value	Schematic	Part No.
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### Fixed Resistors

The 3 color bands denote resistance value. The 4th band (gold) denotes 5% tolerance.

1	220 ohm (red-red-brown)	R4	30130
1	220 ohm, 3/4-watt (red-red-brown)	R11	30005
1	680 ohm (blue-grey-brown)	R9	30136
1	1K (brown-black-red)	R7	30138
2	6.8K (blue-gray-red)	R3,R5	30148
1	8.2K (gray-red-red)	R10	30149
1	15K (brown-green-orange)	R8	30076
1	47K (yellow-violet-orange)	R1	30157
1	330K (orange-orange-yellow)	R2	30167

### Fixed Capacitors

5	.01 uF disc capacitor (marked 103)	C2,5,6,7,8	23260
2	.1 uF (marked 104)	C1,C4	23261
1	1 uF electrolytic capacitor	C3	23264

### Inductor

1	Trifilar (3 windings) balun transformer	T1	21153
---	---	----	-------

### Semiconductor Devices: Transistor, IC, Diodes

3	2N4124 NPN transistor	Q1, Q2, Q3	25258
1	NE556N 14-pin DIP IC	U1	25217
2	1N4148 silicon diode	D1, D2	28001
1	6.8V zener diode	D3	28006
1	LED	LED1	28066

### Other Components, Hardware:

1	Circuit Board for Model 1051		78234
2	100 ohm PC-mount trimmer	R12,R13	30856
1	10K PC-mount trimmer	R6	30857
1	SPDT PC-mount slide switch	SW1	32099
1	RG174 mini-coax (1.0 ft)		46025
1	Model 1051 Instruction Manual		74303

### REQUIRED, NOT SUPPLIED:

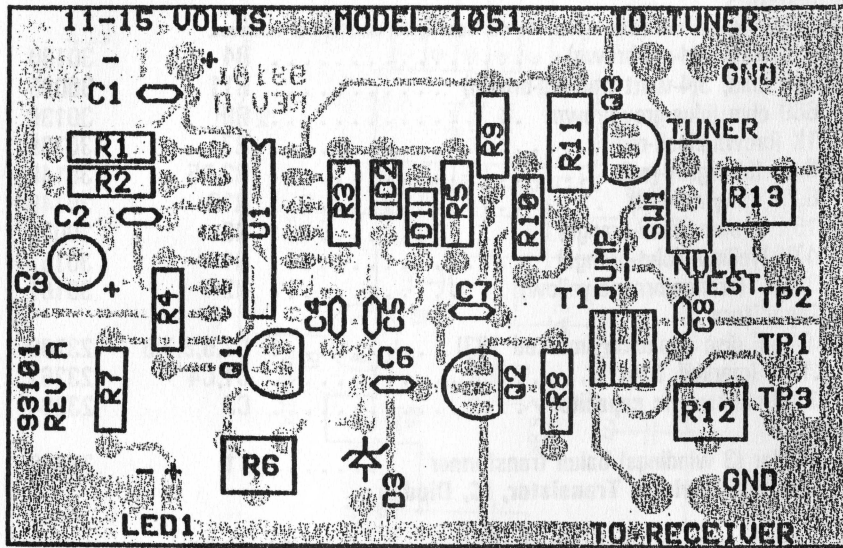
- Battery or regulated, well-filtered 9-15 Volts DC
- 50-ohm coax jumpers to transceiver and antenna tuner

### MINIMUM TOOLS AND TEST EQUIPMENT:

- 15 to 35 watt soldering iron
- diagonal cutters or wire "nippers"
- needle-nose pliers
- adjustable wire stripping tool
- Mini screwdriver for trimmer potentiometers

## T-KIT Model 1051 Tuning Bridge X-RAY View of Circuit Board

NOTE: Your T-KIT circuit board is quality glass epoxy, etched, cleaned and screen-printed in the TEN-TEC plant to the high standards required by our transceiver assembly lines and modernized wave-soldering system.



### Installing Parts on the Circuit Board:

When we say "INSTALL" a part, we mean:

- Choose correct part value
- Insert in correct PC Board location
- Insert *correctly*, if there is a right way and wrong way such as for diodes, IC's, electrolytic capacitors, transistors etc.
- Solder all wires or pins
- Trim or "nip" excess wire lengths

#### USE ROSIN-CORE SOLDER ONLY,

of a type intended for electronic PC-board assembly.

(Available at electronics distributors or Radio Shack stores.)

DO NOT use hardware store solder, paste or flux.

Solder contains LEAD: wash hands before eating!

## Step-by-Step Circuit Board Assembly

While the parts may be soldered in any order convenient to you, the following steps provide many helpful details. Be sure to double-check your work after soldering, using the second set of check blocks.

- 1. Install U1, the 556 dual timer, being sure to align its notched end as outlined on the board. Solder the 14 pins carefully with a clean iron tip, taking care not to form solder bridges. If you provide your own IC socket, use the same care in installing the socket and inserting U1 as in soldering U1 directly.
- 2. Install electrolytic capacitor C3, 1  $\mu$ F, being sure to align its positive side as outlined on the board. The negative side of the capacitor is clearly marked by the dark band.
- 3. Install transistor Q1, NPN type MPS6514, aligning its flat side as outlined on the board.

Install the following, being sure to select correct values:

- 4. Resistor R1, 47K (yellow-violet-orange).
- 5. Resistor R2, 330K (orange-orange-yellow).
- 6. Resistor R7, 1K (brown-black-red).
- 7. Resistor R4, 220 ohms (red-red-brown), 1/4 watt. Don't confuse R4 with R11, slightly larger in size, 3/4 watt.
- 8. Resistor R3, 6.8K (blue-gray-red).
- 9. Resistor R5, also 6.8K.
- 10. Capacitor C2 .01  $\mu$ F (marked 103).
- 11. Capacitor C5 also .01  $\mu$ F.
- 12. Capacitor C4, 1  $\mu$ F (marked 104).
- 13. Capacitor C1 also .1  $\mu$ F.
- 14. Install diode D1, type 1N4148, with its banded cathode end aligned as outlined on the board. D1 and D2 are the diodes identical in style, different from zener diode D3.
- 15. Install diode D2, also type 1N4148, per Step 14.
- 16. Install trimmer potentiometer R6, 10K, being sure not to mix it up with trimmers R12 and R13.
- 17. Install LED1, noting that the anode (+) side has the longer of the two leads. Allow as much lead length above the board as needed for your planned installation, or use insulated hookup wire to extend the LED's position as desired.



- 18. Install zener diode D3 with its banded cathode end aligned per the band outlined on the board.

**PROGRESS NOTE:** At this point, all parts associated with the 556 dual timer are in place, with the board capable of producing a 700 Hz tone pulse and blinking LED. If you are curious to try this part out at this point, connect 9-15 VDC to the (+) and (-) pads marked near C1, and connect speaker or headphones between the cathode of D3 and ground.

Install the following, being sure to select correct values:

- 19. Capacitor C6, .01  $\mu$ F (marked 103).
- 20. Capacitor C7, also .01  $\mu$ F.
- 21. Capacitor C8, also .01  $\mu$ F.
- 22. Resistor R8, 15K (brown-green-orange).
- 23. Resistor R9, 680 ohms (blue-gray-brown).
- 24. Resistor R10, 8.2K (gray-red-red).
- 25. Resistor R11, 220 ohms, 3/4-watt (red-red-brown).
  
- 26. Install transistor Q2, type 2N4124, being sure to orient its flat side as outlined on the board.
  
- 27. Install transistor Q3 per step 26.
  
- 28a. Examine the construction of the trifilar balun transformer. It can be inserted two possible ways, but there is only ONE correct way! Notice that the wire colors are amber, green and reddish brown, and that both amber wires are looped on the outside of one end of the plastic base to their pins. This end with the two amber wires must face C8, already installed.
  
- 28b. Install transformer T1 per 28a, soldering carefully to avoid solder bridges across the pins.
  
- 30. Install trimmer R12, 100 ohms.
- 31. Install trimmer R13, also 100 ohms.
  
- 32. Install SPDT switch SW1 (or use the shortest hookup wires possible to install your own panel-mount SPDT switch).
  
- 33. NOTE ON TP1, TP2, TP3: The purpose of these three test points is to make it easy to measure the settings of R12 and R13 with an ohmmeter. Simply solder 1/2" pieces of bare wire cut from resistors to each of the three pads. If you plan to wire in test jacks to these points, keep the wires extremely short.

- 34. Install TP1, TP2 and TP3 per Step 33.
  
- 35. Use a piece of bare wire from a previously-installed part to install the jumper wire required at JUMP near T1.
  
- 36. Cut the RG-174 coax into two 6" lengths (or to lengths best suited for the installation you are planning).
  
- 37. Carefully strip about 1/2" of outer insulation from all four ends of the two coax pieces.
  
- 38. Gently unravel the braided shield and twist to form a stranded conductor. Do this for all four cable ends.
  
- 39. Strip about 1/8" of inner insulation from the main coax conductor, being careful not to nick the wires. Do this for all four cable ends.
  
- 40. Solder the center conductor of one coax line to "TO TUNER" and solder its shield to the nearby GND pad. Tinning the braid on the top side of the board will add strength.
  
- 41. Per step 39, install the other coax line to "TO RECEIVER" and its GND pad.
  
- 42. Both coax lines are ready to be soldered to the connectors or switch of your choice.
  
- 43. Install red (+) and black (-) hookup wires at the power input pads near C1. The style and location of DC on-off switching is up to you.
  
- 44. DOUBLE-CHECK all preceding steps before going further.

## The Noise Pulses: What To Expect to Hear

The broadband noise fed to the receiver actually has two components: the noise pulses and the steady noise produced by the high gain of the Q2-Q3 amplifier circuit. If your receiver RF gain is set to maximum (for example, to provide accurate S-meter readings), there will be only 2-3 "S" units difference between the steady noise and the pulses. While meter readings can be interesting (and also essential for hearing-impaired folks), you need use only enough receiver gain to let you hear the noise pulses distinctly.

Keep in mind that the tone modulation of the noise pulses is audible only in AM mode, and that you will hear only noise in CW or SSB mode. The tone modulation can be heard in some but not all types of FM receivers. The tone modulation is simply a tuning aid which some users find helpful, and it is NOT at all essential to using the noise bridge. Similarly, the pulsing feature is a tuning aid only. A perfectly useful noise generator can consist of the steady "hiss" only.

When listening in AM mode (with the bridge unbalanced), you hear the pulsing hisses loudest, with the tone modulation in the background. As the noise pulses are tuned to their lowest level, forming a balanced resistance bridge, there comes a sharp point at which the noise pulses become tone pulses, suggesting perfect balance of the bridge.

**NOTE:** On 160 and 80 meters, and to a lesser extent on 40 meters, in SSB-CW modes only, the noise you hear will include weak, chirpy harmonics and overtones from the 556 tone oscillator. This is simply a phenomenon, not a problem, and these oscillations are inaudible in AM mode.

## First Tests and Adjustments

The full usefulness of the 1051 is tested effectively only by making a complete and proper installation using 50-ohm coax, an antenna transmatch, antenna, and the transceiver (in receive mode only). However, the basic operation of the bridge can be self-tested simply by connecting a receiver and adjusting the trimmer potentiometers.

### Procedure:

1. Connect an ohmmeter to TP1 and TP3 (ground).
2. Adjust trimmer R12 to indicate 50 ohms (or some other value of your choice between 30 and 90 ohms.) This adjustment **MUST** be made with nothing else connected to the Transceiver or Tuner inputs and with the switch in TUNER position.
3. Connect receiver or transceiver with 50 ohm coax.
4. Set SW1 to NULL TEST position.
5. Tune the receiver to the 10 meter band, or the highest band of interest to you. (The noise pulses become progressively stronger on the lower bands.)

6. Turn trimmer R6 to its approximate middle position.

7. Connect 12VDC to the 1051 board. You should observe the LED blinking and also hear noise pulses. (Remember that the modulated tone is heard only in AM or FM modes.)

8. Slowly adjust R6 both ways for a distinct peak in the noise pulses.

9. Adjust the receiver RF gain and volume controls so that the noise pulses are distinctly "S9" to your ear.

10. Turn NULL TEST trimmer R13 to one extreme or the other, then slowly turn it for a sharp drop in noise pulse level. At the point of the deepest null, the value of R13 is equal to that of R12, forming a balanced bridge.

11. The value of R13 can be checked with an ohmmeter connected to TP2 and TP3 (with the switch at the TUNER position.)

### Installation Guidelines

Your Tuning Bridge can be put to work in several different ways:

- 1) Connected to Antenna Tuner only when needed.
- 2) Permanently installed outside of Tuner.
- 3) Installed inside Tuner

Using Option 1 simply involves manual connections of the Tuning Bridge between your transceiver and antenna tuner, using standard coaxial jumper cables. The only switch required is the SPST on-off switch to turn the Tuning Bridge on and off.

For Options 2 and 3, **efficient switching** is the key to convenient use of the Tuning Bridge -- and to avoiding accidental damage caused by applying transmit RF to the bridge circuit. An ideal switch would provide three separate poles and two positions (3PDT). Two of the poles switch the Tuning Bridge in and out of the transceiver-tuner line, while the third pole performs the on-off function. However, you may find it more economical to use a husky DPDT switch or relay for the RF switching and a smaller SPST to control DC on-off.

For the most reliable performance, the 1051 board must be shielded within a metal enclosure, whether in its own instrument case or inside an antenna tuner. If the noise bridge circuitry is