THE WEST RAND AMATEUR RADIO CLUB

January 2002
Volume 2, Issue 7

ANODE

Inside this issue:

Special points of interest:

- Contact details on back page

Editor's Comments

Well it's the Saturday before the meeting, again! I have a slumbering black cat on the desk next to me and its 27C in the shack. I really should have done the Anode before this but just like last year its been hectic this last week.

We do have plenty of technical articles this issue. The Tennamatic shows you just how easy it is to automate the antenna tuner on hf.

There is a contest going on as I type this and I hope I can get down to the clubhouse to make coffee etc.

I was just considering re-scanning the diagrams for the Tennamatic article. This is because the file size of the Anode has already gone over 4MBytes. The pictures in the article make the file quite large and even when 'zipped' too big to email. This is an ever growing problem. Isp's don't provide much in the way of storage for emails and quite often reject attachments that take the client over his quota. Several of the hams on the Anode distribution list have run across this problem. I usually get a notification from the Isp saying that the mailbox is full. (Tom please note!)

The other great article is from RF Design. A Crystal Controlled Fre-

(Continued on page 3)

The Tennamatic

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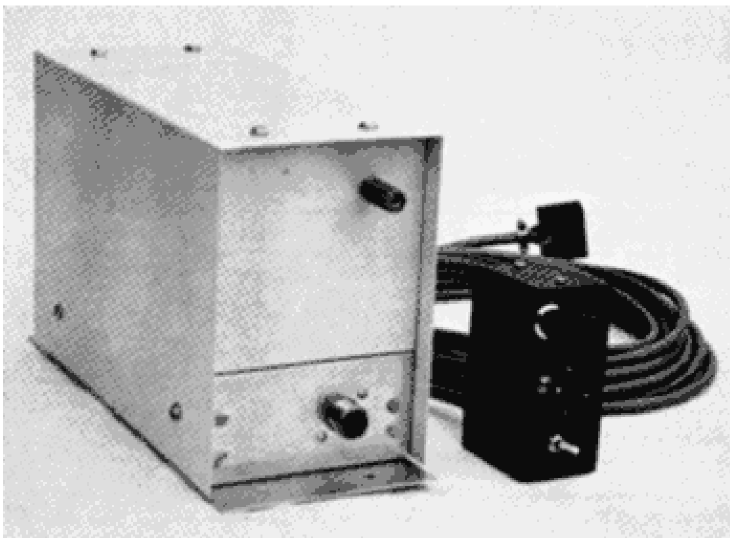


Would you like to operate your mobile station over the entire 40 and 75 meter phone bands with a v.s.w.r not exceeding 1.15 to 1? With a Tennamatic, you can convert a high-Q narrow-bandwidth mobile antenna into a wide-bandwidth system. This means that you can use transceivers having solid-state finals and obtain full output power on any frequency in the 40 or 75 meter phone bands without any manual tuning operations. All you have to do is select frequency, start talking, and the Tennamatic will tune your mobile antenna system to resonance automatically, ensuring maximum field strength. Of

(Continued on page 2)

The Tennamatic

(Continued from page 1)

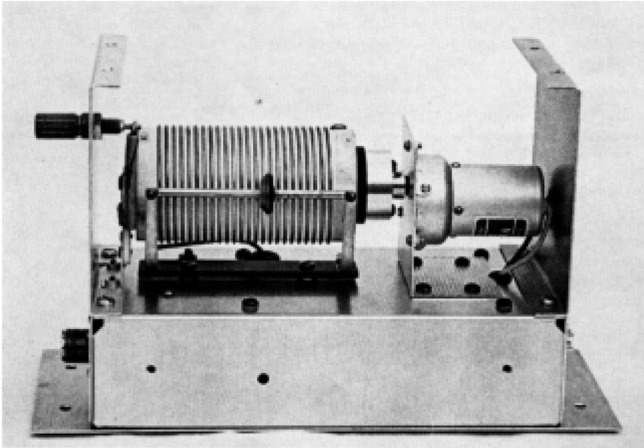
course, if-your transceiver has tubes in the final, you will still have to retune it when you QSY.

Specifications for the Tennamatic are listed in Table 1.

History

About two years ago, I met Don Johnson W6AAQ, and I adopted his---bigDC mobile antenna system. He subsequently described it in his October, 1976, 73 Magazine article entitled "Build a Weird 2 Band Mobile Antenna.---His antenna neatly solved the problem of needing to change antenna loading coils when band-hopping between 40 and 75 meters. It also proved to be an exceptionally efficient radiator compared to the commercials, but it was still limited to only a few kHz of usable bandwidth on each band, and I wanted full band coverage.

To obtain full band coverage, I added a motor driven roller inductor at the base of the antenna and a control switch at the driver's seat, allowing me to QSY the antenna resonant frequency. This worked beautifully for about six months until I ran off a freeway one day while watching a field strength meter as I was peaking the antenna. Luckily, no damage was done, but the experience convinced me that for safety's sake I had to get out of the loop. This conclusion required me to design a servo system.



Design Requirements

I decided that the tuner would be required to tune automatically over all of the 40 and 75 meter phone bands and use easily obtainable parts. The parts count was to be minimized to keep reliability high, complications associated with limit switches were to be avoided, and the power handling capability had to be at least 350 Watts PEP. It had to be easy to duplicate, present a pleasing appearance, and the control head had to be capable of being mounted on the side of an Atlas and be visually compatible. Last of all, the servo system had to be uniquely simple, have a 3 or 4-kHz dead band so it would not hunt or jitter around in the voice pass band, provide constant motor torque while tuning, and operate reliably over a plus ten-to-

Frequency range:	75m—200 kHz 40m—300 kHz
*Slewing rate:	75m—6 kHz/sec. 40m—40 kHz/sec.
Minimum Δf:	75m—requires 3 kHz QSY to activate tuner 40m—requires 4 kHz QSY to activate tuner
Maximum Δf:	75m—50 kHz (QSY of 200 kHz in four increments of 50 kHz requires less than 30 seconds.) 40m—200 kHz (QSY of 200 kHz requires less than 5 seconds.)
Vswr:	typically 1.15 to 1 or better after tuning completed
Modes:	automatic/manual
Input voltage:	10 to 15 V dc, negative ground
Input current:	420 mA at 13.8 V dc while tuning; 125 mA at 13.8 V dc after tuning completed
Power rating:	350 Watts PEP

*Table 1. Tennamatic specifications. *Full carrier inserted. On SSB, the slewing rate is slightly slower due to speech pauses.*

Editors Comments

(Continued from page 1)
quency and Amplitude Calibrator which is both simple to construct and incredibly useful.

The first meeting of the year was last week; the 'Bring and Fix' or social meeting. (The club members resisted attempts to make it the real meeting) A great deal of ham radio matters were discussed and rf consumed in large quantities.

The 'Anode Compendium CD' is now selling well. It was reorganised and the main html page re-written to correct some minor glitches. The auto-start now works properly thanks to the small program I wrote to start the browser. It only costs R20 and all receipts are going to the club funds. Maybe you would like to ask me for one at the next meeting? That's the 14th of January.

Some time ago I said I would probably put all the Amateur Radio software onto the cd. This has proven to be another can of worms. The amount of available Ham radio software is humungous. So I have backed down on that one. But as a project this is a good contender. I intend sorting out several programs written in variations of BASIC for inclusion in the Anode. These programs will provide the Electronic Toolbox for the Radio Ham.

Most of the programs I have seen and tried fail miserably on the user interface. Most don't explain their function properly nor explain the calculations done inside the program. Most however will translate into QBasic and will run satisfactorily under Windows 9x. Do remember you guys that have Windows 95/98 and ME that you have QBasic and the Dos utilities on the master cd. These can quite quickly be copied to the hard disk for your use later.

A lot of these programs were written in the days of GWbasic when memory and space on disk was minimal. This led the writers to remove unnecessary comments and user prompts. Usually to the detriment of the program's quality.

Quite a few are delightful examples of 'spaghetti code'

(Continued on page 6)

The Tennamatic

(Continued from page 2)
fifteen-volt supply voltage range.

The System

These design requirements led to a system consisting of two units. One unit is a control head and the other is the tuning unit. The tuning unit contains a phase detector and a servo system which drives a permanent-magnet dc gear motor. The motor turns a roller inductor taken from a surplus T21/ARC-5 or T22/ARC-5 command transmitter. The tuning unit also contains a toroidal impedance-matching transformer which ensures a good impedance match between the antenna and coaxial line. The control head has directional indicators, an automatic/manual operation switch, an automatic/manual indicator, a manual slewing switch, and an impedance-match selector switch. The units are shown in the photographs.

The Circuit

The circuit which I designed is depicted in Fig. 1. To understand its operation, it is best to start with an explanation of the servo system and work backwards toward the input. The system that I selected is known as a "bang bang" servo system in aerospace circles. It is either off or on in one direction of rotation or the other and provides full motor torque when on. Fig. 2 is a simplified diagram of the servo. It uses two LM311N voltage comparator integrated circuits connected as a window comparator. The circuit states listed in Fig. 2 simply say that if the input voltage (Vin) is a positive voltage between the upper and lower threshold voltages, the outputs *of both comparators will beat supply voltage. If Vin either exceeds the upper thresh

(Continued on page 4)

The Tennamatic

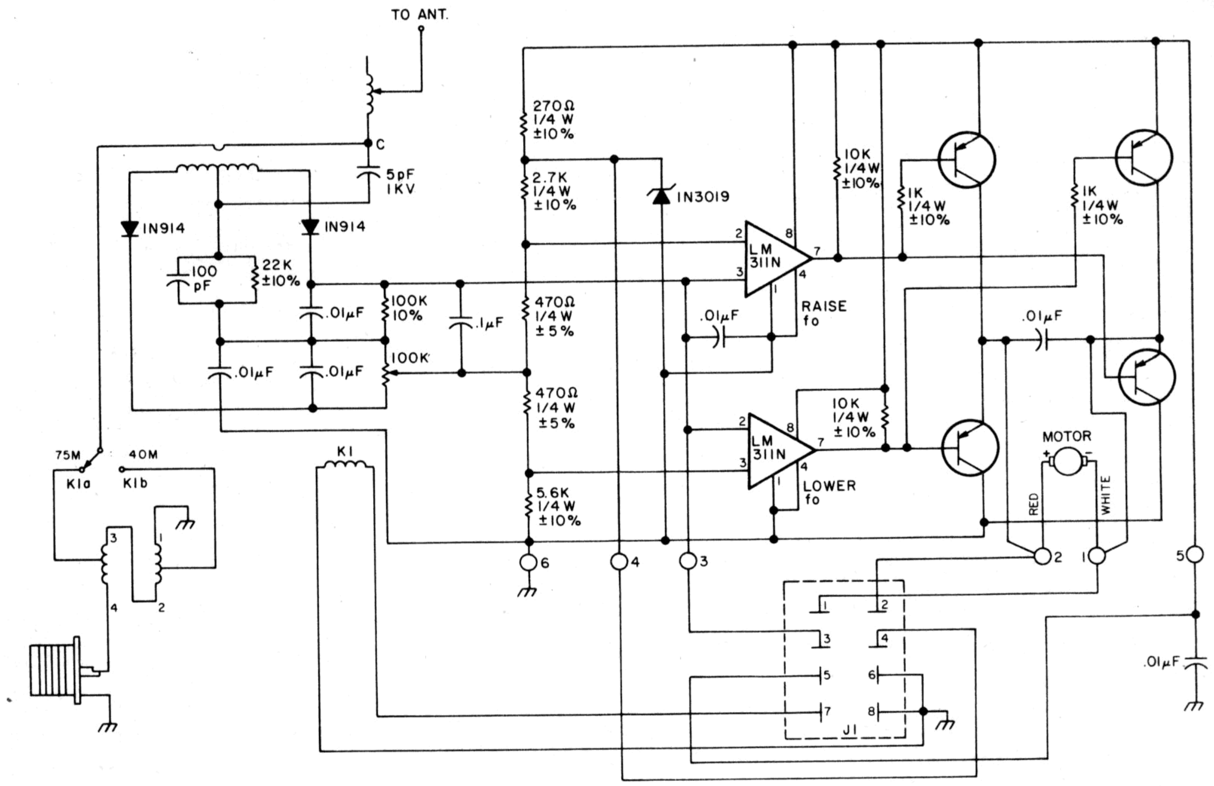


Fig. 1. Tuning unit schematic. The output transistors and motor are discussed in the text. The jack is a male chassis-type Jones plug.

(Continued from page 3)

old. voltage or is less positive than the lower threshold voltage, one or the other comparator's output will be low. The low-state output is about one-half volt positive.

Referring back to Fig. 1, it will be seen that the comparator outputs are connected to diagonally opposite transistors. When a comparator switches on and its output goes low, it turns on the associated transistors, resulting in one side of the motor being clamped to ground while the other side is clamped to the positive supply, turning the motor on. The upper comparator drives the motor in the direction which reduces inductance, raising the antenna system resonant frequency. The lower comparator drives the motor in the opposite direction, increasing inductance and lowering the antenna system resonant frequency.

Fig. 3 shows the input circuit to the voltage comparators. The comparators must operate with their inputs positive with respect to ground, making it necessary to reference the phase detector to a point above ground. This reference point is the junction of the two 470-Ohm resistors. The output of the phase detector is connected to Vin and will be a voltage which will swing positive or negative with respect to the reference point, causing the comparator inputs to swing above Vut or below Vit, depending upon the off frequency condition existing at the time. The voltage divider is zener regulated to hold the switching thresholds constant. The voltage drops across the two 470-Ohm resistors set the width of the dead band to 3 kHz on 75 meters and 4 kHz on 40 meters.

The phase detector compares the phase relationship between the current flowing in the antenna circuit and the voltage from the antenna circuit to ground. When the input frequency is higher than the antenna system resonant frequency, the phase detector produces a dc output voltage across the two 100k load resis-

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The Tennamatic

(Continued from page 4)

tors which is positive with respect to the slider on the trim-

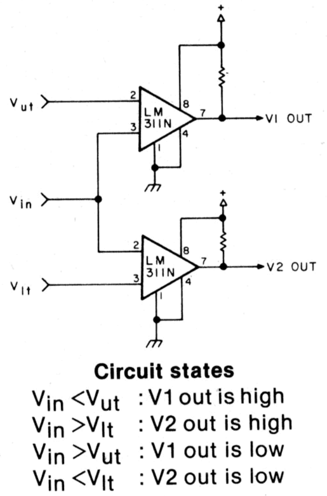


Fig. 2. Window comparator servo simplified diagram.

pot. Conversely, if the input frequency is lower than the antenna system resonant frequency, the output dc voltage is negative.

The trimpot is adjusted in operation to cause the phase detector to find exact resonance. It compensates for the inductive reactance inserted by the toroidal antenna impedance-matching transformer. The reduced output from the low side of the phase detector caused by the trimpot results in need for incremental downward QSY on 75 meters with pauses to allow the servo system to catch up. Even so, a QSY from 4000 kHz to 3800 kHz takes less than 30 seconds.

The impedance-matching transformer is necessary with the DK antenna because of its low input impedance at resonance. The taps are set at the 10-Ohm point for 40 meters and at the 14-Ohm point for 75 meters. These low input impedance values are excellent indicators of the low-loss characteristics and high performance of the antenna. Relay K1, a Potter and Brumfield KT11 D 12 V dc 5-Ampere contact relay, selects the appropriate tap and is controlled by a manual switch on the control head.

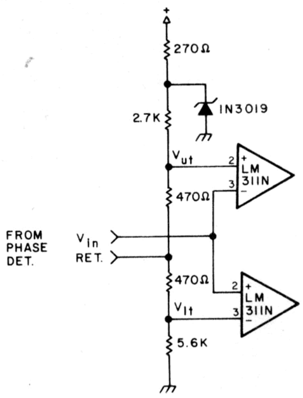


Fig. 3. Window comparator regulated-voltage divider.

Fig. 4 depicts the schematic of the control head. All of the switches, diodes, and 12 V dc indicator lamps are from Radio Shack. Switch S1 provides for switching the tuner into the automatic or manual mode and is a push-on/push-off switch. S3 provides capability to manually slew the tuner up or down in frequency. It is a DIPDT centre-off-type switch. I have found that I use it rarely in operation, but it is nice to have in case you need it. it is needed during the installation adjustments. S2 operates the antenna-matching trans. former tap-selector relay. No power on/off switch is provided, as power is taken directly from the transceiver. This prevents inadvertently leaving power on the tuner unless, of course, you forget to turn the transceiver off when you leave the car.

Construction

The photographs of the tuner reveal how simple the unit is to duplicate. It is built on a standard 2" X 4" X W' aluminium chassis, and the motor bracket, end panels, cover, and bottom plate are easily constructed in the home workshop. Several W65 have built the tuner and made Plexiglas TM covers so that they can see the roller coil go into operation when they QSY. The layout 1 selected results in minimum antenna-circuit wire length and should be duplicated as closely as possible.

Don't get innovative by trying to reduce conductors in the control cable. You can quickly get into trouble because the voltage comparators are sensitive to rf and to ground loops and will go "ape" if you unknowingly build in a ground loop as a result of a circuitry change. Also, keep some spacing between the control cable and the coaxial line, as rf pickup in the control cable can lead to erratic operation. The wiring diagram is shown in Fig. 5. The only precaution here is to note the direction of the antenna wire as it goes through the hole in the toroidal phase-sensing transformer. if it goes through from the wrong side of the printed circuit board, the tuner will drive away from resonance.

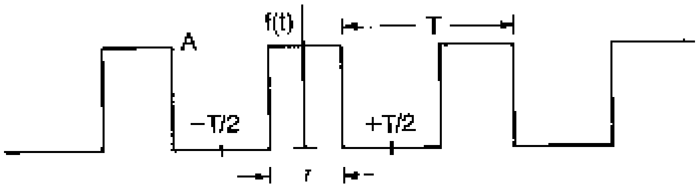
(Continued on page 7)

A Crystal Controlled Frequency and Amplitude Calibrator

By Dan Baker Tektronix, Inc.

The motivation for creating this circuit was to provide a calibrator for both amplitude and frequency over a reasonable range of the HF band. Most modem receivers use frequency synthesis and would receive little benefit from a frequency calibrator However, older receivers and spectrum analyzers need frequency calibration and virtually all receivers would benefit from a broadband amplitude reference. This circuit accomplishes these goals with a simple design that is fundamentally accurate requiring no adjustments.

The design is based on narrow-width pulses with 1 MHz and 100 kHz repetition rate. For a theoretical analysis, consider the following time function:



The double-sided Fourier coefficients for this function are:

$$F_n = \frac{1}{T}\int_{T/2}^{T/2} f(t)e^{-j\omega_o nt}dt = \frac{1}{T}\int_{-\tau/2}^{\tau/2} Ae^{-j\omega_o nt}dt$$

$$F_n = \frac{2A}{\omega_o nT}\left[\sin\left(\frac{\omega_o n\tau}{2}\right)\right] = \frac{A\tau}{T}\left[\frac{\sin\left(\frac{\omega_o n\tau}{2}\right)}{\left(\frac{\omega_o n\tau}{2}\right)}\right]$$

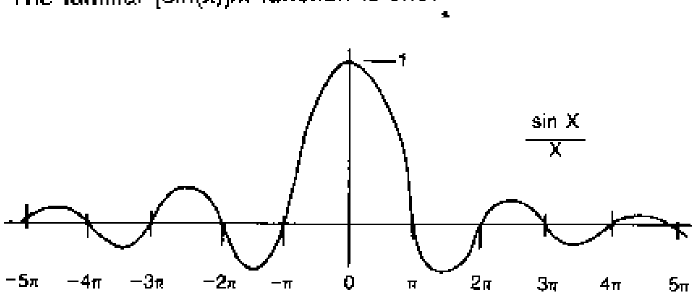
This is of the general form:

$$Fn = \frac{A\tau}{T}\left[\frac{\sin(X)}{(X)}\right]$$

where $X = \frac{\omega_o n\tau}{2}$

$$|F_{(\omega)}| = \sum_{n=-1}^{\infty}\left|2A\tau F_o\left[\frac{\sin X}{X}\right]\right|\delta(\omega - n2\pi F_o)$$

The familiar [sin(x)]/x function is shown below:



The function is zero at integral multiples of Pi. The first zero occurs at:
X = Pi = Pi . nFo . t

nFo = 1 / t = the pulse repetition rate.

A spectrum analyzer or receiver measures the magnitude of Fax The frequency response |F (w)| for a rectangular pulse train is a series of impulses in the frequency domain as follows:

The envelope of the frequency response is dependent only on the pulse shape and not the pulse repetition rate (F.). If the pulse is rectangular and of short duration, the resulting response may be quite flat over a portion of the frequency band before the first zero.

(Continued on page 8)

Editors Comments

(Continued from page 3)

and need extensive re-work. Take a look at the sample below and observe the program flow. It goes around like knitting or spaghetti. In those days structured and typed programming was really only available with heavy duty programming languages. Basic as a language has come a long way from those days. Visual Basic rides on top of all those fine improvements and provides the means to write excellent engineering or business programs. Fortunately Microsoft has been true to the BASIC language in all the versions now available. This means that you can write a program in QBasic, VBA or Visual Basic Control Creation edition and use it in another version such as Visual Basic 6.

BASIC still remains the easiest programming language to learn from scratch. Even for the old-timers! It was after all designed as a teaching language in 1959. It also is highly readable and you can quite quickly get an idea of what the program does.

(Continued on page 8)

The Tennamatic

(Continued from page 5)

Antenna-Matching Transformer

A T-106 red toroidal core, obtained from either C.R. Whitehouse or Amidon Associates, both of which advertise in several amateur magazines, is the heart of the transformer. Fig. 6 provides all necessary details for construction. The sleeve for securing the taps is a model airplane copper gas line obtained from a hobby shop and cut to length with a hacksaw. Should you desire to use an antenna other than the big DK, you must determine the antenna input impedance in Ohms at resonance with an antenna noise bridge and then determine the correct tap position from Table 2. if you don't use the DK, you will still have to change loading coils when changing bands.

Phase-Detector Transformer

Construction details of this transformer are depicted in Fig. 7. When winding the transformer, be sure that the wires remain parallel to each other without any crossovers. Also, count each pass through the hole as a turn.

Remember that it is impossible to wind a half turn on a toroid. This transformer need not be dipped in General Cement Red Glypt, although you may do so if you wish.

Gear Motor

The gear motor which I used and recommend is a Magna-TorC TM permanent magnet 24 V dc motor with a type B gear reduction unit. Operated in the Tennamatic, this motor will turn the roller inductor at

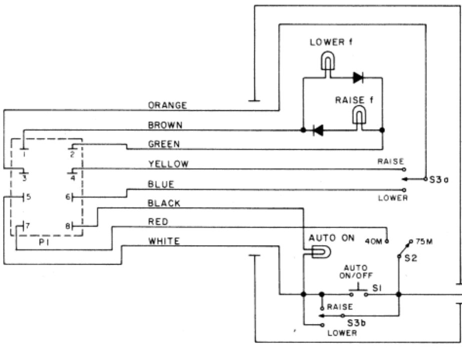


Fig. 4. The control head assembly connects to the Jones-type plug, P1, through 20 feet of TV rotator cable. The diodes are Radio Shack part number 276-1101.

approximately one revolution per second. The motor is manufactured by the Hansen Manufacturing Co., Princeton, Indiana 47670. It may also be obtained from Hartfield, Kennan, and Freytag, PO Box 328, Fremont CA 94536. The motor is expensive at about $21.50 per copy; however, it is the smallest and neatest solution to the drive-motor problem and well worth it.

Others who have built this tuner have found various surplus motors or used window crank-up motors obtained from auto wrecking yards. These high-current motors are quite bulky, do not allow neat packaging of the system, and also require the addition of relays to the output of the tuner, since the transistors can not drive them directly. These surplus motors do have the advantage of being cheap, however.

Shaft Coupler

The shaft coupler mates the gear motor drive shaft to the thumbwheel on the end of the roller inductor. It is made of aluminium turned out on a lathe and is simply bolted with three 6-32 machine screws to the thumbwheel. Fig. 8 provides the dimensional details. One of the photographs shows how it looks when the motor and roller coil are coupled together.

Printed Circuit Board

Fig, 9 depicts the printed circuit board. Be sure that you watch the polarity of the phase-detector diodes when you insert them. Also, it is a very good idea to use integrated circuit sockets instead of soldering the integrated circuits directly into

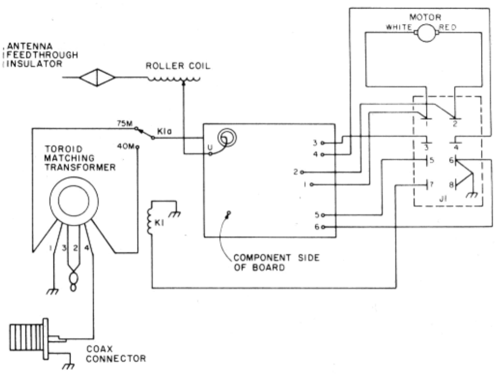


Fig. 5. Tuner unit wiring diagram.

the board. The four output transistors can be Poly Paks green-body PNP power-tab transis-

(Continued on page 11)

A Crystal Controlled Frequency and Amplitude Calibrator

(Continued from page 6)

The circuit shown in Figure 1 generates a pulse of approximately 8 nSec in duration. The pulse duration is loosely controlled by the propagation delay through the inverter and D flip-flop. A more consistent pulse width could be obtained with a 74S04 instead of the 74LS04. However, as will be shown, this is not necessary to meet the design goals.

An 8 nSec pulse width would provide the following flatness error at 50 MHz.

Error = 20 log [sin (50 /125 . Pi) / (50 / 125 . Pi)] = -2.4 dB

This is actually a worst case since 1) the pulse is typically narrower and the first zero greater than 125 MHz, reducing the error at 50 MHz, and 2) the D flip-flop is not capable of generating a very narrow rectangular pulse. The pulse is rounded and, due to slew rate limiting, better approximated by a triangular pulse. This spectrum is flatter than the (sin x)/x frequency response and this effect further reduces the amplitude flatness error at 50 MHz. The measured error of the prototype circuit was < 2 dB.

Circuit Description

To provide markers at 1 MHz and 100 kHz, two programmable synchronous counters are used. Crystals at 12 MHz are readily available and most work well in the TTL inverter oscillator shown. The trimmer capacitor is adjusted to calibrate the oscillator to a frequency standard.

The first counter divides by 12 and the second by 10. The two D flip-flops generate the 8 nSec pulses so that 1 MHz and 100kHz markers can be generated simultaneously or separately. The 12MHz oscillator synchronously clocks the two D flip-flops as well as the counters. This allows the 100 kHz pulses to occur precisely coincident with every tenth 1 MHz pulse. This is necessary for proper in-phase addition of the two spectra when both 1 MHz and 100 kHz markers are to be generated.

The desired output power for the calibrator is -60 dBm for the 100 kHz markers and -50 dBm for the 1 MHz markers (Figure 2). This is rather high for most narrowband receivers and the output may need padding for "S" meter calibration. For the 100 kHz spectral components, the required output into 50 ohms is:

-60 dBm = 20 log Vfo / 224 mV
Vfo = 224uV rms = 317 uV peak

This requires an attenuator on the output of the TTL flip-flop. The values are then calculated as shown in Figure 3a. It is desired that the 1 MHz markers be 10 dB above the 100 kHz marker amplitudes. The attenuator for the 1 MHz mark-

(Continued on page 9)

Editors Comments

```
10 PRINT CHR$(26): REM clear screen kaypro
20 A$ = "JAN"
30 PRINT "                          Inductance Calculations"
40 PRINT "                          ------------------------"
50 FOR X = 0 TO 5: PRINT : NEXT
60 PRINT CHR$(11); : PRINT CHR$(7);
70 INPUT "circular or square coil former (c/s)"; Q$
80 IF Q$ = "c" OR Q$ = "C" OR Q$ = "s" OR Q$ = "S" THEN 100
90 IF A$ = "JAN" THEN 10 ELSE 60
100 IF Q$ = "S" OR Q$ = "s" THEN 190
110 INPUT "coil diameter (mm)="; A
120 A = A / 2
130 GOSUB 260
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(Continued from page 6)

As I said before, the quantity of these programs is large. Most are available for download from the Internet.

I believe that these programs could also be a suitable aspect of

(Continued on page 10)

A Crystal Controlled Frequency and Amplitude Calibrator

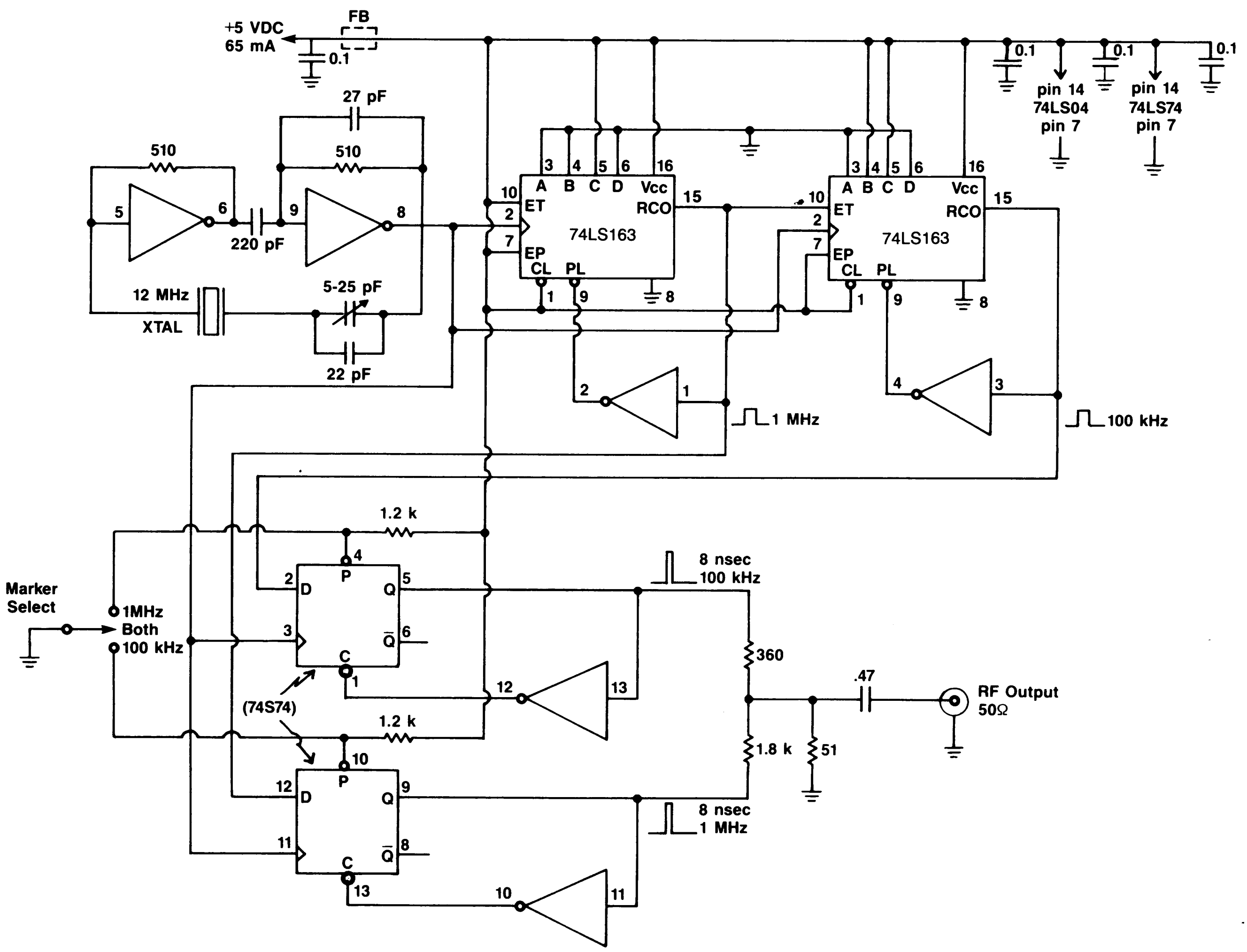

Figure 1. 1 Mhz/100 kHz Amplitude/Frequency Calibrator circuit diagram.

(Continued from page 8)
ers is shown in Figure 3b.

Note that when both markers are present, the 1 MHz markers will be 3.3 dB higher than the amplitude when generated alone. This is due to the in-phase addition of the 1 MHz components of both spectra.

Prototype Results

Figures 4 through 8 illustrate the measured results of the prototype.

Figure 4 is the double-sided (sin #x magnitude response. Note that the first zero is slightly higher than 125 MHz indicating the pulse width is slightly less than 8 nsec.

Figure 5 shows the first 50 MHz of the spectrum and illustrates the predicted flatness error of about 2 dB. Note that the 12 MHz component is too high. This is probably due to crosstalk in the hex inverter. A separate XTAL oscillator would probably eliminate this error at the expense of more parts.

Figures 6, 7 and 8 show a 5 MHz segment of the first 30 MHz. Figures 3 and 4 show the 100 kHz and 1 MHz markers when selected separately. Figure 5 shows the composite calibrator output. Note that the marker amplitudes are about 10 dB different, as predicted. Also note that the 1 MHz markers are about 3 dB lower (Figure 7) when selected individually, as was also predicted.

One note of caution is in order. Receivers have a limited

(Continued on page 13)

Editors Comments

(Continued from page 8)

```
140 N = SQR(L / (.0000004 * PI * A * (LOG(1 + PI * V) + 1 / (2.3 + 1.6 / V
+ .44 / (V * V)))))
150 IF S <> 1 THEN 330
160 GOSUB 450
170 IF Z <> 0 THEN 140
180 GOTO 330
190 INPUT "side of the square (mm) ="; A
200 GOSUB 260
210 N = SQR(L * PI / (.0000004 * PI * A * (LOG(1 + PI * V) + 1 / (3.64 + Z / V
+ .51 / (V * V)))))
220 IF S <> 1 THEN 330
230 GOSUB 450
240 IF Z <> 0 THEN 210
250 GOTO 330
260 INPUT "Space between turns (Y/N)"; S$
270 S = 0
280 IF S$ = "N" OR S$ = "n" THEN B = A: S = 1: INPUT "wire diameter (mm) ="; D: D
= D / 1000: GOTO 300
290 INPUT "coil length (mm) ="; B
300 INPUT "L  (uH) ="; L
310 B = B / 1000: A = A / 1000: L = L / 1000000!: V = A / B: PI = 3.14159
320 RETURN
330 R = N - INT(N)
340 IF R < .5 THEN N = INT(N) ELSE N = INT(N) + 1
350 PRINT "number of turns ="; N
360 IF S = 1 THEN 380
370 PRINT "maximum wire diameter ="; 1000 * (B / N); "mm"
380 FOR X = 0 TO 79: PRINT "-"; : NEXT
390 INPUT "More (Y/N)"; A$
400 PRINT CHR$(11);
410 FOR X = 0 TO 79: PRINT " "; : NEXT
420 FOR X = 0 TO 2: PRINT CHR$(11); : NEXT: REM KAYPRO CURSOR UP
430 IF A$ = "Y" OR A$ = "y" THEN 70
440 END
450 Z = 1: K = N * D: IF ABS((K - B) / B) < .00003 THEN Z = 0: RETURN
460 B = (K + B) / 2: V = A / B: RETURN
```

The Tennamatic

(Continued from page 7)

tors, part number 92CU2227, or Radio Shack PNP power tab transistors, part number 276-1641. Both types are rated at 35 Watts with suitable heat sinking. Heat sinking is not required in this application.

If you use the Poly Paks transistors, bend the tabs at right angles to the body of the transistors to ensure that they clear other components mounted on the board. Make the bend about a quarter inch from the body of the transistor. Test them carefully for leakage before you solder them because I have found that about 25% of them are too leaky to work properly in this circuit. They will cause the directional indicator lights to light even when the system is at resonance. I've had no trouble with Radio Shack transistors.

The photograph of the underside of the chassis shows the printed circuit board as installed in the tuner. The trimpot was mounted on the foil side of the board because, when three-quarter-inch stand-offs for supporting the board are used, the screwdriver access hole in the side of the chassis fails midway in the side.

I have a few extra printed circuit boards available at $5.00 each for those who prefer not to make their own.

Installation

Mount the tuning unit as close as possible to the base of your antenna. Connect the base of the antenna to the tuning unit with insulated AWG #12 or #14 wire. Do not under any circumstances use coax to connect the antenna to the tuner! Make sure that you ground the tuning unit to the car body by means of sheet metal screws or a short bonding strap. Use 50-Ohm coaxial cable to connect the tuning unit to your transceiver. RG-58A/U is satisfactory, and the length is not critical.

One photograph shows how I mounted the tuner in my station wagon. After mounting the control head to the transceiver (I used Velcro fastening tape), connect the control head power lead to the transceiver so that the transceiver power switch will control application of power to your Tennamatic.

DK Antenna Adjustment

After installation of your Tennamatic, your DK antenna (or other antenna) must be retuned to be resonant on approximately 4025 and 7325 kHz. For this adjustment, the roller inductor must be slewed to minimum inductance using the manual slewing switch. Next, you must determine the antenna resonant frequency on both 75 and 40 meters using your v.s.w.r bridge or field-strength meter. Resonance will be lower than it was before the Tennamatic was installed. Don't overlook changing the impedance matching tap when you change bands looking for resonance.

Now that you know where the antenna system resonance's are, you can proceed to raise them by removing turns from the loading coil, shortening the whips, or by a combination of both methods. If the two resonance's are as low as 3900 kHz and 7150 kHz approximately, you may find it better to remove a turn or two from the bottom of the loading coil and one or more turns from the top of the loading coil in order to minimize the amount that must be trimmed off the whips. Remove turns only one at a time. Be sure to check the resonant frequency on each band after each adjustment because they interact, and it is essential that you do not go too far. By the time resonance is approaching the upper band edge on 75 and 40 meters, you should have determined the number of kHz per inch of frequency change you get with each inch cut off. The kHz-per-inch figure will be different for each whip. After reaching 3995 kHz and 7295 kHz, cut off an additional increment from each whip determined by dividing 30 kHz by the number of kHz per inch for each band. This will complete the antenna tuning procedure.

(Continued on page 12)

The Tennamatic

(Continued from page 11)

Tuner Trimpot Adjustment

This adjustment is made to cause the tuner to tune for maximum field strength (coincident with minimum v.s.w.r). When adjusted on 40 meters, it will also be correct on 75 meters. Adjust as follows:

1. Make sure your vehicle is at least fifteen feet away from other vehicles, trees, buildings, or metallic objects.
2. Turn the trimpot fully counter clockwise, and then preset it six turns clockwise.
3. Turn on your transceiver. Place it in the tune mode with carrier inserted on the 40 meter band.
4. While watching a field-strength meter or v.s.w.r indicator, tweak the trim pot until you observe maximum field strength or minimum v.s.w.r. The Tennamatic must be in the automatic mode for this adjustment. Your unit is now ready to operate.

Operating Results

With a year and a half of operating experience, the Tennamatic has demonstrated that high-Q mobile antennas are extremely sensitive to the environment around them. For example, a dense fog will lower the antenna system resonant frequency on 75 meters by as much as 25 kHz, but the Tennamatic will compensate by rolling the inductor to less inductance. I leave it in the automatic mode at all times while driving, and, as long as I am talking, it will compensate quickly for the detuning caused by passing trucks, cars, trees, freeway overpasses, bridges, and residential power line drops as you drive under them. The result is that most of the characteristic mobile fade, which I now realize is due to antenna detuning, is eliminated. The result is such a strong steady mobile signal that I frequently have to convince my contact that I am really mobile!

There is one thing that the Tennamatic cannot compensate for. That is another 75 or 40 meter mobile parked up to twenty feet away. The mutual coupling between antennas, reflected signal, and phase shifts cause it to go "ape." So, if you build one, don't proudly try to demonstrate it when parked near another mobile.

Acknowledgement

I would like to acknowledge with my thanks the numerous suggestions made by Don Johnson W6AAQ as this project proceeded through the breadboard, prototype, final design, and evaluation phases. I also wish to express my grateful appreciation for the photography provided by Jerry Fulstone WA6JEJV.

Taken from 73 Magazine.

Editors Comments

(Continued from page 8)

the Ham Radio hobby which could encourage youngsters to join the hobby and contribute to the experimentation and design.

73 until next month. JB

A Crystal Controlled Frequency and Amplitude Calibrator

(Continued from page 9)
voltage dynamic range at their inputs. Pulses much larger than the ones used in this design can overload a receiver input. If very fine resolution markers are desired using this technique, it would be prudent to consider a chirp or other more complex technique to obtain a flat spectrum with good signal-to-noise ratio.

This circuit provides a cheap, yet quite accurate calibrator of both amplitude and frequency over the 30 MHz HF band. It can serve as a general purpose reference for a general coverage receiver or spectrum analyzer.

From RF Design July 1986

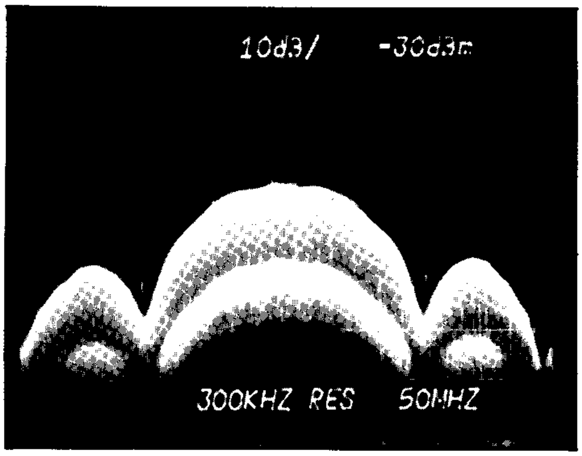

Figure 4. Double-sided (sin x)/x spectrum of the calibrator.

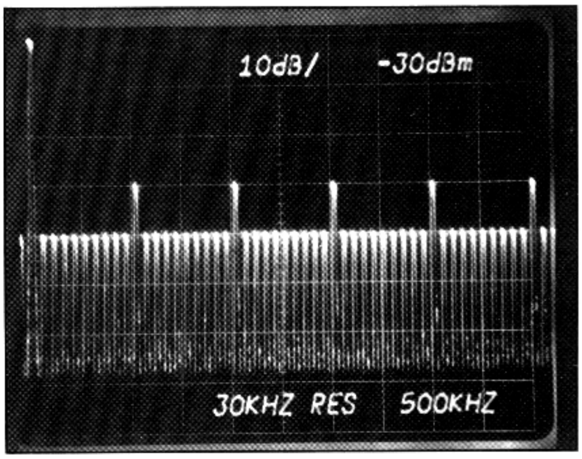

Figure 8. Both markers combined, 0-5 MHz, showing accuracy of amplitude.

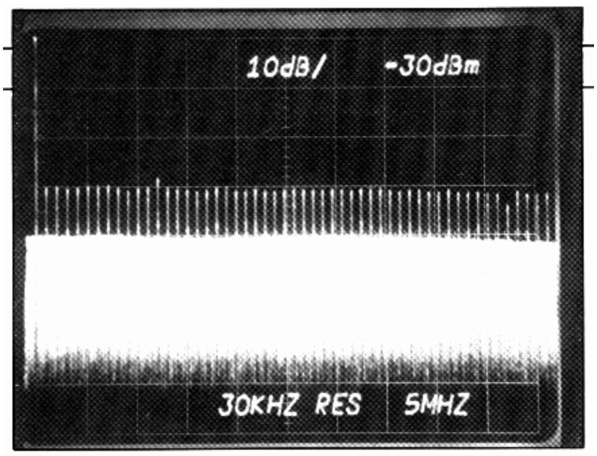

Figure 5. 0-50 MHz markers, showing approximately 2 dB flatness error at 50 MHz.

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Bulletins (Sundays at …)
11h15 Start call in of stations
11h30 Main bulletin start

Frequencies
145,625 MHz (West Rand Repeater)
10,135 MHz (HF Relay)

Radio Amateurs do it with more frequency!

We are going on the Web
www.zs6wr.org.za

Please note this has been just been registered. Our site will be up in the new year.

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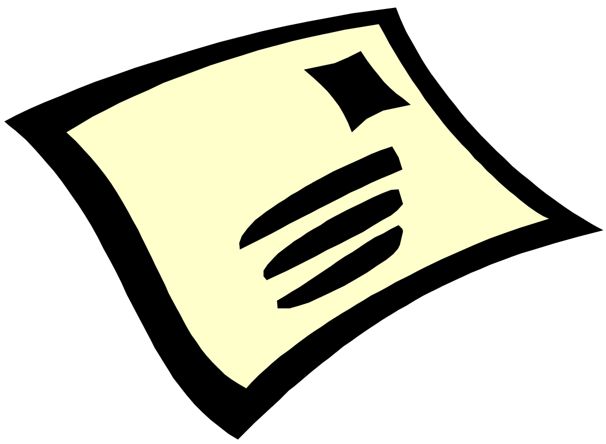
West Rand members input - we need your input!

To make this the best ham radio magazine in South Africa we need your input. Please submit articles, comments, suggestions etc.

Please send plain text with no formatting to the email address below.

In November, we published an Anode Compendium on CD. It has the issues from July 2000 until November this year. This included IE5.5 and the new Adobe reader.



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