QEX 36

February 1985

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The ARRL Experimenters' Exchange

After the ACSSB Packages Then What?

Vern Riportella raised the question of what can we do after Hq has shipped the last ACSSB board sets (see QEX35). We have had a good response, and it looks like we'll have more requests than boards. Individual experimenters and small businesses should think about creating some follow-on packages, either compatible with or possibly even more advanced than the surplus units made available to us by STI. Because there has been so little on-the-air experience with the STI units, all of this may be premature. Indeed there may be much to learn on how to design the best ACSSB system for Amateur Radio applications. Just thought it worthwhile to plant the seed!

If you have been one of the lucky ones and got an ACSSB board set, please drop a line to QEX and share what you've learned with other experimenters.

The Second International Satellite Direct Broadcast Services Users' Conference

This conference will be held April 15-19, 1985 at the Holiday Inn near Baltimore-Washington International Airport. It will provide an exchange of information between users and the designers, operators and managers of environmental satellites. It is co-sponsored by the National Oceanic and Atmospheric Administration (NOAA), National Aeronautical and Space Administration (NASA), World Meteorological Organization (WMO), American Meteorological Society (AMS), and the American Society of Photogrammetry in cooperation with the National Science Teachers Association. There will be some radio amateurs present, including J. van de Groenendall, president of AMSAT South Africa. This conference comes at a time when there is interest in using amateur packet radio for transmission of weather data.

For information, contact: Robert W. Popham, NOAA Co-chairman, ISDBSUC, NOAA/NESDIS, Washington, DC 20233, 301-763-7289; John Kamowski, NASA Co-chairman, ISDBSUC, Code 974, NASA/Goddard Space Flight Center, Greenbelt, MD, 20771, 301-344-5083; or, Jesse Rodriguez, Program Manager, ISDBSUC, NOAA/NESDIS, Washington, DC, 301-344-5083.

Fourth ARRL Networking Conference

For those wishing to present papers, don't forget the March 1 deadline. See QEX33 for details.

Third International Network Planning Symposium

The IEEE Communications Society issued a call for papers for this symposium to be held June 1-6, 1986, in Tarpon Springs, FL. Conference themes are: integration and internetworking, integrated voice and data networking, and network planning issues for the 1990s. There is a May 15, 1985 deadline for a 500-700 word synopsis with graphs and tables from each author. Submit abstracts to: Networks '86, c/o Mr. Cas Skrzypczak, Bell Communications Research, 290 West Mt. Pleasant Ave, Livingston, NJ 07039.

11th Eastern VHF/UHF/SHF Conference

Speakers are now being solicited for this conference to be held at Rivier College, Nashua, NH, May 17-19, 1985. Presentations on antennas, low-noise receivers, propagation, power amplifiers, microwave techniques, measurement techniques, computer applications to RF design, and other topics pertaining to the bands above 50 MHz are welcome.

Contact conference chairman, Thomas J. Kirby, P.O. Box 455, Meadow Knoll, Pelham, NH 03076, 603-635-2514 or 617-449-2000 extension 3505 for details.

AX.25 Link-Layer Protocol Specification

Copies of AX.25 Amateur Packet-Radio Link-Layer Protocol are available from ARRL Hq for $8 in the U.S. and $9 in Canada and elsewhere. This is the protocol that was approved by the ARRL Board of Directors in October 1984.

The AX.25 link-layer protocol is already enjoying widespread acceptance in the North America, Europe, South Africa, Japan, and New Zealand. It will be the protocol used in the JAS-1 and PACSAT satellites to be launched in the 1986-1987 timeframe.

Correspondence

Low-Impedance Microphones

I would like to hear from anyone who owns a Kenwood TS-700A, TS-700S, or a 700SP, and uses a Motorola Mobile Microphone or a Shure Mobile Microphone. Both of these mics are low impedance. What model do you use and how is it wired? — Rich Ballieu, WBØTML, 1109 North 7th St., Rapid City, SD 57701.

RF Transmission Lines of the Open Wire Type

I am looking for the equations to calculate the line impedance and the velocity factor of the accompanying figures.

* In Fig. 1, we see a four-wire line with three wires arranged in the form of an equilateral triangle. The wires are connected together at each end, and the fourth wire is in the center of the triangle. Each wire is of the same diameter.

* The three outside wires are of the same diameter, but the center wire is larger (Fig. 2).

* A five-wire line with four wires are arranged in a square and connected together at each end. The fifth wire is in the center of the circle. Each of the wires are of the same diameter. See Fig. 3.

* The four outside wires are of the same diameter, but the center is of a larger diameter (Fig. 4).

I would appreciate receiving any correspondence concerning this problem directly. -- James W. Welch, KH6HEP, 419A Atkinson Dr., #1001, Honolulu, HI 96814.

Feedback

Another error crept into the article, "Theory, Limitations and Adjustment of Reflectometers and Other SWR Meters," by Albert E. Weller, WD8KBW, (Dec. 1984 QEX, p. 3). Equations 4 and 5 should read:

$$e = j\,\omega\,E(RC \pm MY) \qquad \text{(Eq. 4)}$$

$$e_i = j\,\omega\,E(RC \pm MYo) \qquad \text{(Eq. 5)}$$

Interface Circuit

In the November 1984 issue of QEX (no.33, p. 2), one of our printed questions for the Technical Information Specialist concerned an interface circuit that would connect an 80-V/40-mA loop of a page printer to the TTL input of an AFSK generator. Ben Ascani, WA7NAP, of Arizona supplied the following response: "Assuming that the printer is serial and that you have a source of parts, and the voltage and current are correct, the enclosed circuit (Fig. 5) should give you some idea as how to start."

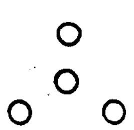


Fig. 1

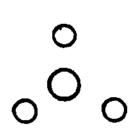


Fig. 2

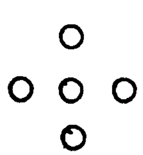


Fig. 3

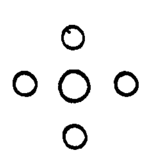


Fig. 4

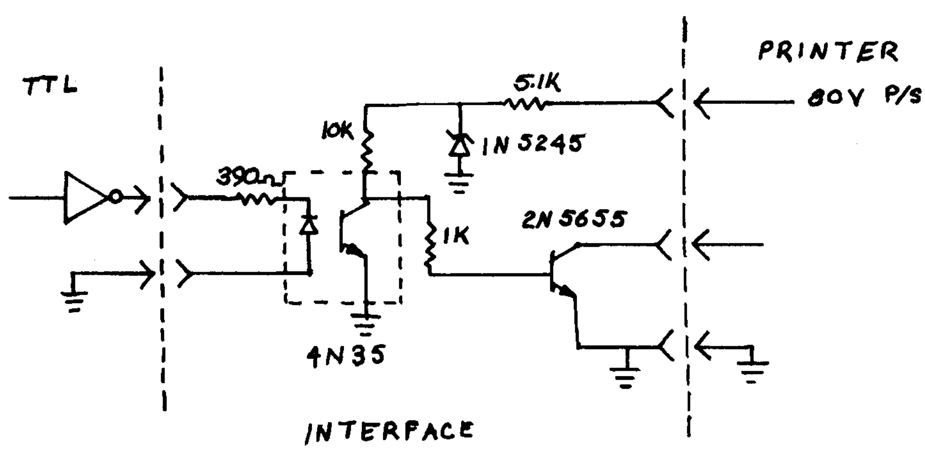


Fig. 5

Audible SWR Indicator

By Eliot Mayer,* W1MJ

One day on the local 04/64 repeater, I heard Kitty, WB8TDA, discussing a neighbor relations problem. It seems that the lady next door didn't like the sight of Kitty's dipole collection. I suggested that she replace all the dipoles with a single Center-Fed Zepp. [1] The catch is that an antenna tuner is required to interface the Zepp to the transceiver. For Kitty to adjust the tuner for proper SWR, something extra would be needed; a blind operator cannot read the SWR meter directly. Enter the ASWRI.

Basically a voltage-to-frequency converter, the ASWRI allows a sightless ham to "hear" an analog meter. The voltage across the meter is measured and converted into an audible tone. The higher the meter reading, the higher the pitch (frequency) of the tone. In addition, a rotary switch lets the operator switch between "measured" and "reference" tones. Reference tones correspond to calibration points on the meter. For instance, by switching back and forth between the SWR meter and the full-scale reference tones, the operator can perform the forward full-scale adjustment needed in SWR measurement. This is done by adjusting the sensitivity knob on the SWR meter (or the transmitter output) until the two tones match. Then, after tweaking the antenna tuner for minimum reflected power, a comparison can be done with the SWR 2:1 reference tone. If the pitch of the measured tone is lower than the 2:1 reference tone, then the transmitter should be happy with

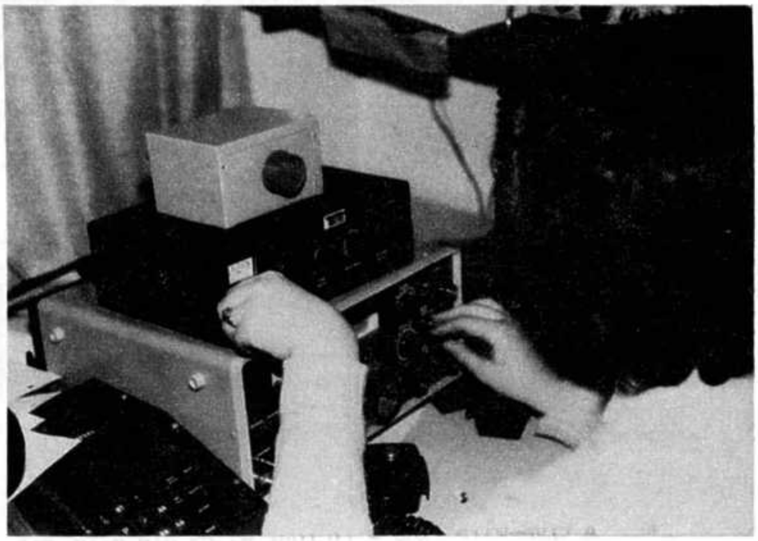


Fig. 1 — WB8TDA tunes her antenna with help from the ASWRI. The ASWRI sits atop, and monitors, a Ten Tec model 228 antenna tuner. It is best to do the initial tuning with the meter sensitivity at maximum, and the transmitter drive just high enough to reach the forward full-scale setting. Kitty also uses the ASWRI to tune her transmitter for peak output by setting the meter to read forward power at reduced sensitivity.

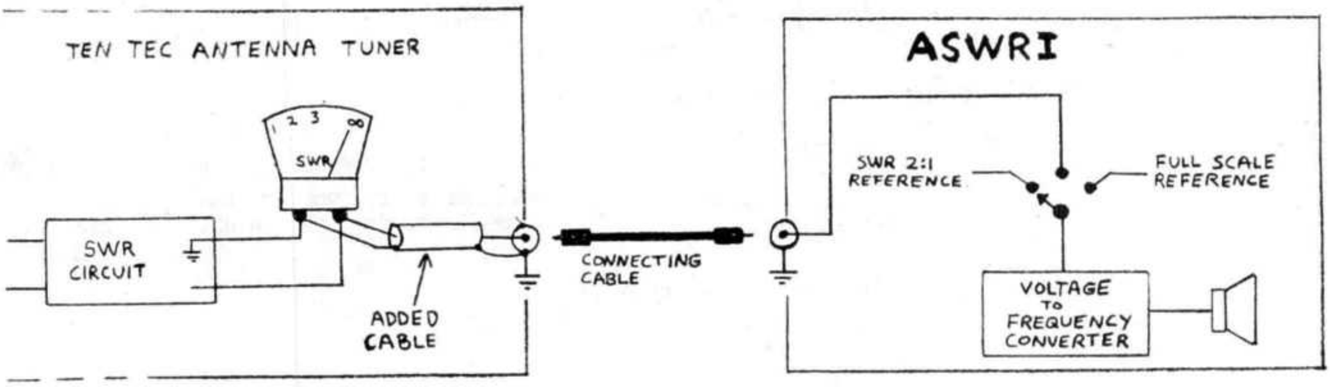
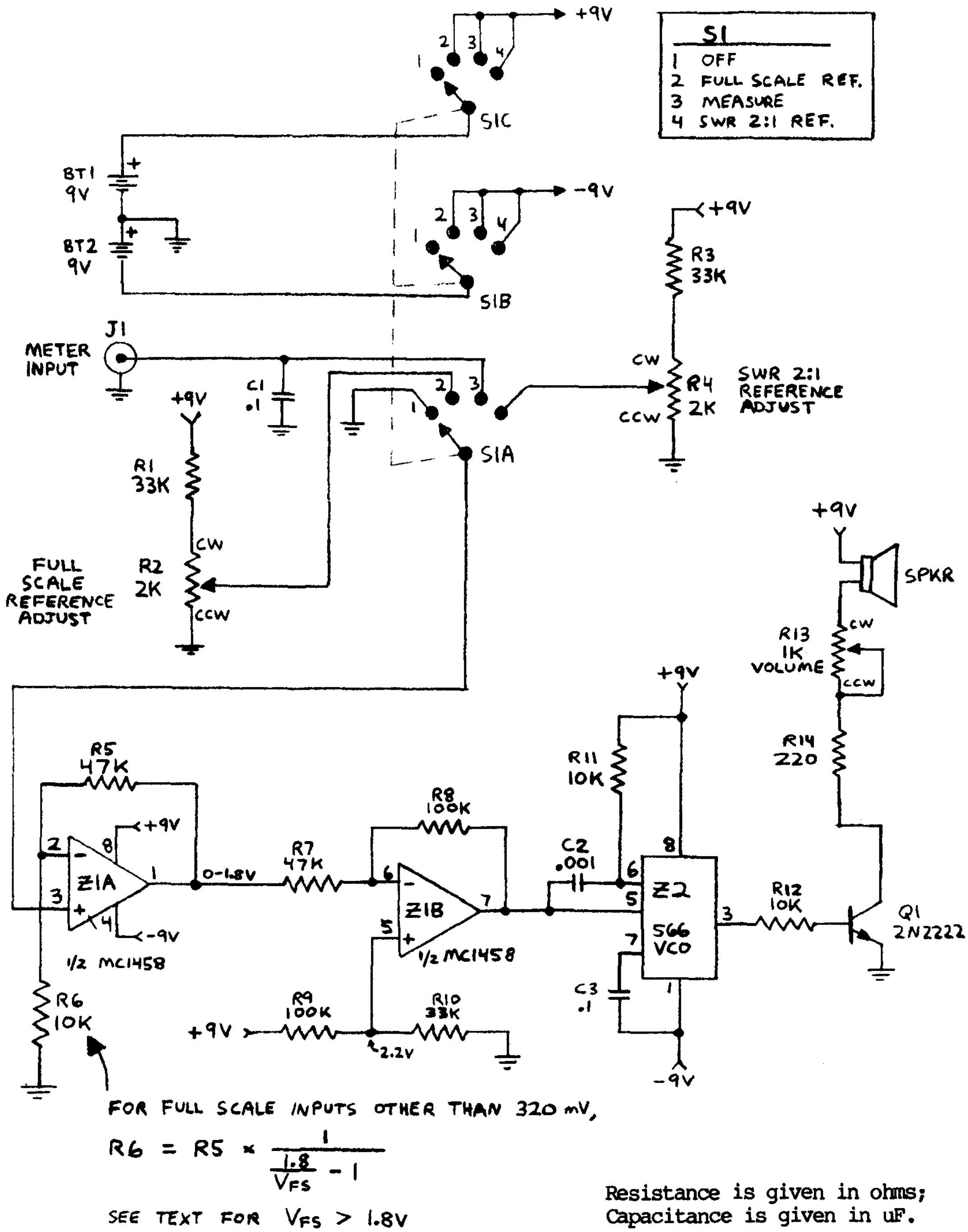


Fig. 2 — System diagram.

*20 Driftwood Drive, Tewksbury, MA 01876



Resistance is given in ohms;
Capacitance is given in uF.

Fig. 3 — Schematic, prototype ASWRI.

(Parts list for Fig. 3 is shown on page 11.)

its load and perform correctly. A reference tone for SWR 1:1 (zero reflected power) is heard in the measure mode when the transmitter is in standby (another 0-volt condition).

In Fig. 1, WB8TDA is shown adjusting her HF transceiver and antenna tuner, with the aid of the ASWRI. A system diagram is shown in Fig. 2. In this set up, one side of the meter was already grounded. Had that not been the case, it would have been necessary to "float" the ASWRI (prevent it from touching ground).

The Circuit

The schematic for the prototype is shown in Fig. 3. Rotary switch S1 selects the desired signal, measured or reference, and also handles the power ON/OFF function. The reference circuits, consisting of R1 to R4, are simple voltage dividers, using the +9-V battery as a reference voltage source. Although not the best reference source, this simple method seems adequate for this application.

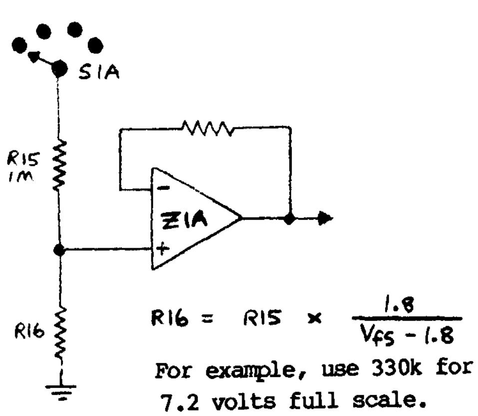
Amplifier Z1A boosts the selected voltage to the 0- to 1.8-V range. For the Ten Tec tuner, the range of the meter voltage is 0 to 320 mV. The 320-mV full-scale voltage was determined by measuring the voltage across the meter while it was at full scale. For other meter types, the gain of Z1A should be modified by changing R6, as shown in the schematic. For voltages over 1.8 volt (e.g., a voltmeter instead of an ammeter), omit R6 and add an input attenuator as shown in Fig. 4. For adjustable range (120-mV to 25-V full scale), the circuit of Fig. 5 could be used, but adjustment could be tricky for settings above 1 volt. Finer adjustments for higher voltage ranges could be achieved by adding a fixed resistor between the switch and the trimpot.

The next stage, Z1B, provides gain, offset and inversion to map 0 to 1.8 volt into 7 to 3 volt. The Voltage-to-Frequency Converter (V/F) IC Z2 (also known as a Voltage Controlled Oscillator, VCO), requires decreasing input voltage to increase the oscillator frequency. The range of tones is set by R11 and C2; experiment with their values if you wish, but keep R11 between 2k and 20k. The output at Z2-pin 3 is a square wave, which is boosted by switching transistor Q1 to drive the speaker.

Construction

Construction of the ASWRI is shown in Figs. 6 through 8. A metal minibox is used to keep RF out. Instead of cutting a big hole for the speaker on the bottom, an array of small holes is drilled, turning part of the box into a speaker grill. The rubber feet raise the base, allowing the sound to escape. The RCA phono jack for meter connection is mounted on the rear, next to the circuit breadboard. On the front panel is the rotary switch. A pointer knob and braille position labels can be added, but Kitty doesn't seem to find them necessary.

Figs. 7 and 8 show the breadboard circuit.



$$R16 = R15 \times \frac{1.8}{V_{FS} - 1.8}$$

For example, use 330k for 7.2 volts full scale.

Fig. 4 — Adding an input attenuator for high full-scale meters, such as voltmeters.

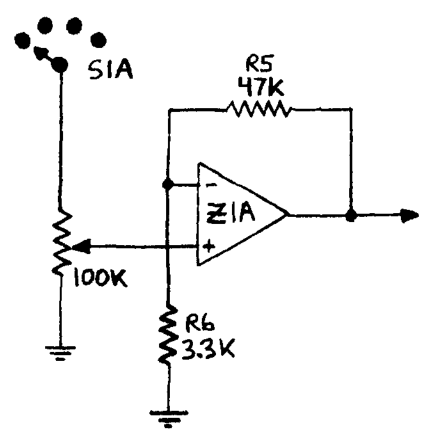


Fig. 5 — Adjustable full-scale range.

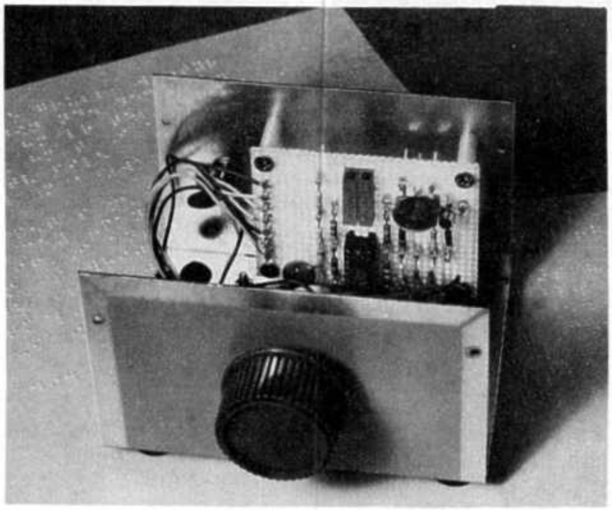


Fig. 6 — ASWRI with the cover removed.

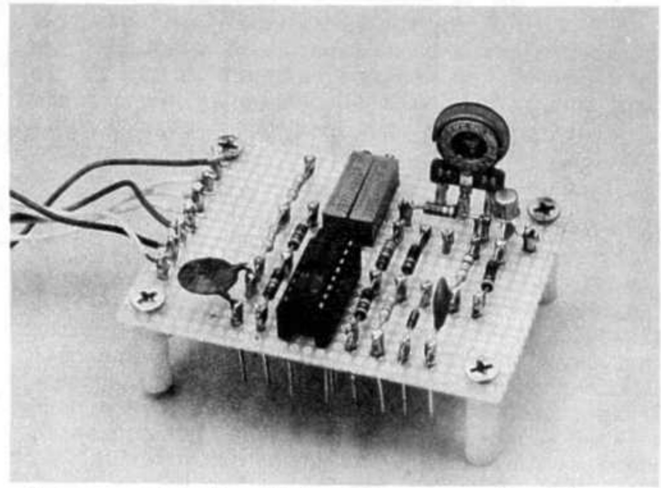


Fig. 7 -- The circuit board removed for display, but still hooked up.

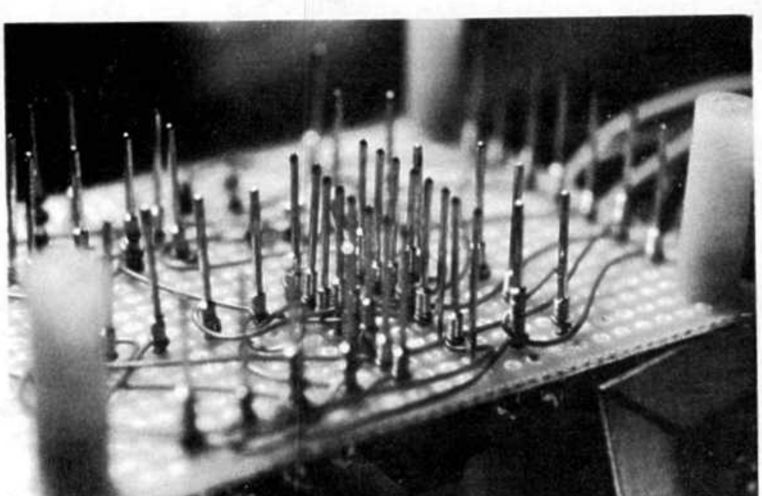


Fig. 8 — The wiring side of the board.

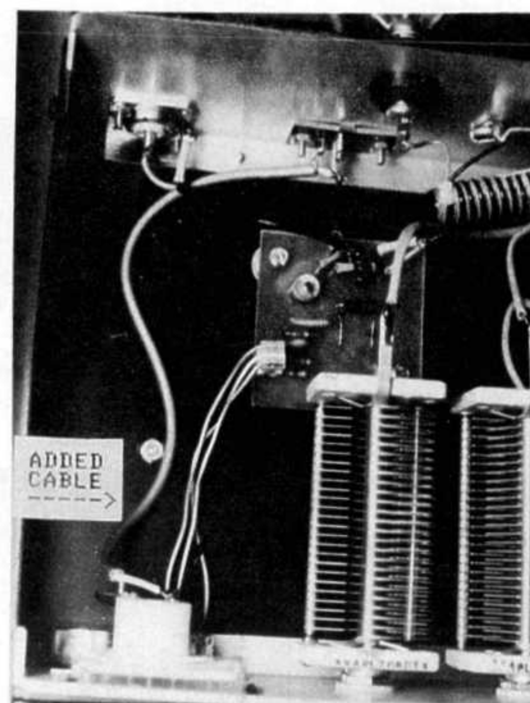


Fig. 9 -- Adding meter output to the Ten Tec 228 antenna tuner.

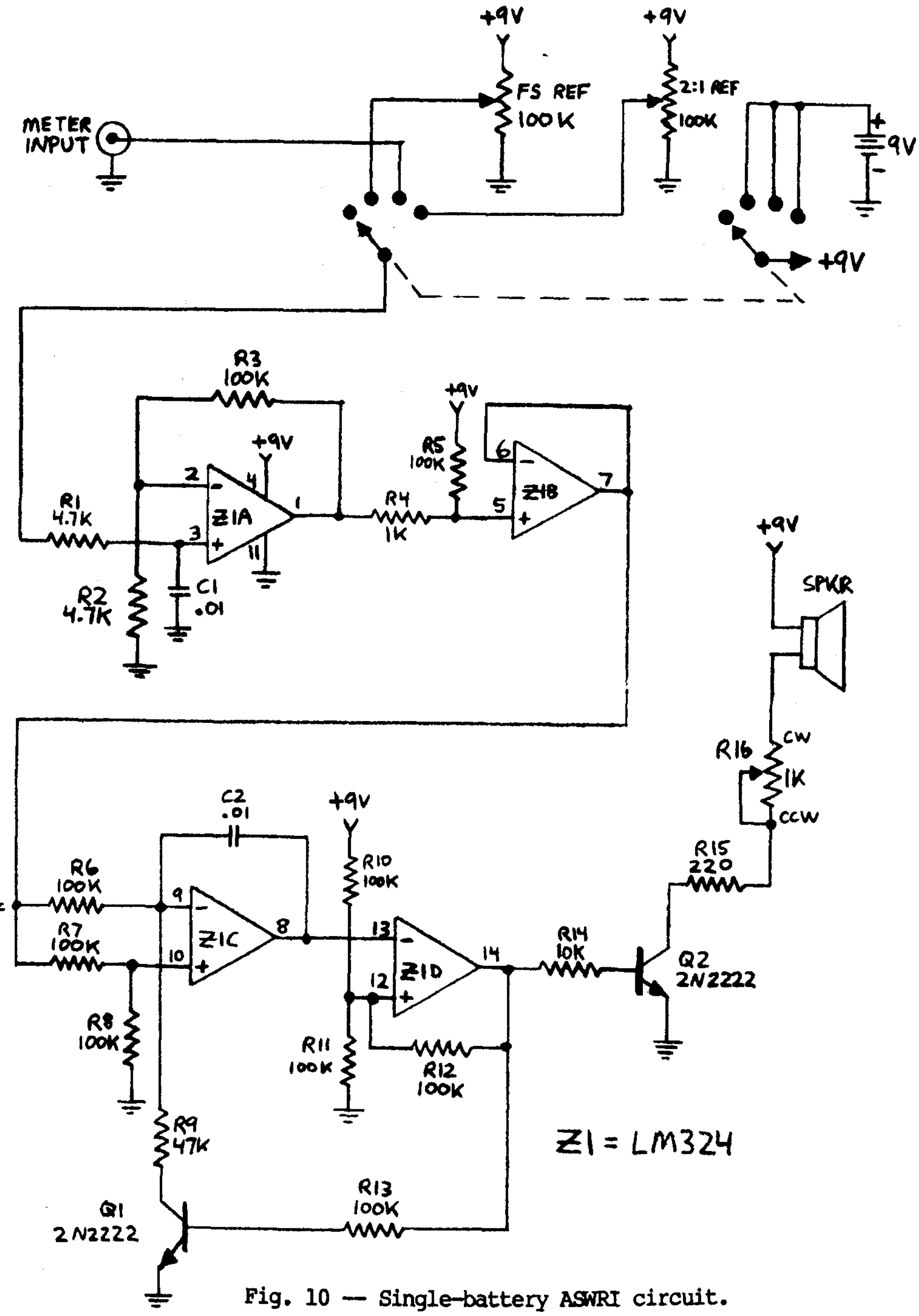


Fig. 10 — Single-battery ASWRI circuit.

(Continued on page 9)

Satellite Signal Source for 2304 MHz

By Paul M. Wilson,* W4HHK

Two Russian satellites believed to be of the early warning type have currently been transmitting audible signals at 2304 MHz. According to AMSAT, they have been identified as COSMOS 1547 and COSMOS 1604, cat. no. 84033A and 84107A, respectively.

At my location near Memphis, TN (35 02 N 89 40 W), they are received more than 23 dB above the cold-sky noise (except at very low elevations) on an 18-ft dish mounted 35 ft above the ground, with horizontal polarization, 4-dB line loss and a 1-dB LNA. Once above the horizon by a few degrees, the S/N of 23 dB is obtained and the signal is steady throughout most of the pass. There is no fading (less than 1/2 dB) except near the horizon.

These signals provide good test signals for measuring antenna beamwidth, side-lobe response and antenna/receiver performance. Al Ward, WB5LUA, in Texas, reports reception on a 2-lb coffee can antenna (10-dB gain) and a low-noise receiver, so reception with a 4-ft dish and a good receiver should be easy.

These two birds were launched earlier this year, according to AMSAT, so these useful signals may be around for a while. In Europe, however, their strength is a nightmare for EME operators, being 52 dB above the cold sky, with subcarriers at 1-MHz intervals plus/minus the main carrier out to 4 MHz. These subcarriers are about 25 dB below the main carrier (barely detectable at my QTH).

*P. O. Box 73, Collierville, TN 38017

My receiver is used in the CW mode with the BFO on.

At the end of each pass, an "off/on" format is observed and modulation (PPM?) is heard. A short time before the final switch-off (final LOS), signal strength briefly rises to approximately 40 dB above the background. There are two passes each day, one for satellite "A" and one for "B." Recent observations at my location revealed the Az-El frequency data shown in Table 1.

Currently, the "A" pass is of a short duration, and the signal is near the horizon and weak. This pass was three hours and 46 minutes in early November. The "B" pass is about five and one half hours duration, providing plenty of time for reception and tests at the high-signal level.

Frequencies indicated are plus/minus 2304.000 MHz. Maximum doppler range observed to date has been from 2303.991 to 2304.01475 MHz. Maximum elevation (occurs at LOS) observed to date is 19.5 degrees in October. Starting time for appearance on the horizon is about five minutes earlier each successive day. For example, acquisition of signal (AOS) for satellite "B" should be about two hours earlier (at 1005Z) on December 19, based on the November 25 AOS (24 days x 5 minutes = -120 minutes).

The S/N level of 23 dB is obtained with a 3-kHz bandwidth in the 51J-4 receiver final IF. Early AOS is obtained with 500-Hz BW (or less) when the S/N is Ø dB or less. Good hunting!

Table I

November 27	at AOS	2048Z	AZ 042 deg	EL 001 deg	Freq - 3 kHz
Satellite "A"	at LOS	2141Z	AZ 049 deg	EL 001 deg	Freq + 1 1/4 kHz
November 25	at AOS	1205Z	AZ 034 deg	EL 000.0 deg	Freq - 9.0 kHz
Satellite "B"	at LOS	1737Z	AZ 091.75 deg	EL 014.0 deg	Freq + 14.75 kHz

(ASWRI continued from page 7)

Vector T49 mounting clips and wire-wrapping techniques were used, but any form of wiring should suffice. The trimpots should be easily accessible. Note that the board-to-chassis wires are long enough to allow servicing the board outside the box. On this unit, the volume control is a trimpot, but a front panel potentiometer would be better.

Fig. 9 shows how the Ten Tec 228 tuner was wired for meter output. A shielded cable connects the meter to an RCA jack on the rear panel. Actually, the jack was already there. It was used for power connection to a meter light. (Since the meter light was useless to Kitty, I removed it and installed it in my Ten Tec 277 tuner, an earlier version without this feature.) A shielded cable with phono plugs, like the type used in home stereo systems, connects the antenna tuner to the ASWRI.

Setting the Reference Tones

The only adjustments necessary on the ASWRI, other than playing with full-scale ranges, are the reference settings. They should be set by a sighted ham who isn't tone deaf. Adjust the transmitter to get to each calibration point (2:1 and FS REF) on the meter, setting the corresponding trimpots (R4 and R2) for matching reference and measured tones at each point.

Variations

Several variations on the circuit are possible. If the 3-pole rotary switch is hard to find, a one-pole version can be used for S1A, replacing S1B and S1C with a separate ON/OFF double-pole toggle switch.

The need for two batteries can be eliminated by using the circuit of Fig. 10. It is based on the single-supply LM324 opamp. The first active stage, Z1A, is similar to the prototype circuit, except for an added input filter R1/C1 (instead of just C1 in Fig. 3). The output of Z1B is an offset version of Z1A. This is needed because the VCO in this circuit goes down to 0 Hz for 0-V input, and that's below the audible range. R4 can be changed to modify the zero-volt tone. The VCO consists of Z1C and Z1D. The circuit is from the LM324 data sheet. [2] Z1C is an integrator, which means that a dc input will cause a ramp output. Z1D is a comparator with much hysteresis. When Z1C ramps up to 6 volts, Z1D goes to 0 volts, turning off switching transistor Q1. This causes Z1C to start ramping downward. When the ramp reaches 3 volts, the comparator switches again, turning Q1 on. The result is a triangle-wave output from Z1C, and a square-wave output from Z1D (see Fig. 11). Capacitor C2 can be changed to modify the full-scale frequency of the VCO. The speaker circuit is identical to that of Fig. 3. There's just one caveat involved with this single-battery circuit; I haven't had a chance to try it yet. But don't let that stop you — be adventuresome.

Customizing

A suggested adaptation for use with more than one meter is shown in Fig. 12. A custom ASWRI can be built for most any ham shack, with as many inputs as necessary. Each input can have as many reference tones as desired. Fixed resistors can be placed in series with the reference trimpots to narrow the adjustment range (see R1 and R3 in Fig. 3).

The Happy Ending

The prototype ASWRI seems to function well for WB8TDA, as evidenced by her repeated requests that I write this article. She has been using the device happily for over 2 years, and hasn't even needed to change the batteries. So, build an ASWRI for a visually handicapped ham friend; he or she won't be quite as handicapped when you're finished.

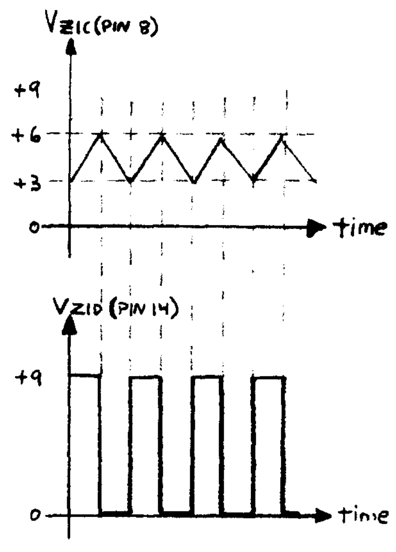


Fig. 11 — VCO waveforms for circuit in Fig. 10.

References

[1] The ARRL Radio Amateur's Handbook, 1983, p. 20-4.

[2] The National Semiconductor Linear Data Book, 1982, p. 3-179 (LM324 data sheet).

Bibliography

Brandt, Raymond W., N9KV, "An Audio Tone-Shift Power/SWR Meter," QST, September 1979, pp. 28 to 29.

Burney, James D., WA4LBX, "Transmitter Tune-Up for Blind Hams," 73 Magazine, January 1981, pp. 120 to 122.

Stockemer, Leroy J., KØWOL, "The SHARC Audible Current Meter," QST, April 1979, pp. 22 to 27.

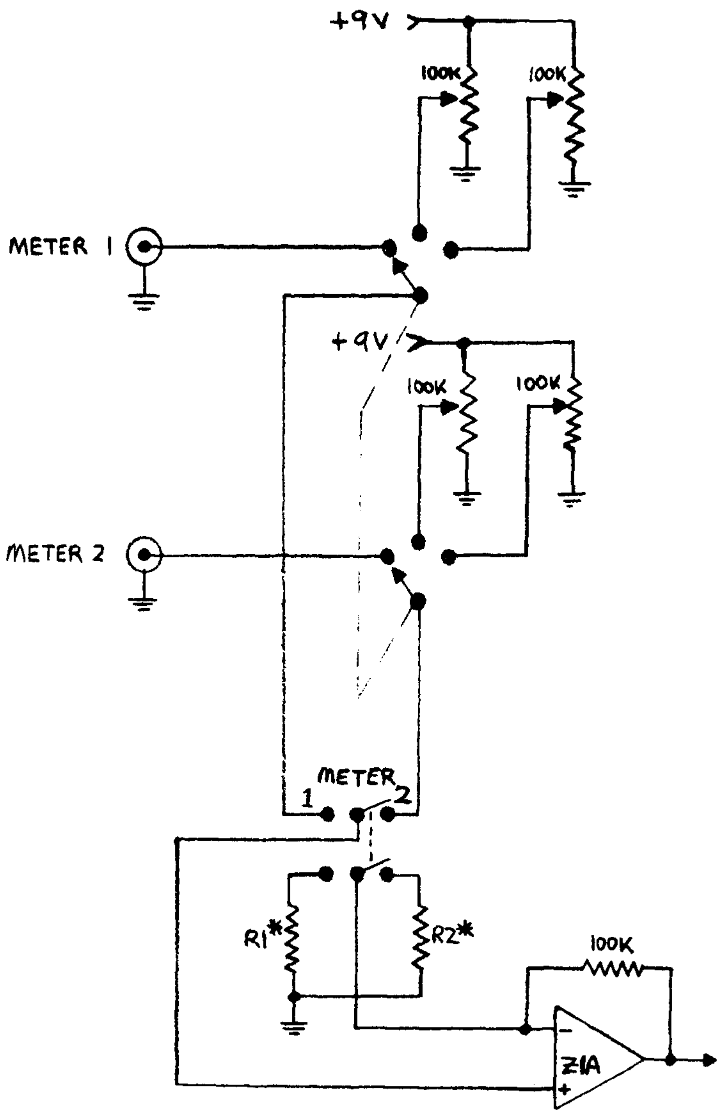


Fig. 12 -- Adapting the circuit to monitor multiple meters.

* Choose R1 and R2 for desired full-scale range of meters 1 and 2, respectively, or use the adjustable method shown in Fig. 5.

Parts List for Fig. 3

Radio Shack part numbers are given in brackets. Resistors are given in ohms. Fixed resistors are 1/4 W, 5%.

BT1, BT2	9-V alkaline battery [Battery snaps: 270-325]
J1	RCA phono jack [274-346]
S1	3-pole, 4-position rotary switch G.C.Electronics 35-379, Centralab PA-1009, Mouser 10YX034*, or see text
R14	220
R6 (see schem) R11, R12	10k
R1, R3, R10	33k
R5, R7	47k
R8, R9	100k
R2, R4	2k trimpot, Jameco 43P-2K*
R13	1k pot, Jameco CMU1021*
C1, C3	0.1 uF
C2	0.001 uF (1000 pF)
Z1	MC1458 [276-038]
Z2	LM566, Jameco*
Q1	2N2222 or equiv., [276-2009]
SPKR	Any small 8-ohm speaker

* Both of these mail order firms are good sources for ham projects; requesting their catalog would be a good idea.

Mouser Electronics
11433 Woodside Ave.
Santee, CA 92071
(619) 449-2222

Jameco Electronics
1355 Shoreway Rd.
Belmont, CA 94002
(415) 592-8097

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