73 AMATEUR RADIO

International Edition

June 1988
ISSUE #333
USA $2.95
CAN $3.95

A WGE Publication

HAMS GO DIGITAL!

Flip-Flop Tutorial
Packet BBS Basics
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Much, much more!

PROJECTS

LED X–Y Scope
PSK Data System
A/D Conversions

REVIEWS

IC–375A Transceiver
LMW 2304 MHz Transverter
Ramsey Multimeter

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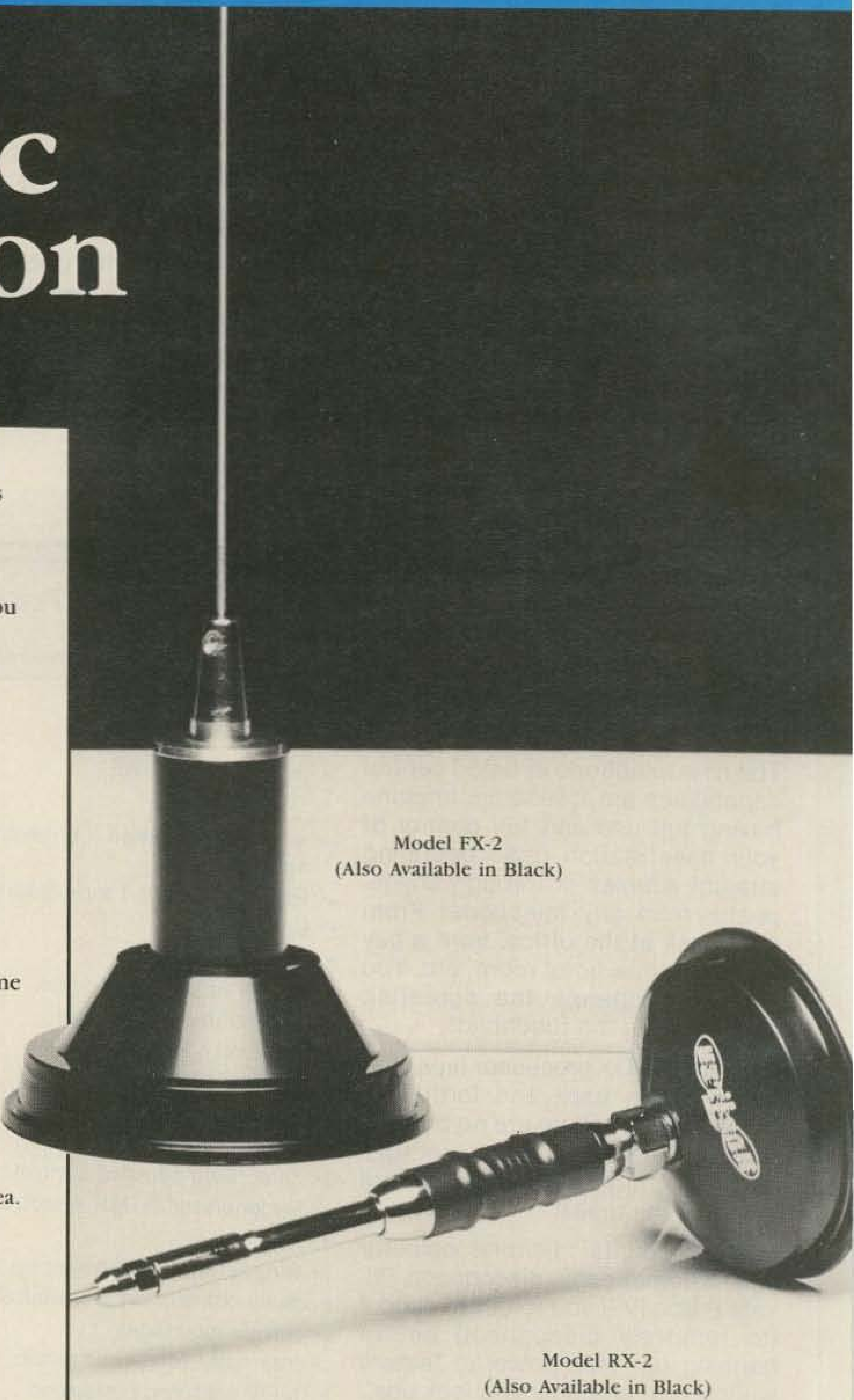
Magnetic Attraction



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- 100 watt rating
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  PL-259 connector installed
- Magnetic mount holds to 75 mph

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Welcome, Newcomers!

Digital communications—what could be easier? Just think about it.

The simplest thing to do with an electronic device is to turn it on and off, or to change a voltage from high to low or low to high. It's easy for a man or machine to differentiate between these two conditions or **logic states**. A light turned on, for example, may mean yes, while off means no; true and false; stop and go; and so on. A simple communications system like this is called **binary**, meaning to have two parts.

In digital communications, all information is expressed in terms of ones and zeros or **bits** (**b**inary dig**its**). A device may interpret a high voltage as a one, and a low voltage as a zero. With two choices, the information passed in such a simple system is obviously very limited. Therefore, we need to expand the system's "vocabulary." We do this by creating digital words, or **bytes**, made up of a convenient number of bits, usually 8, 16, or 32.

Let's take a look at a system that uses two bits for a digital word. The possible choices for words are 00, 01, 10, and 11. The choice of meaning for each digital word is ours alone. We can assign, say, "yes" and "no" to 11 and 00, respectively, and "probably" and "unlikely" to 10 and 01, respectively. Or suppose we wanted to express a voltage with our new vocabulary. This gives us four choices: perhaps 0, 1, 2, and 3 volts, or even 0, 15, 30, and 45 volts. Again, the choice is ours!

Now, let's get really adventurous and try to express the alphabet and numbers 0–9 with digital words. Thus, we need enough choices for all upper and lower case letters (52) and the numbers 0–9. That makes a total of 62 choices required. How large will our digital words have to be?

Every time we add a bit onto a digital word, the possible combinations increase by a factor of two. In the last example, we went from two to four choices by adding one bit. Three-bit words give us eight choices, and so on. To accommodate 62 choices, we need digital words six bits long, which actually produces 64 choices ($2 \times 2 \times 2 \times 2 \times 2 \times 2 = 2^6 = 64$) in our digital vocabulary. Thus, we can have a fairly complete alphanumeric digital vocabulary with six-bit words, and even have enough room for a couple of punctuation characters.

There are many digital coding schemes for alphabets and special computer characters. The five-unit **Baudot** code is used in ordinary radioteletype (RTTY) transmissions. The seven-bit **ASCII** code provides 128 choices for characters, and includes many characters peculiar to computer operations.

How do we turn voice and other **analog** signals into bytes? Special integrated circuits known as analog-to-digital **(A/D) converters** sample a signal periodically, measure its voltage, and convert the voltage to digital words. At the receiver, a **D/A converter** carries out the reverse process.

Once we have data into bits, the next step is to send it over a radio link. Again, we normally only have to worry about two choices—ones and zeros. The simplest method would turn a carrier on for a one and off for a zero, much like Morse code transmission. This method is called on-off keying (OOK). A more reliable method of data transmission uses frequency shift keying **(FSK)** in which two different tones are used to represent ones and zeros. Phase-shift keying **(PSK)** is not as common on the ham bands as in the commercial world. This method takes a constant frequency signal and alters its phase (position in degrees) to send a bit or digital word. A shift of 180 degrees is known as biphase shift keying **(BPSK)**.

Electronic communications links are subject to noise, and to minimize or eliminate errors, many systems use some form of **error correction**. Some error correction methods simply identify that an error has occurred. **Parity** schemes add a bit onto the end of a byte. With **even parity**, the total number of ones in a word will be an even number. For example, if 11101100 is our data byte, the parity bit added to the end would be a one: 111011001, thus giving an even number of one bits in the whole word. If an **odd parity** scheme had been selected, the parity bit would be zero: 111011000.

If the parity does not match upon receipt, the operator or system may request a retransmission of the suspect word.

Mode A of **AMTOR** uses an automatic repeat request **(ARQ)** error correction scheme, while Mode B uses a forward error correction **(FEC)** method. With FEC, additional bits are added to each byte to more closely identify where in a word an error has occurred. FEC schemes can be very complex.

The beauty of digital communications lies in its fundamental simplicity and the ability to **interface** the outside world to electronic devices, computers, and transmission systems. Using these methods, we can exchange, store, and retrieve information in ways only dreamed about a decade ago. Amateur radio has entered a new age, and it's exciting to be a part of it. Come join us! 73

—Larry Ledlow, Jr. NA5E

Glossary for Newcomers

A/D converters—Special ICs that sample incoming waveforms (voice, video, etc) and create digital words (bytes) proportional to the voltage. **D/A converters** reverse the process and recreate the original waveform from the bytes.

AMTOR—AMateur Teleprinting Over Radio; a radio teletype system developed by Peter Martinez G3PLX based on the SITOR maritime system. Modes A and B of AMTOR use ARQ and FEC error correction, respectively.

Analog—A signal that varies its amplitude continuously over a given voltage range.

ASCII—American Standard Code for Information Interchange; a seven-unit teleprinter code designed primarily for computer applications.

Asynchronous—A method of signal transmission that does not use any reference to a time scale; i.e., data transmissions can occur at any time. Manual morse, voice, and manually operated teletype transmissions are asynchronous. **Synchronous** data is sent according to a strict time sequence so the transmitter and receiver are synchronized.

Baud rate—A measure of data transmission speed. One baud is one element or pulse, which may correspond to one or several bits each. Baud rate is NOT always equivalent to bit rate.

Baudot—A five-unit radio teletype code commonly used on the amateur bands. It does not provide for error correction.

bit—A binary digit expressed as one or zero; fundamental element of digital communications.

byte—A digital word, often made up of eight bits.

Error correction—A coding scheme that allows detection and correction of errors in a data transmission. A system may initiate an automatic repeat request, or **ARQ**, which tells the transmitter to repeat a block of data in which an error was detected. **FEC**, or forward error correction, actually builds a correction scheme into a data stream, either by adding bits to each word or by repeating each word several times to increase the chance of proper reception.

FSK—Frequency shift keying; the use of separate tones to send data bits.

Interface—The point at which data is transferred from one component to another.

modem—Modulator/demodulator; a device used to send and receive digital data.

Parity—An expression that indicates whether the number of bits in a code word is even or odd.

PSK—Phase shift keying; the use of phase changes of a constant frequency signal to send data bits. 180-degree phase shifts generate bi-phase shift keying, **BPSK**.

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Wayne Green Enterprises is a division of International Data Group.

73 Amateur Radio (ISSN 0889-5309) is published monthly by WGE Publishing, Inc., a division of Wayne Green Enterprises, Inc., WGE Center, Peterborough NH 03458-1194.

73 AMATEUR RADIO

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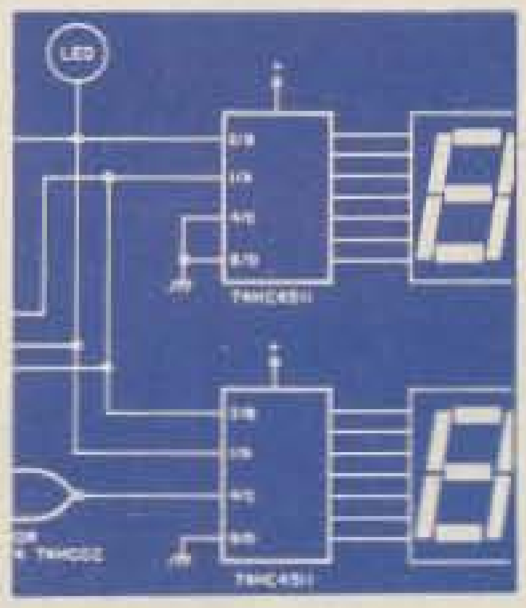

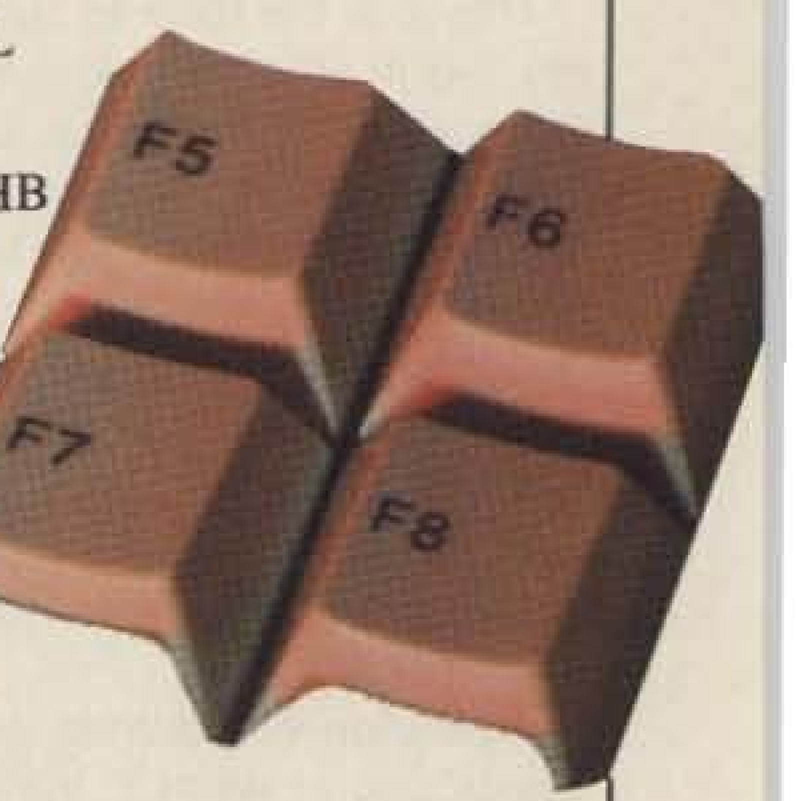

REVIEWS

DEPARTMENTS

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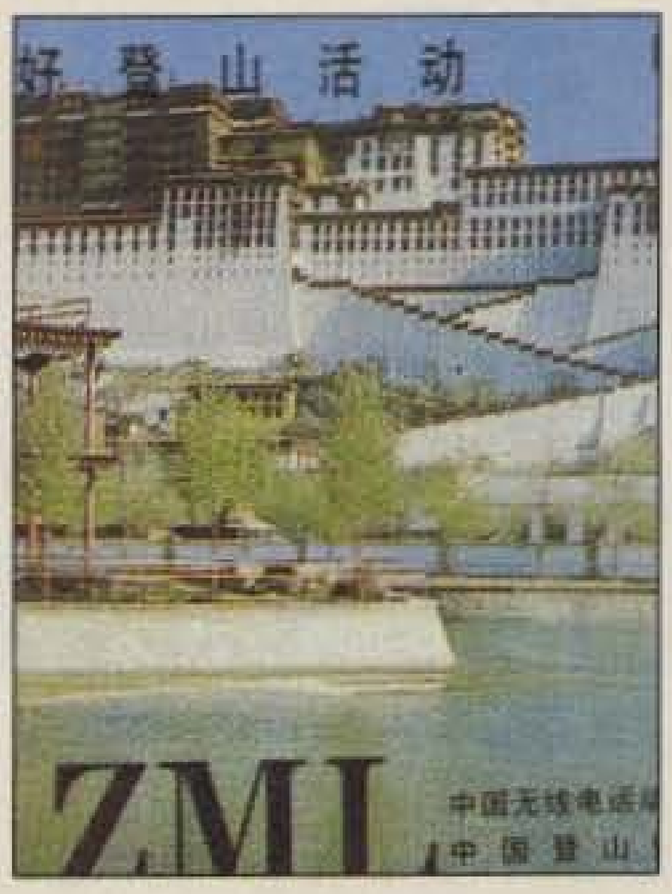

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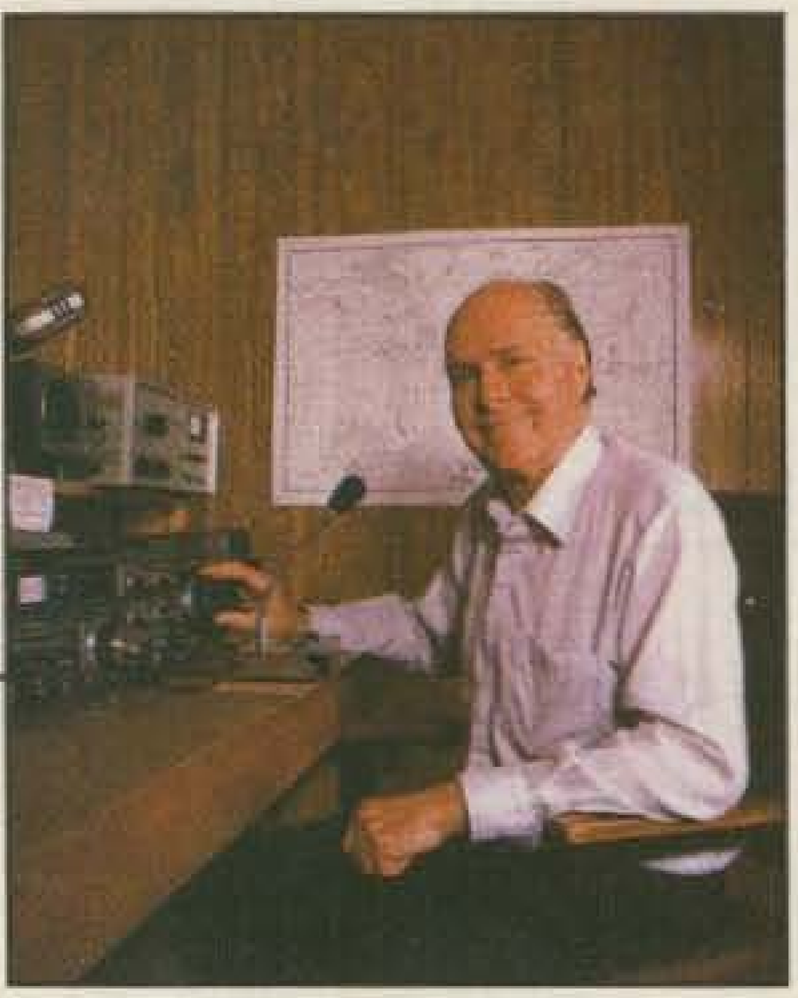

A Small World

An interesting article on cosmology in a recent *Discover* magazine mentioned a Chandra Wickramasinghe as the author of several books. Hmmm. How many Wickramasinghes can there be in the world? Could it be as common in Sri Lanka as Jones in America?

This took me back to 1959 and my flight around the world on Operation World-Wide. Lordy, that was almost 30 years ago! There I met Soma Wickramasinghe 4S7ES and her beautiful daughter Chitra during a two-day visit to Colombo, Ceylon. Soma was by far the most active ham on Ceylon. Indeed, I'd even worked her from my W2NSD home station several times.

Operation World-Wide was the brainstorm of W8PLJ, the PR director at the Pure-Pak division of Ex-Cell-O Corporation. Pure-Pak—you'll see their trade mark on almost any milk carton—was interested in doing a film of their milk container operations around the world. Since the cost of sending a film crew on such a jaunt was prohibitive, some way to cut this cost had to be found. The obvious answer was to get the government to foot the bill.

The Military Air Transport Service (MATS) provided an old C-54 left over from the Berlin Airlift operation and a crew. Pure-Pak provided the film crew. In addition to filming the milk-carton operations, the crew also would do a film on MATS for the government, thereby justifying the expense of the plane and crew. How about a ham station on the plane as it flies around the world? Great idea!

As the then-editor of *CQ*, I heard about the trip, and also found out that one of the two hams selected to go along to operate had suddenly developed a heart problem. I quickly volunteered, and the next thing I knew I was aboard the plane, leaving from McGuire Air Force Base, New Jersey, for a trip around the world.

The ham gear was the newest of new: two of five prototype Hallicrafters FPM-200 sideband solid-state transceivers, with a backup of the older Hallicrafters HT-32 and SX101 tube gear. Aboard with me were Bill Leonard W2SKE for CBS News, Hallicrafters' Bud Drobish W9QVA, Pure-Pak's W8OLJ, the film crew, the Air Force flight crew and an Air Force PR chap.

Unauspicious Start

The first stop was Newfoundland (which was still a separate country then). The two prototype rigs blew up a few hours out of New Jersey. No problem, I thought, let's fix 'em. No, said Bud, we have to ship them back to the factory to be fixed. We had no spares, no schematic or service information and all of the transistors had been soldered into the circuit boards, so repairs were out.

We didn't get that solid-state rig back until late in the trip, despite heroic efforts by Hallicrafters. The older HT-32 tube emergency rig worked fine, so Bill and I were able to talk with hams all around the world as we flew. All contacts were taped and excerpts were used on NBC's "Monitor" program.

(I even heard a contact between me and a Romanian ham on a Hallicrafters 45 rpm record a couple years later. I remember driving along Coney Island Ovenue in Brooklyn in my Porsche Speedster in which I had a Philips record player. I was listening to the Hallicrafters "Listen To The World" promotion record—and there I was! And nobody around to tell.)

The Operation World-Wide route took us in short, low altitude hops to Newfoundland, Bermuda, The Azores, Scotland, Paris, Berlin, Haderslev (Denmark), Rome, Athens, Izmir (Turkey), Alexandria (Egypt), Aden (South Yemen), Karachi, Colombo, Bangkok, Saigon (where an air raid was in progress when we arrived), Philippines, Taiwan, Okinawa, Seoul, Tokyo, Guam, Wake

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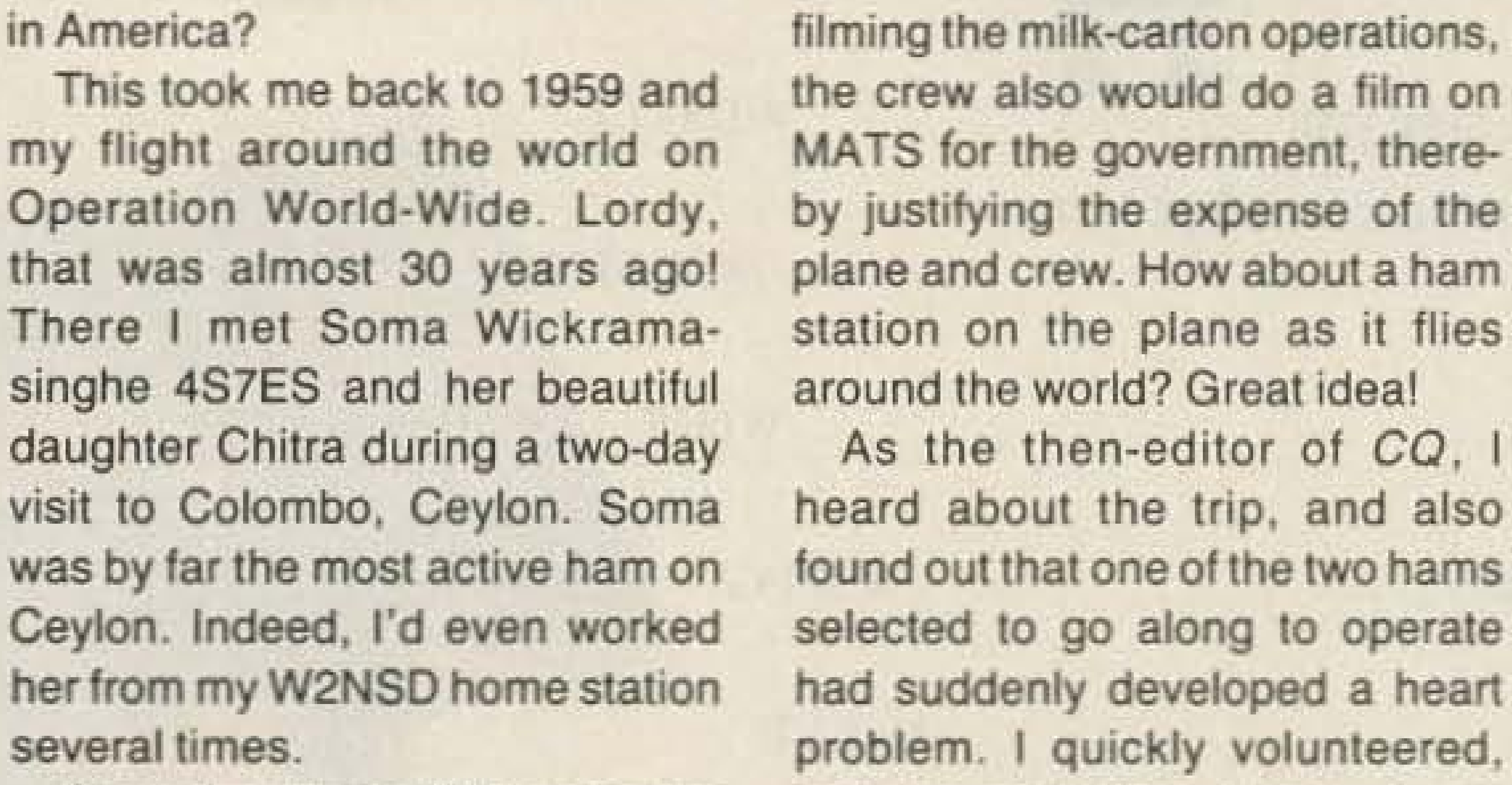

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Subscription Information

One Year (12 issues) $24.97; Two Years (24 issues) $44.98. Canada, Mexico and Foreign Surface: One Year $31.75 (US Funds); Two Year $57.00 (US Funds). Foreign Airmail: One Year $39.00 (US Funds); Two Years $70.00 (US Funds). Send new or renewal notices, inquiries, and change of address to 73 Amateur Radio, P.O. Box 931, Farmingdale NY 11737. Allow 4-6 weeks for subscription and change of address processing. For Customer Service, call toll-free at 1-800-227-7585. For renewals and changes of address, please include the address label from your most recent issue of 73. For gift subscriptions, include your name and address as well as those of the gift recipients. Second class postage paid at Peterborough NH 03458, and at additional mailing offices. Canadian second class mail registration number 9566. Microfilm Edition—University Microfilm, Ann Arbor MI 48106.

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- **TM-321A covers 220-224.995 MHz. The TM-421A covers 438-449.995 MHz.**
- **Built-in front panel selection of 38 CTCSS tones.** TSU-5 programmable decoder optional.
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- **16 key DTMF hand mic., mic. hook, mounting bracket, and DC power cable included.**
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- **Packet radio compatible!**
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- **Programmable band scanning.**
- **Memory scan with memory channel lock-out.**
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RC-10 Remote Controller

For TM-221A/321A/421A. Optional telephone-style handset remote controller RC-10 is specially designed for mobile convenience and safety. All front panel controls (except DC power and RF output selection) are controllable from the RC-10. One RC-10 can be attached to two transceivers with the optional PG-4G cable. When both transceivers are connected to the RC-10, **cross band, full duplex repeater** operation is possible. (A control operator is needed for repeater operation.)

Optional Accessories:

• **RC-10** Multi-function handset remote controller • **PG-4G** Extra control cable, allows TM-221A/TM-421A full duplex operation • **PS-50/PS-430** DC power supplies • **TSU-5** Programmable CTCSS decoder • **SW-100A** Compact SWR/power/volt meter (1.8-150 MHz) • **SW-100B** Compact SWR/power/volt meter (140-450 MHz) • **SW-200A** SWR/power meter (1.8-150 MHz) • **SW-200B** SWR/power meter (140-450 MHz) • **SWT-1** Compact 2 m antenna tuner (200 W PEP) • **SWT-2** Compact 70 cm antenna tuner (200 W PEP) • **SP-40** Compact mobile speaker • **SP-50B** Mobile speaker • **PG-2N** Extra DC cable • **PG-3B** DC line noise filter • **MC-60A, MC-80, MC-85** Base station mics. • **MC-55** (8-pin) Mobile mic. with gooseneck and time-out timer • **MA-4000** Dual band antenna with duplexer (mount not supplied) • **MB-201** Extra mobile mount

Specifications and prices subject to change without notice or obligation.
Complete service manuals are available for all Kenwood transceivers and most accessories.

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- **Wide receiver frequency range.** Receives from 141-163 MHz. Includes the weather channels! Transmit from 144-148 MHz. Modifiable to cover 141-151 MHz (MARS or CAP permit required).
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- **5, 2.5, or 1.5 W output, depending on the power source.** Supplied battery pack (PB-2) provides 2.5 W output. Optional NiCd packs for extended operation or higher RF output available.
- **CTCSS encoder built-in.** TSU-4 CTCSS **decoder** optional.
- **10 memory channels store any offset, in 100-kHz steps.**
- **Odd split, any frequency TX or RX, in memory channel "0."**
- **Nine types of scanning!** Including new **"seek scan" and priority alert.** Also memory channel lock-out.
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- **Easy memory recall.** Simply press the channel number!
- **12 VDC input terminal for direct mobile or base station supply operation.** When 12 volts applied, RF output is 5 W! (Cable supplied!)
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- **Priority alert function.**
- **Monitor switch to defeat squelch.** Used to check the frequency when CTCSS encode/decode is used or when squelch is on.
- **Large, easy-to-read multi-function LCD display with night light.**
- **Audible beeper to confirm keypad operation.** The beeper has a unique tone for each key. DTMF monitor also included.
- **Supplied accessories:** Belt hook, rubber flex antenna, PB-2 standard NiCd battery pack (for 2.5 W operation), wall charger, DC cable, dust caps.

Optional Accessories:

• PB-1: 12 V, 800 mAH NiCd pack for 5 W output • PB-2: 8.4 V, 500 mAH NiCd pack (2.5 W output) • PB-3: 7.2 V, 800 mAH NiCd pack (1.5 W output) • PB-4: 7.2 V, 1600 mAH NiCd pack (1.5 W output) • BT-5 AA cell manganese/alkaline battery case • BC-7 rapid charger for PB-1, 2, 3, or 4 • BC-8 compact battery charger • SMC-30 speaker microphone • SC-12, 13 soft cases • RA-3, 5 telescoping antennas • RA-8B StubbyDuk antenna • TSU-4 CTCSS decode unit • VB-2530: 2m, 25 W amplifier (1-4 W input) • LH-4, 5 leather cases • MB-4 mobile bracket • BH-5 swivel mount • PG-2V extra DC cable • PG-3D cigarette lighter cord with filter

Complete service manuals are available for all Kenwood transceivers and most accessories. Specifications and prices are subject to change without notice or obligation.

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QRX . . .

EDITED BY LARRY LEDLOW, JR. NA5E

AMSAT Phase 3C

OSCAR 13 may well be a reality by the time you read this. Prospects for an on-schedule launch of the latest Phase 3 hamsat looked great at press time. A successful launch of Ariane mission V-21 on March 11 set the stage for missions V-22 and V-23 in May. If V-22 is launched according to plan, V-23 will carry Phase 3C, METEOSAT, and PANAMSAT alofton May 26.

AMSAT will release Phase 3C for general use after a three or four week checkout period.

DXers' Delight

The peak of the current solar cycle could occur much earlier than expected, according to Dr. Patrick McIntosh, Director of Solar Physics Research at NOAA's Space Environment Laboratory in Boulder, Colorado. No doubt many hams have observed the good band openings during the past spring. Dr. McIntosh suggests that if current trends continue, the solar peak could be the most intense ever recorded, surpassing even the legendary 1957 maximum!

Dr. McIntosh warns that solar predictions are risky business, but he bases his predictions on three factors: the total number of sunspots and sunspot clusters; the rate of increase of 10cm band noise; and the progression of "solar crowns," areas of intense magnetic fields, towards the solar poles.

If the scientist's prediction are correct, the next solar peak could occur as early as the end of 1988 instead of 1992.

Calling All Cars

Bill Gardner W8WG has proposed direct communications with police systems for amateur radio operators. In his recent proposal to the FCC, Mr. Gardner outlined two systems that would allow cross-service communications.

His first system would allow cross-band operation, in which both hams and police transmit on their assigned frequencies but monitor each other with "scanner receivers." The other system would establish "National Police Box Frequencies" near the edge of the ham bands (29.690, 50.005 or 52.005, 147.99, and 449.975 MHz), on which police could communicate directly with hams. The latter proposal would require a change to Part 97 to allow police access to amateur frequencies.

Part 97 Rewrite

The FCC has proposed to reorganize Part 97, the rules governing the Amateur Radio Service. Part 97 has not been rewritten since 1951, and the Commission wishes to clarify and update the "patchwork quilt" of rules. Many technology and operational changes have occured since the last reorganization of the rules, and the FCC proposal would clarify and modernize the regulations. The actual text of this Notice of Proposed Rule Making is nearly 90 pages long. The deadline for comments on PR Docket 88-139 is August 31.

No Changes to Access Charges

The FCC has quietly scrapped its plan to increase telephone rates for computer users. According to the *Wall Street Journal*, the Commission notified members of Congress that it would no longer pursue its plan to increase computer network access charges by as much as $5.50 per hour. Computer users across the nation had opposed the proposed move, which represented a potential increase in connect charges of 100 percent or more. Information service companies like Compuserve, GEnie, Delphi, and BIX also opposed the proposal, claiming the steep access charges would have put them out of business.

The decision to drop the rate increase proposal came shortly after Rep. Edward Markey (D-Mass.), chairman of the House Telecommunications Subcommittee, said he would introduce legislation to kill the access charges. The FCC also received about 10,000 letters from computer users opposing the move, a record number of comments for a telephone issue.

The FCC will continue a separate effort to assess charges of $4.50 per hour per user to hook up private telephone networks to local systems.

Senior Ham Recruitment

The ARRL has targeted non-hams aged 50 and over for recruitment into the hobby of amateur radio. A pilot program in the Tampa/St. Petersburg, Florida, area will commence this summer. In an effort to interest more retirees in ham radio, the program will primarily recruit new hams from senior citizens' organizations. If the pilot program proves successful, a nationwide effort will follow.

Data Convention

The Radio Society of Great Britain invites participants and lecturers to the RSGB Data Convention on July 22–23. As part of their 75th anniversary celebration, the Society has organized this two day event for all hams interested in various aspects of digital data transmission and reception. The convention will be held at the Harrow School, Harrow-on-the-Hill, Middlesex. Speakers from Europe and North America will make this a truly interesting meeting, perfect for beginners to experts. For more information, contact Smudge Lundegard, Saxby, Botsom Lane, West Kingsdown, Sevenoaks, Kent TN15 6BL England, or call his office at 011-44-322-613121.

Silver Anniversary

This year is the 25th anniversary of the International Mission Radio Association, Inc. (IMRA). IMRA was founded in 1963 by 50 amateur radio operators—all of them brothers and priests in a Capuchin seminary in Hudson, New Hampshire. It has grown to include not only Catholic missionaries on overseas assignments, but laity and missionaries of all denominations. IMRA hams have offered emergency help and consolation to people whose lives have been ravaged by natural disasters. The ecumenical association's 800 ham operators regularly pass traffic to and for people in remote parts of the world.

FT-727 Dual Band HT

There has been an enthusiastic response to the December 1987 *73 Magazine* product review on the Yaesu FT-727R. Those wishing more information on the 727 should call Bryan Hastings, the author of the review, at the *73* Editorial Offices, as he is often not able to answer correspondence as quickly as he would like! The phone number is (603) 525-4201, Ext. 554.

Muchas Gracias

to this month's QRX news contributors. They are *Westlink Report*, *W5YI Report*, *AMSAT Bulletin*, *Connect International*, *ARRL Letter*, *The Christian Century*, and the *Wall Street Journal*.

73 Magazine welcomes any and all news items and photos of interest to hams. Please send them to the magazine at WGE Center, Peterborough NH 03458-1194. Attn: QRX.

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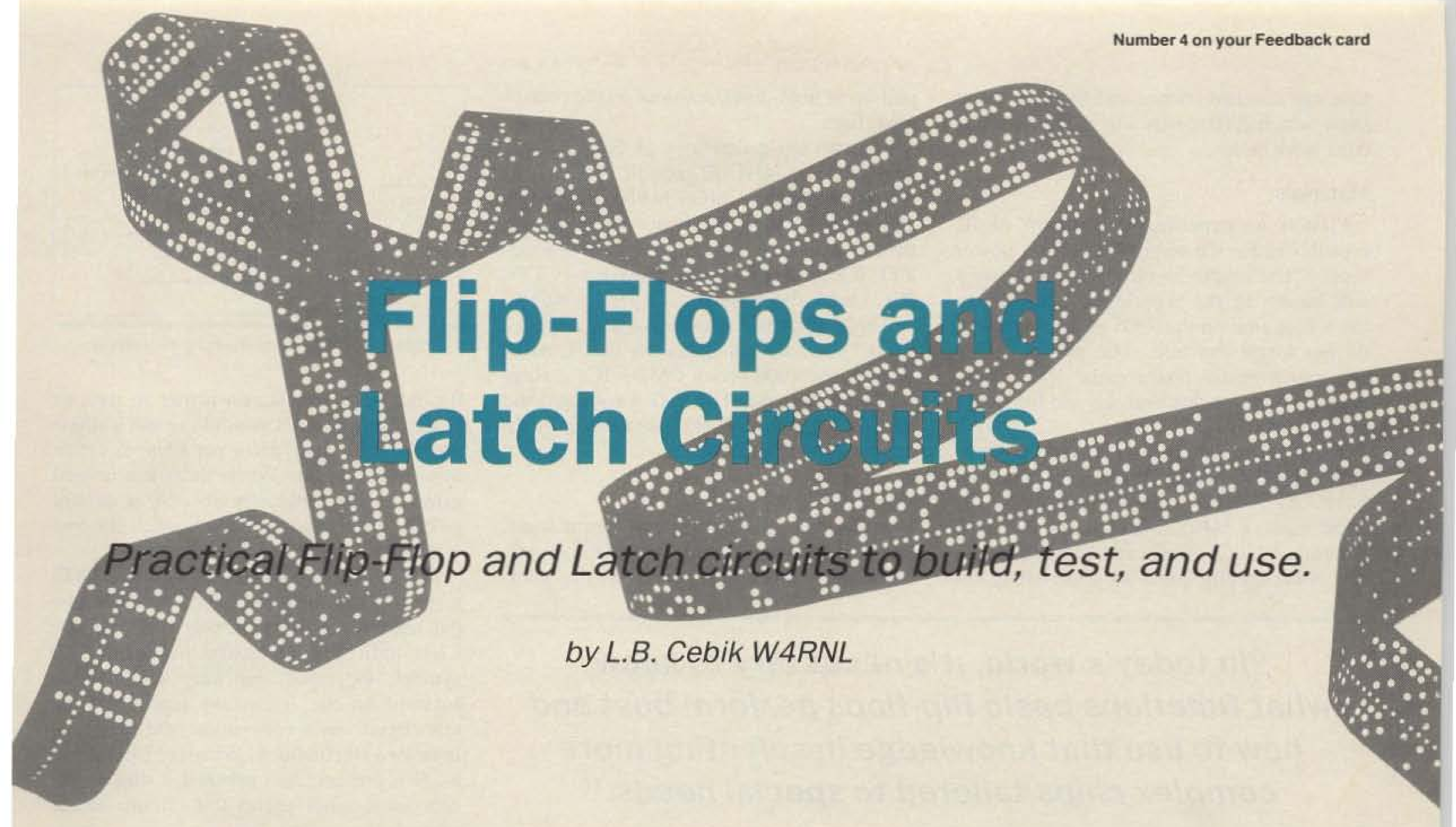


Flip-Flops and Latch Circuits

Practical Flip-Flop and Latch circuits to build, test, and use.

by L.B. Cebik W4RNL

"In today's world, it's necessary to know what functions basic flip-flops perform best and how to use that knowledge in selecting more complex chips tailored to special needs."

Why Know Flip-Flops and Latches?

The flip-flop is one of the most versatile chips in the entire digital IC family. "Flip-flop" is actually the name of a circuit configured in many different ways; for example, with transistors or gate chips. A more formal name for the circuit is the bi-stable multivibrator. The more informal name reflects the fact that modern ICs add special features to the basic circuit to make it even more flexible. It's possible to clock in data, preset the outputs, clear the outputs, and feed the output back to the input. These features allow the creation of many useful circuits.

There are many good sources of information on the basic theory of the flip-flop in its many forms. Lancaster's *Cookbooks* devote entire chapters to fundamental flip-flop operation. Times have changed since the publication of this information. Digital families now have hundreds of members, many of which perform special functions that, at one time, had to be configured with several gate and flip-flop chips. In today's world, it's necessary to know what functions basic flip-flops perform best and how to use that knowledge in selecting more complex chips tailored to special needs. Therefore, there will be little theory here.

This discussion will mainly look at practical circuits and see how hams can apply them to their designs. Some of the jobs basic flip-flops still do best are switching, dividing by two, making controllable shift registers, and controlling circuit functions. This is not all the work fit for flip-flops, but it provides an appreciation of their versatility.

Related to the flip-flop in most data-book listings is the latch. Although somewhat different in internal circuitry and function, the latch also holds a piece of data and controls circuit functions. This presentation will com-

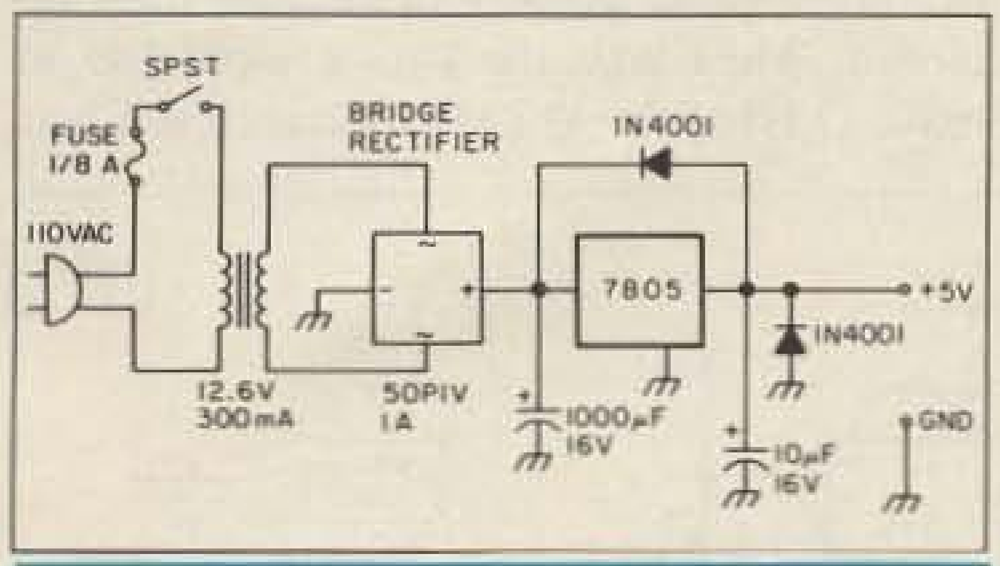


Figure 1. 5-volt test power supply.

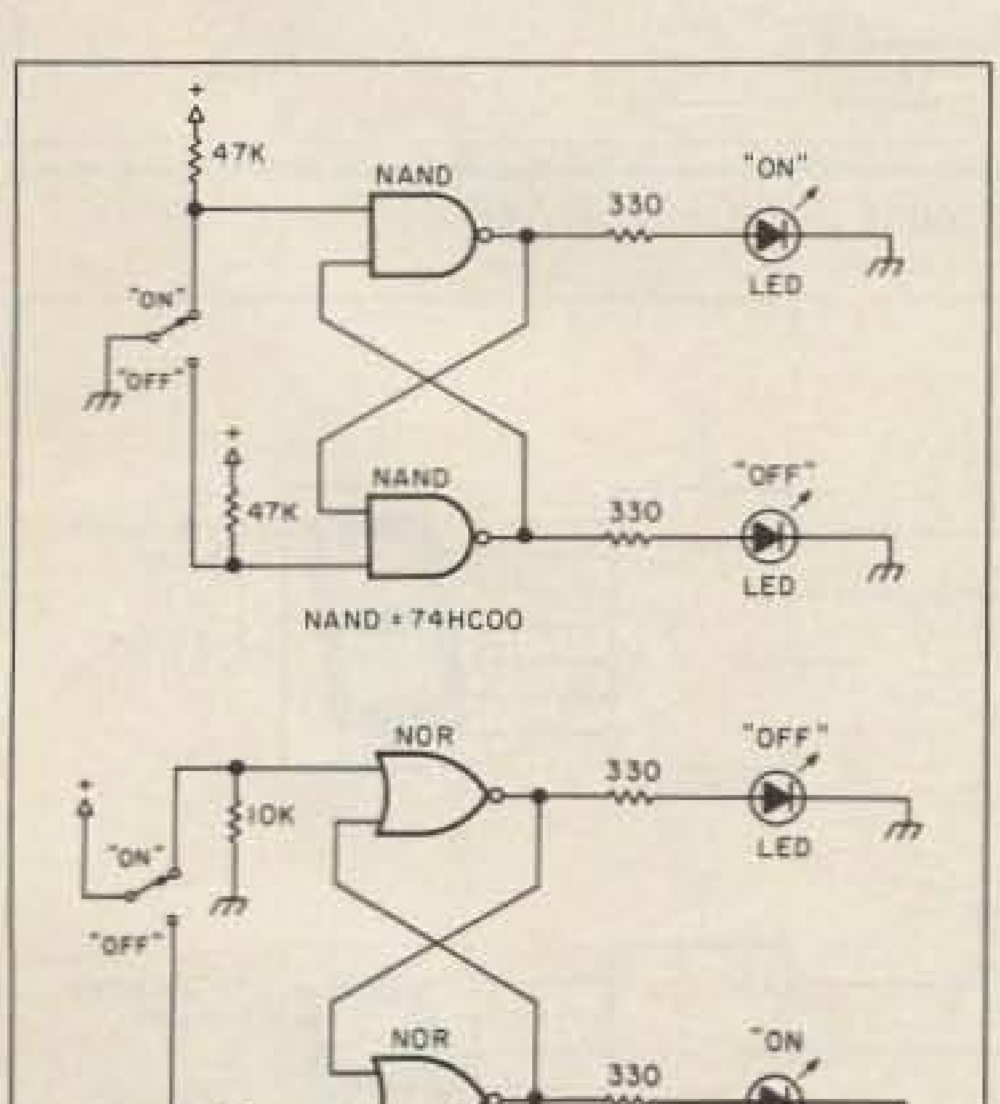


Figure 2. NAND and NOR flip-flop switches.

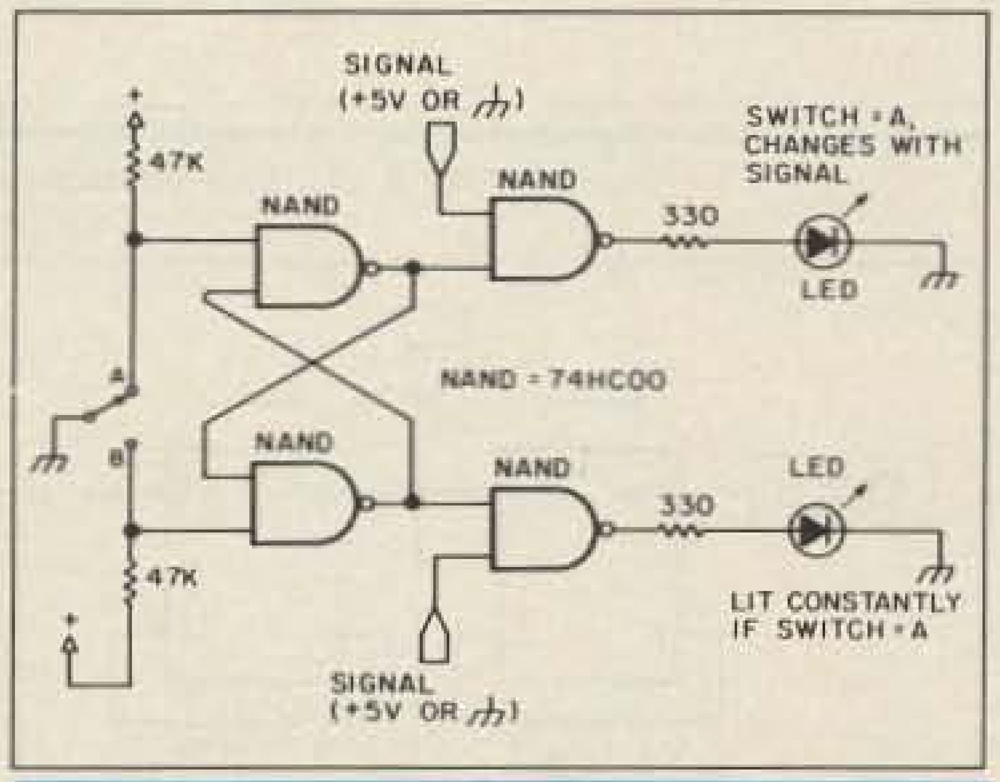


Figure 3. NAND flip-flop controlling pass/block gates.

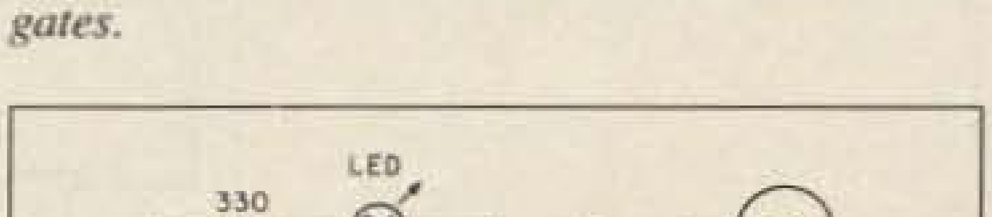


Figure 4. LED indicator symbol to simplify drawings.

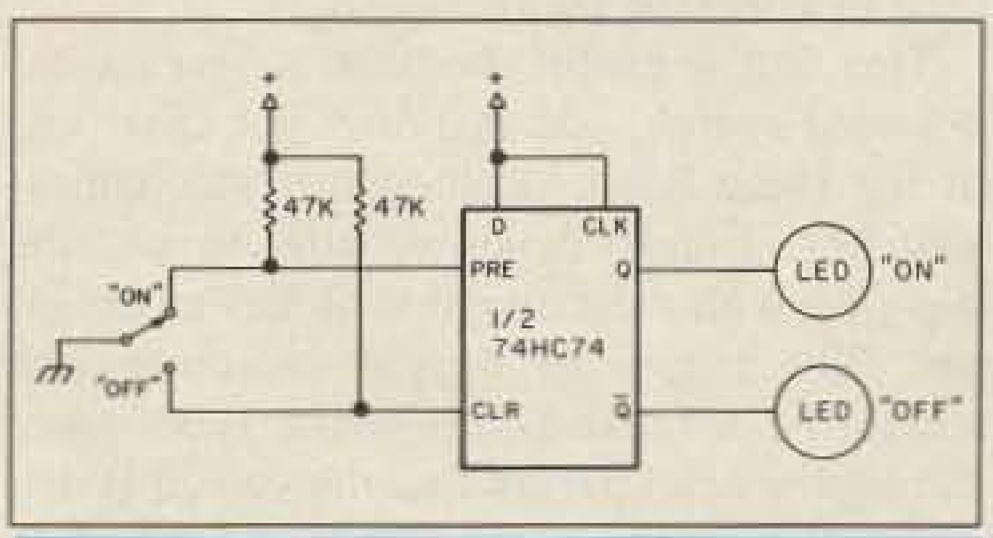


Figure 5. Flop-flop chip used as a debounced switch.

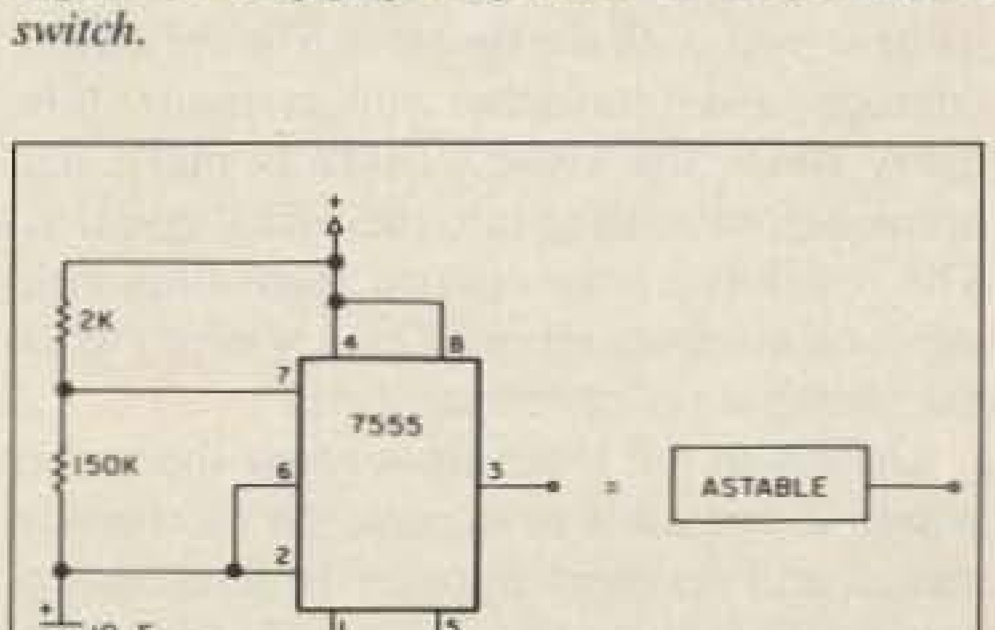


Figure 6. A handy source of slow pulses.

pare and contrast latches and flip-flops, and show which differences will make ham circuits work better.

Materials

First is an experimenter's board or IC breadboard for the tests. Second is a power supply. The simple 5-volt supply in Figure 1 will handle all the experiments. Be sure to use a heat sink on the 7805 regulator. Also, do not forget the fuse. The power supply and experimenter board make up a useful package both for this exercise and for future experiments.

Third, a small collection of parts. Four or five 74HC74 D-type flip-flops, a couple of 74HCOO NAND gates, a pair of 74C02 NOR gates, a 74HC75 latch, a few LEDs, a handful of 330Ω, 10kΩ, and 47kΩ resistors, plus some specific parts for some handy test modules will fill the bill. No soldering will go on here, since these parts will later go into real projects.

"In today's world, it's necessary to know what functions basic flip-flops perform best and how to use that knowledge in selecting more complex chips tailored to special needs."

The Basic Flip-flop

Figure 2 shows a pair of basic flip-flop circuits made from gates. As the two diagrams show, either a pair of NANDs or a pair of NORs will work fine. Because the output of one gate feeds back to an input of the other, briefly changing the rest state of one of the control lines can switch and latch the output state. Not only does the output change when the input changes, it stays that way after releasing the switch or whatever pulse system used to affect the control inputs.

This fact is useful, because it gives a debounced switch, one that does not show any of the make-break problems of mechanical switches. Figure 2 shows how to use the flip-flop with mechanical switches at the input. The rotary or toggle switch switch should be a break-before-make type, since during the brief period that the switch is disconnected between positions, the flip-flop output will remain as it was left. It changes to its new state with the first touch of the switch contacts, and it stays that way, no matter how many times the switch contacts make and break before settling into their final position. The resistors on the control input lines hold the control inputs HI or LO (as needed) when the switch is not reversing them.

The Xs in the input lines show the points where it's possible to remove the mechanical switch and resistors in order to feed control signals directly to the inputs. This mode of operation requires signals always present at the inputs as either HIs or LOs. If a no-signal condition is desired (e.g., following a tri-state buffer) then one should keep the pull-up or hold-down resistors on the control input lines.

The two basic flip-flops in Figure 2 use 74HCOO and 74HCO2 gates. It's possible to substitute regular CMOS NAND and NOR gates (with changes of pin numbers) and use the same value resistors. If using 7400-series TTL ICs or 74LSOO-series low-power TTL ICs, check the manuals for proper pull-up and hold-down resistors. However, since the 74HCOO-series combines the best features of both the 4000-series CMOS ICs (except for the wide range of operating voltages) and the 74LSOO-series, I will use them throughout these experiments.

Versatility

Notice that the flip-flop has two outputs. They are conventionally called Q and −Q, since one is always the reverse of the other. When changing a control input, both outputs change together. This feature is very useful, because some complex circuits may require a HI in one place and a LO in another, with both conditions reversed for the off, inactive, or opposite condition. Figure 3 shows an example, using gates as passing/blocking elements for pulses. When gate 1 passes, gate 2 blocks, and vice versa. The output from the flip-flop tells the gates whether to pass or block. Note that it's possible to use a single gate IC with four gates per chip to create this entire circuit. When there are unused gates and the builder needs only a control switch, the simple flip-flop is often the best way to go.

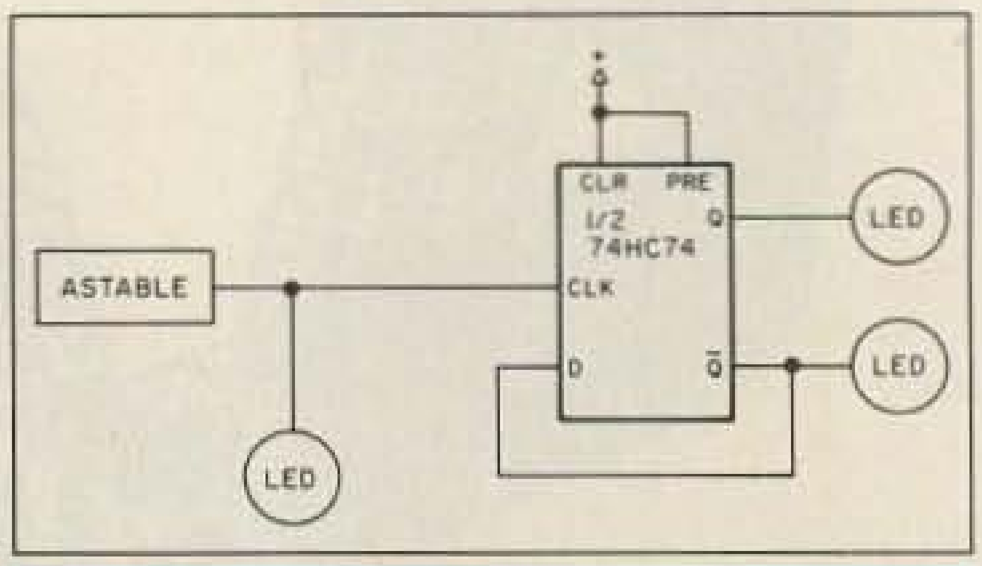


Figure 7. Basic divide-by-2 flip-flop circuit.

In Figures 2 and 3, LEDs with series 330Ω resistors are indicators. Figure 4 shows how the remaining diagrams will represent the LED indicator. By using the simplified symbol, the reader can keep his attention focused on the important aspects of the test circuit. As a convention, the LED will indicate a HI condition. When the LED is off, a LO is present. As I proceed, I shall represent some other useful test circuits in the same way.

One can do the same basic switching job of Figure 4 by using one of the designated flip-flop ICs, such as the 74HC74 D-type flip-flop shown in Figure 5. For the moment, ignore the Data and Clock inputs by tying them to the positive supply voltage line. For this chip, the Preset and Clear inputs are the control lines that correspond to those in the gate flip-flop circuit. Then take the Preset input LO to make Q HI and −Q LO, and take the Clear

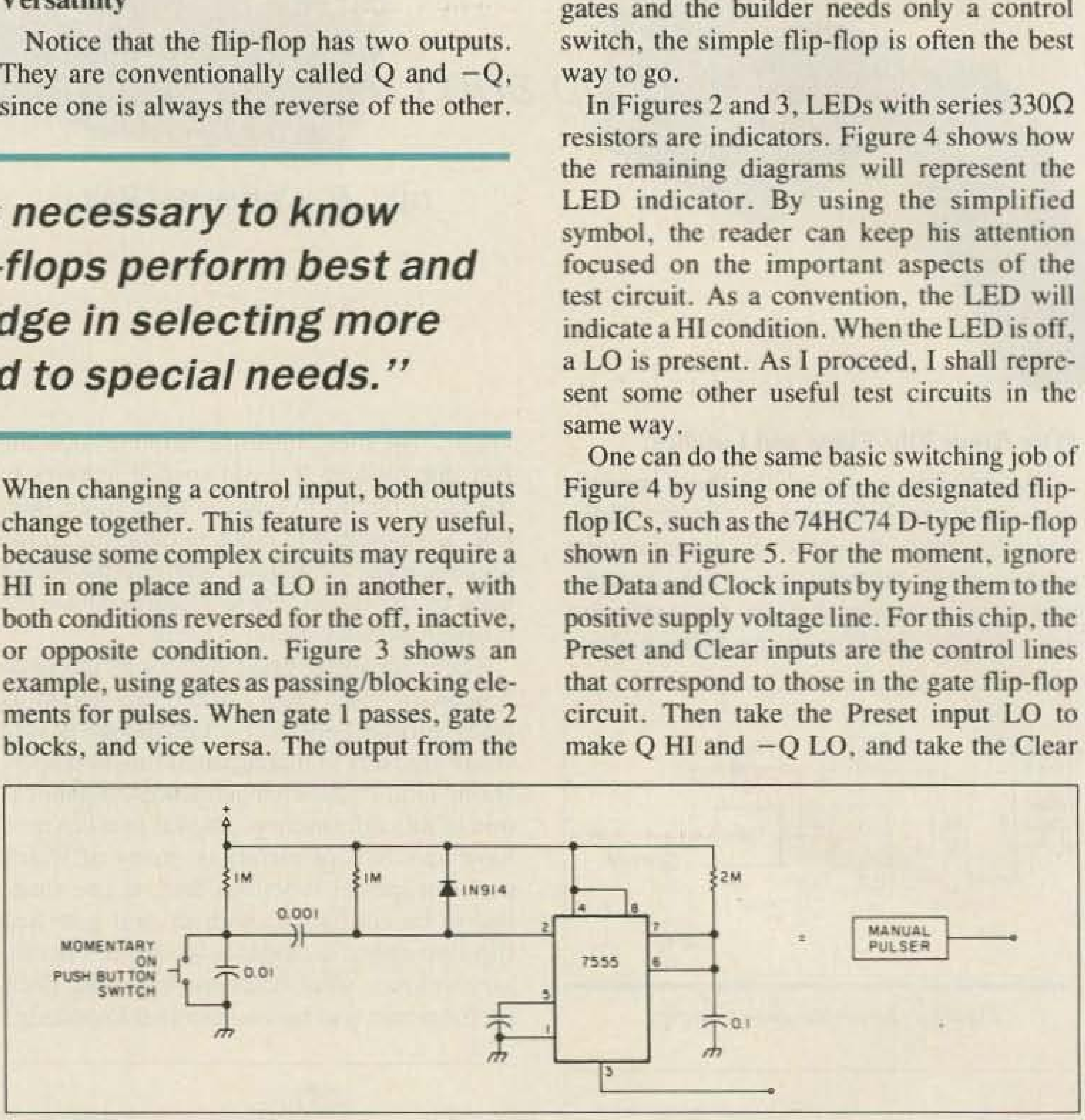


Figure 8. A handy manual pulser (pulse duration ⅓ second).

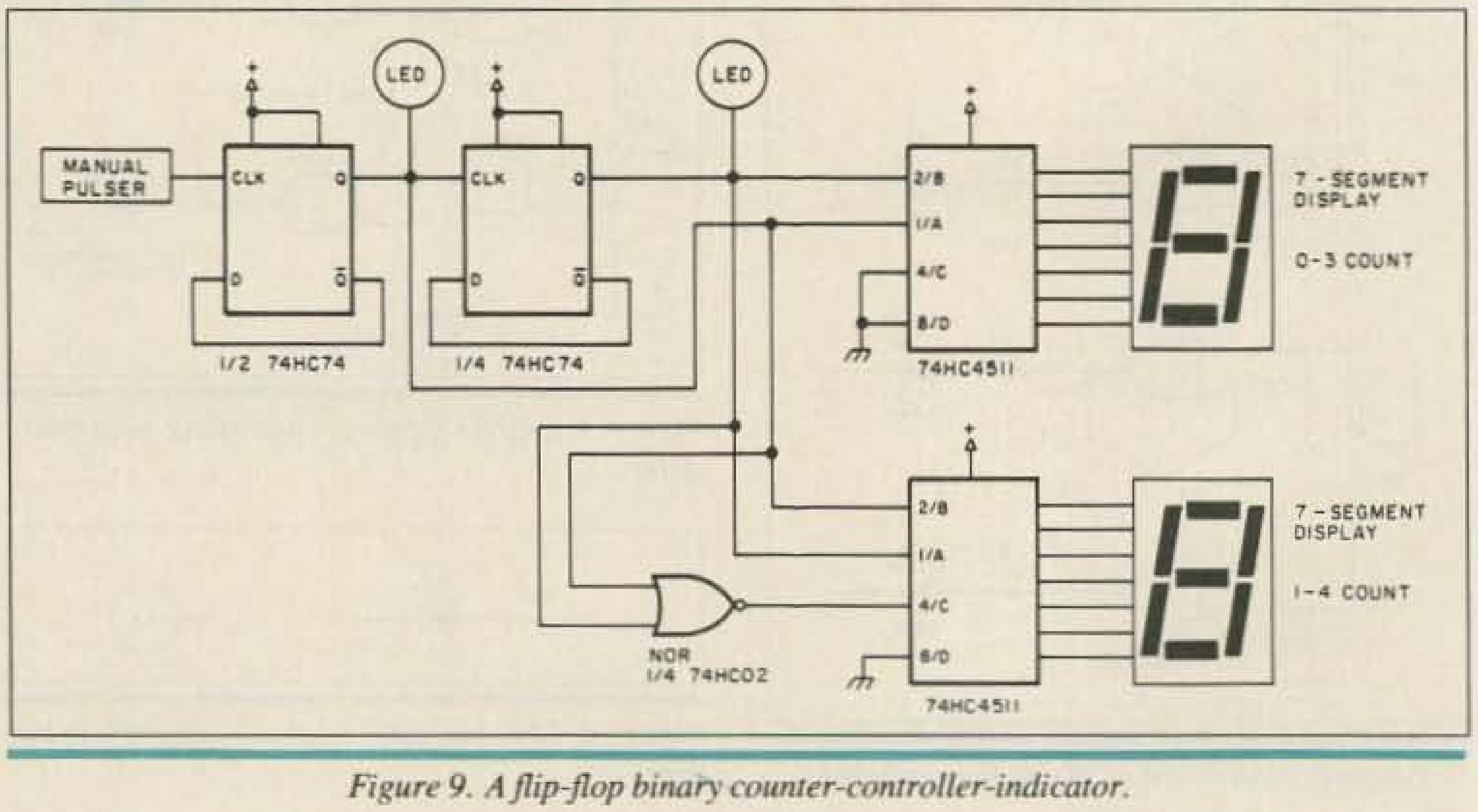


Figure 9. A flip-flop binary counter-controller-indicator.

line LO to make Q LO and −Q HI. Since the 74HC74 has two flip-flops per chip, only half a chip is used, just as the gate version of the switch.

There are other kinds of flip-flop chips, such as the J-K models, and there are multiple flip-flop chips with many individual circuits, but restricted control features. Rather than entering the confusion of trying to track many different kinds of ICs, I'll stick with the 74HC74 so the reader can try to master most of its capabilities. Then the reader can apply the lessons learned to almost any of the other variations.

Flip-flops as Dividers

The D-type flip-flop provides additional circuitry for clocking data into the chip. A pulse source will help make use of this circuitry in these experiments. The astable circuit in Figure 6 uses a 7555 to produce pulses with about a 1 second on-time and a 1 second off-time. The 74HC00-series chips here can handle frequencies well above 10 MHz, but this slow pulse rate allows the reader to see the circuit operation more clearly.

To use the Data and Clock inputs of the 74HC74, hold the Preset and Clear lines HI. Next, we must place the data (a HI or a LO) at the Data input. Finally, place a LO-to-HI transition on the Clock input line. The first step is normally done when wiring the circuit, as in Figure 7. Then, whatever the state of the Data line, when the clock goes from LO to HI, the D-state will appear at the Q output and its opposite will appear at the −Q output.

However, Figure 7 shows the −Q output wired back to the D input. The circuit also shows the 7555 astable circuit feeding pulses to the Clock input. Take a close look.

Assume that Q is LO and −Q is HI. This means that D is also HI. When the Clock pulse goes from LO to HI, the HI on D appears at Q. Then −Q goes LO, which means that D also goes LO. But nothing will happen to D's LO until the next Clock pulse changes from LO to HI. With this second pulse, Q goes LO and −Q goes HI, feeding D a HI. This cycle continues. Note that the Q and −Q outputs make one complete pulse for every two pulses from the 7555. The circuit divides the frequency of the astable by 2.

The divide-by-two circuit is very useful. Sometimes an experimenter needs both the original frequency and another frequency half as fast. In many applications, the tester can start the astable at twice the desired frequency, and use the divider circuit to bring it to just the desired value. Remember that in the 7555 circuit, the HI and LO durations are not exactly equal. If equal on and off times are important (e.g., in coded systems), the divider circuit guarantees equality.

Simple Counter

A builder can make a simple binary counter and controller by stringing together divider circuits. To operate this circuit, let's make a debounced manual pulser. Figure 8 shows a good circuit, again using the 7555. The input resistors and capacitors to the trigger pin simply guarantee that there is one pulse per finger press on the switch. I use some extra keyboard switches pulled from a defunct project for this work. Keyboard switches are among the best press-release switches available. Incidentally, I keep two or three prewired perfboard versions of both the pulse circuit and the astable circuit close at hand and just plug connecting wires into the breadboard. In the long run, that saves a lot of time.

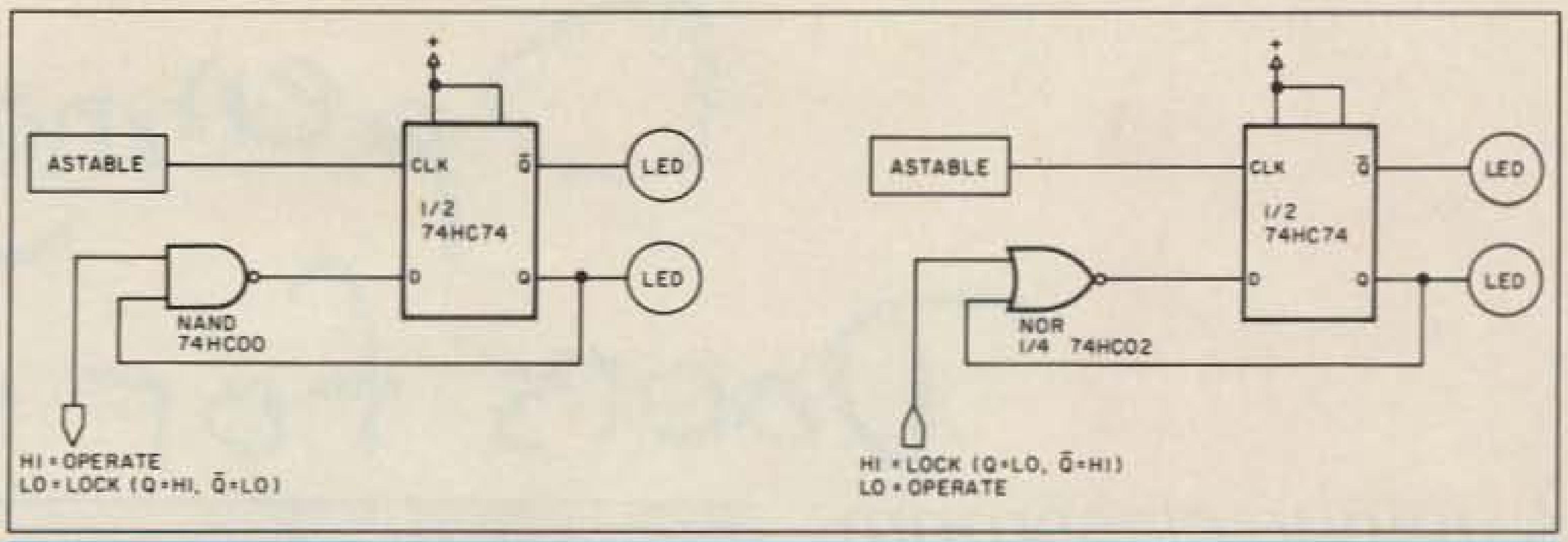


Figure 10. Controlled dividers using NAND and NOR control gates.

Figure 9 shows an example of a simple binary counter using two flip-flops in series. This starts with a debounced pulser. Note that there are four LEDs connected to some gates as a substitute for a controlled circuit. There are up to four pass/block gates or any other type of circuits among which to switch. When pressing the button, the next LED lights—or the next circuit becomes operative—with all the others off.

At the same time, a binary number between 0 and 3 is created, using the Q outputs of the two flip-flops. The experimenter can place these two outputs on the 1 and 2 inputs of a BCD driver chip that feeds a 7-segment display.

Now wire the 4 and 8 inputs low. The result is a display that reads 0-1-2-3 when pressing the button, indicating the number of the activated circuit. Figure 9 also shows some optional additional circuitry to allow the 7-segment display to read from 1 through 4. The NOR gate simply converts the flip-flop LO-LO = 0 into a HI to trigger the 4 digit.

This basic circuit is useful to about one more place for counting up to eight and controlling one of eight circuits manually. However, beyond eight, there are many more flexible binary and BCD counters, as well as programmable divide-by-N counters. There are decade counters (74HC160), dual decade counters (74HC390), 4-bit binary counters (74HC161), dual 4-bit binary counters (74HC393), divide-by-10 counters (74HC4017), up/down counters (74HC191), and 14-bit counters with a built in oscillator (74HC4060). They are all based on flip-flops, but that circuitry is buried inside the chip. One needs only to master the input and output connections and any special rules of operation to use them.

For example, some counters count on a LO-to-HI transition of the Clock input, others on the HI-to-LO transition. Most have Reset lines that instantly return the count to zero, but some need a HI to do the job, and others need a LO. When checking out these counters in data books, be sure to read all the rules.

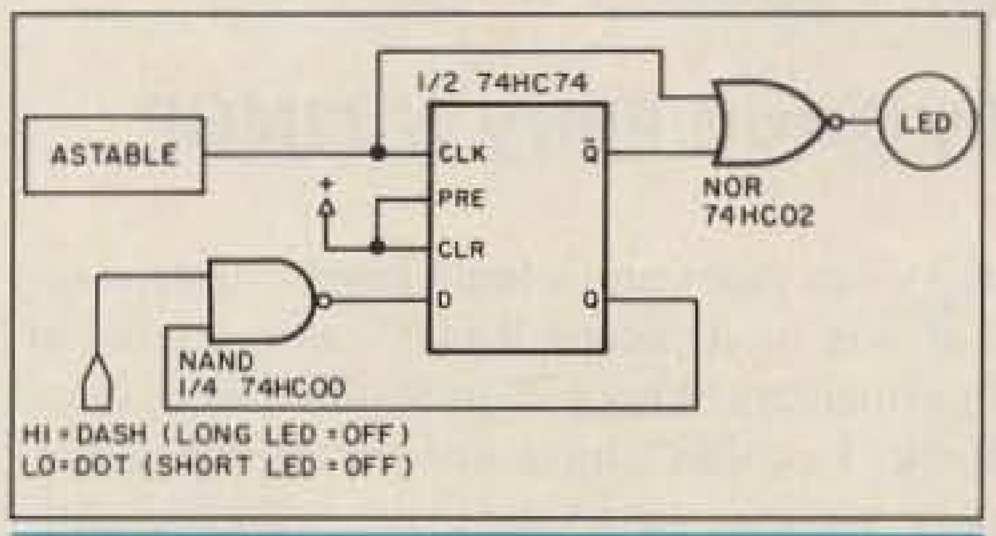


Figure 11. A controlled flip-flop divider for making Morse dashes from dots.

Controlled Dividers

So far, the divide function of D-type flip-flops have been used in an uncontrolled manner, dividing all the time. However, by adding a gate, it's possible to control just when the circuit divides. Figure 10 shows two controlled dividers, using NAND and NOR gates. Which one the experimenter uses depends upon the gates available in his circuit and whether he wants to control the process with a HI or a LO. Since the gate will reverse the level of the feedback signal, he feeds the Q output to the gate (instead of the −Q output).

Figure 11 shows an application of the controlled divider circuit to make Morse code dashes from dot pulses. When the NAND gate input is LO, its output to the D terminal is HI. The clock pulse will make Q HI and −Q LO. Since −Q goes to the NOR gate, the LO permits the gate to pass (inverted) whatever comes in the other input line. In this case, what passes are dot pulses.

When the NAND gate input is HI, its output to the D input will be the inverted Q output. If Q is HI, D is LO. The next clock pulse will make Q LO and −Q HI (with the D input seeing a HI). The −Q HI hits the NOR input and holds its output LO during both the HI and the LO part of the original clock pulse.

Now, with the start of the next clock pulse, the HI D input transfers to Q, with −Q going LO. Thus, one gate of the NOR is LO, allowing the dot pulse to pass as a dot. The result is a NOR output LO three times as long as a dot LO, while the space time (HI) is the same length as usual. By summing the dot pulse and the divider pulse, it makes perfect dashes.

Combine Figure 9 and Figure 10 elements to create a divider-controller-counter that operates only under certain conditions fed to a divider-controller gate. The possibilites are endless!

Next time: Shift register circuits.

Opening Doors for Kids

A unique classroom program in NYC

by Carole Perry WB2MGP

Photo A. Carole Perry WB2MGP and her QSL.

Seven years ago when I began "Introduction to Amateur Radio" as a course at Intermediate School 72 in Staten Island, New York, I couldn't have known the extraordinary success we would have with the children. There was no way of anticipating the tremendous parental and community support this course would inspire.

Since its inception, over 4500 students have come through this unique program. I teach ten classes each term with approximately 35 youngsters per class in sixth, seventh, and eighth grades. A large percentage of them have received licenses; all of them have left with a better feeling about themselves, having learned new skills and having been exposed to an incredible hobby. Most children going through the school system today do not have the opportunities that are available to the children in this program. In fact, when the course is over, a whole new world opens up to the youngsters.

Not a Grind

Instead of "grinding out" Novices and ramming technical jargon and formulas down the children's throats, I use ham radio to motivate the students in all other areas of the school's curriculum. Probably no other hobby can offer the multiplicity of facets to use as motivational tools in a classroom. The philosophy is to have fun and to see that having fun can mean using the radio in an intelligent and responsible manner to learn more about the rest of the world.

I always encourage the youngsters to study at home with a parent or with a sibling. Parents love the idea of sharing something new and interesting like ham radio with their children. They are always very supportive of our program.

"My special thanks to Mrs. Carole Perry for creating a program that bought my son and me closer together. Studying and being tested together was fun, and we're now both in the fantastic hobby of ham radio," wrote Mrs. Marilyn Aronson KA2SXC, mother of Michael Aronson KA2RNP.

Remarkable Progress

What is the most wonderful thing about a program like this? The course has something for everyone. Non-English speaking children have made remarkable progress in learning to speak English because of the skills involved for the telegraph key. After all, CW is a new language for everyone. So everyone in the class starts out on equal footing.

Bright students need to be challenged with exciting and stimulating material. Most of them are overstimulated by the various media to which they are exposed in conventional classroom studies, and they are underworked. Most do not want to work hard to be successful in school. Ham radio offers endless possibilities for the good student. In an age where computers are becoming a household item, these kids are delighted to learn about packet radio. I am quick to point out that hams have obvious advantages for career choices in electronics, computers or communications.

Even more "reluctant learners" recognize that they have a chance to be successful at something for the first time in their school careers. They learn to be responsible and careful in handling the equipment. They may discover skills they have in anything from soldering to designing a creative QSL card. It's my job to keep the motivation high and to make sure that every child succeeds at something.

Even though we have a Novice license pass rate of 75 to 80%, it's not the main objective of the course. My philosophy is to show the students a new and exciting way to learn things in school and to be aware of this most unusual hobby. Who knows? Someday these youngsters may be married to ham radio operators (heaven knows that requires a lot of understanding) or that they might be voting on antenna ordinances. It's important that they learn about amateur radio in a positive and responsible manner.

Photo B. A few hams from Rocci Laurie School.

Helping Others

One of the units I teach in the program deals with "Handi-Hams." This is a great opportunity for a teacher to expose the children to some of the spirit and determination hams are known best for. Joe Schwartz K2VGV is a local operator who has been very supportive of our program. Joe is a double amputee who spends a good deal of his time in the hospital. That hasn't stopped him from making a real impact on the kids. He has invited the children from my classes to his home so he can spend time with them, one on one, showing them radio procedures. Parents go along with their children and are exposed to the wonders of ham radio as well. As anyone will agree, the children are learning more than just radio when they sit with Joe. Handi-Hams working with youngsters reflect all that is the true spirit of our hobby.

One thing I enjoy most about what I do is observing what transpires when my retired ham radio friends come to the classroom to work with the youngsters. They enrich us all by sharing their experiences and expertise with us. The children benefit manifold from these contacts, and so do the retired hams. These are human values being reenforced along with radio skills. How do you beat the winning combination of youth and curiosity coupled with the wisdom and experience of age? I've spoken with many chapters of the New York, Long Island, and New Jersey Quarter Century Wireless Association, and they have always expressed a willingness to help out with my kids.

Photo C. A variety of QSLs made by the student's.

The Next Step

About a year or so ago, I realized we had a real problem of providing a "next step" for the children who had their licenses but were no longer in my program. We lose too many Novices once they get out of "my nagging range." Ham radio is a hobby that thrives on human contact. There were just too many of these Novices out there for me to handle properly. So we began a night class at our school, taught by volunteers from the local radio clubs. It was available to parents and members of the community as well as to the children for upgrading purposes. Because of the night classes and the devotion of many Staten Island ham friends, we've managed to get about a 7–10% upgrading average.

This past spring we planned a huge reunion at a local college. For one whole day, there were exhibits and demonstrations in amateur radio for all ex-students and anyone else who's interested in learning about our hobby. We also provided services for license renewal in an attempt to get former students back into the fold.

Special Contact

On August 1, 1985, amateur radio gave me a chance to help hundreds of children and community members to participate in a once-in-a-lifetime opportunity: to contact an astronaut. For many months the children learned about space travel, NASA's objectives with space shuttles, and radio communications in space. Hundreds of hams from Staten Island and New Jersey donated endless hours of their time and expertise to help make the contact a success. The local TV and radio stations were there at our school to root us on and to record the event for the news that night. The highlight of the day came when we received astroham Tony England's (WØORE's) picture on our school's TV monitor via slow scan TV. The entire event is still talked about with pride in our school and community.


Photo D. A touch of class.

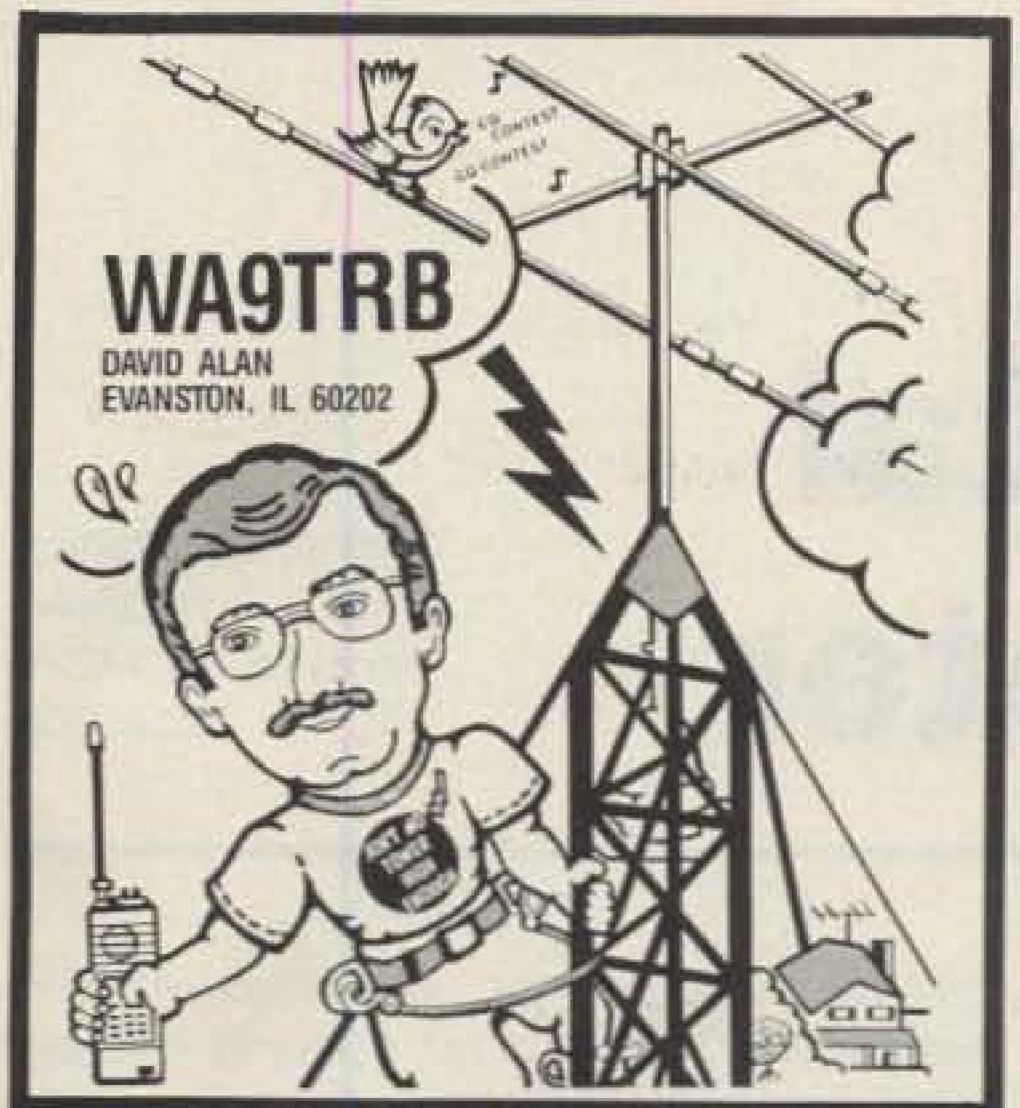
Another nice project we've recently gotten involved in is to check into a Florida/NY net early in the morning on 20 meters. The children love identifying the "regulars" by their voices and then by their call signs. The youngsters have invited the hams from the Carolinas and Florida to visit our school when they come up North. We're all looking forward to that. We've already been fortunate enough to have a ham from Italy come to visit us in our classroom. When Dr. Giorgio Beretta I2VXJ spent the day with us, he provided us with some first hand insights into ham radio in Italy.

Our ham radio newsletter, *The Ragchewer*, gives each child a chance to contribute something and to get to see their names in print. The children do all the artwork, articles, interviews, and publishing themselves. The entire school enjoys the publication.

The next edition of *The Ragchewer* will include an article about Brother Joe AC1U from St. Anthony's in Elizabeth, New Jersey. He has provided my class with a videocassette about the IMRA (International Missionary Radio Association) and has helped to introduce yet another aspect of amateur radio into our classroom.

New Horizons

By emphasizing the human side of our hobby, I hope to provide the children with the key they will need to open the door into the most exciting and diversified hobby and service that exists today. 73



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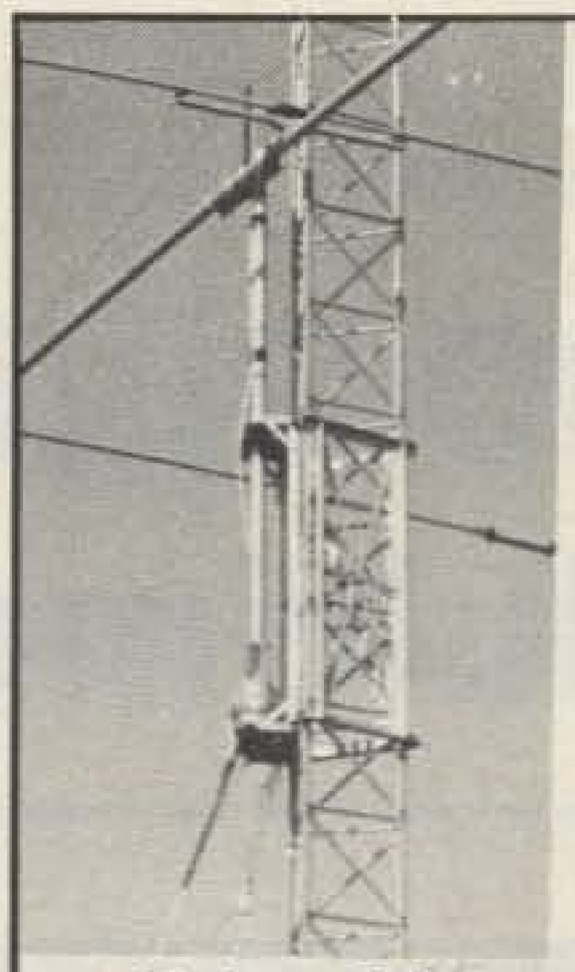

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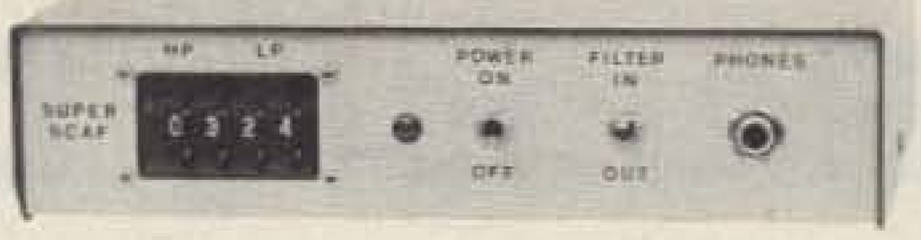

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73 Review

by Larry Antonuk WB9RRT

Ramsey D-5100 Digital Autoranging Multimeter

Ramsey Electronics
2575 Baird Road
Penfield, NY 14526
Price: $50

The VOM is the one piece of equipment that is absolutely mandatory for anyone wishing to do any type of troubleshooting. In the past, hobbyists on a budget wound up with one of the analog Radio Shack models—usable, not highly accurate, able to survive maybe one or two drops before becoming totally unreliable—and they got by. If they actually made some cash fixing something, they might get all the way to the classic Simpson 260 - accurate, tough as nails, impossible to read. Any type of digital meter was completely out of the question.

Things are a little easier these days. For a mere fifty bucks, today's tech can buy a digital meter with accuracy that makes most analog meters look shabby, with autoranging thrown in! The Ramsey D-5100 comes in a compact package. Measuring 2.5" x 1.0" x 5.0", the meter will easily fit into the messiest toolbox. The case is made of high-impact plastic (able to survive plenty of dropping!). A rotary switch selects the function and four pushbuttons determine secondary modes (AC/DC, Range, Hold, Memory). The multimeter comes with those nice rubber-like test leads, with safety banana plugs.

The meter boasts the usual specs: 1000 VDC, 500 VAC, 0–200mA or 0–10A, and 0–2MΩ. A continuity annunciator chirps when reading less than 20 Ωs and is also used to

indicate range changes, overrange, etc. The autoranging feature is not lightning fast, but most readings settled down in well under a second. If the autoranging feature is not desired, a tap on the RANGE button locks the current range or allows the user to step up through the ranges. The MEM button allows the operator to subtract the current reading from subsequent readings. The HOLD button simply controls when making low resistance readings - useful mainly as a "zero" control when making low resistance readings. The HOLD button simply freezes the display; it doesn't let the operator hook the meter up, leave the area, and come back to see the highest voltage, etc. displayed. (A use for this feature has yet to come to mind.) The D-5100 will test semiconductor junctions, and has a low power ohms function for in-circuit testing.

The only weak point in this product is the instruction manual. While fairly complete, the broken English is sometimes difficult to understand. Techs new to digital meters will find a series of examples in the back of the manual that will walk them through any possible use of the instrument.

Thanks to Ramsey Electronics, what used to cost as much as a new car now costs as much as dinner for two. Keep the wife home tonight and put one of these in your toolbox. I'm sure she'll understand. 73

Digital X-Y Oscilloscope Display

A classy, cost-effective tuning indicator.

by Dean R. Becker WA9TYU

X-Y oscilloscopes are very useful as tuning displays for RTTY demodulators and other applications. There have been numerous articles written describing how to make X-Y displays using conventional cathode ray tubes (CRTs). These make excellent tuning indicators, but the size of a CRT and its support circuitry may be larger than the demodulator it complements! The digital scope described here is small, simple, and works great. Power consumption is very low. This unit is powered by a 9V, 100mA plug-in power supply.

The display is created by 100 LEDs arranged in a 10 × 10 square. The LEDs used here have 0.1 inch lead spacing and are mounted 0.1 inches apart from each other. This works very well with standard 0.1 inch spacing circuit board material, such as the Radio Shack 276-158 with soldering ring holes. Any LED may be used, but small LEDs with 0.1 inch lead spacing will work best. The LEDs are wired together in a matrix. The anodes are tied together in each row, and the cathodes are tied together in each column.

The LED display is driven by two LM3914 dot/bar display drivers (Radio Shack 276-1707). These chips normally drive an LED bar graph display. They have everything needed to take in an audio signal and form a linearly proportional output capable of driving LEDs directly. In the X-Y display, one LM3914 is used to drive the LED columns directly. This provides the current sink for the LEDs. The other LM3914 controls ten PNP transistors that source current to the LEDs via the rows. Most any general purpose PNP transistor will do. By using this arrangement only one LED will be on at a time.

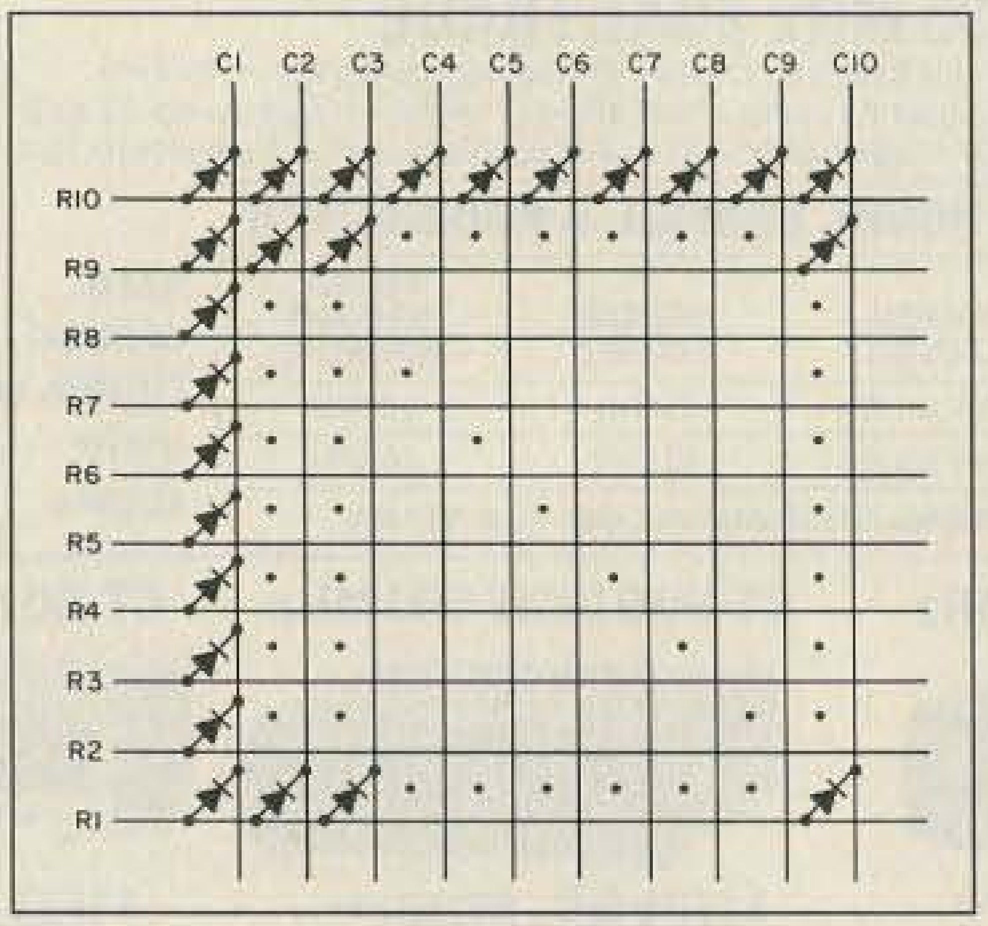

Figure 2. 100 LED Array.

The X and Y inputs are referenced to ground, and each has an amplitude adjustment that scales the input signal to match the display boundaries. An input signal of 1.2 volts can drive the display to full scale. The offset adjustment allows the display to have X,Y = 0,0 in the center, thereby providing a four quadrant display. To use the digital X-Y scope as a RTTY tuning indicator, connect the mark and space filter outputs from the demodulator to the X and Y inputs of the scope.

The display provided by the X-Y digital scope is, of course, not as smooth as that provided by a CRT.

Construction

Two 2.2 × 3-inch circuit boards are used in the construction of the scope. The LED display board mounts in front with the second board mounted about two inches behind. The LEDs should have their leads trimmed so the anodes are ½ inch long and the cathodes are one inch long. Insert and solder the first row of LEDs at the bottom of the board. (Note: the Radio Shack 277-1008 Audio Amp/Speaker has a grid of holes in front that are spaced 0.2 inches apart. This makes a great holder for the LEDs as they are soldered in.)

Now take a length of bare 26 gauge wire and weave it from one LED anode to the next, near the end of the lead. Solder the wire to each anode of the first row. Next insert and solder the next row of LEDs. Using another length of bare 26 gauge wire, solder it to each anode of the second row. Continue this operation for each row until all LEDs are mounted. Next use another length of bare wire to connect the cathodes of the first column near the end of the lead. Do this for each column. When this step is complete connect a short length of wire to each row and each column to be connected to the other circuit board. There should be ten column wires and ten row wires. The column and row bare wires should not contact each other.

Wiring of the second board can be wire wrap or point-to-point soldering. Mount the LM3914s, transistors, resistors, and pots. Connect all intra-board wiring first. Next connect the display wires to the board. Connect the X and Y signal input to phono jacks. And connect the incoming DC power through an on-off toggle switch to the board.

The circuitry can be tested by connecting two oscillators, radio outputs, or RTTY scope outputs as signal sources. Calibrate the offset so that with no signal input, the LEDs in the center of the display light. Provide an input on the X channel only. This should produce a horizontal line in the middle of the display. A similar input to the Y should produce a vertical line in the middle of the display. Connection to the scope outputs of a RTTY demodulator should produce the familiar cross hair pattern in the presence of a RTTY signal.

This design can be modified to include more LM3914s chained to the existing ones. This would allow a larger number of LEDs to in the display if desired. Different color LEDs can also be used to show limits or just to make it more interesting. The LEDs used may be point-source or diffused. This version used point source LEDs, which provide a sharp display. 73

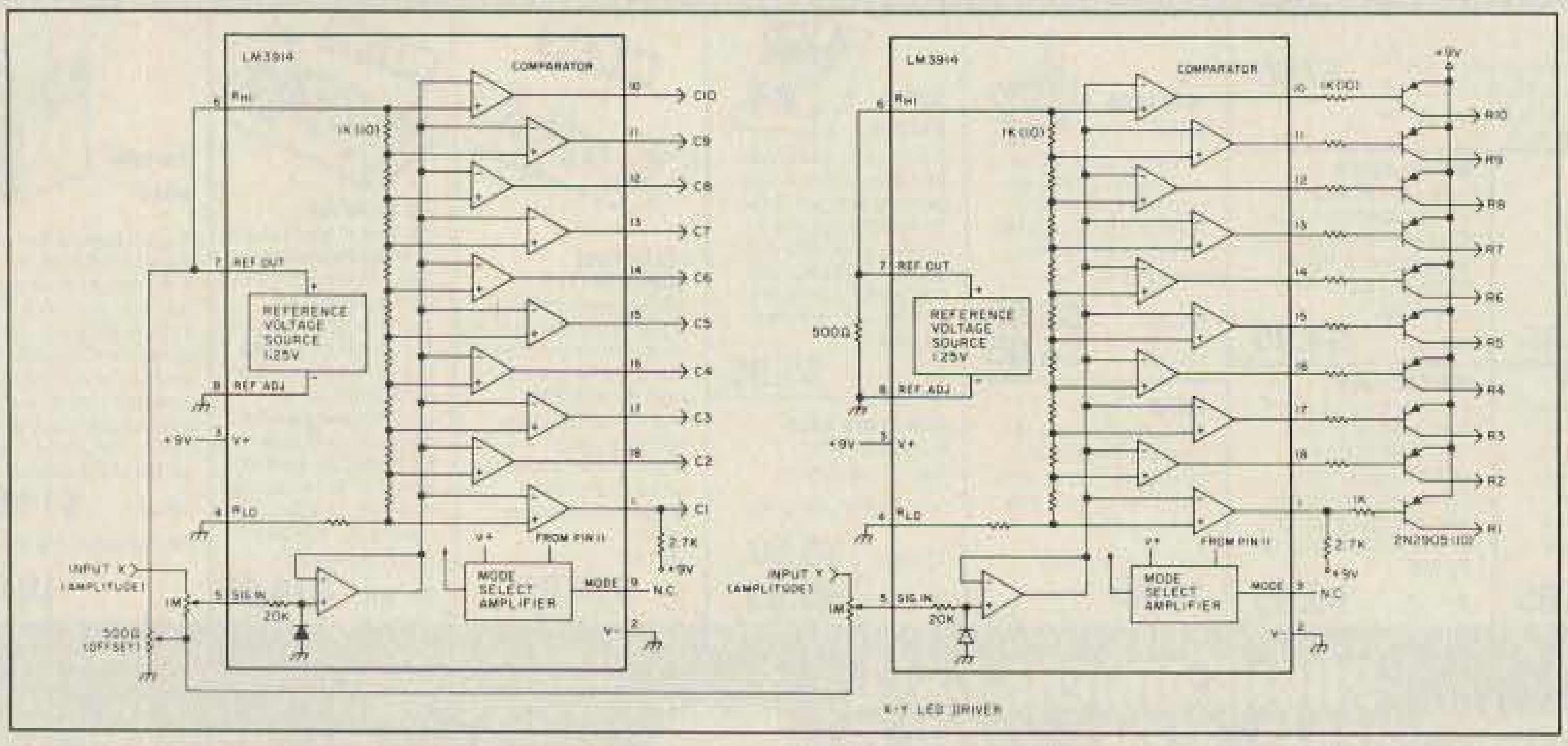

Figure 1. X-Y LED Driver.

The Care and Feeding of a PBBS

Timely tips for packet bulletin board users (Part I)

by David McLanahan WA1FHB

One of the perks of working packet is being able to access one or more of the Packet Bulletin Board Systems (PBBSs) springing up all over the country. These PBBSs are one of the greatest leaps in ham radio operation since voice transmission.

Networking Versatility

The PBBSs offer two exciting features never before available to hams. They are an electronic means of disseminating general information—ARRL and AMSAT bulletins, notices of club meetings and events needing amateur communications help—to the ham community without being tied to a net or bulletin schedule. There is also the capability of leaving personal messages for other hams who are not on the air at that particular moment (and receiving similar messages from other hams). These messages can be forwarded automatically from one PBBS to another, even over transcontinental or transoceanic distances.

How does a ham get involved? Bulletin boards can at first daunt a new packeteer. Many hams have little or no experience with computers and their demand of exactitude from the operator.

Logging On

To log onto a board, a packeteer needs only to connect with it. The board does the rest, greeting him in one of several ways and, perhaps, telling him that he has new mail.

The PBBS software provides for two greetings, long and short. (The short one is sometimes called the "expert" greeting.) Both of these can be personalized for the individual PBBS and, if the operator of the board likes, changed periodically to draw attention to some important event or matter. The selection of the long or the short message for a particular user can be changed either by the user (with the "NE" command) or by the PBBS operator.

The long greeting is friendly: "Welcome, Josephine, to the WA1FHB mailbox in Marlow, NH. You were last on at <time> <date> <Last message> number." These messages are followed by the command choices, ending with a right arrow (>). Practices vary, but most PBBSs use 24-hour Universal Coordinated Time (Greenwich Mean Time to the older of us!), identified by a "z."

Long greetings, however, can take forever to get through during periods of heavy QRM and/or heavy activity. Even during good conditions, the long version wastes the operator's (and the channel's) time. A budding packeteer should move on to the short greeting as soon as possible. Here's an example of the terse prompt:

COMMANDS

With either prompt, the PBBS commands are exactly the same. The commands are single letters that may be followed by a modifier or an argument or, often, both. Please memorize: *A command and its modifier are never separated by a space, but a command and an argument are always separated by a space.*

```
:- Connected to WA1FHB

Hello Peg, Welcome to the wa1fhb Mailbox from David in Marlow, NH
Last on at 2153 on 871210, last message 2383.
X for long menu, NE for short prompt, H for help, L to list new msgs.
You have new mail:
Msg# TR  Size  To     From    @ BBS  Date    Title
2383 PN     1 N1FBC  WB9EUJ          871213 I'll be there Monday!
2381 PN   244 N1FBC  WA1FHB          871213 Thursday?
2378  N   196 N1FBC  KB1HE           871213 Happy Holidays
N1FBC de WA1FHB: at 2053z on 871213 B,D,H,I,J,K,L,N,R,S,T,U,W,X >
```

Figure 1. Long sign-on.

```
N1FBC de WA1FHB: at 2054z on 871213 B,D,H,I,J,K,L,N,R,S,T,U,W,X >
```

Figure 2. Short sign-on.

```
N1FBC de WA1FHB: Date 871213 Time 2053 Last msg # 2382, 109 active msgs
Messages: L - List, R - Read, S - Send, K - Kill
Files:    W - What, D - Download from, U - Upload to
B - Bye, H - Help, N - Enter your name, T - Talk to David
I - Information, J - Calls heard,  X - Short/Long Menu >
```

Figure 3. Long Menu.

Put together, all this turns into a "command string," which is terminated by pressing the return key, or its equivalent. (The return is generally required by TNCs to send the packet, anyway.) For brevity, I won't mention the return with the explanation of each of the commands, but it's always necessary. Note also that, while I show all commands in capital letters for clarity, the board accepts either upper or lower case.

The command sets the basic operation the operator wants the PBBS to do. The modifier then selects a subcategory of that operation, and the argument designates the subject or victim of the operation.

Instant Help

The three most important commands for the neophyte are the ones for assistance. The first is X, which provides a reference to all the other commands. At the long or the short prompt, X toggles a long command menu:

Note the word "toggle." A toggle key alternates a command between two states (such as "on" and "off"). The X command, for example, gives the long command explanation at each subsequent command prompt, until the user toggles it off by sending another X.

The H command downloads the system's Help file. This file may be customized to some extent for each system, but it generally runs about 36 lines of text. Those with a printer can turn it on before issuing the H command, to get a handy command reference to keep beside the keyboard. The Help file shown in Fig. 4 is an example, but those from other boards may be slightly different.

Finally, there's the I command, which accesses information about that specific PBBS—location, equipment, special interests, etc. Just don't expect the Info file to be up-to-date. It is generally prepared with great glee when the board is first put on the air, then totally forgotten as system antennas, towers, rigs and computers come and go.

The Main Commands

These are the commands that actually make the PBBS function. Most of them require an argument.

The first command the user should issue when he accesses a PBBS for the first time is the "name" command. It takes the form "N Ayleen <return>" (using your own name, handle, or alias, of course) and enters your first name into the user file. This has two purposes. In a later connect, it impresses the uninitiated guest to a PBBS demonstration. It also "introduces" the user to the PBBS operator. With a couple of computers in the middle, packet PBBS operation is probably the most impersonal of all the activities in an otherwise friendly and personal hobby—fight the trend!

At the first log-on to a particular PBBS, the board asks the user to specify a home PBBS with the NH command (this concept to be discussed later). If the user isn't sure which board he wants as his home board, he should pick one anyway, since the log-on prompt will keep bugging him for an entry. Simply choose one for the moment, keeping in mind that it's easy to switch. The user should just be sure that if he checks into more than one board, he should specify the same home PBBS on all.

```
This is wOrli 12.0 software. Thanks to Hank for writing it.
Simple commands consist of one or two letters and a RETURN.
The second letter of a command is called a qualifier. Some
commands accept arguments. To add an argument, type a SPACE
after the command or qualifier and then type the argument(s).
UPPER/lower case doesn't matter, but command (string) must end
with ENTER, <cr>, or RETURN.
Do NOT put a space between a command and a qualifier.
For example -- The "L" command lists the messages in the mailbox.
Type just "L" and a RETURN to list all the messages entered since
you last logged in. If there are no NEW messages, you'll get a
"*** None found."
To list just your messages, type "LM" and a RETURN. (The "M"
stands for "Mine".)
To list only messages higher than a particular number, such as
4325, type "L 4325" or "LM 4325". Don't forget the space. This
form is preferred over the plain LM above (faster).
Some other examples:
  SB to send a bulletin message.
  LM 4325 lists only your messages later than 4324.
  LB 4325 lists only bulletins later than 4324..
  LT lists only NTS traffic.
  LL 10 lists the last 10 messages.
  R 3210 to read message 3210.
  K 5432 kills message 5432. (Only works with your messages!)
  KT 5678 kills 5678 (Only works with NTS messages).
  KM kills your messages. *** Please do NOT use! Use K <number>.
  S WORLI to send a message to WORLI.
  SP WORLI to send a "private" message to WORLI.

  N Joe       tells the MailBox that your name is "Joe".
  NH WORLI    tells the MailBox that WORLI is your Home MailBox.
  NE          tells the MailBox to change your Expert status on or off.

 A more complete description of how the use the MailBox is in the
 file DOC.TNC

 Use the D command to download this file:
  D DOC.TNC

 Please leave any comments as messages to walfhb.

     Have Fun!  -  David
```

Figure 4. Help file.

```
Msg# TR  Size  To     From   @ BBS  Date     Title
2381 PN   244 N1FBC  WA1FHB         871213 Thursday?
2378  N   196 N1FBC  KB1HE          871213 Happy Holidays
2375 TN   309 NTS037 WA2SPL WA1FHB 871213 QTC:NEWPORT NH
2374 BN   532 ALL    N1DYF          871213 GSARA Novice course
2373 BN   286 NEPRA  N1DKF  WA1FHB 871213 Al Sears, W1ZHC, SK
2372 TF   232 05445  KA1CRX KD1R   871213 NR707 CHARLOTTE VT
2360 BF   291 NEPRA  N1DKF  KD1R   871213 Al Sears, W1ZHC, SK
2359  F   551 KA2VCS K3PS   KD1R   871213 TNC-1 (@ KD1R-1 IN VT.)
N1CB tried to connect.
2054, fhb,109 msgs>
```

Figure 5. Message listing.

Information, Please

The L command, in various forms, is used to display messages in the PBBS's Mail Box. Surprisingly, the simple, unadorned L command (with no modifier) tends to confuse people. It lists only the messages entered since last log-on. If the packeteer was on the board several hours ago and there hasn't been much activity in the interim, or if she connected over a poor path, then try again using a different digipeater string, an L will come up blank ("None Found," or similar). He needs to use modifiers to dig down into the messages.

LM gives all traffic to or from the logged-on call. LA produces a list of ARRL bulletins, LB lists non-ARRL bulletins, and LT shows NTS traffic on the board. To check on messages to or from another call, use L> W1XXX (messages to W1XXX) or L W1XXX (messages sent by W1XXX). L 789 will show all messages with numbers greater than 789, and LL 10 will list the most recent 10 messages, regardless of message number. None of the List commands will show private messages except those to or from the logged-on call.

An operator can save time (his, the board's and the channel's) when using two-letter L commands (LA, LB, LM, and LT) by limiting the search to the highest message number on the board during his last connect (i.e., LM 5450). This keeps the already-viewed messages from reappearing on the screen. (All of these searches go from most recent back in time, and there's no legitimate way "new" messages could have gotten in to the older part of the listing.)

Here is a display of the result of any of the message listing commands. (The second-to-last line is not part of the message listing.)

The message number comes first. Use that number to read or kill a message. The next column shows the message type and status. The status will be /Y/ for already read (by the addressee), /N/ for not read yet, or /F/ for already autoforwarded to another board. (Boards can be set to kill messages that have been forwarded.)

The column after that displays the message size in bytes, to give an idea of how long it would take to transfer. (A common error is misinterpreting the message size figure as the message number.) Next is the call of the addressee, the call of the sender of the message, and then the optional call of the "home PBBS" of the addressee, followed by the title of the message.

Temporary Data Storage

As the packeteer sits before his monitor perusing the messages, he probably comes across information he wants to write down. There is a quaint, old "low-tech" device I recommend for the purpose: the "Magic Slate." This children's novelty is generally available in five-and-dime stores. It consists of a wax-covered cardboard with a translucent plastic overlay. He can write on the overlay with a stylus or even a fingernail. Lifting the overlay erases it, but, of course, it is non-volatile in the event of power failure.

The Magic Slate is a super place to record the numbers of new messages on a PBBS log-on when reading the first message will probably scroll the other numbers off the screen. Similarly, it's handy for recording interesting file names for sequential down-loading from the PBBS. Put the Magic Slate to good use will prevent load the channel unnecessarily with repeated message listings and directories!

Sending a Message

Most packeteers are anxious to try out this function. Sending isn't difficult, but a little homework with the computer documentation before logging on can go a long way; before logging on, one must determine how to send Control Z.

The common control to end and save a message is "Control Z" (z). For a simple-minded system like an old Teletype™, all one needs to do is find the "Control" key, hold it down while hitting the Z (lower case is fine) then release both. The more sophisticated terminal emulation programs, however, often assume that control characters are commands for them and not to be passed to the TNC. There may be a "lead-in" character to send first. Some boards accept /EX as an alternate message ending.

To send a message, enter S, one space, and the call of the addressee, at the command prompt. The BBS converts lower-case entries into upper case. (The board accepts S <return>, and then prompts for the addressee, but that's doing it the hard way.) Then a prompt for the "title" of the message appears. The program gives up to 80 characters for the title, but one or two short words will usually suffice. If the title is long, it causes line-wrap (use an extra line) every time somebody lists the messages.

When it gets the <return> at the end of the title, the PBBS prompts for the message text and gives the number that it is assigning to that message. Note that number to check the message after entering it.

Be aware of carriage returns when typing the message. Most users have 40-, 64-, or 80-column screens (that's the number of characters displayed in a full line of text or data). If the typed line length exceeds the number of columns on the reader's screen, most computers insert a "default" carriage return/line-feed at the end of the line, probably splitting a word. Some machines substitute the return/line-feed for a character of text. Of course, if this happens, Murphy's Law says that the replaced character will be the third digit of an essential and unlisted phone number.

When done with the message, send the all-important ^Z and a return, and wait. A following prompt indicates that the message has been closed and saved. If the channel isn't busy, check the message by sending an R, space, and the message number to read it.

If the prompt didn't show, assume that the CONTROL-Z didn't make it and the message hasn't been saved. There are several things that may have happened. It's possible that the terminal program went off into the weeds. Recovering it depends on the user's particular set-up. If only the computer is confused, unplug the cable between computer and TNC (so as not to inadvertently disconnect from the PBBS), then reset the computer and reinitialize the terminal program (and, of course, replace the TNC cable) within the three or four minutes the PBBS gives you before it times out and disconnects. If the CONTROL-Z is successfully sent the second time around, the message is saved.

This isn't good packet form and should be used only as a last resort, but if all else fails, turn off the set-up: radio, TNC, and computer. Reinitialize everything and let the bulletin board "time out" in three or four minutes and reset itself. Any message left on the bulletin board, however, will be discarded and gone.

There's one wrinkle to sending personal messages to a recipient on another PBBS. (Message forwarding is discussed in more detail next month). If possible, provide the call of the recipient's home PBBS. To do this, after entering the addressee's call, add a space, then an "at" sign @, another space, and the PBBS call: S WA1VMZ @ WA1FHB or SB ALL @ W0RLI.

Message Categories

There are several modifiers for the S command. (They show up in the "type" column mentioned earlier.)

SP sends a private message. This is not, of course, truly private since the message is sent over a public channel, and the PBBS operator can (and may well) read it. The L command, however, won't list it, except when the addressee is logged on. This makes the L listing for others shorter and more useful, and no one else can read the message over the air. If a friend's call appears in the "Mail for" beacon, but not in the message list, then the message was marked private.

ST is used for formal NTS traffic. The actual contents of the address and "at" fields for NTS messages is presently in a state of flux, with "NTS" plus the ARRL Section abbreviation (e.g., NTSWMA), five-digit zip code, telephone area code, and "NTS" plus the three-digit postal SCF (the first three digits of the zip) all being used in various area. Until this situation settles, determine and follow local practice.

The title of the message should contain the call and message number of the station putting the message into the packet system as well as the *destination* town and two-letter state abbreviation. The normal NTS message preamble should form the first line in the message body.

SA is reserved for official ARRL Bulletins. SB is for general (non-ARRL) bulletins—AMSAT, local club and so forth.

Bulletins

Bulletins are often addressed to ALL. Take care to not use ALL too readily. The title can often target a specific group: AMSAT, ARES, etc.

If a bulletin announces an event (meeting, hamfest, exam session, or the like) put both the location and the date in the title. This saves "over the air" reading time, and helps the PBBS operator purge stale material. There's little as frustrating as reading an invitation to a great hamfest that took place last weekend!

```
Msg# TR  Size  To     From   @ BBS  Date    Title
1668 TN   222 NTSIA  KA1IFC         871119 NR 228 KA1IFC QTC Des Moines, Ia
NR 228 R KA1IFC 18 Baldwinville Ma Nov 18

Bob Kurtz
922 Boulder Ave
Des Moines Ia 50315

515 243 5493

Turkey day fast approaching x
Looking for a bird to
pluck and stuff x You
available query 88

Jean
```

Figure 6. NTS text message.

```
Msg# TR  Size  To     From   @ BBS  Date    Title
2335 SN   548 WB1GXM W1FJI          871212 308 wb1gxm qtc reno nevada
R:871211/2237z @:WB1DSW East Kingston, NH #:1191 O:W1FJI
R:871211/2054z @:K1UGM Wakefield, Ma #:2374 O:W1FJI
R:871211/2030z @:W1AW Newington, CT #:2021 O:W1FJI
R:871211/1930Z @:WA2RKN #2108 [Hyde Park, NY]
R:871211/1927z @:AG3F Towanda, Pa #:5270 O:W1FJI Z:18848
R:871211/1916z @:AG3F Towanda, Pa #:381 O:W1FJI Z:18848 [HF]
R:871211/1616z @:WA5QZI #8008 : Alamo Gateway [San Antonio, TX]
R:871209/2032m @:KE7CZ Dewey, Az #:1715 O:W1FJI
R:871209/1854m @:W1FJI #2381 [Scottsdale, Az.] O:W1FJI
Msg  2371 taken from W1FJI  by W1IBP  at 1854 on 871209
```

Figure 7. NTS service message.

Don't type in long bulletins to ALL on the local PBBS on-line, since it's impossible to edit. Prepare and format the message with a word processor (watching for carriage returns and other details), then log onto the PBBS and send the message as an ASCII file transfer.

Disable any error-checking, such as XModem protocol, that the modem program might like to use. First, the PBBS will not handshake with a telephone protocol. Second, it isn't necessary because packet provides its own error checking. Third, even if it worked, it would nearly double the channel load with XModem's single-character ACKs and NAKs that would have to be made into a packet.

Opinions and Diatribes

Bulletins needn't be limited to announcements of new facilities and club meetings. The first amendment to the US Constitution does not give anyone the inalienable right to publish their views on someone else's PBBS—the board is private property and under the control of its owner. Most PBBS operators, however, feel an obligation to allow and encourage discussions or debate on a wide range of subjects of interest to their readers, whether they, personally, agree or not.

Unless the operator of a particular board has said otherwise, feel free to enter bulletins or messages to ALL on any subject as long as they avoid the business and obscenity prohibitions of the FCC and are not direct, personal attacks.

Follow these guidelines when entering opinions on the local PBBS: Keep them tight and to the point—less than, say, 2000 characters. Messages longer than that are time-consuming to read, even through just one digipeater, and are difficult to forward. Try also to use an honestly descriptive title. Misleading titles often anger and alienate people!

Lastly, pay attention to the presentation. If it's messy, with scattered thoughts, misspellings and poor formatting, its brilliant logic may not shine through and you will do your cause a disservice.

One-liners

Sometimes if a bulletin to ALL or a message is very short, the entire text can be squeezed into the 40 or so characters for the title. You wind up with a message of length 1 (that one is the ^Z that ends the message). "MAPRA Meeting Sunday!" or the like. If you see one of these, don't bother "reading" it with the R command. It's all in the title in the message list. The one-liner is also a way of leaving a short message for someone who may be connecting to the PBBS over a difficult path, because the title is sent prior to the first prompt.

The "message" will show up in every message listing and the addressee call will remain in the mail beacon until it's either read by the addressee (with the R command) or killed. A one-liner is sent the same as any other message. Send the ^Z and <return> when the board prompts you for the text.

Kill!

K <NUMBER> will kill message <number>. Before executing a K instruction, the board will check that the operator is either the sender or the addressee of that message. If not, the command won't work. Of course K won't work if the message is misaddressed–KI("eye")ZJH in place of K1("one")ZJH, for example.

There are several modifiers for the K command. KM will kill messages, KT <number> will kill NTS traffic and, on some boards, generate a service message back to the sender, giving the "killer's" call and the date/time the message was taken. 73

Next month: Disk files and mail forwarding.

uniden®

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Regency INF2-SA2 .....$159.95
Regency INF3-SA2 .....$119.95
Regency INF5-SA2 .....$109.95
Bearcat 200XLT-SA2 ...$262.95
Bearcat 100XLT-SA2 ...$189.95
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The *Bearcat* 760XLT has 100 programmable channels organized as five channel banks for easy use, and 12 bands of coverage including the 800 MHz. band. The *Bearcat* 760XLT mounts neatly under the dash and connects directly to fuse block or battery. The unit also has an AC adaptor, flip down stand and telescopic antenna for desk top use. 6-5/16" W x 1⅜" H x 7⅜" D. Model **BC 580XLT-SA** is a similar version without the 800 MHz. band for only $219.95.

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List price $799.95/**CE price $329.95/SPECIAL**
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The *Regency* RH256B is a sixteen-channel VHF land mobile transceiver designed to cover any frequency between 150 to 162 MHz. Since this radio is synthesized, no expensive crystals are needed to store up to 16 frequencies without battery backup. All radios come with CTCSS tone and scanning capabilities. A monitor and night/day switch is also standard. This transceiver even has a priority function. The RH256 makes an ideal radio for any police or fire department volunteer because of its low cost and high performance. A *60 Watt* VHF 150-162 MHz. version called the **RH606B-SA** is available for $429.95. A UHF 15 watt, 10 channel version of this radio called the **RU150B-SA** is also available and covers 450-482 MHz. but the cost is $419.95.

★★★ *Uniden CB Radios* ★★★

The *Uniden* line of Citizens Band Radio transceivers is styled to compliment other mobile audio equipment. Uniden CB radios are so reliable that they have a two year limited warranty. From the feature packed PRO 810E to the 310E handheld, there is no better Citizens Band radio on the market today.

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PRO510XL-SA *Uniden* 40 channel CB Mobile $49.95
PRO520XL-SA *Uniden* 40 channel CB Mobile $59.95
PRO540E-SA *Uniden* 40 channel CB Mobile $119.95
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NEW! Bearcat® 200XLT-SA

List price $509.95/**CE price $299.95**
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Frequency range: 29-54, 118-174, 406-512, 806-956 MHz. Excludes 823.9875-849.0125 and 868.9875-894.0125 MHz.

The *Bearcat* 200XLT sets a new standard for handheld scanners in performance and dependability. This full featured unit has 200 programmable channels with 20 scanning banks and 12 band coverage. If you want a very similar model without the 800 MHz. band and 100 channels, order the **BC 100XLT-SA3** for only $199.95. Includes antenna, carrying case with belt loop, ni-cad battery pack, AC adapter and earphone. Order your scanner now.

Bearcat® 800XLT-SA

List price $549.95/**CE price $259.95/SPECIAL**
12-Band, 40 Channel • No-crystal scanner Priority control • Search/Scan • AC/DC
Bands: 29-54, 118-174, 406-512, 806-912 MHz.

The Uniden 800XLT receives 40 channels in two banks. Scans 15 channels per second. Size 9¼" x 4½" x 12½." If you do not need the 800 MHz. band, a similar model called the **BC 210XLT-SA** is available for $196.95.

Bearcat® 145XL-SA

List price $189.95/**CE price $98.95/SPECIAL**
10-Band, 16 Channel • No-crystal scanner Priority control • Weather search • AC/DC
Bands: 29-54, 136-174, 406-512 MHz.

The *Bearcat* 145XL is a 16 channel, programmable scanner covering ten frequency bands. The unit features a built-in delay function that adds a three second delay on all channels to prevent missed transmissions.

Bearcat® 175XL-SA

List price $279.95/**CE price $156.95/SPECIAL**
11-Band, 16 Channel • Weather Search Priority control • Search/Scan • AC/DC
Bands: 29-54, 118-174, 406-512 MHz.

The *Bearcat* 175XL has an automatic search feature to locate new frequencies. Priority, lock out, delay and scan speed are all included.

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73 Review *by Pete Putman KT2B*

ICOM America, Inc.
2380 116th Ave. NE
Bellevue WA 98004
Price Class: $1400

ICOM IC-375A 220-MHz Multimode Transceiver

It's finally happened. All diehard 220 enthusiasts can now rejoice and revel in ICOM's latest entry into the VHF/UHF multimode market: The IC-375A transceiver. It's made exclusively for the North American amateur market.

Similar in design and operation to the IC-275 and IC-475, this radio offers a wealth of features for everyone, from the casual FM operator to hard-core packeteers. Considering this is the first time any company has manufactured such a transceiver, one has to be impressed with the sophistication of the design.

Overview

Figure 1 shows the front panel. Note the virtually identical copy of its sister transceivers for 2m and 70cm. The bright, backlit amber LCD display jumps out, showing frequency, VFO, memory channel, RIT, tone squelch, duplex offset, and mode. The frequency selection dial sits beneath the display, and has silky-smooth operation over a variety of tuning increments.

The ICOM IC-375 220-MHz multimode transceiver.

Modes

The 375 has four modes: FM, LSB, USB and CW. Pushing the CW mode switch again enables the optional CW filter (500 Hz), which the operator can use in conjunction with the Passband Tuning (PBT) and Notch controls for enhanced selectivity. Provision is made to switch a tower-mounted preamplifier from the front panel (maximum power: 100 watts) as well as to enable a built-in speech compressor. There are also two speeds of AGC selection.

The user can select sub-tone frequencies on both receive and transmit, and store any combination of offsets, sub-tones, modes and frequencies in 99 seperate memory channels—more than adequate for everyday use. Two priority channels are also available which store similar data.

RIT (Receiver Incremental Tuning) is standard and permits a shift of up to 9.9 kHz either side of the displayed frequency. The RIT can be cleared to zero offset at the touch of a button. This feature works in all modes, including FM.

". . . the user can adjust the tone of his transmitted audio and set the degree of compression in the speech processor."

Additional controls set up the microphone gain (not deviation), RF output power, RF gain, CW keying delay, meter display, and AF tone quality from the built-in speaker. The AF gain and squelch controls are located to the right of the display meter, directly below the main power switch, in order not to confuse them with any other controls.

Several scan rates are available. The standard band scan is incorporated, along with programmable range scanning, selectable mode scanning through memories, and general purpose memory scanning. A skip button allows the operator to lock out undesired channels when in scan mode. When using the programmable scan function, transmitting or touching the main tuning dial erases the pre-programmed band limits.

As on all new ICOM multimodes, the 375 has full break-in keying (QSK). Current activity levels are presently too low for QSK to be really useful now. In many cases also, full break-in keying isn't usable due to sequenced switching of amplifiers and external preamplifiers. The optional AG-30 mast-mounted preamplifier won't function when full QSK is selected either. Semi break-in is also available with the drop-out delay set from the front panel. Note that no VOX operation is available—none of the new '75 series transceivers offer it.

The DATA switch on the 275 and 475 is also available here. ICOM claims a switching time of less than 5 milliseconds, which should be ideal for packet operation. Packeteers will not be able to use an external amplifier or preamplifier, however, due to this rapid switch time. The IC-375 also runs AMTOR, conventional AFSK RTTY, and SSTV.

A small insert with the IC-375A tells of the availability of the ICOM CIS (Communication Interface System), permitting control of these radios through a personal computer and RS-232 port. Such control permits displaying and operating the frequency, mode, memory selection and scanning functions, among others. ICOM doesn't say, however, what software is available to do the job, so look for it in the next few months.

The rear panel also has many controls. In addition to the CW keying speed, the user can adjust the tone of his transmitted audio (brilliant!) and set the degree of compression in the speech processor. The remote connection for the RS-232 interface is here, as well as two accessory jacks for the ICOM AQS automatic squelch system and ALC control/external keying/receiver output.

The operator can also monitor his SWR via a three-way switch on the rear panel as well as power output. Connections for a CW key and external speaker are found here using 2.5mm miniplugs, and the CW sidetone level is accessible here. The antenna connector of choice is the SO-239 "UHF" socket, which is pretty much standard on 220 equipment. Although the IC-375A comes with a built-in AC supply, the user can also access the 13.8 volt input directly for portable use with the supplied DC power cable.

Observations

I've had the IC-375 in my station for quite a few months now, and gave it a fairly hard run during the September VHF QSO Party. Over 50 stations were worked from this location using the IC-375A, a Mirage C1012 amplifier, and a single Cushcraft 220 Boomer at 60 feet. Most of my operation was on SSB and CW (I use primarily an IC-37 for FM work), and the transceiver performed flawlessly the entire weekend. I had to stop operating and switch feedlines on 220 halfway through the contest due to an extremely high SWR condition that apparently made difference to the 375A.

CW was the main mode that weekend due to the generally terrible conditions and weak signals. I preferred the semi break-in mode and use a special eight-pin DIN to RCA plug cable to switch the C1012. The 375A, by the way, keys an external amplifier by pulling it to ground, which is fairly standard practice. The eight-pin plug is similar to the one used by Kenwood. Since there was no available AG-30 preamplifier, I used the preamplifier in the Mirage with minimal results. The front-end sensitivity of the 375A is such that a preamp isn't needed most of the time. However, the S-meter is just as "dead" as on the 275 and 475, as the reader will soon see in the test data.

"The front-end performance of this particular unit . . . is not on a par with the IC-275A and IC-475A."

In practice, I set the AF Tone control at about 10 o'clock to eliminate a high-frequency hiss present with no signals and the squelch open. The speech compressor didn't seem to make much difference on distant contacts. It took as many tries to work weak stations with compression on as it did with compression off.

Specification		Claimed	Measured
Frequency Coverage:	Transmit:	216–236 MHz	216.00–236.00 MHz
	Receive:	same	same
Output Power:	220.100 High	25 watts	28 watts
	Low	2.5 watts	2.5 watts
	223.50 High	25 watts	25 watts
	Low	2.5 watts	2.5 watts
Receiver Sensitivity:			
USB/LSB/CW	10 dB S/N @ 220.100	<.28 uV	.2 uV
	10 dB S/N @ 223.50	<.28 uV	.2 uV
FM	10 dB S/N	<.18 µV for 12 dB SINAD	.2 µV for 12 dB SINAD
Signal for "S9" reading		n/a	3.5 µV
1-dB compression/output		n/a	−9 dB
Conversion Gain, First RF Amp/Mixer		n/a	18 dB
Selectivity, SSB/CW		2.3 kHz/6 dB	n/a
		4.0 kHz/60 dB	n/a
Selectivity, FM		15 kHz/6 dB	as claimed
		30 kHz/60 dB	as claimed

The RIT control is a real help on 220, especially with all the older stations that drift out of the passband.

I used the Programmable Scan to set up limits of 220.080–220.150 MHz so that the radio was always seeking out new stations while I was on other bands. Most of the activity on 220 SSB or CW occurs during the activity hours at 0800Z and 2000Z with the band fairly quiet otherwise. Using this scan feature allows the contester to keep an extra "ear" on the band in case of an opening or a new grid square.

Received signal reports were favorable regarding the crispness of the audio as well as clarity. Based on these reports, I set the MIC GAIN control at 12 o'clock and left it there permanently. The supplied microphone is the ICOM HM-12 scanning type, allowing remote up/down selection of frequency. Serious contesters may wish to go with the optional SM-8 base station microphone and a footswitch, leaving the hands free for logging and tuning. (ICOM also makes the SM-10 microphone with a graphic equalizer and speech compressor.)

Performance

The following measurements were taken with an HP608F generator, Boonton 92 millivoltmeter and Bird 43 wattmeter. Power source was the internal AC supply. Take note, however, of two points.

•The IC-375A transmits across the entire specified range, but power output falls off significantly outside 220–225 MHz.

•Receiver compression point was significantly lower than on similar IC-275A and IC-475A models. See the sidebar.

Conclusions

The IC-375A represents a significant step forward in 220 MHz technology. There is no other comparable product that exists today. ICOM has built every possible feature into this transceiver to cover the wide range of operations and modes on 220 MHz. Its output power is sufficient to drive both solid-state and ground-grid tube amplifiers, such as the 8877 and 3CX800, to near the legal limit.

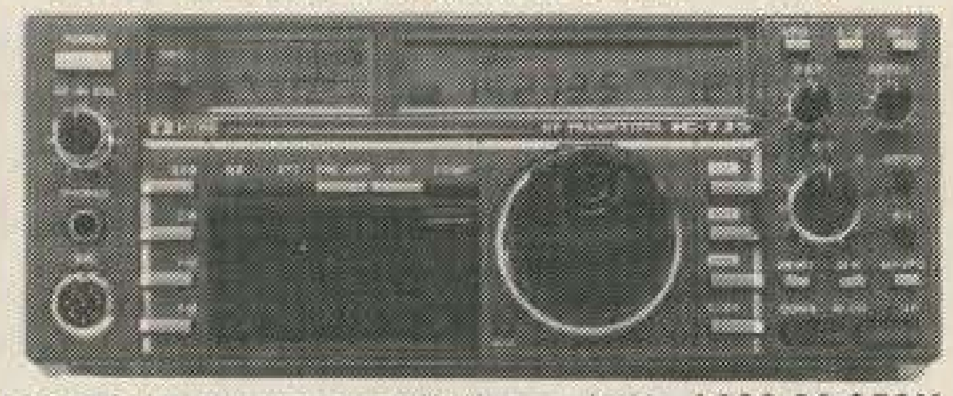
The front-end performance of this particular unit, however, is not on a par with the IC-275A and IC-475A. It took considerably less signal to drive the front end into compression, and this might mean some noticeable intermod products during contest operation, or when strong adjacent channel signals are present such as television channels 12 or 13.

I noticed a slight amount of AGC "pumping" during contest operation when other strong signals were present, but it didn't degrade front-end sensitivity that much. The external preamp might make this situation worse depending on its particular compression characteristics. Indeed, switching my external JFET preamp inline during crowded band conditions did just that.

Still, for the serious UHF operator, the IC-375A is a great way to go for multimode operations. The overall design and performance combined with ease of operation makes this an excellent choice of transceiver. 73

HF Equipment	Regular	SALE
IC-761 HF xcvr/SW rcvr/ps/AT	2699.00	2369
HM-36 Scanning hand microphone	47.00	
SP-20 Ext. speaker w/audio filter	149.00	139^{95}
FL-101 250 Hz 1st IF CW filter	73.50	
FL-53A 250 Hz 2nd IF CW filter	115.00	109^{95}
FL-102 6 kHz AM filter	59.00	
EX-310 Voice synthesizer	59.00	

IC-751A 9-band xcvr/.1-30 MHz rcvr	1699.00	1449
PS-35 Internal power supply	219.00	199^{95}
FL-32A 500 Hz CW filter (1st IF)	69.00	
FL-63A 250 Hz CW filter (1st IF)	59.00	
FL-52A 500 Hz CW filter (2nd IF)	115.00	109^{95}
FL-53A 250 Hz CW filter (2nd IF)	115.00	109^{95}
FL-33 AM filter	49.00	
FL-70 2.8 kHz wide SSB filter	59.00	
RC-10 External frequency controller	49.00	



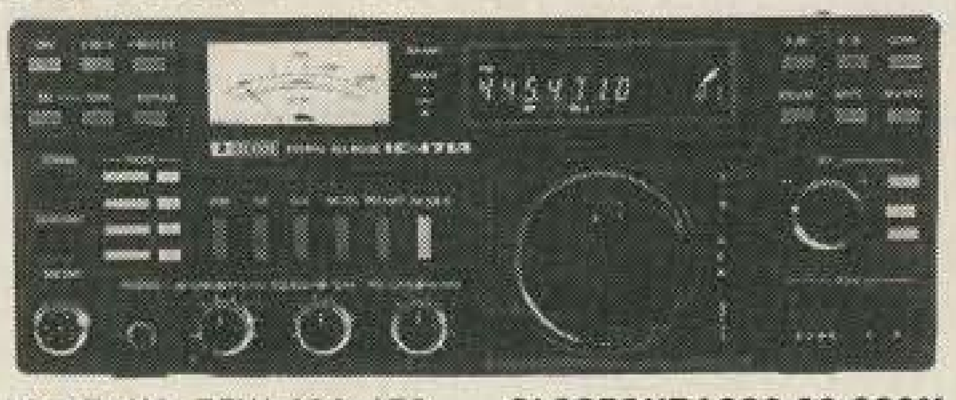
IC-735 HF transceiver/SW rcvr/mic	1099.00	959^{95}
PS-55 External power supply	219.00	199^{95}
AT-150 Automatic antenna tuner	445.00	389^{95}
FL-32A 500 Hz CW filter	69.00	
EX-243 Electronic keyer unit	64.50	
UT-30 Tone encoder	18.50	

Other Accessories	Regular	SALE
IC-2KL 160-15m solid state amp w/ps	1999.00	1699
PS-15 20A external power supply	175.00	159^{95}
PS-30 Systems p/s w/cord, 6-pin plug	349.00	319^{95}
MB Mobile mount, 735/751A/761A	25.99	
SP-3 External speaker	65.00	
SP-7 Small external speaker	51.99	
CR-64 High stab. ref. xtal for 751A	79.00	
PP-1 Speaker/patch	179.00	164^{95}
SM-6 Desk microphone	47.95	
SM-8 Desk mic - two cables, Scan	89.00	
SM-10 Compressor/graph EQ, 8 pin mic	149.00	139^{95}
AT-100 100W 8-band auto. antenna tuner	445.00	389^{95}
AT-500 500W 9-band auto. antenna tuner	589.00	519^{95}
AH-2 8-band tuner w/mount & whip	659.00	589^{95}
AH-2A Antenna tuner system, only	519.00	449^{95}
GC-5 World clock	91.95	89^{95}

VHF/UHF base multi-modes	Regular	SALE
IC-275A 25W 2m FM/SSB/CW w/ps	1299.00	1149
IC-275H 100W 2m FM/SSB/CW	1399.00	1229
IC-375A 25W 220 FM/SSB/CW	1399.00	1229
IC-475A 25W 440 FM/SSB/CW w/ps	1399.00	1249

ICOM

IC-475H 75W 440 FM/SSB/CW	1599.00	1429
IC-575A 25W 6 + 10m xcvr w/ps	1399.00	1249



IC-471H* 75W 430-450 ... **CLOSEOUT**	1399.00	989^{95}
PS-35 Internal power supply	219.00	199^{95}
AG-35* Mast mounted preamplifier	99.75	

***AG-35 $9^{95} with IC-471H Purchase**

Other accessories for IC-471H		
SM-6 Desk microphone	47.95	
EX-310 Voice synthesizer	59.00	
TS-32 CommSpec encode/decoder	59.95	
UT-15 Encoder/decoder interface	34.00	
UT-15S UT-15S w/TS-32 installed	96.00	

VHF mobile multi-mode	Regular	SALE
IC-290H 25W 2m SSB/FM **Closeout**	639.00	549^{95}

VHF/UHF/1.2 GHz FM	Regular	SALE
IC-27A 25w 2m FM/TTP mic **Closeout**	429.00	349^{95}
IC-27H 45w 2m FM/TTP mic **Closeout**	459.00	399^{95}
IC-37A 25w 220 FM/TTP mic **Closeout**	499.00	399^{95}
IC-47A 25w 440 FM/TTP mic **Closeout**	549.00	469^{95}
PS-45 Compact 8A power supply	145.00	134^{95}
UT-16/EX-388 Voice synthesizer	34.99	
SP-10 Slim-line external speaker	35.99	
IC-28A 25W 2m FM, regular mic	429.00	349^{95}
IC-28A 25W 2m FM, **TTP** mic	469.00	409^{95}
IC-28H 45W 2m FM, **TTP** mic	499.00	439^{95}
IC-38A 25W 220 FM, regular mic	459.00	369^{95}
IC-38A 25W 220 FM, **TTP** mic	489.00	429^{95}
IC-48A 25W 440-450 FM, regular mic	459.00	369^{95}
IC-48A 25W 440-450 FM, **TTP** mic	509.00	449^{95}
HM-14 Extra TTP microphone	59.00	
UT-28 Digital code squelch	39.50	
UT-29 Tone squelch decoder	46.00	
HM-16 Speaker/microphone	34.00	
IC-900A Transceiver controller	639.00	569^{95}
UX-19A 10m 10W band unit	299.00	269^{95}
UX-29A 2m 25W band unit	299.00	269^{95}
UX-29H 2m 45W band unit	349.00	319^{95}
UX-39A 220MHz 25W band unit	349.00	319^{95}
UX-49A 440MHz 25W band unit	349.00	319^{95}
UX-59A 6m 10W unit	349.00	319^{95}
UX-129A 1.2GHz 10W band unit	549.00	499^{95}
IC-3200A 25W 2m/440 FM w/TTP	695.00	579^{95}
UT-23 Voice synthesizer	34.99	
AH-32 2m/440 Dual Band antenna	39.00	
AHB-32 Trunk-lip mount	35.00	
Larsen PO-K Roof mount	20.00	
Larsen PO-TLM Trunk-lip mount	22.00	
Larsen PO-MM Magnetic mount	22.00	
IC-1200A 10W 1.2GHz FM Mobile	699.00	629^{95}
IC-1271A 10W 1.2GHz SSB/CW Base	1269.00	1129
AG-1200 Mast mounted preamplifier	105.00	
PS-25 Internal power supply	125.00	114^{95}
EX-310 Voice synthesizer	59.00	
TV-1200 ATV interface unit	139.00	129^{95}
UT-15S CTCSS encoder/decoder	96.00	
RP-1210 1.2GHz 10W 99 ch FM xcvr	1529.00	1349
RP-2210 220MHz 25W repeater	1499.00	1329
RP-3010 440MHz 10W FM repeater	1299.00	1149

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Hand-helds	Regular	SALE
IC-2A 2-meters	289.00	259^{95}
IC-2AT with TTP	319.00	279^{95}
IC-3AT 220 MHz, TTP	349.00	299^{95}
IC-4AT 440 MHz, TTP	349.00	299^{95}
IC-02AT/High Power	409.00	349^{95}
IC-03AT for 220 MHz	449.00	389^{95}
IC-04AT for 440 MHz	449.00	389^{95}
IC-u2AT for 2m w/TTP	329.00	289^{95}
IC-u4AT 440 MHz, TTP	369.00	329^{95}

IC-u2A for 2m w/o TTP
Reg. $299 - **Closeout $259^95**

Accessories for micros - CALL

Aircraft band handhelds	Regular	SALE
IC-12AT 1W 1.2GHz FM HT/batt/cgr/TTP	473.00	419^{95}
A-2 5W PEP synth. aircraft HT	525.00	479^{95}
A-20 Synth. aircraft HT w/VOR	625.00	569^{95}

Accessories for all except micros	Regular
BP-7 425mah/13.2V Nicad Pak - use BC-35	79.00
BP-8 800mah/8.4V Nicad Pak - use BC-35	79.00
BC-35 Drop in desk charger for all batteries	79.00
BC-16U Wall charger for BP7/BP8	21.25
LC-11 Vinyl case for Dlx using BP-3	20.50
LC-14 Vinyl case for Dlx using BP-7/8	20.50
LC-02AT Leather case for Dlx models w/BP-7/8	54.50

Accessories for IC and IC-O series	Regular
BP-2 425mah/7.2V Nicad Pak - use BC35	49.00
BP-3 Extra Std. 250 mah/8.4V Nicad Pak	39.50
BP-4 Alkaline battery case	16.00
BP-5 425mah/10.8V Nicad Pak - use BC35	65.00
CA-5 5/8-wave telescoping 2m antenna	19.95
FA-2 Extra 2m flexible antenna	12.00
CP-1 Cig. lighter plug/cord for BP3 or Dlx	13.65
CP-10 Battery separation cable w/clip	22.50
DC-1 DC operation pak for standard models	24.50
MB-16D Mobile mtg. bkt for all HTs	25.99
LC-2AT Leather case for standard models	54.50
RB-1 Vinyl waterproof radio bag	35.95
HH-SS Handheld shoulder strap	16.95
HM-9 Speaker microphone	47.00
HS-10 Boom microphone/headset	24.50
HS-10SA Vox unit for HS-10 & Deluxe only	24.50
HS-10SB PTT unit for HS-10	24.50
ML-1 2m 2.3w in/10w out amplifier **SALE**	**99.95**
SS-32M Commspec 32 tone encoder	29.95

Receivers	Regular	SALE
R-71A 100kHz to 30MHz receiver	$999.00	869^{95}
RC-11 Infrared remote controller	70.99	
FL-32A 500 Hz CW filter	69.00	
FL-63A 250 Hz CW filter (1st IF)	59.00	
FL-44A SSB filter (2nd IF)	178.00	159^{95}
EX-257 FM unit	49.00	
EX-310 Voice synthesizer	59.00	
CR-64 High stability oscillator xtal	79.00	
SP-3 External speaker	65.00	
CK-70 (EX-299) 12V DC option	12.99	
MB-12 Mobile mount	25.99	
R-7000 25MHz to 2GHz scan rcvr	1199.00	1049
RC-12 Infrared remote controller	70.99	
EX-310 Voice synthesizer	59.00	
TV-R7000 ATV unit	139.00	129^{95}
AH-7000 Radiating antenna	99.00	(11)

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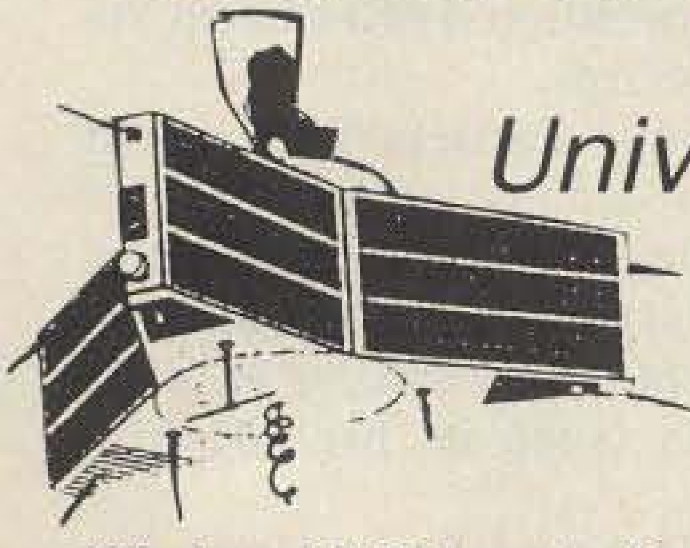
UoSATs: The British Connection Part 2



University of Surrey's Contributions to Hamsats

by Robert J. Diersing N5AHD

Whole-orbit Telemetry Format

In late 1985 and early 1986, both UoSAT spacecraft began to operate under the control of a diary program stored in the on-board computer (OBC). This control program allowed much more flexibility in scheduling the activities of the OBC and data types transmitted on the downlinks. Consequently, whole-orbit telemetry surveys are transmitted very frequently from both spacecraft. The increased frequency of transmissions of whole-orbit data (WOD) make it more desirable to be able to decode and analyze this data. The amateur satellite enthusiast can thus observe the measurements made by onboard sensors when the spacecraft is not within range of his or her ground station. It is important to understand that the whole-orbit data is merely an extraction from the standard telemetry channels that has been stored in the OBC memory.

The amount of OBC memory available for data storage is about 8K for UoSAT-1 and 32K for UoSAT-2. The duration of the survey is under control of the OBC as loaded by the UoS command station. If whole-orbit data is transmitted, the status message transmitted by the command diary will give the date and time of collection and the channels included in the survey. Note that UoSAT-1 and UoSAT-2 computer status messages shown in Figures 1A and 2A include data related to whole-orbit data collection. They show the time WOD collection began and what channels are included. Typical whole-orbit data from UoSAT-1 and UoSAT-2 can be found in Figures 1B and 2B, respectively.

Number of WOD Channels	UoSAT-1 High Serial	UoSAT-2 High Serial
1	0E48	
2	0720	
3	04C0	
4		07E8
8		0FD8

Table 1. The highest observed line serial numbers in WOD surveys for both spacecraft.

WOD Header Lines

There are some important observations to make about WOD surveys. First, each line consists of a four-digit line serial number followed by from one to eight three-digit telemetry channel values and a two-digit checksum. The only exception is the first line, serial number 0000h. In this line the telemetry channel value positions contain the channel numbers of the channels included in the survey. An inspection of the UoSAT-2 sample will verify this. Spaces have been inserted for readability.

0000 011 037 038 039 02

It should be noted that the channel numbers also appear in the status message. However, the date and time of collection can only be obtained from the status message and is not contained in the survey data itself.

The time span between successive lines is determined by multiplying the line serial number increment by the time required to digitize and transmit a standard telemetry frame at the current downlink data rate. Considering the usual downlink data rate of 1200 bauds, the digitize-and-transmit time for UoSAT-1 is 5.28 seconds, and for UoSAT-2 it is 4.84 seconds. Thus, the time between lines 0008h and 0010h in the UoSAT-1 example is (0010h − 0008h) × 5.28 and (0010h − 0008h) × 4.84 for the same lines in the UoSAT-2 example. The duration of a WOD survey can thus be determined by multiplying the highest line serial number by the same factors of 5.28 and 4.84. Various maximum line serial numbers recently observed are shown in Table 1. Both the time between measurements (lines) and the duration must, of course, be considered by any program that will plot the data.

Interleaved Transmission Scheme

The examples in Figures 1B and 2B were only short extractions from an actual WOD survey. Their intent was to show the general format for WOD. A typical survey from UoSAT-1 might consist of lines 0000h through 04C8h while one from UoSAT-2 could have lines 0000h through 0FD8h. The larger number of lines from UoSAT-2 is a result of the larger amount of memory available in which to store the survey. In actual practice, however, multiple sets of lines are transmitted as shown in Figure 3.

The data set with serial numbers 0001h through 0FD9h is transmitted following the data set with serial numbers 0000h through 0FD8h. There may also be a 0002h through 0FDAh set. The previous discussion of time between measurements still holds; i.e., the time between lines 0008h and 0009h is 4.84 seconds since the difference between serial numbers is one. The data is downlinked in this interleaved fashion so that burst errors during downlink reception can be repaired with the following set of "nearby" data points. This feature is particularly useful when observing the WOD in real time as the UoS command station does.

Checksum Validation

In order to verify the checksum, each pair of ASCII characters is taken as a hex byte value and summed. Using modulus 256 arithmetic, the summation should produce a constant result. In the case of UoSAT-1 whole orbit telemetry, the constant value is AAh, which is 170 decimal. For UoSAT-2 the value is BBh, which is 187 decimal. An example of the checksum validation procedure follows. It was taken from the UoSAT Spacecraft Data Booklet.[6]

```
COMMAND DIARY V1.1 IN OPERATION
UNIVERSAL TIME IS 12:54:42
DATE 28/02/88
ATED
MEMORY WASH POINTER AT 1FB5H
LAST CMD SENT BY COMPUTER WAS 29H TO 1
LAST CMDORECD BY COMPUTER WAS 7DH TO 0 WITH DATA 00H

CURRENT WOD COMMENCED AT 00:00:00
DATE 28/02/88
SURVEY INCLUDES CHANS 03,13,28,
```

```
00000030130286C
0008001373376B2
0010002373376A9
0018002373376A1
002000137337769A
0028001373376 92
003000137337758B
0038001373376 82
004000137337767A
0048001373376 72
005000137337766A
0058001373376 62
0060001373376 53
0070002373376 49
0078002373376 41
0080003373376 38
0088002373377 30
0090002373377 28
0098002373377 20
00A0002373377 18
00A8002373377 10
```

Figure 1. Computer status information (1A) and Whole Orbit Data (WOD) (1B) collected from UoSAT-1. Note the status information includes start time and date of the WOD and specifies channels on which data has been collected.

```
COMMAND DIARY V4.8 IN OPERATION
UNIVERSAL TIME IS 03:49:27
DATE 28/02/88
AUTO MODE IS SELECTED
10 RAM ERRORS AT D519H
SPACECRAFT SPIN PERIOD IS -005BH SECONDS
LAST CMD SENT BY COMPUTER WAS 40H TO 1
LAST CMD RECD BY COMPUTER WAS 6DH TO 0 WITH DATA 00H

CURRENT WOD COMMENCED AT 00:00:00
DATE 28/02/88
SURVEY INCLUDES CHANS 37,38,39,47,48,49,57,58,

****!!!!!NEWSFLASH!!!!!****

WOD-DATES ONE WEEK OLD, CHANNELS OK
DE PA3BHF

DIGITALKER ACTIVE
```

```
00000370380390470480490570588C
000842447250346550146449448812
001042447250345950146449448816
001842447150245650046349448815
00204244715024545004634944880F
002842447150245250046349448809
003042447150245150046349448802
003842447150244950046249448803
0040423471502448500462494488FD
0048423471502447500462494487F7
0050423471502447500462493487F0
005842247050244649946249348753
00604224705024454994614934874D
006842247050244449946149348746
007042147050244349946149348740
007842147050144349946149348739
008042147050144249946049348733
00884204705014424994604934872C
00904204695014414994604934862D
00984194695014404984604934862E
00A04194695014404984594934862D
00A84194695014404984594934862 5
00B041846950143949845949348625
00B84184695004394984594924861F
```

Figure 2. Computer status (2A) and Whole Orbit Data (2B) from UoSAT-2.

Consider the WOD telemetry line:

0088511449621693FF

Take this line and add a zero ('0') in front of each three-digit telemetry value to get:

00 88 05 11 04 49 06 21 06 93 FF

Add together the first digit from each pair (remembering A = 10, B = 11, etc.) and multiply by 16:

$16 \times (0 + 8 + 0 + 1 + 0 + 4 + 0 + 2 + 0 + 9 + F) = 624$

Add together the second digit from each pair:

$0 + 8 + 5 + 1 + 4 + 9 + 6 + 1 + 6 + 3 + F = 58$

Add these two previous results together, divide by 256, and note the remainder.

$(624 + 58) \div 256 = 2$ with remainder 170

Lines producing the correct result when subjected to the validation procedure should represent correct data. The UoSAT-2 WOD should produce a remainder of 187 (BBh).

Merging Data from Multiple Orbits

Rarely can a complete WOD survey be captured in a single pass. This is usually due to a combination of two factors. The first is marginal reception due to low elevation passes and/or local interference with the downlink signal. The second is the switching of the WOD on and off the downlink by the OBC resulting in insufficient data capture.

The solution to this problem lies in the merging of data from orbits where the same WOD survey has been transmitted. Care must be taken that the WOD is from the same survey as indicated by the OBC status message. Table 2 shows data from several orbits collected at my station.

For UoSAT-2, a new WOD collection had already begun for the UTC day prior to the first visible pass. This can be seen by referring to the UoSAT-2 data in the preceding table. Note that the highest line serial number for orbit number 12089 is 090Ah, and for orbit number 12090 it is 0D99h. This is because WOD collection was in progress when the data was captured. When monitoring the downlink in real time, "WHOLE ORBIT DATA COLLECTION IN PROGRESS" will be seen in the OBC status messages until the survey has been completed. For listeners in the United States, the best orbits for WOD collection will be the morning passes, since the survey will have been completed by then. Occasionally, a new WOD survey will start around noon UTC, but this is not common.

The same comments apply to UoSAT-1 with one notable exception. The difference is that frequently a new WOD survey is initiated between passes visible in the US, since this is when UTC midnight occurs. This can be seen in the preceding table. Orbit number 27162 occurs on 08/25/86 while orbit number 27163 occurs on 08/26/86. The highest line serial number is again lower on orbit 27163, indicating a WOD survey is in progress.

A Look Ahead

The UoSAT Spacecraft Engineering Research Unit at the University of Surrey (UK) is now building a third UoSAT-OSCAR spacecraft–UoSAT-C. NASA has agreed to provide a launch for UoSAT-C on a DELTA launch vehicle currently scheduled for late 1988. The DELTA should place UoSAT-C into a 43-degree inclination, 500 km circular orbit.

Like UO-9 and UO-11, UoSAT-OSCAR-C will support a world-wide user community of engineers, scientists, educators and communicators. If all goes according to plan, UO-C will provide spacecraft housekeeping telemetry, long-term telemetry surveys, results from on-board experiments, news bulletins and communications facilities on a single downlink through packet-radio techniques. The UoSAT Spacecraft Research Unit will finalize and publish communications modem and protocol details as soon as possible to allow ground stations to equip themselves.

```
000001103703803902
0008345439481513 91
00103444394815138A
001834443948151382
00203444394815137A
002834443948151372
00303434394805136C
003834343948051364
......
0FD033244047451 0D6
0FD833244047451 0CE

000134543948151398
000934543948151390
001134443948151389
002934443948151371
00313434394805136B
003934343948051363
00413434394805135B
004934243948051354
......
0FD13324404745 10D6
0FD93324404745 10CE
```

Figure 3. Example of multiple data sets from UoSAT-2. UoSAT 2 has 32K memory for data collection versus 8K on UoSAT-1.

UoSAT-C, like the previous UoSAT missions, will have a strong element of international collaboration–specifically with members of AMSAT-UK, AMSAT-NA in the US and Canada, VITA, Quadron, NASA, the British National Space Centre and the European Space Agency.

Store & Forward Communications

Since 1983, UoSAT has played a major role in an international collaborative project developing cost-effective digital store-and-forward satellite communications techniques. The UoSAT-OSCAR-11 Digital Communications Experiment (DCE)—funded by the Volunteers In Technical Assistance (VITA) and built by VITA/AMSAT volunteers in the USA, UK and Canada—provided the first operational tests of store-and-forward PACSAT communications within the Amateur Satellite Service. Drawing on the operational and engineering data gained from the DCE, UoSAT and VITA are developing a high performance digital store-and-forward communications payload specially tailored for use by inexpensive ground stations. To test this payload, UoSAT-C will carry the PACSAT Communications Experiment (PCE). The PCE will be openly accessable to Radio Amateurs operating in the 2m and 70cm bands (Mode J). VITA is seeking additional frequency allocations outside the amateur bands to allow limited use of the UoSAT-C PCE by VITA ground stations in remote areas to provide technical assistance and disaster relief.

Radiation Studies Experiments

Microprocessor-controlled payloads such as the PCE cannot be built without VLSI semiconductors, and most recent and affordable VLSI devices have not yet been tested for space use. UoSAT-C will host several experimental payloads studying the effects of the space radiation environment on VLSI devices.

•Cosmic Particle Experiment (CPE)—comprising an array of large-area PIN diodes, will detect energetic particles which cause single event upsets (SEUs) in VLSI circuits (such as high-density RAMs).

•CCD Single Event Upset Experiment—(CCD-SEU) comprising an enclosed Charge-Coupled Device (CCD) array, will detect energetic cosmic particles and evaluate the effect of SEUs on CCD imagers. This data is of particular importance for scientists using sensitive CCDs as star sensors.

•Total Dose Experiment (TDE)—using special FETs located around the spacecraft, will measure the total radiation dose accumulated by the on-board subsystems and payloads. These dose measurements will allow engineers to assess the shielding properties of the spacecraft structure, and to correlate changes in LSI-device power consumption and performance with total radiation dose.

UoSAT-1 Data			UoSAT-2 Data		
Orbit No.	Date	High Serial	Orbit No.	Date	High Serial
27162	08/25/86	049A	12089	06/07/86	090A
27163	08/26/86	0242	12090	06/07/86	0D99
27170	08/26/86	0722	12096	06/07/86	0FD0
27171	08/26/86	0722	12097	06/07/86	0FD9
			12098	06/07/86	0FD8

Table 2. A summary of UoSAT data collected at the author's location (27.28N, 97.24W).

Satellite Technology Experiments

UoSAT-C will carry a range of satellite technology experiments associated with power systems, on-board data handling (OBDH), attitude determination, control and stabilization (ADCS) and RF modulation.

•POWER—The spacecraft will be powered from GaAs solar cells and will include experimental patches of novel GaAs, InPe and Si solar cells with a variety of newly-developed cover-slides. The performance of these cells will be monitored throughout the mission as a function of radiation dose. The spacecraft onboard computers will constantly monitor and adjust the Battery Charge Regulator and Power Conditioning Module to optimize power conversion and storage efficiency.

•OBDH—UoSAT-C will include several computers. In addition to the primary RCA1802 on-board computer (OBC-1) running DIARY-type software, there will be a more powerful 80C86-based OBC-2 supporting complex attitude control algorithms and spacecraft data networks. Four TRANSPUTERS in a parallel-processing array will be available for highly sophisticated on-board image and data processing, and the PCE will employ an 80C186-family computer to manage high-speed communications links and several megabytes of RAM.

A wide range of memory devices using different technologies and architectures will make up a total on-board capacity of around five megabytes of RAM. The radiation-induced effects on the processors and associated memories will be monitored and evaluated throughout the lifetime of the spacecraft. The network of computers on UoSAT-C will make this spacecraft the most computationally powerful of its class and will support demanding experiments in advanced spacecraft attitude determination and control, data communications and image processing.

•ADCS—The 43-degree inclination, non-sun-synchronous nature of the UO-C orbit will necessitate the use of new attitude determination and control mechanisms to maintain accurate Earth-pointing. In addition to more complex attitude control algorithms executed by OBC-2, improved analog and digital sun sensors and Earth horizon sensors are being developed at UoS for the mission.

•DSP—If time and resources permit, a Digital Signal Processing Experiment may be included on UO-C to evaluate modulation/demodulation schemes.

A new concept of highly modular construction has been developed and is under test for UoSAT-C. This new, modular structure should result in much improved utilization of the available spacecraft envelope, greater ease of assembly and integration, and allow a more rapid response to future launch opportunities.

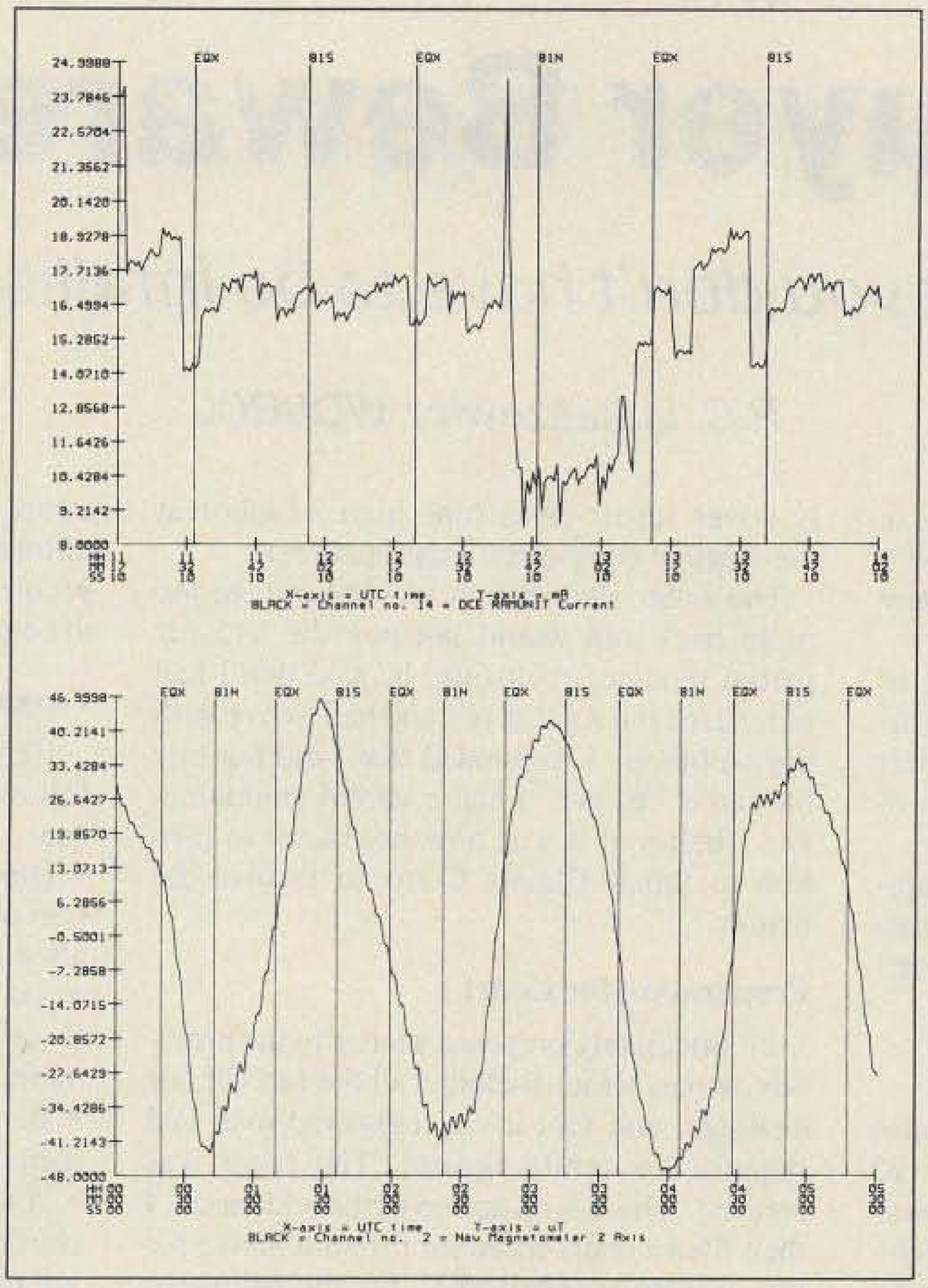


Figure 4. Two examples of Whole Orbit Data plotted against time. 4A shows magnetometer readings over 5½ hours, and 4B illustrates variations of the Digital Communications Experiment (DCE) RAM unit's current demand in milliamperes.

For More Information

Information about UoSAT operations can be obtained by copying the bulletins transmitted by the satellites. Examples of bulletins can be found in Figures 1B and 2B. These bulletins are usually updated on Thursdays so listening on the weekends will provide the latest information. The bulletins transmitted by UoSAT-2 are longer than those sent by UoSAT-1 since there is more RAM available for storing the bulletin text. The bulletins contain important information for all operational satellites.

Orbital information can be obtained from a variety of sources. The most popular method is to run predictions with the aid of a computer program. In the UK, programs for various microcomputers are available on both diskette and cassette tape from AMSAT-UK, 94 Herongate Road, Wanstead Park, London, E12 5EQ. In the US, programs are available for a number of microcomputers from AMSAT-NA Software Exchange, Box 27, Washington, D.C., 20044. The reference elements sets are available through the various AMSAT nets and publications.

The UoSAT Newsletter is published periodically by the University of Surrey Electrical Engineering Department. It is sent to those who have a record of serious interest in using the UoSAT spacecraft. A complete description of the UoSAT-1 experiments was given in the August/September 1982 issue of *The Radio and Electronic Engineer* published by the Institution of Electronic and Radio Engineers, London. Another comprehensive description of UoSAT-1 can be found in *UoSAT: The University of Surrey Satellite Project* published by the UoS Department of Electrical Engineering. Another issue of *The Radio and Electronic Engineer* has recently been devoted to the UOSAT-2 spacecraft. Copies are available from AMSAT-NA and AMSAT-UK.

Publications available in the US containing information about UoSAT are *QEX/SAT* published by the American Radio Relay League, and *Amateur Satellite Report (ASR)* and the *AMSAT-NA Technical Journal (ATJ)* both published by AMSAT-NA. *ASR* is a membership service and is published every two weeks. *ATJ* is published twice yearly in January and July and contains high-level engineering and scientific papers related to amateur radio and other low-cost spacecraft projects. 73

Acknowledgements

The material in the sections on UoSAT-C Mission Profile and UoSAT-C Payloads is taken directly from the public announcement of the UoSAT-C mission prepared by Dr. Martin Sweeting, G3YJO, Director of Satellite Engineering at the University of Surrey, England.

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Number 11 on your Feedback card

Buyer Beware!

But you don't have to be infallible

R.C. Lukaszewicz WD8RCL

Have you ever bought a piece of gear that did not live up to the seller's claims? There is a solution to get your money back or to recoup repair costs!

Buying used equipment carries the risk of inheriting someone else's troubles. Unfortunately, not all hams honestly represent their hand-me-downs. Here are some pointers to avoid being left "holding the bag."

I am not an attorney and I am not attempting to provide legal advice regarding the matters put forth in this article, but my experience could offer some valuable lessons.

The Transaction

A short time ago, I heard a ham announce over a 40 meter net that a five-year old, 25 watt, synthesized, two meter mobile was available for $165. I called him on the telephone to question the condition of the radio and if the price was negotiable. After speaking with the seller, I was convinced that the only flaw with the radio was a bulb that had reached the point of no return in the T/R meter. The price was not negotiable, and I believed that the radio functioned properly. Eventually, I followed through and made arrangements to examine the rig at a Swapmeet.

We met, and I examined the radio. Unfortunately, there were no provisions for testing the rig, and again I questioned the seller on its condition. I was given a verbal guarantee that nothing but the bulb was inoperative. Also, the seller claimed he had used the rig daily in his home without a problem. I thought that since this statement came from a fellow amateur, it was good enough for me. I paid the owner his full asking price of $165 in cash.

The Ultimate Test

Upon arriving home, I immediately connected the unit with my Bird wattmeter in line. I quickly discovered that the maximum output power was a mere eight watts, the T/R meter was not operating in the receive mode, and there was objectionable audio distortion on receive.

Immediately I called the previous owner and explained the problems. He agreed to make amends and reluctantly agreed that the T/R meter was not functioning on receive. We agreed to talk the following day with information on repair options.

The next day I was armed with as much information I could accumulate for the repair cost of the unit on short notice. I called the previous owner again and courteously asked that he either repay the cost of the unit or provide me with a modest $45 to partially cover repair costs (one hour of labor at the original equipment manufacturer).

The seller said that he would not take the radio back and would not pay the $45 for partial repairs. In closing, he said that I had purchased the rig "as is" and had to live with the problems. I responded that I did not buy the radio "as is." I had a verbal guarantee, and I believed it was now necessary to take him to Small Claims Court to resolve the matter.

Preparation for Court

I immediately prepared a letter to the previous owner, which included all the facts of our dealings, and sent it via registered mail and requested a return receipt. The letter was refused, which is an option of the addressee. I then filed a court claim for the sum of $45 for the in-factory repair, $21 for the estimated replacement of the final power amplifier, and $20 court costs for a total of $86.

I then obtained a written quote from the manufacturer highlighting the cost of examining the radio. I obtained the FCC rule book and highlighted Part 97, ownership Subpart-C Technical Standards, section 97.67, Maximum authorized transmitting power subsection(a) and subpart E-Prohibited Practices and Administrative Sanctions, section 97.121, False Signals subsection(a).

I gathered together the equipment specification sheet, the radio, power supply, antenna, Bird wattmeter and associated cables to demonstrate the radio in court if necessary.

Trial Day

At the trial I informed the court that the case was a matter of principle. I felt I could prove that the radio I had purchased was sold with the knowledge of it being a defective radio. I stated the facts, presented the refused, unopened registered letter, Specification Sheet, ARRL/FCC rule book, equipment examination estimate, and radio. The seller simply stated to the court that he was unaware of any problems with the radio.

I pointed out the meter on the face of the radio, and said that I felt it had to have been observed by the previous owner. I then pointed out that, per the rules and regulations, that the seller would have been operating illegally by not knowing his output or by transmitting false signals into a repeater by not having the T/R meter working. I then offered to set up the rig and demonstrated the power output deficiency.

This was all that was necessary for the court to rule in my favor. I received the full award of $66 plus court costs that I sought. I ultimately repaired the T/R meter and audio problem myself, with the power problem yet to be tackled.

Caveat Emptor

Here are some common sense guidelines to follow when considering a purchase of used gear.

- Thoroughly quiz the seller about the condition of the piece of equipment. Make certain about the condition of the gear before buying.
- Ask the seller if he would refund all monies if you are not totally satisfied with the equipment.
- Be certain to obtain the seller's complete name, address, phone number and call sign.
- Ask the seller if he will take a personal check with proper ID. Some sellers are willing to take a check if they believe the equipment's damage was described properly. On the other hand, some amateurs have been inconvenienced by bad checks.
- Ask for a demonstration on the spot if possible.
- If you purchase through the mail, "sight unseen," be sure the seller will provide a return privilege in writing.

The Small Claims laws are different in many States, so check the options. Keep in mind, however, that it is not a joyous occassion to take a fellow amateur to court. Still, it is better to have the courts decide rather than taking the law into your own hands. Also, the time lost in attending court may not be worth the claim, and it then becomes a matter of principle.

Summary

It is wise to scrupulously check the piece of equipment as effectively as possible before buying it.

If you are ever taken taken advantage of, be patient in the effort to resolve the matter mutually between the buyer and the seller. If all else fails, the Small Claims Court may become the only alternative.

Remember, even if the equipment was bought "as is" and there are defects above and beyond what was bargained for, the damages may be reclaimed. If fraud can be proven, the seller of the equipment may have to rescind the deal or hand over the costs for the repairs.

Since laws in each state may be different, a consultation with an attorney may prove worthwhile before filing a claim.

Knowing there is solid recourse, I will continue to buy used gear and continue to look for those bargains.

CIRCLE 41 ON READER SERVICE CARD

A New Pulsed Bi-Phase Digital Communications System

19.2 kB in a 3 kHz bandwidth? Read on to see how!

by William Hotine K6HH

Amateurs have traditionally been the forerunners of radio progress. They have pioneered short waves in the 1920s, and single signal superhets and single sideband in the 1930s and 1950s. Well, the same pioneering can be done in digital telecommunication techniques!

This article describes a new technique of pulsed, bi-phase shift-keyed (BPSK) modulation that opens up the new field of narrow band digital radio. The system tailors new methods to fit the requirements of a narrow band system, and abandons the conventional method of 180° sinusoidal phase reversals, which produces a large number of sidebands and a consequent wide frequency spectrum of the signal. This wide bandwidth has been accepted in the past as a necessary evil of digital communication.

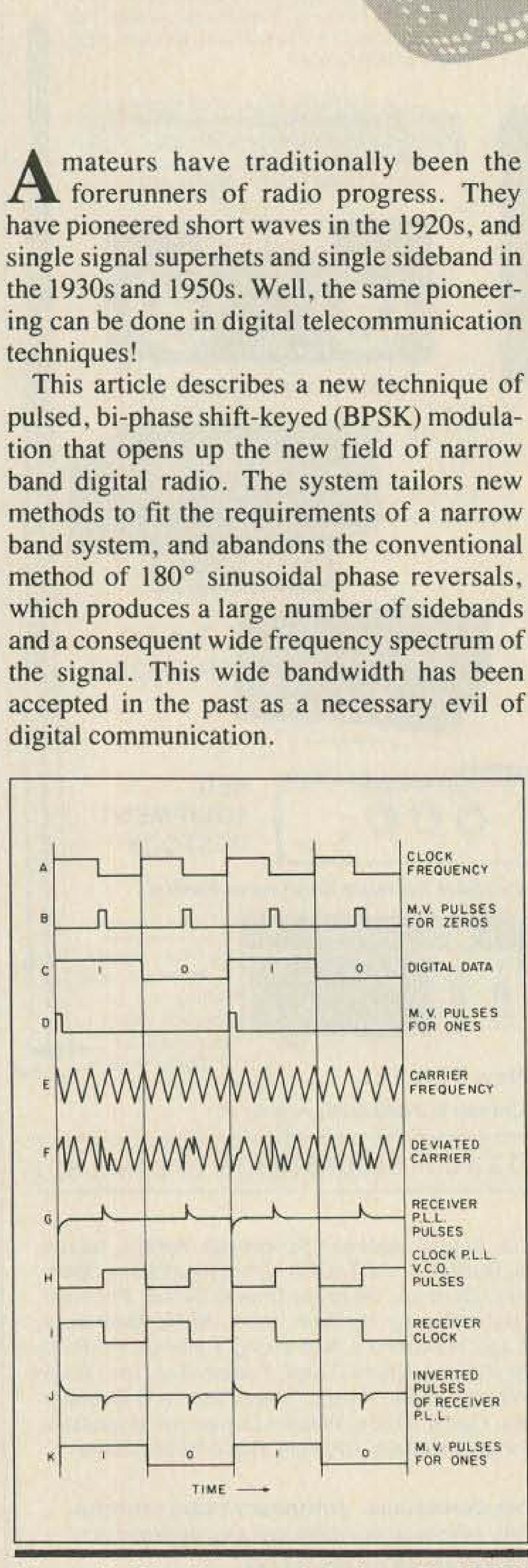

Figure 1. Waveforms used in the pulsed BPSK system and their timing relationships.

Small Phase Deviation

The key elements in the new pulsed BPSK modulation system are: 1) the very small phase angle deviation, and 2) the nanosecond linear transient of the phase modulation.

Hund[1] analyzed the sidebands generated by small phase deviations. At small phase angles of 0.2 radian (11.5°) or less, only two main sidebands, similar to AM sidebands, are generated. The modulating frequency *f* determines the sideband spacing from the carrier. The width of a sideband is the the modulating frequency variation, as in AM. Each sideband contains an equal amount of information. This allows PSK transmission on a single sideband (SSB) by using a small deviation angle and a bandpass filter to pass one sideband and reject the carrier and the other sideband. The width of this single sideband is reduced by a novel coding method that uses pulsed phase deviations of 0.02 radians (1.2°) to represent the digital information. The novel coding incorporates a timing pulse in every bit, which provides a coherent clock at the receiver enabling synchronous operation.

Synchronization

How does a receiver demodulate this single sideband without a reference carrier? By pulse coding the deviations to allow polarized pulsed detection in a digital phased locked loop (PLL) demodulator system. Binary "one" is encoded as a brief pulse of a leading phase angle at the start of a clock period and a brief pulse of a lagging phase angle at the middle of this clock period. Binary "zero" is encoded only as a brief pulse of a lagging phase angle at the middle of a clock period. This coding thus provides a timing pulse at the middle of every bit for directly transmitting the clock.

The phase deviations arise from the transitions at the rising and falling edges of the rectangular phase modulating pulses approximately 1μs long. The phase angle deviation during the nanosecond rise and fall of the modulating pulse is approximately 0.02 radian or 1.2°. The sine wave carrier is phase modulated during a very small portion of a single carrier cycle when using this method, so modulation products occupy a very small frequency spectrum.

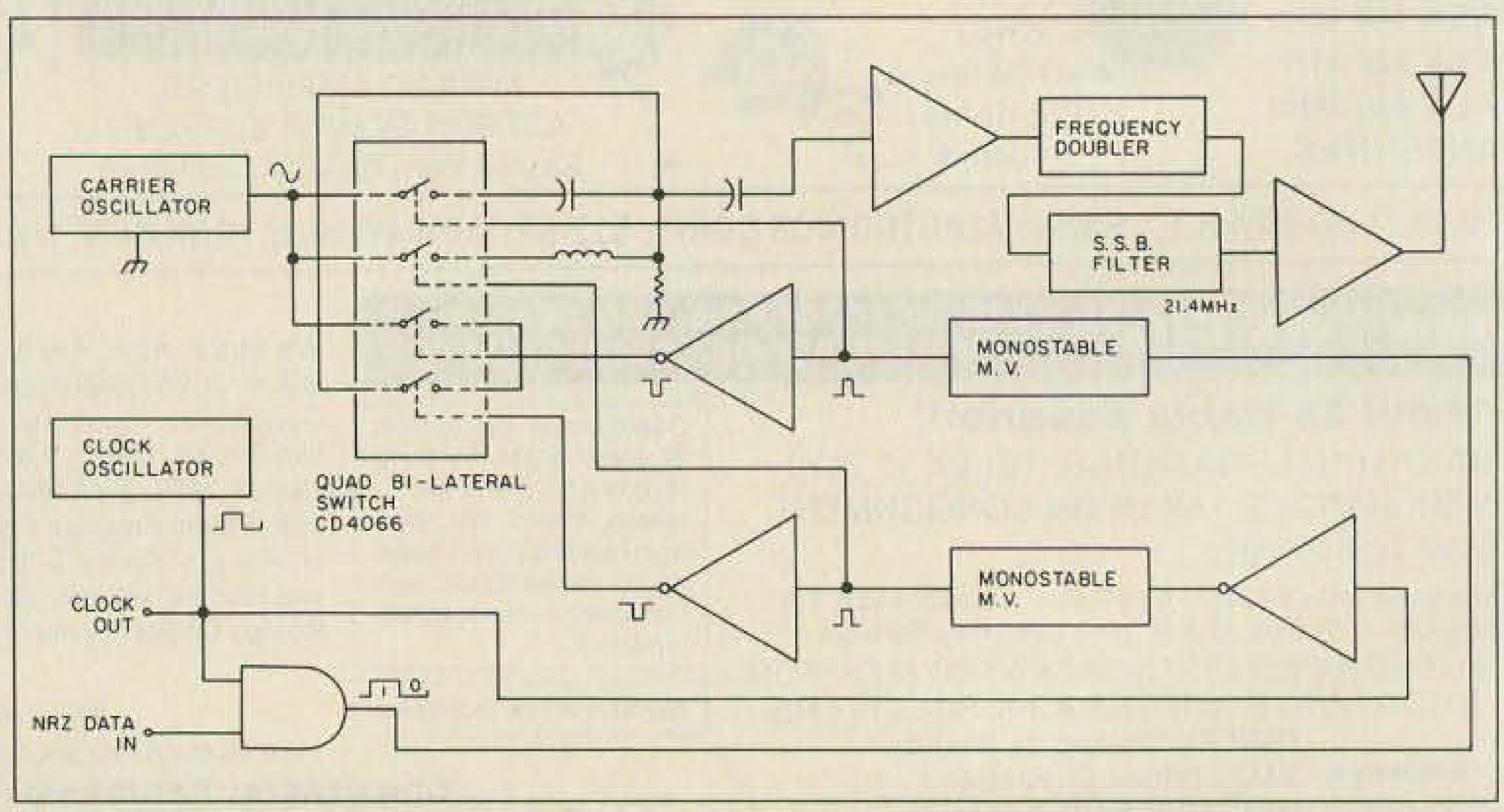

Figure 2. Transmitter block diagram.

TX Modulator

The wave shapes used in this system are shown in Figure 1. Figure 2 shows a block diagram of the transmitter's simple modulation system.

A sine wave oscillator feeds a one-volt signal through the quad bilateral switches to separate L and C phase shift circuits when these switches are pulsed. The sine wave remains unshifted during the intervals between the digital bit pulses. The square wave clock oscillator circuit drives an inverter, which in turn drives a monostable multivibrator (M.V.) to produce a "zero" modulating pulse at the middle of every clock cycle. This pulse drives a switch to connect the L phase shift circuit to produce a lagging phase angle.

The NRZ data input, clocked by the clock oscillator, drives one side of the AND gate while the clock frequency drives the other side. When a digital "one" appears at the gate, the AND gate drives a second monostable M.V. to produce a "one" modulating pulse at the start of a clock cycle. This pulse drives a switch to connect the C phase shift circuit to produce a leading phase angle.

Inverters driven by the pulses open the switches, which transmit the carrier directly for the pulses' duration. When no pulses are present at the inverter inputs, the inverters drive the two switches closed to transmit the carrier directly to the load R without phase shift. The load resistance is coupled to a high impedance input amplifier, the output of which drives a frequency doubler.

At this point, there is a carrier with two sidebands present. The sidebands are about 1% of the carrier amplitude. A crystal single sideband filter selects the upper sideband, and an amplifier feeds the narrow single sideband to the antenna.

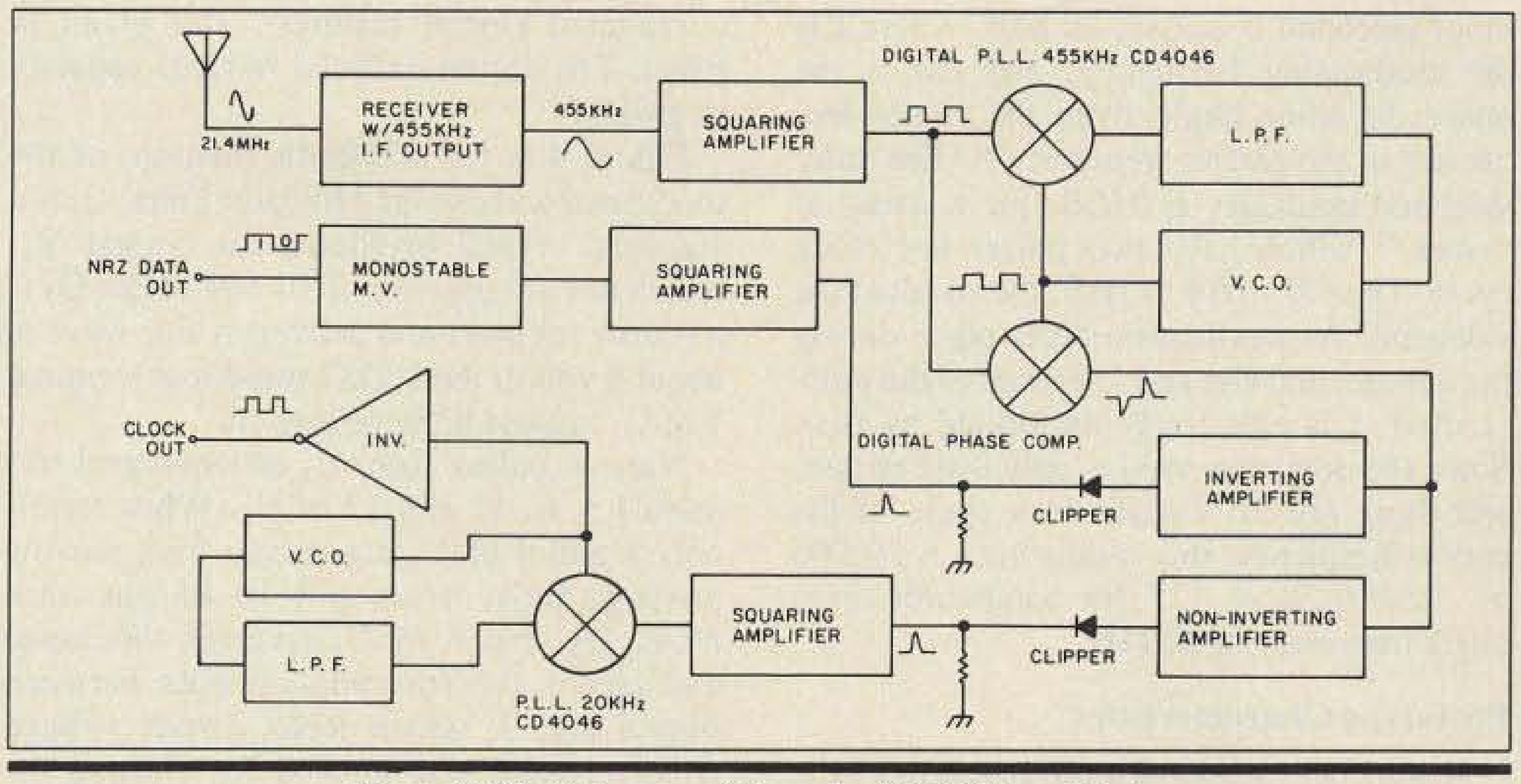

Figure 3. Block diagram of the pulsed BPSK demodulator.

At The Receiver

Here, the SSB sine wave signal at a 455 kHz intermediate frequency (IF) is amplified to make it a square wave at the logic level (Figure 3). The square wave is further squared by a Schmitt trigger, and its leading edge is compared to the leading edge of the PLL voltage-controlled (VCO) square wave in the digital phase comparator of a well-damped PLL by RCA. The signal square wave input is also compared in a second digital phase comparator with the PLL VCO. The second digital phase comparator gives a positive output pulse for a lagging phase angle input, and a negative pulse for a leading phase angle input. This allows unambiguous identification of digital "ones" and "zeros" without a reference carrier, not possible in previous PSK systems.

The digital PLL locks on to the frequency of the bit stream. An inverting amplifier then amplifies the negative output pulses denoting binary ones from the second phase comparator. A diode clipper removes the negative portions of the signal. The positive "zero" pulses are amplified to a square wave at the logic level. A PLL digital phase comparator then compares these pulses with the square wave output of the VCO at the clock frequency but 180° out of phase. An inverter brings the VCO output into phase and feeds the clock output terminal, thus furnishing a coherent clock for the receiver.

Bandwidth Limits

With this encoding method for a clock frequency f, a string of "zeros" gives the

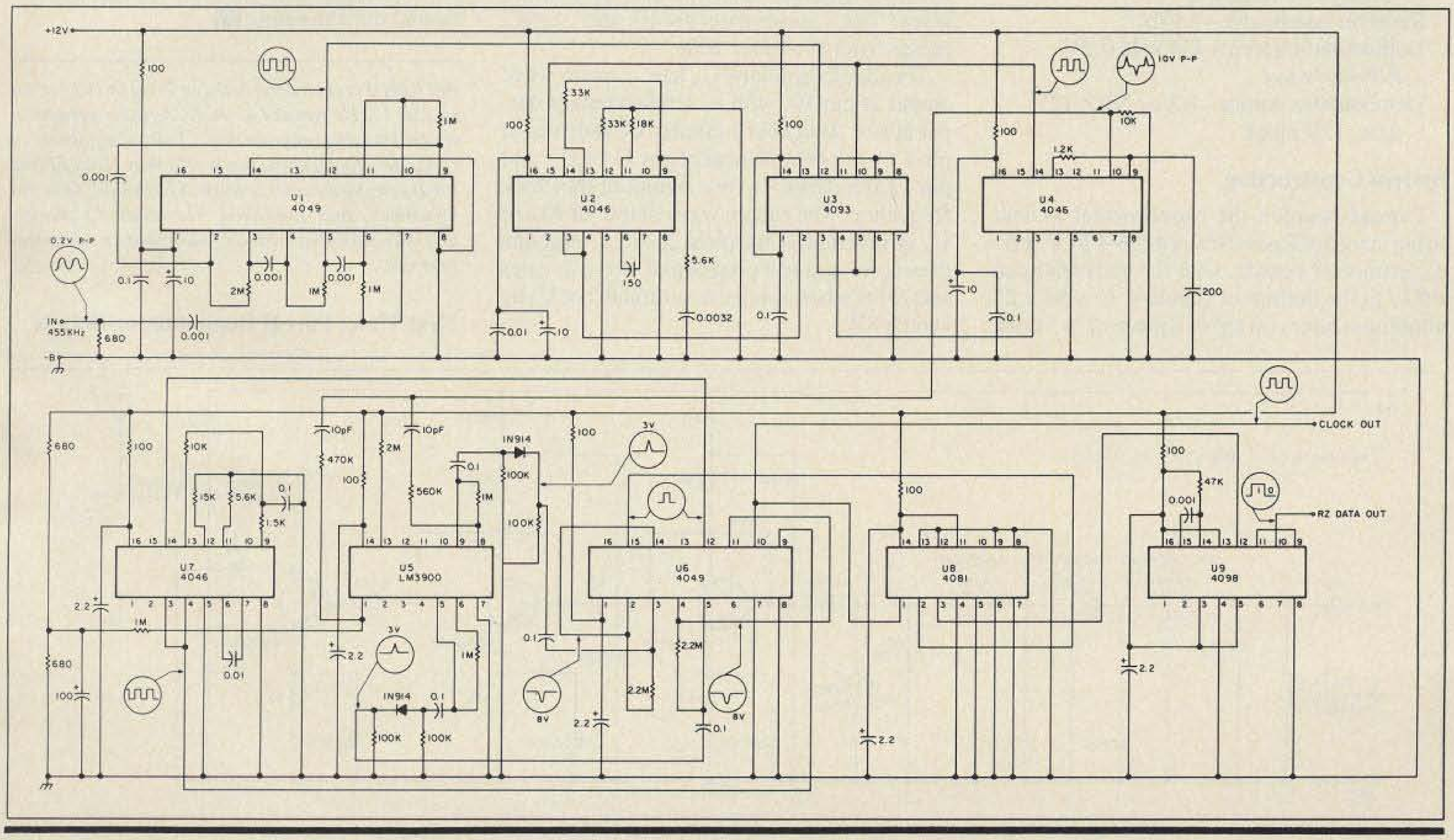

Figure 4. The transmitter schematic. It provides a pulsed BPSK output on 21.4 MHz.

inner sideband boundary as $f\Delta\theta$, where f is the modulating frequency, and $\Delta\theta$ is the phase deviation angle from the center frequency of the carrier frequency F. The outer sideband boundary is $2f\Delta\theta$, for a string of "ones," which have two pulses per clock cycle. Then $2f - f\Delta\theta = f\Delta\theta$, the width of the sideband. As modulation takes place during the nanosecond rise and fall times of the pulses used, f is effectively multiplied by two. Since the deviation used is only 0.02 radian, and there are 2π radians in a cycle of the carrier frequency, this results in $(2 \times 20{,}000 \times .02) \div 6.28 = 127$ Hz bandwidth for a clock frequency of 20 kHz.

Prototype Characteristics

A working breadboard prototype has been operated at a carrier frequency of 21.4 MHz and a clock frequency of 19.6 kHz, an adequate speed for digital telephony or transmission of computer data. These benefits come, however, by sacrificing the high speed performance of the conventional 180-degree phase shift systems. It's a trade-off of speed for economy, simplicity, synchronous operation, and bandwidth. The experimental system is capable of synchronous transmission and reception of 6-bit digital telephony in a bandwidth formerly associated with CW transmission!

The breadboard system has the following characteristics:

Transmitter—Carrier frequency 21.388 MHz
Upper side band—21.400 MHz
Clock frequency—19.6 kHz
Digital input RZ or NRZ—12V data
Power output—10 mW
Receiver—Hammarlund HQ-101A with 455 kHz IF 0.2V P-P
Receiver bandwidth—3 kHz
Demodulator accepts 455 kHz 0.2V P-P sine wave
Demodulator output—RZ or NRZ 12V data, 12V clock

System Construction

I bread-boarded the experimental system using standard Radio Shack #276-174 2" x 6" experimenter boards, with the ends trimmed off to fit the bottom of standard 3" x 5" x 2" aluminum boxes on top of a piece of ⅛" thick corrugated carton material, and glued in place. The carton material reduces capacity to ground.

Figure 4 is the schematic diagram of the modulator and carrier generator units. Q_1 is a standard crystal oscillator for crystal Y_1, which has a frequency of 10.694 MHz. Q_2 is a source follower and delivers a sine wave at about 1 volt to the 1.2kΩ resistor at terminal 1 of U_1, a quad bilateral switch.

Narrow pulses from U_4 drive control terminals 5, 6, 12 and 13 of U_1. When terminals 8 and 9 of U_4 are driven by a narrow positive pulse from pin 10 of one shot M.V. U_5. Pin 6 of U_1 receives this pulse and closes the transmission gate between pins 8 and 9, which feeds carrier voltage from terminal 1 to C_1 and R_1, shifting the phase of the carrier to a leading phase angle. The complementary pulse from inverter pin 10 of U_4 at the same time opens the transmission gate between pins 3 and 4 of U_1, which had been closed to transmit the carrier directly to R_1. Also, when pins 12 and 13 of U_1 are driven by a narrow positive pulse from terminal 6 of U_5, pin 12 of U_1 receives this pulse and closes the transmission gate between terminals 10 and 11, which feeds carrier voltage from pin 1 to L_1 and R_1, shifting the phase of the carrier to a lagging phase angle. The value of R_1 determines the phase angle.

The complementary pulse from inverter #11 of U_4 at the same time, opens transmission gate between pins 1 and 2 of U_1, which had been closed to transmit the carrier directly to R_1. When no pulses appear at pin 6 and 12 of U_1, as in the time between pulses, gates between 1 and 2, 3, and 4 are closed by the inverters, so the carrier appears across R_1 without any phase shift. The dual M.V. at U_5 gives "one" pulses from pin 10, and "zero" pulses from #6, 1µsec wide.

The clock oscillator U_2 has a square wave output at pin 10, with a complementary output at #11. Frequency divider U_3 is driven at pin 1 by the complement at pin 11 of U_2, and pin 12 is a divide-by-two output of the clock frequency. The square wave output of #12 of U_2 is inverted at terminal 3 of U_4, and can then serve as a test program of alternate ones and zeros when applied to terminal 2 of U_6 by switch SW_1.

The clock frequency square wave from pin 11 of U_2 is sent through three AND gates of U_6 to delay its leading edge until later than the trailing edge of the "one" pulse at pin 2 of U_6. This delay prevents a false "AND" output from pin 3. A small capacitor might be necessary from #9 of U_6 to ground to increase this delay in cases where clocked data signals are delayed excessively by the digital processor in use.

Pin 5 of U_5 is driven by the trailing edge of the clock pulse to produce "zero" pulses from #6 at the middle of each clock cycle. Terminal 12 of U_5 is driven by a pulse from pin 3 of U_6 when the rising edge of a "one" pulse and the rising edge of the clock pulse are "ANDed" at pin 3. In this manner, a "one" pulse is delivered at #10 of U_5 and a "zero" pulse is delivered at #6 of U_5 at the proper times to accomplish the coding of the phase deviations of the carrier.

Output Coupling

The carrier voltage on R_1 drives a source follower Q_3, with high input impedance, and its low impedance output drives the amplifier Q_4, which in turn drives the frequency doubler Q_5. Output tank L_2 C_2 is tuned to the second harmonic of oscillator Q_1. A few turns on L_2 serve to couple to the output terminal at low impedance.

The output terminal and ground are connected by twisted pair to the input of the single sideband filter unit shown in Figure 5. The six-pole crystal filter centered at 21.400 MHz has a bandwidth of 12 kHz and drives a high impedance input amplifier Q_1. Amplifier Q_2 drives the output stage Q_3. Output tank L_1 C_1 is tuned to 21.400 MHz. A few turns on L_1 are used to couple to a few feet of antenna wire adequate for the 10-milliwatt experimental transmissions. 73

Bill K6HH received the callsign 2WQ in 1921 when he was 17. He worked as an RCA radio technician while studying engineering. Following work in radar development during World War II at ITT and Raytheon, he went on to work at Fairchild, General Dynamics, and Lockheed. He holds 32 patents and has had five articles published in technical journals.

Next Time: Part II Demodulator Details

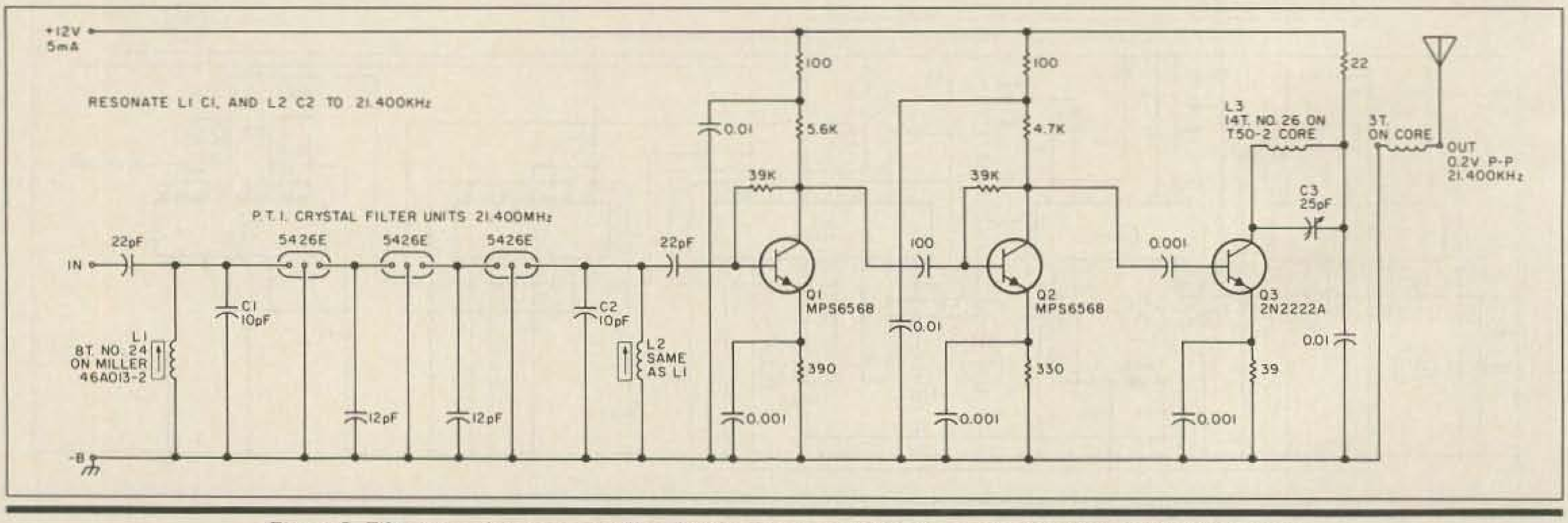

Figure 5. Filtering and antenna coupling details. Test transmissions generated approximately 10mW output.

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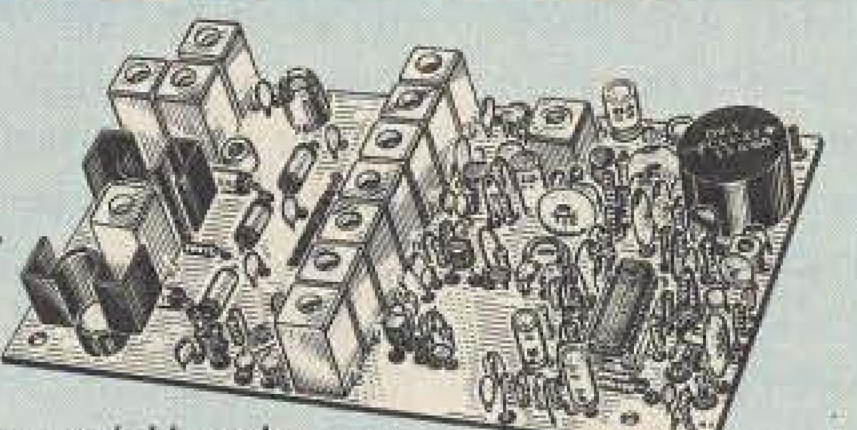

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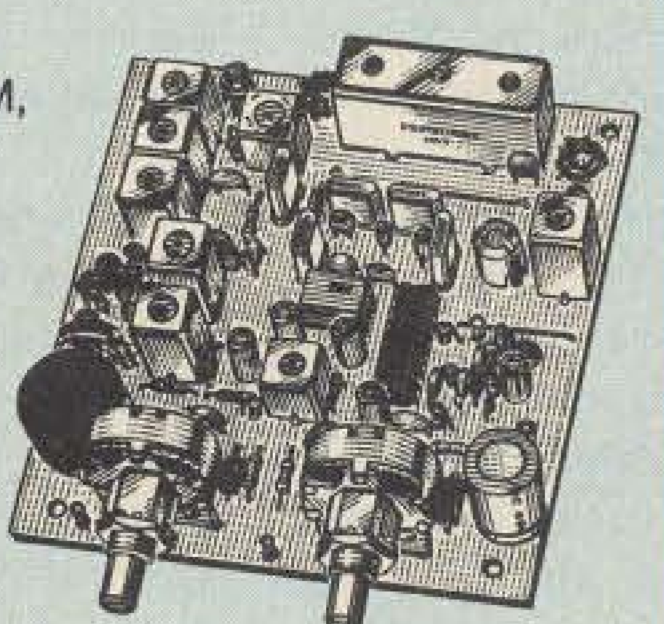

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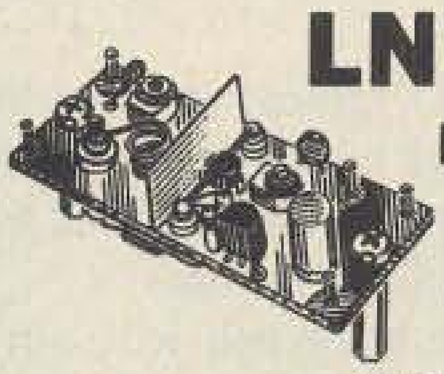

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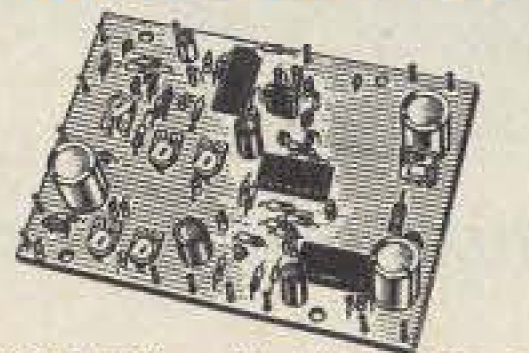

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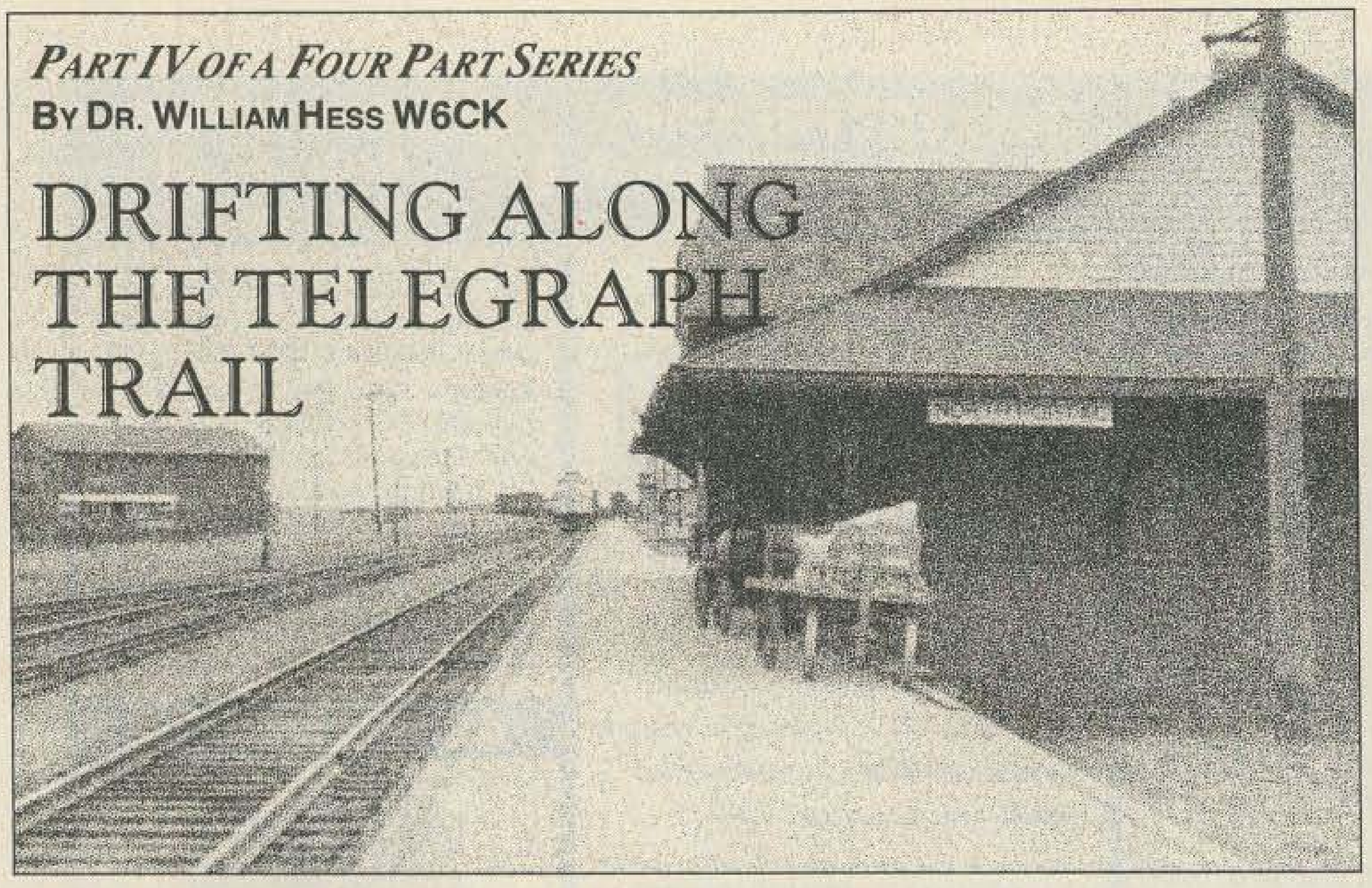

Memoirs of a Former Telegrapher

The Dodge Institute of Telegraphy located in Valparaiso, Indiana, was established early in this century. The Institute primarily trained American-Morse operators for employment by railroads; however, most of the operators employed by Western Union and Postal Telegraph were "home-grown" right on the premises. These 14-year-olds were employed as messengers and would practice American Morse on some available "pony" wire while waiting for a new batch of messages to deliver. They eagerly looked forward to working in the steam-heated world of the Morse Operator instead of pedaling their bikes out in the rain, snow and cold delivering messages.

Western Union messengers who brought a sufficient number of replys to messages delivered, were given a new bicycle as an award.

One routine death message to be delivered read:

"YOUR FATHER IS DEAD STOP COME AT ONCE"

By coincidence, the son to whom the telegram was addressed had also died on almost the same day as his father. The persistent messenger, who could already visualize himself on the new bike, would not leave the gathering following the funeral of the son until he had been given a reply telegram. Finally, the mourners composed this gem:

"I CANT COME STOP I IS DEAD TOO"

Dodge Institute

Poor farm boys looked upon telegraphy as about the only available means to avoid spending the rest of their lives walking between the handles of a plow on the farm. High school graduation was not necessary for entrance into the Dodge Institute.

Professor G.M. Dodge's Pierce Arrow Sedan, which could be seen parked in front of the Institute, was a definite clue that the Professor wasn't "hurting" financially. Such a vehicle cost five thousand dollars in 1925, equivalant to $25,000 in today's "cheap" dollars. Older readers will remember the distinctive headlights of the Pierce Arrow automobiles, which seemed to "grow" right out of the front fenders.

The telegraph wires of all three railroads operating through Valparaiso were routed through the dormitories of the Institute. The clicking of telegraph sounders was heard twenty four hours a day, no doubt the first use of sleep learning by anyone, anywhere.

The well trained graduates of the Dodge Institute, all of whom used the code commercially, never forgot how to read Morse code, even if they lived to be a hundred years old.

Later, when jobs for radio operators aboard ships and at shore stations became available, the school changed its name to Dodge Institute of Radio and Telegraphy, erected its own radio station and of course began teaching International Morse code and radio theory in addition to American Morse. During World War II, it trained hundreds of radio operators for the Armed Services.

The buildings are now part of Valparaiso University. During the fifty years the Institute was in operation, five large letters comprising the word DODGE were fastened over the doorway to the Main Building. When the school closed its doors forever and these letters were removed, the lack of sunlight behind them for half a century had indelibly etched the word "Dodge" into the stone building and that is the only trace left today of a school dear to the hearts of many a landline or radio telegrapher. Inquires relative to the Dodge Institute at Valparaiso University today are apt to be responded to with a blank stare by employees of the latter school.

Switchman Mooney

In 1949, I became acquainted with "Haywire Mac" McClintoc, a writer of short stories concerning railroads. He told me a true story about a boomer switchman named Mooney. He appeared one cold and blustery evening at a railroad switching yard in Chicago. McClintoc was a foreman of one of the switching crews there.

Mooney was in very poor condition. Due to participation in a druken brawl, he had a black eye and deep lacerations in his face. Dental problems were of no concern to him, he had no teeth. His clothes were ragged and his shoes had large holes completely through the soles. Nevertheless, the yardmaster was in need of switchmen, so Mooney was hired. He began work on the so-called "graveyard" shift beginning at midnight. Mooney immediately started cutting out cardboard soles for his shoes, utilizing the narrow switch-list forms available in the yard office. These forms were printed on a rather tough type of thin cardboard. The temperature that evening was ten below zero.

All went well throughout the night in switching cars, although a stop had to be made occasionally while Mooney half-soled his shoes with new pieces of carboard. However, at 5 AM, Mooney flashed a violent "wash-out" (stop) sign with his electric lantern to the rest of the crew. As foreman, McClintoc walked the length of a long string of box cars to determine the cause of this emergency signal and discovered that they had run over a hobo, completely severing the body. On the hobo's feet were a brand new pair of leather boots. Mooney was instructed to remain with the corpse while McClintoc went to the yard office to call the police and the coroner. When the latter arrived at the scene, he concluded that the case was a rather simple one, declaring that the hobo probably thought he was boarding a trian for warmer climes and had slipped on the abundant ice present in the yard and thus fell under one of the moving cars. The coroner then added one statement on his assessment of the accident and said "There's one thing I don't understand though and that is what this poor fellow was doing out in this kind of weather without any shoes."

Mac looked over at Mooney and saw that Mooney was wearing a brand new pair of high boots. The Lord works in mysterious ways.

Years later, Mac was walking down State Street in Chicago on a summer afternoon when someone he did not recognize called his name. The man was wearing a completely white suit, patent leather shoes, a Panama hat and a diamond ring with a stone in it about the size of a dime. The "stranger" turned out to be Mooney. Mooney, having had his fill of druken fights, missed meals and shoes with out soles, had turned into a "home guard" (a railroad man who stays on the same job for a long time) and accumulated many years of seniority.

A further postscript to this story is that at the time of my conversation with Mr. McClintoc, NBC Television had a weekly program featuring a different song writer each week. The writer would sing and play his more popular "hits" and explain how he happened to compose each song and so on.

I was struck by the extreme modesty of Haywire Mac in not mentioning to me, during our long visit, that he was a successful composer of popular songs. 73

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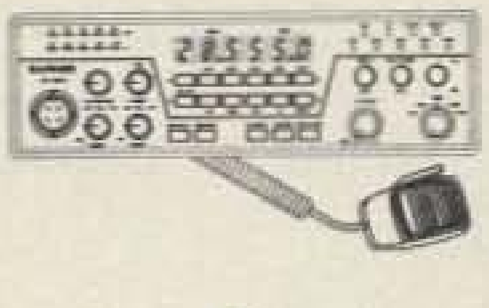

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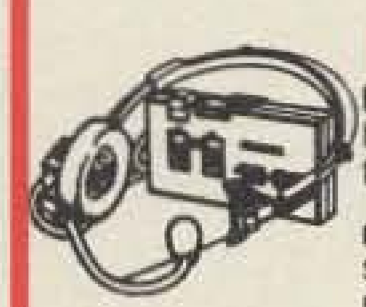

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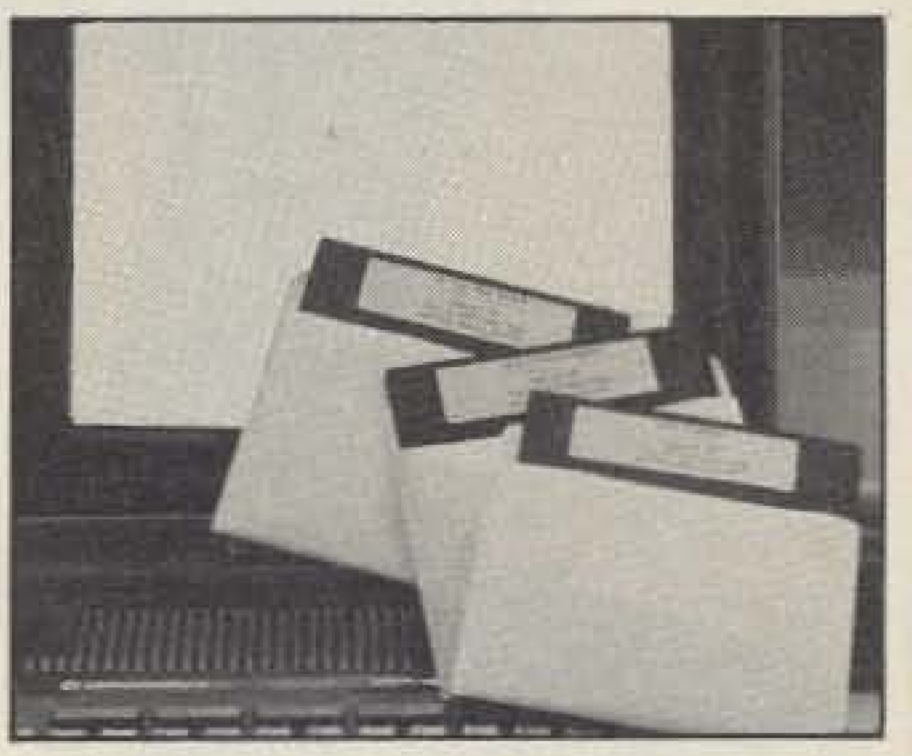

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Briefly Speaking: RS-232C

Understand what this term really means.

by W. Max Adams W5PFG

Contrary to popular belief, RS-232C is not a physical unit of electronic equipment. It is the Electronic Industries Association (EIA) *designation* of a standard means for interconnecting digital equipment. "RS-232C" is an accepted "buzzword" which, like "Zeerocks" and "Clean-x," has a more lengthy name that completely describes EIA's recommendations. It is "Interface Between Data Terminal Equipment and Data Communication Equipment Employing Serial Binary Data Interchange." RS-232C is a much easier verbal mnemonic to cope with than IBDTEDCE-ESBDI!

The category Digital Equipment has two subcategories: Data Terminal Equipment (DTE), and, Data Communication Equipment (DCE). DTE is a machine that originates and/or receives digital data, such as a computer. DCE is a machine that provides functions to establish, maintain, condition and terminate digital data signals for transmission to another machine, such as a telephone modem or packet-radio Terminal Node Controller. The physical (hard-wired) connection (interface) between most of today's equipment is according to the popular Electronics Industries Association (EIA) RS-232C specification.

The EIA RS-232C standard defines four areas of data equipment interfacing:

1. Mechanical characteristics of the interface.
2. Electrical signals of the interface.
3. Signal functions.
4. Secondary functions for some applications.

The first three areas of the RS-232C specification are those of primary interest to the amateur radio or computer enthusiast.

The EIA RS-232C mechanical standard specifies:

1. Assignment of signals to connector pins.

PIN NO.	EIA CKT	SIGNAL DESCRIPTION	TYPICAL MNEMONIC	FROM DCE	TO DTE
1	AA	PROTECTIVE (FRAME) GROUND	GND	*	*
2	BA	TRANSMIT DATA	TD		*
3	BB	RECEIVE DATA	RD	*	
4	CA	REQUEST TO SEND	RTS		*
5	CB	CLEAR TO SEND	CTS	*	
6	CC	DATA SET READY	DSR	*	
7	AB	SIGNAL GROUND	SG	*	*
8	CF	RECEIVE LINE SIGNAL DETECTED	DCD	*	
9		RESERVED			
10		RESERVED			
11		UNASSIGNED			
12	SCF	SECONDARY RX LINE SIGNAL DET.		*	
13	SCB	SECONDARY CLEAR TO SEND		*	
14	SCA	SECONDARY TRANSMIT DATA			*
15	DB	TRANSMIT SIGNAL ELEMENT TIMING (DCE)		*	
16	SBB	SECONDARY RECEIVE DATA		*	
17	DD	RECEIVE SIGNAL ELEMENT TIMING		*	
18		UNASSIGNED			
19	SCA	SECONDARY REQUEST TO SEND			*
20	CD	DATA TERMINAL READY			*
21	CG	SIGNAL QUALITY DETECTOR		*	
22	CE	RING INDICATOR		*	
23	CI	DATA SIGNAL RATE SELECTOR (DTE)			*
24	DA	TRANSMIT SIGNAL ELEMENT TIMING (DTE)			*
25		UNASSIGNED			

232REV (880123)

Table 1. EIA RS-232C Mechanical standard pin-out designations and applications.

2. Female pins in the DCE connector.
3. Male pins in the DTE connector.
4. Maximum cable length of 50 feet.
5. Maximum cable capacitance of 2500 picofarads.

RS-232C standard input/output (I/O) connectors are commonly called "serial ports" where data bits are "shipped" in and out, one bit after the other. Baud rate (number of signal events per second), signal voltage (or current in some applications), and protocol (responses to data) in digital communication must be the same, thereby allowing individual data machines to understand each other.

One of the most often cussed and discussed RS-232C subject is its signal characteristics and functions. RS-232C was written to standardize telephone (wire line) interfacing. Its original application has been carried over into many other digital communication systems. Some RS-232C features are therefore not presently used. For example, "Ring Indication" is not required for packet-radio equipment interfacing. Table 1 lists RS-232C standard mechanical (pin-out), EIA circuit designation, signal description, common mnemonic and typical DCE/DTE application.

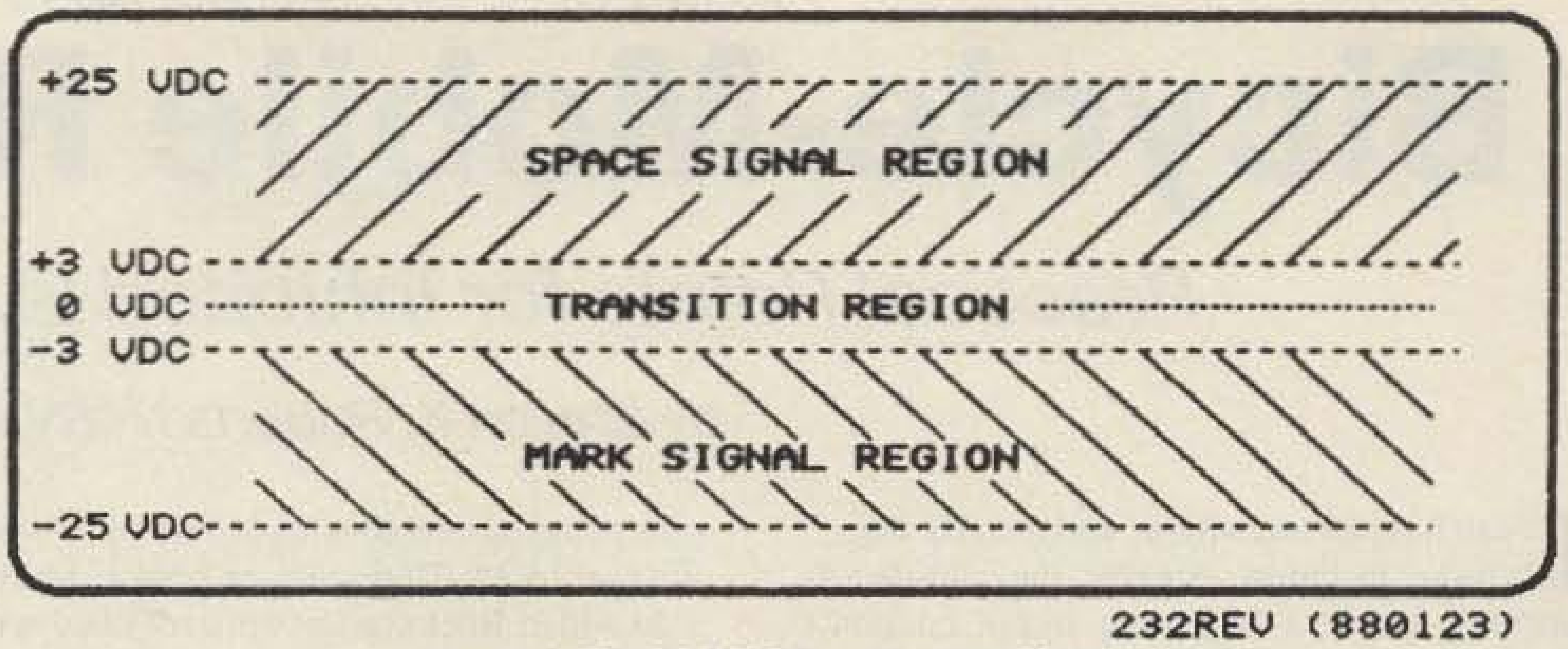


Figure 1. EIA RS-232C Receiver signal levels.

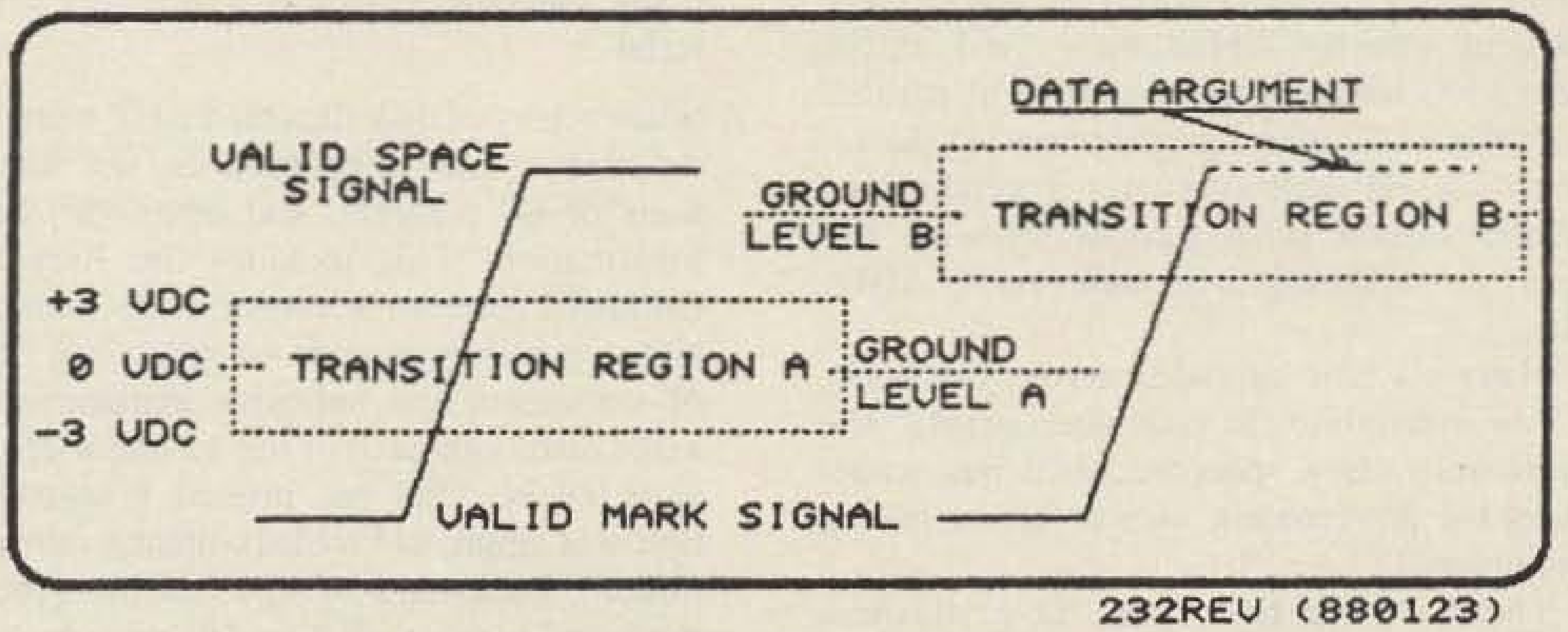


Figure 2. Unbalanced RS-232C ground signal conditions.

Connections

RS-232C mechanical standard is often misunderstood. For example, a DB-25 type connector isn't specified by RS-232C. It became a *de facto* "standard" because of its popular use. RS-232C pins one through seven (and Pin 20) are of major interest in amateur radio applications. Only four of these, however, are required in amateur packet-radio equipment interfacing: protective Ground (GND, Pin 1), Transmit Data (TD, pin 2) from DTE to DCE, Receive Data (RD, pin 3) from DCE to DTE, and Signal Ground (SG, pin 7).

Data signal voltage levels, according to the RS-232C standard, are shown in Figure 1. Negative signals between -3 volts and -25 volts are recognized as Mark signal conditions, and voltages between $+3$ volts and $+25$ volts are recognized as Space signal conditions. Mark and Space voltage levels do not have to be the same. For example, Mark signal voltage can be -5 VDC, and Space signal voltage can be $+12$ VDC. (Note: Mark and Space cannot be generally defined as "logic Zero" or "logic One" signals, or vice-versa, since this relationship is a function of each individual electronic system). Other readily available voltage levels can (and are) used, but often require "conditioning" to *safely* interface with other equipment. Signal voltages cannot reside in the Signal Transition Region and must be within their limits beyond the transition region.

Signal Ground (Pin 7) is common to both transmit data (TD) and receive data (RD) lines, which often results in a major disadvantage of RS-232C application. For example, consider a computer and modem using RS-232C signal level interface. Each unit, operated from its own DC power supply, can cause different reference (power and signal) ground levels at each end of the interface cable, as shown in Figure 2. Data between equipment with different reference levels can be "misunderstood," thereby resulting in program or information "glitches."

RS-232C standard signal current is specified to a level that will not burn up interfaced equipment due to faulty or improperly connected cables or connectors. The equipment can be damaged, but should not "smoke!" (In electronics, never say "never." Mr. Murphy's well-known laws often puts egg on one's face.)

Ham Shack Analogy

Using an RS-232C interface is somewhat like using a radio transceiver to interface with another ham radio station. The receiver is patched to the data source station transmitter, and the transmitter is patched to the destination station receiver. Both source and destination equipment "parameters" (i.e., frequency, communication mode, communication protocol, etc.) must be the same for mutual understanding. RS-232C does not specify baud rates, communication mode, or communication protocol.

RS-232C does, however, provide flexible equipment interfacing and some interesting discussions on your local repeater!

Briefly speaking, the primary purpose of EIA's RS-232C standard is a reference for system design. Manufacturing considerations produce a wide variety of connectors, special signals and voltage/current levels. Hopefully, the equipment manufacturer provided documentation to aid the user.

The functions of RS-232C standard signals are well documented.

Pin 1—PROTECTIVE GROUND.

Pin 2—TRANSMIT DATA (TD). Connect it to a receive INPUT.

Pin 3—RECEIVE DATA (RD). Connect it to a transmit OUTPUT.

Pin 4—REQUEST TO SEND (RTS). A signal from the data source that tells the associated (receiving) device it (the source) has data to be transmitted.

Pin 5—CLEAR TO SEND (CTS). A signal from the associated receiving equipment to the data source (transmit) equipment, it (the receiver) is ready to accept data input.

Pin 6—DATA SET READY (DSR). DSR is "asserted" (made available) on PIN 20, when the equipment is operational and ready to transmit and/or receive data. DTR (and DSR), in some applications, are jumpered at the cable connector and not physically connected to other equipment.

Pin 7—SIGNAL GROUND (SG). This is *not* the same as pin 1. Pin 7 is the "return" path that Mr. Ohm requires.

When all else fails, look at the reference material in the bibliography. It may well allow the reader to come up with the seventh answer to a six-way-QSO RS-232C question on your local repeater, or at the next brown-watering hole (coffee shop) QRM session. ■

1. *ARRL, "AX.25 Amateur Packet-Radio Link-layer Protocol, Version 2.0", October 1984.*
2. *Lyle Johnson WA7GXD, "Join the Packet-Radio Revolution, Parts I, II and III",* 73 Magazine, *Sept/Oct 1983, January 1984.*
3. *Margaret Morrison KV7D, et al, "Amateur Packet-Radio, Parts 1 and 2", Ham Radio, July/August 1983.*
4. *W. Max Adams W5PFG, "Briefly Speaking, Basic Amateur Radio Packet Radio",* CQ Magazine, *November 1985.*
5. *Radio Shack No. 62-1388, "Understanding Telephone Electronics".*
6. *Radio Shack No. 62-1389, "Understanding Data Communications".*
7. *Radio Shack No. 62-2010, "Understanding Digital Electronics".*

Number 15 on your Feedback card

Bicycle-Mobile R & D Lab

Practical Points for Inhibited Experimenters

by Steven K. Roberts N4RVE

It can happen anywhere, and usually does. I wake in camp, breathe the vapors of morning inside a billowing nylon cocoon, rustle a warm hand from the depths of my sleeping bag to touch KA8ZYW, and lie there thinking intently. "Hmmmm. . . if I let the new TNC handle speech control in parallel with the BCP, then I can sign on via packet from the HP and carry on a synthesized conversation with people around the bike. . . monitoring their audio on 49 MHz. Gee. . ."

Maggie's hair cascades across my neck. "You were talking in your sleep again," she murmurs. "Is a speech-control bus something the government uses to arrest boring politicians?"

Those are the first clues. Over flawless campground coffee, I stretch, sketch, and mumble, scan my listings and schematics, regale the morning-sweet YL with complex tales of logic and technomagic. The maps are forgotten and there's no rush to pack. . . for it's a tinkering day!

Well, so now what? There's no room on a bicycle for diagnostic tools, documentation library, R & D inventory, prototyping board, and drafting equipment—or is there?

One of the things I've learned from this whole traveling circuit of mine is that no complex system is ever finished. And while reliability has been generally excellent, I find a lot of reasons to crawl under the hood and do some engineering. As such, I've had to put together a passable mobile R & D lab. . . and in this, the fifth column of the series, I'd like to take the reader on a quick tour.

The First Issue: Documentation

If I had to work on the Winnebiko from memory, nothing would ever get done for fear of screwing it up beyond recognition. A project in progress becomes etched so deeply in the brain that the builder is sure he always remember exactly how it works. A few grim all-nighters of staring glumly at undocumented creations, however, dispelled that fallacious notion from my head. I now carry three forms of documentation on the bike:

A clamp-style binder, stuffed with about ¾" of schematics, listings, notes, wiring specs, idea sketches, and so on. This is the irreplaceable document that completely defines the custom parts of the electronics package, and I periodically photocopy the whole mess and mail it back to my office as a backup.

An "aquarium of microfiche" containing highly reduced copies of key IC databooks, software and hardware manuals, reference guides, and so on. A 20X Keyan reader gives easy access to what would otherwise amount to 15–20 pounds of books. I have also added Buckmaster's microfiched amateur radio call directory, a number of maps, and other convenient reference material.

A subdirectory of disk files on the HP laptop, defining operating procedures, the functions of all controls, and other variable information. This includes the Bicycle Control Processor's source code listings and—equally important—a sprawling file of comments and narrative explanations associated with each of the 15 major revision levels. This has proved invaluable time and again, as I wade hesitantly into an obscure backwater of this real-time program and wonder what madness possessed me back when I wrote it.

Adding new documentation is something that should happen at the time of any change to the system, of course, so my "R & D pack" also contains a small case with basic drawing tools and templates.

Tiny Test Bench

With space at a premium, I had to forego a few basic essentials. I carry no oscilloscope, function generator, spectrum analyzer, hammer, or milling machine. But I do have a logic probe, digital multimeter, SWR bridge, prototyping board, software development system, bench supply, built-in current monitor, "Quick-Connect" wiring tool, butane soldering iron, and extensive toolkit.

It's amazing how much can be done with a few basic lightweight tools when the constraints of a nomadic lifestyle demand it. My software contains a library of test loops that exercise all I/O logic in a way that makes it amenable to debugging with a logic probe and development system. Internal jacks offer convenient supply voltages for prototyping, and a ledge inside the console even carries a permanent parts tray and soldering-iron stand. The point of all this, of course, is to make development work as painless as possible. . . even if it happens in a campground.

Easy prototyping depends upon a convenient packaging method, and I use the Robinson-Nugent Quick-Connect boards exclusively. They're faster than wirewrap, lower profile, and more rugged (a major issue on a bicycle). The boards are hinged in my installation, so modifications can be made without having to unplug any connectors or dangle live hardware from a cable harness.

One more thing. Despite convenient onboard equipment, there are still occasional projects that require more in the way of support facilities than I can carry. I keep a list of such "long-range TO-DO's" on disk, and scan it whenever I find myself visiting someone who owns a well-equipped lab. "Ahhhh. . . I see you have a spectrum analyzer. You know, I have some birdies that have been giving me trouble. . . got a near-field probe for that thing?"

The Junk Box

As we all know, no lab is complete—or even possible—without a well-equipped junk box of tinkering stock. It's just not possible to experiment effectively if the only access to components is a shopping list (hamfests and surplus stores notwithstanding).

I carry about six pounds of parts, as well as a bag of fundamental essentials such as Ty-raps, wire, heat-shrink, and the like. There is a sheet of antistatic foam with a hundred or so 74HC glue parts, along with a collection of particularly interesting devices I just gotta have. (You know how it is: "Well, someday I'll find a neat use for a high-speed array processor on my bike. . . sure, I'll take it.") There are a few dozen individual Zip-Loc bags, dedicated to such things as R's, C's, D's, Q's, connectors, switches, ferrites, packaging parts, mechanical hardware, spade lugs, and so on—with, amazingly, enough depth and variety to support a typical day of tearing into the system with new ideas in mind.

Keep On Tinkerin'

The bottom line, of course, is that no-one need be prevented from experimenting by the constraints of a nomadic, cramped, or socially hampered lifestyle. I have an old friend who lost the spark of tekwizardry when he married a rather dull preppie more obsessed with style than substance. The books in the living room were sorted by color of binding, the dog was a designer model far beyond their budget, and all that junk of his cluttering the basement JUST HAD TO GO! Before long he gave in: The subscriptions to journals lapsed, the equipment was all sold or given away, and this promising designer of early microprocessor systems became just another dull employee with no passions, no hobbies, no energy, no dreams.

But a single desk can hold enough to keep the creative spark alive—enough to keep the nose wrinkling with the acrid smell of solder. . . the eyes gleaming in the light of dancing phosphor. . . the ears perking to the distant call of an unmet friend as yet another idea survives the smoke test and reinforces the reason for being.

Creativity can thrive anywhere—let it! 73

Continued from page 6

Island, Oahu, Calfornia, Missouri...and back to New Jersey. It was a fantasic six week trip, meeting hams at every stop and talking with thousands more while we were flying. Unfortunately, I was so irritated by OLJ's arrogance that I refused to write the story of the trip.

Where was I?

Now, Chandra...Well, on the strength of the article in the March *Discover*, I bought her book, *Evolution From Space*, a theory of cosmic creationism, written with Sir Fred Hoyle. Chandra, it turns out, is a well-known astronomer.

The book was utterly fascinating. I couldn't put it down. Chandra does a very scientific job of lining up all of the facts available from astronomy, geology, biology, and other sciences, and presents them as a completely new concept of how life started and developed on Earth. No, the ideas are not supportive of biblical creationism, nor of Darwin, for that matter. She makes a powerful case, carefully documented every inch of the way. Most impressive.

Particularly fascinating to religious zealots may be the problem of their cherished beliefs being challenged by science. Of course, that's supposing such a transformation is possible, which I don't accept. Religious, like political beliefs, often are remarkably durable, able to withstand incredible onslaughts of reason and facts with nothing more lasting than deep resentment resulting.

Unconventional Wisdom

While on the one hand Chandra demolishes all the accepted explanations of how life began on Earth, she comes up with both a mathematical and a scientific proof of the existence of God. Scientists who haven't had a religious brainwashing may find this irresistable.

For instance, Chandra shows clear evidence that life occurred on Earth at the earliest instant it could have survived here. She shows mathematically the utter impossibility of life getting started by chance. If you feel like arguing with her theory, read the book ($5.95 in paperback), don't get steamed up just from this microreport.

She shows that microbes are small enough to be pushed through space millions of light years by the pressure of light. She shows that they can live for billions of years in suspended animation, awaiting a suitable planet to colonize. She shows that there seem to be vast quantities of such cells moving through space.

I suspect Chandra's book may appeal to people in an inverse proportion to the degree of religious brainwashing they've received, mostly from parents when they're very young. "Give me a child until he's seven and I'll give you the man." Was it Freud who said that? If you watched the PBS program "7-14-21-28," you probably understand the startling truth of this concept.

Brain Power

Now, this brainwashing thing takes me back even before my exciting adventures on Operation World-Wide. We've all seen the Hari Krishnas at airports and read about Moonies, so we know on some level that brainwashing works terrifyingly well. We may think that there's a requirement for some sort of brain damage or stupidity to make someone susceptible to these religions.

No, it can happen to the most intelligent people. It's got little to do with intelligence or education. It has more to do with hypnotism, which is a mysterious working of the mind only a few people understand. For that matter, it's not really possible to say that anyone really understands how the mind works. Heck, we still don't even have a clue as to where or how memories are stored.

Anyway, quite a few years back there was a chap who came out with an outrageous explanation of how the mind worked. This, in turn, suggested a way to repair some of the more serious mental problems. Naturally the medical establishment quickly branded him as a quack, the same treatment they give almost anyone with a new idea, right or wrong. But I'm willing to give new ideas a chance, so I read carefully on the subject. Then, fascinated by what I'd read, plus some very convincing experimental proof, I left my job as a radio engineer/announcer and went to work with the chap for a while in his new research foundation.

One of the beauties of brainwashing with hypnotism is that the people hypnotized not only are unaware that anything strange has happened, they will fight to the death for their new beliefs. This is why it is so difficult to kidnap and reprogram people who have been captured by the fanatical religious sects. This is one of the reasons why we have terrorists. You just can't reason with such deeply ingrained mind programming.

So What?

In general I've found that the louder and the more impassioned the noise from politicians and religious leaders, the less I'll find of truth and the more I'll be expected to accept beliefs on blind faith.

How can we tell when we are reacting because of brainwashing or hypnosis? Heck, that's easy, if you think about it. The flashing red light should come on when you find yourself getting mad. This is a class A warning that reason is fighting some sort of belief. The easy way out is to get mad. This blanks the mind from receiving any further reasoned input. When you get mad you are no longer able to think rationally. Just listen to angry people screaming out slogans. Many things they say don't even fit the occasion, but their conscious mind is so heavily blanked by angry emotions that they aren't even aware of all this.

The Impossible is Possible

It's frustrating to realize that all of us are, to some degree, operating on the basis of early brainwashing. We're embarrassed at the thorough job our ancestors did on the American Indians. Could never happen again, right? Then we think about the job the Germans did on people not all that long ago. They killed about six million Jews and another six million non-Jews. Stalin wiped out over double that. The Chinese wiped out tens of millions fairly recently. 600,000 Ugandans have been murdered in the last few years. Several million Afghanis. Who knows how many Iranians and Iraquis?

The people who are doing all this killing are people. People like us. The only difference is in the degree and type of brainwashing. Old timers like me will remember the force of patriotism that fueled WWII. There was little thought of not fighting. Men were caught up in it, pushed hard by their wives and mothers. The media and Hollywood cooperated with the government in massive media hype. It worked.

It's fascinating to demonstrate the power of even the simplest of post-hypnotic suggestion. For instance, if you tell a person under hypnosis that when you touch your cuff he'll take off his coat and when you touch your ear he'll put it back on, you can have him taking off and putting on his coat dozens of times, always with a logical (to him) explanation, one he truly believes. It isn't until you have him taking it off and putting it on several times a minute that he finally realizes something is wrong that he can't explain. It's absolutely amazing how well even a simple exercise like this is protected by the mind from recognition.

Yes, with the appropriate therapy it's possible to go back and decondition all this mess, setting people free to actually think. This must take a long time, right? No, it's incredibly faster than any of our accepted mental therapies. We're talking about months of cure in hours.

Lamentation

I bump into Bud at Dayton occasionally. I haven't seen W8OLJ since the trip, thankfully. It would have been an infinitely better trip except for him. Bill W2SKE was a great traveling companion. He went on to become the head of CBS News and retired a few years ago.

I'll have to write about the trip. I don't remember that anything like it has ever happened again in amateur radio. It was a ham's idea of nirvana, visiting 24 countries, all the while keeping in touch with the entire world with the ham station on the C-54.

Old timers will remember when Arthur Godfrey went on a trip to Africa and took along amateur radio. I remember trying my darndest to get through when he was on the air from French West Africa (FF8)—not to talk with Arthur, but with a close friend of mine, Carol Cone, who was along with him on the safari. Never made it.

Somewhere in the barn I have a couple of the old Operation World-Wide Ampex tapes. I wonder what ever happened to the dozens of tapes with the thousands of QSOs from that trip?

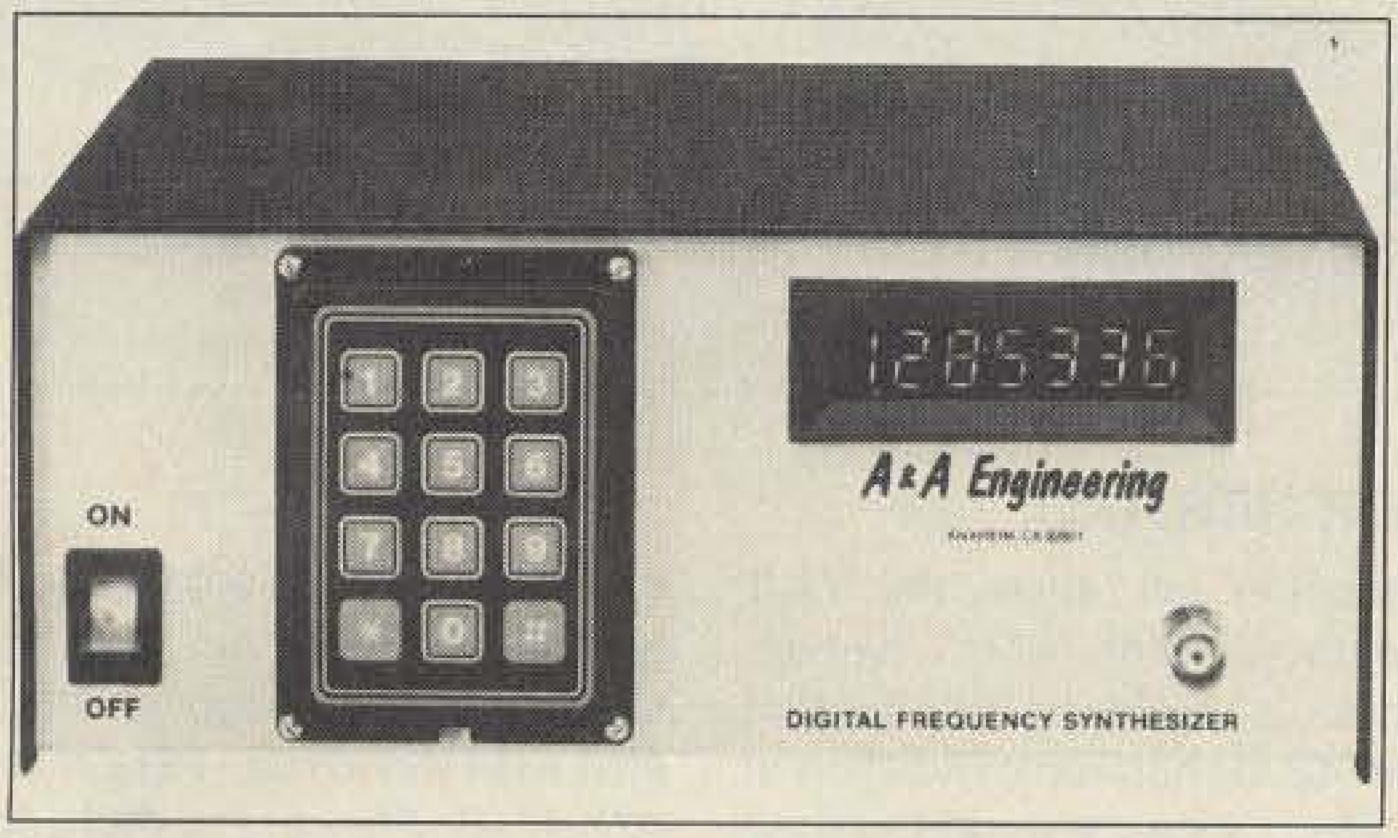
Ah, a lament for the old DXpedition days: the Hallicrafters DXpedition into darkest Africa; Godfrey; Don Miller, for all his shenanigans, gave us contacts from almost everywhere. Gus Browning W4BPD's trips; Danny Weil and the YASME; Dick McKircher WØMLY's African barrage.

Say, where are Lloyd and Iris now? 73

Number 16 on your Feedback card

NEW PRODUCTS

Compiled by Linda Reneau



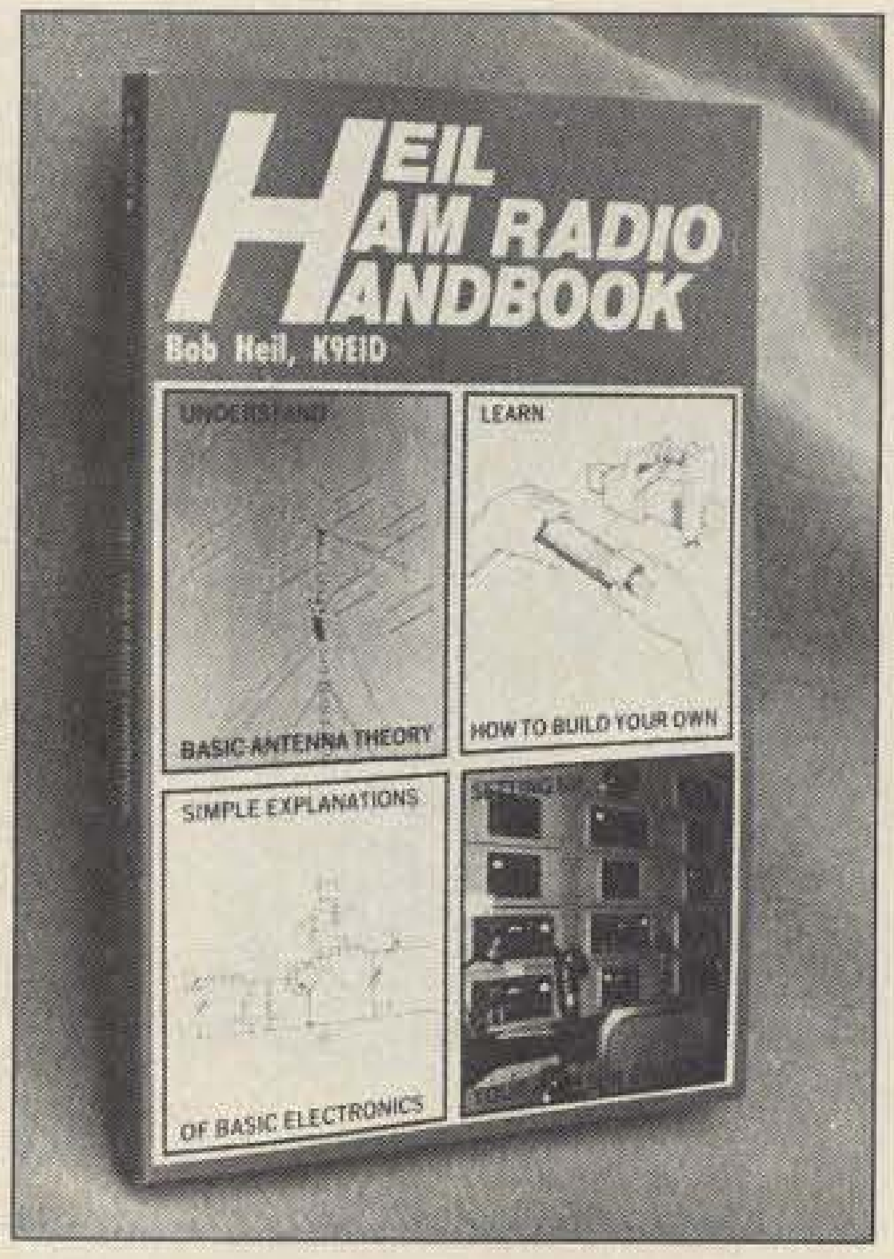
PRODUCT OF THE MONTH

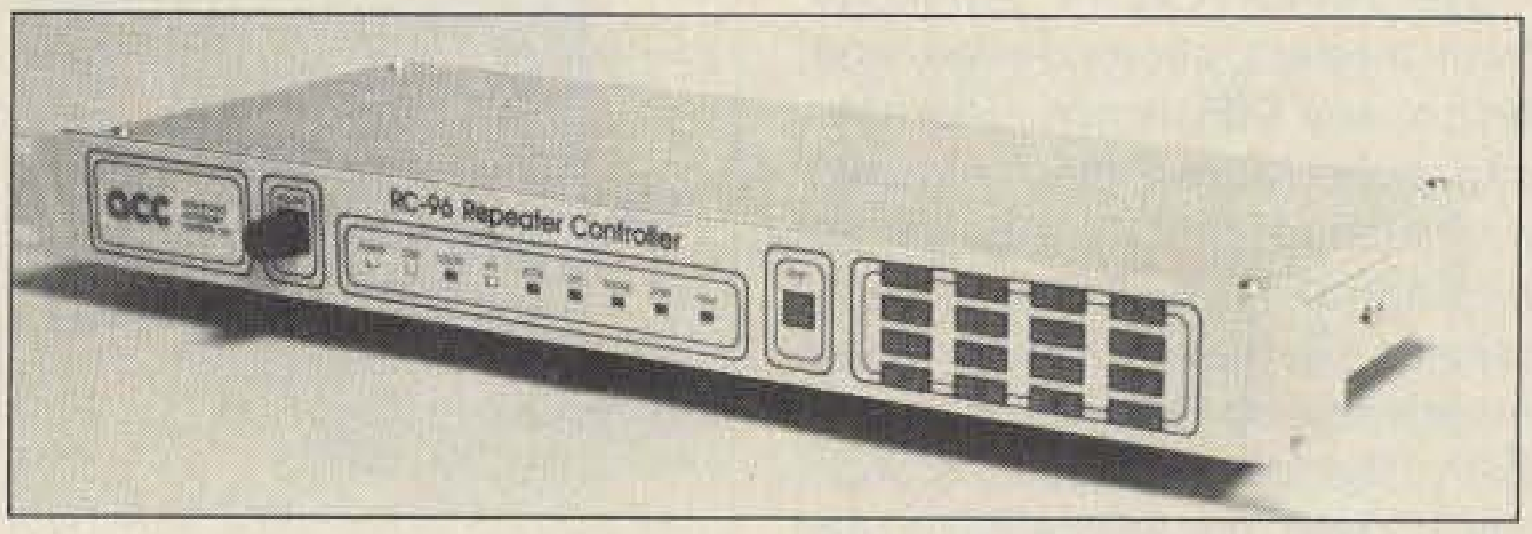
A & A ENGINEERING

A & A Engineering's new Digital Frequency Synthesizer has 1 Hz resolution, an output of ½V peak-to-peak into 75Ω with almost no phase noise to frequencies in excess of 6.5 MHz. Digital synthesis techniques elimate VCO, PLL, and loop setting time. It comes complete with RF unit, microprocessor controller, seven segment display, keyboard, and 110 VAC power supply. The controller offers a standard 12-key program and accepts as many as 32 keys. Unused EPROM and RAM space allows the user to program custom features. The price is $429.95 per unit, FOB Anaheim. Quantity discounts. Call or write *A & A Engineering, 2521 W. La Palma, Unit K, Anaheim CA 92801; 714-952-2114.* Or circle Reader Service number 211.

MELCO PUBLISHING

The *Heil Ham Radio Handbook*, written by Bob Heil K9EID explores the practical aspects of installing antennas, soldering connectors, grounding your station, identifying transitor leads, and much more. This book has lots of handy hints and money-saving ideas in easy to understand language. To order, send $9.95 plus $1 postage to *Melco Publishing, PO Box 26, Marissa IL 62257.* Or circle Reader Service number 202.





ADVANCED COMPUTER CONTROLS, INC.

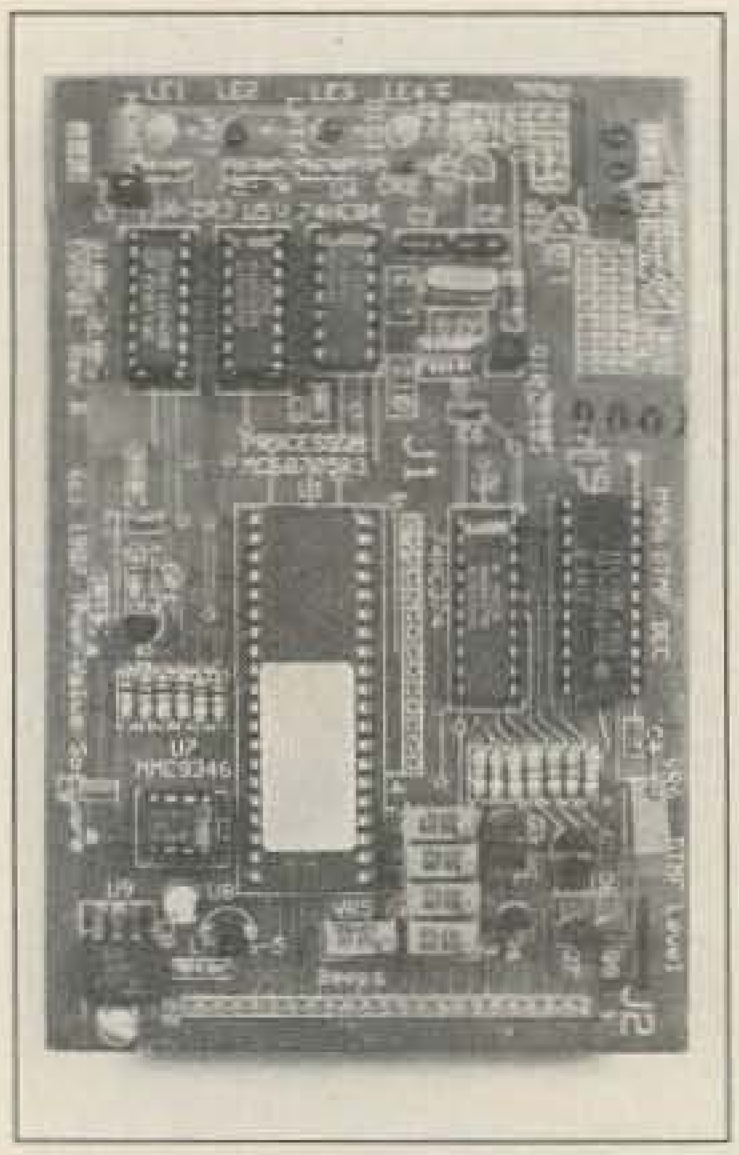
The new RC-96 Repeater Controller has remote programming, autopatch with autodialer, and memory for 200 phone numbers. It also features a talking S-meter, built-in keypad and shielded DIN cables. The RC-96 Repeater Controller supports pocket pagers, linking to other repeaters, and a bulletin board. A gas discharge tube across the phone line and transient suppressors on each signal line minimize the risk of lightning damage. The suggested retail price is $1,350. For more information, contact *Advanced Computer Controls, Inc., 2356 Walsh Avenue, Santa Clara CA 95051, or call 408-727-3330.*

APPLIED DIGITAL RESEARCH, INC.

ADR announces SAT TRAK II, an automatic satellite tracking controller. SAT TRAK II calculates satellite position and antenna angle in real time. It will drive most azimuth and elevation rotors including the Kenpro KR400/KR500, KR5400A, KR5600A (an interface is provided for the "A" series), and CDE rotors. The $435 price includes all necessary connectors and a 110 VAC power supply. *Applied Digital Research, Inc., PO Box 10184, Sarasota FL 34232; 813-378-3410.* Or circle Reader Service number 201.

AMECO PUBLISHING CORP.

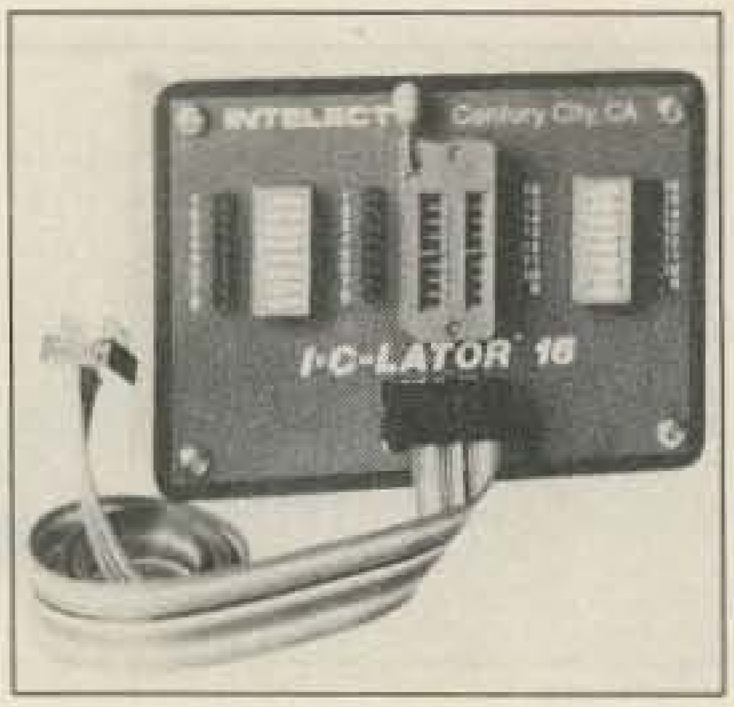
AMECO's new tunable preamplifier Model PT-3 continuously covers 1.8 through 54 MHz. Options are available for second receiver and separate receiving antennas. Retail, the PT-3 Preamplifier is $109.95. The P-12T power supply adapter is $8.95. For further information, contact *AMECO, 220 E. Jericho Turnpike, Mineola NY 11501; 516-741-5030.* Or circle Reader Service number 214.



TRUE VALUE SOFTWARE

True Value Software TVS701B repeater controller can be remotely configured without ROMS or jumpers. The unit offers voltage telemetry and alarms to monitor batteries and power levels. A watchdog timer and EEPROM protect the unit from power failure. TVS701B has 74 functions, four levels of control security, digital inputs and outputs for auxiliary control and alarms. Easy-to-build kit price: $190. Assembled and tested, $300. *True Value Software, 2805 E. Sherran Lane, Phoenix AZ 85016; 602-956-4259.* Or circle Reader Service number 204.

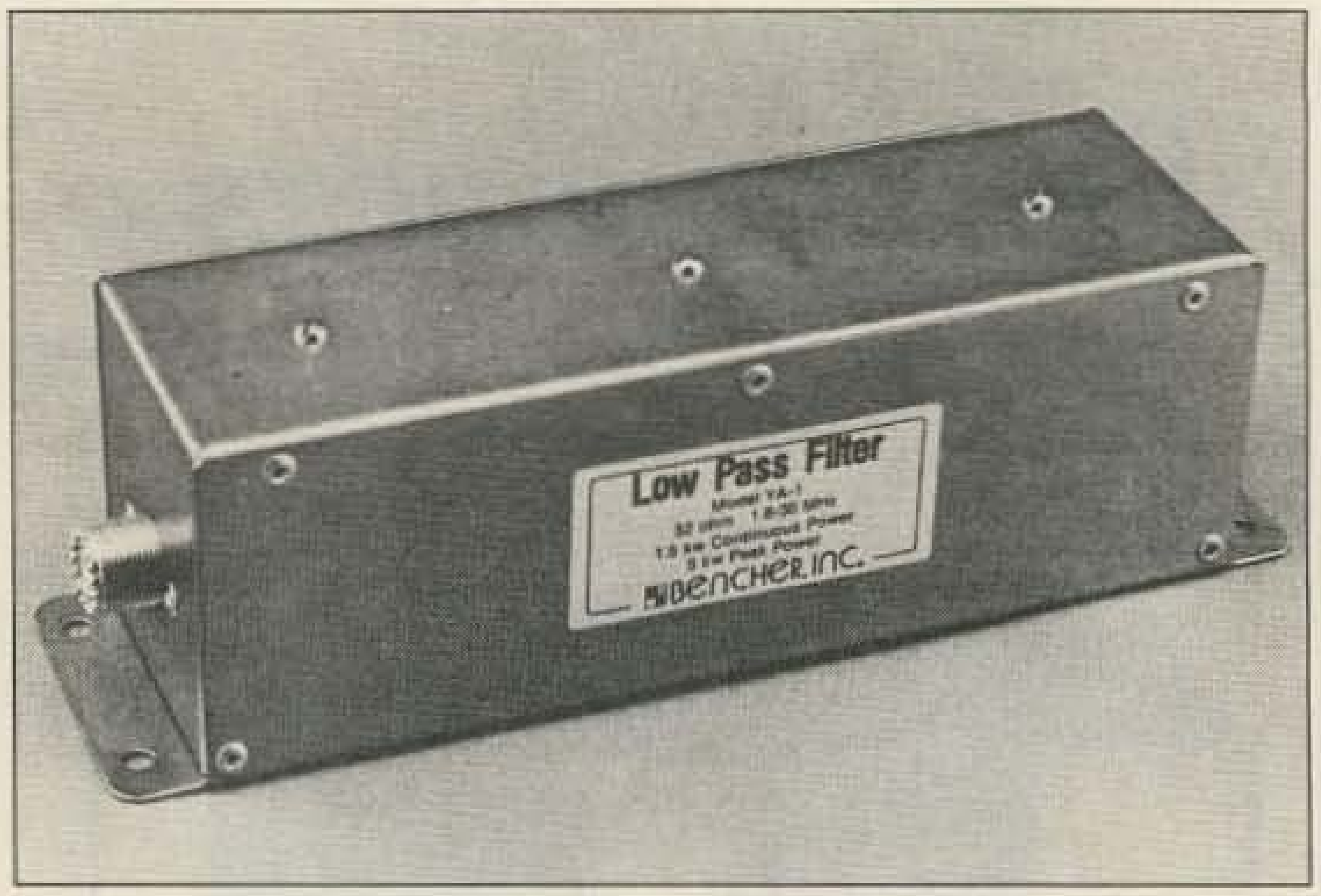
INTELECT



The I-C-LATOR 16, available from Intelect, allows design and test of any DIP device. The user can open loops, inject signals, and modify circuits outside an original assembly. The experimenter can measure current and independently open each signal path. The user replaces the original IC with the I-C-LATOR 16's cable, elminating the need for card extenders. The unit will accommodate 6- to 16-pin analog or digital ICs. It can be used with emulator probes, function generators, logic analyzers, and scopes. Price: $49.75. Free brochure. INTELECT, 2908 Nebraska Ave., Suite A, Santa Monica CA 90404. *Or circle Reader Service number 203.*

TRIDOS

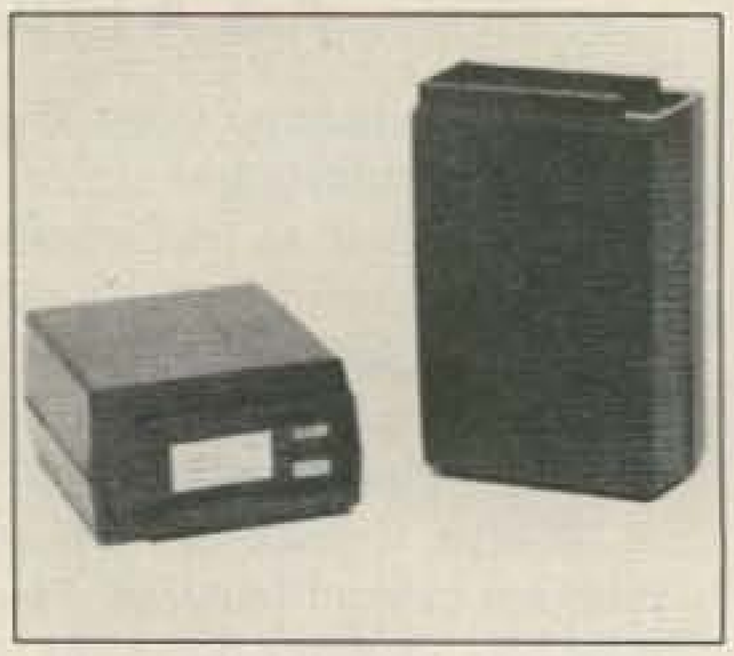
Terminator, from TriDos Software Publishers, is a real time graphic emulation of the Geochron™ clocks. The graphic map of the earth shows the terminator line between night and day. The time algorithms consider solar declination, apparent size of the solar disk, atmospheric refraction, and the difference between solar and earth times due to the earth's slightly elliptical orbit. To display areas on the map add the user's name, longitude, latitude, and time zone to the parameter file. Terminator is available from dealers for $39.95 or from *Spite Software, 4004 SW Barbur Blvd., Portland OR 97201. Order toll free at 800-237-9111.* Or circle Reader Service number 210.



BENCHER, INC.

Bencher introduces the YA-1 Low Pass Filter, which demonstrates a minimum attenuation of 80 dB for harmonic radiation at 54 MHz. It has a working range of 1.8 to 29.7 MHz, an impedance of 50Ω, power rating of 1.5kW continuous, and 5kW peak. The YA-1 sells for $39.95 plus $3 postage. *Bencher, Inc., 333 West Lake Street, Chicago IL 60606. MCI Mail 277-5159, TELEX 650-277-5159, Phone 312-263-1808.* Or circle Reader Service number 215.

PERIPHEX, INC.



Periphex announces new replacement battery packs for the Yaesu FT-23/R/33R/73R. The FNB-10, 7.2V 600mA for 2.5W output and the FNB-12, 12V 500mA for 5W output are both available from stock. Charge with standard Yaesu wall or desk chargers. Both battery packs offer a one year guarantee. FNB-10 is just $33, and the FNB-12 is $49 + $3 shipping. For further information on these or other battery packs, contact *Periphex, Inc., 149 Palmer Road, Southbury CT 06488; 1-800-634-8132, in CT 203-264-3985.* Or circle Reader Service number 205.

DATAK

DATAK's latest 30-page catalog is for the ham who builds or customizes his own gear. The catalog offers electronic title sets; multi-color transfer designs to make special meter dials and tap switch patterns; alphabet and number sheets; resist patterns for making printed circuits via the "Direct Etch" method; and a patented "Photo Etch" set that will copy circuit patterns from a magazine without harming the page. DATAK also has over 600 JotDraft™ printed circuit patterns, PC tapes, etching and plating chemicals, and protective coatings. For your free catalog write to *The DATAK Corporation, 3117 Paterson Plank Road, No. Bergen NJ 07047.* Or circle Reader Service number 213.

AMATEUR RADIO SCHOOL

Amateur Radio School announces their newest course, the Video Novice. Using your TV and VCR, this course demonstrates subjects not easily understood from books alone. Video Novice covers practical demonstrations and explanations for everyone new to amateur radio. The course consists of two, two hour VHS cassettes, one C90 audio cassette, and a study guide with 302 questions, answers, and a frequency chart. Cassette #1 has two hours of theory, and #2 has one hour of theory and one hour of visual code instruction. The Video Novice Course is $39.95 plus $5 postage. To order or for more information, write or call *Jerry Ziliak KB6MT, Amateur Radio School, 2350 Rosalia Drive, Fullerton CA 92635. 714-990-8442.* Or circle Reader Service number 206.

GREAT CIRCLE MAP COMPANY

The Great Circle Map Company now has azimuth-equidistant wall maps that give the radio amateur instant information on range and beam headings to any location on earth. Each map is unique, specially drawn using computer techniques, and centered on the individual's QTH. The major surface features are detailed by hand. The station's callsign are hand-lettered on the lower right. Suggested retail, $59. For more information on these brightly colored, 35" x 23" maps, write *The Great Circle Map Company, 8409 Bear Tree Circle, San Antonio TX 78255.* Or circle Reader Service number 209.

WM.M. NYE COMPANY

The NYE RF Power Monitor gives peak, average or peak-and-hold readings using a sample-and-hold analog memory circuit. The monitor can display the correct peak power reading of a single 1 msec pulse for up to 20 seconds. Other features include adjustable ALO, automatic SWR, interchangeable couplers, SWR/REV warning display, NiCd batteries with a separate charger, and full-wave detection system. Rated up to five kilowatts, the RFM-003 and the RFM-005 differ only in wattmeter scaling. Priced at $297. Contact *Wm. M. Nye Co., 1614 130th Ave. NE, Bellevue WA 98005; 206-454-4524.* Or circle Reader Service number 208.

SHURE

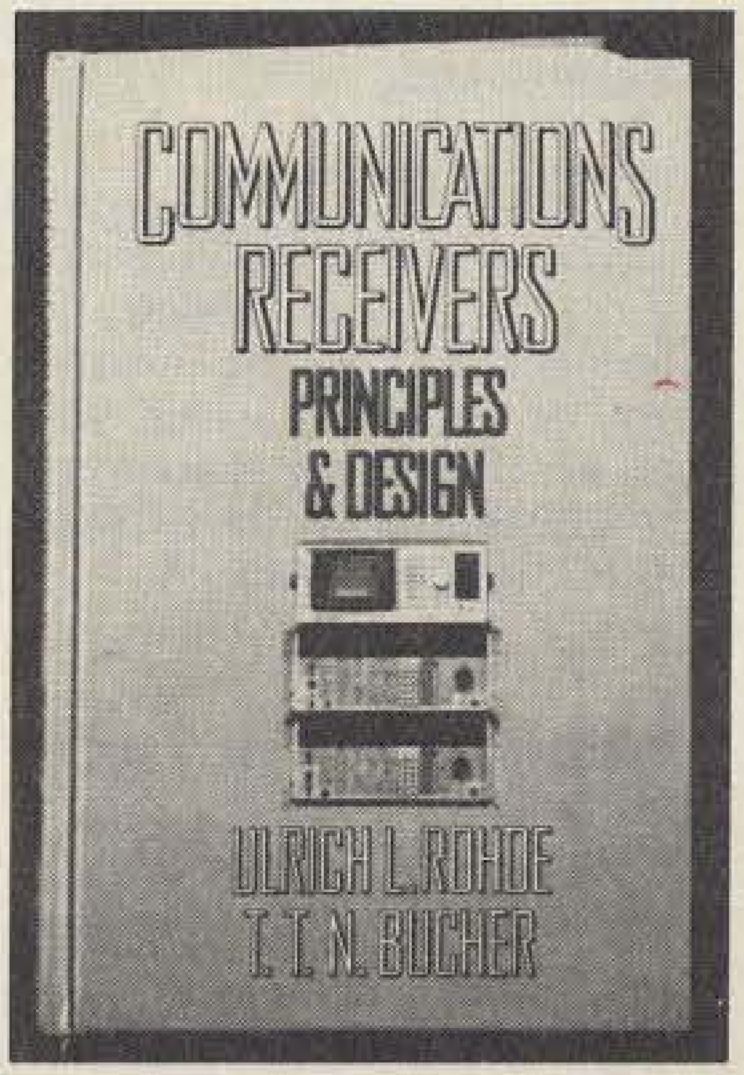
The Shure 444D Omnidirectional Controlled Magnetic Microphone offers switch selectable impedance, a normal/VOX selector, and Shure's patented leaf switch with locking and momentary action. Frequency response is tailored for optimum speech intelligibility and purchasers can receive a free individually printed plate with their call letters. The suggested retail price is $78. For more information contact *Shure, ATTN: Carolyn Gunnell, 222 Hartrey Ave., Evanston IL 60202; 312-866-2200.* Or circle Reader Service number 212.

KENWOOD

Kenwood announces the new TM-721A FM dual-band, 2m/70cm mobile transceiver. Features include a dual-channel watch function, selectable full duplex operation, extended frequency coverage with 30 memory channels, large multi-color digital LCD displays, and programmable scanning with 45 watts output on VHF and 35 watts on UHF. Retail, $649.95. For more details, contact *Kenwood USA Corporation, Communications & Test Equipment Group, 2201 E. Dominguez St., Long Beach CA 90810; 213-639-4200. Fax 213-604-4487.*

McGRAW-HILL BOOK COMPANY

Communications Receivers: Principles and Design, by Ulrich L. Rohde and T.T.N. Bucher, is a guide to the theory and design of all types of communications receivers—shortwave, military, broadcast, aeronautical, marine, and direction-finding. Accessories and peripheral equipment are covered, along with a wide range of design topics and engineering concepts. There are 583 pages with 402 illustrations. Cost is $59.50. *McGraw-Hill Book Company, 11 West 19th Street, New York NY 10011; 212-337-5945 or 337-5951.* Or circle Reader Service number 216.



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Number 17 on your Feedback card

HAM HELP

Your Bulletin Board

We are happy to provide Ham Help listings free, on a space available basis. To make our job easier and to ensure your listing is correct, please type or print your request clearly on a full (8½ x 11) sheet of paper. Double space and use upper and lower case letters where appropriate. Also, write numbers carefully—a 1, for example, can be read as an l or an i or a 7. Thanks.

I am collecting amateur radio license plates from each of the US states and possessions, and the ten provinces and two territories of Canada, for a public display. I am also looking for any information on Amateur radio license plate history, such as which region first started issuing them, when, and if they are issued in countries besides the US and Canada. Finally, I'm interested contacting any other license plate collectors for possibly forming a voice net.

I will gladly pay all photocopying, shipping and handling costs. Thanks!

Bryan Hastings KA1HY/AE
64 Concord St.
Peterborough NH 03458

Looking for front panel, part #205-178-1 for Heath VF-7401 two meter rig. Heath no longer sells that part. Will pay for part and shipping.

Bob Clark N5GSE
5430 Markwood Lane
Houston TX 77053

I need schematic and alignment info for Lafayette Model HA-700 Receiver. I will copy and return. Thanks.

T.W.Brown KA7NIE
5104 E. Farmdale
Mesa AZ 85206

Need conversion info re/Hy-Gain V, Model #2705, 40 channel, SSB, CB transceiver. The board is #PTBM048AOX. It is desired to start Ch. 1 at 28.300 MHz and work up from there. Any information on this conversion would be greatly appreciated. See you on 10.

Edward R. Levy WB3EVY
PO Box 161
Blakeslee PA 18610

Help wanted for information. Cost of copy or dispatch will be gladly refunded. 1) Any information or ECN's for improvement/modifications on the Spectrum Generator and PLL Synthesizer part of National HRO-500 Receiver. 2) Circuit and alignment info of SINGER Electronics Universal Spectrum Analyzer Model MF-5 and Plug-in unit Ultrasonic Module UR-3. 3) Diagram of MFJ 931 Tuner. 4) Technical info and application circuit of TOKO's Mechanical Filter MF 455A 120F with coils 9579A and 9580A. 5) Possibility of adding the 7th digit-display TS-830S.

Fred Olte C3ØLEN
25C, La Pleta Ordino,
Principat d'Andorra (EUROPE)

Wanted manuals/schematics for G.E.L. Receiver 13B1, A.C.L. Receiver TR140A, G.R. 1617 Cap. Bridge, Waters 1003B Diode-checker, Singer-Gertsch FM9CG SIG. Gen., Motorala S1323 Meter.

W. Kinne
1163 Ingerson Road W.
St. Paul MN 55112

HELP! I'm looking for a schematic or conversion manual if available for a Navy receiver in the RAX-1 Series. It has 4 band coverage from 1.5 MHz to 9 MHz. It's type CG-46116. I'll pay a reasonable price.

Gary Nelson
P.O. Box 3676
Portland ME 04104

Looking for a vanishing breed. I would like to contact for friendly correspondence and mutual assistance any and all who are into collecting, restoring and using the classic receivers—Collins S-Line, 51-J, R-390, SP 600, HROs, etc. Also high grade, useful military surplus.

J.L.Browning
6442 Cathay Cir.
Buena Park CA 90620

I'm looking for schematic of AN/VRC-19 150–160 MHz, mobile, 24-volt FM TX and RX equipment, or data on same.

Richard Thompson
234 Spring St.
Hanover MA 02339

I need an instruction manual and/or schematic for the Hickock 6000 series tube tester. Will pay any copying and mailing costs.

T.H.Killoran W7PP
8316 54th Dr. NE
Marysville WA 98270

Propagation forecaster wanted! *73* needs a new propagation writer, since Jim Gray W1XU plans to take his retirement seriously later this year. Naturally, you should be familiar with modern propagation prediction techniques, though writing experience is not required. Send queries to:

Larry Ledlow NA5E
73 Magazine
Peterborough NH 03458

Digital Voice Compression

Potential for smaller bandwidth

by Charles Opitz WA3YQY

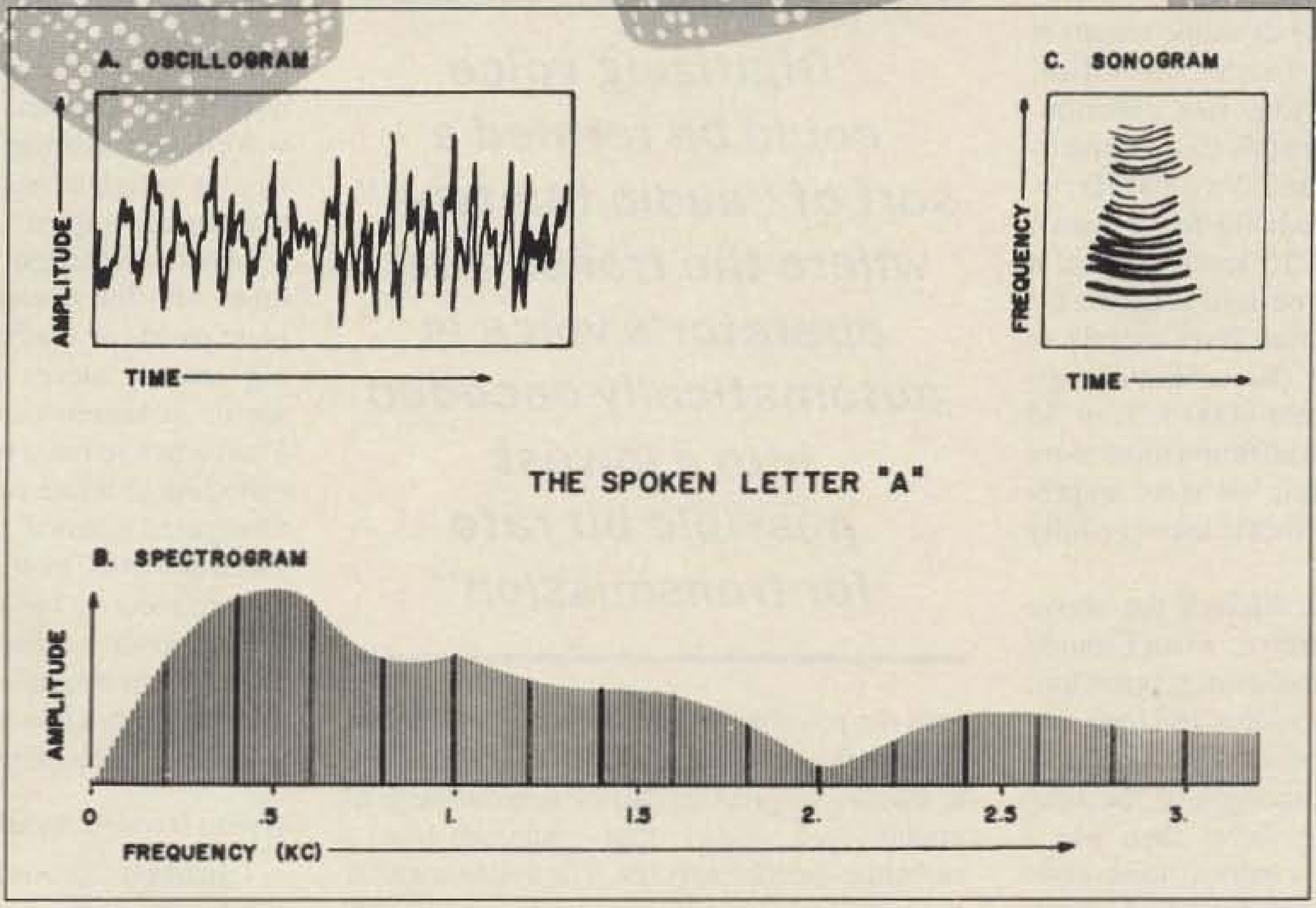

Figure 1. Three different ways to look at a fundamental sound of speech, or phoneme. Note that most of the information is contained below 2 kHz. Future voice compression techniques will probably take advantage of the redundancy of sounds in speech.

Since a good friend of mine recently lost the use of her vocal cords, I have recently given a lot of thought to state-of-the-art speech synthesizers.

One of the primary interests in amateur radio is to obtain the narrowest passband. Voice naturalness is often a secondary concern. Digitizing voice is a sort of "audio teletype," where the transmitter operator's voice is automatically encoded into a lowest possible bit rate for transmission, and where the receiver decodes this message and generates, in more or less real time, an audio version of the input spoken word. The synthesized voice must contain the meaning of the original voice message, and do so with an acceptable low error rate (1–3%).

I predict that regenerated voice will be a standard pitch male voice. (No chauvinism here, but the female voice is much more difficult to synthesize). The new voice will lack subtle cues for emotional state of the speaker. In essence, the generated speech will have just about the information content of an equivalent printed word message, but without the redundancy of spelling of the printed English word.

Note that I say English here, because that will be the language used in any first-generation voice compression system (VCS). All the advance work in speech analysis/synthesis is in English. Also, English has relatively few phonemes, and is becoming the world's lingua franca.

Smaller is Better

When receivers are white-noise limited, the signal-to-noise ratio (S/N) is proportional to narrowness, required transmitter power is inversely proportional to narrowness, and the number of permissible communication channels within a given band is directly proportional to narrowness of the transmissions.

Many have mentioned an ultimate voice transmission bandwidth of 25 Hz. E.C. Cherry, an early English worker in this field, wrote a paper that suggested this number. I have never seen, however, that value rigorously derived, It's possible, though, that it came from removing the redundancy of spelling from printed matter, then using the true information content (bits) and taking the average person word-speaking rate to compute the bit rate. The average ham QSO information rate is more like ½ that rate, but for now this article will work with the 25 bits/second figure.

Since there's no common system on the market today, I believe that a relatively inexpensive commercial device with a bandwidth as wide as 500 Hz would be quite marketable. Think of the expensive and sophisticated equipment hams gladly acquire to cut the required bandpass of AM to one half with SSB! Imagine cutting the SSB signal bandpass again by a factor of ⅛ or just ½.

Figure of Merit

For discussion purposes, here's an attempt to quantify the quality of DVC systems by using a figure-of-merit (FOM). The FOM is referenced to the "ultimate" 25-Hz passband mentioned above. In this score system, the perfect system, which is the one with a 25-Hz passband, gets 100%. Any system with a wider passband gets a lower score. Where BW = system bandwidth in Hz:

$$FOM = 100(25/BW)\%$$

The FOM in dB would be:

$$FOM = 10(\log[25/BW])dB$$

For example, a typical telephone quality link with a bandpass of 250–2800 Hz has a BW of 2550 Hz, in which case, the FOM is only 0.98% or −20 dB regarding the ultimate system.

Please note that for this discussion I assume the permissible bit/second rate is proportional to bandwidth in Hz for simplification purposes. I am aware of Shannons' information theory equations, so in this case let's permit about 1% word error, in which case my assumption is about right for simple pulse modulation with a S/N in the channel of about 15 dB.

Using ultimate VCS system parameters, let's go to the year 2000. The FCC has allocated a 100 kHz slice of the 20-meter phone band to VCS. Rather than allowing 30 simultaneous QSOs with conventional SSB rigs, this band would supporting about 3000 VCS channels and 1 kW transmitters generating the same S/N in receivers that a conventional 100,000 watt SSB transmitter does in an old fashion SSB receiver.

There is one little problem left—how to manufacture a compact, inexpensive 100% FOM VCS? It's impossible to say. I predict, however, that compromised systems in the laboratories today will be seen shortly.

Why Digital Voice?

Many of the early workers in voice analysis/synthesis used analog devices, such as lumped constant filters, electro-optical frequency analyzers/generators, etc. Filters, particularly audio frequency wave filters of this type are large, heavy, and expensive. Fortunately, nearly all the old analog functions can now be equaled (or exceeded) with relatively inexpensive microcomputer chips or dedicated ICs.

Thus, digital processing is applicable to all three "popular" forms of speech synthesis today: formant synthesizers (FS), articulatory synthesis (AS), and waveform concatenation (WC).

Brute force digitizing of voice signals to reproduce telephone quality (e.g., 250 Hz–2800 Hz, and about 26 dB dynamic range) at the receiver is subject to the theoretical Nyquist minimum sampling rate criterion, among other things. But in this case, a practical sampling rate would be 2.5 x 2800 Hz, or 7 kHz. Then to accommodate a full dynamic range of 26 dB (at least 20 level quanta), a 5-bit binary word should be used to define the level of each 1.7000 second level sample of the speech signal. Thus, the minimum digitized voice signal becomes 7000 x 5, or 35 kHz. Since brute force digitization must more or less be used for music (it is so unpredictable), hi-fi digitized music takes awfully wide bandwidths.

Back in 1975, I went through the above types of arithmetical exercises when I sought to develop a real time voice encryption unit used on existing military radios and long distance telephone lines, both of which have the narrow passbands. The thought at the time was to first digitize the voice, then add a number from a pseudo random noise code generator. The receiving end used an identical pseudo random noise code generator. This was synchronized to the transmitter unit to decode the digital word when the random number was subtracted from each digital level word. This system works fine, but only with a passband of 25–35 kHz, a width NBFM military radios don't have.

Redundant Features

Obviously, brute force digitizing was not practical for existing narrow band voice circuits. All early workers agreed. Help came from Claude Shannon's work on information theory.

Harry Nyquist's minimum sampling rate barrier could not be assailed directly—it was written. The bright developers then turned to the basic human speech pattern to look for redundancy, and here they hit pay dirt. Unlike music, voice patterns are quite redundant. The duration of phonemes, basic sounds in speech, is 20–30 milliseconds, so using this knowledge, they believed that they had about 1.30–1.50 of a second in which to encode the phonemes and send a digital word defining each one, rather than a level sample every 1.7000 second. This approach could affect a sample rate reduction of at least 140 (that is, 7000.50). This implied that, regardless of which of the three synthetic approaches one takes, there are about 1.30–1.50 of a second to encode the basic building blocks of speech. And that is a long time for today's digital ICs.

Phonemes

Let's first consider the problem of identifying each phoneme in real time, that is, within about 1.30 of a second. For realism, one must consider the base frequency, amplitude, spaces, and rhythm of the phoneme. It becomes more difficult when considering differences in speech such as accent.

Here is a paraphrase from one of the best state-of-the-art survey papers on speech analysis/synthesis where the waveform concatenation (WC) synthesis is discussed.[1] Klatt says it's possible to consider speech synthesis by concatenation; that is, by stringing together chunks of prerecorded or subroutine generated voice sounds, upon command from a real time speech analyzer. The syllable unit is not practical, because there are over 10,000 different syllables in English. The phoneme appears much more attractive because linguists say about 40 are found in English.

"Digitizing voice could be termed a sort of "audio teletype" where the transmitter operator's voice is automatically encoded into a lowest possible bit rate for transmission"

However, as of September 1987, all efforts to concatenate only 40 phoneme-size samples had failed because of "well-known coarticulatory effects," an effect between adjacent phonemes that cause substantial changes to the acoustic manifestations of a phoneme, depending on the context. Fortunately, these effects tend to be minimal at the center of the phoneme. One worker proposed to generate a synthetic phoneme which he called the "diphone." This comes from a sample made from the center of one phoneme to the center of the next. As 40 squared is 1600, there can be 1600 diphones, but it has been demonstrated that a usable system can work with only 1000.

In addition to the 40 English phonemes, there are about 14 commands for phoneme stress, silence, and syntactic considerations, such as primary stress and question intonation. Diphone duration was not mentioned, and that is important, too. So if one puts the 1000 diphone dictionary into binary code, it will take a 10-bit word. So, accepting a minimum diphone duration of 20 milliseconds, about 50 10-bit diphone words per second for a total bit rate of about 50 bits per second are required. Using the previous S/N link criterion, it would appear that a diphone approach could be realized with a 50 Hz passband, so let's say 100 Hz and be safe for now. In this system, the 1000 diphones for the synthesizer would easily be stored in a small ROM.

Now let us look at another approach to the problem, one that is in much use today.

Waveform Encoding

This second example of analysis/synthesis has been in existence for several years. Examples of instruments using this technique are talking clocks, and the Texas Instruments' "Speak 'n Spell" educational toy.

Waveform encoding works on the wave's time domain, rather than the frequency domain, as do the formant analyzer/synthesizers. It, too, relies on redundance of the phonemic waveforms. The technique, which uses linear prediction encoding of speech waveforms, estimates following waveforms from a weighted sum of about 10 previous waveform samples.[2]

Linear prediction analysis of speech does quite well for storing and playback of complete words or sentences, but for concatenating smaller pieces of speech to form new words or sentences, some difficulties arise. Words per se have been stored in waveform encoding at a rate of 1000 bits/sec in ROM. Compared to brute force binary encoding of voice at 32,000 bits/second, this is an impressive reduction, but using my S/N criterion, the improvement factor amounts to a FOM of 32%. Even so, this technique may be the easiest approach to a first generation system, since TI has the chips.

Demo Record Available

I strongly recommend the reader to copy the 52-page review and tutorial on text-to-speech conversion for English in the Acoustical Society journal. This Dennis Klatt production also included a vinyl demonstration floppy record, 33-⅓ rpm, tucked inside the cover of the Journal. The record demonstrated every practical form of speech synthesis used in the recent past and today. The reader can contact Klatt at Room 36-523 at MIT. 73

Charles WA3YQY has been a ham since 1939, and was first licensed as W2MKO. Though not an expert in voice compression, he has learned quite a bit about the subject during his tenure as a senior scientist for Lockheed Electronics until 1974, and most recently working for International Signal and Control. Charles now runs his own company called Rondout Electronics. His favorite aspect of ham radio is 75-meter and 10-meter phone operation. He also likes photography, yachting, and studying underwater acoustics.

References

[1]Klatt, Dennis H. "Review of text-to-speech for English" pp. 737–793, *Journal of the Acoustical Society of America*, Vol. 32, No. 3, 3 Sept 1987.

[2]Wiggins, R. "An Integrated Circuit for Speech Synthesis," *IEEE Int. Conf. Acoust. Speech Sig. Process. ICASSP-80*, pp. 398–401.

Voltage Sampling with a Computer

A Practical Project with an A/D Converter

by Joe Magee

Have you ever wondered how long it takes a battery to run down or just what the voltage drop looks like during those last few minutes? How fast does it get light in the morning or dark in the evening? Getting the answers to those and other questions has recently gotten much easier, thanks to Radio Shack.

One of the items introduced in the 1987 Radio Shack catalog is called an "8-Bit A/D Converter IC". The description further states "Complete Data Acquisition System in One IC". That is a big claim—I just had to buy one and find out.

The catalog description was pretty accurate. The only extra components you need are a power supply and a stable reference source. The finished product is an analog-to-digital (A/D) converter with a recommended range between 0 and 5 volts DC with an 8-bit resolution giving 256 steps of value between 0 and 5 volts.

Figure 1 gives the schematic. Everything in the schematic and all the hardware was purchased at Radio Shack and all the Radio Shack part numbers are given.

How It Works

The IC itself is a Texas Instruments TLC548. It contains a complete analog to digital conversion circuit. In addition to the power supply requirements mentioned above, only three data lines are required to interface it to a microcomputer. These lines are chip select, clock, and data.

Basically, to get data from the chip, the chip select line is pulled low, and the most significant bit (MSB) of the previous voltage conversion is presented on the data line. If the

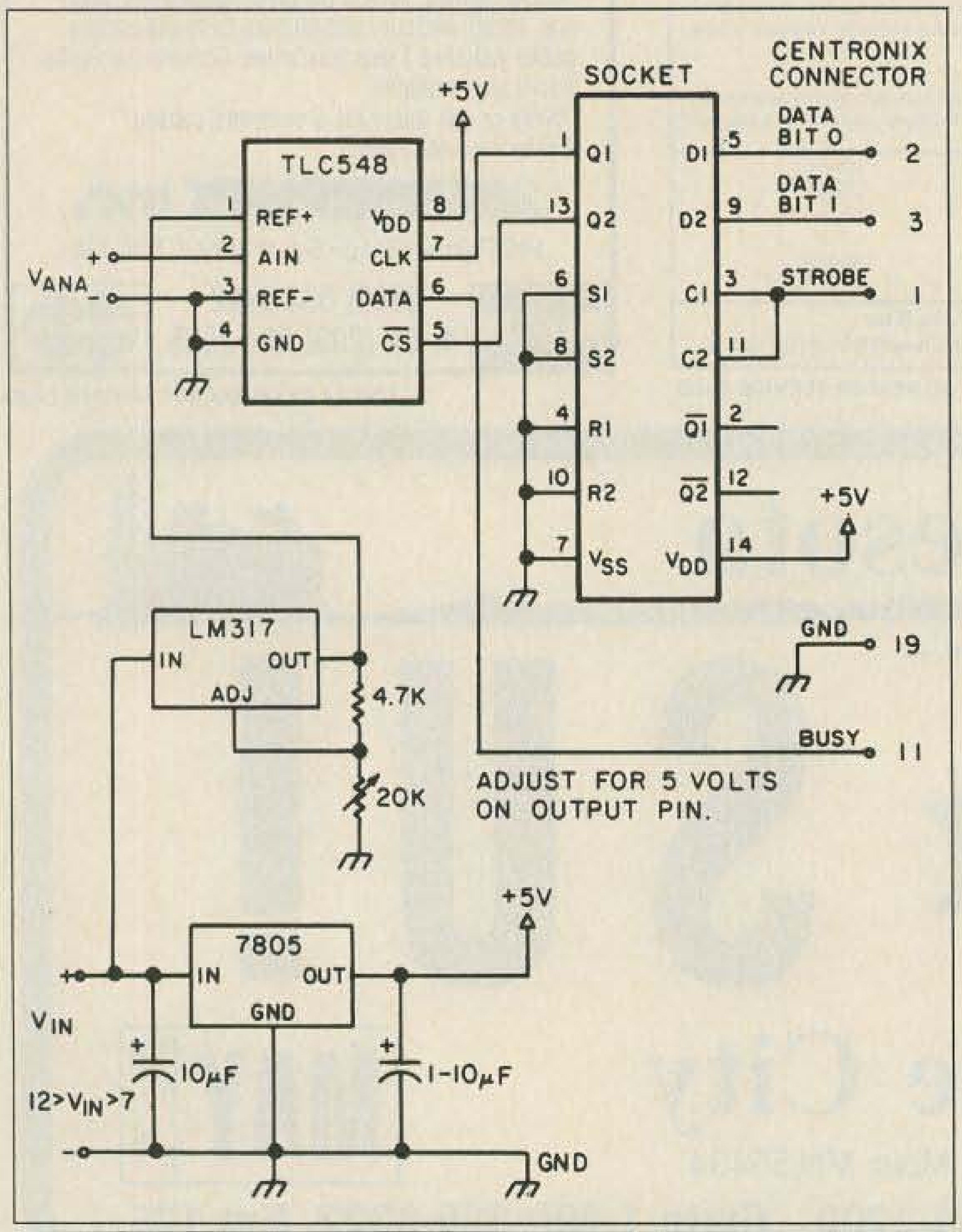

Figure 1. The simple electronics required to interface the TLC858 A/D converter to a Centronics parallel printer port.

```
1 ' ATOD.BA
2 ' JOE MAGEE, APRIL 16, 1987
90 CLEAR 256,62000        ' CLEAR ASSEMBLY LANGUAGE AREA
100 LET PA = 177 ' PIO PORT A, OUTPUT DATA
110 LET PB = 178 ' PIO PORT B, NOT USED
120 LET PC = 179 ' PIO PORT C, BUSY CONDITION RETURN
200 LET CH = 1   ' CLOCK HIGH PATTERN
210 LET CL = 254 ' CLOCK LOW  PATTERN
220 LET SH = 2   ' SELECT HIGH PATTERN
230 LET SL = 253 ' SELECT LOW  PATTERN
240 LET BB = 4   ' BIT POSITION OF DATA RETURN BIT
1000 GOSUB 10000 ' POKE ASSEMBLY LANGUAGE ROUTINE
1005 CLS
1006 RD = 1       ' COUNT OF READINGS MADE SO FAR
1007 PRINT "VOLTAGE ="
1008 PRINT "READING #"
1010 GOSUB 10400 ' LOWER THE SELECT LINE ON CONVERTER CHIP
1090 AN = 0       ' INITIALIZE ANSWER
1100 FOR I = 1 TO 8  ' LOOP READING 8 DATA BITS
1110 AN = (AN * 2) OR ((INP(PC) AND BB) / 4) ' SHIFT IN NEXT ANSWER BIT
1120 GOSUB 10600 ' RAISE CLOCK
1130 GOSUB 10800 ' LOWER CLOCK TO GET NEXT BIT
1190 NEXT I       ' GET ALL 8 BITS FROM CONVERTER
1200 GOSUB 10200 ' NOW RAISE SELECT BIT TO DESELECT CONVERTER CHIP
1290 PRINT @10,"";    ' CLEAR ANY PREVIOUS CONVERSION
1300 PRINT USING "#.##";(AN / 255) * 5.0 ' CONVERT ANSWER TO VOLTS AND PRINT
1310 PRINT @50,"";
1320 PRINT RD     ' PRINT COUNT OF READINGS MADE SO FAR
1330 RD = RD + 1 ' INCREMENT READN^ COUNT
1400 A$ = INKEY$ ' CHECK TO SEE IF OPERATOR WANTS TO STOP
1410 IF A$ <> "" THEN 9000 ' QUIT IF ANY KEY PRESSED
2000 GOTO 1010    ' OTHERWISE, GET ANOTHER READING
9000 ' WRAP UP ROUTINE
9100 CLEAR 256,MAXRAM ' RESTORE RAM TO SYSTEM
9990 END          ' DONE
10000 ' GET ASSEMBLY LANGUAGE PROGRAM INTO MEMORY
10010 READ X      ' GET COUNT OF BYTES TO DO
10020 FOR I = 1 TO X ' LOOP POKING INSTRUCTIONS
10030 READ D      ' READ NEXT ASSEMBLY LANGUAGE INSTRUCTION
10040 POKE 62001 + I,D    ' PUT IT INTO NEXT MEMORY LOCATION
10090 NEXT I      ' END OF POKE LOOP
10100 DA = SH     ' SET UP SELECT HIGH PATTERN
10110 GOSUB 11000     ' INITIALLY DESELECT CONVERTER CHIP
10190 RETURN      ' DONE WITH INITIALIZING ASSEMBLY LANGUAGE PROGRAM
10200 ' SELECT HI
10210 DA = DA OR SH   ' INSERT SELECT BIT HIGH PATTERN
10220 GOSUB 11000     ' WRITE NEW PATTERN TO PARALLEL PORT
10390 RETURN
10400 ' SELECT LOW
10410 DA = DA AND SL ' MASK OUT SELECT BIT
10420 GOSUB 11000     ' WRITE NEW PATTERN TO PARALLEL PORT
10590 RETURN
10600 ' CLOCK HI
10610 DA = DA OR CH   ' INSERT CLOCK BIT HIGH PATTERN
10620 GOSUB 11000     ' WRITE NEW PATTERN TO PARALLEL PORT
10790 RETURN
10800 ' CLOCK LOW
10810 DA = DA AND CL ' MASK CLOCK BIT
10820 GOSUB 11000     ' WRITE NEW PATTERN TO PARALLEL PORT
10990 RETURN
11000 ' WRITE PORT A
11010 POKE 62000,DA   ' PUT DATA FOR PARALLEL PORT WHERE IT CAN BE FOUND
11020 CALL 62002      ' CALL ASSEMBLY LANGUAGE PROGRAM TO WRITE DATA AT 62000
11190 RETURN
59999 ' ASSEMBLY LANGUAGE PROGRAM
60000 DATA 16
60010 DATA 243
60020 DATA 58,48,242
60030 DATA 211,177
60040 DATA 62,2
60050 DATA 211,224
60060 DATA 62,0
60070 DATA 211,224
60080 DATA 251
60090 DATA 201
```

Figure 2. BASIC program for TRS-80 Model 100 to read data from the converter.

```
(*********************************************************************)
(*                                                                   *)
(* Module Name:          atod                                        *)
(*                                                                   *)
(* Disk File Name:       atod.pas                                    *)
(*                                                                   *)
(* Purpose:              This program reads the serial analog to digital *)
(*                       converter and displays the result on the screen.*)
(*                                                                   *)
(* Revision History                                                  *)
(* Date      Programmer  Reason                                      *)
(*                                                                   *)
(* Author:               Joe Magee                                   *)
(*                                                                   *)
(* Date Written:         10/02/86                                    *)
(*                                                                   *)
(* Copyright (C) 1986, OM Systems                                    *)
(*                                                                   *)
(* Inputs:               none                                        *)
(*                                                                   *)
(* Outputs:              none                                        *)
(*                                                                   *)
(* Other Info:           none                                        *)
(*                                                                   *)
(*********************************************************************)

program atod;

var
  loop_count:   integer;
  reading:      integer;

{$i atodutil.pas}

begin
  clrscr;
  gotoxy(16,1);
  write('Serial Analog to Digital Converter Data Display');
  gotoxy(1,3);
  writeln('Voltage = ');
  writeln('Reading # ');

  atodinit;
  loop_count := 0;
  repeat
    reading := read_atod;
    gotoxy(11,3);
    write(reading / 255 * 5.0:4:2);
    gotoxy(11,4);
    write(loop_count);
    loop_count := succ(loop_count);
    delay(200);
  until keypressed;
end.
```

Figure 3. Turbo PASCAL program for an IBM PC clone to read A/D data.

```
(*********************************************************************)
(*                                                                   *)
(* Module Name:          various                                     *)
(*                                                                   *)
(* Disk File Name:       atodutil.pas                                *)
(*                                                                   *)
(* Purpose:              This file contains utilities used to read the  *)
(*                       serial a to d converter.                    *)
(*                                                                   *)
(* Revision History                                                  *)
(* Date      Programmer  Reason                                      *)
(* 10/05/86 Joe Magee    Modified for IBM PC                         *)
(*                                                                   *)
(* Author:               Joe Magee                                   *)
(*                                                                   *)
(* Date Written:         10/02/86                                    *)
(*                                                                   *)
(* Copyright (C) 1986, OM Systems                                    *)
(*                                                                   *)
(* Inputs:               none                                        *)
(*                                                                   *)
(* Outputs:              none                                        *)
(*                                                                   *)
(* Other Info:           See specifications for TI TLC548 a to d     *)
(*                       converter, sold as Radio Shack 276-1796.    *)
(*                                                                   *)
(*********************************************************************)

const

  busy_bit     = $80;         (* data bit 7 is busy bit              *)
  clk_bit_hi   = $01;         (* clock is bit 0                      *)
  clk_bit_lo   = $fe;         (* lowers bit 0                        *)
  sel_bit_hi   = $02;         (* select line is bit 1                *)
  sel_bit_lo   = $fd;         (* lowers bit 1                        *)

var
  port_data:    byte;         (* image of port 18 data               *)
  cent_port:    integer;      (* port address of lpt1: data          *)
  busy_port:    integer;      (* port address of lpt1: busy          *)

procedure atodinit;
begin
  cent_port := mem[$0040:$0008] + 256 * mem[$0040:$0009];   (* from DOS *)
  busy_port := succ(cent_port); (* status at next address             *)
  port_data := sel_bit_hi;
  port[cent_port] := port_data;
end;

procedure select_lo;
begin
  port_data := port_data and sel_bit_lo;
  port[cent_port] := port_data;
end;

procedure select_hi;
begin
  port_data := port_data or sel_bit_hi;
  port[cent_port] := port_data;
end;

procedure clock_lo;
begin
  port_data := port_data and clk_bit_lo;
  port[cent_port] := port_data;
end;

procedure clock_hi;
begin
  port_data := port_data or clk_bit_hi;
  port[cent_port] := port_data;
end;

function read_atod:integer;
var
  i:         integer;
  atod:      integer;
begin
  atod := 0;
  select_lo;
  for i := 1 to 8 do
  begin
    atod := atod shl 1;
    if port[busy_port] and busy_bit = 0 then    (* busy inverted on IBM *)
      atod := succ(atod);
    clock_hi;
    clock_lo;
  end;
  select_hi;
  read_atod := atod;
end;
```

Figure 4. Utilities for the PASCAL program in figure 3.

clock line is raised and lowered, then the next most significant bit is presented to the data line. After 8 such clock transitions, all 8 bits of the conversion will have been available on the data line. The chip select is then taken high. Following this procedure one will get the previous conversion's data and initiate the next conversion.

> ***"Only three data lines are required to interface (the A/D converter) to a microcomputer."***

Connecting these signals to a microcomputer is most easily done through the parallel printer port rather than the serial port, even though this chip provides a serial data stream. Many serial data interfaces from microcomputers do not have clock signals available to send to external devices. Also, they are expecting RS232 voltage levels. On the other hand, a parallel port works with TTL (0 to 5 volt) voltage levels, and these are compatible with the TLC548.

Circuit Specifics

The schematic diagram indicates one IC and two voltage regulators. The IC is the TLC548. One of the voltage regulators is a 7805, or 5-volt regulator. An input voltage of at least 7 volts should be applied to the 7805 to generate a stable 5 volts for the Vcc pin of the TLC548. The other voltage regulator provides a reference voltage for the converter. The converter provides a count, or reading, that is proportional to the ratio of the unknown input analog voltage and the reference voltage. The TLC548 is designed to perform best with a reference voltage of 5 volts.

The voltage reference should be as accurate and stable as possible, and semiconductor devices exist for this purpose; however, Radio Shack does not stock any. Thus, the second voltage regulator is provided. Another 7805 was not used since these regulators are not specified to be exactly on 5 volts. Instead, an LM317 was selected. It is an adjustable regulator. After connecting power the first time, it was calibrated using an external voltmeter to provide as close to 5 volts as possible to the TLC548 for its reference voltage input. This is not as accurate or stable as would be desirable, but it is about all Radio Shack has to offer.

The specifications for the TLC548 imply that the maximum allowable input voltage on the analog (or unknown) voltage pin is Vcc + 0.3 volts and the minimum allowable voltage is -0.3 volts. With this restriction in mind, the -Vref pin and the chip ground pin are tied together. This means that the converter does not appear to have a true differential input and will measure only ground-referenced signals.

Other Hardware Considerations

In order to make this unit easy to interface to a large number of computers, I chose to use a 5-pin DIN connector on its I/O interface. Thus, with only one interface cable, the unit should interface to nearly any computer with a standard Centronics interface. If the computer has some sort of other connector on its parallel interface, a different cable will be required.

The circuit is constructed on a standard perfboard, catalog number 276-158. It is housed in a box, 270-627, which required several holes drilled and filed into it. Power is supplied by a 9 VDC wall transformer, 273-1455.

Some computers use the parallel printer port for more than one thing. This will cause extraneous signals to appear on the lines, which will confuse the TLC548. In order to avoid this, some type of latch was required. The extra IC, an MC14013, is a dual flip-flop capable of latching two data lines. Just enough for the chip select and clock. These data lines are latched into the MC14013 by using the strobe signal, also part of a standard Centronics interface. On the converters I constructed, a socket for the MC14013 was included on the perf board along with a dummy socket not connected to anything. A header shorts pins 1 and 5 together and pins 9 and 13 together. Thus, if the computer in question had no extraneous signals on the parallel port, then the header would be put in the MC14013 socket. If required, the MC14013 itself would go into the socket. The unused device should then be stored in the dummy socket.

Software Requirements

Using the parallel printer port on a microcomputer solves some problems, but it raises others. The good points are that individual lines are easily controlled. This makes it easy to raise and lower the chip select and clock lines from software. However, very few parallel ports are bi-directional. By that, I mean that they are almost always output lines. There is no way to tell what the TLC548 is trying to send back.

However, all parallel printer ports have a busy line. Thus, to find out what value the converter is sending back, one needs only to monitor the busy line. The problem with this is that no popular microcomputer operating system allows for easy checking of the busy line of the parallel port. Moreover, trying to output anything to the port, such as new clock information, will not happen if the busy line is high. The operating system assumes a high level to mean that the printer is not available for new data.

In short, to use this converter, you must know something about hardware of the parallel printer port and write a program that can manipulate it properly. I will discuss three computers and give information required to communicate with the converter through their parallel printer ports.

The TRS80 Model 100

I chose this computer for the project because it is from Radio Shack and battery powered. This means that a remote data gathering setup is possible if the converter circuit is also powered from a battery. This is easy to do with any voltage greater than about 7 volts. Also, the Model 100 parallel port serves multiple purposes requiring the use of the MC14013 latch on the data lines.

Figure 2 is a listing of the BASIC program used to continuously read a voltage from the converter. The data statements are for a small assembly language routine used to send data to the parallel port. This routine is needed to disable hardware interrupts while this program sends data to the converter. It is a lot faster than using BASIC to send the same data out the port.

The BASIC program is short and to the point. The first few lines set up the needed constants. PA, PB, and PC are the addresses of the parallel ports in the 81C55 chip, a parallel I/O adapter. CH and CL are used to raise and lower the clock bit in the parallel printer port data byte. As each bit is taken from the converter chip, the next one must be clocked out by making the clock line high and then low. Data bit 0 is used as the clock bit. SH and SL are used to select and deselect the converter chip. In order for the chip to deliver the converted data and accept clock bits, it must be selected. This is done by lowering the select bit. In this application, the select bit could be left lowered, thus selecting the converter all the time, because no other hardware shares the data lines used to communicate with the TLC548. Finally, the variable BB defines the bit position held by the BUSY line in the status byte appearing on port c, PC, of the pio.

The program clears the screen and prints headings used to identify the value just read and how many times a value has been read. To read data from the converter, the program lowers the select line, uses a loop to clock in the 8 data bits, and then raises the data line.

Examining the loop reveals that the level of the data bit from the TLC548 is read in. As it is read in, it is shifted from bit 2 to bit 0 by dividing the input value by 4. The answer is then masked with a value of 1 to

```
(**********************************************************************)
(*                                                                    *)
(* Module Name:         atod                                          *)
(*                                                                    *)
(* Disk File Name:      atod.pas                                      *)
(*                                                                    *)
(* Purpose:             This program reads the serial analog to digital *)
(*                      converter and displays the result on the screen.*)
(*                                                                    *)
(* Revision History                                                   *)
(* Date      Programmer  Reason                                       *)
(*                                                                    *)
(* Author:              Joe Magee                                     *)
(*                                                                    *)
(* Date Written:        10/02/86                                      *)
(*                                                                    *)
(* Copyright (C) 1986, OM Systems                                     *)
(*                                                                    *)
(* Inputs:              none                                          *)
(*                                                                    *)
(* Outputs:             none                                          *)
(*                                                                    *)
(* Other Info:          This program released into the public domain  *)
(*                      for non-commercial purposes. Joe Magee 04/16/87 *)
(*                                                                    *)
(**********************************************************************)

program atod;

var
  loop_count:   REAL;
  reading:      integer;

{$i atodutil.pas}

begin
  clrscr;
  gotoxy(16,1);
  write('Serial Analog to Digital Converter Data Display');
  gotoxy(1,3);
  writeln('Voltage = ');
  writeln('Reading # ');

  loop_count := 0;
  repeat
    reading := read_atod;
    gotoxy(13,3);
    write(reading / 255 * 5.0:4:2);
    gotoxy(11,4);
    write(loop_count:6:0);
    loop_count := loop_count + 1;
    delay(200);
  until keypressed;
end.
```

Figure 5. Turbo PASCAL routine for the Kaypro 4-84 computer to read and display the digitized data.

```
(**********************************************************************)
(*                                                                    *)
(* Module Name:         various                                       *)
(*                                                                    *)
(* Disk File Name:      atodutil.pas                                  *)
(*                                                                    *)
(* Purpose:             This file contains utilities used to read the *)
(*                      serial a to d converter.                      *)
(*                                                                    *)
(* Revision History                                                   *)
(* Date      Programmer  Reason                                       *)
(*                                                                    *)
(* Author:              Joe Magee                                     *)
(*                                                                    *)
(* Date Written:        10/02/86                                      *)
(*                                                                    *)
(* Copyright (C) 1986, OM Systems                                     *)
(*                                                                    *)
(* Inputs:              none                                          *)
(*                                                                    *)
(* Outputs:             none                                          *)
(*                                                                    *)
(* Other Info:          See specifications for TI TLC548 a to d       *)
(*                      converter, sold as Radio Shack 276-1796.      *)
(*                                                                    *)
(*                      This program released into the public domain  *)
(*                      for non-commercial purposes. Joe Magee 04/16/87 *)
(*                                                                    *)
(**********************************************************************)

const

  cent_port     = $18;         (* centronics data port               *)
  busy_port     = $14;         (* centronics busy signal port        *)
  busy_bit      = $40;         (* d6 is busy bit                     *)
  clk_bit_hi    = $01;         (* clock is bit 0                     *)
  clk_bit_lo    = $fe;
  sel_bit_hi    = $02;         (* select line is bit 1               *)
  sel_bit_lo    = $fd;

var
  port_data:    byte;          (* image of port 18 data              *)

procedure atodinit;
begin
  port_data := sel_bit_hi;
  port[cent_port] := port_data;
end;

procedure select_lo;
begin
  port_data := port_data and sel_bit_lo;
  port[cent_port] := port_data;
end;

procedure select_hi;

begin
  port_data := port_data or sel_bit_hi;
  port[cent_port] := port_data;
end;

procedure clock_lo;
begin
  port_data := port_data and clk_bit_lo;
  port[cent_port] := port_data;
end;

procedure clock_hi;
begin
  port_data := port_data or clk_bit_hi;
  port[cent_port] := port_data;
end;

function read_atod:integer;
var
  i:        integer;
  atod:     integer;
begin
  atod := 0;
  select_lo;
  for i := 1 to 8 do
  begin
    atod := atod shl 1;
    if port[busy_port] and busy_bit <> 0 then
      atod := succ(atod);
    clock_hi;
    clock_lo;
  end;
  select_hi;
  read_atod := atod;
end;
```

Figure 6. Utility routines for the program in figure 5.

isolate the bit. Then this value is added to the variable AN, thus building the final answer.

The converter chip yields a number from 0 to 255. This number is the ratio between the analog input voltage and the analog reference voltage on the chip. The actual voltage read can be calculated by multiplying the reference voltage by the ratio of the returned count and maximum count.

For instance, if the input voltage is exactly 1 volt, the ratio of 1 to 5 is .2. The value read will be .2 times the maximum count (255) or 51. Dividing this value by the maximum count will give this ratio, and then multiplying the ratio by the reference voltage gives the answer: (51/255) x 5.0 = 1.0.

The rest of the program is devoted to displaying the answer and checking the keyboard. If the operator presses any key, the program terminates.

The small assembly language routine actually writes the clock and select line levels to the converter ship. Because the data lines used in the parallel port are shared by the keyboard scan hardware, this scan must be stopped while the converter is communicated with. In addition, while not addressing the TLC548, the data lines on the port change value while the keyboard is scanned. This dynamic changing data pattern confuses the converter and cause invalid results to be obtained. To avoid this problem, a latch is installed in the converter circuit as discussed above. The strobe line, a part of all parallel printer interfaces, is used to latch the desired levels of the clock and select lines to the TLC548. The strobe line toggling is also handled by the assembly language routine.

Ubiquitous PC Clone

One good thing about IBM computer clones is the care taken to match the IBM hardware. This means that nearly any PC-DOS or MS-DOS computer with a parallel printer port will probably have exactly the same hardware at an I/O address that is easily obtained. Figure 3 is a Turbo Pascal program that will obtain the address of the LPT1: port and use it to read the converter.

The main portion of the program is very short. We will cover it first. As in the BASIC program, the screen is cleared and descriptive titles are printed. In addition, a loop or reading counter is initialized.

The rest of the program (figure 4) is in a file called "atodutils.pas". This file contains procedures and functions to initialize the IBM hardware and to take a reading from the analog to digital converter.

Reviewing this file, the definitions of the various bits and their positions comes first. In the IBM program, the address of the parallel printer port must be determined. The operating system conveniently keeps this address at location $0040:$0008. This is a strange looking address. The first number, $0040, is the paragraph number to use as the base of the actual physical memory address. A paragraph is 16 bytes long. In the Intel 8088 world, memory addresses are defined as a base address and an offset. Each base, or paragraph, address can point to up to $10000, 65536, individual physical addresses. These numbers are called the offset, and they form the second part of the address description; that is, the ":$0008" above.

A/D Converter Parts List	
TLC548 8-bit D/A converter	RS #276-1796
7805 5-volt regulator	RS #276-1770
LM317T adjustable regulator	RS #276-1778
10 uf capacitor	RS #272-1013
4.7 kΩ ¼ resistor	RS #271-0340
20 kΩ variable resistor	RS #271-1330
Optional parts:	
5-pin DIN jack	RS #274-0005
8-pin W/W socket	RS #276-1988
16-pin W/W socket	RS #276-1994
DC power connector	RS #274-1575
Experimenter's box	RS #270-0627
Perf board	RS #276-0162
Wall power supply	RS #273-1455

In any case, as mentioned, the contents of that address is the base port address of the parallel printer port assigned as LPT1. The data for the port is at the base address, and the status is at the next higher address.

In addition to getting the address, the initialization program also sets the select bit high on the TLC548. It also initializes a variable, "port-data," to equal the value just written. This is necessary, because the value just written cannot be read back in from the data port. The only way to know the value is to save it somewhere. Notice that in this case, no strobe line toggle is necessary. The IBM, the parallel printer port is dedicated to the printer alone and no other data will appear on it. Thus, the latch in the converter circuit is removed. In my prototype, I simply unplugged the MC14013 device and replaced it with the jumper block already described and stored the MC14013 in the spare socket.

The function that reads the measured value is simpler than it looks. It starts out with a read value of 0 and adds in the values from the TLC548 one at a time.

The first step is to lower the select line as in the BASIC program. Notice that this is done by a logical AND between the current value in the parallel port with a constant called "sel_bit_lo." "Sel_bit_lo" has a value of $fe. When this value is ANDed with the port value, bit 1 of the port value will unconditionally set to 0, and all others will remain as they were. In the value $fe, bit 1 is a zero, and all others are ones.

Most of the rest of the function is a loop that gets the current data bit from the converter chip and saves it. First the accumulated answer is shifted to the left to make room for the next data bit. The data bit value comes in on the busy bit of the printer port. In the IBM this bit is inverted. Once again, the logical AND trick is used to determine the value. In this case the constant is $80, because the busy signal is in bit 7 of the status data. This time, we want to know the value of that bit, so all the other bits are 0. Thus, with a logical AND all bits will set to 0 except bit 7. Bit 7 will be remain unaffected. If it is 0, then the bit coming from the TLC548 was a 1 and the least significant bit of the answer is set to a 1 by simply adding 1 to the value. Then the clock line on the converter chip is toggled to bring out the next data bit. After the loop, the select line is returned to a high value, and the converted value is returned to the procedure that called the read-atod function.

The main routine calls the read function. It then takes the converted value and makes it into a voltage, just as in the BASIC program above. This value is displayed on the screen. A small delay is included in the program to make the answer readable. If the voltage read is not exactly on a value that is one of the 256 steps between 0 and 5 volts, the answer may fluctuate between the closest such values. This program can read and display the voltage so quickly that the screen display can flicker between the different values and the actual number cannot be read before it changes. The small delay gives us poor humans a chance to catch up with the machine. The last statement is a check of the keyboard. If any key is pressed, the program stops.

The Pickup Truck of the CP/M World

The CP/M world is not as lucky as the MS-DOS world. Standardization of port addresses and hardware did not occur. I have several CP/M computers, but the one that I use the most is a Kaypro 4-84. It is representative of a CP/M computer, and the parallel port on it is similar to other Kaypro 8-bit computers. The program (figures 5 and 6) is very similar to the one for MS-DOS, since it also is written in Turbo Pascal. However, the programmer must determine the address of the parallel printer data and status ports. This information is available in the documentation which comes with the Kaypro. As in the IBM, the printer port is dedicated to the printer and no strobe line toggling is required. If you have a different CP/M-80 computer, this program can be used if you determine the hardware addresses of your printer data and status ports. You will also need to know the location of the busy line bit in the status port, and whether any other data appears on that port. Most likely, however, in a CP/M computer the data port will be dedicated to the printer.

There you have it. Get busy! If you have a computer, you should be able to go down to Radio Shack and get the parts needed to let you too turn it into a voltmeter. Next week you should be able to tell me things like how long it takes a battery to discharge, or what time the sun came up 7 days in a row, or maybe the average S-meter reading on 20 meters over a 24 hour period. Let's see, how about the temperature for the last 24 hours? I'll have to think about that one. 73

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Germantown MD 20874

Building a Duplex Digipeater

I promised some time ago to present details of the duplex digipeater that our group uses in the Washington DC area. It's a simple device that requires little hardware and no software.

The first step in constructing a duplex digipeater is to choose a frequency and a site. The group chose the frequency pair on 220 MHz to conform with standard voice repeater operations, i.e. frequency and split. The group's initial duplex digipeater had the frequency assigned and coordinated by The Mid-Atlantic Repeater Council (TMARC) as if it were a voice repeater.

Since that time, there have been changes in Part 97 of the FCC regulations that differentiate between digital communication devices and ordinary repeaters. It's now permissible to construct a duplex digipeater and operate it in any portion of the amateur radio spectrum above 50 MHz where the emission mode is legal, provided the transmissions use the AX.25 protocol. This means a duplex digipeater can operate on two meters outside the standard repeater subbands of 144.5–145.5 and 146–148. Our group has two new duplex digipeaters under construction that have inputs in the range of 145.6–145.7 and outputs in the range of 145.0–145.1, using the standard 600-kHz split.

Hardware Selection

There are four major pieces of the duplex digipeater: the duplexer, the receiver, the modem, and the transmitter. The duplexer is any standard duplexer used for normal repeater operation. Our group has been quite satisfied with the performance of a WA-COM four-cavity duplexer.

The receiver is any NBFM receiver. The group uses a Midland 13-509, but just about any receiver should do. A receiver designed for repeater service is a better choice due to the higher quality and wider environmental tolerance designed into these devices.

The group's modem is a Bell 202T look-alike produced by Rixon found at a hamfest for about $40. This turned out to be a very good performer, because its carrier detect circuitry doesn't trigger on voice signals. Only a valid Bell 202 carrier causes the carrier detect to assert. This is very important, because the carrier detect signal of the modem is used to key the transmitter.

The transmitter is the transmitter section from a Midland 13-509 but just about any NBFM transmitter will do. As in the case of the receiver, a transmitter designed for repeater service is probably the best choice. Be sure to have full schematics for the transmitter for slight modifications to ready it for duplex digipeater operation.

Signal Flow

It's imperative to have the duplex digipeater key and unkey very rapidly in response to packets at the input. The duplex digipeater output alerts all other users to activity on the channel and to stand by until the channel goes clear. This is what carrier sense multiple access (CSMA) is all about. In order for this to work, the duplex digipeater needs to key up the transmitter as soon as a valid data carrier is detected by the modem. The following diagrams and directions should help.

The incoming signal goes directly from the detector in the receiver. The receiver's squelch and COR (if it is a repeater receiver) are NOT used. The signal from the detector travels to the buffer amplifier shown in Figure 1. Buffer adjustment consists of applying a 5 kHz deviation, 2200 Hz modulated signal to the receiver, and adjusting R2 to provide a 0.77 Vrms (0 dBm) signal at the buffer output.

The buffer output goes to the input of the Bell 202T modem. The data output of the modem is looped back to the data input of the modem, regenerating the

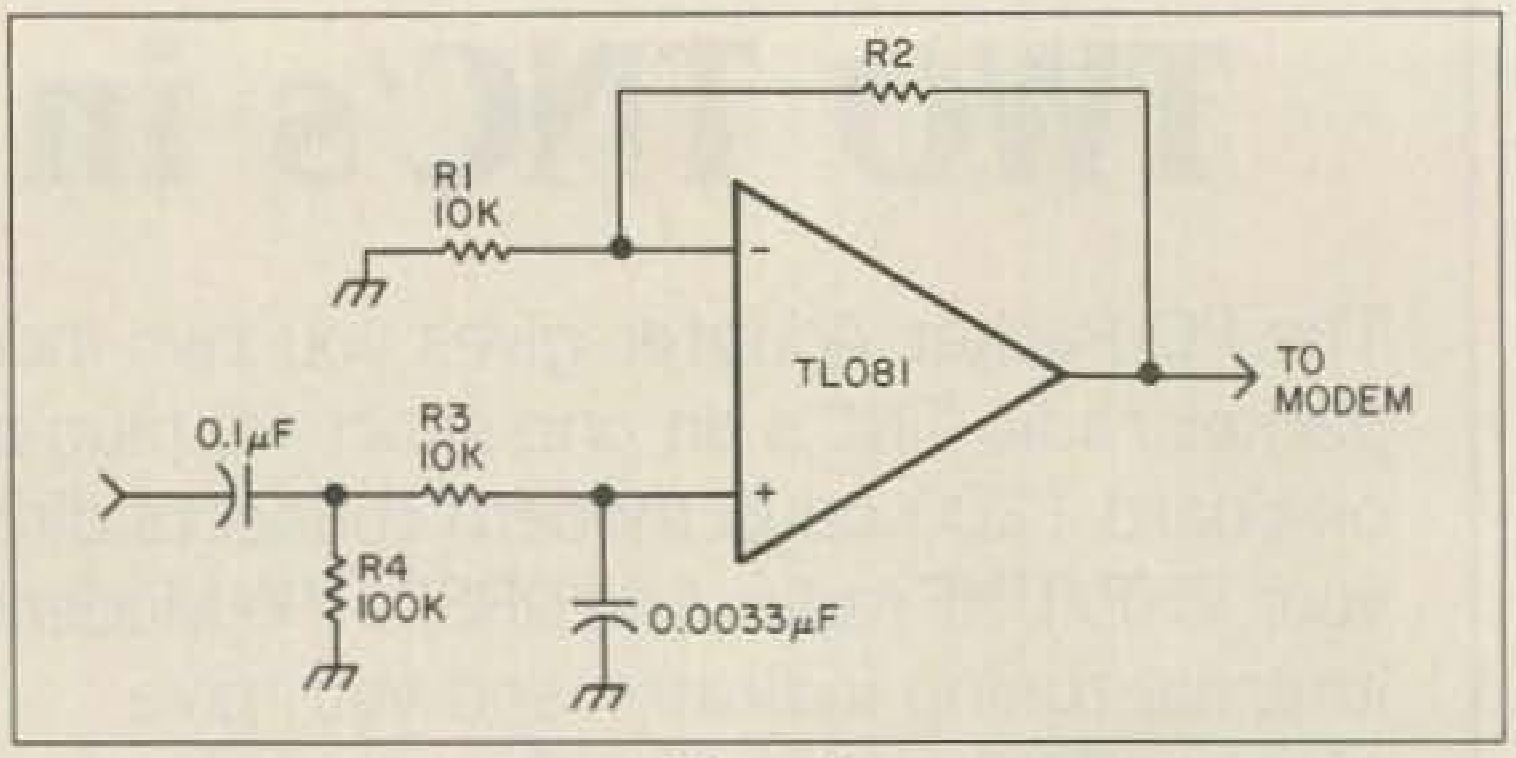

Figure 1.

tones. The modem output goes to the transmitter input AFTER all signal processing stages. The modem signal MUST enter the transmitter as close to the modulator as possible. Be sure to bypass all microphone preamp, limiter, and low-pass filtering circuits in the transmitter. Usually the wiper of the deviation control is a good place to inject the signal (See Figure 2). Adjust the modem output level so the 2200 Hz high tone produces exactly 3 kHz deviation.

The transmitter requires one special modification in order for it to key very rapidly and still provide good signal stability. Wire the transmitter so all stages are powered all the time. In order to key and unkey the transmitter rapidly, one of the intermediate stages in the transmitter needs to be keyed. Since the amplification and multiplication stages of most FM transmitters operate Class-C, the transmitter is stable and quiet with no drive. I modified the last multiplier stage so its emitter is keyed by a small keying transistor, which is turned on (keyed down) by the application of a positive voltage. Be sure to use plenty of bias on the emitter of the keyed stage to ensure its continued stability. See Figure 3.

"A duplex digipeater can operate on two meters outside the standard repeater subbands."

In a Nutshell

A received signal is amplified and buffered by the buffer amplifier and presented to the demodulator in the modem. Only a valid data signal activates the data carrier detect (DCD) line. The DCD line turns on the keying transistor, which pulls the emitter of the last multiplier stage to ground turning the multiplier on. This allows RF to pass from the multiplier to the amplification stages in the transmitter (our transmitter keys in about five microseconds). The data is detected by the demodulator in the modem and passed to the modulator through the jumper between pins 2 and 3 of the RS-232 connector. The regenerated tones now modulate the transmitter.

So far this technique has worked very well. The keyup delay is only 8 msec—essentially the time it takes the modem to detect carrier. Since the modem does a very good job at differentiating between noise, voice, and valid data, it's almost impossible to get the duplex digipeater to falsely key up. The duplex digipeater remains keyed until the signal goes away. (One can always add a watchdog timer that will unkey the transmitter after some period of time, say a minute, should someone's TNC stay on the air too long.)

Since the duplex digipeater has no IDer of its own, one of the TNCs on the frequency should broadcast an ID packet for it at least every 10 minutes. This should keep everybody happy and everything legal.

A Few Caveats

Don't try to use the COR in an existing repeater receiver to key the transmitter. The squelch in most receivers is too slow to work effectively and it cannot differentiate between a voice and a data signal. The duplex digipeater must pass only data to be eligible for operation outside the repeater subbands.

Don't try to key the transmitter by keying the audio and oscillator stages of the transmitter (this is how most repeater transmitters are keyed). The transmitter needs to key up more quickly than most of these stages can accommodate.

Use a Bell 202T modem that

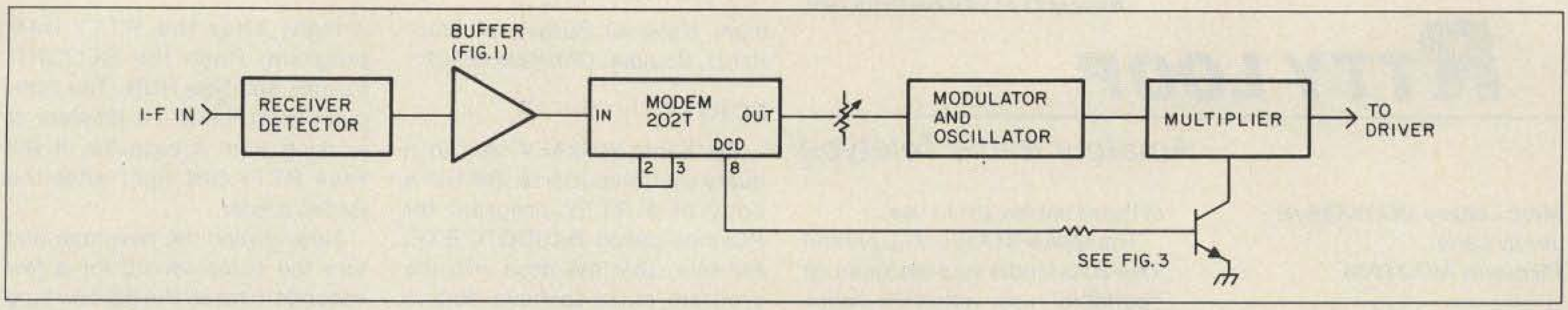

Figure 2.

does not falsely trigger on voice or noise. For this reason, neither the 2211 PLL nor the 7910 world modem chips used in most TNCs are suitable. The 2211 will not reject voice and the 7910 will assert DCD for any signal, even noise.

Go build one! Find out what packet radio is like when everyone in your area can "hear" everyone else. Just be sure to remind users to turn on the duplex switch on their radios prior to attempting connections to their neighbors directly (no digipeater specification required).

Backbones

One of the biggest problems facing amateur packet radio is how to build long-haul networks that pass data efficiently without losing it. Digipeaters were not very useful for constructing long-haul backbones. Packet loss rates rendered them useless for more than one or two hops. The proliferation of NET/ROM and bulletin boards was an attempt to solve this problem. Bulletin boards act as store-and-forward devices and NET/ROM added link-layer acknowledgments (hop-by-hop ACKs) in an attempt to make each link appear to be more reliable. This improved things somewhat but didn't solve the problem. It just made it less visible. The real solution is to make the links truly reliable.

The measure of link reliability is its packet loss rate. A reliable link doesn't lose packets. Packets are lost for two major reasons: poor link implementation and collisions. The reliability of a link can be improved by properly adjusting the modems, radios, and antennas to ensure that transmitted packets will be received with a very low probability of error. Collisions can be avoided by ensuring that only one transmitter uses the frequency.

The first suggestion, proper installation and adjustment of the hardware, seems straightforward but the second suggestion, that of having a single transmitter to a frequency, seems rather unusual. How can there be a network with only one transmitter to a frequency? The key to this issue is proper network topology. It requires some rethinking about packet radio based networks.

Collision-Free Network

Phil Karn KA9Q wrote a very interesting paper for the ARRL 6th Computer Networking Conference entitled "A High Performance, Collision-Free Packet Radio Network." The interesting thing about Phil's paper is that the concepts presented therein apply to any radio-based network regardless of networking protocol! These concepts will work for TEX-Net, NET/ROM, TCP/IP, ROSE (COSI), or even plain vanilla AX.25 with digipeaters. A network based on Phil's ideas, in addition to being collision-free, is also inherently full duplex! Here is a general description of how a network based on Phil's ideas would work.

Every node in the network has one and only one transmitter. That transmitter operates on a frequency assigned to only it for a region. Each of the adjacent network nodes has a dedicated receiver and possibly an antenna to listen to that frequency. This means that each node in the network has one transmitter on its own frequency and one or more receivers each tuned to the transmit frequency of the adjacent network nodes. The transmitters should probably use omnidirectional antennas and the receivers should use directional antennas to increase link signal margin and reduce interference from undesired signals.

To make the network easier and less expensive to implement the transmitters at adjacent nodes should probably operate on different amateur bands. This reduces or eliminates the need for cavities or duplexers at a site.

Do not discount 6m and 2m as link bands. Users can transmit signals up to 20-kHz wide on these two bands. The 220 and 430 MHz bands allow signals up to 100 kHz wide. For bands above 450 MHz, the signals can be as wide as the band itself. Based on these bandwidths, speeds of 9,600 bauds (6m and 2m), 56,000 bauds (220 MHz and 430 MHz), and 10 Megabauds (902 MHz and up) are possible.

The packet switch hardware at each node must handle multiple receivers and a single transmitter. Currently the KA9Q TCP/IP networking code supports this topology and, with only a slight modification, the multiport digipeater and NET/ROM code could also. Imagine a network where eight digipeater hops are considered normal and acceptable with negligible packet loss rates!

Users should have access to the network on a seperate band from backbone links. This is where the duplex digipeater comes in. Local users communicate with one another through the duplex digipeater. Should someone wish to communicate with another user reachable only through the network, the packets are switched off the LAN and onto the backbone. When the packet finally arrives at the destination LAN, it is switched to the duplex digipeater and then delivered to the destination.

Our group is constructing a network that uses duplex digipeaters to define and support the LANs and has a collision-free backbone to tie the duplex digipeaters together into a single network. The network node switches will support NET/ROM, TCP/IP, and AX.25 digipeater connections. Users will have their choice of networking protocols all with a very high probability of packet delivery. I will keep the readers posted on this progress.

NET/ROM Update

There are two significant developments of interest to the NET/ROM users. First, the Northern Germany Packet Group has written a NET/ROM replacement package and placed it into the public domain. This package is fully compatible with NET/ROM version 1.3, but has no encrypted callsigns. The software is in the public domain and is available in either source ('C' plus a tiny bit of assembler) and/or object code format. Those interested in information or a copy of the software should contact:

Michael Roehner DC4OX
Hans Georg Giese DF2AU
Hinter dem Berge 5
D3300 Braunschweig, FRG

There is also a new version of the KA9Q TCP/IP code that is NET/ROM compatible. This code permits a TCP/IP station to be part of a NET/ROM network, passing both AX.25 and TCP/IP traffic over the same link at the same time. This code doesn't support end-user NET/ROM access (i.e., it does not allow connections with an ordinary TNC), but it's ideal for a backbone packet switch with restricted backbone access. A vote of thanks and a hearty "well done" go out to Dan Frank W9NK for this addition to the KA9Q TCP/IP net package. 73

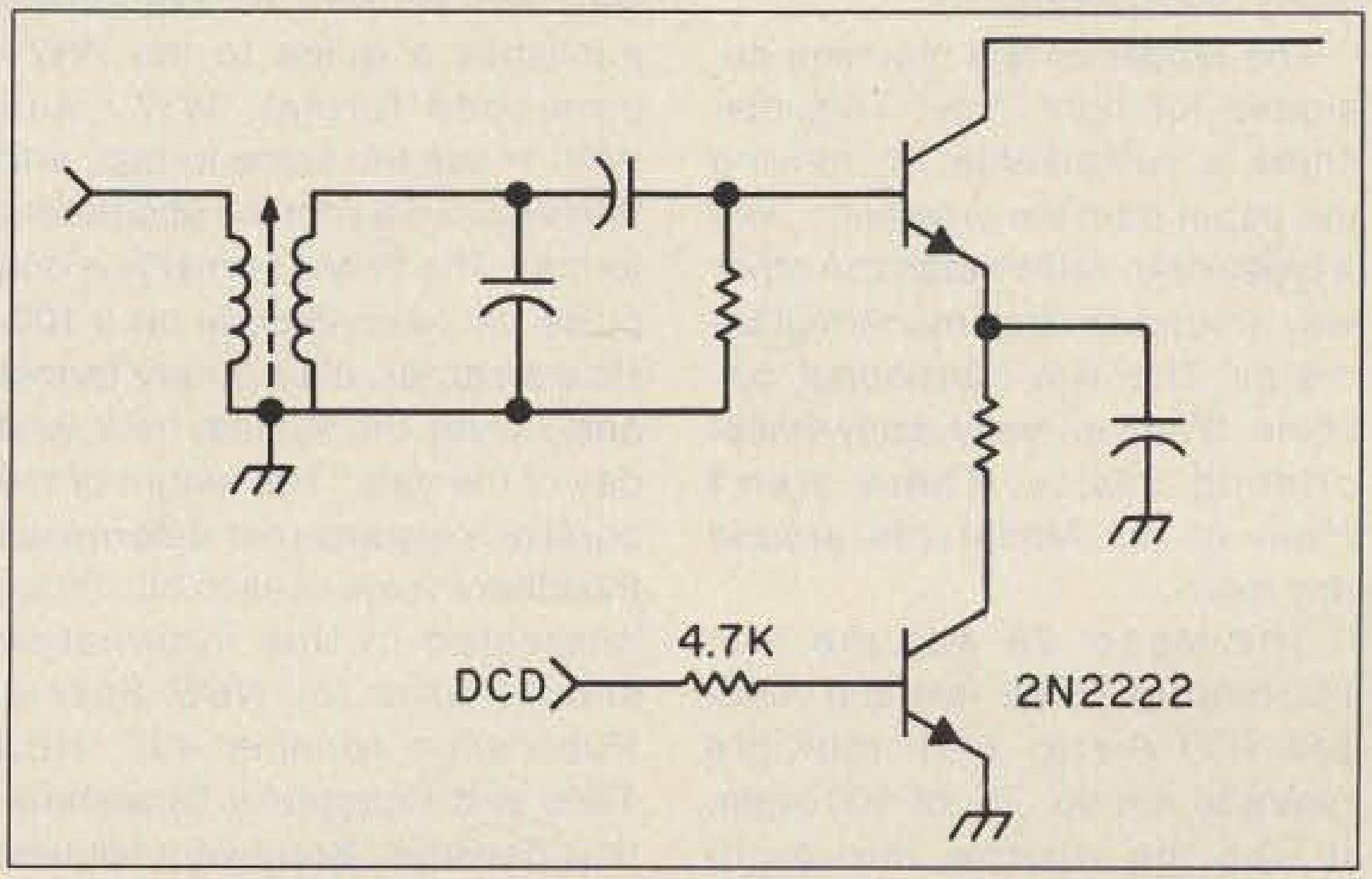

Figure 3.

Number 21 on your Feedback card

RTTY LOOP

Amateur Radio Teletype

Marc Leavey MD WA3AJR
Jenny Lane
Pikesville MD 21208

Teleprinter Machines

This month's RTTY Loop column takes a look at the models the Teletype Corporation produced. Although other companies, notably Kleinschmidt, have produced teleprinter machines, those from the Teletype Corporation have the widest circulation in the amateur RTTY community.

Baudot/Murray Machines

First on the list is the Model 12. This ancient boat anchor allowed many an amateur to use RTTY in the early days. With six magnets in the typing unit, each requiring 300 mA of current, it generated more electrical noise rather than mechanical noise, (the latter still being considerable). This is a machine for masochists.

The Model 14 series are strip printers and tape punches.The tape versions of this series are commonly combined with the Model 15 into a Model 19. More on those in a paragraph or so.

The Model 15 is the "standard" if ever there was one. This machine comes immediately to mind when someone mentions "Teletype." This sturdy page printer runs on a 60-mA loop supply, and will stand up to use day in and day out, longer than an amateur will want to run it.

The Model 19 is equivalent to a Model 15 on a table with a Model 14 tape punch. (Who knows why it's not called the Model 29?) It's the forerunner of today's "ASR" (Automatic Send-Receive) sets. The Model 19 is still in service at many installations.

The Model 26 is a machine designed for light duty. This machine is remarkable for moving the paper past the type head, like a typewriter, rather than the other way around as most modern printers do. This is a transitional machine. It has an early daisy-wheel printing device. There aren't many of the Model 26s around any more.

The Model 28 was the first machine to break into the modern RTTY era. With multiple gears to run 60, 75, or 100 wpm, it was the window into high-speed RTTY. There are many of these babies still in use.

The Model 31A is a strip printer! This 20-pounder was designed for "portable" use, within the definition of portable in the late 1960s. I have not seen or known anyone who has this specimen.

The Model 32 is a modern five-level teleprinter, which may as well be the ultimate machine. It's the Baudot version of the Model 33, a familiar machine to the ASCII crowd.

ASCII Machines

The Model 33 is the standard in ASCII teleprinters. This modern teleprinter has many versions. Use the "Call Control Unit," which is on the right plate of the machine, as a key to learn what the machine is wired for.

The Model 35 is the ASCII version of the Model 28. Even though this is an ASCII machine, many of the internal parts are the same as the Model 28, and interchangeable. Note that although the selector magnets in the Model 35 have a rather high current demand (500 mA), an internal selector magnet driver takes care of the interfacing. The Model 35 tends to be the heavier-duty version of the Model 33.

Thanks to the people who offered information on various machines, especially Bob Roehrig K9EUI, R. Lee Hagan K4OZQ, Doug Reed, and Tom KA4RKT (via CompuServe).

WWV

I mentioned WWV two months ago and wondered if decoding the encoded information was possible. Well, Bob K9EUI also passes along the information that the National Bureau of Standards publishes a guide to the WWV time-code format. WWV and WWVH use the same format, and WWVB uses a somewhat different format. The WWV format is a one pulse per second code on a 100-Hz subcarrier. It's a binary format and it gives the minute, hour, and day of the year. The length of the burst of the subcarrier determines the binary value of each bit. Those interested in this information should write for *NBS Special Publication Number 432*, NBS Time and Frequency Dissemination Services. Send your request to the Time and Frequency Division, National Bureau of Standards, Boulder, Colorado 80302.

PC RTTY

Bill Kantz WD2AEV sent in a query via CompuServe. Bill has a copy of a RTTY program for PClones called BAUDOTC.EXE. He said that the docs with the program claim to have source code available, but he can't find it anywhere. He's looking around for information on RTTY for the PC.

Well, there are quite a few public domain programs for the PClones. One I have looked at is available on CompuServe's HamNet for downloading. RTTY.EXE was written by Perry Taylor WØSE, and T.L. Vinson WØNW. It seems to be a rather full-featured program, with selectable speeds, modes, disk access, and the like. Free for the taking and that may be hard to beat. The reader might make note also of WØKU, a net user, who also asked about PClone RTTY via the Delphi information system.

KB8BMN sent along a Delphi Mail message, wondering about slow scan programs for the CoCo. Well, the first one that comes to mind is Marty Goodman's famous WEFAX program. It's a transmitting version and is available on Delphi for downloading. This may be just the ticket for the ham who wants to try SSTV on a shoestring. Hardware solutions are around as well, of course, with the AEA PK-232 described here a while back, leads the pack. The cost of the AEA PK-232 may be more money than one is willing to plunk down to try something out.

CoCo Instructions

Several hams have received a copy of January's RTTY program for the CoCo on tape and have asked for more specific information on how to use the program. The tape will have two programs on it. First of all, there are three CSAVEs of RTTY.BAS. This is the driver program for the RTTY routines, and will be the program to run first to get the thing started. So, CLOAD RTTY into the computer, then CSAVE RTTY onto a new tape only once. Now, put the tape back in and CLOAD MAKERTTY. The MAKERTTY program is a BASIC program that will create a binary program, usually called RTTY.BIN. This is the "gut" of the program.

Therefore, after loading MAKERTTY, put the new tape back into the recorder, position it right after the RTTY.BAS program. Push the RECORD buttons and type RUN. The computer must know the amateur is working from a cassette. It will save RTTY.BIN right after the BASIC loader.

Now, rewind the new tape and turn the computer off for a few seconds to reset. Put the new tape in, press PLAY, and type CLOAD RTTY. When the BASIC program is loaded, RUN it, and the computer will load the binary routine and start the ball rolling. Okay? Is that clear enough? Let me know.

Odds and Ends

Jim W. Pook is a Canadian friend who would like to monitor RTTY on his Apple II-gs. We have covered Apple software before, and I have sent Jim a list of what I know about that software. But, with the enhanced capabilities of the II-gs, I would think that there should be some new and exciting programs on the market.

Manuals and books are the object of Robert E. Becker's search for RTTY information. On the market, the current information is precious and very little, besides what I've talked about here in the column. I like to think that RTTY Loop remains one of the most current sources of RTTY and ham-computer information. While there isn't a "book" of RTTY Loop columns, back issues are available from little old me. Send me a self-addressed, stamped envelope and I will send an index of this column dating back more than ten years.

Input from readers has been heavy this month, by mail and computer. Let me hear from you! Send letters to the above address, with a self-addressed, stamped envelope for personal replies, or Email via CompuServe (ppn 75036,2501) or Delphi (username MARCWA3AJR). I always look forward to hearing from the amateurs.

Some of the most exciting hardware and software items have tickled my interest lately, and they will show up here in RTTY Loop. Not only that, but as I write, the Greater Baltimore Hamboree and Computerfest is on the horizon with goodies galore to fill next month's column. How can that be missed?

Check that subscription label on the wrapper of *73* right now, before it gets thrown out, and make sure it hasn't run out. The last thing you want to do is miss next month's RTTY Loop!

ABOVE AND BEYOND

VHF and UHF Operation

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TX MIXER BOARD FOR LMW 2304

Last month's column covered the Universal Local Oscillator (ULO), Receive Mixer, and IF Amplifier sections of the LMW 2304-MHz transverter kit. This column details the Transmit Mixer board construction, as well as the completed chassis and on-air performance.

Overview

Figure 1 shows the the transmit mixer board. This is the most intricate stage to assemble and perhaps the trickiest to align! The somewhat obscure pictorial diagram doesn't help matters. The schematic is correct and the final word on parts placement.

The design is quite simple. 144-MHz drive is injected through a large resistive pad that allows up to a 10-watt signal level. A 100Ω potentiometer adjusts the saturated drive. This output is connected to a diode mixer stage. A pair of HP2835 diodes function as a ring mixer stage, but there is not a lot of conversion gain. Due to this, the 144-MHz drive needed for saturated output is typically 1–2 watts. This level is easily obtainable.

The ULO board has more than adequate output at 1080 MHz (see last month), delivering between 40 and 50 mW across 50Ω. This signal is injected into TR1, an NEC 85637 bipolar device functioning as a doubler stage. Gain is about 3–4 dB and the output at 2160 MHz is fed to the ring mixer stage. Tuning here is critical, both to suppress the unwanted 2160-MHz LO signal and peak the desired 2304-MHz mixer product.

This stage is followed by five Class-A stages that run straight through at 2304 MHz and develop about 4–5 dB each. TR2 to TR5 are also NEC 85637 bipolar devices. TR6 is a Phillips BLU98 stage that develops 400–500 mW output maximum. All stages except TR6 run at 8 volts derived from a regulated bus line. TR6 is a more conventional 14-volt stage, and takes its power directly from the 13.8-volt input.

Construction

The assembly is quite tricky—check work often against the schematic. Of all the pictorial diagrams in the kit, this is by far the hardest to read. The importer, Bill Olsen of Down East Microwave, plans to have some of diagrams redrawn to alleviate this problem.

Perhaps the trickiest area of the board are around the driver and final stages. Here, the builder must carefully solder coils, resistors and diodes in a tiny area. For example, the pictorial does not show a 47Ω ¼W resistor from the base of TR5 to its associated choke, but the schematic does. Furthermore, placing the resistor with minimum lead length and attaching the choke (1 turn of wire with 4mm inside diameter) presents quite a challenge! I cut the leads down so far they were virtually non-existent and stood the resistor on end, making the shortest possible connection to the choke.

Also make sure to solder ALL the plated-through holes around the PC board, especially at the ground end of each etched inductor. I missed a few the first time, which adversely affected the unit's performance. LMW supplies strings of tiny pins to push through the holes and solder. They often don't fit without extra drilling, so use cut-off leads from components instead. Form these into a tight "U" shape and insert them into the board. After soldering, clip the leads flush to the board.

The trimmers are also tricky. The tiny leads at the head of the trimmer need to pass through the PC board to solder on the backplane. Pull them as tight as possible while holding the trimmer flush to the top of the PC board, and apply solder to make a smooth flux. Clip the excess leads as close to the board as possible. The trimmer bodies are made of a gold alloy and solder quite easily to the circuit traces. Use a low-wattage iron (40 watts is plenty) and tin them slightly before fluxing the solder to the trimmer body.

There are plenty of small chip capacitors—cautiously solder them to the designated points. These devices are susceptible to high heat, so just lightly flux solder over the ends. DON'T APPLY HEAT DIRECTLY FROM THE SOLDERING IRON!! There are only enough chips to make the kit work. Replacements have to be ordered from Down East.

Install the transistors last. LMW instructs the builder to pass the emitter leads for TR1–TR3 through the mounting holes and solder them to the backplane for the lowest impedance ground. Since the holes aren't large enough, enlarge them with a hand drill.

TR4, TR5 and TR6 solder entirely to the top of the board. (I mistakenly soldered the emitter leads from TR4 to the backplane, but it had no apparent adverse effect.)

Create the regulated 8-volt bus by strapping #22 wire between each of the insulated feedthrough capacitors. Again, enlarge the too-narrow holes with a hand drill. Install the feedthroughs with the solder flange on the backplane side and flux each flange completely to make a well-grounded and mechanically secure connection. I used uninsulated wire for the bus, but any type will suffice.

The DC voltage regulator mounts to the backplane. Apply a small coating of silicon grease (not included) since the regulator gets plenty warm during use! Bend the leads carefully to make sure the flange lines up with the screw hole punched in the board, and fasten securely. The DC relay fits nicely into its pre-drilled holes.

The remaining components are easy to install. Most of them go on the top of the PC board. Cut the leads as short as possible to keep a low profile when installing the diode bias networks. Watch the resistor markings! I mistakenly installed 100Ω types where 10Ω resistors were called for and vice-versa. This made things quite exciting on initial power-up.

Tune-up

First make sure the 8-volt bus functions correctly. Do this before connecting any of the collectors from TR1 through TR5.

Next, determine the operating bias. Monitor the collector current of each device with a milliammeter when testing the resistors marked "SOT." I found a value of 390–470Ω yields the desired collector current on each stage. The range is not critical. If the manual specifies 10–12mA, for example, anywhere from 8 to 15mA will do.

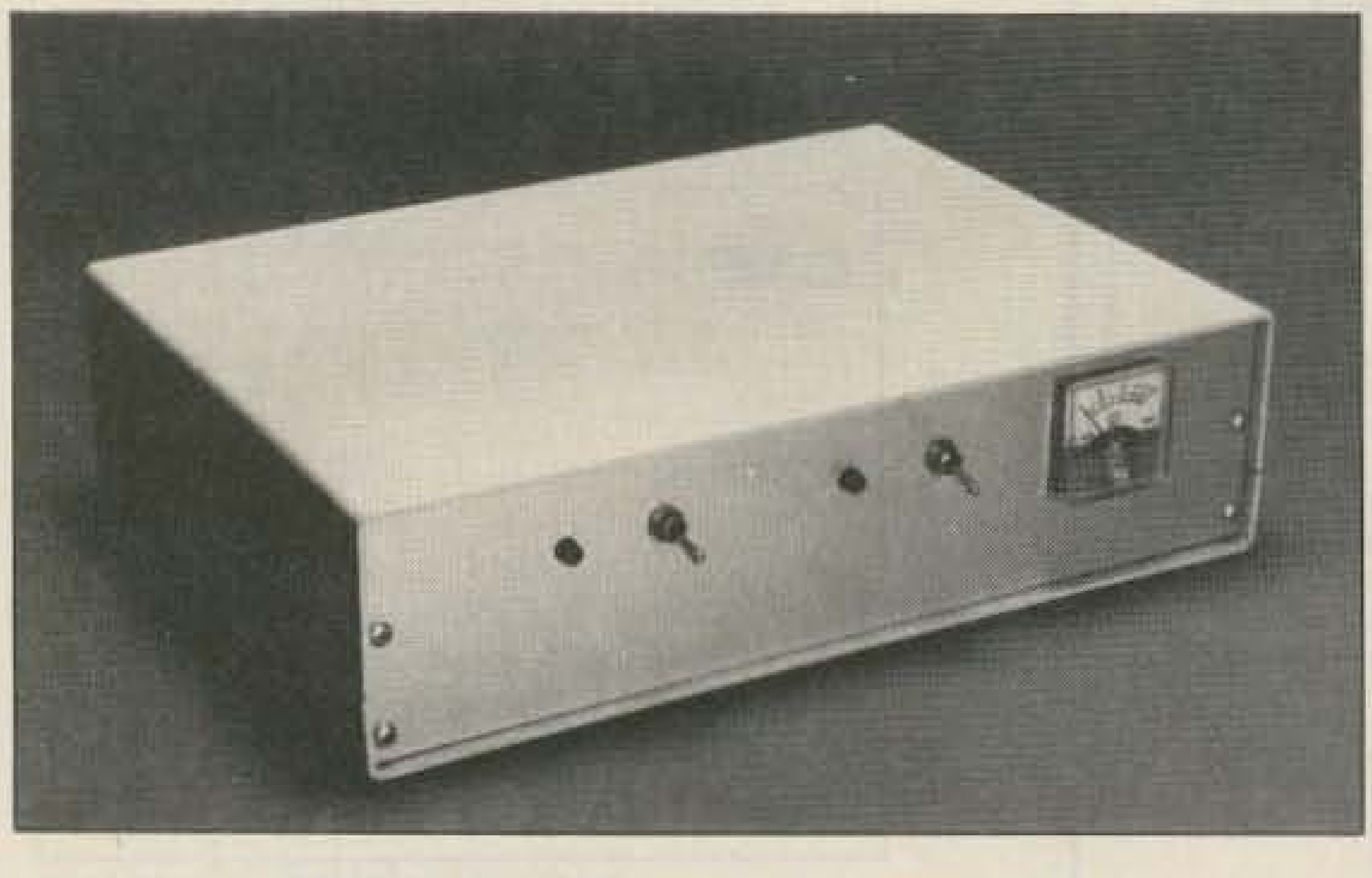

Photo A. The completed 13cm transverter.

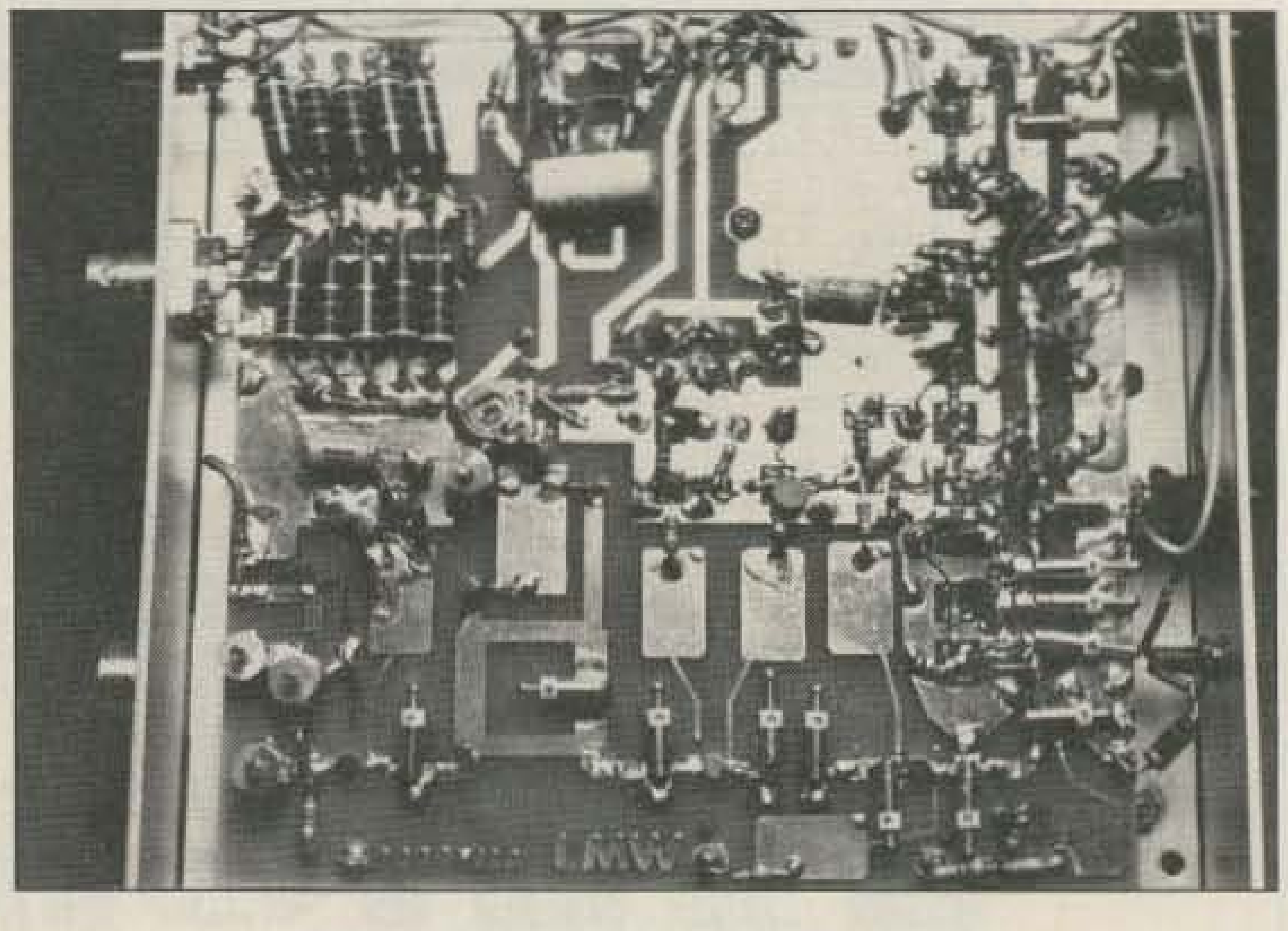

Photo B. Interior view of the transverter.

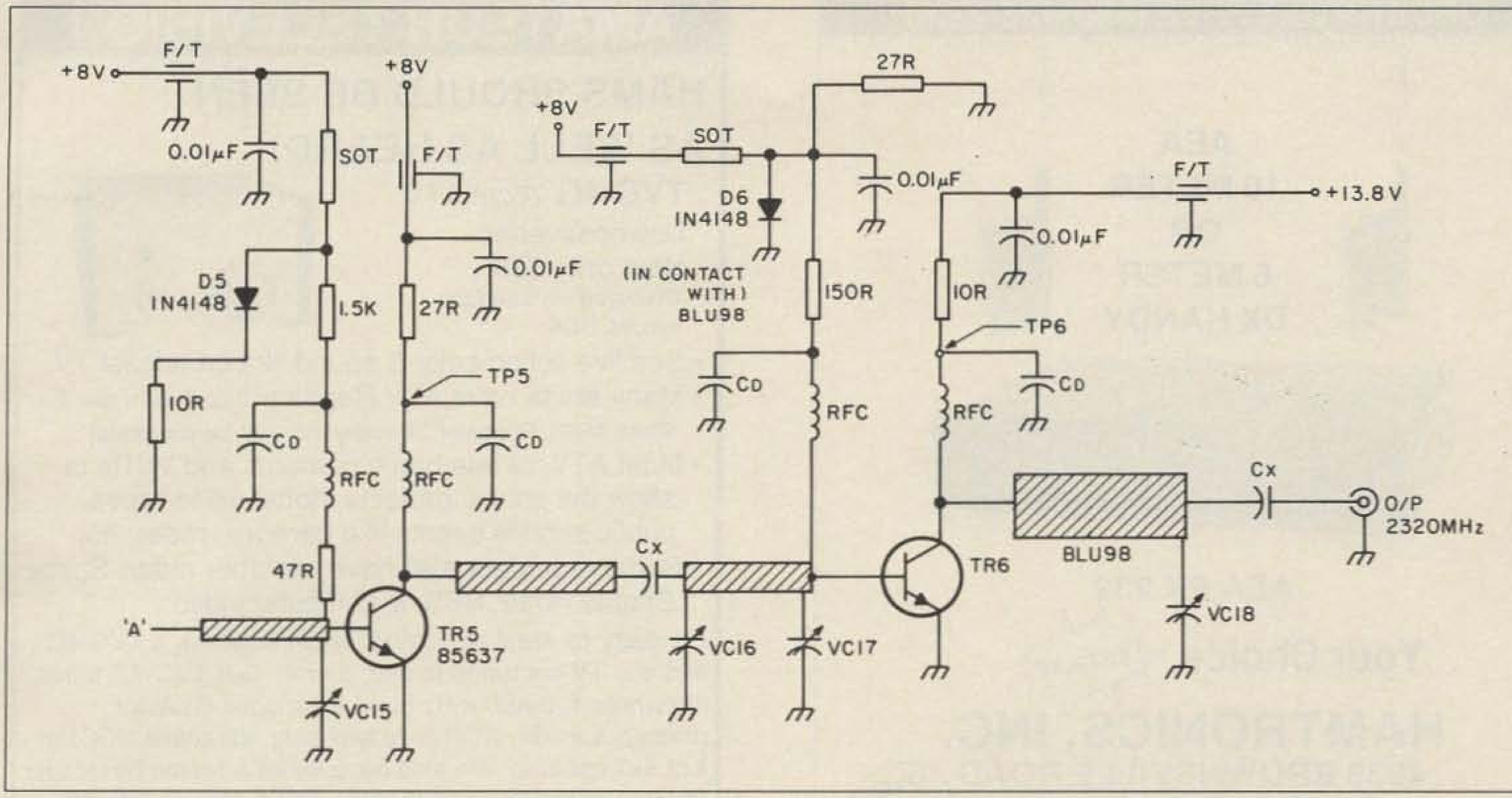

Figure 1. The schematic for the LMW 2304 13cm transverter TX mixer board.

Once the bias has been established for each stage, set up the ring mixer. This is a tough job without a spectrum analyzer or RF probe! Dave Mascaro WA3JUF checked out mine with a analyzer probe, which he also used to roughly align all the gain stages. A spectrum analyzer, however, isn't a must. The builder can still peak up the mixer and gain stages by using an RF probe or absorption wavemeter, both of which are readily found as surplus.

Set the trimmers on TR1 for maximum output by following the pictorial and checking with a probe. Next, connect the probe to each stage and adjust for maximum output while monitoring collector current. Each stage should have output peaks at minimum current values. Distinguish between the LO output and 2304-MHz composite signal by momentarily cutting the 144-MHz drive. The output should drop off completely. If this does not occur, the LO output has been peaked instead of the 2304-MHz signal. In this case, retune the ring mixer. If the output does drop off, the correct signal is present. Continue alignment as before.

Use a good 50Ω load to tune TR6 and carefully monitor collector current. Although the manual claims that 100mA will be the peak value, the stage can go into oscillation and considerably exceed that value! The final alignment of my unit yielded 65–75mA with the drive saturated. I used a Boonton 92 with 2W 50Ω load—not very accurate at 2304, but 50Ω nonetheless.

Use the above scheme to tweak the ring mixer and suppress the 2160-MHz LO signal. Apply power to the board and increase the Boonton 92's sensitivity until a signal is present. This is the LO signal. When I readjusted the trimmers, it dropped almost 10 dB, after which 144 MHz was re-injected and TR2 repeaked. The manual claims 35 dB of LO rejection at 500mW output. With 300mW output, there was an adequate 40 dB of rejection.

Final Assembly

The truly fun part is stuffing everything into a chassis! LMW makes a nice housing for the kit that allows space for the accessory 2-watt amplifier. Photo A shows the completed unit with front panel controls for POWER and TRANSMIT. Red and green lamps respectively indicate the status of these switches. A small Calectro milliammeter monitors final collector current and also displays relative output when the final board is installed.

There are separate connectors for 2304 RX in, 2304 TX out, 144 TR, and DC control and power. I chose the standard 5-pin chassis connector used by Microwave Modules. It's easily found in parts stores and the connectors are quite reliable. A surplus Teledyne relay with SMA connectors takes care of antenna switching, but the Tohtsu 500-series relays[1] with N connectors are probably better choices. These use 13.8 volts instead of the 28 volts needed for the Teledyne.[1]

Operation

The completed transverter was barely ready for the January VHF Sweepstakes. With the barefoot 300mW output into a Down East Microwave 45-element loop yagi atop my roof tower, I gathered 11 contacts in 2 grid squares–not bad at all! N2SB in southern New Jersey, a 40-mile path away, was my most distant contact. Most contacts were on CW, with a scattering on SSB.

Conclusions

The LMW 2304 Transverter kit is an inexpensive way to get a signal on 13 centimeters, but I don't recommend it for the inexperienced builder. Those who know their way around microwave circuitry, however, should find it a snap to assemble and align. All of the boards, especially the ULO, are well engineered. The importer quickly corrected, at no cost, the problem of missing parts and obscure documentation.

The feeling of working that first contact on 2304 after building the kit is unmatched! Those who want to take a plunge on 13cm should give this LMW kit a try.[2] 73

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[1] Tohtsu 500-series relays are available from Transverters Unlimited, PO Box 6286, Station A, Toronto, ONT Canada M5W 1P3, (416) 759-5562.

[2] LMW Transverters are available as kits or assembled from Down East Microwave, Box 2310 RD #1, Troy ME 04987, (207) 948-3741.

QRP

Number 23 on your Feedback card

Low Power Operation

Mike Bryce WB8VGE
2225 Mayflower NW
Massillon OH 44646

Packet QRP

Last month's column looked at some of the digital modes of communications QRPers have at their fingertips. This month's column finishes up digital QRP with packet radio before moving on the phone operation.

Packet radio is so far most at home on the two meter FM band. HF packet is not reliable enough for most people's tastes. I use a TNC (terminal node controller) and a two meter FM transceiver running at two watts output. By using the built-in digipeating capability of the TNC, a packeteer can communicate across the state using QRP power levels. Small portable packet stations will soon become the mainstay of communications during emergencies. Solar energy can power light-weight computers and TNCs. Packet is still quite new, but there are many good books out on the subject, such as *The Digital Novice* by Jim Grubbs K9EI and The *Packet Radio Handbook* by Jonathan Mayo KR3T. Also check out the PacketTalk column in this magazine.

Phone QRP

As much fun as the digital modes can be, they almost always require an interface between operator and radio. Phone operation requires much less—just the rig and the mike! That of course rules out the Heath HW-8 and the HW-9. Ten-Tec's Argosy and Argonaut are super on Single Side Band (SSB), but there are also many other fine SSB radios on the market.

SSB

Working SSB while running QRP can be most interesting. You can find other QRPers running phone on the 3985, 7285, 14285, 21385, and 28885 kHz. There is a move within the Board of Directors of the QRP ARCI for a QRP calling frequency for the Novice ten meter phone bands. When the board settles on a frequency, I'll list it here.

Most important in phone operation is clear, articulate speech. Don't talk very fast. Adjust the audio/mike gain for the best sounding audio. An oscilloscope takes all the guesswork out of setting the controls for the best audio.

Calling CQ while using SSB on QRP is usually a waste of time. Tail-ending a QSO produces far better results. This is the method I use with very good results. Don't forget to check out the other bands. Many times you can find 15 meters open and the DX running but with few stations working the band. Don't overlook the Novice phone band. Ten meters can support some really fine DX openings without the need of QRO (high power).

AM

This is perhaps the oldest form of voice communication. AM phone had its heyday in the early years of ham radio until the 1950s, when SSB came into use. AM is now experiencing a resurgence, however, especially for local to medium distance ragchewing, because of the much more pleasant and realistic sound than one hears on SSB.

Many of the older radios support AM. QRPers who can get their hands on a old Viking, Johnson, Elmac, or Heath DX-100, will be on AM phone with style. Some of the newer, high-tech imports also have AM operation, but they just don't have the punch of the old plate-modulated rigs.

It's true that AM is a high-power mode. There aren't many AM QRPers. There was a lot of AM on the ten meter band several years ago with the use of converted CB radios, and this can happen again with the increasing solar flux. The reader can buy back issues of *73 Magazine* that contain modifications for many different types of CB radios. Amateur radio, however, really needs a good band plan for AM operation on the ten meter band.

It should be possible to amplitude modulate an HW-8 by modulating the PA transistor. Any QRPers want to try? It would be an interesting experiment! A solid state low-level modulator should not be hard to build. Prospective AMers looking for more info can drop a letter to S.P.A.M. (Society for Promotion of AM) F. A. Dunlap, 14113 Stoneshire, Houston, TX, 77060. Send an SASE.

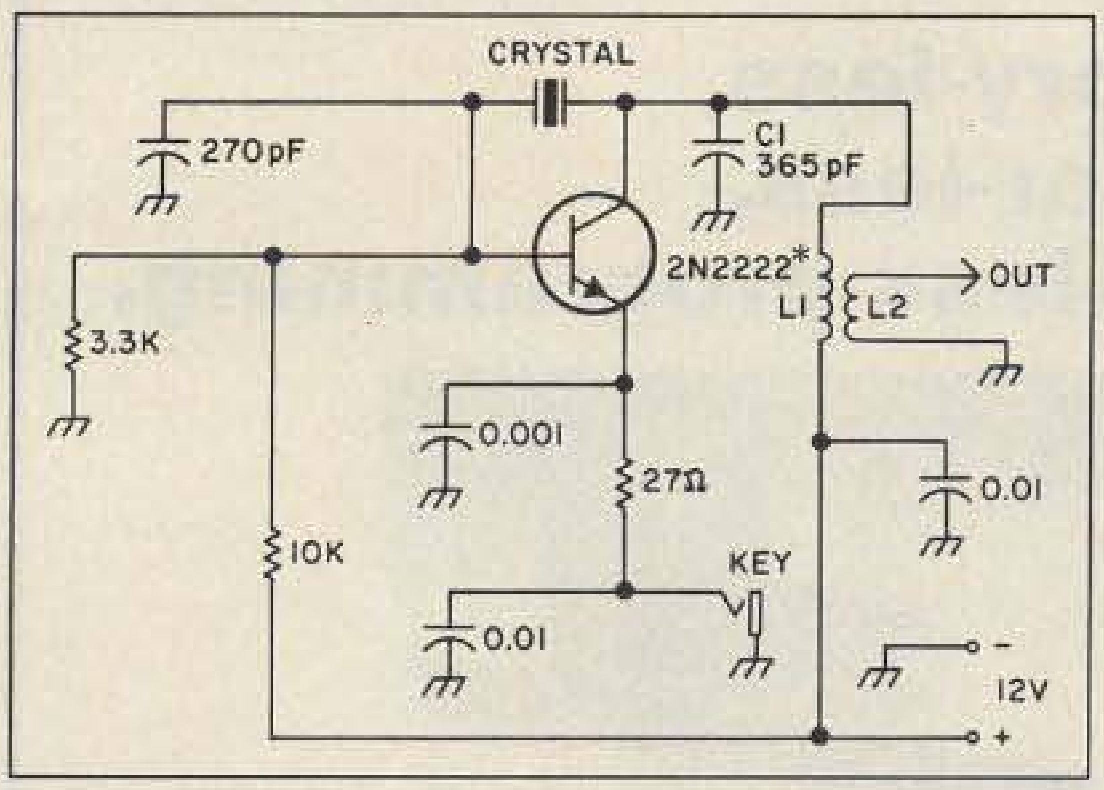

Figure 1. An easy-to-build rig that runs about 500mW input. A perfect project for a rainy day.

PJØM

DX chasers should keep an eye out for this call. An expedition to Saba Island, manned by 6M DX Society members Mario Karcich WB2CZB, Jim Holt N3AHI, and John Laing W1EXC, has been finalized for 7–14 July 1988. Operation will be on all bands, 80 through 6, SSB and CW will be used. Particular attention will be paid to QRP operators. WB2CZB will be actively soliciting QRP contacts. QSL via Mario K2MUB. (SASEs, please!)

Field Day?

Those not looking for DX may be too busy getting getting ready for Field Day. This column would've focussed on this event, but no one responded to my call for Field day items!

Field Event station W8NP did something different last year. A computer logging system kept track of contacts. That setup proved itself so well that we're going to use it again this year. Forrest Hudspeth WA3FAE wrote it and called it "TestLog." The program is in Microsoft Quick Basic™ and runs on a IBM computer or clone. It has very, very fast dupe checking, error trapping, and error correcting ability. VHF grid collectors can also use this program. The program will hold more than 2000 calls per band!

After going home from Field Day, the contester can load the program up on the home computer and batch-print the entire contest while he bags some much needed sleep.

Interested readers can get a copy of the program directly from Forrest for $20. This price includes all the printer routines and all the docs with which to run the program. This could well be the best $20 a contester ever spent. Drop Forrest a letter at 5883 Woodbine Road, Woodbine, MD, or leave a message on Compuserve (#ID 72126,1173)

More Program Listings

Propagation master Bob Brown NM7M put together the "QRPers Basic Propagation Tool Kit." This is a handbook of propagation hints alone with several small basic computer programs listings. Each program can stand alone, or link together to become a rather slick propagation program. The programs are written in generic Microsoft basic, executable on almost any personal computer.

The tool kit contains 45 pages of text and comes in a 6 x 9 inch book. Copies are available from the QRP Candy Store, Bob Spidell W6SKQ, 45020 N. Camolin Ave., Lancaster, CA, 93534.

Ask for a flyer. The Candy store sells many QRP goodies. (Don't forget the SASE.)

"Milliwatting"

Here's the awaited milliwatt rig. Jim WB2NGN sent this in to me, saying the source was likely from an issue of *73* from some years back. It runs about 500 milliwatts input, and is a very easy "rainy-day afternoon" project to build and get running.

Although the schematic does not show what frequency the transmitter covers, I'd say 40 meters. L1 is 17 turns #24 wire 1¼ inch diameter. L2 is 3 turns link. C1 is adjusted for the best sounding CW tone and best keying. The transistor can take up to 50 mA, so it's best to heatsink it. Also, I have found that the metal 2N2222 gives a bit more bite than the plastic versions. Since the transistor keys on and off by grounding the emitter, use a low resistive keying device. A straight key is fine. An electronic-keyer driven reed relay is also OK.

There is no PC board for this project. Use perf-board or make the small PC board.

The term "milliwatting" is starting to replace the awkward-sounding phrase "QRPp." Running less than half a watt really makes the hair thin. This requires the absolute best antenna system possible, operating style, and every trick in the book, will be needed to catch a QSO.

One last word for those milliwatters out there: "Success grows from the soil of despair!"

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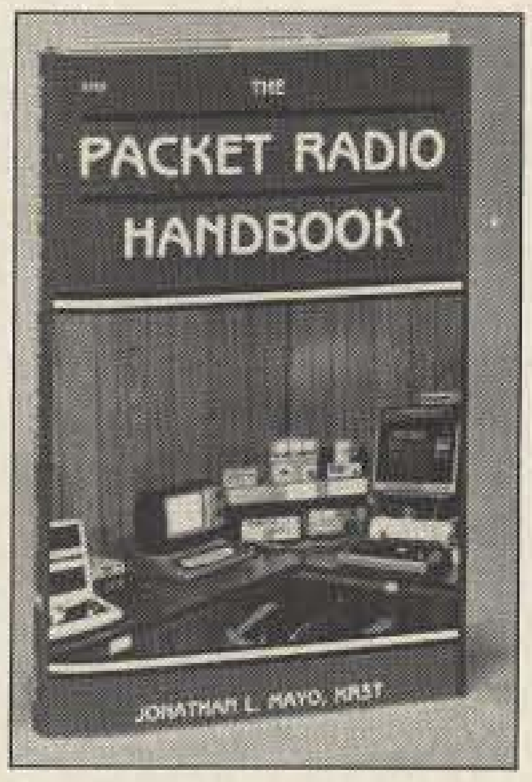

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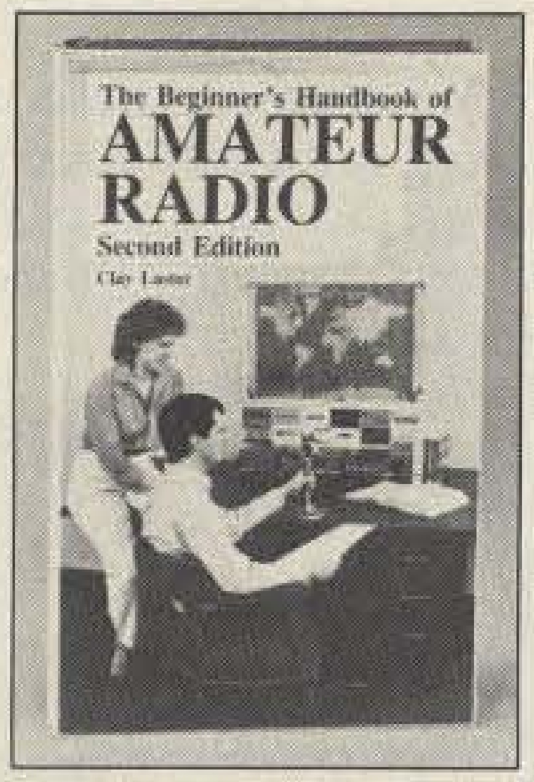

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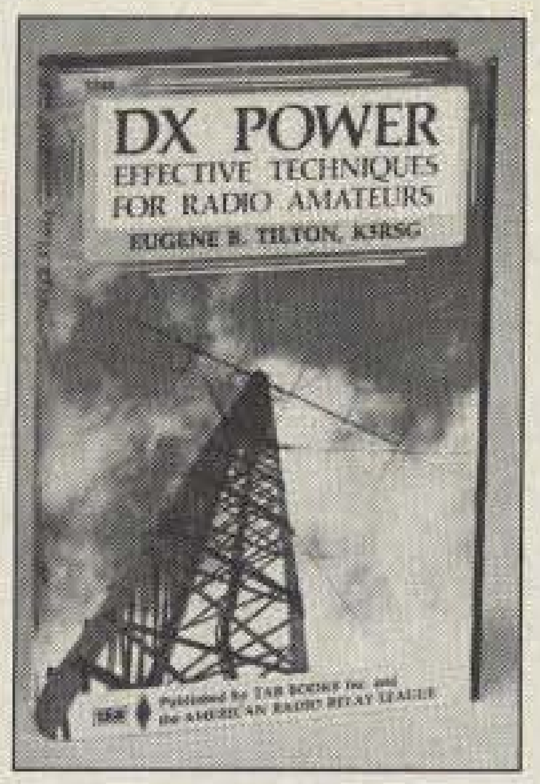

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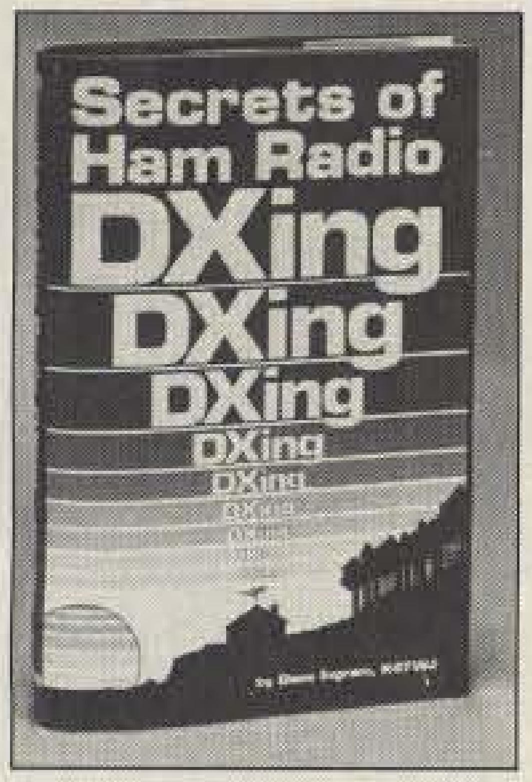

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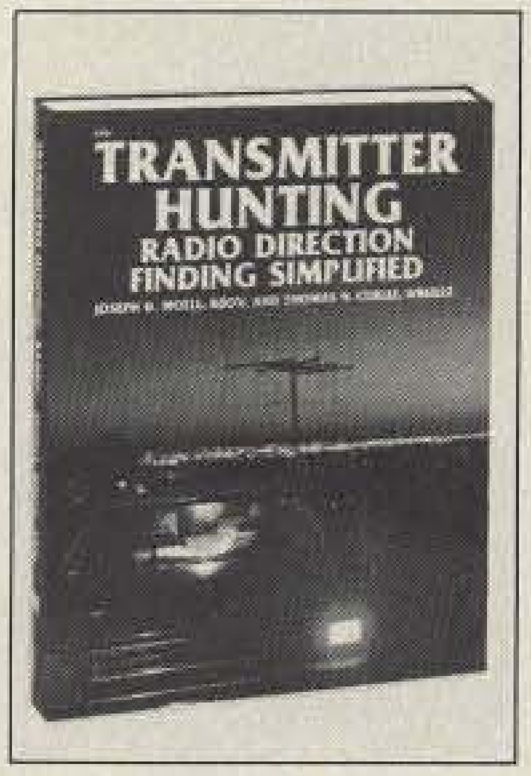

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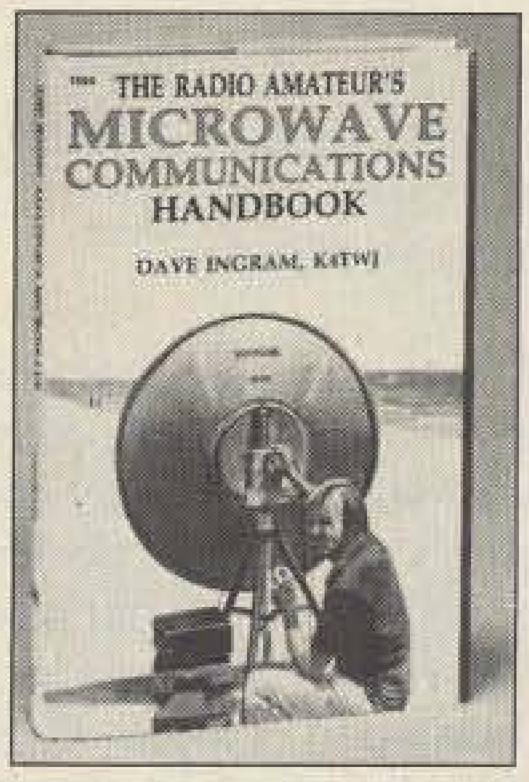

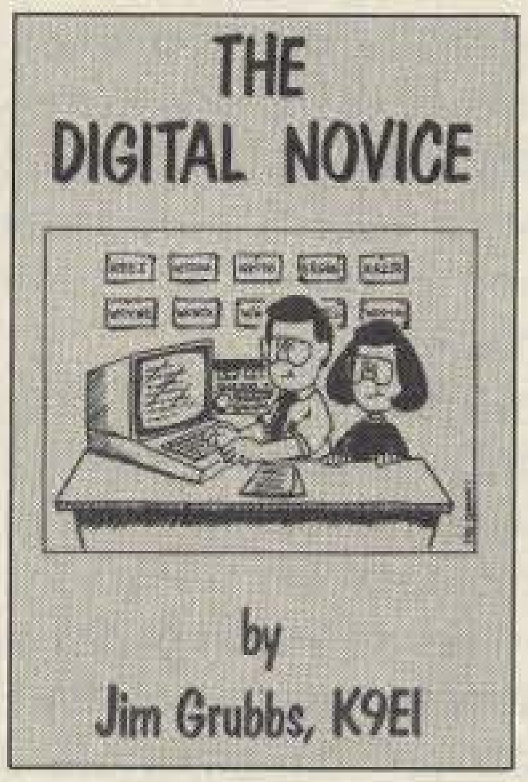

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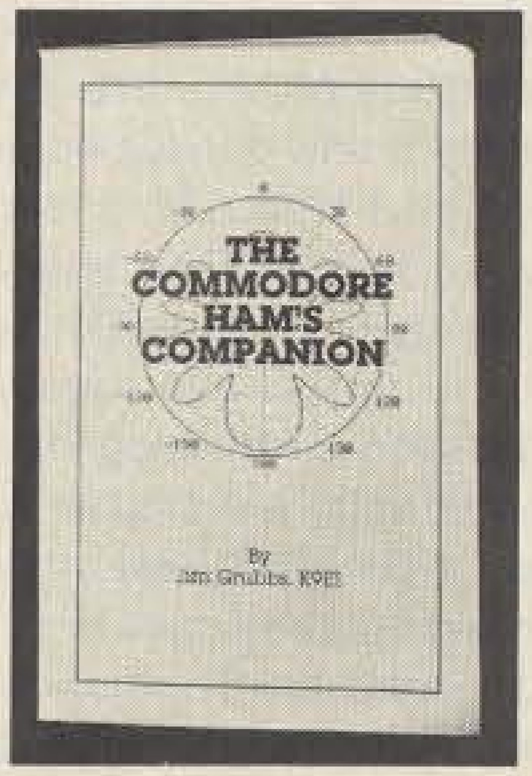

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WEATHERSATS

View On Video Processing

Dr. Ralph Taggart WB8DQT
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This month's column deals with quite literally the "big picture"—the whole earth to be precise. Following the US and Soviet polar orbiters is a way to get a very detailed view of the weather in the reader's part of the continent, but it falls far short of viewing the whole earth from space. The sat-chaser can greatly enhance that view by adding WEFAX capability to his station.

Worthwhile Investment

Although early WEFAX experiments involving image relay via geostationary satellites were begun in the early 70s using VHF transmissions, all current WEFAX activity is now conducted on 1691 MHz (plus 1694.5 MHz for the European METEOSAT spacecraft). This requires the addition of some S-band microwave hardware to the station. Since image transmission formats are similar to those used by the VHF polar orbiters, an S-band upgrade can be as simple as the addition of a small dish (typically 4 feet or 1.2 meters in diameter) and a downconverter to convert the 1691 MHz signal down to a standard VHF frequency (typically 137.50 MHz). The *Weather Satellite Handbook* (*WSH*) covers many of the hardware details. There are some very real advantages to having WEFAX capability:

(1) The U.S. GOES and European METEOSAT spacecraft are geostationary, so once the sat-chaser has the antenna aligned on a spacecraft within range, he simply locks it in place and forgets it!

(2) A wide variety of image products, including weather charts, mosaics (polar and mercator) of polar orbit imagery, and samples of GOES imagery, are available for viewing. Over 100 images are contained in the GOES central daily schedule.

(3) All images are transmitted on a fixed daily schedule, making it easy to plan the reception of particular pictures of interest.

The most interesting pictures for most experimenters are the images derived directly from the GOES spacecraft themselves. GOES East and GOES West scan

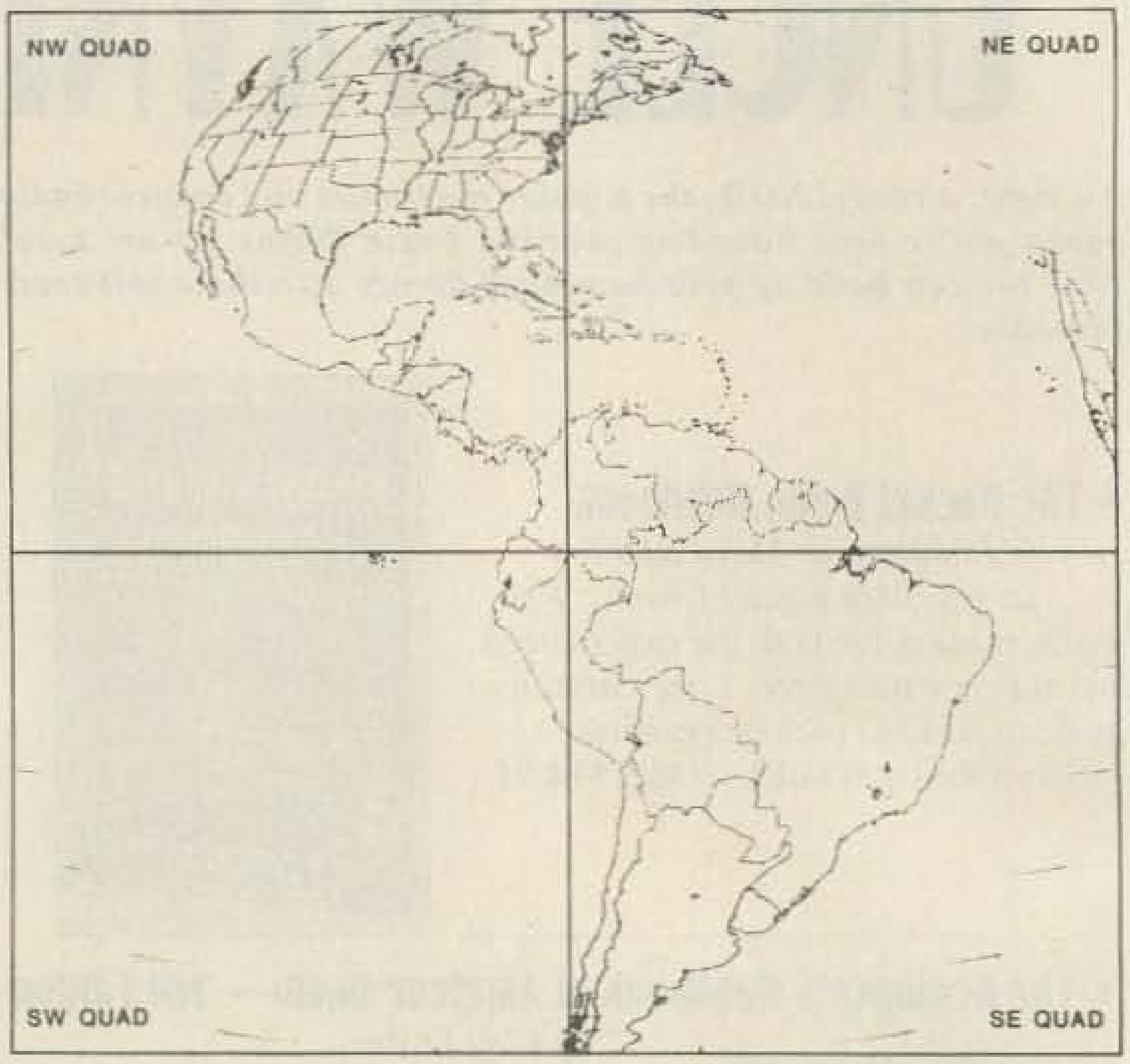

Figure 1. Diagram of the arrangement of WEFAX quads that make up the mosaic of the full earth disc as imaged by one of the GOES spacecraft. This particular diagram shows the coverage from GOES E and is reproduced from Clark, R.M. and E.W. Feigel. 1981. The WEFAX User's Guide. Nat. Earth Sat. Serv., NOAA, U.S. Dept. of Commerce.

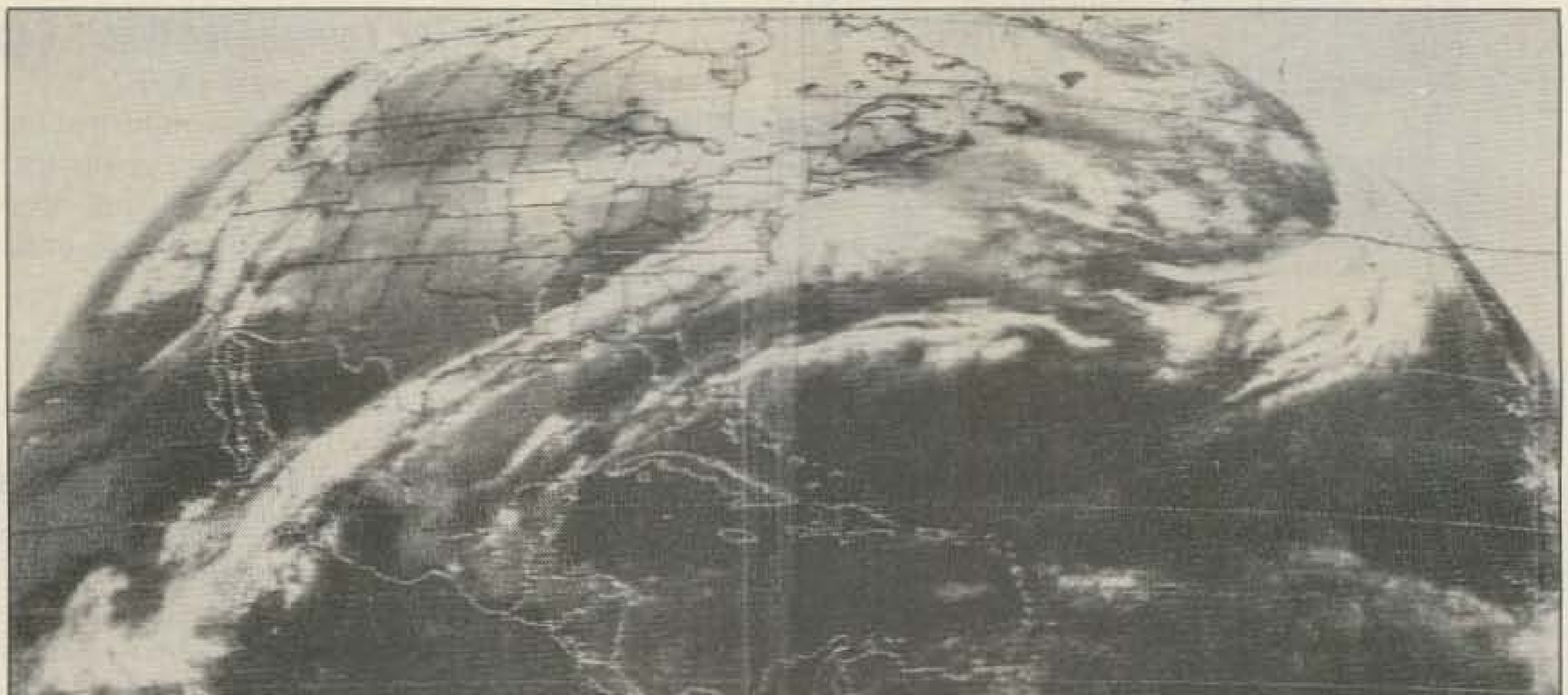

Figure 2. Manual assembly of prints of individual quads is the standard way to reconstruct the earth disc. This example shows an 1800Z IR image derived from GOES E and transmitted through GOES Central. Although this procedure is simple, it takes time, uses up four sheets of FAX paper, and the resulting image is too large for convenient storage! This image was prepared from four Smartfax prints from the scan converter video memory. Each quad represents 768 image lines, each line digitized to 1024 pixels. All of the examples shown here are late December (1987)/early January (1988) IR with plenty of nasty winter weather in northern North America.

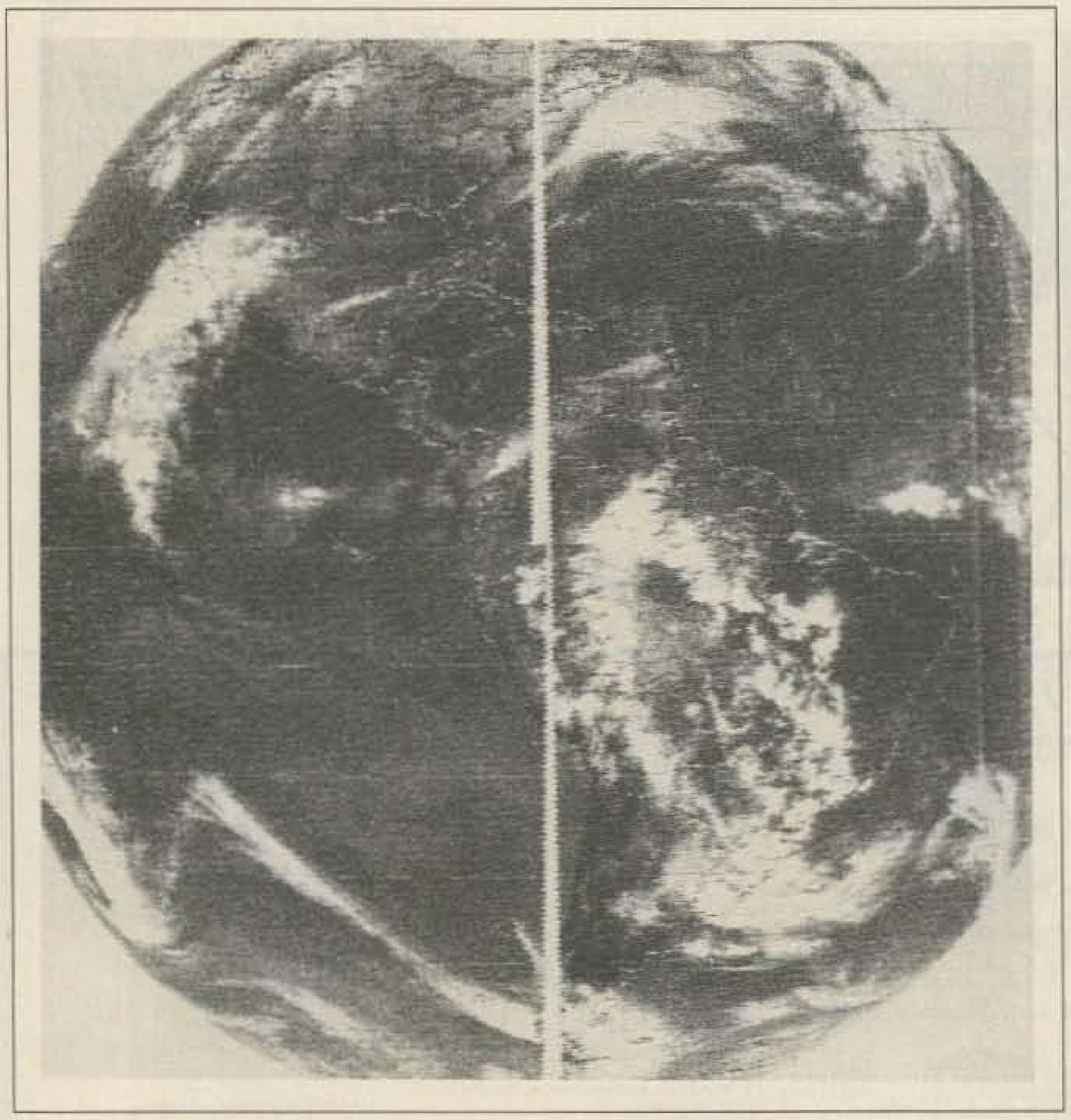

Figure 3. The first attempt at electronic assembly of the disc image. While the software routines worked just fine, a slight clock error prohibited merger of eastern and western quad pairs.

the entire earth disc every half hour and transmit the highly detailed, multispectral images back to earth in a wide band digital format. These digital signals are transmitted back through the originating spacecraft in a time stretched format to reduce the required bandwidth, but it requires quite a sophisticated ground station to receive, decode, and display these digital images. A number of dedicated experimenters have accomplished this formidable task, but such installations are still out of reach for most satellite hobbyists.

Good News

Fortunately, the images of the earth disk are available, at reduced resolution, via WEFAX transmissions through the primary imaging spacecraft and via GOES Central, which is dedicated entirely to WEFAX relays. The NOAA ground computers, which digest and format the detailed digital images, are also used to format the earth disc imagery for WEFAX transmission. The primary format involves breaking the earth disc up into four quadrants: NE, SE, NW, and SW (see Figure 1) which are transmitted in sequence.

The WEFAX format is quite easy to process. The *WSH* scan converter, for example, operates automatically in the WEFAX mode, displaying each picture as it comes in. This is a rather neat way to observe the many WEFAX images that are transmitted—just watch them instead of using up film or paper. The viewer inevitably gets the itch to put those four quadrants together to see what the entire earth looks like. To do so, he has to print each image quadrant (using a FAX printer) or photograph and print each one (if he is using a CRT display system). With hardcopy of the four quads in hand, the rest is just manual labor. Each quad overlaps its neighbor by just a small amount, so the four images can simply be overlapped slightly to reconstruct the earth disk image.

The whole process gets a bit tedious and time consuming, but the results are often spectacular, as shown in Figure 2. Aside from the time required to prepare the disc mosaic, there are a few other factors that interact to reduce the number of such pictures the viewer is likely to construct:

(1) He must print out each of the image quads. Each disc requires at least four sheets of FAX paper.

(2) Phasing must be very precise. If he loses a portion of one or more quads, a good match up may be impossible.

(3) The contrast for each of the quads must be identical. Tonal variations between quadrants detracts from the appeal of the image.

(4) The resulting images are quite large since they represent four normal prints. The *WSH* FAX recorder prints images that are approximately 7 inches square, so the final disc image will be almost 14 × 14 inches. This is fine for hanging on the wall, but the pictures are difficult to store, not to mention the bill for FAX paper!

The use of the scan converter eliminated some of the problems in that succeeding WEFAX images could be registered laterally with an error of less than 0.1% (under 1 pixel displacement error in a 1024 pixel line) and line registration is virtually perfect. At a given contrast setting, tonal variation from quad to quad is unnoticeable, provided the NOAA computers do their job properly!

Figure 4. A complete rewrite of the software to compensate for any reasonable clock errors resulted in an essentially perfect merge of the quads. In addition to being able to preview the disc image using the scan converter, hardcopy printouts now only require a single sheet of FAX paper and the print is easily filed away. Each quad in this image consists of 384 image lines, each digitized to 512 pixels, resulting in a total of 768 lines for the composite with 1024 pixels per line. This image is a Smartfax print directly from the scan converter video memory.

Smart Idea

The development of the simple Smartfax recorder (see WEATHERSAT for September and October 1987) made it quite easy to print pictures directly from the scan converter memory and that, in turn, made it a bit easier to prepare full-disc mosaics. In the case of Figure 2, the original quad transmissions were taped and each was automatically loaded in turn into the scan converter memory. A Smartfax print was made of each quad and then the prints were trimmed and fitted together to prepare the mosaic. It still took time and paper, the pictures were still too large to handle or store easily, and the taped junctions between quads were more visible than I really liked, but it was an improvement over direct FAX printing.

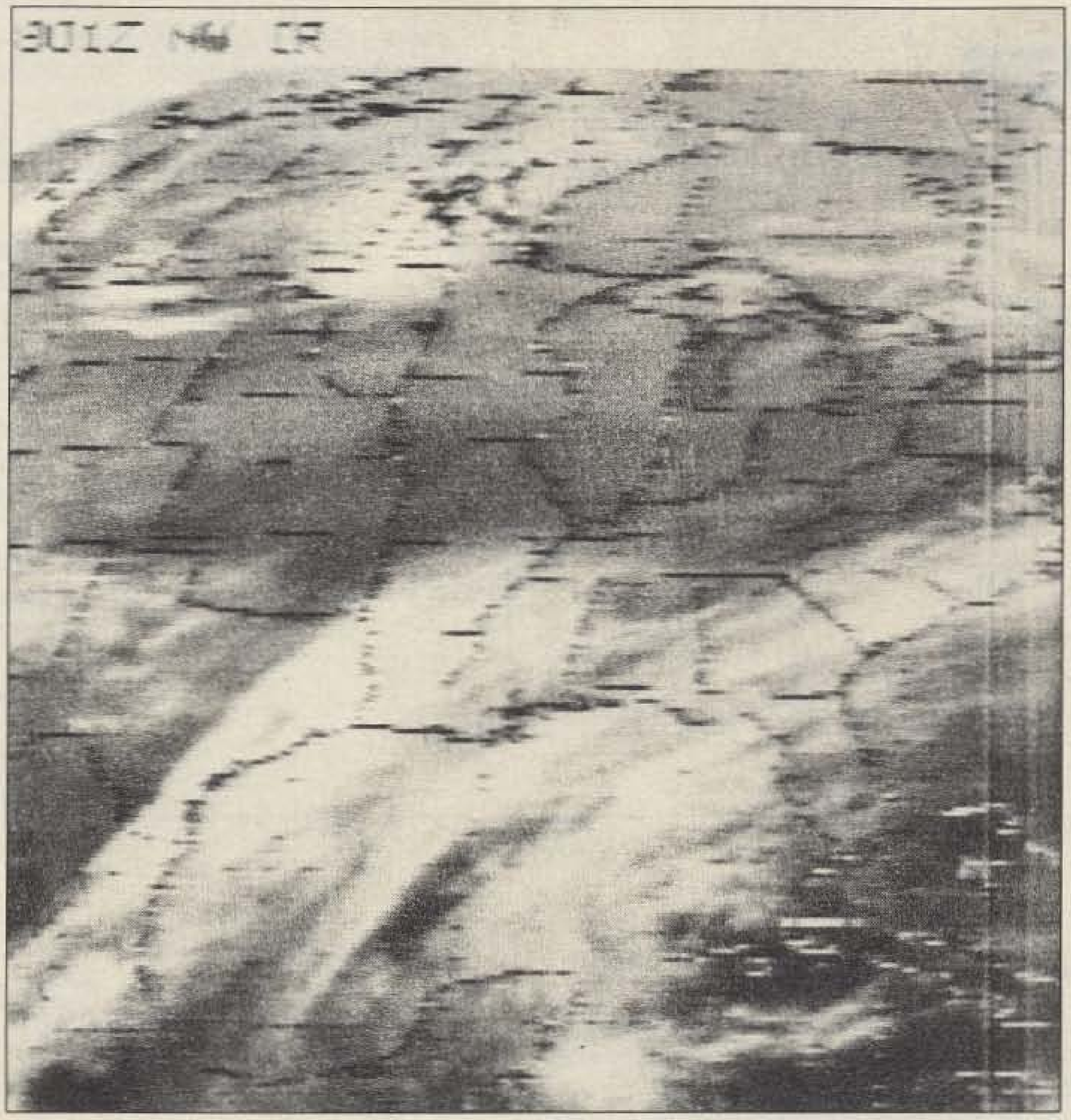

Figure 5. Although quad resolution must be reduced to fit the full disc into memory, resolution is still acceptable as shown by the Smartfax print of a high resolution zoom into the image memory. State boundaries are recognizable, cloud features are reasonably detailed, and the image even shows the waters of Lake Michigan to be warmer (darker) than the surrounding land surface. The area of this high resolution zoom represents about 1/16th of the total image area.

After printing out a number of disc mosaics in that way, despairing of rising paper costs, I considered letting the computer do the job using the scan converter. Normal scan converter operation involves sampling each line by 1024 pixels and loading 768 of these lines to the image memory (380K). If the sampling density were dropped to 512 pixels per line and each quad were limited to 384 lines (sampling every other line), each quad would occupy ¼ of the total image memory. In theory at least, if the quads were properly loaded to the correct part of the memory, the final image would consist of the proper arrangement of all four quads—basically the entire earth disc!

Having gotten that far, I decided to carry through and develop a new WEFAX mode to properly assemble the quads automatically. Setting the revised sampling rates was easy, as was the problem of proper placement in memory, but there were additional programming challenges I had not adequately anticipated.

Programming Hurdles

A child can do the manual preparation of mosaics, which involves the trimming off of extraneous border material from each print and fitting together the four quads. The computer, however, is an absolute dunce by comparison. The electronic trimming and fitting turned out to be a major programming task that required many hours of measuring and calculation of the limits of extraneous border and the horizontal and vertical overlap of quads, all in terms of pixel counts.

"Holding the full disc at full resolution would require over 1.5MB of RAM!"

Figure 3 shows the first attempt at electronic quad assembly. The quads were all in the right place and the joining of northern and southern quads was fine, but the image showed those nasty white wedges between the eastern and western quads! The problem was a slight error in the master clock frequency, tilting each image just enough to make east-west merge impossible. Getting the clock *precisely* on frequency would solve the problem, but I chose to completely redo the programming so the quads could be merged even with noticeable clock errors.

Perfection At Last

Since a lot of reprogramming was necessary in any case, I decided to refine the software to completely eliminate the border material and place the disk on a blank background for the most pleasing appearance. The final result of this programming effort is shown in Figure 4 and features a virtually perfect merge of the four quads.

In addition to the convenience of being able to view the whole disc on the TV monitor, the image can be printed via Smartfax using just a single sheet of paper! While manual assembly of a disc almost always requires the use of tape recordings of the quad transmissions, this is not true of the software assembly. It works so well that I can set up the station system to input the sequence of quads into the scan converter directly from the receiver so that the 1800Z earth disc can be waiting for me when I get home!

The only disadvantage is that one has to reduce the effective resolution of each quad in order to fit all four into the 380K video memory. Holding the full disc at full resolution would require over 1.5MB of RAM! The reduced resolution, while noticeable, is not really too serious, balanced against the spectacular view. Figure 5 is a Smartfax print of a high resolution zoom into the disc image. While bro- ken up a bit, all the state boundaries are still recognizable and cloud features adequately detailed. Those hams who want to look at the whole world's weather should try upgrading to WEFAX! 73

References

References to the *WSH* refer to the Third Edition of the *Weather Satellite Handbook*, available from the columnist for $15. Outside of the US, please include an additional $1 for postage.

Ed note: We encourage the exchange of weathersat ideas and software on the 73 BBS. Call 603-525-4438 (300/1200 baud) and sign on.

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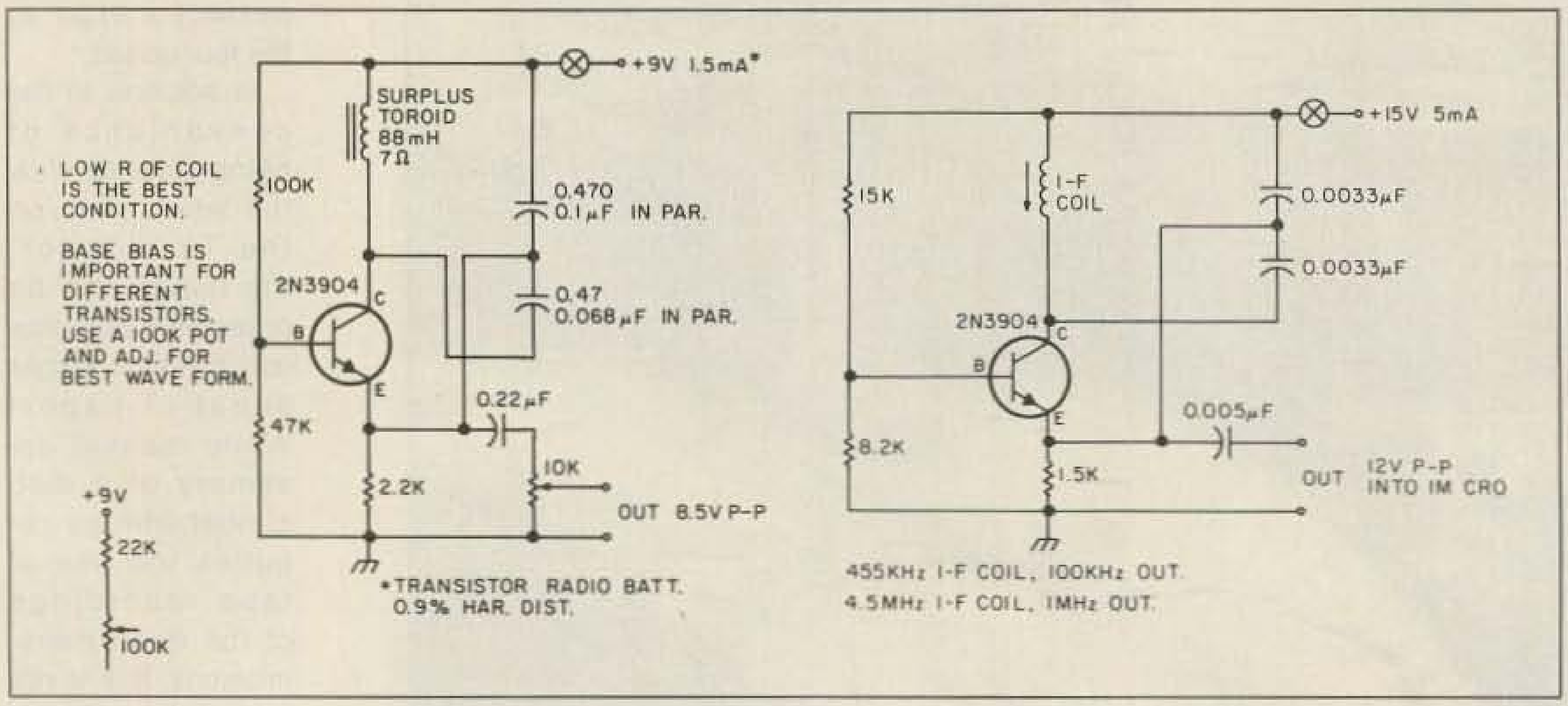

SIMPLE OSCILLATOR CIRCUIT

It occurred to me that some of my fellow hams might be interested in a simple oscillator circuit that I have used for years.

Almost any NPN transistor will work, but the base bias should be varied for each transistor. Characteristics vary a great deal. Also the lower the resistance of the inductance, the better the circuit will work. If the resistance is too high, the circuit will not oscillate.

The figures show the versatility of the circuit.

L.C. Pochop W6LBH
Ontario, CA

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If your amplifier has a tube-type pi-network output circuit, it should be an easy job to add our lowest frequency band to its coverage. Either adjust the output capacitor to minimum or disconnect it. Add an external coil (about 2-inch diameter and 4-inches long and 8 turns per inch) and 2000 pF capacitance. Partly variable. Adjust to resonance using your dummy load and reduced drive level.

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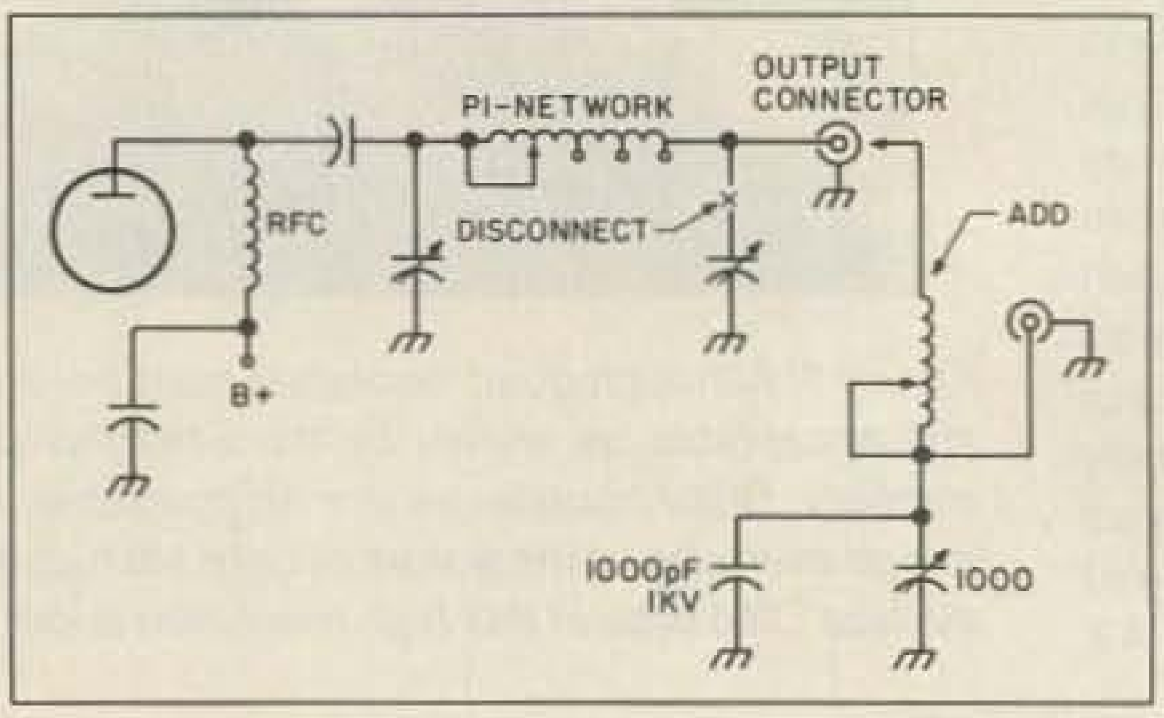
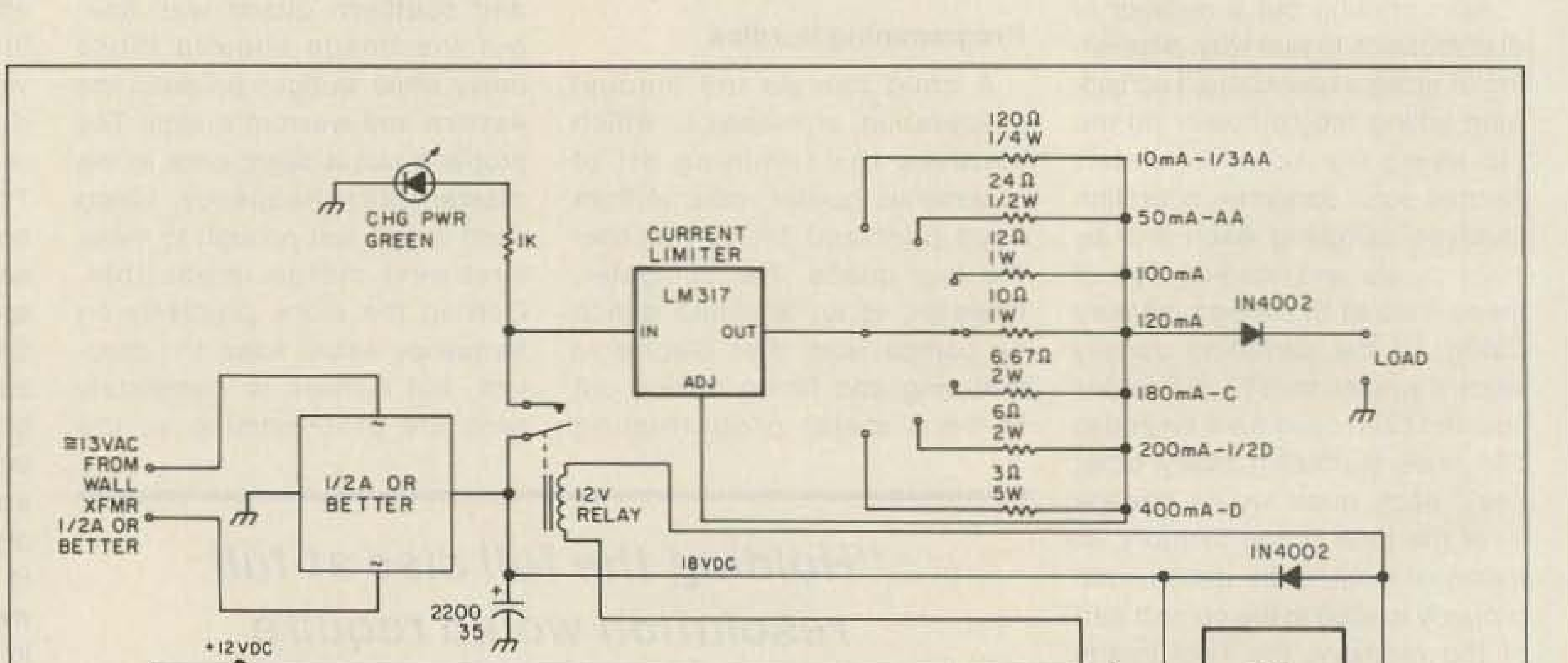


SELECTABLE NiCd CHARGER

This unit was originally built to charge cells "rescued" from bad battery packs. It is much better to slow charge NiCds. There is always the danger of forgetting to remove the cells from charge at the appropriate time, so a timer was incorporated. With the normal tolerance of tantalum capacitors, the timer should time out between 15.5 and 17 hours. The relay used is a small low current relay. A surplus 13.5 VAC 750 mA wall transformer is used as the AC source and a one amp bridge was used to recitify it. The resistors were made up of stock units in series or parallel to make up the proper value, checked with a DMM.

R.R. De Jongh WB7CPT
Bellevue, WA



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HOT DX!

June has several interesting characteristics including the longest day of the year; the greatest amount of potential ionization; and the longest band openings from our part of the world to DX locations. It is also the month when VHF opportunities abound. The general conditions for DX are expected to be good for the first ten days of the month, fair to poor for the next ten days, and fair to good for the last ten days. The daily forecast will indicate the days on which the magnetic field is expected to be unsettled (F), to active (P). DX will not be as good as it was in March—April, or as good as it will be in September—October, but the sunspot numbers and solar flux values are climbing, so good openings may occur. In particular, look for the gray-line DX along the darkness path at dawn and dusk, since signals can be excellent at these times.

The best days for any DX path, particularly the difficult ones, is when the solar flux rises to about 100 or more, and the magnetic field is quiet (G). The A and K indexes for the day and the solar flux, may be found by tuning in to WWV at 18 minutes past each hour. Because WWV gives data for the previous day and the expected data for the following day, plot trends may be made.

Bear in mind that daily forecasts may vary one way or the other, by a day or two. Sometimes the sun and magnetic fields don't behave as predicted at all, that makes propagation forecasting as much an art as science!

JUNE

SUN	MON	TUE	WED	THU	FRI	SAT
			1 F–G	2 G	3 G	4 G
5 G	6 G	7 G	8 G	9 G	10 G	11 F
12 F–P	13 F–P	14 P	15 P	16 P	17 P	18 P–F
19 F	20 F–P	21 P	22 P–F	23 F	24 F–G	25 G
26 G	27 G–F	28 F	29 F–G	30 G		

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	--	--	--	--	--	--	20	--	--	--	--	--
ARGENTINA	20	20	20	40D	40D	--	--	--	--	--	10	15
AUSTRALIA	--	--	--	20	20	40D	20D	20D	--	--	--	--
CANAL ZONE	15	20	20	--	--	--	20	20	20	--	10D	15
ENGLAND	20	--	40/80	40/80	--	--	--	--	--	20	20	20
HAWAII	15D	20	20	20	40D	40D	--	--	--	--	--	15D
INDIA	20D	20D	--	--	--	--	--	--	--	--	--	--
JAPAN	--	--	--	--	--	--	20	--	--	--	--	--
MEXICO	15	20	20	--	--	--	20	20	20	--	10D	15
PHILIPPINES	--	--	--	--	--	--	20D	--	--	--	--	--
PUERTO RICO	15	20	20	--	--	--	20	20	20	--	10D	15
SOUTH AFRICA	--	40	40	20D	20D	--	--	--	--	--	20D	20D
U. S. S. R.	20	20/40	20/40	--	--	--	--	--	--	--	20	20
WEST COAST	40	80	--	--	--	--	--	20	20	20	15	40

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	--	--	20D	--	--	40D	--	20	--	--	--	--
ARGENTINA	20/40	20/40	20	40D	--	--	--	15	15	15	15/20	20
AUSTRALIA	15D	15D	15/20	20	20	40D	20	20	--	--	15D	15D
CANAL ZONE	20	20	20	40D	40D	--	20	20	15/20	15	10D	10D
ENGLAND	20	--	40D	40D	--	--	20D	20D	--	--	20	20
HAWAII	15	15	20	20	20	40D	20	20	--	--	--	15D
INDIA	20D	20D	--	--	--	--	20D	20D	--	--	--	--
JAPAN	--	--	20D	--	--	40D	--	20	--	--	--	--
MEXICO	20	20	20	40D	40D	--	20	20	15/20	15	10D	10D
PHILIPPINES	--	--	--	--	--	--	20D	20D	--	--	--	--
PUERTO RICO	20	20	20	--	--	--	20	20	15/20	15	10D	10D
SOUTH AFRICA	--	--	40D	20D	20D	--	--	--	--	--	--	--
U. S. S. R.	--	--	--	--	--	--	20D	20D	--	--	--	--

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	--	--	--	20	20	20D	40D	20D	20D	--	--	--
ARGENTINA	15	20D	20	20	--	--	--	20D	--	--	--	15
AUSTRALIA	15	15	15	20	20	20/40	40	20/40	--	--	--	--
CANAL ZONE	10D	15	20	20	40D	40D	--	20	20	--	15	10D
ENGLAND	20	20	20D	--	--	--	--	20D	--	--	--	20D
HAWAII	15	15	15/20	20	20	20/40	40/80	--	20	--	15D	15
INDIA	--	--	20D	20D	--	--	--	20D	20D	--	--	--
JAPAN	--	--	--	20	20	20D	40D	20D	20D	--	--	--
MEXICO	10D	15	20	20	40D	40D	--	20	20	--	15	10D
PHILIPPINES	--	--	--	20D	20D	--	--	20D	20D	--	--	--
PUERTO RICO	10D	15	20	20	40D	40D	--	20	20	--	15	10D
SOUTH AFRICA	--	--	--	20D	20D	--	--	--	--	--	--	--
U. S. S. R.	20D	20D	20D	--	--	--	--	20D	--	--	--	--
EAST COAST	40	80	--	--	--	--	--	20	20	20	15	40

The band openings are for June, July and August. Note that a (D) will indicate a difficult path. Try on days when the geomagnetic field is quiet (G) and when solar flux is 100 and greater.

Tropospheric Propagation

Summer usually brings with it enhanced propagation conditions for the VHF and UHF bands. Most of the weather occurs in the lower portion of the atmosphere, or troposphere, and many times certain weather will support VHF/UHF propagation over hundreds of miles, well beyond normal line-of-sight.

Atmospheric conditions can bend radio waves, just like they affect light to create mirages and other optical illusions. In the case of radio signals, the distribution of water vapor has a dominant effect on tropospheric propagation. Water vapor content, atmospheric pressure, and temperature all determine the atmosphere's index of refraction, n, which is a measure of air's transmission characteristics. In particular, $n = 1 + N \times 10^{6}$, where N is called refractivity. Refractivity is calculated by $N = (77.6P/T) + (4810e/T^2)$, where P is atmospheric pressure in millibars, T is temperature in degrees Kelvin, and e is the water vapor pressure in millibars.

When all of these variables change quickly as a function of height, or when the atmosphere is layered as in the case of a cold or warm front, tropospheric propagation can be very favorable. In fact, if n changes very sharply, say within the lower 500 feet of the atmosphere, signals can become trapped in a tropospheric "duct." Ducts can even support microwave propagation over distances of 1000 miles or more!

HAMSATS

Amateur Radio Via Satellite

Andy MacAllister WA5ZIB
2310 Romayor Court
Pearland TX 77581

Spaceborne Bits

Amateur satellites and *73*'s theme this month, digital communications, have much in common. Excluding CW telemetry, digital hamsat-generated transmissions began with AMSAT-OSCAR-7. This satellite used RTTY as an alternative to CW for communicating its vital signs to control stations on earth. There's been a rapid move to high-speed ASCII and packet since this beginning in the early seventies.

AMSAT-OSCAR-10 used PSK (Phase Shift Keying) at 400 baud as the primary downlink of telemetry. This speed and format is also incorporated in the system on board Phase 3C. Only a few stations around the world are designated for ground control of the satellite's functions. Before the memory on A-O-10 gave out, these stations were able to leave short messages for each other via specially designated parts of the telemetry data stream set aside for this purpose. It worked well as a limited form of store-and-forward communications.

The UoSAT series have provided many with an opportunity to experiment with automatic data capture and telemetry decoding using mainly 1200 baud ASCII. With several passes a day from two satellites, UoSAT-OSCAR-9 and UoSAT-OSCAR-11, it's easy for interested hams to find orbits that fit their operating schedules.

Store-and-Forward

In addition to the telemetry and bulletins, UoSAT-OSCAR-11 provided the first amateur satellite store-and-forward system for use by hams not actively involved as ground control stations. This DCE (Digital Communications Experiment) on U-O-11 has allowed global communications for designated stations active in the experiment and others with packet connection to them. The DCE shares downlink frequencies with the beacon and uplink frequencies with satellite command channels, so access must be limited.

Gateway stations have been created to allow other amateurs to pass messages through the system. These stations collect traffic from local and regional packet systems and send the messages to the satellite while downloading messages for local distribution. Harold Price NK6K in Redondo Beach, near Los Angeles, is one of the U.S. stations set up to forward traffic through U-O-11.

In August of 1986, Fuji-OSCAR-12 became amateur radio's first packet radio satellite available for general use. Although power budget problems prevent long continuous operation, this offering from the cooperative efforts of the Japan Amateur Radio League, JAMSAT and NEC, may be used by any licensed amateur with the desire and equipment needed to do the job. Due to the special equipment requirements, there aren't many stations using this resource. This is both good and bad.

Two-sided Coin

On the good side, it keeps activity to a manageable level. The satellite can only handle a limited number of "connected" stations at a time. Imagine the confusion of a single digipeater with most of the United States able to hit it via line-of-sight. If this "digi" only provided bulletin board service most of the time like F-O-12, any reasonable communications would be uncontrollable, since everyone on the system simultaneously attempts to upload messages and read replies.

The bad news is that for many, F-O-12's digital transponder is too much effort for too little return. Look back to the August 1987, Hamsats column. A station minimally equipped for F-O-12 Mode JD (the digital mode) will have two-meter FM with reasonable antennas or power or both; 70cm sideband receive capabilities; with an automatic circuit for Doppler correction of the downlink frequency during the pass; a PSK modem hooked to a packet radio TNC (Terminal Node Controller); and a computer. Other niceties that make the system more manageable include an automatic computer-driven rotator system and high-gain circularly-polarized antennas with power and preamplifiers. It is also useful to have a way to capture all of the activity on a pass via recorder, disk storage or paper print-out.

A few hundred hams around the world have put the pieces together, but for others, the wait for packets from space continues.

P3C's New Offerings

With the launch of Phase 3C, a new form of packet radio experiment from orbit will begin operation. Although access won't be limited to select stations, the equipment requirements will keep away all but dedicated enthusiasts.

RUDAK (Regenerating Transponder for Digital Amateur Communications) uses 1269 MHz 2400-baud PSK for the uplink and 400-baud PSK on 435 MHz for the downlink. The exact frequencies are shown in Table 1. A complete RUDAK earth station will start with a PSK modulator; two-meter transmitter set up for the necessary bandwidth to handle 2400 baud; and a two-meter-to-24cm transmit converter with power amplifier. For receive, any good 435 MHz multi-mode rig will do. The antenna for 24cm should be at least a 45-element loop Yagi or a four-foot dish with circular feed. An 18-element crossed Yagi with preamp will work well on 70cm.

The heart of the system includes a computer, or terminal, and a modified TNC2 (or clone) with an appropriate demodulator connected to the modem disconnect jack inside the TNC. Like the F-O-12 modems, nothing is available in commercial form prior to launch and subsequent proof that the system works in orbit. Empty circuit boards from AMSAT DL in West Germany or AMSAT UK in England can be purchased for those who can't wait.

It will require serious effort to build a complete system. The majority of RUDAK users will likely be European satellite/packet experimenters until competitively-priced 24 cm radios and appropriate modems can be bought or constructed from kits available here in the states.

The Next Generation

A third UoSAT spacecraft, UoSAT-C, is currently under construction at the Engineering Research Unit at the University of Surrey in England. It is scheduled for launch as early as the end of this year on a Delta launch vehicle. The orbit will be circular and 500km high with a 43° inclination.

Among the many experiments on board is PCE (PACSAT Communications Experiment). Using a Mode J style system with two-meter uplink and 70cm downlink, the PCE will be available for amateur radio use, while additional frequency allocations may be used by VITA (Volunteers in Technical Assistance) outside the amateur bands. VITA activities will focus on message store-and-forward from remote areas to provide technical assistance and disaster relief. Access will be much easier since the system will use FM up and down with standard TNC's and no external modems.

In a recent demonstration of the potential of a LEO (Low Earth Orbit) packet satellite operation to U.N. officials, AMSAT NA President, Rip Riportella WA2LQQ used a complete station carried in an attache case. With external ground-plane antennas in place, the station could be used for reliable and portable satellite communications through a future PACSAT. Such a system would be used primarily for emergency use from remote locations.

Companies supporting the demonstration included Radio Shack with a new model laptop computer, Yaesu with the latest miniature HT's, and Tasco of Japan with their new ultra-miniature TNC, the size of a cigarette pack. The day for easy satellite packet operation may come soon.

Mode B:	Uplink:	435.420–435.570 MHz
	Downlink:	145.975–145.825 MHz
	General Beacon:	145.812 MHz
	Engineering Beacon:	145.985 MHz
Mode JL:	Uplink 1:	1269.620–1269.330 MHz
	Uplink 2:	144.425–144.475 MHz
	RUDAK up:	1269.710 MHz
	Downlink 1:	435.715–436.005 MHz
	Downlink 2:	435.990–435.940 MHz
	RUDAK down:	435.677 MHz
	General Beacon:	435.651 MHz
Mode S:	Uplink:	435.601–435.637 MHz
	Downlink:	2400.711–2400.747 MHz
	Beacon:	2400.325 MHz

Table 1. Revised Phase 3C Frequency Plan

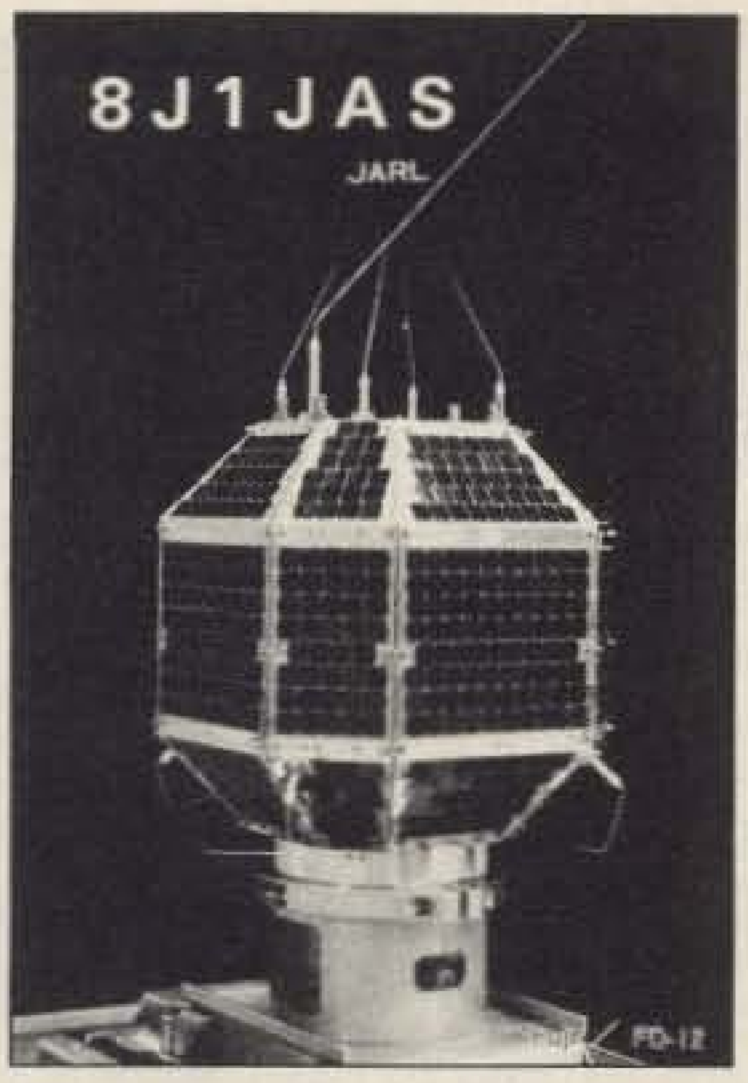


Photo A. Fuji-OSCAR 12 QSL card.

QSLs Available

For those who have listened to or operated through F-O-12, the JARL has a very nice full-color QSL available for a reception report of the downlink telemetry. A sample is shown in Photo A. Send to the JARL, 1-14-2 Sugamo, Toshima, Tokyo 170, Japan.

The University of Surrey has QSL cards for reception reports of U-O-9 and U-O-11. A U-O-11 card is available by sending a detailed report of digitalker reception during the Skitrek/Project Nordski Comm operation to: UoSAT Spacecraft Engineering Research Unit, University of Surrey, Guildford, Surrey GU2 5XH, England.

Field Day

June is Field Day month and a satellite station in the woods or out on the beach is great fun. Satellites available for use this year may include RS-10/11, A-O-10 and F-O-12.

For RS-10/11 a simple station should do the job, but don't cut corners. With the transponder full of stations looking for the bonus points for a satellite QSO, those with only a few watts to quarter-wave whips will have trouble getting a complete exchange through. For two-meters, use a small to moderate beam, and on ten meters a dipole will work fine. Hopefully, the satellite will be in Mode A only, since simultaneous Mode K operation, with its 15-meter uplink, will put a lot of earth-bound Field Day participants unwittingly in the transponder passband. Watch out for generator noise, the HF stations nearby, and take along a preamp.

AMSAT-OSCAR-10 should be in full sunlight by the end of June. Check the AMSAT nets for the latest schedule of operation. The satellite experiences a little eclipsing on almost every orbit in 1988, so strict adherence to posted schedules is important to preserve the batteries. Antennas for this satellite are not quite as portable compared to an RS-10/11 arrangement. A 14- to 20-element crossed Yagi with preamp for the Mode B two-meter downlink, and 25 watts to a 16- or 18-element crossed Yagi on 70cm should be sufficient. Some hams have made several contacts on Field Day with much less, but usually with a very experienced satellite chaser operating the station.

For F-O-12, the antennas used for A-O-10 will do the trick, but that's assuming that the satellite is available for Mode JA, the analog transponder mode, for Field Day. Last year the satellite was scheduled for JD operation for the duration of the outing.

Get your club or group involved with a satellite Field Day station. It does not count as a transmitter in the final tally, yet it can make a lot of points if conditions are right. It is also a fine opportunity to demonstrate the fun of hamsat activity.

Launch and Orbit
Launch at: 20:45, 12 August, 1986 UTC
Launch by: NASDA, with H-I rocket
Launch from: Tanegashima Space Centre, Japan
Orbit: circular, altitude of 1500km
Period: 116 minutes
Inclination: 50 degrees

Construction
Weight: 50kg
Configuration: polyhedron of 26 faces covered in solar cells
Size: 400mm (dia) X 470mm (height)

Antennas
Receiving: A quarter Wave slanted monopole at the top of satellite.
Transmitting: A turnstile at the top for analog signal, and a turnstile at the bottom for digital signal; both radiate circular polarized wave.

Power
Solar array: output 8.5W,n/p silicon 2cm X 2cm
Storage Battery: NiCd, 6AH

Table 2. Major Specification of JAS-1

TECH TIPS

PC-Board Fabrication

W.C. Cloninger's article, "EZ PCB's," was very interesting (*73 Amateur Radio*, August 1987). TEC-200 film is unquestionably the easiest of several PC board processes that I have tried, but it does have its limitations. I would like to share some of my PC-board fabrication experiences with other readers.

Be aware that thermal expansion of TEC-200 film while transferring an image to the copper surface tends to spread or smear the pattern. This effect is small and does no harm in most cases but could be a problem with large boards, especially those with very fine traces.

A far more serious problem is size change when photocopying. Most office photocopiers don't make copies that are exactly 100 percent of the original size and of course the error is doubled when making a reversed image. I had to discard some etched and drilled boards because the holes didn't even come close to matching pins on a long connector. Check dimensions on the final film before proceeding with the remaining steps. If the error is too large, try another copy machine.

With regard to etching, the author alludes to warming the etchant to speed up the process. As a matter of fact, heating the etchant to 90° to 115° is mandatory to achieve advertised etching times. I used a 250 watt heat lamp about 12 inches above the tray.

Continuous agitation to bring fresh etchant into contact with the copper is also essential. A motorized tray rocker is handy (though not essential) and numerous designs have appeared in amateur radio publications. Experimenters who make many boards may want to build a bubble etcher for even greater efficiency. Jim Stinson has described an easy-to-build etcher that utilizes a plastic refrigerator box and an aquarium air pump in *QST*, November 1984, page 45.

Finally, don't "push" the etchant too far. Depleted etchant works slowly and produces poor results. For tray etching of average to large size boards, I use just enough etchant to cover the board and discard it after a single use. This procedure may be modified when making several small boards or for bubble etchers, which generally require a larger volume of etchant.

Experimenters should not feel intimidated by these comments. Printed circuit board fabrication isn't as difficult as it might appear and TEC-200 film is an excellent way to get started. Proceed carefully, making corrections if needed, and you're likely to turn out a perfect board on your very first attempt.

Scott Hofer N7DFR
Federal Way WA

Flashlight Battery Hazard

Recently, an individual replaced the 1.5 volt, D-size batteries in a flashlight. The batteries were of two different brands and types (one general purpose and one alkaline battery). The flashlight was checked for operation and issued for use. Ten minutes later a worker returned the flashlight as inoperable. The inoperable flashlight was placed aside and a new flashlight issued. Twenty minutes later, the inoperable flashlight was checked for condition. The handle was too hot to hold and nearly burned the individual handling the flashlight. The individual then used a cloth to empty the batteries into a metal container so as not to damage the counter top. The plastic covering of the alkaline battery began to melt and was too hot to handle for 1.5 hours. The incident was reported to wing safety of an AF Form 457, Hazard Report.

Investigation of the incident found a warning on the alkaline battery which read: "Do not dispose in fire, recharge, put in backwards, mix with used or other battery types. May explode, leak or cause personal injury." The incident was caused by the mixing of two different types of batteries. Alkaline and rechargeable batteries (nickel-cadmium) should always be used by themselves.

Normally, general purpose (carbon-zinc) and heavy duty (zinc chloride) batteries may be mixed together in the same flashlight or electronic component (portable radio, tape player, etc.). However, alkaline and rechargeable should always be used alone and never mixed with any other type of battery. Mixing of either of these two types of batteries could cause a hazard. For example, if a rechargeable battery and an alkaline battery is used in a flashlight, the rechargeable battery will probable lose its charge first. This may cause the alkaline battery to reverse its charge or leak.

The alkaline battery is an extremely powerful battery and should be handled carefully following the manufacturer's instructions for the battery and the equipment being powered by the battery. If the spring in the battery compartment should tear the protective coating of the battery, it could cause the battery to short out and overheat. An alkaline battery that overheats can reach a temperture of 200 degrees Fahrenheit, which could cause burns when handling. For this reason, alkaline and rechargeable batteries should be handled carefully at all times.

Craig Bledsoe K4TXK
Fairbanks AK

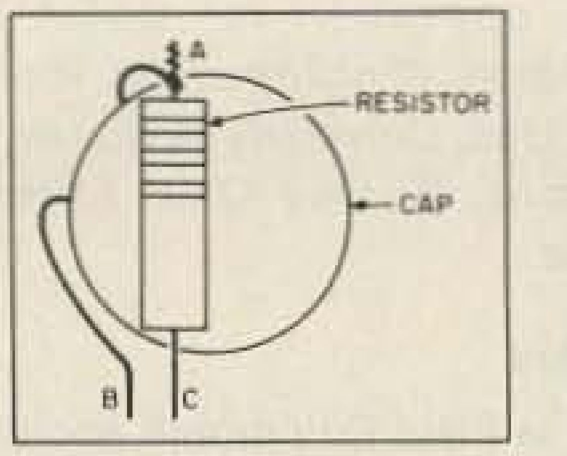
A Quick HT Holder

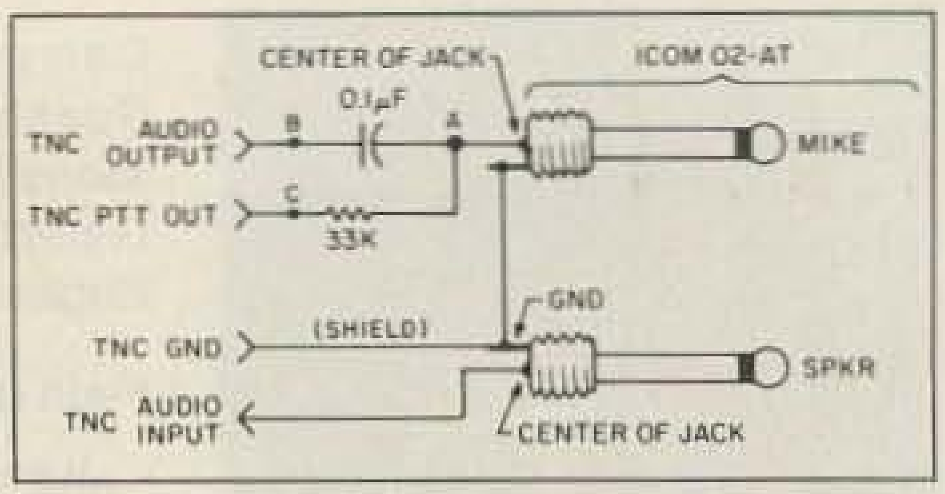
An inexpensive dashboard mount for handheld transceivers can be made by attaching a colonial-style strap-iron drawer pull to the top of the dashboard with screws. Bend the ears slightly to compensate for the slant of the dashboard padding. Hook the HT's belt clip over the handle.

Screw a small cabinet hook to the dashboard to hold the power and antenna cables out of the way of the HT's front panel.

The HT can easily lift off the mount and use it anywhere in the vehicle. A number of holsters and mounts are available on the market for holding an HT on a vehicle dashboard. These are much more expensive than this simple handle, and none holds the HT any better. Also, they take up much more room on the dashboard when the HT is not present.

Charles E.Cohn KK4CS
Austell GA





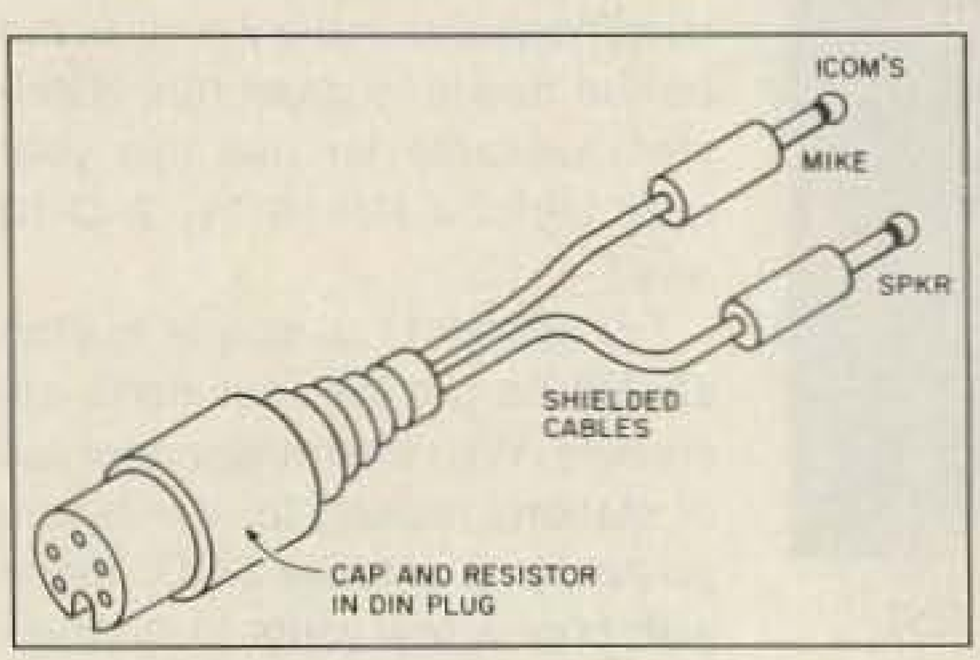


Fig. 1. (top left) How to configure the circuit parts for "Connecting Circuit" to fit inside the DIN plug.
Fig. 2. (Top right) Circuit to interface the PK-232 with the IC-02AT.
Fig. 3. (bottom) The patch cord connecting the PK-233 with the 02-AT.

Connecting Circuit

I have read with interest the 1987 issue on Packet. The circuit to connect an IC-2AT is interesting. However there is a much simpler way to do it.

I have been using an IC-02AT for more than a year with an MFJ-1270 and later with a PK-232. I obtained the information on how to connect my rig to the TNC from the local BBS VE7KIT. I don't know who originated this connecting circuity. *It's Not Me!* And I don't take credit for it!! But it works really well! One may have to experiment with the value of the resistance the recommended 33kΩ worked fine with my system. I don't have any RFI problems and my TX Delay works fine at zero. I built the whole "circuit" in the DIN plug itself (isolating the leads to avoid shorts) as there is only a cap and a resistor.

I have seen this circuit on our BBS for months and I thought it was available on all BBS. As far as I know it works for the IC 2-AT as well as the 02-AT.

Patrick M. DuBois
Richmond, B.C. CANADA

Ten Meter Ground Plane Antenna

Now that the sunspots are returning and lower grades are admitted to ten meters, many people are shopping for suitable antennas. My choice was to build a ground plane, using a matching system which was widely used (commercially) on two meters about twenty years ago, which some people call a Beta match.

Actually, it is a shorted stub in parallel with the feed point, using one of the radials as part of the stub. It is very tolerant and broad-banded, which is important on such a wide band as ten. I made mine for 29 MHz, because I am interested in FM, but it works adequately over the whole band. Longer dimension would lower the frequency to your choice.

Radiator and radials are 8' 2" long and the stub is a 19" piece of RG8U, with cover and braid removed, wrapped in a loose spiral around the radial to keep it from sagging. Make all of the elements adjustable so it can optimize for frequency and SWR. This is a grounded antenna, for DC and perhaps also for lightning!

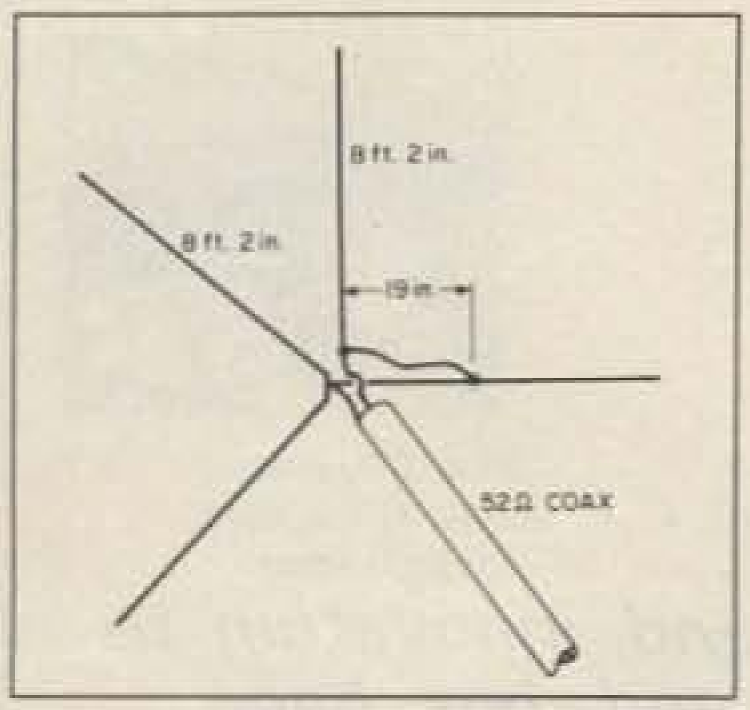


Fig. 4. 10m ground plane antenna.

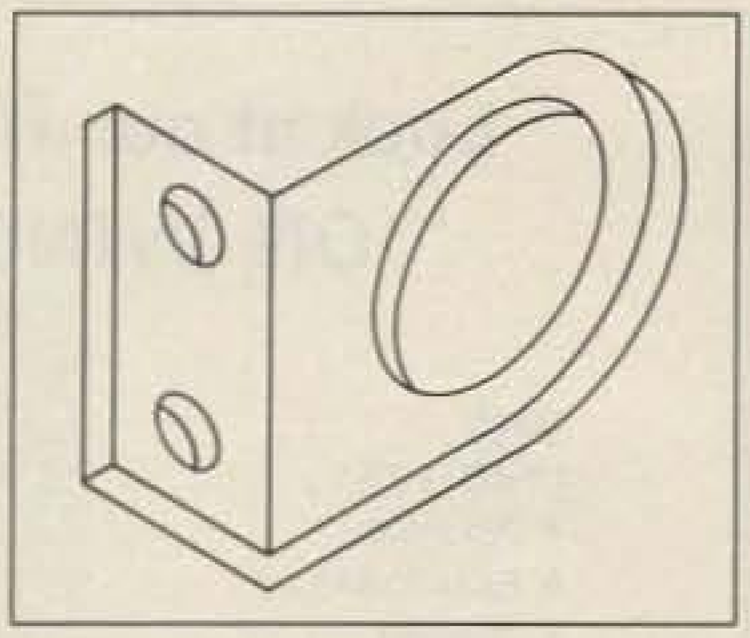


Fig. 5. Bracket for coax socket.

Improved J Pole Match

I have liked J poles for years and built many of them, but never found a simple way to get a completely flat SWR. Now I have. It looks a little unconventional in theory but it measures well. I made this one with square aluminum tubing, which is easier to work with mechanically, although not always easily available. If available, the mounting hardware is simpler as the diagram shows. The main difference between this model and others is the length of the radiating portion, which is increased from 38" to 47½" and allows a completely flat match at the design frequency. SWR readings are shown in Figure 2. Apparently, what we have here is a ⅝ wave element and a quarter wave matching section, at DC ground potential at the bottom, in the usual fashion. Remember that on these frequencies, lead dress of coax affects SWR as does proximity to other objects. Adjust installation with a meter for best results.

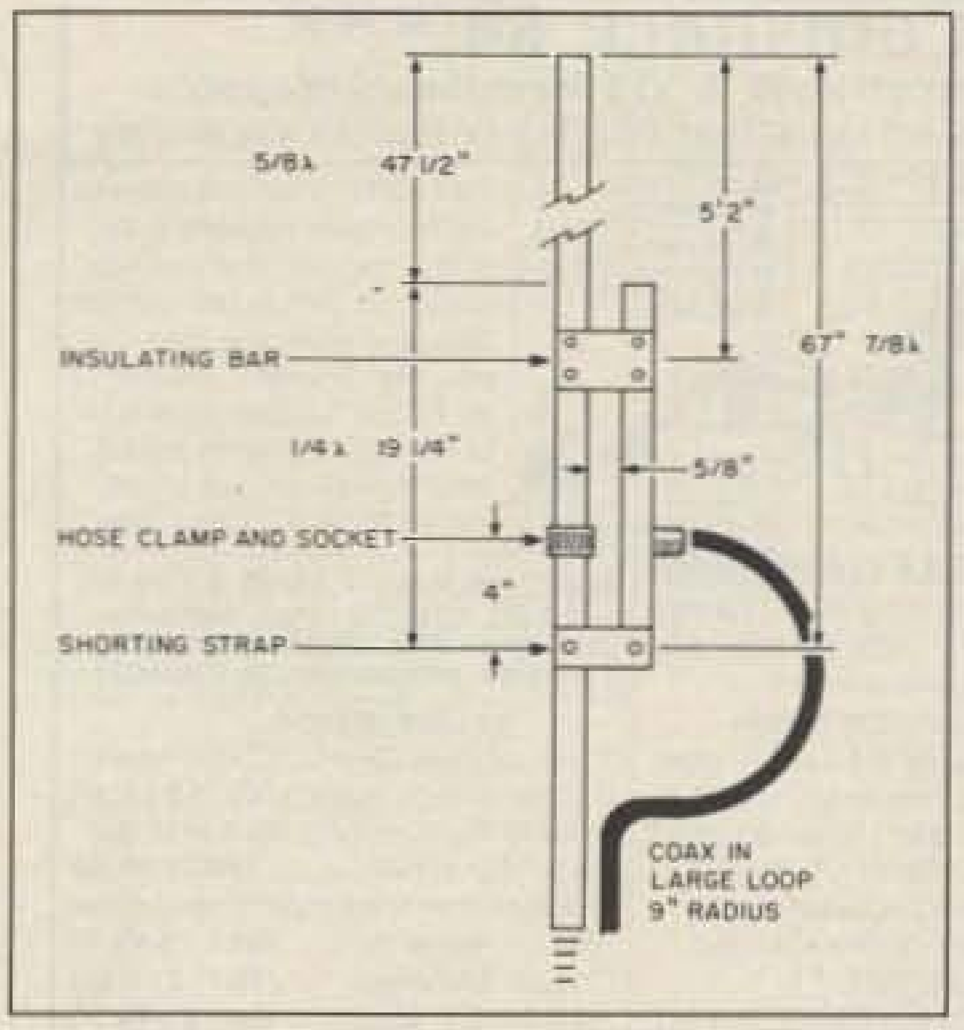


Fig. 6. Construction details of the improved J-Pole match.

Materials:

two pieces ¾" square aluminum tubing, one 19¾" for stub, one at least 7' long, for the radiator and main support, drilled for 8–32 bolts as indicated.

aluminum strap, ¾" x 2⅛" drilled one 7.16" ctr.

insulating bar, 2" x 2⅛" drilled one 7.16" ctr.

stainless steel hose clamp

small bracket to support coax socket (see drawing)

short piece of #14 wire between socket and stainless steel strap.

eight 8–32 bolts, nuts, and lock washers

Wm. Bruce Cameron
Temple Terrace FL

Number 38 on your Feedback card

INDEX: June 1988

Issue #333

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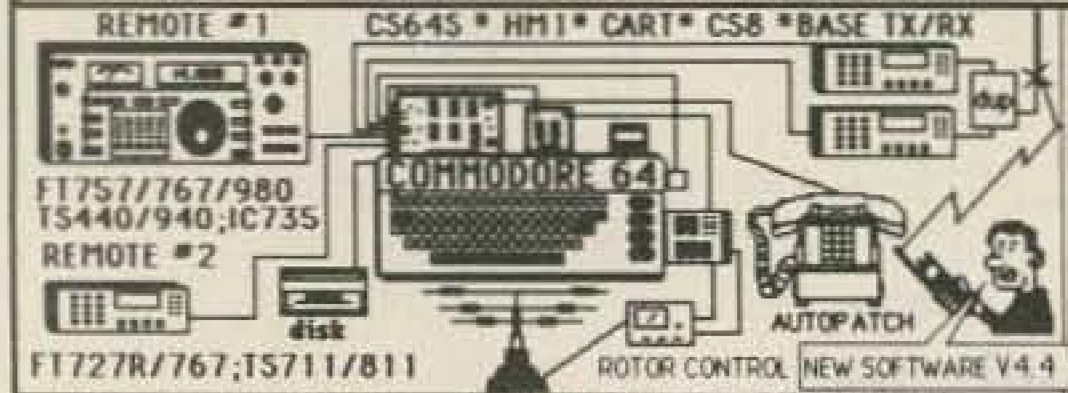

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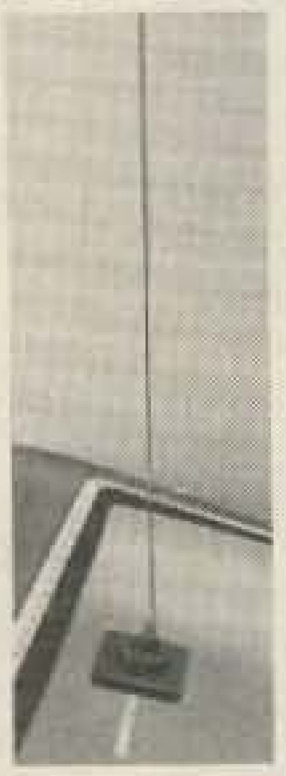

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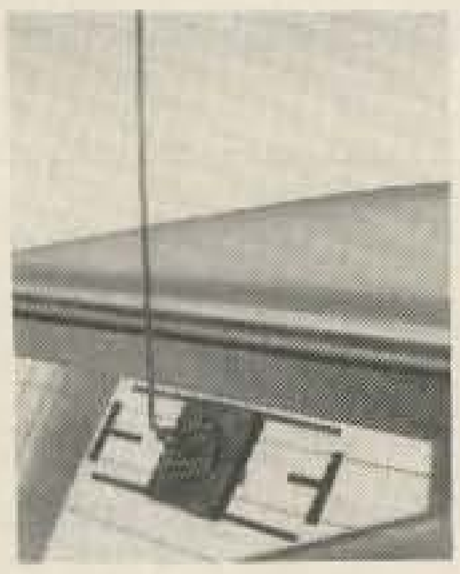

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RTTY DXing

The recent RTTY equipment revolution has dramatically improved the sport of RTTY DXing. Once the neglected stepchild of DX, RTTY DXing is rapidly entering the main stream of the pursuit of new countries.

With the replacement of the noisy, troublesome Model 19 by silent, smoothly-operating electronics, many more amateurs have joined the digital DX crowd, including many stations in other countries.

An important benefit of the shift to electronics has been the addition of RTTY gear to major DXpeditions. Clipperton FOØ, Peter I 3Y1, and Howland Island KH1 are just a few of the many DXpeditions that packed RTTY gear as well as SSB and CW equipment.

The portability of modern RTTY gear has also led to a new phenomenon: the RTTY mini-DXpedition. Many countries, especially in the Caribbean, had seen little or no RTTY activity until a few short years ago. Now vacationers heading for some sun can pack some RTTY gear along with their portable transceivers, and generate some fierce digital pile-ups from their seaside QTH.

The increasing popularity of RTTY contests, especially the new CQWW RTTY test at the end of September, has prompted contest DXpeditions, such as the HD8DX digital trip to the Galapagos Islands in 1987. These DXpeditions greatly increase the number of countries available on the digital modes.

Getting Started

RTTY DXing shares many aspects with CW and SSB DXing. A DXer needs a station of at least average capabilities, better if possible, including a good rig and antenna farm. It is more difficult to copy ("print") weak stations on RTTY than on SSB or CW, so a good station proves more important in digital DXing than in other modes. Ideally, the rig should be very stable, as even a slight frequency change can garble transmissions. The ability to use a narrow CW filter while in the lower sideband mode is another DXing advantage. The rig should also be capable of continuous transmissions for extended periods. RTTY demands a great deal of stamina from a rig and its power supply.

RTTY DXers will probably want an amplifier, for the reasons given above. Again, continuous duty is a requirement, so amps with marginal power supplies may not be up to the task. The Drake L4B, Henry 2K, and Alpha amps are good choices.

There's a wide choice of computer and dedicated RTTY gear. I use a simple Commodore C-64, and AEA Pakratt PK-64 with HF modem, for example. In any case, read the instructions carefully, and master the CQ keys, callsign insertion, receive and transmit buffers, and all the other features of the equipment before trying to chase rare DX.

The single most important piece of equipment in RTTY DXing is exactly the same as that in other DXing: your ear. DXing is at least 90% listening (or watching). Almost all HF RTTY contacts occur in very limited band segments, with 14075–14100 kHz being the most popular. With increasing sunspots, check out the corresponding band segments on 10 and 15 meters, as well as the low band spot DX frequencies of 3590 and 7040 kHz. RTTY is permitted on the new WARC bands: tune around 10145, 18105, and 24925 kHz.

Beginning RTTY DXers will make the most headway toward digital DXCC by scanning 14075–14100 kHz on a regular basis. In addition to listening for DX signals, the DXer should also print QSOs from some of the better known, more active DXers on the band. JA1ACB, TG9VT, VK2SG, W3KV, and KT1N are good stations to copy, as they are usually informed about current RTTY DX activities.

The print publications contain useful RTTY DX information as well. The *RTTY Journal* includes a DX column by KT1N with lots of DX activity reports. And the weekly DX newsletters often have RTTY reports.

Don't neglect the rest of the band while concentrating on the RTTY segment. By listening to signals on the rest of 20 meters, for example, a DXer can get an idea of the propagation paths and band openings. Many rare RTTY DX stations dislike pile-ups, and tend to answer CQs. So when the band is open to that particular part of the world, a directional CQ might put a new country in the RTTY log.

As with any DXing, keep the calls short and to the point. Avoid sending strings of RYs or repeating the DX station's callsign. Try "1 x 5" calls—the DX station's call once, followed by yours five times. And listen, listen.

RTTY DXing offers one feature not found on the other modes: It is entirely possible to have a valid contact with a station when no operator is present! Some DX stations maintain automatic "mailbox" stations and message centers. These stations will log a call and respond to it without need of an operator. A DX RTTYer can confirm TG9VT when John is not in the shack. Many of these RTTY bulletin boards can provide DX information, as well as lists of other such automatic stations. VK2AGE on 14073 kHz AMTOR has a weekly DX bulletin compiled by VK2SG, for example.

The RTTY DXer will also want to make good use of RTTY contests, especially the British Amateur Radio Teleprinting Group (BARTG) spring test, and the CQWW RTTY fall activity. The relaxed pace of the RTTY contests is a refreshing change from the feeding frenzy of SSB tests, but there's still plenty of excitement available for the digital DXer. Be sure to check out the rules and the scoring systems. (I'm still trying to figure out my BARTG score.)

The rapid increase in sunspots and the increasing availability of RTTY gear and stations means digital DXing will be great in the next few years. Why not give it a try? See you on the bands. 73

LA5HE's Commandments for QSL Managers

1. By accepting to act as a DX-station QSL manager, the volunteer assumes the responsibility to ensure that everybody who wants a card gets it in one way or another.
2. All cards received must be checked against the log copies received from the DX station, and a QSL card should be made out immediately and returned via the QSL bureau.
3. One of the services of a national society is to provide a QSL bureau for its members. The volunteer should maintain the membership of his national society (IARU member) to ensure proper receipt of QSLs via the bureau.
4. The volunteer should always make sure that the society's bureau is aware of the fact that he is handling QSLs for a station in a difficult part of the world, to ensure smooth cooperation from all parties concerned in his own country.
5. If the national QSL bureau is not automatically accepting QSLs for, or on behalf of, overseas DX stations, the volunteer should take the necessary actions to obtain acceptance before undertaking the responsibility to act as someone's QSL manager. This is very important, as the bulk of the world's QSL cards are sent via the bureau.
6. For prompter handling of QSL cards, many avid DXers are prepared to pay postage plus the service of a direct QSL card by air or surface mail. If the volunteer is prepared to provide this service, he should make sure that this information is provided by the DX station, as well as being published in the various DX news bulletins and Ham magazines. A good idea is to advise how many IRCs (International Reply Coupons) are required for air mail within the volunteer's own continent and the rest of the world, as one IRC covers surface postage only. He should make it known also if SASEs (Self Addressed Stamped Envelopes) are required.
7. For direct replies, the volunteer should never demand more than needed for actual costs. QSLs managers are expected to do their work out of dedication and pleasure. He should be prepared to accept a small loss, which will be compensated to some extent by those people sending excessive postage. Being a QSL manager, however, is most certainly a non-profit operation.
8. Remember: Being someone's QSL manager is a responsibility—not an ego trip!

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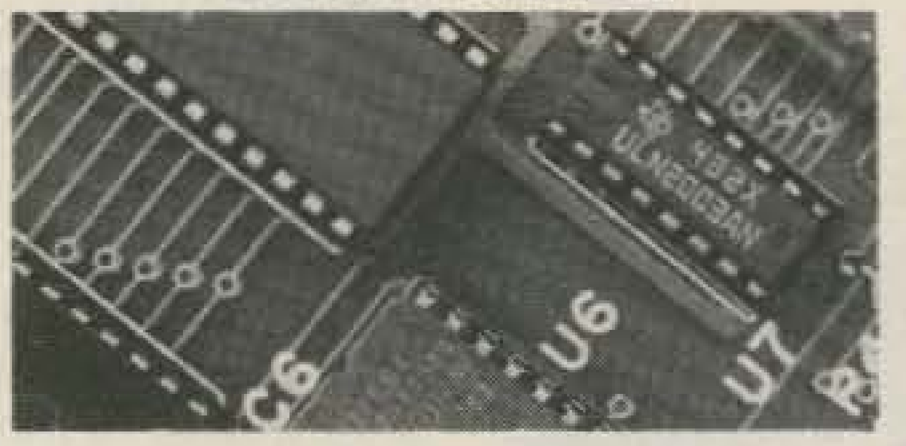

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FLC78 7/8" Cablewave corr.copper blk jkt	3.92/ft
NM12CC N conn 1/2" corr copper m/f	25.00
NM78CC N conn 7/8" corr copper m/f	54.00

COAXIAL CABLES (per ft)

1180 BELDEN 9913 very low loss	.52
1102 RG8/U 95% shield low loss foam 11ga	.36
1110 RG8X 95% shield (mini 8)	.17
1130 RG213/U 95% shield mil spec NCV jkt	.39
1140 RG214/U dbl silver shld mil spec	1.85
1705 RG142B/U dbl silver shld, teflon ins	1.50
1310 RG217/U 50 ohm 5000 watt dbl shld	.98
1450 RG174/U 50 ohm .100" od mil spec	.14

ROTOR CABLE-8 CONDUCTOR

8C1822 2-18ga and 6-22ga	.21/ft
8C1620 2-16ga and 6-20ga	.39/ft

CONNECTORS-MADE IN USA

NE720 Type N plug for Belden 9913	$3.95
NE723 Type N jack for Belden 9913	4.95
PL259 standard UHF plug for RG8,213	.65
PL259AM Amphenol PL259	.89
PL259TS PL259 teflon ins/silver plated	1.59
PL258AM Amphenol female-female (barrel)	1.45
UG175/UG176 reducer for RG58/59 (specify)	.22
UG21DS N plug for RG8,213,214 Silver	3.35
UG83B N jack to PL259 adapter, teflon	6.50
UG146A SO239 to N plug adapter, teflon	6.50
UG255 SO239 to BNC plug adapter, Amphenol	3.29
SO239AM UHF chassis mt receptacle,Amphenol	.89

GROUND STRAP-GROUND WIRE

GS38 3/8" tinned copper braid	.35/ft
GS12 1/2" tinned copper braid	.50/ft
HW06 6ga insulated stranded wire	.35/ft
AW14 14ga stranded Antenna wire CCS	.14/ft

All prices plus shipping, $3.00 min, Visa/Mastercard $30 min, COD add $3.00
Call or write for complete price list. Nemal's new 36 page CABLE AND CONNECTOR SELECTION GUIDE is available at no charge with orders of $50 or more, or at a cost of $4 with credit against next qualifying order.

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Number 31 on your Feedback card

QTH-DX

QTH is AUSTRALIA

Leon Fletcher N6HYK

Amazing Australia

Many nights, there are so many clear signals coming in from VK-land (Australia) that some California hams would say, "VK hardly counts as DX."

Many East Coast hams also find Australia fairly easy to work. Even hams in Europe, who are located the farthest from Australia on this planet, do not include VK in their list of "100 most wanted countries."

But Australia, the world's largest island, is certainly one of the world's most fascinating countries. For starters, it ranks in the top ten nations in a startling 51 features. Some Australians are considered to live with the best physical quality of life and have the most graduates and pupil-to-teacher ratio. Australia has the most new houses built, passenger cars, radio receivers, hospital beds, and airfields per capita. It is also proud of the civil aviation flying distances, advertising expenditures, registered industrial designs, and magazines. And the Australians consume more meat, sugar and rubber per capita than any other country.

Intriguing Contrasts

Within these rankings, reported in *New Book of World Rankings* by George Kurian, there are some intriguing contrasts. For example, Australia has the world's highest literacy rate for both males and females, yet it also tops the world in rates of rape and other sex offenses. Despite Australia's high ranking as seventh on an index called "New Social Progress," it ranks second in the world for juvenile crime.

Even though Australia is considered to be among the top ten nations of the world in having the best physical quality of life, many of its citizens apparently feel a need to escape from that desirable existence by being one of the leading countries for drug-related crimes.

Population Stats

Many Americans know Australia is about the same size as the continental United States. But some people are surprised to learn that Australia's population is less than 16 million, nearly a million fewer people than in Texas!

There are 17,207 hams in Australia, smaller than the ham population of Pennsylvania. Australia has one ham per 916 residents, compared with one ham for every 529 residents in the United States.

Amazingly, one of every four residents in the nation live in Sydney. Sydney is the country's most populated city, with about 3.3 million people. Australia's capital, Canberra, has about 250,000 residents, roughly the same as Rochester, New York, or Fresno, California.

The unusual facts about Australia, some of which were reported in the February 1988 edition *National Geographic,* seem unending. It is the only nation that is a continent. Its largest lake, Eyre, is 3,600 square miles, about 1.5 times as large as Delaware—yet it is bone-dry almost all of the time. Australia has ten times as many sheep as people. It is one of the least densely populated countries in the world with only an average of only five people per square mile. Voting is compulsory. Nearly all of the world's opals come from Australia. And its per-capita income is one of the highest in the world at $11,200 equivalent in US dollars.

Man-made and Natural Wonders

Not statistics, but sights are Australia's major attractions. They range from impressive man-made drama to spectacular wonders of nature.

Pictures of Sydney's unique Opera House show the tops of its curved walls flowing inward to become roofs, uninterrupted by the 90-degree angles. Those walls soar up to 230 feet high, about the height of a 21-story building. The structure is covered with 1,056,000 white tiles made in Sweden. To some people, the building looks like billowing sails of a beautiful ship, to others it looks like a pile of broken eggs.

But the Opera House is much more than its name suggests. Indeed, opera is not even its major production. The structure includes five main performing halls, with the Opera Theater being the second largest in the building. Even though the Opera Theater seats 1,547 people and has a curtain longer than half a football field, the larger is the Concert Hall. The Concert Hall seats 2,690 people. It is used for symphony performances, chamber music, jazz and pop concerts, conventions, and such. The Australians claim the largest mechanical action organ in the world is housed here–10,500 pipes, built at a cost of $1.2 million.

Also located in the Opera House are a Drama Theatre, a Playhouse, and a Recording Hall. Then there are five rehearsal studios, an exhibition hall, two restaurants, six bars, and a library; a total of 900 rooms!

The natural wonders of Australia are indeed diverse. Wildlife includes about 400 native animals, plus about 600 species of birds unique to the country. There are more than 170 marsupials–kangaroos, koalas, wombats and such. The 50 types of kangaroos range from just a few inches tall to over six feet; some of the big "roos" jump 20 feet and race along at 30 miles an hour.

Another impressive wonder of nature in Australia is the world's biggest collection of coral in the world, the Great Barrier Reef. It extends for 1,250 miles along the country's northeast coast, lies about six to 62 miles offshore and ranges from 10 to 150 miles wide.

The reef, along with Australia's many other superior beaches, draw many locals to become almost year-round swimmers, beach loafers, snorkelers, skin divers, shell hunters, and sun-worshipers supreme. But such pleasures give Australians the unenviable record of suffering from the world's highest rate of skin cancer.

Another spectacular wonder of nature is Ayers Rock, the largest rock in the world. It is located in the middle of the continent with the nearest town of Alice Springs only 280 miles away. Ayers Rock is 1,143 feet high, 5.5 miles around, set virtually alone in a broad, sandy plain. The rock is open for tourists to climb. The Aborigines call it "Uluru" and consider it a very sacred site since many of their legends center on it.

Australian Aborigines have wandered the continent for at least 40,000 years. Anthropologists estimate that about the time European ships reached Australia, the Aborigine population was more than 300,000. Today there are only about 50,000, plus 150,000 part-Aborigines.

Happy Birthday!

This year, Australia is celebrating it 200th birthday. On January 26, 1788, after an eight-month passage from London, a fleet of eleven ships arrived in what is now Sydney Harbour. The vessels had set sail from London with 776 convicts. Britain had decided to reduce crime by shipping convicts to Australia. That continued for 80 years and by the time such banishment was outlawed, 162,000 criminals had been sent to Australia.

Many outsiders find the strangest feature in all of Australia is the language they speak. It is English but not the brand known to Americans. It's *fair dinkum* (absolutely true) that if you're really *up a gum tree*(in a quandary) for a QSL card from Australia, *give it a burl* (try it) by calling "CQ VK-land"–chances are you'll soon be hearing a *copper* (friend) from Down Under answering, "Goo'dye mite!"

73 Advertiser's Product Index

A convenient service for our Readers.

FEEDBACK

In our continuing effort to present the best in amateur radio features and columns, we've decided to go directly to the source—you, the reader. Articles and columns are assigned feedback numbers, which appear on each article/column and are also listed below. These numbers correspond to those on the feedback card opposite this page. On the card, please check the box which honestly represents your opinion of each article or column.

Do we really read the feedback cards? You bet! The results are tabulated each month, and Larry (our editor in chief) takes a good, hard look at what you do and don't like. To show our appreciation, we'll draw one feedback card each month and award the lucky winner a free one-year subscription (or extension) to *73*. To save some money on stamps, why not fill out the the Product Report card and the Feedback card and put them in an envelope. Toss in a damning or praising letter to the editor while you're at it. You can also enter your QSL in our QSL of the Month contest. All for the low, low price of 25 cents!

Number 33 on your Feedback card

73 INTERNATIONAL

edited by Richard Phenix

Notes From FN42

Not a week passes here at Wayne Green Enterprises without at least one exotically-stamped envelope arriving, bearing within a request for a free subscription to 73 Amateur Radio. *Many of the requests are made by individuals who have thought to themselves, gosh, they print tens of thousands and probably have hundreds left over. It would cost them only the postage. . . .*

It doesn't work that way, of course. Magazine prices are set to cover all the costs of production and distribution not covered by advertising income. One item of expense: courtesy subscriptions for a limited number of individuals (or organizations) who have earned them in one way or another or whose subscriptions may lead to greater circulation. The magazine industry is, after all, supposed to be profit-making.

In the amateur radio field there is a nonprofit element, however. It can never be preached too often that amateurs have public service responsibilities, and are licensed with the understanding that they will meet their obligations. 73 Amateur Radio, *therefore, does give a number of free subscriptions on behalf of those obligations. It is our hope that amateurs and amateur organizations, particularly in international terms, will also assist hams who, for instance, live in areas or under circumstances where outside help clearly could make the difference between healthy and growing ham activity and perhaps no activity at all.*

Underwriting the cost of a subscription to the amateur radio magazine of your choice is one example of assistance that can be given, and from time to time you will see in these pages, an opportunity to do this. See the Nepal item below. In the case of Nepal, we are sending 9N1MC a one-year subscription.

Dates to remember in June: 1—Children's Day, China, National Day in Tunisia; 2—Anniversary of the Republic, Italy, Coronation Day, Great Britain; 3—Labor Day, Bahamas; 4—Queen's Birthday, New Zealand (on the 11th for Australia and Great Britain); 5—Liberation Day, Seychelles (which celebrates Independence on the 29th); 6—Memorial Day, South Korea, Bank Holiday, Ireland, National Holiday, Sweden (and for Portugal on the 10th, Luxembourg on the 23rd); 7—Independence Day, Norway (12th for the Philippines, 26th for Madagascar and Somalia); 14—Flag Day, USA (20th in Argentina); 17—Commemoration Day, Germany, Republic Day, Iceland; 18—Evacuation Day, Egypt; 19—Revolution Day, Algeria, Father's Day, USA; 22—National Sovereignty Day, Haiti; 24—Peasants Day, Peru, King's Day, Spain; 28—Mothers Day, Central African Republic.

Australia. LATE WORD. EXPO88 plans (see April issue) drastically changed—no ham activity at the site, for example. Double check all information before counting on it.

Roundup

Correction. In the box on page 94, February issue, the two addresses in Portugal should be **REP-Rede dos Emissores Portugueses, Rua D.Pedri V, 4-4 Lisboa, 1000 Portugal** (and the reciprocal license fee is around US$30); and **Direccao dos Servicos Radioelectricos, praca Francisco Sa Carneiro 13, 1, Lisboa, 1000 Portugal.**

China. The China Radio Sport Association (CRSA) of the People's Republic of China (Zhonghua Renmin Gonghe Guo) set up stations BTØLS and BTØZML last March for SSB and CW communications for a very special March-to-May, tri-nation mountaineering party (see QSL cards). The mountain: "the highest in the world—Qomolangma," writes Chang Han Dong. [*Mt. Everest—or Mt. Zhumulangmafeng—Ed.*] Half the mountaineers were to climb the north face, half the south, to meet at the peak and keep going, making the first-ever dual, over-the-peak conquering of Everest's 29,028 feet. ZML was the base camp station, LS was in LaSha (Lhasa), capital of Tibet. May 5th was to be the meeting day at the peak, at which time the Japanese Broadcasting Net planned a telecast via satellite to the whole world. The frequencies allocated for the occasion were 14.180, 14.330, 21.330, 21.180, and 7.080 MHz.

Czechoslovakia. Our Czech correspondent, Rudolf Karaba OK3CMZ, has indicated that no additional information is called for by his country beyond that requested in our draft Universal Permit Application form (for operating permission) as published on p. 78 of our January issue. He proved it by filling one out for himself and sending it to us, with the attachments called for. (We now know he drives a Fiat when mobiling, has grey eyes, and his call suffix, phonetically, is Cyril, Maria, Zuzana!) Thanks!

Israel. Want to learn the international (UN approved) language, Esperanto? Reportedly it can be learned in one-fifth to one-twentieth the time needed for a typical national language. Or, as the Esperantists say, Inteligenta persono lernas la lingvon Esperanto rapide kaj facile. Tune in Naftali 4Z4RM's weekly magazine-on-the-air linked between 40 meters and VHF repeaters in the north and south of Israel, where Rami Shlain 4Z4LX will give you a ten-minute lesson. (See the October 1987 international column for his picture.) It also is taught at the Tel-Aviv Youth Center, the home of the 4X4HQ radio club. There is a 350-plus-member International League of Amateur Radio Esperantists (ILERA) which puts out a quarterly magazine, each issue edited in a different country, and has an annual international contest in Esperanto on the HF bands on the third weekend in November. Last year 162 stations in 22 countries participated. Rami represented Israel at last year's 72nd conference of the Universala Esperanto Asocio (UEA) in Poland where 80 countries were represented, of which 18 had representatives on the Esperanto ham organization.

Republic of Korea (South Korea). Our special Olympic correspondent, HL5AP (see the International column for November, 1987, page 96), wrote a few months ago that he was QRL, following duty with some 30 others as radio men for the Olympic Practice Yacht Regatta in the Bay of Suyong, off Pusan. He will be providing the same kind of volunteer service for the Seoul Olympic Yacht Regatta. Frequencies have been allocated for the Olympics (see box), and we hope to have more details from Byong-joo Cho soon. If you plan to go to Seoul (the Sports Complex and Olympic

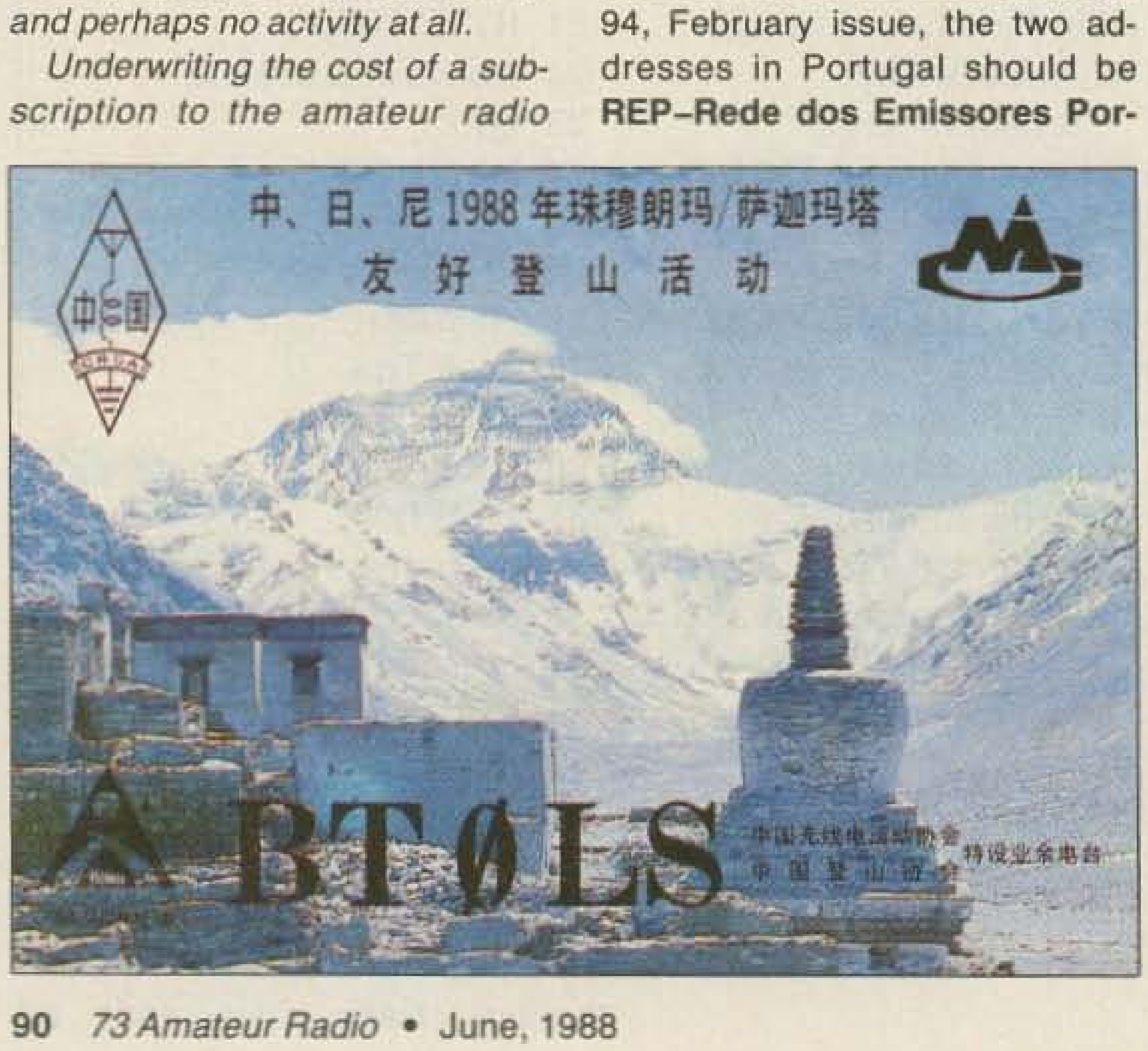


Photo A. Byong-joo Cho HL5AP.

OLYMPICS FREQUENCIES

HF, 50 W, CW, SSB, RTTY: 3500–3550, 3790–3800, 7000–7100, 14,000–14,350 kHz; FM also: 28,000–29,700 kHz.

VHF, 25 W, CW, SSB, RTTY, FM: 50–54, 145-146 MHz; same for UHF, 435.075–440.000 MHz.

Park are 10 miles from the city, just over the Han River) you'd better make arrangements yesterday. A recent report said that there are about 32,000 tourist rooms in Seoul, and 240,000 visitors are expected.

Nepal. Krishna B. Khatry 9N1MC, Chief Engineer for the Nepalese Ministry of Communications, writes that he is "trying [his] best to promote amateur radio in this country." [*To help, we are sending him a courtesy subscription of 73. The Kingdom of Nepal (Sri Nepala Sarkar), about the size of North Carolina, has a population of about 17.5 million; Kathmandu, 125,000, is the capital. Virtually closed to the outside world for centuries, it now is linked to India and Pakistan by road and air, and to Tibet by road.—Ed.*] He wrote of the DXpedition license granted to the Japan UNICEF Ham Club of Hokkaido for a ten-day period last December, as part of the celebration of the 43rd birthday of His Majesty, King Birendra Bir Bikram Shah Dev, of Nepal. Station 9N7YDY was operated from Kathmandu. Seven operators were authorized: JA7 BOB and XBG, JA8 OW and RUZ, JH1LKH, JH7WKU, and JN1XWO.

Sweden. The proposed Universal Permit Application looks good to Rune Wande SM0COP and Erik SM0AGD, and they suggest two additions: a place on the form where the applicant can suggest the call he would like to have assigned to him. This can be helpful to some countries where uncertainty is felt about the call to assign. "We have experienced very strange calls in some cases." And: "If there is a host or a contact person in the country one wants to work ham radio from, it [could break] red tape in many cases." [*See Zimbabwe, below, where 8000 km (5000 miles) away, give or take a few hundred, the same bright idea struck. . .*]

Photo B. Nepal's 9N1MC, center, with (L to R) Yasuo Makiyama JA7BOB, Tetsuya Sakabe JA7XBG, Lloyd Colvin W6KG (who operated 9N5QL with W6QL, separately), Masakazu Sezaki JN1XWO, and Toshikazu Kawanishi JA8RUZ.

Zimbabwe. Bernard C. Herring Z21EI also endorses our Universal Permit Application as proposed. He makes the excellent suggestion [*and see Sweden, above!*] that in some countries the whole matter could be smoother for everybody if the application were made for the use of the gear of a resident amateur and, again in some countries, for that use to be under the supervision of the local ham. This could be made easier yet if a local amateur radio organization endorsed the idea and became the contact point for the prospective visitor looking for a local sponsor. [*A list of such countries can be added to the Universal Permit Application kit if enough national groups agree to sponsor visitor assistance plans. Let us know!*]

CANADA

Garry V. Hammond VE3XN
5 McLaren Avenue
Listowel, Ontario
Canada N4W 3K1

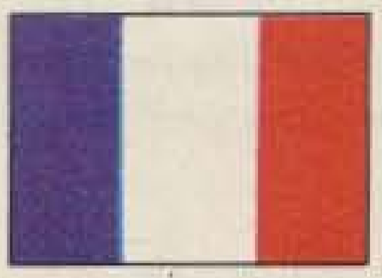
[*VE3XN is National Awards Manager for the Canadian Radio Relay League, CARF, and the Maple Leaf Radio Society. He has been chasing one aspect of amateur radio after another for 30 years, starting with SWLing and now awards. Over the years he has used over 16 Canadian prefixes, with the most recent being VX3SN (in conjunction with the Calgary Winter Olympics) and VE8XN, for use at the base camp of the Polar Bridge Ski Expedition of UA–VE (see January issue, p. 72). He is QSL manager for himself, HS1AMM, VP2MF, and ZF1MA. His present two-letter call was used by a Canadian pioneer operator, Hobbs Langford. The XN-4 was an early Canadian radio receiver. Nine of his Canadian prefixes were with XN. He publishes* The Amateur Radio Awards Directory of the World, *(a revised edition each year). What would you bet that the kids in the Listowel secondary school district get especially interesting geography lessons? Garry has headed the Geography Department there since 1962.—Ed.*]

The CRRL 1988 Polar Bridge Diploma

In honor of the Transpolar Ski Expedition, Severnaya Zemlya, USSR, to Ellesmere Island, NWT, Canada. A bilingual certificate for nine QSOs or loggings between February 15 and June 15, 1988:

- 3 different calls from North West Territories—usually VE8, but the CI8 prefix is optional here
- 3 different calls from Asiatic RSFSR (Russian Soviet Federated Socialist Republic)—usually UA9 or UA0
- 1 Base Camp Station from either Canada or the USSR (CI8C will be heard from the Resolute Bay, NWT Camp)
- 1 station from national capital region of Ottawa
- 1 station from national capital region of Moscow

Send application, certified log data (no QSLs), and 10 IRCs or $5 to me at the above address.



FRANCE

Claude Guee FD1DGY
11 Rue Emile Labiche
28100 Dreux
France

[*FD1GY was last heard from two years ago; and that column came two years after the one before "due to a car crash and other QRM," as he put it. Hope all QRM clears up and it won't be 1990 before we hear again—how about more information about the "Gateway" project, and is there any chance that France's process for granting operating licenses to foreign visitors will be simplified?—Ed.*]

Some news from France

- The first "radio-amateur" association in France now has for the first time a YL at its head, Therese Normand FE6EPZ. Let's wish courage and good luck to this valiant YL in any future hard struggles...a new difficulty has arisen which may slow future growth, and already France probably has a smaller rate of amateurs—the cost of a license has gone up, and also the examination charges (practically double from last year, for a beginner).
- 50 MHz could be allowed in France, but with strong restrictions in area and power, due to the use of TV.

• Sandrine FA1MSG is the youngest radio amateur in France (13 the day of her exam)! Her A license doesn't allow many international QSOs, but this is only a beginning!

• This year, our national license is extended to Austria, Liechtenstein, Monaco, Netherlands, Norway, Switzerland, and West Germany, with Belgium possibly next. (With reciprocity, of course.) This may be the beginning of a Europe-wide license, an important step, and maybe even more, why not?

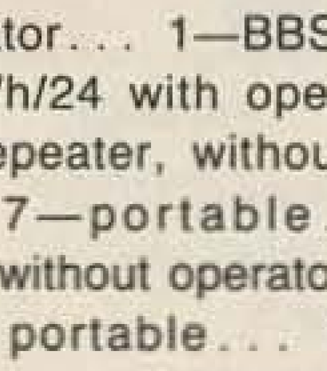
• Packet radio is growing rapidly here. The "hexagone" is now covered by more than 80 repeaters (144,675). Only in the west (the IN square) is there relative inactivity. There are now over 1,000 packetteurs and more than 80 BBS's, on the same frequency. F6ABJ's Paris BBS is also on 145,275 because of heavy activity. The live-wire group ATEPRA (FE6WV, F6ABJ, etc.) has been promoting this new activity.

During the last congress, in Provins, the following standardization was recommended for the SS IDs:

Ø—operator... 1—BBS... 3—QRV 24/h/24 with operator... 4,5,6—repeater, without operator... 7—portable... 8—portable without operator... 9—mobile, portable... 10-13—reserve... 14—emergency... 15—reserve.

"Gateway" is a very ambitious project by F6ABJ, with an HF station near Paris (7-element beam, 14 MHz, 30 meters ASL) connected with a UHF link to the capital, to make easier intercontinental packet QSOs.

• Chuck AB4Y has left France after a too-short stay here. He was the founder of PIARA, the international amateur radio club in Paris which is so helpful to travelers to Paris. Monthly meetings are held in the famous restaurant, Jenny. Many thanks, Chuck, and *a tres bientot!*



HONG KONG

Phil Weaver VS6CT
10A Bonaventure House
91 Leighton Road
Hong Kong

[*This is Part 2 of a two-part report; Part 1 was in the April issue—Ed.*]

Our Class B licenses continue to expand, and at the end of 1987 we had 373. With 190 Class A, this meant a total of 563, and expansion will continue as exams are now going to be given in Chinese. Until now they have been the same as those given in the U.K. by the City & Guilds of London, in English only.

As 10 meters becomes more active, I am afraid you will be hearing a lot of AM interference from illegal stations in Asia. Hong Kong is not alone in having this problem, where the taxi drivers have discovered a brand new world of communications amongst themselves to the detriment of other amateurs. The two main frequencies they use are 28.405 and 28.515 kHz. The local telecommunications authorities are well aware of the problem and, in conjunction with the police, catch the occasional transgressor, but the problem is endemic, and unless we can get complaints from around the world, there is little more that will be done. The problem exists in Malaysia and Indonesia also, and when the band is open to that part of the world, you will well and truly know about it!

Because of my new job [*in charge of the Port of Hong Kong Communications Center—see Part 1.—Ed.*] I have had to resign from the Committee of HARTS, after seven years, but it was good to leave after an Annual Dinner with 166 people present made it the best ever; and there were over US$7,000 worth of door prizes, thanks to local Kenwood, Waysun, Goodyear, and Pacifica Products dealers!

HARTS had five transceivers stolen from one of its 2-meter sites, and it will be some time before we can collect the money to get back to normal activity. Private repeaters have been authorized recently, and three licenses have been issued. I am sponsoring one, using English, which will be helpful for those unable to understand Cantonese.

Last August, typhoon Rima swept through the Far East, leaving a trail of smoked radios, toasted antennas, fried amplifiers, and disillusioned amateurs in Bangkok, Macau, and the Philippines. Luckily, Hong Kong was spared.

Finally, I regret to announce that our Telecommunications Authority friend, Mr. T.C. Chan VS6DW, MBE, has retired. He has done so much for amateur radio, from the official side, that his shoes may never be filled: his post will not be filled at this time because there is nobody knowledgeable enough. There will be two people splitting up his work load. We understand he is retiring to Canada; and all of us wish him a happy retirement.

SWEDEN

Rune Wande SMØCOP
Frejavagan 10
S-155 00 Nykvarn
Sweden

Common License Approved

The European Common License has been approved in Sweden as of March 1—in part. It is in accordance with the so-called CEPT Recommendation and is valid for amateurs from those other countries which also have implemented this kind of license. It means that amateurs from West Germany, Norway, Denmark, The Netherlands, Luxembourg, Belgium, Austria, Switzerland, France, and Monaco do not need to apply for a visitor's license when in Sweden—IF they are satisfied working only VHF according to CEPT Recommendation Class 2. Unfortunately, the Swedish authorities did not accept the full CEPT plan. The Swedish Telecommunication Authority did accept the full plan, but was overruled by some other government entity. Let us hope that the obstacles, whatever they were, will be cleared away in the near future.

Did you work 7S8AAA? The Swedish Antarctic Research Program (SWEDARP) was assigned the call 7S8AAA, and early this year a group of 12 geology researchers spent a few months in the Antarctic. Kent SM7DSE, a University of Lund professor, was the one who made amateur radio a part of the expedition. He planned to work CW, SSB, RTTY, AMTOR, and HF Packet. They also had a license for 3Y Bouvet, but as of this writing it is uncertain whether they'll get there this time.

QSL cards can be sent via SKØ MT, Club Taby Sandaramatorer. If you didn't work 7S8AAA this time, you will probably get another and bigger chance next year. I'll keep you posted.

Market Reef SI8MI!

SKØMT has become a very active club. They managed to get a special call for the Swedish part of the Baltic Sea rock known to DXers as Market Reef (prefix OJØ). For years the Finnish lighthouse on this tiny rock was on the Swedish side, and the national border was drawn through the rock! In 1985 the border was redrawn to put the lighthouse back in Finland (see map). On September 26 of that year SI8MI went on the air for the first time, but for only a few hours because of bad weather, and there are no shelters on the Swedish side. There is a good possibility that the call will be heard again this summer, however. Although it does not have DXCC status, it is a rare call! QSL via club SKØ.

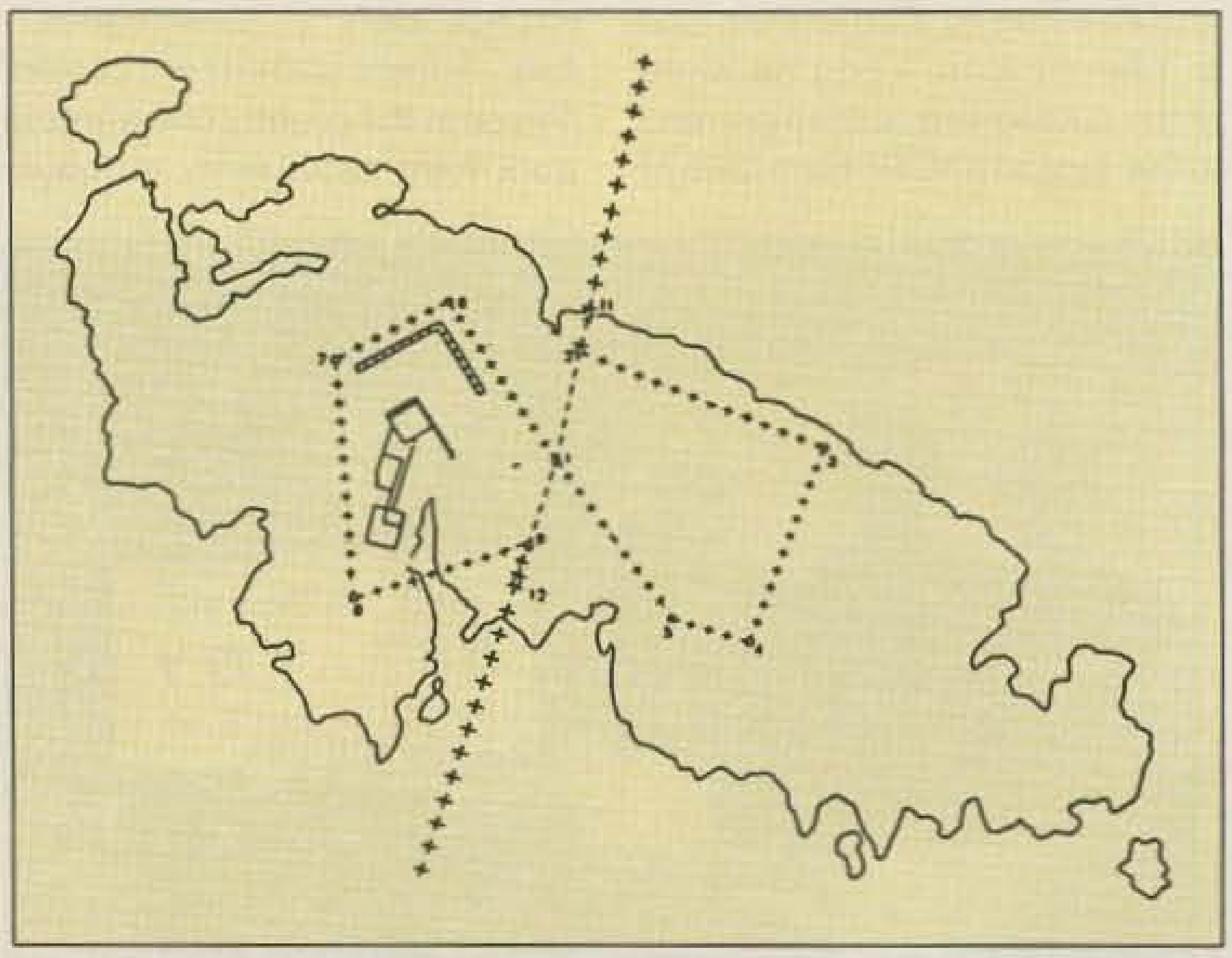


Figure 1. The old border went vertically through the middle of Market reef, which in all is about 400 meters in length and averages about 150 meters wide. The new border cuts left and around the lighthouse, and then cuts back into Finland to give Sweden an area of rock equal to the area that went with the lighthouse.

Food for thought.

Our new Universal Tone Encoder lends its versatility to all tastes. The menu includes all CTCSS, as well as Burst Tones, Touch Tones, and Test Tones. No counter or test equipment required to set frequency - just dial it in. While traveling, use it on your Amateur transceiver to access tone operated systems, or in your service van to check out your customers' repeaters; also, as a piece of test equipment to modulate your Service Monitor or signal generator. It can even operate off an internal nine volt battery, and is available for one day delivery, backed by our one year warranty.

- All tones in Group A and Group B are included.
- Output level flat to within 1.5db over entire range selected.
- Separate level adjust pots and output connections for each tone Group.
- Immune to RF
- Powered by 6-30vdc, unregulated at 8 ma.
- Low impedance, low distortion, adjustable sinewave output, 5v peak-to-peak
- Instant start-up.
- Off position for no tone output.
- Reverse polarity protection built-in.

Group A

67.0 XZ	91.5 ZZ	118.8 2B	156.7 5A
71.9 XA	94.8 ZA	123.0 3Z	162.2 5B
74.4 WA	97.4 ZB	127.3 3A	167.9 6Z
77.0 XB	100.0 1Z	131.8 3B	173.8 6A
79.7 SP	103.5 1A	136.5 4Z	179.9 6B
82.5 YZ	107.2 1B	141.3 4A	186.2 7Z
85.4 YA	110.9 2Z	146.2 4B	192.8 7A
88.5 YB	114.8 2A	151.4 5Z	203.5 M1

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2175	941	1633	1750	2000	2300	2550
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SPECIAL EVENTS

Ham Doings Across the Country

Special Events listings will be provided by 73 *magazine free of charge on a space-available basis. Announcements must be received by the first of the month, two months prior to the month in which the event takes place (by April 1, for example, for a June or later event). Please mail to Editorial Offices,* 73 Magazine, *WGE Center, Peterborough NH 03458. ATTN: Special Events*

LONG BRANCH NJ
JUNE 1–5

The Second Annual Convention of Chaverim International, an association of Jewish Amateur Radio operators, will be held this year at the Harbor Island Spa at Long Branch. Cost is $286 per person double occupancy, $436 per person single occupancy. Talk-in on 1 June 147.05 Asbury Park repeater. Deposit of $25 required. For reservations and information, contact *Foster Kawaler NV2W, 46 Megill Circle, Eatontown NJ 07724, or Bernie Schreibman, 362 Meadowbrook Ave., Eatontown NJ 07724.*

ST. PAUL MN
JUNE 3–4

The North Area Repeater Association will sponsor a swapfest and exposition at the state fairgrounds in St. Paul. Exhibits, flea market, dealers, prizes, license exams. $4 in advance, $5 at door. Write *Amateur Fair, PO Box 857, Hopkins MN 55343, or call 612-566-4000.*

BROOKFIELD IL
JUNE 4

The Chicago Suburban Radio Association will operate N9BAT from the Brookfield Zoo as part of the West Suburban Council Boy Scouts of America Scout-O-Rama. Operation will be on SSB frequencies 7.240 MHz, 14.260 MHz, and 28.350 MHz, and 2 meter FM 146.55 MHz. For full color QSL card, send your QSL card and large SASE to *CSRA N9BAT, Special Event, PO Box 88, Lyons IL 60534.*

PITTSBURG KS
JUNE 4

VEC exams, indoor flea market, free tables and parking, hamfest at Lincoln Park Pavilion sponsored by the Pittsburg Repeater Organization. Admission $5 per adult, $1 per additional family member over fifteen. Talk-in on 146.34/.94 or 147.84/.24. Contact *Ken Johnston KCØVZ, PO Box 1303, Pittsburg KS 66762.*

KITCHENER, ONTARIO
JUNE 4

The 14th Annual Central Ontario Amateur Radio Fleamarket, sponsored by the Guelph ARC and the Kitchener-Waterloo ARC, will be held at Bingeman Park. Admission $3, tables $5, children under twelve free. Talk-in KSR 146.37/.97, ZMG 144.61–145.21, Simplex 52/52. Contact *Fleamarket Co-Chairman, Ray Jennings VE3CZE, 61 Ottawa Crescent, Guelph, Ontario CANADA N1E 2A8. 519-822-8342.*

BANGOR ME
JUNE 4

The Pine State Amateur Radio Club is sponsoring their 2nd annual outdoor hamfest at the Hammond Street Campground. Admission $2, overnight camping June 3–5 available. PSARC annual meeting, election of officers, VEC exams, prizes, free swapfest space and more. Talk-in on 146.34/.94. Contact *Gerry Bell N1DQX, RFD 1 Box 1377, Bangor ME 04401. 207-942-3654.*

MADISON OH
JUNE 4–5

The Wireless Institute of Northern Ohio (WINO), sponsored by the Lake County AR Association, will be on the air to commemorate Ohio Wine Month. On June 4 from 2300Z to 0300Z, W.I.N.O will be operating from a local winery on 3860 and 7235 kHz, and on June 5 from 1500Z to 1900Z, they will be on 7235 and 14235 kHz. Call is KO8O. Legal-size SASE for QSL certificate from *KO8O - WINO Weekend, 10418 Briar Hill, Kirtland OH 44094.*

MANASSAS VA
JUNE 5

The Ole Virginia Hams will present the Annual Manassas Hamfest and Computer Show at the Prince William County Fairgrounds from 8 AM to 4 PM. Admission $5, children under twelve free. Tailgating $5/space. YL Program, ARRL booth, CW proficiency awards, dealers, indoor space. Talk-in on 146.37/.97, 146.52. Contact *Joe Schlatter K4FPT, 703-368-8599 (evening) or Randy Moler KA4UFF, 703-791-3061, or write Ole Virginia Hams ARC, PO Box 1255, Manassas VA 22110, or call Jack Gunsett KI4VP, 703-361-5255.*

HUMBOLDT TN
JUNE 5

The Humboldt ARC will sponsor its annual hamfest at Baily Park from 8 AM to 4 PM. Admission $1, refreshments, flea market, and parking for RVs. Talk-in on .37/.97. Contact *Ed Holmes W4IGW, 501 N. 18th Ave., Humboldt TN 38343. 901-784-3490.*

CHELSEA MI
JUNE 5

The 11th Annual Chelsea Swap 'N Shop, sponsored by the Chelsea Communications Club, will be held at the Chelsea Fair Grounds. Donation $2.50 in advance, $3 at door. YLs, XYLs, kids under twelve free. Table space $8, trunk sale space $2. Campgrounds and parking. Call *313-475-1795, Robert Schantz, 416 Wilkinson Street, Chelsea MI 48118.*

SORRENTO LA
JUNE 6–12

The Ascension ARC will hold its Annual Jambalaya Festival from 1500Z to 2359Z daily on 20–15 and 10 meter bands. Special Event package contains three Jambalaya Recipes, Certificate and Club Card with station, state and country worked, plus Honorary Membership Certificate for three or more stations worked. Send $1 postage and QSL card with calls to *A.A.R.C., PO Box 278, Sorrento LA 70778-0278.*

LOVELAND CO
JUNE 10–11

The Northern Colorado ARC is sponsoring the Tenth Annual SUPERFEST at the Larimer County Fairgrounds in the McMillan Building. Prizes, dealers, VEC examinations, refreshments, and a flea market. Station WØINK will be operating on HF with talk-in on 2 meter. Contact *Bud Hayes WØJFN, 3109 N. Douglas, Loveland CO 80537. 303-663-3119.*

MIDLAND MI
JUNE 11

The Central Michigan Amateur Repeater Association (CMARA) is sponsoring its Fourteenth Annual Hamfest at the Midland Community Center. Donation $3 at door, tables $4 and $8. FCC exams, new and used equipment. Contact *David C. Burdeaux WD8DII, CMARA Vice-President, CMARA Hamfest, PO Box 67, Midland MI 48640.*

WINSTON-SALEM NC
JUNE 11

The Forsyth Amateur Radio Club is sponsoring the Winston-Salem Hamfest & Computer Electronics Fair '88 at the Dixie Classic Fair Grounds. FCC exams (preregistration suggested), indoor dealer space, prizes, and flea market/tailgating space. Admission $4 in advance, $5 at door. Talk-in on 146.04/.64. For preregistration (SASE) contact *Dave Ward KA1LVO, 5573 Vienna-Dozier Rd., Pfafftown NC 27040.* For dealer information, contact *Jim Rodgers N1DRI, Box 11234, Winston-Salem NC 27116, 919-760-2493.* For exam information, contact *Bob Gates KJ4IC, Box 60, Cedar Grove Park, Kernersville NC 27284.*

RIO DE JANEIRO BRAZIL
JUNE 11–12

Hundreds of CW operators in South America will be on the bands this weekend. They welcome other hams who wish to meet them for the World Wide South America CW Contest. WWSA is sponsored by *Antenna-Eletronica Popular* with the cooperation of Pica-Pau Carioca and other South American CW groups. *Antenna, PO Box 1131, 20001 Rio de Janeiro, RJ, BRASIL.*

GALESBURG IL
JUNE 11–12

If you would be interested in participating in an International Telegraph Speed contest, and want more details on awards, contact *Jim Woods, The Blackhawk Chapter of the Morse Telgraph Club, RR #4 Box 22, Galesburg IL 61401.*

QUEENS NY
JUNE 12

The Hall of Science ARC Hamfest will be at the New York Hall of Science parking lot, Flushing Meadow Park, 47-01-111 Street in Queens from 9 AM to 3 PM. AR exhibit station, tune-up clinic, films. Donation $3. Sellers $5/space. Talk-in on 144.300 simplex link 223.600 repeat and 445.225 repeat. Contact (evenings) *Steve Greenbaum WB2KDG, 718-898-5599 or Arnie Schiffman WB2YXB, 718-343-0172.*

WINFIELD PA
JUNE 12

The Milton and Central Susquehanna ARCs will host the 15th Annual Central PA Ham and Computer Fest at the Winfield Fireman's Fairgrounds from 0800 to 1700 EST. VEC testing (advance registration), good food, contests, Demo BBS, packet radio, and more. Donations $4, YLs, XYLs, and children are free. Tailgating 6' table for $1. Talk-in on 146.97, 147.18, and 146.52. Call or write *Jerry Williamson WA3SXQ, 10 Old Farm Lane, Milton PA 17847, 717-742-3027 or Bob Stahl KA3PYT, 452 Fourth St., Northumberland PA 17857, 717-473-7050.*

COVINGTON KY
JUNE 12

The Northern Kentucky ARC will hold its HAM-O-RAMA 88 at the Erlanger Kentucky Lions Park. Admission $4 in advance, $5 at gate. Children under fourteen free. Prizes, ARRL, packet and emergency forums, vendors, and a outside flea market ($4/space, tables not provided. Talk-in on 147.855/.255 and 147.975/.375. For advance registration or more information, contact *WA4BRM, c/o NKARC, PO Box 281, Florence KY 41042, 606-371-8545.*

WILLOW SPRINGS IL
JUNE 12

The Six Meter Club of Chicago is sponsoring The Thirty-First Annual Hamfest at Santa Fe Park. Admission $3 in advance, $4 at gate. Prizes, large swapper's row, picnic grounds, displays in pavilion, and an AFMARS meeting. Talk-in K9ONA on 146.52 or K9ONA/R 37–97. Advance tickets and information from *Mike Corbett K9ENZ, 606 South Fenton Ave., Romeoville IL 60441.*

AKRON OH
JUNE 12

The 21st Annual Goodyear Family Hamfest will be at Wingfoot Lake Park near Akron. Family admission is $4 in advance, $5 at gate. Picnic and flea market ($3 per vehicle), and sheltered indoor dealer area ($6 per table, advance reservation suggested). Prizes for the OM, XYL, children, and Mobile Check-in. Park facilities and concessions. For tickets and information, contact *Don W. Rogers WA8SXJ, 161 Hawkins Ave., Akron OH 44313. 216-864-3665.*

SOUTH DARTMOUTH MA
JUNE 12

The Southeastern Massachusetts AR Association is holding its Semara Hamfest from 9 AM to 5 PM. General admission is free. Dealer admission is $8 in advance, $10 at door. VEC exams by appointment, Nepra packet workshop, working HF stations, and Tail Gate Sale. Hamfest talk-in on 147.000/.6 and 145.4900/.6 for backup. Contact (send SASE, please) *Peter M. Kodis N1EXA, PO Box 9187, North Dartmouth MA 02747. 617-993-1828.*

PHILADELPHIA PA
JUNE 15

A technical session featuring recent developments in Amateur Radio will be part of the IEEE International Conference on Communications '88 in Philadelphia. Jim Metzger KA3HWD, will take visiting Amateurs on a tour of the club station where they may use the repeaters (145.25 (KA3HWD/R), 224.52 (K2PM/R), and 443.10 (K3QFP/R) at the Liberty Bell site. For information, write *ICC '88, c/o ATT Network Systems, 1800 John F. Kennedy Blvd., Suite 1300, Philadelphia PA 19103 or call 1-800-ICC-88PH or 215-972-1308 (outside the US), weekdays 8 AM to 4:30 PM EST.*

NEW YORK NY
JUNE 16

The IEEE New York Section Broadcast Technology and Vehicular Technology Chapters are sponsoring "Professional Certifications Programs: An Overview." There will be representatives from the SBE, NABER, NARTE, and possibly the FCC. Admission is free. Time: 6:30 PM at the NYC Technical College, Klitgord Auditorium at 285 Jay St., Brooklyn. For more information, call *Mike Hayden at 212-246-2350, ext. 278, from 9–5 PM.*

HUGO CO
JUNE 17–19

The 13th annual SMIRK Party Contest will be held from 1900 CDT on the 17th to 1900 CDT on the 19th. Exchange callsign, SMIRK # and Grid Square. Crossband contacts, multi-operator or partial contacts not allowed. For scoring, rules, and information on awards, write *Lisa Lowell KAØNNO, PO Box 547, Hugo CO 80821.*

CORTLAND NY
JUNE 18

The Courtland Hamfest, sponsored by the Skyline ARC, will have indoor/outdoor flea markets, prizes, plenty of space and refreshments. Talk-in on 147.225 (+600) or 145.490 (-600). For reservations, contact *Skyline Amateur Radio Club, PO Box 5241, Cortland NY 13045 or call Jerry Falletta KD2DR 607-844-9350, Billy Williams N2AGF 607-749-3766, or Bill Ackroyd WA2UFQ 607-844-4815.*

DUNELLEN NJ
JUNE 18

The Raritan Valley Radio Club will hold its 17th annual Hamfest at Columbia Park. Donation $4, children and spouses free. Seller spots are $6/space or $12/multiple spaces. Prizes and refreshments. Talk-in on club repeater W2QW/R 146.025/.625 and 146.52 simplex. Advance tickets from club members or call *Dave KA2TSM at 201-763-4849, or John WA2C at 201-968-5070.*

PARK RIDGE NJ
JUNE 18

The 3rd annual SWL FEST will be at Gilfer Shortwave, 52 Park Ave., from 10 AM to 3 PM. Free admission. $3 per space for sellers (call early for reservations). Contact *Paul Lannuier N2HIE, PO Box 239, Park Ridge NJ 07656. 201-391-7887.*

MIDDLETOWN MD
JUNE 18

The Frederick ARC will hold its 11th Annual Hamfest at the Frederick County Fairgrounds from 8 AM to 4 PM. Admission $3, tailgaters $2 extra. First table $10/ea, extra tables $5/ea. YLs and children free. For more information, write *Dave Durkovic N3BKD, 7128 Limestone Lane, Middletown MD 21769.*

MONROE MI
JUNE 19

The 1988 Monroe County Radio Communications Association Hamfest will be at the Monroe County Fairgrounds. Tickets are $2 in advance or $3 at gate. Spouses, children free. Table space $6 and trunk sales $2 per space. Simplex talk-in on 146.52 MHz. Local repeaters are W3SOG/R on 146.73 MHz and WA3OHI/R on 147.06 MHz. To reserve space or order tickets, send request with SASE to *Larry Lindner KB8AIZ, 2001 Ida-Maybee Rd., Monroe MI 48161 or call Larry at 313-587-3663.*

ESCONDIDO CA
JUNE 19–25

The Escondido Amateur Radio Society will operate N6WB in conjunction with the 100th anniversary of the City of Escondido. For a large certificate, send QSL and large SASE to *Glenn Bodeker N6WB, 127 Walnut Hills Dr., San Marcos CA 92069.*

REDLANDS CA
JUNE 20–JULY 4

KX6B will operate mobile as part of the support team of Car #73 in the running of the 6th annual Great American Race to commemorate the 80th year since the original New York to Paris race. Operations will be daily 1500 UTC until 2300 UTC on the lower 25 kHz of the 40, 20, and 15 meter general phone band. Some evening operation on 75 meter phone band. Mobile Packet on 145.01 and 2 meter FM on area repeaters. For QSL send SASE to *Dick Raley KX6B, 2610 Camloop Drive, San Jose CA 95130.*

KELLEYS ISLAND OH
JUNE 29

Members of the Ohio Underwater Research Association will operate N8HHG from 1500Z to 0100Z underwater from Lake Erie aboard a shipwreck and other submerged as well as surface locations within the Lake Erie Islands area. Frequencies: 7.230, 14.245, 28.450, and 146.475 MHz (all ± 10 kHz). For photo QSL card, send QSL (SWL letter welcome) and SASE to *Paul Buescher N8HHG, 1752 Stone Creek Lane, Twinsburg OH 44087.*

LETTERS

Rare Finds

We, the radio amateur, are our own worst enemy. Good quality public relations that the public can understand is rare. This is only part of the problem. I became an amateur in 1971 while at college. There was a sense of discovery—an air of mysticism, of being able to take junk parts from the local radio/TV shop and make them talk around the world. There was a sense of comradeship, of adventure. Over the years we have lost out: We have become appliance operators lacking the ability to build even the simplest equipment. Part of the problem comes from ham radio magazines. They seem to think that since technology has advanced, so have the building abilities of amateurs. Seldom do I find simple, goof-proof projects using 'Radio Shack' parts that are worth any time or effort to build. If *73* magazine could, in addition to or within its current departments include those simple, goof-proof projects for amateurs, it would be providing a service that no one else provides.

Larry G. Sloop WB4UYY
Millers Creek NC

Many of our readers have similar requests, but how many understand we can only publish what writers send to us? Quality projects are few and far between in every US electronics magazine. Get busy, guys!. . . de NA5E

Russian Views

When I decided to visit the USSR, I started to learn some rudiments of Russian. No, I don't know much, but a minimum, just to ask for my way, for prices, comment about the weather, etc. Our guide did not care about me when he saw that I would not make any trouble for him and that I would not get lost. So, when I wanted to find hams, all I had to do was to examine the antennas on the roofs, and ring at the flats where the coax ended. The Q-code with my micro-knowledge of Russian made the rest. I found lots of helpful friends there. Being quite Vodka-proof, our friendship became even more cordial and I found that at least my friends were not great party fans. They admitted that being a party member helps a lot to get the private ham ticket. They also explained that for hamming they would do even more. Maybe Mr. Gorbatcheff will change the need for such an involvement.

People in the USSR are not easy to access. Their raw behavior shows timidness to strangers. But once the ice is broken, they are friendly, hearty, and handsome. As a foreigner it's up to you to show your interest and good will. Money is no argument for sympathy, in opposition to my experiences in the US.

By the way, do you know why the typical Russian SSB station has its characteristic sheet-iron sound? There is a shortage for all technical components on the privately accessable market. There are no stations to buy, no crystal filters, and no high-tech ICs. So the average station is built from scratch with the available TV repair material, often bought by friends who are thousands of miles away. Several projects have been published in the *Radio* magazine. The best known "19 tube, home built transceiver" is of course always the same model. SSB is made with a balanced multiplier in the 100 kHz region, LC filtered, then mixed up twice. Output power is about 200 watts, using 3 TV line amplifier tubes. How will you expect such a technology to compare to our factory built high-tech transceivers? But at least they build their own stations.

Club stations usually sound better, as they get obsolete marine transceivers which are often older than the operator. Do you really want to criticize these members of the international ham family, just because you had the privilege to be born into an easier world?

Roger A.U. Jung HB9BBR
Switzerland

Having visited 120 countries so far, my interest isn't in remaking them like America as much as seeing them and understanding them. I reported on what I saw and experienced...Wayne

Times Have Changed

I enjoy doing a variety of things within the amateur arena. Sure don't care for the B.S. that clutters up the low bands... sure enjoyed the days when you could get into a good technical conversation with another amateur. I know with the high-tech aspect of equipment these days it requires more study and time, but the rewards are worth it. Of course, the experimenters, innovators and real gentlemen of ham radio are out there, it's just more difficult to find them sometimes.

Bill Tipton W4TAL/NNN0LLX
Navy-Marine Corps MARS
Jacksonville AL

70cm Concern

We have received correspondence from a VE3CAB SAAC News Release alerting us to the fact that the Canadian DOC intends to re-classify a meteorlogical Clear Air Doppler Radar (CADR). Its present operating area is 404.37 MHz and it will be relocated in the 430–450 MHz 70cm amateur radio UHF band. This system, we understand transmits high-power, triple beam, broadband radar pulses.

We are very concerned about the proposed move to these transmitting devices on our northern boarders as it will almost wipe out and QRM the entire 70cm UHF amateur band. It will also disrupt all present modes of FM, SSB, ATV OSCAR, packet, and EME communications! Likewise, if this system is allowed to relocate without challenge, it is just a matter of time before the US will be pressured to endorse such a relocation as well. This will put the highly used 70cm amateur radio band into serious jeopardy!

What is the reason given for this Canadian move? We feel it is a longer range plot to overtake the 70cm amateur UHF band. We have already lost a vast amount of usable frequency spectrum to the LINE-A restrictions placed upon us. We cannot afford to lose any more!

Mike Stone WB0QCD
USATVS
Editor SPEC-COM

Who Wants the Hot Potato?

The FCC has said that recognized coordinators will decide the right to use a given repeater frequency. Great in theory, but who is the recognized frequency coordinator?

Several questions come to mind.

1. Who picks the coordinator?
2. Who determines who is a coordinator?
3. What are the qualifications to be a coordinator?
4. What other factors are to be considered when determining who is the frequency coordinator?

Some hams have suggested that the ARRL act as the coordinators' coordinator. Their answer: No way. Some have suggested the FCC should take a more active role. Their answer: No personnel, no money, and perhaps no care. Let's throw the names in a hat and have a lottery. Why have rules, tests, or even licenses? If nobody cares let's have a ball and we will have the 11-meter mess again.

I don't see Commission lawyers donating any time to the problem. They want to be paid for their time.

Who is going to coordinate the appointment of the arbitrators? What is to be the arbitrators' qualifications? Will the arbitration be binding? Who will defend the arbitrator if he gets sued? (California, with an arbitration statute gives them immunity, but tell that to a bull-headed amateur.) What about any financial liability? Who is going to develop the forms, rules, procedure, and handle the paper work?

Nice idea but . . . I guess we might do it the Old West way: He who has the highest mountain and the biggest amplifier gets the frequency or maybe we will go back to the old repeater wars.

Oh well, welcome to the new Citizen's Band radio. Uncle Charlie old buddy, you really have a hot potato, with lots of potential law suits. I suggest you "Tell it to the Judge," when you are sued, to enforce Part 97.

Joseph Merdler N6AHU
Atty At Law
Los Angeles CA

QRP Confusion

ARRL recommends 7040 kHz for "RTTY DX" while Mike Bryce, representing *73*, calls 7040 kHz "the QRP calling frequency..." My guess is that this co-use of the frequency is pretty hard on the little guys, viz., QRP'ers.

Frank R. Prina N2DLN
Springville NY

Tone Decoder Notes

I'd like to make the following clarifications regarding my 4+1 DTMF decoder (April issue).

The present circuit may not decode tones if the receiver's volume control is set too high. This problem can be reduced by replacing C1 (0.01µf) with a 1kΩ resistor in series with a 0.01µf capacitor. Also, the brightness of LED can be increased by reducing R1. R1 can be as low as 100Ω, depending upon the LED.

If the Midland Technologies PC board is used, note that R9 is wired clockwise to decrease the speaker on time.

Finally, many people spend too much for tone decoder chips. The SSI-202 sometimes sells for $15 or more. The equivalent chip, the RCA CD22204, is sold by RCA distributers in single lots for $4.50. If local distributors do not stock the CD22204, and the builder does not want to wait 12 weeks for delivery, the chip is available through Circuit Specialists (P.O. Box 3047, Scottsdale, AZ 85257) for about $6.

Andrew Mitz WA3LTJ
Kensington, MD

Down Under No-Code

I would like to point out an error in the *QRX* page in the December 1987 issue (only recently received!). Under the heading of "Aussie Novice 2m Phone?", you incorrectly state that "Australia still has no-code license class." Permit me to point out that Australia has had a no-code license class since about 1959, when the "Limited" class license was introduced. It can therefore be seen that Australia has had a no-code licence for something like 30 years, along with many other countries!

Basically, the "Limited" call allows full power and modes on all bands above 30 MHz, and indeed, much of the pioneering work on these bands was performed by these "Z" calls. Why are they called "Z" calls? Under the Australian licensing scheme, "Limited" calls were issued with the series "VKnZAA" to "VKnZZZ", subsequently extended to "Y" suffixes, then "X" suffixes, and now "T" suffixes.

David I. Horsfall VK2KFU
Australia

Computerized CW

I have noticed that CW is not one of Wayne's favorite operating modes. (In fact, it probably does not have a spot on a lot of people's lists of operations.) However, I recently discovered the pleasures of CW via my computer. It is a very interesting way to get on the air.

My XYL gave me an AEA PK-232 for Christmas, and I have had a great time with packet, RTTY, and CW. This morning I had a 45-minute QSO with a local ham on 40m CW. We operated at 30 wpm and discussed antennas, the local ham politics, antenna projects, power supplies, etc.

Dust off your computer and try some computerized CW. I'll bet you enjoy it (despite yourself).

Tom Hart AD1B
Dedham, MA

Circuit Correction

I started building your circuit "Beacon Transmitter" in the April 1988 issue and found that there is a slight problem. In order to get the circuit to oscillate, you need to connect pin #6 to pin #2 on both IC-1 and IC-2. The way it is set up now, the circuit is in the monostable mode and needs a trigger to keep it going. With pin #6 and pin #2 connected, the circuit is in the astable mode and the oscillator will be free running.

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Carpentersville, IL

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It's a lesson you learn very early in life. Many can be good, some may be better, but only one can be the best. The PK-232 is the best multi-mode data controller you can buy.

1 Versatility

The PK-232 should be listed in the amateur radio dictionary under the word Versatile. One data controller that can transmit and receive in six digital modes, and can be used with almost every computer or data terminal. You can even monitor Navtex, the new marine weather and navigational system. Don't forget two radio ports for both VHF and HF, and a no compromise VHF/HF/CW internal modem with an eight pole bandpass filter followed by a limiter discriminator with automatic threshold control.

The internal decoding program (SIAM[tm]) feature can even identify different types of signals for you, including some simple types of RTTY encryption. The only software your computer needs is a terminal program.

PC Pakratt Packet TX/RX Display

Facsimile Screen Display

2 Software Support

While you can use most modem or communications programs with the PK-232, AEA has two very special packages available exclusively for the PK-232....PC Pakratt with Fax for IBM PC and compatible computers, and Com Pakratt with Fax for the Commodore 64 and 128.

Each package includes a terminal program with split screen display, QSO buffer, disk storage of received data, and printer operation, and a second program for transmission/reception and screen display of facsimile signals. The IBM programs are on 5-1/4" disk and the Commodore programs are plug-in ROM cartridges.

3 Proven Winner

No matter what computer or terminal you plan to use, the PK-232 is the best choice for a multi-mode data controller. Over 20,000 amateurs around the world have on-air tested the PK-232 for you. They, along with most major U.S. amateur magazines, have reviewed the PK-232 and found it to be a good value and excellent addition to the ham station.

No other multi-mode controller offers the features and performance of the PK-232. Don't be fooled by imitations. Ask your friends, or call the local amateur radio store. We're confident the PK-232 reputation will convince you that it's time to order your very own PK-232.

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OP ED

by Larry Ledlow, Jr. NA5E

Promoting the Higher Bands

Apparently, most hams' ideas of DX involve the HF bands. Ask a ham to describe what it's like to operate above 30 MHz, and more often than not you'll hear terms like "two meters," "FM" and "repeaters." We have ourselves to blame for perpetuating such narrow views of hamming. We humans sure are creatures of habit. Well, when the language gets too bad on the local two meter machine, or when you get hoarse from yelling into a pileup on 20 meters, think long and hard about exploring some of the many (albeit poorly publicized) possibilities on the VHF and UHF bands.

DX and Contests

Beauty, of course, is in the eye of the beholder, and so is DX. Those two letters, which make up the most popular term in the ham radio lexicon, definitely take on new meaning and present fantastically fun challenges above 30 MHz. Whether chasing countries, zones, states, or grid squares, the DXer gets a kick from working a new one. The tally is a testimony to his or her tenacity and skill. VHF DX is no different.

Six meters usually receives a lot of attention during a few years of every solar cycle. Sporadic E propagation occurs each year, but when the solar index begins to peak, six meters can support worldwide contacts. DXCC and *73*'s DX Dynasty Award on six are becoming relatively easy to obtain, too, since more countries are adopting amateur radio allocations on this band.

More and more DXpeditions these days take along gear for six meters. For example, both Jim Treybig W6JKV on Aruba and Harry Schools KA3B on St. Pierre will have six meter gear turned on for the June 11–12 VHF QSO Party. Bart Jahnke KB9NM will activate 4U1UN on 50 through 2304 MHz (!) for the contest, too. (Don't forget that 4U1UN counts for DXDA and DXCC country credit. It is also in grid square FN30). July 7–14 will also see some HF and six meter activity from PJØM, courtesy of the Six Meter DX Society.

Two and 1.25 meters and 70cm usually come alive with DX activity during the summer, too. Most DX action here is due to tropospheric ducting, which actually occurs with great regularity during the warmest months. Contacts over several hundred miles are very common, even on a bad day. When I lived in the UK, I regularly worked two meters into France, Germany, Switzerland, Scandanavia, and even Eastern Europe using 25 watts from my IC-290H and a single KLM-13LBA antenna. (Get Wayne to tell you about his two meter exploits 40 years ago. Now *that's* DX.) Although the majority of DX contacts involve SSB and CW, try giving a shout on 145.52 FM simplex once in a while.

> ***"Do you think any of these guys would work so hard to turn on these bands if there wasn't any DX action and excitement on VHF and UHF?"***

Our own Pete Putman KT2B and company will take advantage of the generally good VHF and UHF summer conditions along the East Coast to operate in the June QSO Party from Chincoteague Island (grid FM27). His group plans an impressive operation on 50, 144, 220, 430, 903, 1296, and 2304 MHz. Do you think any of these guys would work so hard to turn on these bands if there wasn't any DX action and excitement on VHF and UHF?

Modest Requirements

No, you don't need to go out and spend a zillion dollars on good VHF/UHF gear. You can get perfectly acceptable results with transverters, which will take an SSB signal from, say, your HF rig, translate it to a higher frequency, and downconvert VHF/UHF signals for reception on the HF rig. Many transverters come in kit form, but others are already assembled. You don't need kilowatts of power to have a respectable signal on the higher bands, either. One or 200 watts is serious RF at these frequencies, and a modest VHF amplifier costs about one tenth the price of an HF amplifier.

I like to work at VHF and UHF, because the erection of a high gain antenna system doesn't require a great deal of real estate or manpower. Rotor systems are smaller, too.

All in all, you keep the costs down with smaller system requirements. Take a look at previous "Above and Beyond" columns to see how inexpensively you can get on the other bands.

Campaign for 902 MHz

Not long ago I asked a few hams if they knew of any activity in their area on the 33cm band. More than one answered with something like, "You mean 1296? Nah." No, I meant 33cm, not 23. "*That's* not a ham band . . . is it?" All together, hit list. They'll be after that band once they get 220 MHz.

I had a nice chat the other day on 70cm with Harry Chase WA1VVH. Harry's got the UHF bug, and he's doing a lot of interesting work on 902 and 1296 MHz. In fact, Harry is custodian of the 919.10 MHz repeater in Pepperell, MA. He expressed disappointment at the lack of press 902 MHz gets. I have been pro-902 from the beginning, and I thought Harry brought up some valid points. I think *73* should do its bit to promote activity on 33cm.

There's a great lack of detailed information on groups actually involved with 33cm work. I know of a few ATV and repeater clubs, and packeteers are investigating high-speed networks on this band. Most of these groups operate in relative isolation, however. We need to document and keep track of all the activity on 902 MHz to aid and encourage these groups' work. Also, a central source of 33cm material would help dispel the notion that there's no activity on the band. This will be very important when the FCC accepts a petition from a commercial interest group to take the 33cm band away from us.

> ***"Think long and hard about exploring some of the many (albeit poorly publicized) possibilities on the VHF and UHF bands."***

now, turn to Section 97.61 of the Amateur Radio Service Rules and Regulations. Yes, the 902–928 MHz band is allocated to amateur radio.

Take a look at the 1987–88 *ARRL Repeater Directory*. You'll find a handful of 900 MHz ATV repeaters and two-and-a-half dozen FM repeaters scattered from Massachusetts to California. Disappointing, to say the least, but understandable considering the lack of readily available 900 MHz equipment. Certainly the Big Three amateur radio manufacturers don't support 902 MHz, and I've only come across a couple of 33cm transverters in the past several years.

I don't get it. We go to all the trouble to get a 902 MHz allocation from WARC, and hardly anyone takes advantage of it! You'd better believe that 902 MHz is next on the commercial interest

Thus, we have two main goals for the "73 for 33" campaign. We need an individual or group to coordinate and disseminate 33cm information, and to keep 902 MHz enthusiasts in touch with each other. Then, of course, we need the shakers and movers at 902 to start writing articles promoting the band. Since there is little commercial gear available, I expect quite a few good 33cm projects to grace the pages of *73*. Get busy and start writing!

Is this just a 902 MHz pie in the sky? Well, that's what a lot of people thought about Wayne's push for FM repeaters 20 years ago. Sometime around 1998, when I ask hams to describe the activity on VHF and UHF, I expect to hear things like "digital ATV," "40 megabaud," and even "902 MHz." Remember, 73 for 33! 73

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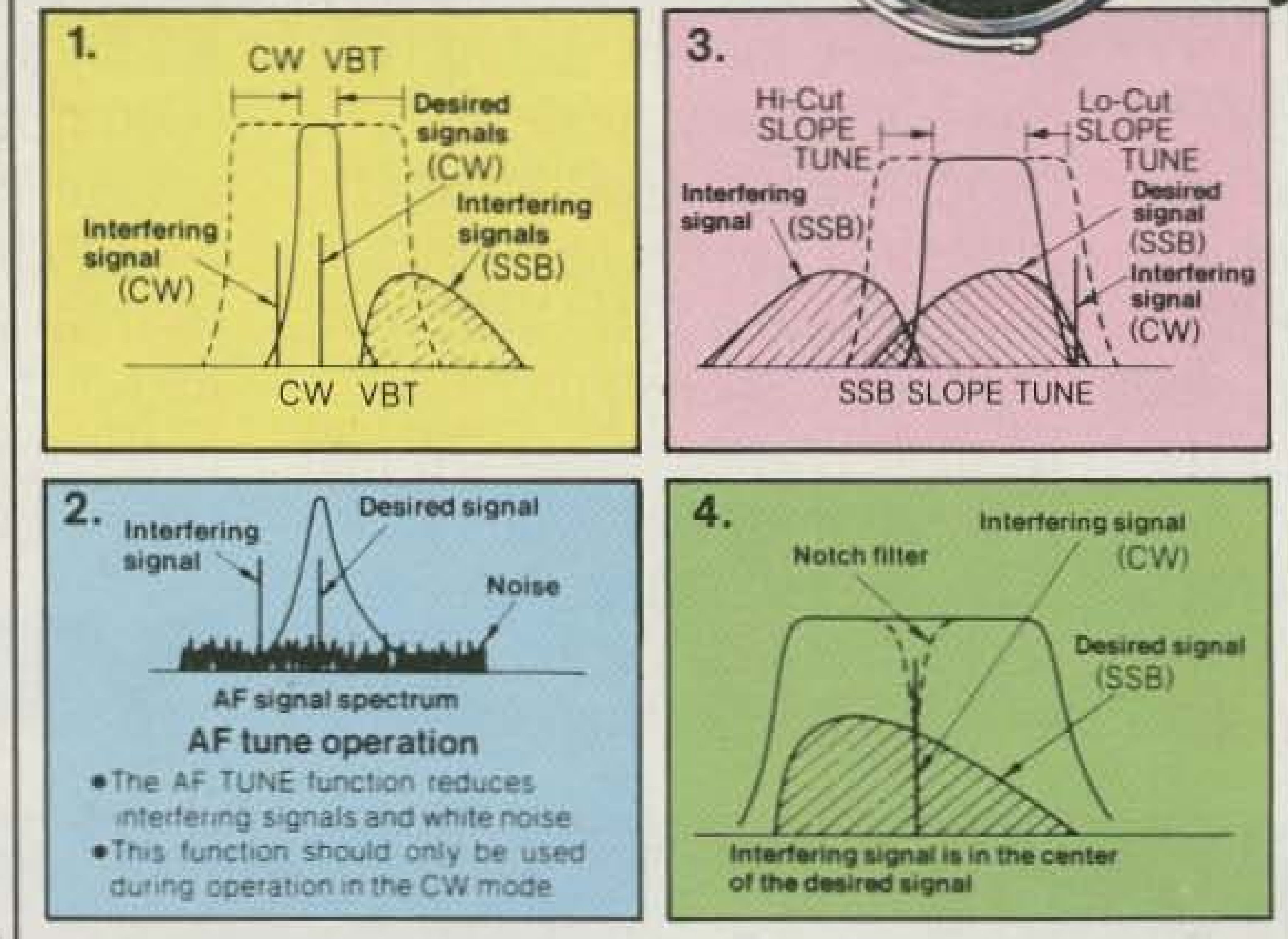

1) CW Variable Bandwidth Tuning. Vary the passband width continuously in the CW, FSK, and AM modes, without affecting the center frequency. This effectively minimizes QRM from nearby SSB and CW signals.

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Complete service manuals are available for all Kenwood transceivers and most accessories. Specifications, features, and prices are subject to change without notice or obligation.

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