December 1980 $2.95

73 MAGAZINE

FOR RADIO AMATEURS

Who Really Invented Radio?

tempo does it again

THE WORLD'S FIRST 440 MHz SYNTHESIZED HAND HELD RADIO

Tempo was the first with a synthesized hand held for amateur use, first with a 220 MHz synthesized hand held, first with a 5 watt output synthesized hand held.. and once again first in the 440 MHz range with the S-4, a fully synthesized hand held radio. Not only does Tempo offer the broadest line of synthesized hand helds, but its standards of reliability are unsurpassed...reliability proven through millions of hours of operation. No other hand held has been so thoroughly field tested, is so simple to operate or offers so much value. The Tempo S-4 offers the opportunity to get on 440 MHz from where ever you may be. With the addition of a touch tone pad and matching power amplifier its versatility is also unsurpassed.

The S-4...$349.00
With 12 button touch tone pad...$399.00
With 16 button touch tone pad...$419.00
S-40 matching 40 watt output 13.8 VDC power amplifier...$149.00

Tempo S-1

The first and most thoroughly field tested hand held synthesized radio available today. Many thousands are now in use and the letters of praise still pour in. The S-1 is the most simple radio to operate and is built to provide years of dependable service. Despite its light weight and small size it is built to withstand rough handling and hard use. Its heavy duty battery pack allows more operating time between charges and its new lower price makes it even more affordable.

Tempo S-5

Offers the same field proven reliability, features and specifications as the S-1 except that the S-5 provides a big 5 watt output (or 1 watt low power operation). They both have external microphone capability and can be operated with matching solid state power amplifiers (30 watt or 80 watt output). Allows your hand held to double as a powerful mobile or base radio.

S-30...$89.00* S-80...$149.00*

*For use with S-1 and S-5

Tempo S-2

With an S-2 in your car or pocket you can use 220 MHz repeaters throughout the U.S. It offers all the advanced engineering, premium quality components and features of the S-1 and S-5. The S-2 offers 1000 channels in an extremely lightweight but rugged case.

If you're not on 220 this is the perfect way to get started. With the addition of the S-20 Tempo solid state amplifier it becomes a powerful mobile or base station. If you have a 220 MHz station, the S-2 will add tremendous versatility.

Price...$349.00 (With touch tone pad installed...$399.00)
S-20...$89.00

Specifications:
Frequency Coverage: 440 to 449.995 MHz
Channel Spacing: 30 KHz minimum
Power Requirements: 9.6 VDC
Current Drain: 17 ma-standby 400 ma-transmit (1 amp high power)
Antenna Impedance: 50 ohms
Sensitivity: Better than .5 microvolts nominal for 20 db
Supplied Accessories: Rubber flex antenna 450 ma ni-cad battery pack, charger and earphone
RF output Power: Nominal 3 watts high or 1 watt low power
Repeater Offset: ± 5 MHz

Optional Accessories for all models
12 button touch tone pad (not installed): $39 • 16 button touch tone pad (not installed): $48 • Tone burst generator: $29.95 • CTCSS sub-audible tone control: $29.95 • Leather holster: $20 • Cigarette lighter plug mobile charging unit: $6

TEMPO VHF & UHF SOLID STATE POWER AMPLIFIERS

Boost your signal. . . give it the range and clarity of a high powered base station. VHF (135 to 175 MHz)

Drive Power	Output	Model No.	Price
2W	130W	130A02	$209
10W	130W	130A10	$189
30W	130W	130A30	$199
2W	80W	80A02	$169
10W	80W	80A10	$149
30W	80W	80A30	$159
2W	50W	50A02	$129
2W	30W	30A02	$ 89

UHF (400 to 512 MHz) models, lower power and FCC type accepted models also available.

53 YEARS OF SERVICE

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Henry Radio

Please note, as of Dec. 1, 1980 we will occupy our new world headquarters building with a new Los Angeles address and phone number.

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A LIFETIME GUARANTEE AND 11 OTHER REASONS TO BUY AN "OPTOELECTRONICS" FREQUENCY COUNTER

1. SENSITIVITY: Superb amplifier circuitry with performance that can't be matched at twice the price. Average sensitivity of better than 15 mV from 10 Hz to 500 MHz on every model and better than 30 mV from 500 MHz to 1.1 GHz on the Series 8010A and 8013.

2. RESOLUTION: 0.1 Hz to 12 MHz, 1 Hz to 50 MHz, 10 Hz over 50 MHz.

3. ALL METAL CASES: Not only are the heavy gauge aluminum cases rugged and attractive, they provide the RF shielding and minimize RFI so necessary in many user environments.

4. EXTERNAL CLOCK INPUT/OUTPUT: Standard on the 8010/8013 series and optional on the 7010 series is a buffered 10 MHz clock time base input/output port on the rear panel. Numerous uses include phase comparison of counter time base with WWVB (U.S. National Bureau of Standards). Standardize calibration of all counters at a facility with a common 10 MHz external clock signal, calibrate scopes and other test equipment with the output from precision time base in counter, etc., etc.

5. ACCURACY: A choice of precision to ultra precision time base oscillators. Our ± 1 PPM TCXO (temperature compensated xtal oscillator) and ± 0.1 PPM TCXO are sealed units tested over 20-40°C. They contain voltage regulation circuitry for immunity to power variations in main instrument power supply, a 10 turn (50 PPM) calibration adjustment for easy, accurate setability and a heavily buffered output prevents circuit loads from affecting oscillator. Available in the 8010 and 8013 series is our new ultra precision micro power proportional oven oscillator. With ±.05 PPM typical stability over 10-45°C, this new time base incorporates all of the advantages of our TCXO's and virtually none of the disadvantages of the traditional ovenized oscillator: Requires less than 4 minutes warm-up time, small physical size and has a peak current drain of less than 100 ma.

6. RAPID DISPLAY UPDATE: Internal housekeeping functions require only .2 seconds between any gate or sample time period. At a 1 second gate time the counter will display a new count every 1.2 seconds, on a 10 second gate time a new count is displayed every 10.2 seconds. (10.2 seconds is the maximum time required between display updates for any resolution on any model listed).

7. PORTABILITY: All models are delivered with a 115 VAC adapter, a 12 VDC cord with plug and may be equipped with an optional ni-cad rechargeable battery pack installed within its case. The optional Ni-Cad pack may be recharged with 12 VDC or the AC adapter provided.

8. COMPACT SIZES: State-of-the-Art circuitry and external AC adapters allowed design of compact easy to use and transport instruments.
Series 8010/8013: 3" H x 7-1/2" W x 6-1/2" D
Series 7010: 1-3/4" H x 4-1/4" W x 5-1/4" D

9. MADE IN U.S.A.: All models are designed and manufactured at our modern 13,000 square foot facility at Ft. Lauderdale, Florida.

10. CERTIFIED CALIBRATION: All models meet FCC specs for frequency measurement and provided with each model is a certificate of NBS traceable calibration.

11. LIFE TIME GUARANTEE: Using the latest State-of-the-Art LSI circuitry, parts count is kept to a minimum and internal case temperature is only a few degrees above ambient resulting in long component life and reliable operation. (No custom IC's are used.) To demonstrate our confidence in these designs, all parts (excluding batteries) and service labor are 100% guaranteed for life to the original purchaser. (Transportation expense not covered).

12. PRICE: Whether you choose a series 7010 600 MHz counter or a series 8013 1.3 GHz instrument it will compete at twice its price for comparable quality and performance.

MODEL 8010A/8013 1.1 GHz/1.3 GHz

MODEL 7010A 600 MHz

MODEL	RANGE (From 10 Hz)	10 MHz TIME BASE			AVG. SENSITIVITY		GATE TIMES	RESOLUTION			EXT. CLOCK INPUT/OUTPUT	SENSITIVITY CONTROL	NI-CAD BATTERY PACK
		STABILITY	AGING	DESIGN	10 Hz to 500 MHz	500 MHz to 1.1 GHz		12 MHz	60 MHz	Max. Freq.			
7010A	600 MHz	± 1 PPM	<1 PPM/YR	TCXO*	15 mV	N/A	(3) 1, 1, 10 sec	.1 Hz	1 Hz	10 Hz (600 MHz)	YES OPTIONAL	NO	YES OPTIONAL
7010.1A		± 0.1 PPM											
8010A	1.1 GHz	± 1 PPM	<1 PPM/YR	TCXO*	15 mV	30 mV	(4) .01, .1, 1, 10 sec.	.1 Hz	1 Hz	10 Hz (1.1 GHz)	YES STANDARD	YES	YES OPTIONAL
8010.1A		± 0.1 PPM											
8010.05A		± .05 PPM		OCXO**									
8013.1	1.3 GHz	± 0.1 PPM	<1 PPM/YR	TCXO*	15 mV	30 mV	(4) .01, .1, 1, 10 sec.	.1 Hz	1 Hz	10 Hz (1.3 GHz)	YES STANDARD	YES	YES OPTIONAL
8013.05		± .05 PPM		OCXO**									

*TCXO = Temperature Compensated Xtal Oscillator **OCXO = Proportional Oven Controlled Xtal Oscillator

SERIES 7010A

#7010A	600 MHz Counter - 1 PPM TCXO	$199.95
#7010.1A	600 MHz Counter - 0.1 PPM TCXO	$249.95
OPTIONS:		
#70-H	Handle/Tilt Bail (not shown)	$2.95
#Ni-Cad-701	Ni-Cad Battery Pack & Charging Circuitry Installed Inside Unit	$19.95
#EC 70	External Clock Input/Output	$35.00
#CC 70	Carry Case - Padded Black Vinyl	$9.95

SERIES 8010A/8013

#8010A	1.1 GHz Counter - 1 PPM TCXO	$399.00
#8010.1A	1.1 GHz Counter - 0.1 PPM TCXO	$450.00
#8010.05A	1.3 GHz Counter - .05 PPM Oven	$499.00
#8013.1	1.3 GHz Counter - 0.1 PPM TCXO	$550.00
#8013.05	1.3 GHz Counter - .05 PPM Oven	$599.00
OPTIONS		
#Ni-Cad-801	Ni-Cad Battery Pack & Charging Circuitry Installed Inside Unit	$49.95
#CC-80	Carry Case - Padded Black Vinyl	$ 9.95

ACCESSORIES

#TA-100	Telescope antenna with right angle BNC	$ 9.95
#P-100	Probe, 50 Ohm, 1X	$13.95
#P-101	Probe, Lo-Pass Audio Usage	$16.95
#P-102	Probe, Hi-Z General Purpose	$16.95
#LFM-1110	Low Frequency Multiplier X 10, X 100, X 1000 For High Resolution of Audio Freq.	$119.95

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Contributions in the form of manuscripts with drawings and/or photographs are welcome and will be considered for possible publication. We can assume no responsibility for loss or damage to any material. Please enclose a stamped, self-addressed envelope with each submission. Payment for the use of any unsolicited material will be made upon acceptance. All contributions should be directed to the *73* editorial offices. "How to Write for 73" guidelines are available upon request.

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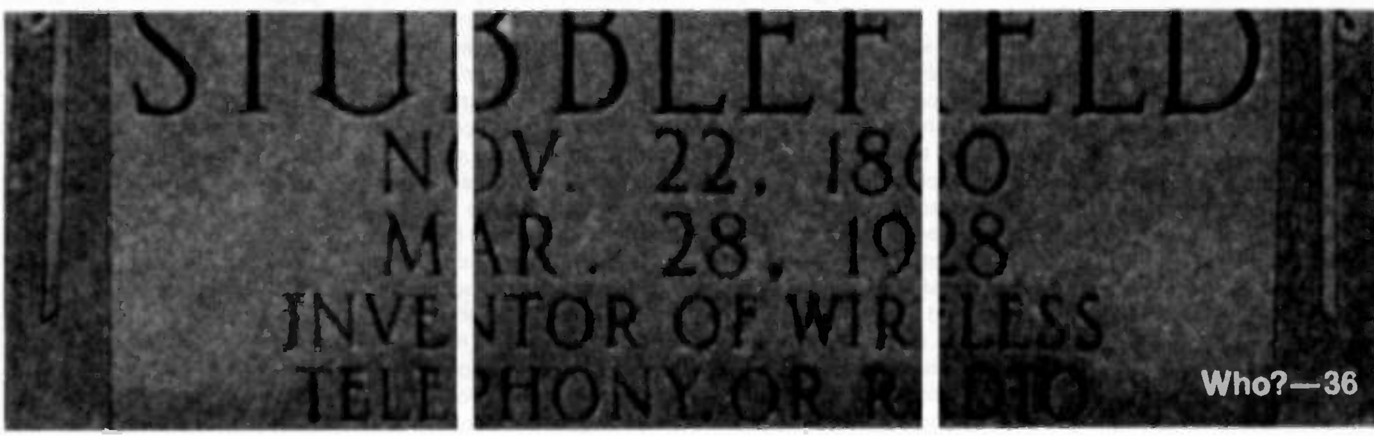
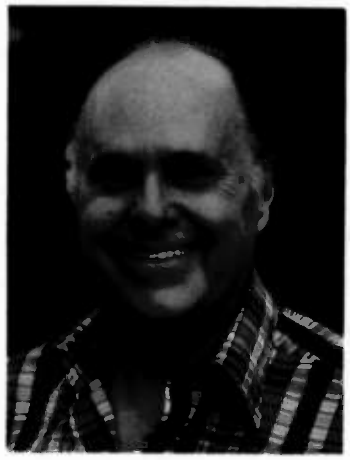

Who?—36

W2NSD/1
NEVER SAY DIE
editorial by Wayne Green



SHADES OF THE PAST!

The year was 1950 and Wayne Green, not very long out of college, was fresh from a job in Dallas as a television producer-director (the damned station went from live productions to all film, throwing the entire production crew out of work). I was looking for something temporary to tide me over until I could find work in television again.

Having a first class ticket and experience as an announcer, I put an ad in *Broadcasting*, looking for a combination spot: engineer-announcer. There was a big need for that kind of experience at that time and I was soon sitting there sorting out telegrams from over 50 broadcast stations with good jobs open. One of the best bets was from WSPB in Sarasota, Florida.

I loaded my ham gear into my old 1941 Ford . . . NBFM kilowatt for all bands, dipole antenna, SX-28A receiver . . . and drove down to Sarasota, the "Air Conditioned City." It was pleasant there temperaturewise, but the mosquitos were worse than those in New Jersey or the swamps of Brooklyn.

It didn't take long before I settled into a comfortable routine, opening the station mornings, lying on the beach afternoons, and hamming evenings. One of the chaps who popped in to do a radio show daily was Bandel Linn, also a ham. We hit it off right away. Linn lived nearby on one of the keys and his mailbox said, "Corporal Bandel Linn." This was in retaliation for all the other mailboxes with retired colonels, generals, and such.

One of Bandel's best friends was a little known writer, McKinley Cantor. He became better known after his book, *Andersonville* was published. He's had a peck of best sellers down through the years. McKinley would come by the station occasionally with Bandel and we'd talk. I think the thing I enjoyed the most about both of them was their sense of humor.

McKinley did a number on Bandel one time. He went out and bought an enormous number of old books from a defunct used book store. He had a stamp made up which said, "If found, please return to Bandel Linn" . . . etc., along with Linn's address. McKinley traveled a lot and would drop off these books in stores everywhere he went. Bandel was soon up to here in returned books, arriving with every mail from all over the country . . . or people driving up to bring them back personally.

When I decided to start a ham magazine in 1960, I got in touch with Bandel, who in addition to being a great radio personality was also a nationally known cartoonist, and got him to do the cover for issue #1. Bandel is still cartooning and broadcasting, holding forth from Pensacola these days. I get to see him every now and then when I get down to Mobile for the reunion of my old submarine crew.

There are a few people I've known who have really been enjoyable to talk with . . . such as Jean Shepherd, John Campbell, and Linn. All are hams, oddly enough, though I seldom talked hamming with any of them. John is gone now, but he left a raft of admirers. I'm sure it was his editorials in *Astounding Science Fiction* . . . and later in *Analog* . . . which got me started writing long editorials. I enjoyed them for years and it just never occurred to me that an editor would do anything other than write long editorials. I don't think I gave it much thought until a couple of months ago when it suddenly dawned on me that I'm probably the *only* editor writing these damned things.

Of course the pressures of writing editorials for three big magazines a month, plus a fourth just for the microcomputer industry, and the shadow of two more magazines getting started all helped to focus my awareness on a good thing overdone. Now, with a month-long trip coming up to Asia, the managing editors are pushing me to write a month ahead. Hells bells, I can hardly get 'em done for one month, much less two.

We've got a series of cartoons by Bandel starting in the magazine. I hope you enjoy his humor as much as I do.

THAT ARKANSAS WARHEAD

Those of you who read the fine print on the silo explosion in Arkansas may have noticed that the newspapers were able to print a transcript of a tape-recorded Air Force radio conversation about the search for the warhead. Some chap has receivers tuned to Air Force and other channels with recorders ready in case of any emergency . . . then he is able to sell the information to the papers. If ever there was a case where the FCC rules in Section 605 regarding the privacy of radio transmissions was being broken, it is here. If the FCC lets this go untouched, they are turning their heads when their rules are clearly being broken.

It is against the law to sell information gotten over the air from anything other than broadcast stations. This is the heart of 605. The reception is not prohibited, only the *use* of the information. What are you going to do about this, FCC?

SAROC SHOOTS SELF IN FOOT

The pitiful shreds of what was once a halfway decent hamfest will be aired again in January. This, I believe, is a commercial exploitation of hams for the personal gain of one chap, who the last I heard was disavowed by all ham clubs which had ever tried to work with him. At the last of these hamfests I attended, the technical sessions were a joke and the exhibits few. The advanced registration for this disaster is $16, if you are that eager to throw your money away.

The hamfest has been bounced from one hotel to another, presumably for some good reason. Now it is at the Dunes and filling a date obviously unwanted by any sane group: January 1. Bring playing cards, if you are so totally desperate on New Year's Day as to go to this silly thing . . . so at least you'll have *something* to do.

One of the major ham dealers tried exhibiting at the show not long ago and went away totally disgusted. Other than some free booze courtesy of *Ham Radio* magazine, apparently out to help create more alcoholics, the dealer felt ripped off.

If you are absolutely desperate to go to Vegas, wait a couple days and catch the Winter Consumer Electronics Show, starting January 8th. Then, if you still have time on your hands, why not come up to Vail for the ham industry convention January 10-17th?

NARA EVAPORATED

A couple of months ago, I wrote about what appeared to be a scam to fleece hams, with the only action I could see coming from a chap with a bad record . . . convicted of conning hams. If there was anyone who did not get his money back from NARA, I'd like to hear from them.

I first heard of this one while at a hamfest in Wiesbaden, Germany, last May. A chap there had just come from the Dayton Hamvention and mentioned that NARA was there, taking memberships. I was at a loss to understand how a group could get started without being in touch with me . . . if they were legiti-

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Processor, N/W switch, IF shift, DFC option

TS-130S/V

An incredibly compact, full-featured, all solid-state HF SSB/CW transceiver for both mobile and fixed operation. It covers 3.5 to 29.7 MHz (including the three new Amateur bands!) and is loaded with optimum operating features such as digital display, IF shift, speech processor, narrow/wide filter selection (on both SSB and CW), and optional DFC-230 digital frequency controller. The TS-130S runs high power and the TS-130V is a low-power version for QRP applications.

TS-130 SERIES FEATURES:

- **80-10 meters, including three new bands**
  Covers all Amateur bands from 3.5 to 29.7 MHz, including the new 10, 18, and 24-MHz bands. Receives WWV on 10 MHz. VFO covers more than 50 kHz above and below each 500-kHz band.
- **Two power versions . . . easy operation**
  TS-130S runs 200 W PEP/160 W DC input on 80-15 meters and 160 W PEP/140 W DC on 12 and 10 meters. TS-130V runs 25 W PEP/20 W DC input on all bands. Solid-state, wideband final amplifier eliminates transmitter tuning, and receiver wideband RF amplifiers eliminate preselector peaking.
- **Built-in speech processor**
  Increases audio punch and average SSB output power, while suppressing sideband splatter.
- **CW narrow/wide selection**
  "N-W" switch allows selection of wide and narrow bandwidths. Wide CW and SSB bandwidths are the same. Optional YK-88C (500 Hz) or YK-88CN (270 Hz) filter may be installed for narrow CW.
- **SSB narrow selection**
  "N-W" switch allows selection of narrow SSB bandwidth to eliminate QRM, when optional YK-88SN (1.8 kHz) filter is installed. (CW filter may still be selected in CW mode.)
- **Sideband mode selected automatically**
  LSB is selected on 40 meters and below, and USB on 30 meters and above. SSB REVERSE position is provided on the MODE switch.
- **Built-in digital display**
  Six-digit green fluorescent tube display indicates actual operating frequency to 100 Hz. Also indicates external VFO or fixed-channel frequency, RIT shift, and CW transmit/receive shifts. Also analog sub-dial for backup frequency indication.
- **IF shift**
  Allows IF passband to be moved away from interfering signals and sideband splatter.
- **Single-conversion PLL system**
  Improves stability as well as transmit and receive spurious characteristics.
- **Built-in RF attenuator**
  For optimum rejection of intermodulation distortion.
- **Built-in VOX**
  For convenient SSB operation, as well as semi break-in CW with sidetone.
- **Effective noise blanker**
  Eliminates pulse-type interference such as ignition noise.
- **Built-in 25-kHz marker**
  Accurate frequency reference for calibration.
- **Compact and lightweight**
  Measures only 3-3/4 inches high, 9-1/2 inches wide, and 11-9/16 inches deep, and weighs only 12.3 pounds. It is styled to enhance the appearance of any fixed or mobile station.

Optional DFC-230 Digital Frequency Controller
Allows frequency control in 20-Hz steps with UP/DOWN microphone (supplied with DFC-230). Includes four memories (handy for split-frequency operation) and digital display. Covers 100 kHz above and below each 500-kHz band. Very compact.

Ask your Authorized Kenwood Dealer about the compact, full-featured, all solid-state TS-130 Series.

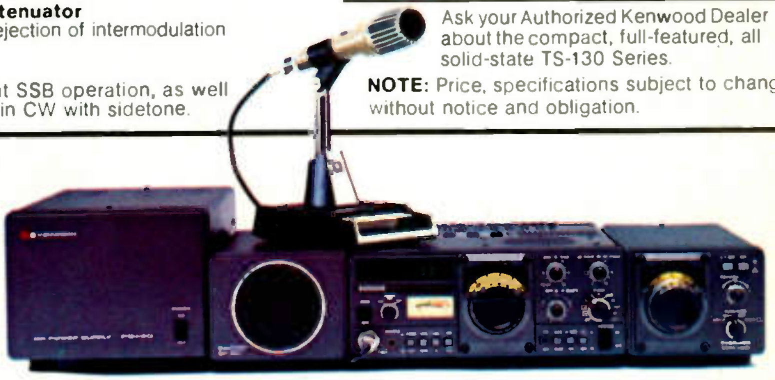
NOTE: Price, specifications subject to change without notice and obligation.

MATCHING ACCESSORIES FOR FIXED-STATION OPERATION:

- PS-30 base-station power supply (remotely switchable on and off with TS-130S power switch).
- SP-120 external speaker
- VFO-120 remote VFO
- MC-50 50kΩ/500Ω desk microphone

Other accessories not shown:

- YK-88C (500 Hz) and YK-88CN (270 Hz) CW filters
- YK-88SN (1.8 kHz) narrow SSB filter
- AT-130 compact antenna tuner (80-10 m, including 3 new bands)
- MB-100 mobile mounting bracket
- MC-30S and MC-35S noise cancelling hand microphones
- PC-1 phone patch
- TL-922A linear amplifier
- HS-5 and HS-4 headphones
- HC-10 world digital clock
- PS-20 base-station power supply for TS-130V
- SP-40 compact mobile speaker
- VFO-230 digital VFO with five memories



mate. The story of a group of ten hams putting up $35,000 each in seed money didn't ring true either. I know many of the hams with a spare $35,000 and I can't believe they would put out that kind of loot without checking with me.

Then, I found out who the chap was behind the whole thing and remembered his previous record. Ask the ARRL about it; *QST* ran his ads which brought about the troubles and the conviction. But if something like this was afoot, why no word from the ARRL? They certainly couldn't say they didn't hear about it...or that they didn't know the chap. I have no explanation for this.

Once my editorial piece appeared, NARA seemed to disappear. I got a letter from a ham who had joined, saying he had gotten his $10 back and that the NARA telephone number had been disconnected, with no forwarding number. He did some sleuthing and found that the chap had moved to Virginia and was now operating under the name of Keswick Sales, with ads in the yellow sheets. The report went on to say that over two hundred orders had been received with payments, but nothing had been shipped and no payments had been returned. No explanation by mail to the customers. It appears that the FTC rules on back orders has already been broken. Will he move on again, leaving mulcted hams in his wake?

ELECTRONIC DESIGN BUNK

I really hate it when I see another magazine print a letter from some uninformed person and it puts down amateur radio. Thanks to W5IFH for sending me a clipping from the September 13th issue of *Electronic Design*, wherein is a letter from a Collins man, a program engineer named Roe. He fears that amateurs now are "nothing more than hobbyists and gadgeteers, lacking the inquisitive and inventive spirit which made the early days of amateur radio so productive. Now, the only innovations come from the R&D labs of the amateur equipment manufacturers."

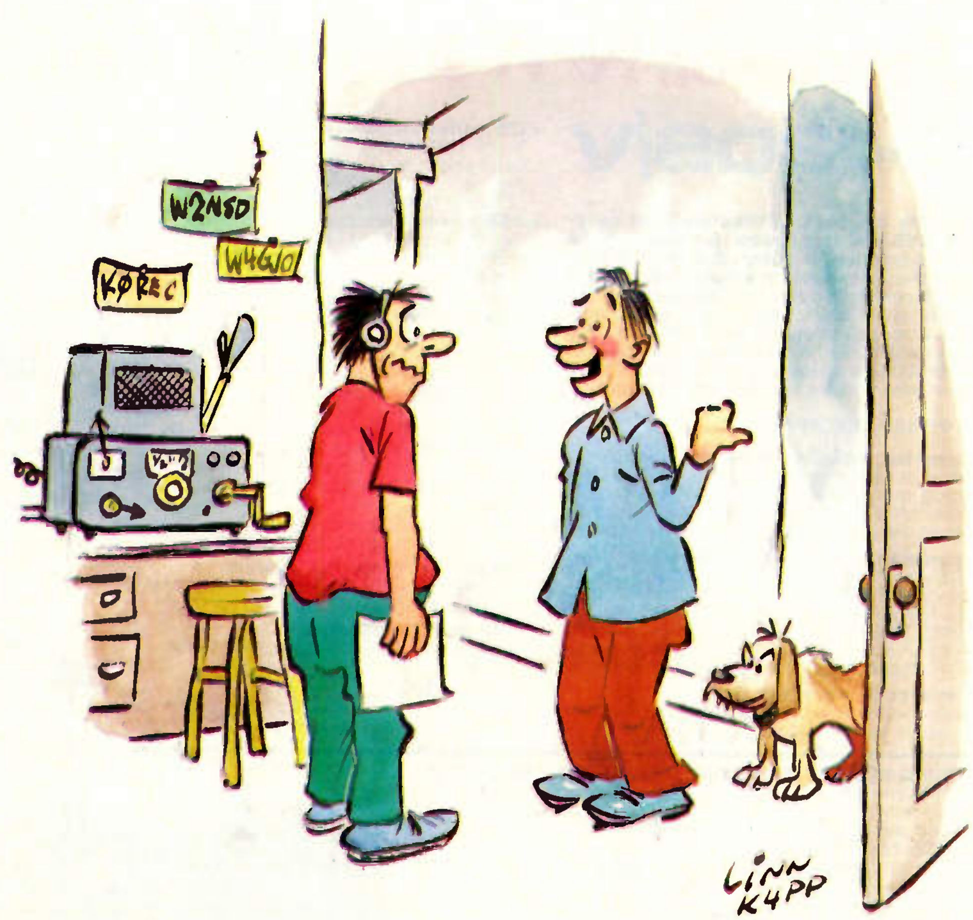
Amateur radio needs this type of hogwash like another Incentive Licensing attack. The facts are quite otherwise, as Roe would know if he were a reader of *73*. It is true that the FCC has been doing all in its power to prohibit amateurs from experimenting and pursuing the FCC's own regulations (see 97.1c), but despite this, amateurs have been building more than ever before in history and have been developing new circuits and modes of communications.

In case you think that hams are not building...and I get that crap a lot from old-timers who

Continued on page 189

Well...I Can Dream, Can't I?

by Bandel Linn K4PP

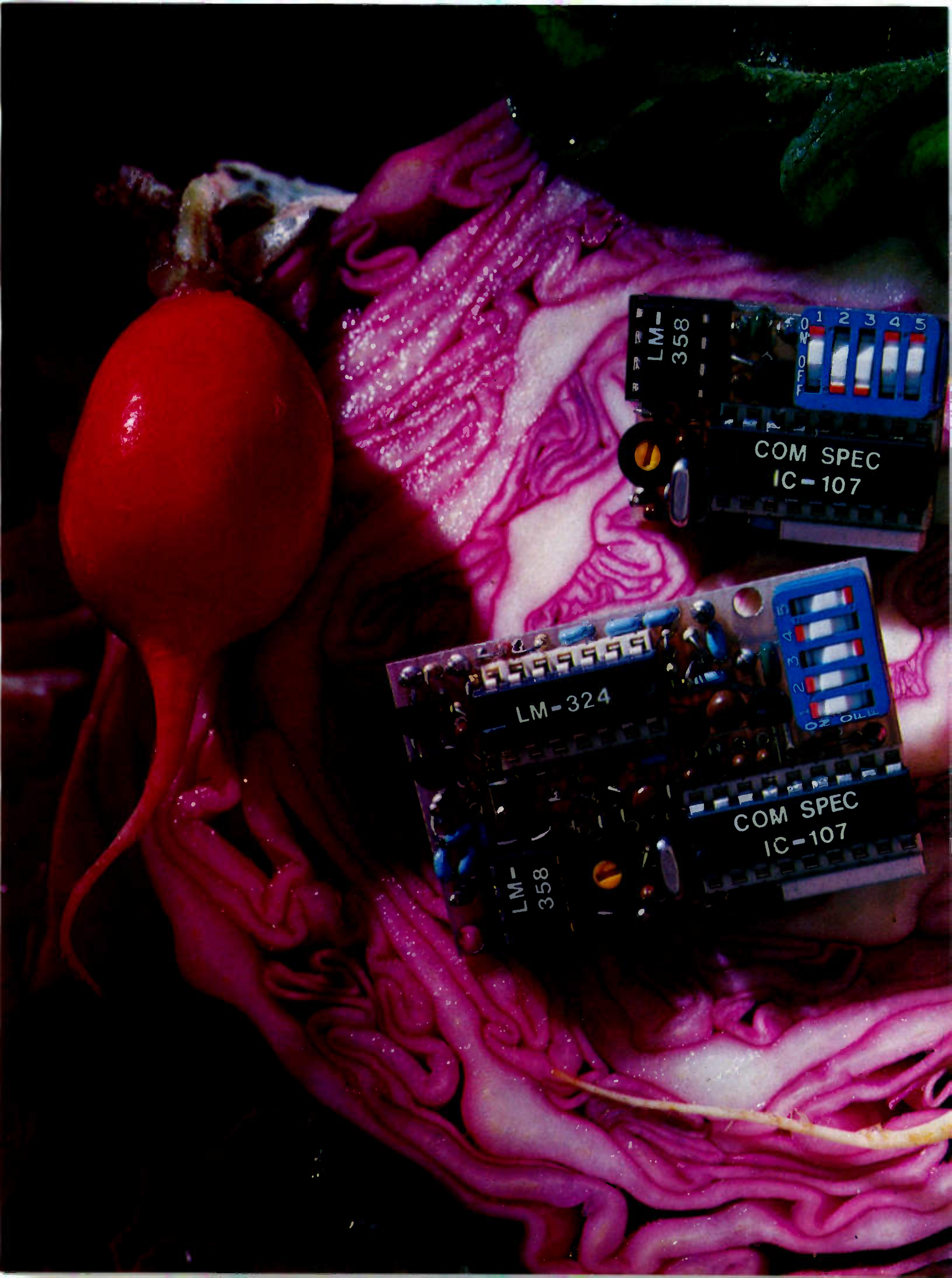


"I live next door and I came over to thank you for those little squiggles and lines on my TV—They're very interesting!"

2A Versatility

10 Options Guaranteed to Make the Extremely Popular 2A and 2AT Even More Popular!

ICOM


LM-358
ON OFF
0 1 2 3 4 5
COM SPEC
IC-107
LM-324
1 2 3 4 5
ON OFF
COM SPEC
IC-107
LM-358

A fresh idea!

Our new crop of tone equipment is the freshest thing growing in the encoder/decoder field today. All tones are instantly programmable by setting a dip switch; no counter is required. Frequency accuracy is an astonishing ± .1 Hz over all temperature extremes. Multiple tone frequency operation is a snap since the dip switch may be remoted. Our SS-32 encode only model is programmed for all 32 CTCSS tones or all test tones, touch-tones and burst-tones. And, of course, there's no need to mention our 1 day delivery and 1 year warranty.

TS-32 Encoder-Decoder

- Size: 1.25″ x 2.0″ x .40″
- High-pass tone filter included that may be muted
- Meets all new RS-220-A specifications
- Available in all 32 EIA standard CTCSS tones

SS-32 Encoder

- Size: .9″ x 1.3″ x .40″
- Available with either Group A or Group B tones

Frequencies Available:

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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2805			1800	2100	2350	

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15

LOOKING WEST

Bill Pasternak WA6ITF
24854-C Newhall Ave.
Newhall CA 91321

OPEN REPEATERS DON'T EXIST DEPARTMENT

There is no such thing as an "open" repeater—at least not in the eyes of the Federal Communications Commission. This came about as the final result of a well-intentioned rulemaking request filed some three years ago by a Texas amateur. Jones Talley W5TJE had requested that closed and private repeater operation be outlawed. In addition, Mr. Talley felt that much on-channel interference between repeaters could be eliminated by lowering all repeater power levels.

I recently interviewed Mr. Talley for Westlink and found him to be a most delightful person. Moreover, he is a very dedicated amateur. He told me that the reasoning behind his twin petitions (There were two, but the FCC elected to combine both into one rulemaking action.) was that he and many others felt that repeater operations that required membership in an organization were not in the spirit of the amateur service. Further, that with the large number of repeaters currently operating, there was precious little spectrum left for new operations. By lowering the power levels, there would be less chance of on-channel interference as new systems came into being. I should add that Mr. Talley is a broadcast engineer with many years of experience behind him. He understands very well the many technical aspects of radio communication.

So, Mr. Talley elected to file his petitions to lower maximum power levels for repeater operation and also to gain acknowledgement for the concept of the open repeater, a concept that we as amateurs have understood for years. For many moons, things sat quiet in Washington—not a peep on the topic. Most amateurs, including me, had all but forgotten that such a rulemaking request was on file with the Commission.

Then, in late July, came the blockbuster. It was all but unnoticed by most hams since it was merely a dismissal order on two rulemaking requests, one of which belonged to Mr. Talley. It was only after reading the order several times that the implications came to light, that in the eyes of the FCC, no such thing as an open repeater existed. In fact, the text you are about to read is that of the order itself. I suggest that you pay close attention to the first portion of Section 2, because this may well set a precedent.

Before the
Federal Communications Commission
Washington, D.C. 20554
PR
FCC 80-351
27525

In the Matter of

Rulemaking petitions
requesting "open" repeaters; and,
to require license endorsement
authorizing repeater operation.
RM-2844 and RM-3461

ORDER

Adopted: June 17, 1980;

Released: July 2, 1980

By the Commission:

1. Rulemaking petition RM-2844, submitted by Jones P. Talley (W5TJE), of Dallas, Texas, proposed that Section 97.85 of the Amateur Radio Service rules be amended by adding a provision that no repeater be operated as a "closed" repeater. In support of his petition, Mr. Talley offered these reasons. He said that, in the majority of the country, there are no longer any available frequencies for new repeaters. Further, according to the petitioner, no one, in the history of the Amateur Radio Service, has ever had an assigned or a closed frequency. Mr. Talley feels that the Amateur Radio Service should remain open and clear for all properly licensed Amateur radio operators. In addition, petitioner suggested that Section 97.67 of the Commission's Rules be amended to lower the maximum amount of power that Amateur radio stations in repeater operation could use. For example, on frequency bands above 52 MHz, the power would be 50 Watts, rather than 100 Watts, where the antenna height above average terrain is below 100 feet. His reason for the proposal is that he believes that most repeaters are covering more area than just the local area, thereby causing interference between repeaters in surrounding areas. This, in turn, he alleges, is why the surrounding areas have no available frequencies. Mr. Talley says that lower maximum power levels will correct this problem. Only one comment was filed in RM-2844. The Amateur Radio Club of the Veterans Administration Medical Center, Montrose, New York, supported the petition saying that closed repeaters violate the spirit of Amateur radio communications.

2. With respect to the matter of forbidding a station in repeater operation to be closed to anyone, we do not agree that such a stance is desirable. The control operator of the station must be in a position to deny access to any person who is violating our rules. Any other view would be construed as our approval of unlawful acts. Moreover, a fundamental principle is at stake here. At all times, the control operator of a station in repeater operation is responsible for the proper operation of the station. Open repeaters would militate against that basic operator accountability. Further, we do not concur in Mr. Talley's suggestion to lower the maximum power levels for repeaters. The maximum power levels specified in the present rules are not mandatory. Less power may always be used. In fact, we expect Amateur radio operators to take appropriate means to avoid interfering with each other's transmissions. Amateur radio licensees have always been known for self-disciplining and a cooperative spirit in the use of Amateur radio frequencies. There is no reason to believe that they have relinquished working together to solve mutual usage problems.

5. Accordingly, in view of the reasons herein given, it appears that the public interest would best be served by dismissing the instant petitions. Therefore, IT IS ORDERED, That RM-2844 and RM-3461 ARE DISMISSED and that these proceedings ARE TERMINATED. For further information, contact Maurice J. DePont, 2025 M Street, N.W., Washington, D.C. 20554, (202)-254-6884.

FEDERAL COMMUNICATIONS COMMISSION
William J. Tricarico
Secretary

Now, before you run out and tell all your users that they must immediately purchase some form of CTCSS generator if they intend to continue operating on your repeater, sit back a moment and permit me to point out why this is not necessary. We must go back into the archives a bit, but I think you will enjoy the trip, especially if you are a newcomer to FM.

In the late 1960s, amateur radio FM and repeater operation took off like the proverbial bat out of you know where. After a while, some amateurs who just could not leave well enough alone decided that what repeaters needed were rules, and a number of petitions were sent to the FCC requesting these. As usual, time went by, and in the interim, the problems inherent to the implementation of anything new were solved. In this case, the solution took the form of individuals and groups providing voluntary coordination for repeater operations. Then, with the arrival of the 1970s, came something known as Docket 18803. 18803's implementation brought FM relay growth to a screeching halt. The regulations were *that* restrictive. They also were not needed—the problems had been solved.

For a number of years, amateurs from all over the nation worked hard to try to initiate some relief from the restrictions of 18803. Among these was Capt. Richard McKay K6VGP. Dick owned a "private" category repeater located in Palos Verdes and was able to obtain "Special Temporary Authority" to operate his repeater without 24-hour-a-day, full-time control operators on hand.

The success of this experiment on WR6AAD convinced the Commission to issue another "Special Temporary Authority" to the Palisades Amateur Radio Club of Culver City, California, for a similar experiment. After a year's time and many filings with the Commission detailing progress of the experiments, a petition was filed to permit what was termed "automatic remote control" over amateur repeaters.

One of the first actions taken in the deregulatory process was the adoption of two control standards based upon the classification a repeater operated under. A closed or private repeater could operate under the doctrine of "fully automatic remote control," while open repeaters were given limited relief in the form of "semi-automatic remote control." I won't go into the details of each at this time; it would take pages to do so. An exact account of the entire deregulatory process can be found by going through back issues of *73* containing this column. We lived it and we reported on each step in the long process.

What is important is the contention that this first step in deregulation of amateur relay activity initially gave FCC recognition of both open and closed/private repeater operation. This being the case, the report and dismissal order on RM-2844 is a direct contradiction of what has been stated in the past. Additionally, while we in amateur radio have developed our own definitions concerning relay system operation categorization, the FCC never has done likewise. You and I know what constitutes an open, closed, or private repeater, but the Commission has never seen fit to offer any definitions of their own.

Continued on page 192

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DX

Jim Cain K1TN
306 Vernon Avenue
Vernon CT 06066

THE NEW BREED

Comments made here the past few months have brought some interesting letters, most reinforcing our own attitudes about DXing today compared to a decade or more ago. As very little of life in 1980 is like life in 1960, it comes as no particular surprise that amateur radio in general and DXing specifically often leave many old-timers somewhat cold.

For example, the FCC has just announced that the CW portion of their exams is changing again, with the exams to be only ten questions, fill-in-the-blank instead of multiple choice, and a passing grade will be only seventy percent instead of eighty. This is a test?

On the same sheet where we read that FCC news was the story of a Conditional class amateur who was traversing the court system because he had not, for some obscure reason, been grandfathered to General class. The FCC had called him in to take a 13-wpm code test and he refused. Obviously, he doesn't know the code, probably cheated on his original Conditional test (with the aid of another amateur, sorry to say), and that's that.

Aside from the FCC making it possible for people to operate kilowatt transmitters on the HF bands with little or no knowledge of what are recognized as basic radio techniques, the actual styles of operating today often add to the confusion and lowering of standards on the bands. Here's a case:

An American operated last autumn from Africa, on CW only, from a fairly rare country. Great, you say, at least he knows the code! True, but his methods frustrated many who also know the code. Operating split, this DXer listened up in frequency, often as much as 50 kHz. In addition, he Immediately moved his receiving vfo after each contact, making it nigh impossible for the good operators to ply their trade of finding his last contact, zeroing the frequency, and making one short call on his known listening frequency—not "tail-ending," mind you, but just being where the DX is listening is operating at its best. It was not to be in this case.

It used to be that when the neophyte DXer discovered he could not always crack the pileups with a hundred Watts and a dipole, pennies began going into the bank for an amplifier, and a safety belt was purchased for future antenna work. Learning to trust the belt, lean back, and use both hands on the tower was part of the process whereby one became a "real ham," a "true DXer," or whatever. It was simple: If you couldn't get through to the station you wanted, either your signal was too weak or your operating technique was not appropriate. And the solutions were equally straightforward: Build a better station, practice operating, and be patient. As a result, the bands continually witnessed new crops of hams who became proficient by their own efforts. (Made it without using the word "bootstraps!")

Now that this hole has been dug, I might as well just climb on in. Today's saviors of the bands have found new solutions to the devastating blow of not being able to work your favorite DX station. Those solutions are called "nets" and "lists." They have ruined DXing for what it once was: the second most competitive aspect of amateur radio (after contesting).

It seems unlikely that anyone reading this column does not know the net and list style; either one uses it or hates it or, occasionally, both. Let's look at the implications of this new breed of operator and the possible future in store if the trends continue.

The list and net operator (L/N) will tell us that the new style enables the weaker stations to work through to the DX, that L/N maintains order on the bands, that it gives everyone a fair shake, and, hoo-boy, here it comes, that new DX operators are spared the massive pileups which had previously driven a few of them into other pursuits, such as stamp collecting. We are sure to hear from some of you with other justifications, such as that there are just too many hams on the bands now when compared to 1960 and new techniques are consequently required, or that maybe not everyone can afford a second vfo in order to operate split.

Of course, it will be said that if an operator wishes to use L/N because he is an inexperienced amateur on Island X (which everyone needs), it is his own decision and those who don't like it can lump it. Those who play his game will be rewarded with a contact (often despite the fact that they can't hear him). Those who refuse to play the game will go away empty-handed.

A parallel: The US national speed limit is now 55 mph, on highways designed for 70 mph + driving. This was instituted in 1974 to "save gas," and was later further justified by a contrived set of statistics "proving" the reduced speeds resulted in fewer highway accident deaths. Voilà! The temporary law becomes permanent.

The fact is that L/N has driven off more avid DXers in a couple of years than pileups ever did in forty years. L/N has raised a cacophony of tooth grinding by those with beams, amplifiers, and savvy. L/N is what brought the "frequency policemen" and catcallers to their heyday, as they trash the frequencies in anger at their inability to just jump in there and call until they work what they want.

In fact, highway deaths have not gone down, particularly on the limited-access interstates. As for fuel consumption, guzzlers do use less fuel at 55 than at 70; so do, for that matter, all autos. Now here's the point: Say you are driving, oh, a diesel Rabbit at 50 mpg and are restrained to 55 mph so the Cadillacs can produce 18 instead of 15 mpg. You have gone the full mile to conserve fuel; you have reacted to the situation in the most efficient, intelligent manner. Yet, you are punished because you are in the minority.

Back to the new DX station on the band. You wrenched your back getting that new beam up, smelled up the entire house smoke-testing your new amplifier, but now you're LOUD. Further, you have practiced your ham radio hobby, not expecting to set the world on fire your first couple of years on the bands, but now you're a "good operator." Now you've found that DX station, but they've already taken calls from your call area and you might just as well turn off your radios. So mail your postcard to the list taker for the next time, take down your beam, and sell your amplifier, because when your turn comes, you won't need them. You won't need your brain, either.

What's coming in the future? Unfortunately, probably more of the same, as mediocrity breeds mediocrity. As more and more new DXers come to know no operating style other than L/N, they will demand, verily, that L/N becomes the norm. New, inexperienced operators may be easily enticed into the rut, during that period of time when they need a sheet to determine whether it is the plate current or the output that is supposed to be peaked. As L/N grows, additional DXers will be driven from the bands only to be replaced by still more L/N operators.

Make no mistake about it! It already is happening, and the pace is accelerating. Blame it on the lax FCC exams, on the Welfare State, on the "Me Decade," on the weather, on the Democrats, the Republicans, the hippies. The only ones who can reverse the trend and make DXing what it once was—a competitive activity—are you and me. DXing was never supposed to be easy, from the first time Hiram Percy Maxim used a relay in Windsor Locks to work from Hartford to Massachusetts. DXing has been the true spirit of amateur radio. If it ceases to be so, many will find new hobbies and hamming will be the less for their loss.

One thing L/N has done is given amateur radio column writers and bulletin editors some cannon fodder, as they stake their claims on one side of the issue or the other. You may disagree violently with this column's

Continued on page 182

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600 khz offset
simplex/duplex
Hi/lo power

TOP VIEW

BNC antenna connector "Rubber Duckie" standard
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squelch
volume control

on/off
5 khz channel selection
10 khz channel selection
speaker/mic jack

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CONTESTS

Robert Baker WB2GFE
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Atco NJ 08004

CONNECTICUT QSO PARTY
Starts: 2000 GMT December 6
Ends: 0200 GMT December 8
Rest period: 0500 to 1200 GMT December 7

Sponsored by the Candlewood Amateur Radio Association (CARA). Phone and CW are considered to be the same contest. Stations may be worked once on each band and each mode. Out-of-state portables and mobiles operating in Connecticut are requested to identify themselves as such as are Connecticut mobiles operating in other counties.

EXCHANGE:

Send QSO number, RS(T), and ARRL section or Connecticut county.

SCORING:

Out-of-state stations multiply total QSOs by the number of Connecticut counties worked (8 maximum). Connecticut stations multiply total QSOs by the sum of ARRL sections and provinces. Additional DX contacts count for QSO points, but only one DX multiplier overall is allowed. W1QI, the club station, will be operating CW on the odd hours and SSB on the even hours, and counts as 5 points on each band and mode. Novice contacts count as 2 points each and OSCAR contacts count 3 points each.

FREQUENCIES:

CW—40 kHz up from the bottom of each band.

SSB—3927, 7250, 14295, 21370, 28540.

Novice—3725, 7125, 21125, 28125.

ENTRIES & AWARDS:

A Worked All Connecticut Counties certificate will be awarded to each station working all Connecticut counties. Other awards given as usual, minimum of 5 QSO points! Logs must show category, date/time (GMT), stations, numbers, bands, QSO points, and claimed scores. Enclose a large SASE for results. Logs must be postmarked by January 2nd and sent to: CARA, c/o Steve Grouse KA1ECL, 3 Queens Court, Danbury CT 06810.

CANADA CONTEST
Starts: 0001 GMT December 28
Ends: 2359 GMT December 28

Sponsored by the Canadian Amateur Radio Federation, the contest is open to all amateurs. Use all bands from 160 to 2 meters, CW and phone combined, and everybody works everybody. Classes of entry include: single-operator, all band; single-operator, single-band; and multi-operator, single-transmitter, all band. All contacts with amateur stations are valid. The same station may be worked twice on each band: once on CW and once on phone. No cross-mode contacts and no CW contacts in the phone bands allowed.

EXCHANGE:

Signal report and consecutive serial number starting with 001. VE1 stations will also send their province (NS, NB, PEI).

SCORING:

10 points for each contact with Canada, 1 point for each contact with others. 10 bonus points for each contact with any CARF official news station using the suffix TCA or VCA. Multipliers are the number of Canadian provinces/territories worked on each band and mode (12 provinces/territories × 8 bands × 2 modes for a maximum of 192 possible multipliers).

FREQUENCIES (as applicable):

Phone—1810, 3770, 3900, 7070, 7230, 14150, 14300, 21200, 21400, 28500, 50100, 146520.

CW—1810, 3525, 7025, 14025, 21025, 28025, 50100, 144100.

Suggest phone on the even hours (GMT), CW on the odd hours.

AWARDS:

The CARF Canada Contest Trophy will be awarded to the highest scoring single-operator entry. Certificates will be awarded to the highest score in each entry class in each province/territory, USA call area, and DX country, to the highest score from a Canadian non-advanced amateur (no phone on 3.5-21 MHz), and where participation warrants.

ENTRIES

A valid entry must contain log sheets, dupe sheets, and a summary sheet showing a chart of multipliers per band/mode and score calculation. Send your entry with comments to: Canadian Amateur Radio Federation, 203-1946 York Avenue, Van-

Continued on page 182

CALENDAR

Dec 6-7	**ARRL 160-Meter Contest**
Dec 6-8	**Connecticut QSO Party**
Dec 13-14	**ARRL 10-Meter Contest**
Dec 28	**Canada Contest**
Jan 3-5	**Zero District QSO Party**
Jan 10-11	**Hunting Lions in the Air**
Jan 17-18	**73's International 160-Meter Phone Contest**
Jan 17-18	**Michigan QRP Club CW Contest**
Jan 17-19	**QRP SSB QSO Party**
Jan 18	**FRACAP Worldwide Contest**
Mar 7-8	**1981 SSTV Contest**
Mar 21-22	**Bermuda Contest**
Aug 8-9	**European DX Contest—CW**
Sep 12-13	**European DX Contest—Phone**
Nov 14-15	**European DX Contest—RTTY**

RESULTS

BERMUDA CONTEST 1980 RESULTS

West Germany

DK9WB	383,295
DK5EZ	343,600
DL7SU	113,220
DF6UO	109,410
DF9ZP	78,715
DK8OP	32,065
DF6JX	22,100
DF1JI	19,450
DF6AT	15,795
DL2OY	14,740

USA

W3MA	128,975
N1ZZ	125,775
KB8JF	71,225
K3DH	39,600
WA2RUX	31,510
W3HNK	25,415
K6SVL	16,260
KA1EP	15,900
W9RE	14,880
W2FFQ	12,500

United Kingdom

G4DSE	532,740
G3VPW	484,560
G3VOF	267,930
GI4ELQ	102,600
GI4ISR	72,080
G3TKF	56,140
G2FXQ	16,290
G4FJT	13,910
G4HQN	7,370
G4GFH	5,680

Canada

VE5RA	100,270
VE3HGZ	99,000
VE1AIH	72,450
VE3NE	45,560
VE2NL	43,520
VE3DJX	13,870
VE3KK	8,550
VE4ADS	2,520

Bermuda

VP9IB	3,025,000
VP9IX	1,128,245
VP9IW	557,230
VP9JQ	68,370

Check Logs

DF0HX	VP9CP
DL0JK	VP9HL
HI3DJP/W2	VP9II
VE3PE/VP9	VP9IJ
VE7VX	VP9KL
VP9AD	W3ARK

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All Lunar products are designed and manufactured under the direct supervision of Louis Anciaux, head of Lunar Electronics. While Lunar maintains a complete QA department, Louis controls the final check-out. If it's not right, it's not shipped.

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LUNAR LINEARIZED AMPLIFIERS

One reason our Linearized amp/pre-amp combos are the best selling amps in the amateur market is the superior linearity our units exhibit in the SSB mode. To be "Linear," the amplifier's output signal must be an exact reproduction of the input signal, with only the power level changed.

Lunar is the originator of the LINEARIZED process, and all of our amps exhibit this by the very small amount of side-splatter produced. Others may attempt to copy us. But, why buy a copy when you can have the original.

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For 220 MHz
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FOR COMMUNICATION CAPABILITY

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RTTY LOOP

Marc I. Leavey, M.D. WA3AJR
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December would be a bleak month indeed, if it were not for the holidays at the end. Whether you celebrate Christmas or Hanukkah, or just enjoy exchanging gifts, the season provides a warm flicker in the middle of winter. This month, we will look at some gift ideas for the amateur involved in RTTY. Perhaps this will give you an excuse to let this copy of *73* sit around where someone else can see it!

At the outset, let me make it clear that I am not describing expensive or exotic items. Most of these will be under ten dollars, and many far less than that. Several of them are not even exclusively amateur radio items, which will make it that much easier for the spouse or child to find. Above all, I have tried to compile a list of unique gift ideas that are affordable, useful, and obtainable, any one of which would delight the heart of the recipient.

As any of us in RTTY know, it is the little things that mean a lot. A trip to any stationery store will turn up many items useful to the RTTYer. Ribbons are always needed by the hard-copy devotee. There is no need to look far and wide for Teletype® ribbons; standard Underwood typewriter ribbons are a perfect fit and are usually much more available. For hard usage, heavily inked cotton ribbons, specifically made for teleprinter applications, are best, and these may often be found at larger office supply houses.

What do we type on but paper, and this is another item often in short supply in the shack. I have found that standard roll paper, 8.5 inches wide, is available from most business form suppliers at a fairly reasonable price. Look in the Yellow Pages for a supplier near you and check several out. While you are asking, check on the availability of 11/32-inch paper tape. This is another perpetual "need" of the teleprintophile, especially one who is involved with RTTY art or traffic, both of which are quite popular this time of year. Although hamfests are usually the most economical places to stock up on these paper goods, they can be had, albeit at list price, from dealers in most areas.

Maintenance items for the mechanical teleprinter are often overlooked and fall into the "make-do" category. How about a big can of grease for the type bars? Lubriplate is one popular make and is available at most large hardware stores. Don't forget the oil for the felts. I use automobile oil; get something expensive for snob appeal—it goes a long way! Is the print all mucked up? Get back to the stationery store for some type cleaner. All kinds of products are available, from liquids to gobs of sticky stuff to press into the type. The kind I have found most useful is a sheet designed to be placed into the machine, like a piece of paper, with the ribbon off. Run all the characters a few times on tape and the type is clean! A sure winner for anyone.

Perhaps the ham is interested in keeping the shack looking tiptop (obviously never saw mine!). Black wrinkle finishes, such as are found on many kinds of RTTY equipment, perk up nicely under a coat of black liquid shoe polish. When you're getting a bottle, pick up some paste wax, the old-fashioned kind, for other equipment finishes around the shack. A bottle of spray-on glass cleaner would round out a "spic-and-span" gift package.

Another item, the need for which is obvious to anyone who ever worked on a teleprinter away from running water, is a box of pre-moistened hand wipes, like "Wash-n-Dry." Certainly not expensive, but throw it into any of the above packages, or by itself, and it will be appreciated the first time something breaks down.

For the RTTYer who is using a computer, consider a supply of cassettes or diskettes. Neither is very expensive, but they come in handy when you need to make a record of something. Diskette cases, which are now stocked by many office supply houses, come in useful for organizing the disk-based shack; cassette racks, which are available in a wide variety of styles at audio and discount houses, do the same for the taper.

Consider reading material. Subscriptions to *73 Magazine*, *RTTY Journal*, or other amateur radio publications may be just the ticket. If computers are involved, try *Kilobaud Microcomputing*, *80 Microcomputing* (for the TRS-80 addict), *68 Micro Journal*, or any of the other computer magazines. Look through the *73* Bookshop ad in the back of this magazine for many titles of interest to the RTTYer, computerist, and ham in general. There is surely one there to delight any ham.

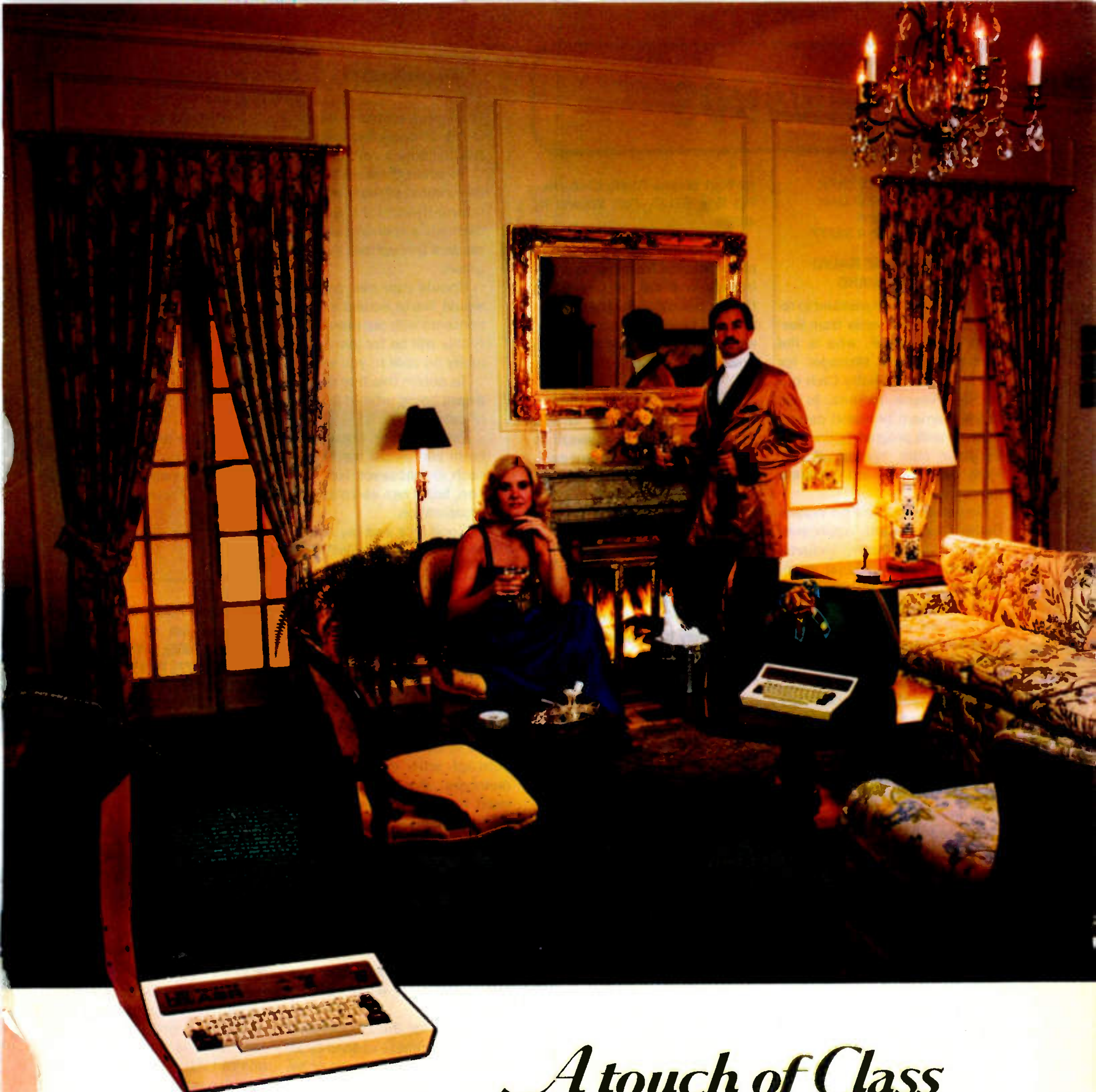
In the realm of reading material that may be more difficult to come by, is there a set of manuals to the RTTY machine in your life? The Teletype Corporation put out extensive manuals on the Model 15, Model 19, Model 28, and other Teletype machines in common use. If you, or your ham, do not have them, check the ads for suppliers who may. Finding them may be difficult, but there will be real joy in the eyes when they detail the way to deal with a problem.

Want to spend a little more money? How about a low-priced demodulator? Monitors are available for those computer nuts who are still using converted TV sets. Other kinds of gizmos are out there, any of which would be eagerly received by a hungry ham. Logic probes, breadboard kits, and gift certificates at a local emporium on up to hundred-dollar counters, single-board computers, and disk drives, there is something to delight the ham's heart from pennies up. I hope these suggestions help.

Now let's pick up a letter from Wayne Hall WB4OGM from Colorado. Wayne writes that he has acquired a MITS 680b microcomputer, which has all of 1K of RAM in it, and wonders if there is any way to add more memory. For those who are not familiar with the 680b, this was a machine that MITS, whose first machine, the Altair 8800, started this computer craze, brought out to exploit the then-new Motorola 6800. Although it used the same CPU as the more-successful Southwest Tech 6800 machine, it used a bus unique to itself. Thus, neither S-100 boards nor SS-50 boards will fit.

Well, this problem was tackled in an article in *Kilobaud* (that's all it was called then!) in its third issue, March, 1977. In fact, there are two articles on the 680b in that issue. The first, by Anthony R. Curtis, describes building the 680b and is a sketchy review of the box. The other article, entitled "Make Your 680b Smarter," describes the efforts of Stu Mitchell and Phil Poole to design and build an S-100 adapter that fits inside the 680b case. This allows the use of S-100 memory. Although an 8K board was considered hot stuff back in 1977 (my, how time flies), you can get quite a bit more on a board now. The article includes a printed circuit layout of the board and full details on implementing the augmentation.

More reviews on the way, with whatever I can lay my hands on as the target. Reader questions and more fun, here in RTTY Loop in eighty-one!



AWARDS

Bill Gosney WB7BFK
2665 North 1250 East
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Oak Harbor WA 98277

FORT WAYNE RADIO CLUB AWARD

This week, I was pleased to receive a very nice letter from Bernard Holm K9JDF, who is the Communications Manager for the Fort Wayne Radio Club out of Fort Wayne, Indiana. In his letter, Bernard provided details of an awards program sponsored by their club station, W9TE. Here are the award program details.

To qualify for the Fort Wayne Radio Club Award, applicants within Allen County, Indiana, must work 25 individual members of the Fort Wayne Radio Club. Applicants located elsewhere in the United States must work a minimum of 5 Fort Wayne Radio Club members. There are no band or mode restrictions, but all contacts must be made after January 1, 1979, to be valid.

To apply, prepare a list of claimed contacts in order by callsign. Include the name of the station operator, the date and time worked in GMT, and the mode and band of operation. Have this list verified by at least two other amateurs or by a radio club official, stating that QSL cards were in your possession at the time verification was made.

Enclose your application with an award fee of $1.00 or 2 IRCs to: Fort Wayne Radio Club, Inc., PO Box 15127, Fort Wayne IN 46885.

Last month, I featured a couple of awards from our amateur friends in Brazil. Not realizing the popularity of these programs, I received two more that I would like to share with you now.

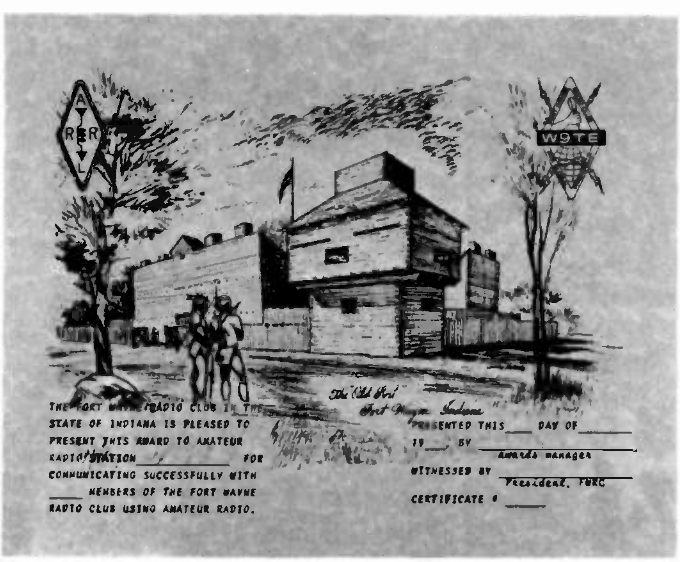
GPCW AWARD FROM BRAZIL

Sponsored by the Grupo Praiano de CW, this award is made available to amateur operators throughout the world.

To qualify for the GPCW award, applicants must establish two-way contacts with at least 5 members of the Group. These contacts must have been made after November 5, 1973, to be valid. All authorized amateur bands may be utilized, but only CW contacts with a minimum report of 338 may be claimed.

To apply, prepare your list of contacts, listing the usual logbook information, and have it authenticated by a local radio club or at least two fellow amateurs. Enclose your application with at least 5 IRCs to: GPCW, Box 556, 11100 - Santos, Brasil, South America.

GPCW members who qualify as contacts are: PY2ARX, BBO, BKT, BOP, CE, CJW, CSI, CYE, CZL, DBU, DHP (YL), DYX, EQR, EW, EWB, FYF, EXD, FDO, FNB, FPE, FRW, GUN, GYJ, RG, TT, YON, ZY, and PY1DG/2.



AN OPEN LETTER TO CLUBS AND ORGANIZATIONS

Each year, literally thousands in our fraternity of radio amateurs seek ultimate recognition by accomplishing the many levels of operating excellence. And, thus, "award hunting" has become a unique aspect in amateur radio operation.

To achieve the many goals established by them, amateurs rely almost entirely on publications such as *73 Magazine* to inform them of the various award incentives. Each month, I dedicate a special multi-page Awards column to over 150,000 readers throughout the world. With every edition, this figure grows.

Should your own organization have an awards program, I would like to extend a personal invitation for you to share its contents with our many readers. What an excellent opportunity this will be for you to gain worldwide recognition at absolutely no cost to you whatsoever!

To obtain this free service, please forward 1) rules for each award being offered and 2) a sample copy of each award certificate.

Perhaps your organization doesn't have an awards program yet? Allow me to encourage your officers to consider such an endeavor. Not only will it bring immediate recognition, but it can serve as a reliable source of revenue for your organization.

Good luck and my sincere thanks for your dedicated support!—Bill Gosney WB7BFK

PPC AWARD FROM BRAZIL

Radio amateurs the world over are invited to become eligible for the PPC Award, sometimes referred to as the "Carioca Woodpecker's Award."

To qualify, applicants are required to establish two-way CW contact with different PPC members. Brazilian amateurs must make 10 contacts, while amateur operators located outside the country of Brazil must conduct 5 individual QSOs on the CW bands.

To be valid, all contacts must be made after March 1, 1965, which is hailed as Rio de Janeiro's 4th centenary. A minimum signal report of 338 must have been logged for each claimed contact.

To apply for the PPC Award, have your contacts verified by at least two fellow amateurs or by a radio club official. Enclose this list along with an award fee of 5 IRCs addressed to: PPC Bureau, PO Box 2675, 20000 Rio de Janeiro, RJ, Brazil, South America.

This award also may be earned by SWLs and the same rules apply.

PPC members are: PY1AFA, ARS, AVV, AZ, BHO, BIR, BLG, BOA, CBW, CC, CCE, CFS, CIP, CMT, CTP, DDI, DMZ, DNL, DNS, DOG, DUB, DUJ (YL), EFX, EHF (YL), EHN, EIR, HO, JN, KO, LA, LG, MB, RJ, SJ (YL), PY2EW, PY2FWT, PY2RG, PY4CZ, PY6HL, PY7CGV (YL), and the following list of Silent Keys: PY1AIF (1966), PY1BXO (1968), PY1DB (1977), PY1TC (1977), and PY1DNN (1977).

Traveling abroad, we learn of a very challenging award from Sardinia. At least from a DXer's standpoint on the west coast of the states, this one ain't easy, my friend!

GOLD SARDINIA AWARD

Sponsored by the URS Club of Sassari, Sardinia, the Gold Sardinia Award is granted to any licensed amateur or shortwave listener who has made contact with or heard stations in Sardinia since January 1, 1976.

To qualify, European applicants must accumulate a total of 20 points, while amateurs outside Europe must gather 15 points total. The points are figured this way: Each contact with a URS Club member counts 4 points on HF and 5 points on the VHF bands. A contact with ISØLYN counts 6 points regardless of the band. All other Sardinian contacts count 1 point on the HF bands and 2 points on the VHF bands. The same station may be worked on the same band on different days or the same day on different bands for award credit. For example, should you be fortunate enough to work ISØLYN on all three

Continued on page 183

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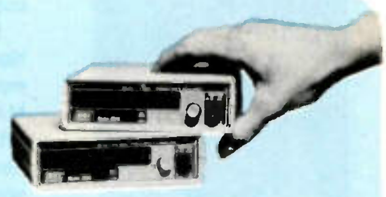

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West Germany (089) 7144065
Dynatrade
Schimmelbusch Str. 25
4006 Erkrath 2
West Germany

Belgium
MCR Electronics
Chaussee De Nivelles 100
1420 Brane L'Alleud
Belgium

LEAKY LINES

Dave Mann K2AGZ
3 Daniel Lane
Kinnelon NJ 07405

Tired of knocking your brains out in DX pileups? Frustrated by the sheer idiocy of self-appointed monitors and vigilantes who congregate on the DX station's exact frequency and QRM the action with bickering and other abuse? Turned off by selfish operators who either refuse to abide by the DX station's instructions or who don't bother to listen to them in the first place?

If any or all of these examples fit your present frame of mind toward DX chasing, I may have a solution for you. It may not put you on the Honor Roll, but it will afford you the satisfaction which comes from genuine accomplishment. But let me tell you of the circumstances which led to the idea.

When I finally made the coveted Honor Roll after years of dedicated effort, I was faced with a gloomy prospect. I'd grown so used to chasing DX that I'd become bored with other facets of the hobby. DX had become the *ne plus ultra*, and it was all I thought about in connection with ham radio. This feeling of dreariness devolved out of the realization that only four countries remained on my want list, and while there did exist some slight possibilities that those four would eventually be activated, this did not appear likely in the immediate future.

I had to find some new interest to take the place of DX; this was clear.

Never much of a constructor, I couldn't envision starting to build at this late date. That possibility was out.

Slow scan television and moonbounce had never "put bubbles in my blood," nor had amateur satellite communications. Mind you, I do not criticize them. But they are just not my cup of tea.

I had never enjoyed participation in traffic nets, and with the exception of a few years of MARS activity, I was not overly attracted to the prospect. (I believe that my distaste was inspired by one of those simulated emergencies back in the 50s, when, as part of an AREC group which I'd joined, I observed one of my colleagues calling Net Control with the astonishing news that Yonkers, New York, had been hit simultaneously with a devastating nuclear attack and a cholera epidemic. I threw up my hands.)

No! The sudden and abrupt realization that DX was about to become a thing of the past for me was a shock. And I could not find a way to cope with it.

Then one day an inspiration hit me like a bolt out of the blue. I was idly thumbing through the *Callbook*, and my eye was suddenly captured by one of those special entries; you know the sort I mean...the listing was separated from all the others and printed in bold type. And this particular callsign had the same suffix as my own. I had never worked anyone with my own suffix, and I thought it might be nice to hook up with a few and to exchange QSLs. I began writing down in my notebook the prefixes of the various AGZ stations, and I started listening for them on the air. Eventually I latched on to a couple. The first was KØAGZ, and others followed after a few months.

I even ran into a few foreign ones, and this prompted me to investigate the possibility of writing to several and proposing on-the-air schedules. They were all over the map, in all countries. For the most part, they showed up at the suggested time and frequency; we established contact and ultimately exchanged cards. In some cases, we have continued to meet on a regular basis ever since the first contact.

To shorten the story, I now have over 75 AGZ cards, and I'm sure that I will eventually have 100 of them.

The best part of this, of course, is that notwithstanding the fact that all the other AGZ stations are desirable from my point of view, there is absolutely no competition from anyone else. I don't have to worry about pileups or the loonies who have begun to make a shambles and fiasco out of DX. I can chase AGZs to my heart's content, and there's not another soul who's going to give me a hard time. Others with my suffix seem just as desirous of working me, and there hasn't been a single instance of QSL difficulty: The cards generally arrive by the quickest route.

Some are in Europe, some are in South America; there are many in Canada and in the Antipodes. I have quite a few from the West Indies and from Africa. And, as I mentioned, it's my own game and I can play it to my heart's content. The only limits are dictated by my own energy and willingness to exert myself.

I found that whenever I mentioned this activity, it seemed to elicit interest among others. And the thought occurred that this might be a new and different radio-sport that could be adopted by others who may have become bored with the usual and commonplace and are looking for a novel and unique pursuit.

I thought: Suppose the game could be organized, with certificates, endorsements, annual listings, and the like? Suppose it were possible to send out a computer printout of every applicant's callsign counterparts throughout the world, together with mailing addresses? And suppose there were a quarterly newsletter listing standings, profiles of the top contenders, and the like? And suppose there were special awards for multiband and multi-mode?

The idea began to feel exciting. In sounding out friends, I found more than casual interest. I had the feeling that perhaps it might meet with general enthusiasm, both here and abroad. Why not?

The only fly in the ointment, of course, is that if all these supplementary adjuncts were to be incorporated in the game, it would cost some initial money to get the thing off the ground. The printing of a suitable certificate would be costly, and the computer readout would cost several bucks as well. While an awards program can be managed at minimal cost, it cannot be done for peanuts. Perhaps the applicants themselves would be willing to help to underwrite these costs by paying a moderate fee of, say, five dollars or some equally modest sum. No one would get rich on the proceeds, that is certain. But no one would go broke either.

What to call the award? How about WYOS, Work Your Own Suffix? Not too bad. But perhaps it would be better if the initials formed an acronym such as do VISTA, Volunteers In Service To America, or NOW, the National Organization for Women. Unfortunately, my background as a professional songwriter and creator of comedy material invariably bubbles to the surface, and I find that every acronym that occurs to my mind turns out to be a four-letter word of questionable taste. Amateur Suffix Society, Callsign Radio Amateur...oh, well, you get the idea, I'm sure. Out there in the vastness of ham radio land, there are enterprising and creative minds; there must be someone who can come up with a unique name in keeping with the spirit of the thing.

But please, I beg you, don't send in your suggestions at this time. And don't send in any applications or money. If and when the program is inaugurated, an appropriate announcement will be made in this space. In the meantime, I urge you to try chasing your own suffix in the same way that I do...on your own and at your own pace. There's no reason why you should have to wait for this activity to be organized.

In fact, it might be better if it remained an off-the-cuff thing without all the hoopla of certificates and competition of standings and listings. Since there is no competition in it now, why introduce it anyway? And if it happens that some of you should happen to amass a total which you think unusually high, you might let me know about it. I'll be happy to mention it here so that you can gain the recognition that the achievement deserves.

But let me warn you: Despite the lack of competition, it is not the easiest thing in the world to accomplish. It will take dedication and persistence.

Go to it, and the very best of luck to you all.

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LETTERS

LEARNING THE CODE

I just wanted to drop you a quick note to say how much your *73* code course helped me. I have sporadically attempted to get my ticket for seven years now. The theory is no problem (I have a commercial 1st phone and have worked in RF for five years), but that code practice would get me every time. I tried manuals and the ARRL code course, but I would memorize the code sent on the cassettes, or, with the manuals, I'd stay on the first few pages and never move on, until I lost interest.

I honestly can't say this about the *73* cassette. I couldn't memorize the code groups, and it introduced new characters so fast and furious that before I knew it, I was through the whole alphabet.

Anyway, I passed the exam for my Tech ticket yesterday, after practicing with the cassette for two weeks! Before, I'd have practiced for a month or so before losing faith. Your code course is great. Now I'll work on my Advanced ticket in my spare time. Tnx again!

Grant Howes
Jackson MI

Grant, you should have started with the 13 per...it's no more difficult to learn the code at that speed than at 5 wpm, so why horse around and extend the agony?—Wayne.

BUT THEY WORK

I wish to congratulate you and your staff on a job well done regarding your *73* code cassettes. They are indeed the most mind-boggling, frustrating, teeth-gnashing, high-blood-pressure-causing pieces of recorded material I have ever purchased...but they work!

I used your 21 wpm tape most recently to help me achieve the elusive Amateur Extra class ticket. I don't know how many times I have personally told others of the virtues of your cassettes, but I firmly believe yours are the best on the market, and I have heard them all.

I found that after a month and a half with your tapes, I could copy plain English code at better than 25 wpm. Considering that a year and a half ago I didn't know a dit from a dah, I've made pretty good progress.

I believe in giving credit where credit is due; therefore, thank you for helping me to enjoy a great hobby. By the way, your ad states, "...you'll almost fall asleep copying the FCC stuff..." This was not exactly the case, but your point is well taken. Thanks again.

Steve Lewis KF8G
Rossford OH

CHRISTMAS DX

The Clark County Amateur Radio Club (Jeffersonville IN) will go on a DXpedition to Bethlehem IN from 1700 UTC December 13th until 1700 UTC December 14, 1980. Using the callsign W9WWI/9, they will operate phone on 3.900, 7.235, 14.285, 21.360, 28.510, and 147.300 simplex. Special Christmas season cards will be sent to all stations and the envelopes will be stamped with the unique Bethlehem IN postal stamps consisting of the Three Wise Men and the Star of David. QSL (with SASE) to Clark County Amateur Radio Club, PO Box 352, Jeffersonville IN 47130.

John W. Shean N9TV
Jeffersonville IN

SATISFACTION

On my return from an extended vacation, I found the August issue of *73 Magazine* in the mail, with my article ("Over There") on page 86.

I must compliment whoever was involved for some very fine editorial work. It is not uncommon these days for a writer, in looking at the printed version of his work, to wonder, "Why did they slip those commas in *there*?" or "What happened to the last two words of that sentence?" or even "Don't the damn fools know that 'the' is spelled 't-h-e?' " But then, I have frequently remarked on the quality of the magazine and its editorial standards in the past few years.

Likewise, I was amazed by the quality of the photo reproduction. The negatives are, of course, close to 40 years old. The prints I made late one night, a Sunday, of course, when I could not get paper and had only a few odds and ends of various grades left.

In all, I am pleased (and I know that you will accept this in the proper light) that *73* printed the article...payment aside. It is a source of real satisfaction to an author when everything comes out right.

It may also interest you to know that I've received two letters from old friends who learned of my whereabouts from the piece.

Julian N. Jablin W9IWI
Skokie IL

It's nice to have someone notice the superb job Jack has been doing with the editing and production of the magazine... thanks for the bouquet. By the way, it's good to get an article from one of the old guard in New York. I remember contacts and seeing you at radio clubs 30 years ago.—Wayne.

NOT ONE?

GOOD LORD!! Wayne Green in Mensa for 20 years?? It's strange I haven't agreed with one *73* editorial. (Congrats.)

Robert Roither WD0FDK
Florissant MO

All of which goes to prove that brains and common sense are not necessarily parallel endowments.—Wayne.

HORSE HOCKEY

At the present time I am stationed with the military in West Germany, where we have the largest American population outside the United States. In the past, the FCC has dispatched examiners to Germany twice a year and many individuals have taken advantage of this. They've traveled from all over Germany and its neighboring countries ...they came by plane, by train, and by car. Examination rooms were jam-packed with more people than you could shake a stick at. Now, all of a sudden, someone in a higher echelon of the government decides that "excessive" travel must come to a halt. And the result? Many people will be denied the opportunity of obtaining or upgrading an FCC license whether it be amateur or commercial. It's a damn shame! These same people are the ones putting their lives on the line defending this country and ensuring the preservation of peace. As Colonel Potter of M*A*S*H would say, "horse hockey!"

Before I go any further, let's go back to the basics. One of the first things we all learned in our study of amateur radio was its basis and purpose. This can be found in Section 97.1 of Subpart A of Part 97. Listed there are "five" principles of our radio service. To print them here would use too much valuable space, so I will extract some of the finer points for you. Principle number one talks about the recognition and advancement of the Amateur Radio Service and emergency communications. Numbers two and three contain key words such as encouragement, improvement, and advancing skills. Expansion of the existing reservoir of trained operators, technicians, and electronics experts is outlined in number four. And, finally, principle number five mentions our unique ability to enhance international goodwill. This drastic measure taken by the FCC will impede the exercise of these very principles! It's simple arithmetic.

As for us here in Germany, look under the "Delta Alpha" callsigns in the latest edition of the DX *Callbook*. You will find approximately 600 amateurs, of which 85% are Americans. Isn't this enough "clout" to warrant resumption of FCC testing? The number 600 may not seem like much, but with our current problem of a stagnant growth rate, the FCC's policy could show adverse affects. With dwindling numbers and no encouragement from or improvement in the operations of our governing body, the FCC, how are "we" supposed to expand, become "encouraged" and "improved"? We are a public service, dammit! When a natural disaster strikes, hams are usually the first ones on the scene ready to help. And when we do, we are praised and glorified...sometimes. But

Continued on page 193

✓ Reader Service—see page 226

FUN!

John Edwards WB2IBE
78-56 86th Street
Glendale NY 11385

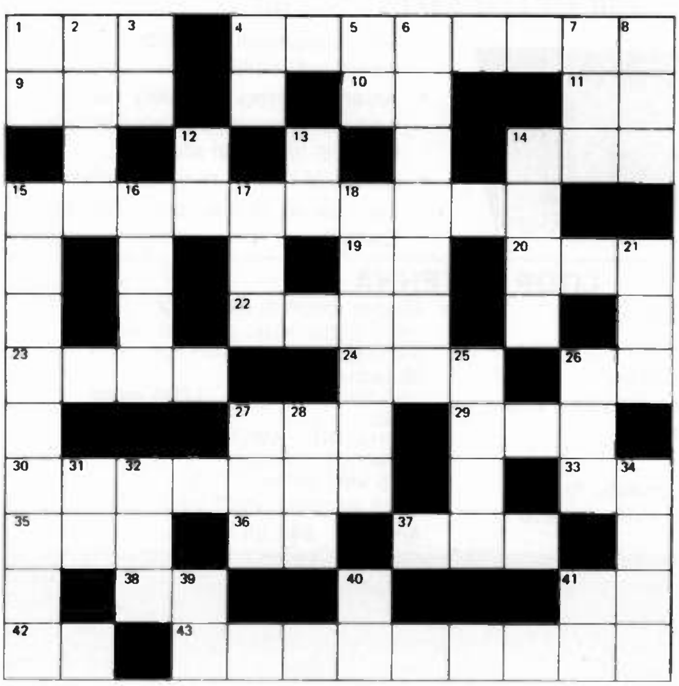
ELEMENT 1—CROSSWORD PUZZLE

Across

1 A microcomputer memory (abbr.)
4 RTTY machine
9 Radio users (abbr.)
10 Greenland prefix
11 Cable prefix
14 Something to chew
15 Scientific test
19 A prosign
20 Teletype (abbr.)
22 Automatic Picture Retransmission (abbr.)
23 What a signal usually carries (abbr.)
24 Keyboard Send-Receive (abbr.)
26 Soviet space satellite (abbr.)
27 A Model 15 is extreme in this
29 HW_______?
30 A display medium
33 Sudanese prefix
35 Moonbounce (abbr.)
36 Tough WAS state (abbr.)
37 Formal shack title (abbr.)
38 Old repeater prefix
41 Pakistani prefix
42 "Idiot Box" or fast scan (abbr.)
43 Pictures via radio

Down

1 RTTY Read-Only (abbr.)
2 Vertex
3 Meteor scatter (abbr.)
4 Transmitter-distributor (abbr.)
5 Opposite of Hi
6 Proficient hams
7 Public Relations Assistant (abbr.)
8 Code of Ethics laid one
12 Morse "from"
13 Code Chuckle
14 Radioteletype (abbr.)
15 Specialized modes require lots of this
16 RTTY tape unit
17 Radio Corporation of America (abbr.)
18 Crystal use
21 Soft hams (abbr.)
25 "Ears" (abbr.)
26 RTTY test string
27 Amateur television (abbr.)
28 Past of "get"
31 Ham salutation (abbr.)
32 What most specialized modes are
34 Recording or paper (mylar, too)
39 Transmitter power (abbr.)
40 FCC country (abbr.)
41 Familiar battery (abbr.)



SPECIALIZED MODES

Have you ever been accused of being an "appliance operator"? Are you a complete blockhead when it comes to doing anything more technical than shouting into a microphone or tapping a key? When the other guys talk about slow-scan television, do you think they're referring to the instant replays on last Sunday's football broadcast? If so, this month's puzzles are for you.

While RTTY, SSTV, ATV, EME, ASCII, and MSTV may just sound like a bowl of alphabet soup to many of us, there's a whole class of fellow amateurs out there who consider these modes to be the *real* amateur radio—a place for experimenting, not just communicating. So, for those of you not yet hooked on an exotic operating mode, and even for those who are, grab a pencil and see how much you know about ham radio's other side.

ELEMENT 2—MATCHING

Match the specialized mode in Column A with the appropriate equipment in Column B.

Column A	Column B
1) Slow-scan television	A) Horn antenna
2) Meteor scatter	B) Murphy receiver
3) Digital communication	C) Stylus
4) Fast-scan television	D) Keyer (CW)
5) Facsimile	E) Model 33
6) Satellite communication	F) Wideband 10-meter receiver
7) Moonbounce	G) Steerable dish antenna
8) Microwave communication	H) 2-meter transmitter/10-meter receiver
9) Radioteletype	I) Stock Robot 400
10) Medium-scan television	J) Model 15
	K) Commercial TV set and converter

ELEMENT 3—TRUE-FALSE

	True	False
1) Eleven meters was the first amateur band opened to slow-scan television.	____	____
2) One of the inventors of the teleprinter was Joy Morton, owner of the Morton Salt Company.	____	____
3) AF2M is the official FCC designation for frequency-shift telegraphy.	____	____
4) The Geminids are a December meteor shower.	____	____
5) The ARRL sponsors both RTTY and SSTV DXCC awards.	____	____
6) Amateur 10-GHz signals have spanned the English Channel.	____	____
7) Most moonbounce activity takes place on 144 and 432 MHz.	____	____
8) The facsimile DX record is from New York, N.Y., to Seattle, Wash.	____	____
9) Medium-scan television's frame rate is 2 per second.	____	____
10) To operate a mode not permitted under amateur rules, one can request an "STA" from the FCC.	____	____
11) Most RTTY enthusiasts gain their WAS awards from "cards" printed on their Teletype.	____	____
12) Maximum radioteletype shift is 900 kHz.	____	____
13) "NBVM" stands for Negative Bias Voltmeter.	____	____
14) ASCII is permissible on 160 meters.	____	____
15) FSK is allowed on all CW bands, even Novice.	____	____
16) Many amateurs call moonbounce "EME" in honor of the late K6EME.	____	____

Continued on page 180

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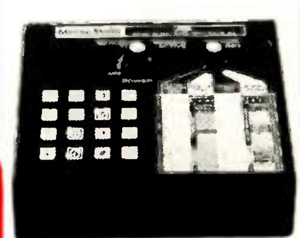

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		100	1.8	5.9
		200	2.6	8.5
		300	3.3	10.8
		400	3.8	12.5
RG8/u Foam .81VF	8214 32¢/ft.	50	1.2	3.9
		100	1.8	5.9
		200	2.6	8.5
		300	3.3	10.8
		400	3.8	12.5
RG8/u Regular .66VF	8237 28¢/ft.	100	2.0	6.6
		200	3.0	9.8
		400	4.7	15.4
		900	7.8	25.6
RG8/u Non-contaminating	8267 36¢/ft.	100	2.0	6.6
		200	3.0	9.8
		400	4.7	15.4
		900	7.8	25.6

8448 24¢/ft.
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AWG (in mm) —
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2-18, (16 × 30). (1.19)

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No. of Cond. — 8
AWG (in mm) —
2-16, (26 × 30)
6-18 (16 × 30). (1.17)

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OSCAR Orbits

Courtesy of AMSAT

Any satellite placed into a near-Earth orbit suffers from the cumulative effects of atmospheric drag. The much publicized descent of the Skylab space station was a graphic demonstration of these effects.

The OSCAR satellites are subject to atmospheric drag, of course, and the present period of intense solar activity has accentuated the problem. During this period, our sun has been expelling huge numbers of charged particles, some of which find their way into the Earth's upper atmosphere, increasing the density (and thus the drag) there. It is through this region that the OSCARs must pass. OSCAR 8, in a lower orbit than OSCAR 7, is the more seriously affected of the two.

If the drag factor is not considered when OSCAR calculations are performed, long-range orbital projections will be in error. For example, by the end of 1979, OSCAR 8 was more than 20 minutes ahead of some published schedules. The nature of orbital mechanics is such that extra drag on a satellite causes it to move into a lower orbit, resulting in a shorter orbital period. Thus, the satellite arrives above a given Earthbound location earlier than predicted.

Using data supplied to us by Dr. Thomas A. Clark W3IWI of AMSAT, the equatorial crossing tables shown here were generated with the aid of a TRS-80™ microcomputer. The tables take into account the effects of atmospheric drag and should be in error by a few seconds at most.

The listed data tells you the time and place that OSCAR 7 and OSCAR 8 cross the equator in an ascending orbit for the first time each day. To calculate successive OSCAR 7 orbits, make a list of the first orbit number and the next twelve orbits for that day. List the time of the first orbit. Each successive orbit is 115 minutes later (two hours less five minutes). The chart gives the longitude of the day's first ascending (northbound) equatorial crossing. Add 29° for each succeeding orbit. When OSCAR is ascending on the other side of the world from you, it will descend over you. To find the equatorial descending longitude, subtract 166° from the ascending longitude. To find the time OSCAR 7 passes the North Pole, add 29 minutes to the time it passes the equator. You should be able to hear OSCAR 7 when it is within 45 degrees of you. The easiest way to determine if OSCAR is above the horizon (and thus within range) at your location is to take a globe and draw a circle with a radius of 2450 miles (4000 kilometers) from your QTH. If OSCAR passes above that circle, you should be able to hear it. If it passes right overhead, you should hear it for about 24 minutes total. OSCAR 7 will pass an imaginary line drawn from San Francisco to Norfolk about 12 minutes after passing the equator. Add about a minute for each 200 miles that you live north of this line. If OSCAR passes 15° east or west of you, add another minute; at 30°, three minutes; at 45°, ten minutes. Mode A: 145.85-.95 MHz uplink, 29.4-29.5 MHz downlink, beacon at 29.502 MHz. Mode B: 432.125-.175 MHz uplink, 145.975-.925 MHz downlink, beacon at 145.972 MHz.

At press time, OSCAR 7 was scheduled to be in Mode A on odd numbered days of the year and in Mode B on even numbered days. Monday is QRP day on OSCAR 7, while Wednesdays are set aside for experiments and are not available for use.

OSCAR 8 calculations are similar to those for OSCAR 7, with some important exceptions. Instead of making 13 orbits each day, OSCAR 8 makes 14 orbits during each 24-hour period. The orbital period of OSCAR 8 is therefore somewhat shorter: 103 minutes.

To calculate successive OSCAR 8 orbits, make a list of the first orbit number (from the OSCAR 8 chart) and the next thirteen orbits for that day. List the time of the first orbit. Each successive orbit is then 103 minutes later. The chart gives the longitude of the day's first ascending equatorial crossing. Add 26° for each succeeding orbit. To find the time OSCAR 8 passes the North Pole, add 26 minutes to the time it crosses the equator. OSCAR 8 will cross the imaginary San Francisco-to-Norfolk line about 11 minutes after crossing the equator. Mode A: 145.85-.95 MHz uplink, 29.4-29.50 MHz downlink, beacon at 29.40 MHz. Mode J: 145.90-146.00 MHz uplink, 435.20-435.10 MHz downlink, beacon on 435.090 MHz.

OSCAR 8 is in Mode A on Mondays and Thursdays, Mode J on Saturdays and Sundays, and both modes simultaneously on Tuesdays and Fridays. As with OSCAR 7, Wednesdays are reserved for experiments.

OSCAR 7 ORBITAL INFORMATION FOR DECEMBER

ORBIT #	DATE	TIME (GMT)	EQ. CROSSING (DEGREES WEST)
27653	1	0018:49	79.8
27666	2	0113:04	93.4
27678	3	0012:22	78.3
27691	4	0106:36	91.9
27703	5	0005:54	76.7
27716	6	0100:09	90.3
27729	7	0154:23	103.9
27741	8	0053:41	88.7
27754	9	0147:56	102.3
27766	10	0047:14	87.2
27779	11	0141:28	100.8
27791	12	0040:46	85.6
27804	13	0135:00	99.2
27816	14	0034:18	84.0
27829	15	0128:33	97.6
27841	16	0027:51	82.5
27854	17	0122:05	96.1
27866	18	0021:23	80.9
27879	19	0115:37	94.5
27891	20	0014:55	79.3
27904	21	0109:10	92.9
27916	22	0008:28	77.8
27929	23	0102:42	91.4
27941	24	0002:00	76.2
27954	25	0056:14	89.8
27967	26	0150:29	103.4
27979	27	0049:47	88.2
27992	28	0144:01	101.8
28004	29	0043:19	86.7
28017	30	0137:33	100.3
28029	31	0036:51	85.1

OSCAR 8 ORBITAL INFORMATION FOR DECEMBER

ORBIT #	DATE	TIME (GMT)	EQ. CROSSING (DEGREES WEST)
13969	1	0013:32	59.6
13983	2	0018:18	60.8
13997	3	0023:04	62.1
14011	4	0027:50	63.3
14025	5	0032:35	64.5
14039	6	0037:21	65.7
14053	7	0042:06	66.9
14067	8	0046:52	68.1
14081	9	0051:38	69.4
14095	10	0056:23	70.6
14109	11	0101:09	71.8
14123	12	0105:54	73.0
14137	13	0110:39	74.2
14151	14	0115:25	75.4
14165	15	0120:10	76.7
14179	16	0124:55	77.9
14193	17	0129:40	79.1
14207	18	0134:26	80.3
14221	19	0139:11	81.5
14234	20	0000:44	56.9
14248	21	0005:29	58.2
14262	22	0010:14	59.4
14276	23	0014:59	60.6
14290	24	0019:44	61.8
14304	25	0024:29	63.0
14318	26	0029:14	64.2
14332	27	0033:59	65.4
14346	28	0038:44	66.7
14360	29	0043:29	67.9
14374	30	0048:13	69.1
14388	31	0052:58	70.3

OSCAR 7 ORBITAL INFORMATION FOR JANUARY

ORBIT #	DATE	TIME (GMT)	EQ. CROSSING (DEGREES WEST)
28042	1	0131:05	98.7
28054	2	0030:23	83.5
28067	3	0124:38	97.1
28079	4	0023:56	82.0
28092	5	0118:10	95.6
28104	6	0017:28	80.4
28117	7	0111:42	94.0
28129	8	0011:00	78.9
28142	9	0105:14	92.4
28154	10	0004:32	77.3
28167	11	0058:46	90.9
28180	12	0153:01	104.5
28192	13	0052:18	89.3
28205	14	0146:33	102.9
28217	15	0045:51	87.7
28230	16	0140:05	101.3
28242	17	0039:23	86.2
28255	18	0133:37	99.8
28267	19	0032:55	84.6
28280	20	0127:09	98.2
28292	21	0026:27	83.0
28305	22	0120:41	96.6
28317	23	0019:59	81.5
28330	24	0114:13	95.1
28342	25	0013:31	79.9
28355	26	0107:45	93.5
28367	27	0007:03	78.4
28380	28	0101:17	91.9
28392	29	0000:35	76.8
28405	30	0054:49	90.4
28418	31	0149:04	104.0

OSCAR 8 ORBITAL INFORMATION FOR JANUARY

ORBIT #	DATE	TIME (GMT)	EQ. CROSSING (DEGREES WEST)
14402	1	0057:43	71.5
14416	2	0102:28	72.7
14430	3	0107:12	73.9
14444	4	0111:57	75.2
14458	5	0116:41	76.4
14472	6	0121:26	77.6
14486	7	0126:10	78.8
14500	8	0130:55	80.0
14514	9	0135:39	81.2
14528	10	0140:23	82.4
14541	11	0001:56	57.8
14555	12	0006:40	59.1
14569	13	0011:25	60.3
14583	14	0016:09	61.5
14597	15	0020:53	62.7
14611	16	0025:37	63.9
14625	17	0030:21	65.1
14639	18	0035:05	66.3
14653	19	0039:49	67.5
14667	20	0044:33	68.8
14681	21	0049:17	70.0
14695	22	0054:01	71.2
14709	23	0058:45	72.4
14723	24	0103:29	73.6
14737	25	0108:13	74.8
14751	26	0112:57	76.0
14765	27	0117:40	77.2
14779	28	0122:24	78.4
14793	29	0127:08	79.7
14807	30	0131:51	80.9
14821	31	0136:35	82.1

✓ Reader Service—see page 226

DRAKE 7-Line Family

ACCESSORIES

(A) Model 7077 Dynamic Desk Microphone

• Audio and level characteristics custom designed to match the transmit audio requirements of the Drake TR7. • **Features both VOX and PTT** operation without modification. • **High Impedance** • **Includes coil cord and plug** wired for direct connection to the Drake TR7. • **Style and color** provide a beautiful match to the Drake 7-line • **Size** 4.3"W x 5.8"D x 9.3"H (10.9 x 14.7 x 23.6 cm). **Weight** 1 lb 7 oz (650 g).

Model 1553

(C) SP75 Speech Processor

Provides an increase in average power/readability of a single sideband voice signal during weak signal, high interference conditions. The SP75 is connected between the microphone and microphone input of the ssb transmitter, requiring no modification of existing transmitter or transceiver. A front panel switch allows the processor to be switched in or bypassed. Two additional inputs, such as a tape player or phone patch, may be front panel selected.

Rf envelope clipping adjustable between zero and twenty decibels. LED indicates proper audio input level.

Muting circuitry reduces gain during speech pauses, allowing VOX operation with the processor on.

SPECIFICATIONS • **Processing Type:** Preclipping audio compression followed by rf envelope clipping at the processor intermediate frequency. • **Rf Clipping Range:** Adjustable 0 to 20 dB from front panel control. • **Input Level (Microphone Input):** 3.5 mV minimum for full processing. Gain adjustable to accommodate up to 300 mV maximum. • **Input Level (Tape and Patch Inputs):** 15 mV minimum for full processing. 30 mV maximum. • **Input Impedance (Microphone):** 1 megohm. • **Input Impedance (Tape and Patch):** 50 kilohm. • **Output Level w/Processing:** 0-50 mV adjustable into 50 kilohm load. • **Output Impedance:** 50 kilohm. • **Muting (Microphone Input Only):** 10 to 20 dB attenuation during speech pauses. • **Frequency Response:** 400-6000 Hz@6 dB. • **Distortion:** Less than 5% T.H.D.@1kHz, 20 dB clipping. • **Power:** 11-16 V-dc@95 mA. • **Size:** 7"L x 6¼"W x 2¼"H (17.3 x 15.9 x 5.4 cm). • **Weight:** 1.4 lbs. (.63 kg).

Model 1520

(D) P75 Phone Patch

Hybrid Phone Patch for use with 7-line or other receiver/transmitter combination. • In/out Switching • Adjustable TX and RX level controls.

Model 1535

(E) CS7 Coax Switch

• Switches up to five coax-fed antennas via one main feed line. • Allows selection of up to five radios at other end of main feed line. • Minimizes amount of coax needed for multi-antenna installation. • Grounds unused inputs (both local and remote).

DRAKE CS7 SPECIFICATIONS • **Maximum Input Power:** 2000 watts PEP • **Frequency Range:** Up to 30 MHz, insertion of Switch changes VSWR no more than 1.05:1. From 30 MHz to 150 MHz, insertion changes VSWR no more than 1.5:1 (both switches). • **Operating Temperature Range:** −40°F. to 150°F. • **Supply Voltage:** 120 V-ac or 240 V-ac selectable, 50/60 Hz, 50 watts. • **Dimensions & Weight: Console**—5.25"H x 6.81"W, 7.06" cabinet depth (13.3 x 17.3 x 17.9 cm); 4.33 lbs (1.96 kg); **Remote Antenna Switch**—7.13"H x 5.88"W x 4.39"D (18.1 x 15.0 x 11.1 cm). 8.19" (20.8 cm) center to center mounting; 5 lbs (2.27 kg).

Model 1531

(B) MS7 Matching Speaker

• **Size:** 7.5"D x 6.9"W x 4.6"H excluding feet (19 x 17.5 x 11.6 cm). • **Weight:** 2.5 lbs (1.13 kg).

"Dry" Dummy Loads

—no oil required

Model 1551

Model 1550

Model 1551 Drake DL-1000

• **1000 watts** for 30 seconds, with derating curve to 5 minutes. Accepts Drake FA7 cooling fan for extended high power operation. • **VSWR of 1.5:1 max.** 0-30 MHz • **SO-239 coax connector** • **Rubber feet** for desk or bench use • **Size** 14" x 3.6" (35.6 x 9.1 cm). **Weight:** 2 lbs (910 g).

Model 1550 Drake DL-300

• **300 watts** for 30 seconds, with derating curve to 5 minutes. • **Built-in PL-259** coax connector for direct connection to rear of transceiver or transmitter—no jumper coax necessary. • **VSWR of 1.1:1 max.** 0-30 MHz 1.5 max 30-160 MHz • **Ideal as bench test device** for amateur or commercial hf and vhf gear. • **Small size** fits conveniently in any field service tool box. 6.7" x 2.08" (17.0 x 5.3 cm). **Weight:** 11 oz (310 g).

WH7 Directional Rf Wattmeter

Model 1514

• Directional, in-line wattmeter. • Removable coupler provides remote metering. • Three calibrated scales (0-20, 0-200, and 0-2000 watts. • Fourth scale provides direct reading VSWR.

SPECIFICATIONS: • **Frequency Coverage:** 1.8-30 MHz. • **Line Impedance:** 50 ohm resistive. • **Power Capability:** 2000 W continuous. • **Jacks, Removable Coupler:** Two SO-239 input and output connectors. • **Semi-conductors:** Two power meter rectifiers. • **Accuracy:** ±(5% of reading + 1% of full scale). • **VSWR Insertion:** Insertion of wattmeter in line changes VSWR no more than 1.05:1. • **Shipping Weight:** 3 lbs (1.4 kg). • **Dimensions:** 5.3"H x 6.9"W x 7.5"D (13.5 x 17.5 x 19 cm).

Model 1230

LA7 Line Amplifier

Line output, 1 mW nominal into 600 ohm balanced, adjustable by internal pre-set level control.

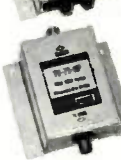
TV Interference Filters

High Pass Filters for TV Sets

More than 40 dB attenuation at 52 MHz and lower. Protect the TV set from amateur transmitters 6-160 meters.

Model No. 1603
Drake TV-300-HP

For 300 ohm twin lead. New terminals for easy installation.



Model No. 1610
Drake TV-75-HP

For 75 ohm TV coaxial cable; TV type "F" connectors installed.

Low Pass Filters for Transmitters

Four pi sections for sharp cut off above the hf amateur bands and to attenuate transmitter harmonics falling in any TV channel and fm band. 52 ohm. SO-239 connectors built in.

Model No. 1608 **Drake TV-3300-LP**

1000 watts max. below 30 MHz. Attenuation better than 80 dB above 41 MHz. Helps TV I-f interference, as well as harmonic interference.

Model No. 1605 **Drake TV-42-LP**

A four section filter designed with 43.2 MHz cut-off and extremely high attenuation in all TV channels for transmitters operating at 30 MHz and lower. Rated 100 watts input.

✓19

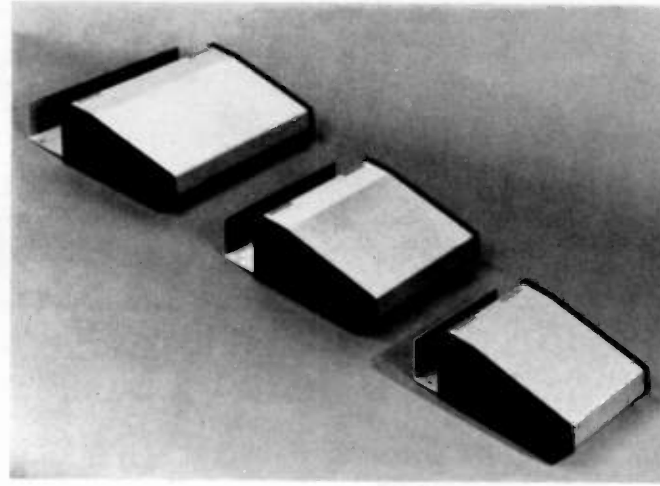
Specifications, availability and prices subject to change without notice or obligation.

R. L. DRAKE COMPANY DRAKE

540 Richard St., Miamisburg, Ohio 45342, USA Phone: (513) 866-2421 • Telex: 288-017

✓ *Reader Service—see page 226*

NEW PRODUCTS



Jameco's desk-top enclosures.

AEA'S MODEL CK-1 ELECTRONIC KEYER

The new AEA Model CK-1 iambic electronic keyer incorporates virtually all of the features of the renowned AEA MorseMatic, with the exception of the trainer and beacon modes. The CK-1 keyer also has two preset speeds for fast recall and a stepped variable speed control for fast contest operation. The speed range is 1- to 99-wpm in one-wpm increments. The unit operates from 12 volts dc (plus or minus 3 volts dc) for maximum DXpedition flexibility. An optional ac adapter is available from AEA.

The keyer offers the contest operator a competitive edge with a flexible automatic serial number generator. The memory has a storage capability of approximately 500 Morse characters. AEA's exclusive soft partitioning™ of the memory means that all of the memory can be allotted to one message or divided up into as many as ten separate messages of varying length as long as the total is no more than the 500 characters. If you make a mistake loading the message, it can be easily corrected by using exclusive AEA editing. The edit mode can save the CW operator time and frustration, especially in loading a long message. The CK-1 memory can be loaded in the automatic word/character space load for easy flawless memory loading or in the real-time load mode. In either case, memory load does not initiate until the first character is sent so that there is no undesirable delay in playback. The memory playback can be halted in the middle of a message for manual keying by tapping the paddle and resumed where interrupted, or from the beginning. When loading memory, a significant drop in sidetone frequency signals a "memory full" condition.

The CK-1 keyer features a serial number generator that was designed after analyzing suggestions from many successful contest winners. The serial number automatically increments each time a message preprogrammed with a serial number is sent. The serial number can even be repeated several times (in another message) if the exchange was not made the first time. The serial number is not restricted to the same position in a message. It can be placed anywhere within a message and as many times as desired, and it does not increment until a message is repeated. Any new serial number may be selected in less than three seconds. The serial number can be loaded with as little as one character space between it and the preceding character.

AEA's CK-1 electronic keyer.

Like all other keyers in the AEA computerized electronic keyer line, the CK-1 features independent dot and dash ratio adjustment (full weighting). Also, dot and dash memories can be independently turned on or off. For the operator who enjoys operating with a bug, the CK-1 features semi-automatic operation. In the semi-auto bug mode, an operator can even load the message memories. The CK-1 will key any modern transceiver and features a single output jack (RCA phono type) for keying either plus or minus keyjack voltages to ground. The CK-1 also features an automatic tune mode which can be halted by tapping any keypad button, or the paddle.

The CK-1 is packaged in a high-impact plastic case, ideal for placing next to the keyer paddle without wasting valuable operating desk space. AEA engineering has provided maximum rf protection to avoid frustrating false keying. All ICs are socketed and, like all AEA products, each unit is fully tested and burned in at 50° C to "shake out" component failures. Mating power and paddle connectors are provided.

The CK-1 is easy to learn and easy to use, providing the operator the maximum amount of enjoyment with CW.

For further information, contact *Advanced Electronic Applications, Inc., PO Box 2160, Bldg. O&P, 2006-196th SW, Lynnwood WA 98036; (206)-775-7373/524-7374.*

NEW DESK-TOP ELECTRONIC ENCLOSURES

Jameco Electronics has announced a new Designer Series of desk-top enclosures to accommodate electronic equipment. These stylish enclosures are designed to blend and complement today's modern computer equipment and can be used in both industry and home.

The unique four-piece construction of the series enables easy access for servicing while providing strong protection. The end pieces are precision-molded high-strength epoxy with an internal slot (all around) to accept both top and bottom panels. The aluminum panels (.080" thick) are fastened to ¼"-thick mounting tabs inside the end pieces to provide maximum rigidity. For service, the rear/bottom panel slides backward on slotted guide tracks.

The aluminum panels are coated with an alodine type 1200 finish for best paint adhesion. The molded end pieces are mocha brown, matte finish, but can be painted to match any color scheme.

The Designer Series enclosures are available in three

Continued on page 186

Yesterday you could admire all-band digital tuning in a short wave receiver.* Today you can afford it.

Tune in the Panasonic Command Series™ top-of-the-line RF-4900. Everything you want in short wave at a surprisingly affordable price.

Like fluorescent all-band readout with a five-digit frequency display. It's so accurate (within 1 kHz, to be exact), you can tune in a station even before it's broadcasting. And with the RF-4900's eight short wave bands, you can choose any broadcast between 1.6 and 31 MHz. That's all short wave bands. That's Panasonic.

And what you see on the outside is just a small part of what Panasonic gives you inside. There's a double superheterodyne system for sharp reception stability and selectivity as well as image rejection. An input-tuned RF amplifier with a 3-ganged variable tuning capacitor for excellent sensitivity and frequency linearity. Ladder-type ceramic filters to reduce frequency interference. And even an antenna trimmer that changes the front-end capacitance for reception of weak broadcast signals.

To help you control all that sophisticated circuitry, Panasonic's RF-4900 gives you all these sophisticated controls. Like an all-gear-drive tuning control to prevent "backlash." Separate wide/narrow bandwidth selectors for crisp reception even in crowded conditions. Adjustable calibration for easy tuning to exact frequencies. A BFO pitch control. RF-gain control for improved reception in strong signal areas. An ANL switch. Even separate bass and treble controls.

And if all that short wave isn't enough. There's more. Like SSB (single sideband) amateur radio. All 40 CB channels. Ship to shore. Even Morse communications. AC/DC operation. And with Panasonic's 4" full-range speaker, the big sound of AM and FM will really sound big. There's also the Panasonic RF-2900. It has most of the features of the RF-4900, but it costs a lot less.

The Command Series from Panasonic. If you had short wave receivers as good. You wouldn't still be reading. You'd be listening.

*Short wave reception will vary with antenna, weather conditions, operator's geographic location and other factors. An outside antenna may be required for maximum short wave reception.

Panasonic.
just slightly ahead of our time.

✓380

MFJ NEW PRODUCTS

exciting new ideas from the world's leading manufacturer of amateur radio accessories

NEW MFJ/BENCHER Keyer-Paddle Combo — "The Pacesetter"

MFJ-422 Combo $99.95 (+$4)

MFJ-422X Keyer only $69.95 (+$4)

The best of all CW worlds — a deluxe MFJ keyer in a compact configuration that fits right on the BENCHER iambic paddle! And you can buy the combination or just the keyer to fit on your BENCHER.

New MFJ keyer — small in size, big in features. Curtis 8044 IC, *adjustable weight and tone*, front panel *volume and speed controls* (8-50 wpm), built-in *dot-dash memories*, speaker, sidetone, and push-button selection of semi-automatic/tune or automatic modes.

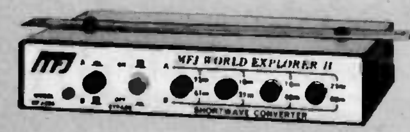
Ultra-reliable solid-state keying: grid-block, cathode and solid-state transmitters (−300 V, 10 mA max; +300 V, 100 mA max). *Fully shielded.* Uses 9 V battery or optional AC adapter ($7.95 +$2)

Beautiful functional engineering. The keyer mounts on the paddle base to form a small (4⅛Wx2⅝H x 5½"L) attractive combination that's a pleasure to look at and use.

The BENCHER paddle is a best seller. Fully adjustable; gold-plated silver contacts; lucite paddles; chrome plated brass; heavy steel base with non-skid feet.

NEW MFJ 4 & 8-Band Mobile Shortwave Converters

MFJ-304 $59.95 (+$4)



MFJ-308 $79.95 (+$4)

Another MFJ "first," these low cost mobile SWL converters provide new excitement and variety for your driving/listening pleasure.

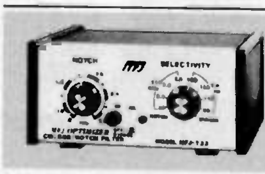
Two models to choose from. The 4-band "World Explorer I" (MFJ-304) offers complete *19, 25, 31 and 49 meter coverage* (the most popular HF bands due to their distance capabilities at various times of the day and year). Hear countries from Europe, Africa, Middle East, Asia, the Islands, North and South America. The 8-band "World Explorer II" (MFJ-308 adds *13, 16, 41, and 60 meter* bands) for even greater listening variety.

Compact and sensitive. The 4-band model measures just 5¼W x 1¼H x 4"D to *fit anywhere* in your vehicle (the 8-band version is just 1" wider and 1" deeper). Two dual-gate MOSFETS give these converters *excellent sensitivity and selectivity* when combined with your automotive receiver.

Easy to use, easy to install. Push a converter button to choose the band, tune in stations with your regular car radio. To install, just plug the car antenna into the converter and insert the converter cable into your car radio antenna jack; connect the power lead to 12 VDC.

Listen to the world on the road. Get the new MFJ mobile SWL converters — "World Explorers I & II."

NEW MFJ Active CW/SSB/Notch Filters



MFJ-722 $69.95 (+$4)

MFJ-723 $49.95 (+$4)

Two new super-selective filters. The new MFJ-722 "Optimizer" offers *razor sharp, no-ring CW filtering* with switch-selectable bandwidths (80, 110, 150, 180 Hz centered on 750 Hz), *steep-skirted SSB filtering*, and a *300-3000 Hz tunable 70 dB notch filter*.

The 8-pole (4-stage) active IC filter gives *CW performance no tunable filter can match*. (80 Hz bandwidth gives −60 dB response one octave from center and up to 15 dB noise reduction). *The 8-pole SSB audio bandwidth is optimized* for reduced sideband splatter and less QRM (375 Hz highpass cutoff plus selectable lowpass cutoffs at 2.5, 2.0, and 1.5 kHz, 36 dB/octave rolloff). Size: 5x2x6".

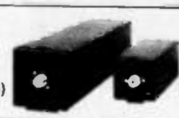
New model MFJ-723 is similar to the 722 but is for CW only, has a 60 dB notch tunable from 300-1200 Hz, and measures 2x4x6". Other models: **MFJ-721, $59.95,** like 722 but less notch; **MFJ-720, $39.95,** like 723 but less notch.

Versatile, all models plug into the phone jack, provide 2 watts for speaker or can be used with headphones. All require 9-18 VDC, 300 mA max (or 110 VAC with optional AC adapter at $7.95 +$2).

Enjoy pleasant listening and improved readability with one of these new MFJ filters.

NEW MFJ "Dry" 300W & 1KW Dummy Loads

MFJ-262 $49.95 (+$4)



MFJ-260 $26.95 (+$4)

Air Cooled, *non-inductive 50-ohm resistors* in perforated metal housings with SO-239 connectors; both rated to full load for 30 seconds; de-rating curves to 5 minutes included. Just right for tests and fast tune up.

Low VSWR. 300W: 1.1:1 max to 30 MHz, 1.5:1 max. 30-160 MHz. **1 kW:** 1.5:1 max to 30 MHz. **MFJ-260** (300W) is just 2½x2½x7"; **MFJ-262** (1kW) is 3x3x13".

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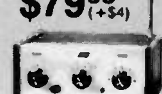

MFJ-1020 $79.95 (+$4)

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Boosts weak signals, rejects out of band signals, reduces images. *Covers 1.8-54 MHz* with up to 20 dB gain from low noise MOSFET circuitry. *Works with 2 antennas and 2 receivers* (even XCVRS to 350W input).

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Reader Service—see page 226

Who Really Invented Radio?

—the twisted tale of Nathan B. Stubblefield

Larry Kahaner WB2NEL
73 Associate Editor

I decided to buy the $3-a-day collision insurance for my Avis rent-a-car. It might be that kind of assignment.

When they send you to unravel the twisted tale of Nathan B. Stubblefield—who Murray, Kentucky, residents insist invented radio while Marconi was just a lad—you're bound to run into trouble.

As I neared town, I first heard it on the AM radio. The country-western station played, appropriately enough, "Stand By Your

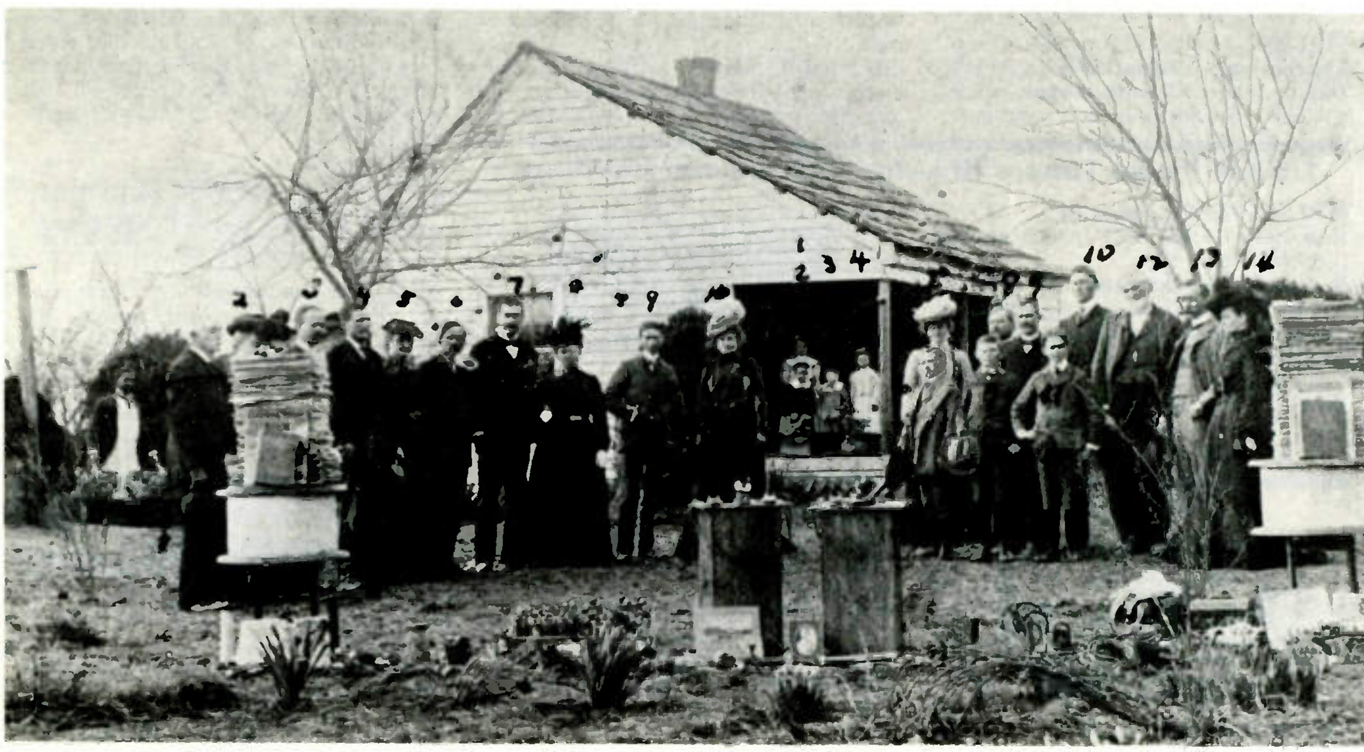


Photo A. Family and friends gathered (date unknown) at the home of Nathan B. Stubblefield on North 16th Street, Murray, Kentucky. From left, Sam Stubblefield, the black man, and then, identified by numbers, (1) Mr. John P. McElrath; (2) Mrs. John P. McElrath; (3) O. T. Hale; (4) John H. Keys; (5) Mrs. John H. Keys; (6) James M. Cole; (7) Solon Higgins; (8) Mrs. Solon Higgins; (9) O. J. Jennings; (10) Mrs. Ella Hale Woodruff; and then, (1) Pattie Stubblefield; (2) Helen Gould Stubblefield; (3) Oliver Stubblefield; (4) Victoria Stubblefield; (5) Mrs. Hattie Keys Beale; (6) Bernard Stubblefield; (7) Isaac W. Keys; (8) James H. Coleman; (9) Abe Thompson; (10) Ben B. Keys; (11) George Gatlin; (12) Tip Wilcox; (13) Nathan B. Stubblefield, and (14) Mrs. Nathan B. Stubblefield. (Photo courtesy of Murray State University.)

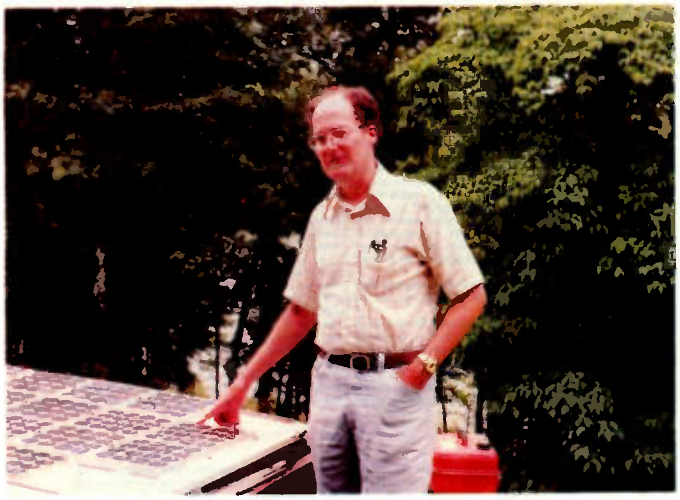


Photo B. William Call KJ4W, vice president and trustee of the Murray State University Amateur Radio Club, pointing out his solar panel employed for Field-Day operation this year. "It may have been magnetic induction. But you won't find that opinion around here much because it offends people. They want to believe he invented radio."

Photo C. Ronnie Outland, 22, lives next to the private cemetery where Stubblefield is buried. "Until recent years the grave was not kept up. There were weeds all around and I used to play here when I was younger. There was a big controversy about whether he invented radio. Now they think he did."

Man," and its call letters were WNBS: Nathan B. Stubblefield. These folks were serious.

When I arrived in Murray and called the motel, I saw it in the phone book. Right there on page III was a photo of Nathan B. standing in the woods, head cocked to one side, holding the wireless device to his ear. The text called him the inventor of the radio.

Add to that the granite monument in front of his homesite and the state highway market pinpointing his birthplace, and there was little doubt left.

Murrayites meant business.

Who was that man with the bowler hat and handlebar moustache? And why, if he invented radio, has he been largely ignored outside of Murray? And why, if he had willing financial backers for his invention, did he die a pauper, found locked in his cabin outside of Murray where a pet cat seeking moisture had licked out his dried eyes? And why was it that the hundreds of articles written about Stubblefield, a PhD thesis, and a play about his work failed to halt the controversy and contradictions surrounding this eccentric genius?

It was frustrating enough to make me aim my silver Chevette for the nearest telephone pole and take advantage of that $3-a-day coverage.

Instead, I headed for Murray State University where Dr. Keith Heim, head of special collections, had gathered a respectable file of information. Unfortunately, most of it was secondary source material.

In the journalism biz, information is divided into primary and secondary sources. Primary sources are best because they include government documents, photographs, taped and transcribed interviews with people who witnessed an event, and so on. Secondary sources include magazine, newspaper, and other pieces written about an event. They are not as reliable as primary sources because they are secondhand information. Primary sources are the writers' mother lode.

MSU's Stubblefield files contained materials (even from highly touted publications) that contradicted each other. I saw differences in simple items such as names, dates, spellings, and attribution. Even Stubblefield's middle name was argued. Smart money is on Beverly, but some pieces list it as Bowman (his mother's maiden name) or Bedford. Each additional article I read only muddled the issue.

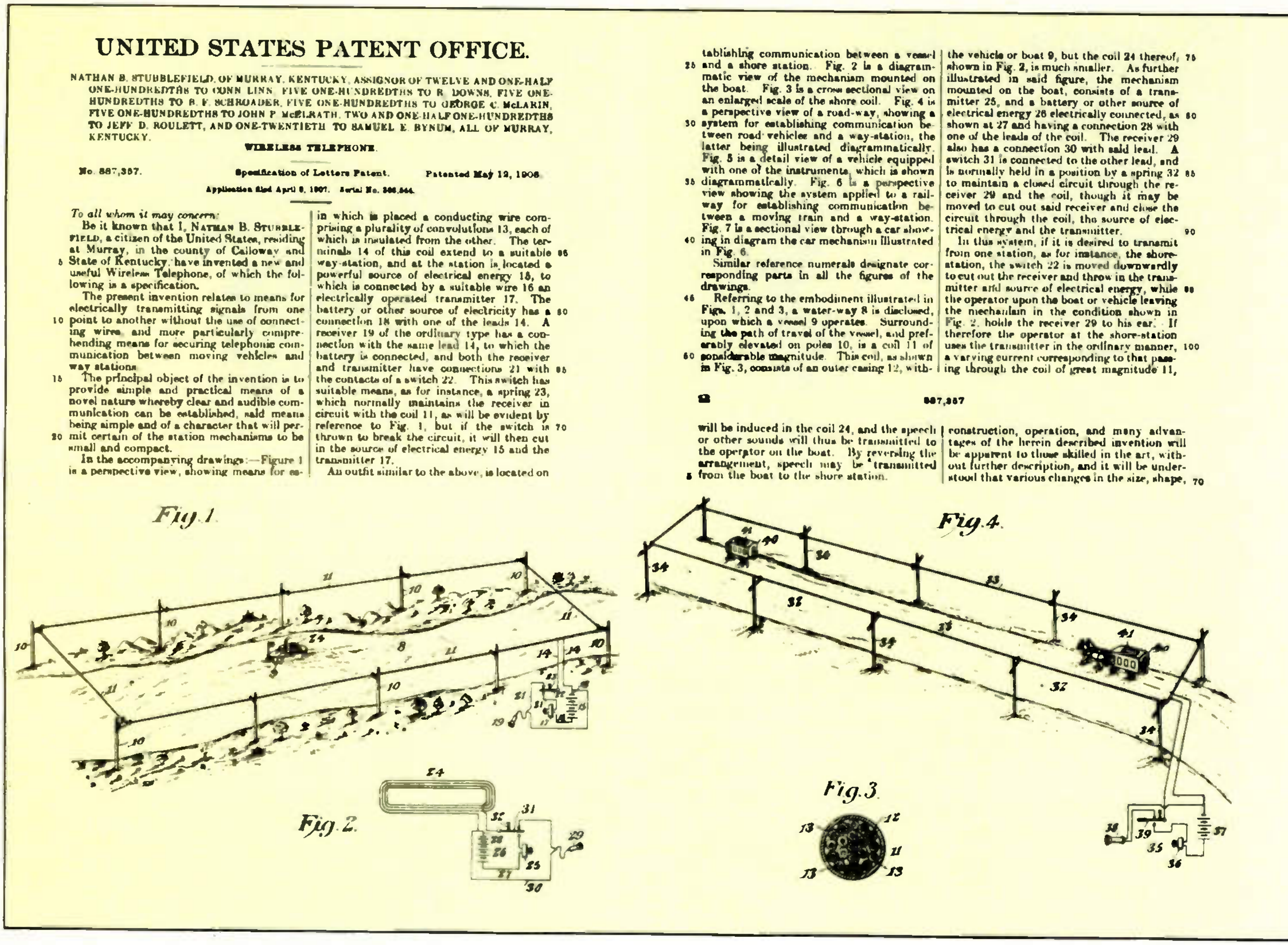
In addition, it appeared that much of what has been written about Stubblefield was based on the research of two prominent Murray citizens who are less than unbiased about the role of the farmer/inventor in radio's early days.

It was not an auspicious beginning.

Some things are certain, however. Few disagree that Stubblefield was born in 1860 in Murray, the son of Victoria and William Stubblefield. He was a loner and had few friends besides Duncan Holt, a boyhood chum.

As they grew up, they became fascinated by the work of Nikola Tesla and Heinrich Rudolf Hertz. They read all they could about the burgeoning interest in this new concept of electrical waves and com-

Photo D. Gravestone in Photo C located behind the Watson home, Route 8, about a mile north of Murray.



UNITED STATES PATENT OFFICE.

NATHAN B. STUBBLEFIELD, OF MURRAY, KENTUCKY, ASSIGNOR OF TWELVE AND ONE-HALF ONE-HUNDREDTHS TO CONN LINN, FIVE ONE-HUNDREDTHS TO R. DOWNS, FIVE ONE-HUNDREDTHS TO B. F. SCHROADER, FIVE ONE-HUNDREDTHS TO GEORGE C. McLARIN, FIVE ONE-HUNDREDTHS TO JOHN P. McELRATH, TWO AND ONE-HALF ONE-HUNDREDTHS TO JEFF D. ROULETT, AND ONE-TWENTIETH TO SAMUEL E. BYNUM, ALL OF MURRAY, KENTUCKY.

WIRELESS TELEPHONE.

No. 887,357. Specification of Letters Patent. Patented May 12, 1908.

Application filed April 5, 1907. Serial No. 366,444.

To all whom it may concern:

Be it known that I, NATHAN B. STUBBLEFIELD, a citizen of the United States, residing at Murray, in the county of Calloway and State of Kentucky, have invented a new and useful Wireless Telephone, of which the following is a specification.

The present invention relates to means for electrically transmitting signals from one point to another without the use of connecting wires, and more particularly comprehending means for securing telephonic communication between moving vehicles and way stations.

The principal object of the invention is to provide simple and practical means of a novel nature whereby clear and audible communication can be established, said means being simple and of a character that will permit certain of the station mechanisms to be small and compact.

In the accompanying drawings:—Figure 1 is a perspective view, showing means for establishing communication between a vessel and a shore station. Fig. 2 is a diagrammatic view of the mechanism mounted on the boat. Fig. 3 is a cross sectional view on an enlarged scale of the shore coil. Fig. 4 is a perspective view of a road-way, showing a system for establishing communication between road vehicles and a way-station, the latter being illustrated diagrammatically. Fig. 5 is a detail view of a vehicle equipped with one of the instruments, which is shown diagrammatically. Fig. 6 is a perspective view showing the system applied to a railway for establishing communication between a moving train and a way-station. Fig. 7 is a sectional view through a car showing in diagram the car mechanism illustrated in Fig. 6.

Similar reference numerals designate corresponding parts in all the figures of the drawings.

Referring to the embodiment illustrated in Figs. 1, 2 and 3, a water-way 8 is disclosed, upon which a vessel 9 operates. Surrounding the path of travel of the vessel, and preferably elevated on poles 10, is a coil 11 of considerable magnitude. This coil, as shown in Fig. 3, consists of an outer casing 12, within which is placed a conducting wire comprising a plurality of convolutions 13, each of which is insulated from the other. The terminals 14 of this coil extend to a suitable way-station, and at the station is located a powerful source of electrical energy 15, to which is connected by a suitable wire 16 an electrically operated transmitter 17. The battery or other source of electricity has a connection 18 with one of the leads 14. A receiver 19 of the ordinary type has a connection with the same lead 14, to which the battery is connected, and both the receiver and transmitter have connections 21 with the contacts of a switch 22. This switch has suitable means, as for instance, a spring 23, which normally maintains the receiver in circuit with the coil 11, as will be evident by reference to Fig. 1, but if the switch is thrown to break the circuit, it will then cut in the source of electrical energy 15 and the transmitter 17.

An outfit similar to the above, is located on the vehicle or boat 9, but the coil 24 thereof, shown in Fig. 2, is much smaller. As further illustrated in said figure, the mechanism mounted on the boat, consists of a transmitter 25, and a battery or other source of electrical energy 26 electrically connected, as shown at 27 and having a connection 28 with one of the leads of the coil. The receiver 29 also has a connection 30 with said lead. A switch 31 is connected to the other lead, and is normally held in a position by a spring 32 to maintain a closed circuit through the receiver 29 and the coil, though it may be moved to cut out said receiver and close the circuit through the coil, the source of electrical energy and the transmitter.

In this system, if it is desired to transmit from one station, as for instance, the shore-station, the switch 22 is moved downwardly to cut out the receiver and throw in the transmitter and source of electrical energy, while the operator upon the boat or vehicle leaving the mechanism in the condition shown in Fig. 2, holds the receiver 29 to his ear. If therefore the operator at the shore-station uses the transmitter in the ordinary manner, a varying current corresponding to that passing through the coil of great magnitude 11,

2 887,357

will be induced in the coil 24, and the speech or other sounds will thus be transmitted to the operator on the boat. By reversing the arrangement, speech may be transmitted from the boat to the shore station.

construction, operation, and many advantages of the herein described invention will be apparent to those skilled in the art, without further description, and it will be understood that various changes in the size, shape,

munication. They spent hours reading magazines, *Scientific American* being a favorite.

Stubblefield and his wife had several children, but only their son Bernard took a fancy to his father's tinkering, and he later became a trusted cohort.

Another man, Rainey T. Wells, who went on to found Murray State Teachers College, figured heavily in the inventor's life and was allegedly present when Stubblefield demonstrated his wireless invention in 1892. Before that, though, Stubblefield supposedly told Holt of his discovery in 1885. However, it was not until January 1, 1902, that he gave the first documented public demonstration of his device in Murray's town square.

The instruments he and his son exhibited by the courthouse consisted of a transmitter and receiver—200 feet apart—and metal rods thrust into the ground connected by wire to both devices. Coils spread all over the walkway.

In an interview with a *St. Louis Post-Dispatch* reporter ten days after the demonstration, Stubblefield was quoted as saying: "I had been working on this ten or twelve years before I heard of Marconi's efforts (Marconi successfully sent radiotelegraphy in 1896, but not voice) or the efforts of others to solve the problem of transmission of messages through space without wires. I have solved the problem of telephoning without wires through the earth as Signor Marconi has of sending signals through space. But I can also telephone without wires through space as well as earth because my medium is everywhere."

He never said what that medium was.

Stubblefield demonstrated his wireless voice device on his farm to the reporter. Bernard stayed in the house while his father and the reporter walked to a cornfield about 500 yards away.

The reporter wrote: "The transmitting apparatus is concealed in a box. Two

Photo E. Monument erected by L. J. Hortin and others to mark the home (since torn down) of Stubblefield. The massive stone was established at the edge of the Murray State University campus in the 1930s.

The use of coils for both stations, each coil consisting of a plurality of convolutions has been found by experience to be of the utmost value, and furthermore experience has demonstrated that the employment of coils of different magnitudes is of great importance, for it has been found that while two small coils can be used to transmit but a short distance, if one large coil of the character set forth is employed, the other may be very small, and speech or sounds can be transmitted comparatively great distances from one to the other. These sounds are clearly audible.

The structure disclosed in Figs. 4 and 5 is of the same general character. A road-way 32 is disclosed surrounded by a coil 33 of great magnitude that is supported on suitable poles 34. The way-station 35 consists of a transmitter 36, a source of electrical energy 37 connected thereto, a receiver 38, and a switch 39, whereby the receiver or the transmitter and source of electrical energy can be thrown into circuit with the coil 33. The vehicles 40, which operate on the road-way, are provided with smaller coils 41 and instruments consisting of receivers 42, transmitters 43, sources of electrical energy 44 and switches 45 all arranged in the manner already described. In a system of this kind, it will be evident that the occupant of one vehicle may telephone to the home or way-station, and the message can be transmitted to another vehicle. Thus it will be evident that communication can be established between two moving vehicles or between a way-station and any vehicle desired which is within the range of the home- or way-station.

The system is also capable of use in connection with railways, and in Figs. 6 and 7, such a system is disclosed in connection therewith. A comparatively great coil 46 is supported on opposite sides of the railway 47 by poles 48 and a station 49 has a receiver 50 and a transmitter 51, a source of electrical energy 52 and a switch 53, the last mentioned being employed for throwing either the receiver or the transmitter and source of electrical energy into closed circuit with the coil 46. One or more cars of a railway train is equipped with an outfit consisting of a coil 54, a receiver 55, a transmitter 56, a source of electrical energy 57, and a switch 58 for throwing either the receiver or the transmitter and source of electrical energy into circuit with the coil 54. It will be evident that the operation of these two last described systems are substantially the same as that first set forth, and no extended description thereof is believed to be necessary.

From the foregoing, it is thought that the proportion, and minor details of construction, may be resorted to without departing from the spirit or sacrificing any of the advantages of the invention.

Having thus fully described my invention, what I claim as new, and desire to secure by Letters Patent, is:—

1. In a system of the character described, the combination with a vehicle, of a comparatively small coil of conducting material mounted thereon, electrical transmitting and receiving mechanism including a source of electrical energy connected to the small coil and carried by the vehicle, a stationary aerial coil of much greater magnitude than the small coil having its opposite stretches or sides extending along the opposite sides of the path of travel of the vehicle and elevated above the same and above the vehicle coil, and electrical transmitting and receiving mechanism connected to the greater coil and including a source of heavy electrical current.

2. In a system of the character described, the combination with a vehicle, of a coil of conducting material mounted thereon, electrical transmitting mechanism, a source of electrical energy connected thereto, receiving mechanism, means for connecting either the transmitting mechanism and source of electrical energy or the receiving mechanism to the coil, a stationary coil of greater magnitude surrounding the path of travel of the vehicle and comprising a plurality of convolutions of conducting material, the different convolutions being insulated one from the other, means for supporting the coil in an elevated position, electrical transmitting mechanism, a source of great electrical energy connected to said transmitting mechanism, electrical receiving mechanism, and means for electrically connecting either the transmitting mechanism and source of electrical energy or the receiving mechanism to the said coil of greater magnitude.

3. Means for communicating between a plurality of stations which consists of an aerial electrical coil of great magnitude, means for supporting the said coil, a station electrically connected to the great coil and comprising transmitting and receiving mechanism that includes a source of heavy electrical energy, and a plurality of other separate stations simultaneously in coacting relation with the aerial coil, each of said latter stations comprising a coil of conducting material spaced from but in coacting relation with said great coil and below the same, and transmitting and receiving mechanism connected to said other coil and including a source of electrical energy.

887,357 3

4. Means for communicating between a plurality of stations which consists of an aerial coil of conducting material of great magnitude, transmitting and receiving mechanism connected to said aerial coil and including a source of heavy electrical energy, a plurality of vehicles movable between the opposite sides or stretches of the great coil, coils carried by said vehicles and disposed within the field of action of the aerial coil, and transmitting and receiving mechanism mounted on each vehicle and including a source of electrical energy.

In testimony, that I claim the foregoing as my own, I have hereto affixed my signature in the presence of two witnesses.

NATHAN B. STUBBLEFIELD.

Witnesses:
J. P. McElrath,
J. H. Coleman.

Fig. 6.

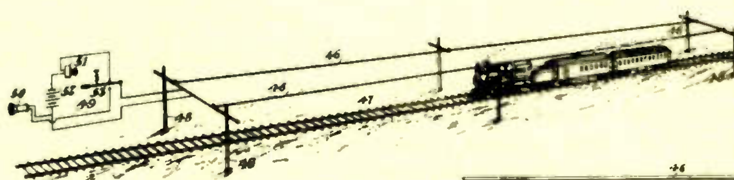


Fig. 5.

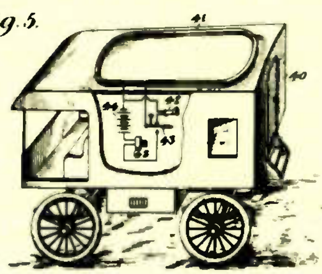
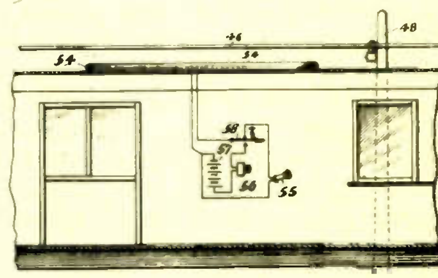


Fig. 7.



wires of the thickness of a lead pencil coil from its corners and disappear through the walls of the room and enter the ground outside. On top of the box is an ordinary telephone transmitter and a telephone switch. This is the machine through which the voice of the sender is passed into the ground to be transmitted by the Earth's electrical waves to the ear of the person who has an instrument capable of receiving and reproducing it.

"We went into the cornfield back of the house. After walking five hundred yards, we came to the experimental station the inventor has used for several months. It is a dry goods box fastened to the top of a stump. A roof to shed the rain has been placed on top of it; one side is hinged for a door, and the wires connected with the ground on both sides run into it and are attached to a pair of telephone receivers. The box was built as a shelter from the weather and as a protection to the receivers. I took a seat in the box and Mr. Stubblefield shouted 'hello' to the house. This was a signal to his son to begin sending messages. I placed the receiver to my ear and listened. Presently, there came with extraordinary distinctness several spasmodic buzzings and then a voice which said: 'Hello, can you hear me? Now I will count to ten. One-two-three-four-five-six-seven-eight-nine-ten. Did you hear that? Now I will whisper.'"

The demonstration continued with the reporter and Stubblefield walking about a mile from the house, the reporter placing the rods anywhere he wished and hearing Bernard talk as clearly as when they were 500 yards away.

The reporter quoted Stubblefield: "The earth, the air, the water, all the universe as we know it is permeated with the remarkable fluid which we call electricity, the most wonderful of God's gifts to the world and capable of the most inestimable benefits when it is mastered by man. For years I have been trying to make the bare earth do the work of the wires. I know now I have conquered it."

Photo F. The back of the monument in Photo E.

Photo C. This sign, erected by the state of Kentucky, marks Stubblefield's birthplace. Ironically, it is almost directly opposite the tower of radio station WNBS.

Stubblefield claimed his invention would work for any distance. He also said that eventually he would invent a tuning apparatus so that many conversations could go on at the same time without interference. And, he said it wasn't necessary to use the ground rods.

The father and son team demonstrated the wireless device in Philadelphia, New York, and Washington, D.C. Newspapers and magazines documented the events and Stubblefield's fame grew. The March 20, 1902, experiment was particularly unique in that Stubblefield transmitted from the ship *Bartholdi* on the Potomac River, and it was billed as the "First Marine Wireless Telephone Demonstration." He transmitted about ¾ of a mile.

During all his demonstrations, Stubblefield employed what he called "an earth battery." Although no one knows for sure what it was, Stubblefield claimed the cell, which he placed in the ground, converted the earth's natural current into electricity. That, in turn, transmitted his voice.

(Stubblefield received patent #600,457, March 8, 1898, for a "primary battery" consisting of a bare iron wire and insulated copper wire wound helically on an iron core. The patent claimed this construction increased the output of the couple, using water as an electrolyte. A couple is two dissimilar metals touching. He proposed placing the battery in moist earth, but it was never proven to be the one used in his voice transmission experiments, although it probably was.)

Interestingly enough, his Philadelphia experiments as well as his Washington showings were successful, but his New York trip was a bust. Some observers attribute the poor performance to the hard, dry bedrock in the area.

Around this time, Stubblefield became quite well known. *Scientific American* printed an article about his work, and a coterie of sharp financiers took notice. They saw his system as a moneymaker. A group of New York businessmen formed The Wireless Telephone Company of America to promote the still unpatented device. Several Murray men owned stock. But, for some reason, Stubblefield shied away from the operation after it got underway. It's rumored that he turned down a half million dollars for his invention.

He finally applied for a patent on April 5, 1907, and received it May 12, 1908. He also obtained foreign patents.

Then, for some unknown reason, Stubblefield retreated to his home, disillusioned, distant, and despondent.

Some say his invention was stolen. Others say he became angry at his backers' greed. Still others contend he went mad.

After a Washington trip in 1912, Stubblefield told his friends and associates to withdraw their investments, go away, and leave him alone. That same year his house burned to the ground.

Later, his wife and children left him and he built a cabin about six miles north of Murray. There he continued to tinker, and apocraphyl stories abounded about his strange experiments which supposedly involved drawing energy from the earth for lighting.

He died March 28, 1928, of natural causes, and two days later Horace Churchill, country coroner, and his son, Ronald, broke down the door to Stubblefield's cabin. He was dead on the floor.

In his report, Churchill wrote: "...he had been dead for some time. I wouldn't know, but he was pretty stiff and all. Rigor mortis has set in. That cat had licked out his entire eyeball sockets. That's what the cat was doing."

One question still remains amid all the conjecture, weird tales, and questionable articles. Did Nathan B. Stubblefield invent radio? Are the people of Murray correct; did hometown boy make good?

It all depends on how you look at it and who you ask.

L. J. Hortin, one-time chairman of the Murray State University journalism school, spent 50 years studying Stubblefield. He has written hundreds of articles about the man and his work and is responsible for raising most of the money for a monument at Murray State University honoring Stubblefield.

But, like Stubblefield, Hortin appears distant and bitter about the whole affair, and although he claims to possess documents, affidavits, and photos attesting to Stubblefield's inventions, he refuses to let anyone see them. "I've been giving it out free for years," Hortin said. "I'm tired of people making fun of him and getting their information wrong. I've decided to put it all together and write a book.

"Pardon my vehemence," he continued, "but I've been doing this for 50 years.

"I say he invented radio about 1890, but I don't think anyone really knows. When someone questions me, I say, 'Let's see what you have. Who do you think did it?' That usually quiets them down.

"Radio is a device that transmits and receives voice over considerable distance without connecting wires," Hortin said. "Stubblefield invented, manufactured, and demonstrated

"Be it resolved by the General Assembly of the Commonwealth of Kentucky: That the General Assembly of the Commonwealth of Kentucky hereby publicly recognizes Nathan B. Stubblefield, who was a native of the city of Murray, Calloway County, Ky., as the true inventor of the radio, and it is the sentiment of the General Assembly that said Nathan B. Stubblefield is entitled to the highest honor and respect at the hands of the people of this Commonwealth and of this nation for his outstanding service."

—Resolution by the Kentucky Legislature, 1944.

such a device and did so before anyone else on this planet. That's my claim." He described "considerable distance" as several miles.

James L. Johnson is another unabashed Stubblefield booster. In a 1961 speech, the former executive secretary of the Murray chamber of commerce told the annual convention of The Kentucky Broadcaster Association in Louisville: "'Hello Rainey . . Hello Rainey.' These four words, highly insignificant in themselves, were the gateway that opened a fabulous industry in the late 19th and early 20th century. These were the first words ever broadcast by radio. These four words put you people in business."

Following the address, the association presented the chamber of commerce a plaque recognizing Nathan B. Stubblefield as the inventor of broadcast radio.

But Riley Kaye W4LMF holds a different view of the Stubblefield story.

"I think Stubblefield invented the induction telephone. He used loops above the ground. There appeared to be no carrier. He used audio frequencies, and that's where the challenge comes in," said the man who worked for 7 years as chief instructor at RCA and high-frequency development engineer for Western Electric in Chicago.

"There is no proof that he used radiation. There's no proof he used resonant circuits. That would be radio."

Kaye, 9DKN during sparkgap days, added: "Nobody can challenge that he didn't invent the wireless telephone and that he was the first to transmit voice without wires. He deserves a lot of credit and Murray can be proud of him."

Despite its limitations, Kaye believes that Stubblefield's system needs a closer look. "It's not a private system, but it is cheap. It has a range of about five miles and seems perfect for community civil defense and emergencies. That avenue has not been pursued."

(Note that in Stubblefield's patent the ground rods are missing. In his early work, he employed a conduction system of telephony using the earth, but he later switched to an induction system. Evidently, Stubblefield confused the two media, thinking his voice traveled through both of them in a similar fashion.)

Another local ham takes issue with the Stubblefield saga. William Call KJ4W is vice-president and trustee of the Murray State University Amateur Radio Club. "It may have been magnetic induction," he said. "But you won't find that opinion around here much because it offends people. They want to believe he invented radio. On what I've seen," the school's electrical engineer said, "I don't believe he invented radio, but one thing almost everyone agrees on is that Stubblefield was a genius."

That he was.

Assaults on his claims of inventing radio have drawn attention from Stubblefield's other brilliant inventions. In 1888, he patented the first mechanical telephone, and he linked Murray with the system. It worked well until Bell introduced his electrical telephone which was superior in voice quality and reliability. He also invented a new type of primary battery, previously mentioned, whose revolutionary design stepped up dry-cell technology many notches.

So, if Stubblefield didn't invent radio—and it appears from his patent that he really didn't—who did?

According to many experts, another relatively unknown inventor, Reginald Aubrey Fessenden, on December 11, 1906, gave the first public demonstration of voice transmission using Hertzian waves—radio as we know it.

Photo H. Built in 1948, radio station WNBS was the first broadcast station in Murray. Its call letters were chosen to honor Nathan B. Stubblefield.

The exhibition by the one-time chief chemist of Thomas Edison's lab took place at Brant Rock, Massachusetts. He reportedly told a journalist in 1915 that he had been toying with the invention for some time and perfected it in December, 1900. He gradually increased the transmission range until, in 1904, he could cover 25 miles. Then he offered it to the Navy for development.

Fessenden was born October 6, 1866, in East Bolton, Quebec, and died July 23, 1932, in Bermuda.

So, it appears that although Stubblefield didn't invent radio, he was indeed the first person to send wireless voice transmission and suggest that it be employed in a moving vehicle such as a boat or horseless carriage.

But he holds another title, too. He was the first to transmit wireless voice from a ship.

In a 1971 thesis paper for Florida State University titled "The Contribution of Nathan B. Stubblefield to the Invention of Wireless Voice Transmission," author T. Morgan wrote: "Nathan B. Stubblefield was not the father of radio broadcasting. Stubblefield was the first man to successfully transmit and receive the human voice without wires. Therefore, let him be called the father of wireless voice transmission, for this title is truly his."

Perhaps I should drive to East Bolton and see if the residents there agree. ■

Carl M. Chernan WA3UER
1135 Constitution Drive
Tarentum PA 15084

In Search of the Elusive SES

—track solar activity with this simple VLF receiver

With the continuing and growing interest in solar flare activity, including the predictions for Cycle 21, radio amateurs and experimenters alike are searching for methods to follow and record this fascinating phenomenon. The SES (Sudden Enhancement of Signal) receiver that I am going to describe in this article provides a simple answer.

Photo A. Finished package with the fine-tune control added.

When a solar flare occurs on the sun, there is a major emission of X-rays. This has the effect of increasing the electron density of the D layer, immediately enhancing the storm noise (or the transmitted signal) to levels about twice normal. The effect is very prominent in the LF and VLF ranges. This enhancement, though it has a rather rapid rise time as seen from the recordings in Fig. 1, has a slow decay time as the D layer reestablishes its normal condition which can take from 30 minutes up to an hour.

Heat generated by the sun in the daytime periods expands the gas in the D layer, lowering its efficiency for radio propagation

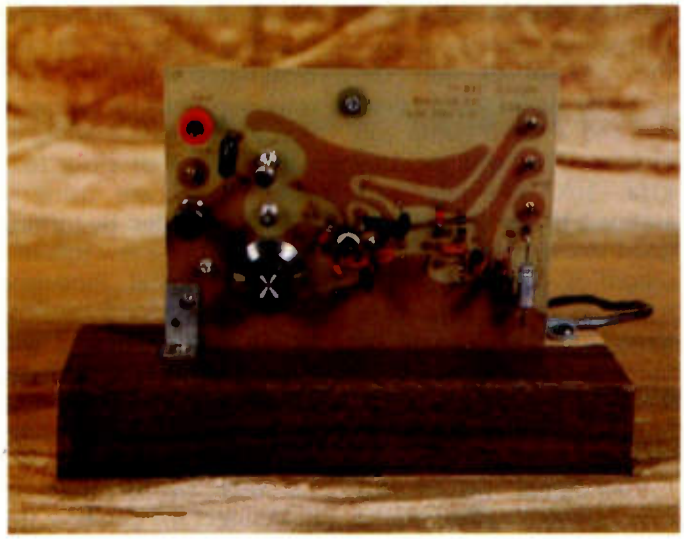


Photo B. Prototype receiver—front view.

Photo C. Prototype receiver—rear view, showing the shielding method used.

during the day. Similarly, the cooling of the layer allows the gas to contract, increasing its efficiency; this, of course, is the reason that AM radio stations are received at greater distances at night. There also are seasonal effects which occur as the Earth heats or cools, depending upon the angle of the sunlight as it strikes the Earth.

Receivers used to record these enhancements come in two categories. The first is an SEA receiver that is tuned to an unused frequency spectrum in the VLF range—hence the name, Sudden Enhancement of Atmospherics. The second type is tuned to a transmitted signal in the VLF range, and is the SES receiver—referred to above. SES receivers are easier to tune, and you do not have to be an expert to interpret the recording charts.

Building the SES Receiver

A proven circuit for building a tunable SES receiver is shown in Fig. 2. It is basically a high-gain amplifier which is tunable from 17.8 to 35 kHz. If you use the exact components shown on the schematic, the frequency range will be from 17.8 to 23 kHz. This circuitry is then followed by a detector and integrator and finally by a dc amplifier which brings the dc signal-related current up to a proper level to operate an analog meter or a recording device.

The recorder recommended is a model 288 Rustrak (0-100 uA) with a chart speed of 1" per hour, although I have used Esterline Angus 0-1-mA chart recorders successfully. The receiver has more than enough gain to peg a 0-1-mA meter.

All of the parts used in the construction of the receiver are standard, with the exception of the inductor coils. These inductor coils (Miller 6319) are high-Q types and are Litz-wire wound. They can be obtained from Bell Industries, J. W. Miller Division, 19070 Reyes Avenue, PO Box 5825, Compton CA 80224.

Wiring of the circuit is not critical; however, I suggest that a socket be used to mount the IC amplifier. A

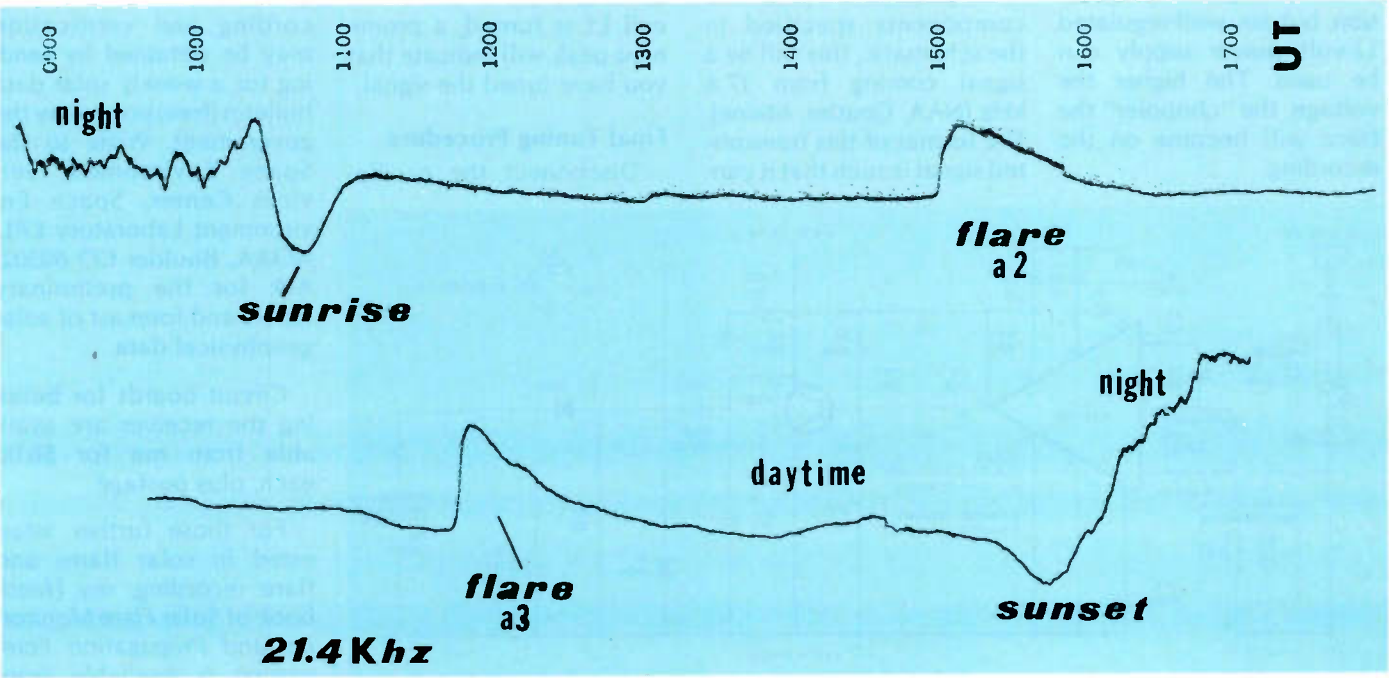


Fig. 1. Actual recordings showing characteristic fast rise/slow decay times.

Photo D. Shield removed to show coils, L1, L2, and gain pot.

substitution for the RCA CA3035 amplifier array is the more-readily-available Sylvania ECG-785. Both wideband amplifier arrays are made up of three individual ultrahigh-gain amplifiers. These amplifiers have low noise characteristics, can be operated either independently or in cascade, and have excellent high cascade voltage gain—129 dB at 40 kHz. The output transistor (RCA SK3019) can be replaced with either a Sylvania ECG-108 or a GE-214. Power supply requirements are 9.3 V dc for optimum operation, but any well-regulated 12-volt power supply can be used. The higher the voltage, the "choppier" the trace will become on the recording.

Initial Tuning Procedure

Run the cores of L1 and L2 completely in. Proceed to turn the gain control (R1) ¼ turn clockwise. Connect the antenna (preferably an 18-foot vertical or an 8-foot CB whip) to the receiver input jack. Ground the receiver using a good *earth* ground. Connect an oscilloscope (using the vertical input) to the test-point jack on the receiver. Turn out L1 one full turn. A large sine wave will appear on the screen, showing a prominent "hump."

If you have used the components specified in the schematic, this will be a signal coming from 17.8 kHz (NAA, Coutler, Maine). The format of this transmitted signal is such that it cannot be used in solar flare studies, so continue to turn the core of L1 out. The 17.8-kHz signal should drop out and a small hump will appear. This will be 18.6 kHz—NAA's 1-megawatt station. If the signal has good strength, by all means record it. If the signal is weak, as in my case, continue with the turning by opening the core of L1 until it's almost fully open or until a large signal reappears on the screen.

This signal will be 21.4 kHz (NSS) radiating a 200-kW signal. This station is an excellent choice for flare propagation recording for a number of reasons. First, it is easy to access (you cannot mistake the signal) and tuning is straightforward. Second, my records, along with the records at the AAVSO (American Association of Variable Star Observers) show that a lot of small flares are recorded at this frequency while they are often completely missed at other low frequencies.

If an oscilloscope is not available for tuning, the receiver can be tuned with a 0-200 uA meter placed across the receiver's recorder output terminals. When coil L1 is turned, a prominent peak will indicate that you have tuned the signal.

Final Tuning Procedure

Disconnect the oscilloscope or tuning meter and place a recorder at the designated terminals. Turn up gain control R1 to give you a mid-scale reading of either 50 uA or close to 1 mA if you are using a 0-1-mA recorder. By turning L1 in and out a few threads, peak the signal. Fine-tune the signal with 5-6 turns of L2. In some cases, it will show a prominent increase; in others, it will not. (Since all coils are not the same, the tuning of L2 may vary.) To test for oscillation, disconnect the antenna; the signal on the recorder should drop to zero or almost to zero. When the ground is disconnected, the signal definitely should drop to zero.

Other Hints and Correlation Ideas

The receiver itself can be housed in any standard metal or wood enclosure, but be sure to make use of adequate shielding around the inductor coils to ensure proper mixing. I use small, lined aluminum cans attached to brackets which are mounted to the circuit board. These make excellent shields.

Good correlation on an official basis for flare recording and verification may be obtained by sending for a weekly solar data bulletin (free) printed by the government. Write to the Space Environment Services Center, Space Environment Laboratory ERL, NOAA, Boulder CO 80302. Ask for the preliminary report and forecast of solar geophysical data.

Circuit boards for building the receiver are available from me for $8.00 each, plus postage.

For those further interested in solar flares and flare recording, my *Handbook of Solar Flare Monitoring and Propagation Forecasting* is available from Tab Books.■

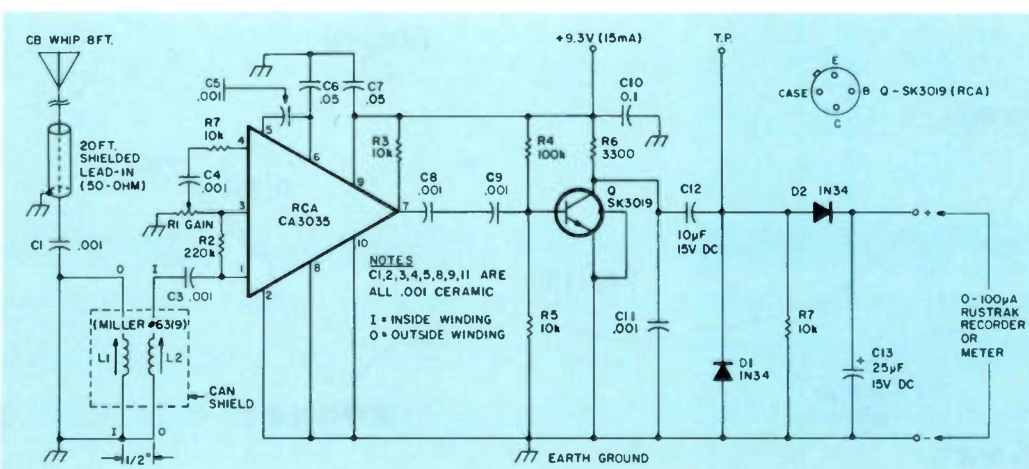


Fig. 2. Circuit for a tunable SES receiver.

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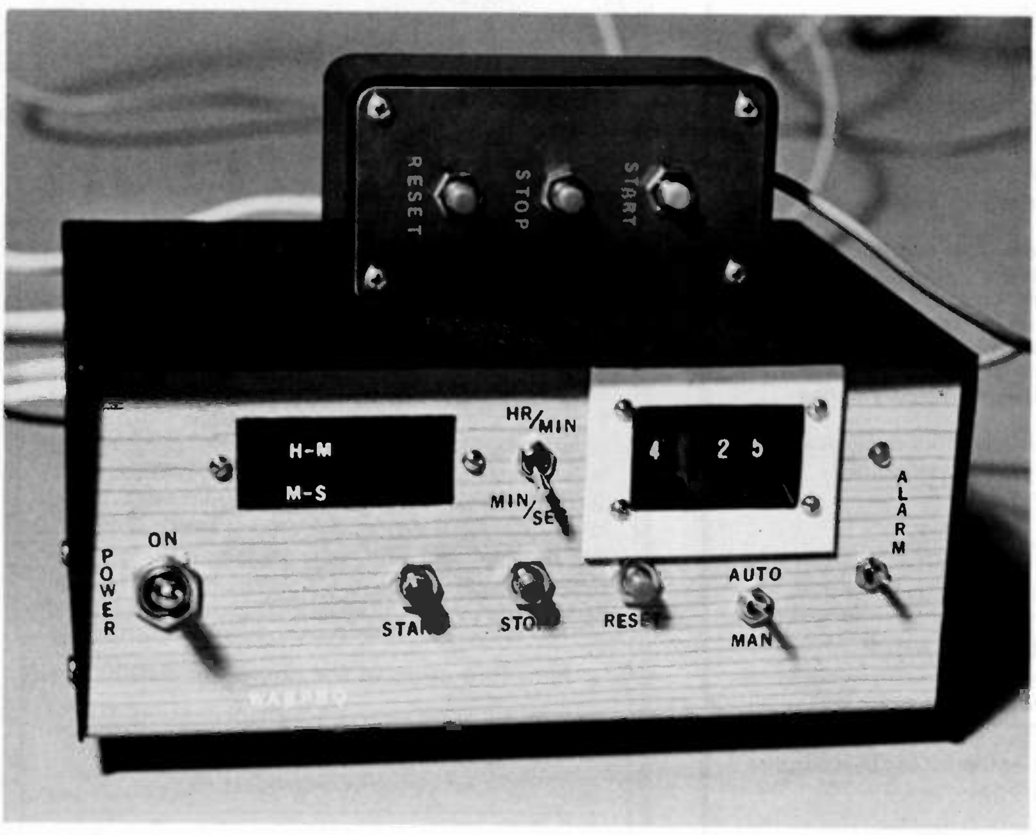
An Even Better IC Timer

—better than what?

Photos by Joe Woelfel



This is the front of the timer. Three 7-segment LEDs are behind a red plastic filter mounted in the upper left section. One digit is to the left of the letters; two are on the right. Discrete LEDs behind the H-M and M-S indicate whether the timer is in the hours/minutes or minutes/seconds mode. They are controlled by the toggle in the upper center. Thumbwheel switches are in the upper right section. The white frame is a piece of plastic covering a mistake made when cutting the hole. Lying on top of the timer is the remote switch box connected by a 4-wire cable. Woodgrain contact vinyl was used to cover the bare aluminum of the Radio Shack cabinet. Labels are dry transfer letters.

This project is a good example of the use of elaborate means to accomplish a simple task. Having become hopelessly hooked on the fun and logic of TTL devices, I was intrigued by an article by Kenneth Williams WB3ELV, in *73*, September, 1978. He had designed a circuit board for a 10-minute ID timer described by Ken Henry K3VTZ in a May, 1977, *73* article. His timer used a single 7-segment readout and cycled through 10-minute intervals.

After reading most of the series of *73* articles on how to use ICs, by Alexander McLean WA2SUT, I decided it would be more fun to have a timer which indicated minutes *and* seconds. I had a 10-minute timer working on the breadboard when I found another *73* article, "Build a Unique Timer," by Marc Leavey WA3AJR (August, 1977). His timer, built for darkroom use, will time to either 99 seconds or 99 minutes and used a 555 as the timebase. That article exposed me to the 7485 comparator chip and thumbwheel switches. My timer grew out of all these, along with some basic design concepts from *The TTL Cookbook*.

My timer will do everything these will do and more. It will run to any user-selected time up to 9 minutes, 59 seconds by seconds or it will run from 1 minute to 9 hours, 59 minutes by minutes. At the end of the selected interval, an alarm may be sounded and a 115-V ac appliance may be turned on or turned off. The timing sequence may be interrupted by a manual reset. The timer may also be used as a stopwatch or an elapsed-time recorder. It may be stopped and restarted with or without resetting to zero.

The block diagram, Fig. 1, shows the general operation of the timer. A wave-shaper converts 60-Hz sine-wave current from the transformer secondary into the square wave required by TTL. A gate, controlled by a start/stop flip-flop, routes these pulses to the divider chain which divides by 60 twice to produce one pulse per second and one pulse per minute. These, as selected by the mode switch, go to the counter/driver/display section which shows minutes and seconds or hours and minutes. The output of the counters is compared with the settings of external thumbwheel switches. When these match, an alarm sounds and all dividers and counters are reset to zero.

The wave-shaper consists of two resistors, a diode, and a Schmitt trigger circuit using two inverters on U1. I have seen circuits which used only a diode to clip the sine-wave output, but I did not get dependable triggering until I included the trigger. Most TTL devices require negative-going pulses and tend to get confused unless they see very fast high-to-low switching. The circuit shown does not produce a 50% duty cycle square wave, but the negative-going pulses follow each other at a 60-Hz rate. Switching time is very short—on the order of a few nanoseconds.

The shaper output goes to the divider chain through a gate on U2 controlled by the start/stop flip-flops. U3 and U4 divide by 6 and 10 and produce one pulse per

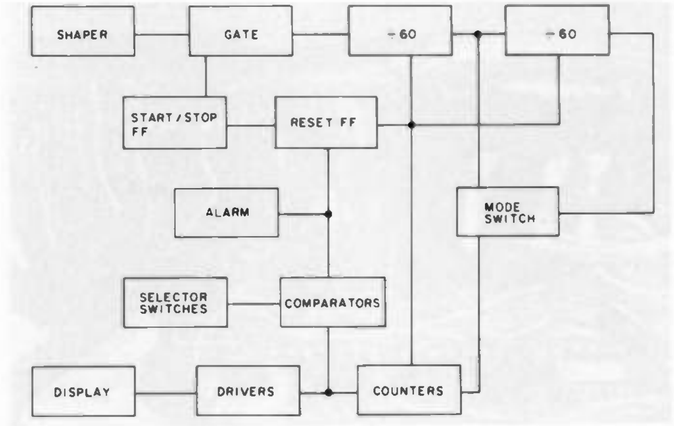


Fig. 1. Block diagram.

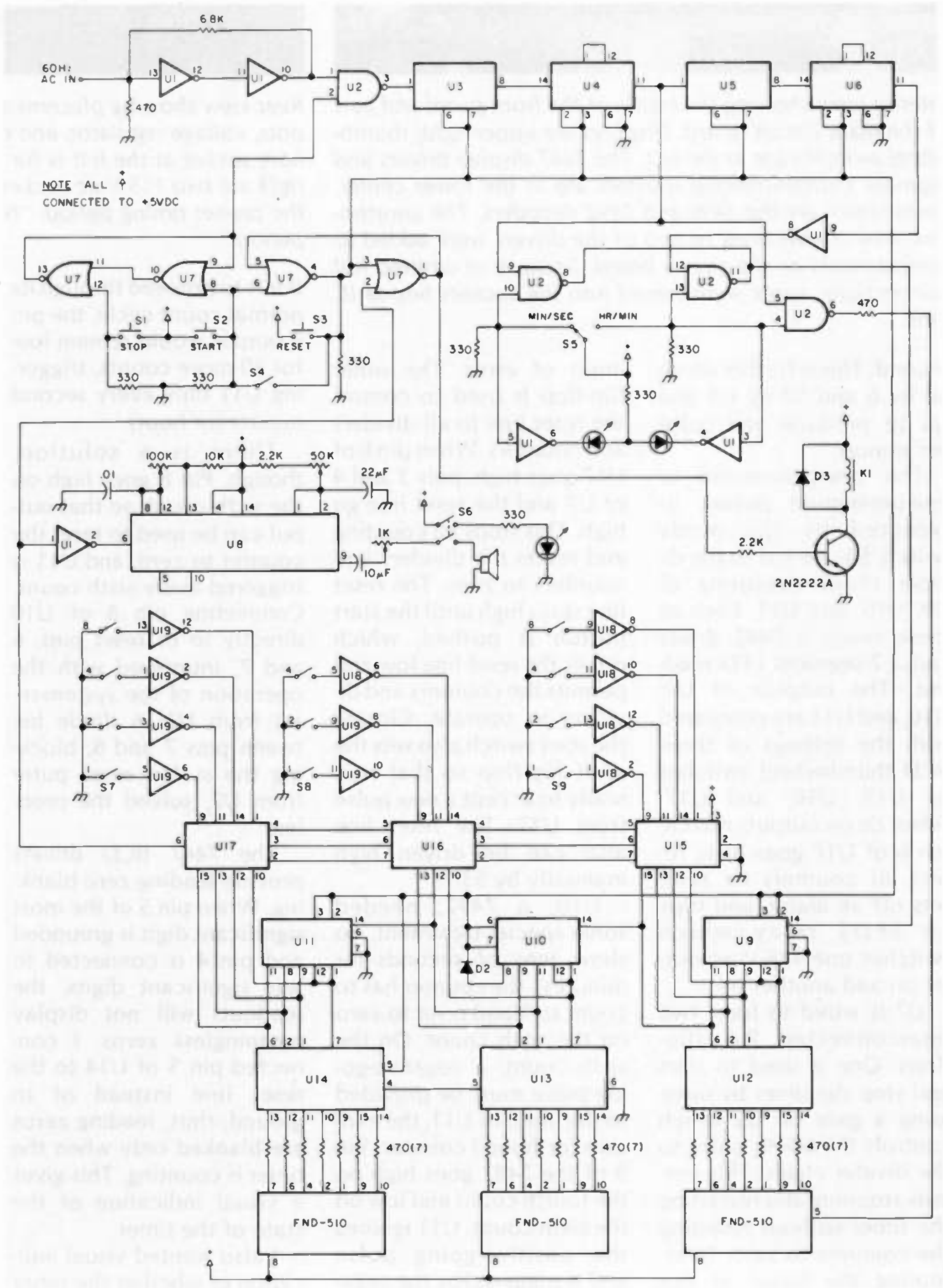
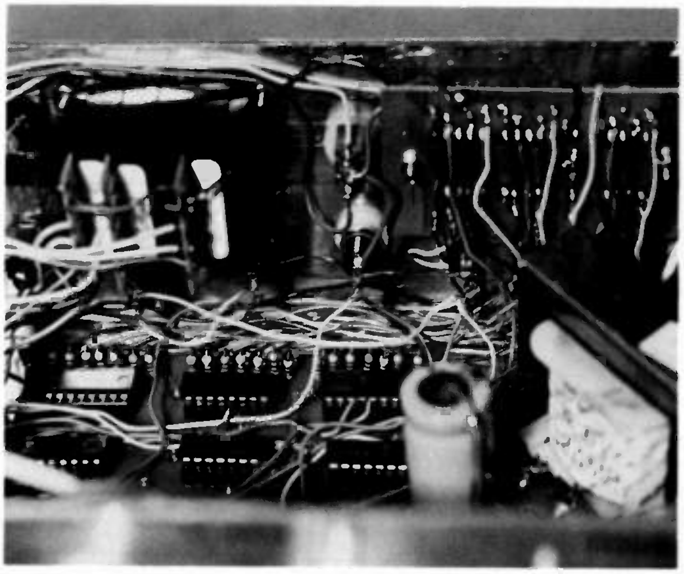
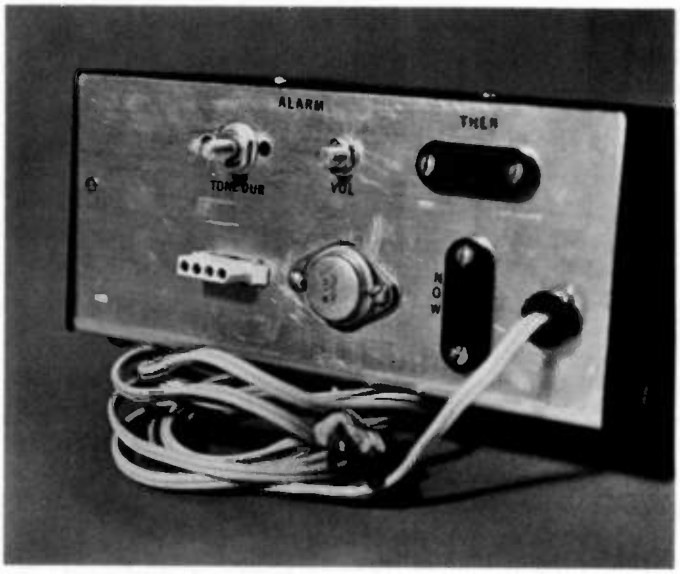


Fig. 2. Schematic.



Interior view showing the inside of the front panel and part of the main circuit board. Displays are upper right; thumbwheel switches are at the left. The 7447 display drivers and segment current-limiting resistors are in the lower center. Below them are the 7490 and 7492 decoders. The unorthodox wire connections to two of the drivers were added to correct errors on the circuit board. Because of omitted foil connections, wires were forced into the sockets beside IC pins.



Rear view showing placement of tone duration and volume pots, voltage regulator, and external connections. The four-hole socket at the left is for the remote switch box. At the right are two 115 V ac sockets, "THEN" is hot at the end of the pre-set timing period. "NOW" is hot during the timing period.

second. This is further divided by 6 and 10 by U5 and U6 to produce one pulse per minute.

The one-per-second or one-per-minute pulses, as selected by the mode switch, S5, are fed to the divider chain consisting of U9, U10, and U11. Each of these feeds a 7447 driver and a 7-segment LED readout. The outputs of U9, U10, and U11 are compared with the settings of three BCD thumbwheel switches by U15, U16, and U17. When those outputs match, pin 6 of U17 goes high, resets all counters to zero, sets off an alarm, and trips an SPDT relay which switches one 115-V ac outlet on and another off.

U7 is wired to form two interconnected R-S flip-flops. One is used to start and stop the timer by operating a gate on U2 which controls the 60-Hz pulse to the divider chain. This permits stopping and restarting the timer without resetting the counters to zero. Interrupting the count at this point introduces a minimum of error. The other flip-flop is used to control the reset line to all dividers and counters. When pin 6 of U17 goes high, pins 3 and 4 of U7 and the reset line go high. This stops all counting and resets the dividers and counters to zero. The reset line stays high until the start button is pushed, which drives the reset line low and permits the counters and dividers to operate. Closing the start switch also sets the reset flip-flop so that it is ready to accept a new pulse from U17. The reset line also can be driven high manually by S3.

U10, a 7492, needed some special treatment. To show tens of seconds (or minutes), the counter has to count to 5 and reset to zero on the sixth count. On the sixth count, a negative-going pulse must be provided to the input of U11, the minutes (or hours) counter. Pin 9 of the 7492 goes high on the fourth count and low on the sixth count. U11 ignores the positive-going pulse and is triggered by the negative-going pulse. However, if left to proceed through its normal count cycle, the pin 9 output would remain low for 10 more counts, triggering U11 only every second minute (or hour).

There is a solution, though. Pin 8 goes high on the sixth count, so that output can be used to reset the counter to zero, and U11 is triggered every sixth count. Connecting pin 8 of U10 directly to its reset pins, 6 and 7, interfered with the operation of the system-reset from U2. A diode between pins 7 and 8, blocking the system-reset pulse from U2, solved the problem.

The 7447 BCD drivers provide leading-zero blanking. When pin 5 of the most significant digit is grounded and pin 4 is connected to less significant digits, the readouts will not display meaningless zeros. I connected pin 5 of U14 to the reset line instead of to ground; thus, leading zeros are blanked only when the timer is counting. This gives a visual indication of the state of the timer.

I also wanted visual indication of whether the timer was in the hours/minutes or minutes/seconds mode. The obvious solution was to use discrete LEDs as indicators. Also, in the hours/minutes mode, the readout changes only once per minute. To provide assurance that something was really happening, I made one of the readout decimal points blink at a 1-Hz rate. Switching all those functions would be simple with a 3-pole, 2-position switch. However, switches are expensive; ICs are cheap. With the use of gates on U2 and inverters on U1, the hours/minutes and minutes/seconds timing pulses, the LED indicators, and a pulsing decimal point for hours/minutes are all switched with an SPDT toggle, S5.

When S5 is in the minutes/seconds position, pin 10 of U2 is high, allowing the 1-Hz pulses to reach the counter chain. Also, pin 5 of U1 is high and pin 6 is low, providing a ground for the minutes/seconds indicator LED. In the hours/minutes position of S5, pin 13 of U2 is high and one pulse reaches the counter each minute; pin 4 of U1 is low, providing a ground for the indicator, and pin 4 of U2 is high, passing one pulse per second to the decimal point of the units readout.

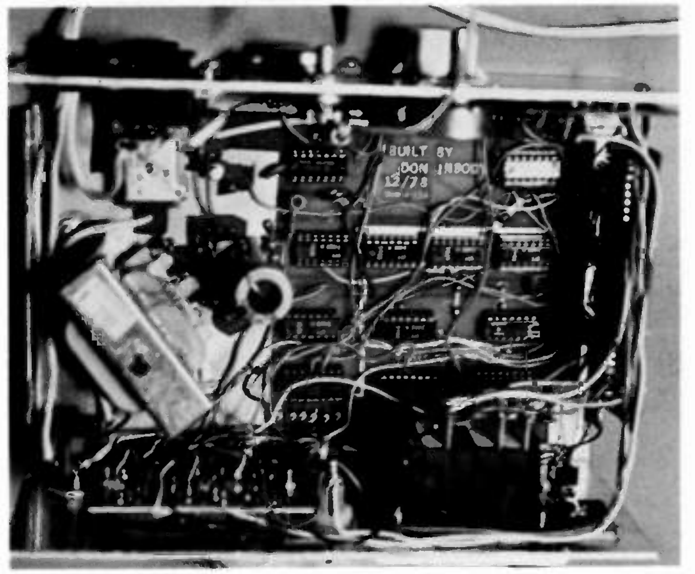
All this switching caused a small problem. I discovered that in the hours/minutes mode, the timer indicated 1 minute after 48 seconds had elapsed. Just a little examination of the 7490 logic table revealed the reason. Pin 11 of a 7490 is low for 8 counts, high for 2 counts, then goes low. That negative-going pulse triggers other devices. However, I had routed the pulses through a 7400 gate and inverted everything. Thus, the positive-going pulse at the eighth count of U6 was seen at the input of U9 as a negative-going pulse. Of course, each succeeding "minute" was 60 seconds long. The problem was corrected by running the minutes output from U6 through an inverter on U1.

The same inaccuracy exists with the 1-Hz output from U4. The first "second" is only .8 second long. I decided to live with that error, because no more inverters were available without adding another IC. By now I realized that the whole problem (and some others) could have been avoided by using a 7408 for U2 instead of a 7400. I did not have a 7408, and my circuit board was already laid out. Oh, well. Next time!

S4, an SPST toggle, was added to increase the versatility of the timer. When it is closed, the reset and start push-buttons are shorted together. Pressing either switch resets everything to zero and immediately starts a new timing sequence. The alarm still sounds at the end of the selected interval, but it is not possible to stop and restart the count without returning to zero. This mode also effectively disables the 115-V ac switching function as the stop-reset-start sequence is so fast that the relay does not trip. I called the closed position of S4 "auto" and the open position "manual." The strange location of the switch happened because this feature was not installed until the project was complete. With a little forethought, the switch could have been located in a better place.

Two 115-V ac sockets are provided for the operation of external appliances such as lights, radio, TV, etc. An SPDT relay with a 6-V coil switches the outlets on or off. One is on and one is off during the timing sequence. This is reversed at the end of the selected interval. Pin 1 of U7 is high during the timing period, so that output was used to make a 2N2222A transistor switch 5 V dc to the relay. A 1N914 diode across the relay coil reduces voltage spikes which occur when the coil is switched out.

The alarm circuit is built around a 556 timer. This is a dual 555 with one part serving as an oscillator to produce a tone and the other as a timer to set the duration of the tone. Pin 6 must be low to trigger the multivibrator, so the high output from pin 6 of U17 is inverted through U1. The pitch of the alarm tone may be adjusted with a 100k pot mounted on the circuit board. The duration of the alarm tone may be varied from a fraction of a second to several seconds with a 50k pot mounted on the rear of the cabinet. I placed a 2.2k resistor in series with the pot so that there would be some tone when the pot was at minimum resistance. The volume of the alarm tone may be adjusted with a 1k pot on the rear of the cabinet. The alarm can be completely disabled with a toggle switch mounted on the front of the cabinet. I included an LED to indicate when the alarm is enabled. If the indicator were omitted, an SPST switch could be used.



Interior view of the timer. The power supply and ac switching relay are on the left. Displays are at lower left; thumbwheel switches are at lower right. The 7485 comparators and 7405 inverters are on a small circuit board mounted vertically at the right. The unorthodox wires on the ICs in the upper right and lower left were used to correct circuit board mistakes. Some foil connections were omitted, so wires were forced into the sockets beside the IC pins.

The switch input to the 7485 comparators requires a BCD complement. I have read that complement mode switches are available, but I could locate only straight BCD switches. A couple of 7405 hex inverters were used to generate the complements of the selected numbers.

The power supply as shown in Fig. 3 is conventional. A 12.6-V, 1-A transformer was used because it was on hand. Anything that will produce at least 7.5 V at .5 A should work. I used a 7805 regulator and mounted it on the rear of the cabinet. Any +5-V regulator capable of handling .5 A could be used. A 10-uF tantalum capacitor from the output of the 7805 to ground is necessary to prevent oscillation and should be mounted as close to the output terminal as possible. De-spiking is provided by several .01-uF disc capacitors. These are not shown on the schematic, but were placed at various locations where the +5-V dc lines were near ground buses. Good TTL design calls for one de-spiking capacitor for every 3 ICs, and one at every place the supply line enters a circuit board.

To make the timer more useful for timing games, for use as a stopwatch, and to generally improve portabil-

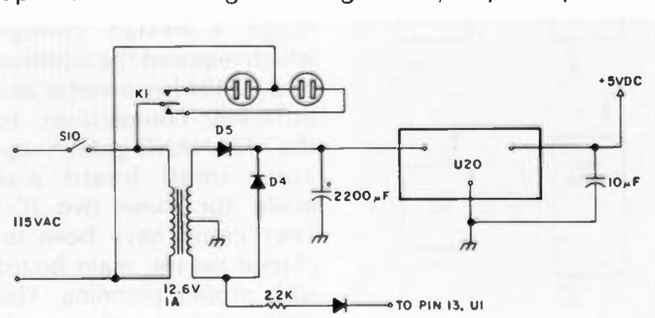
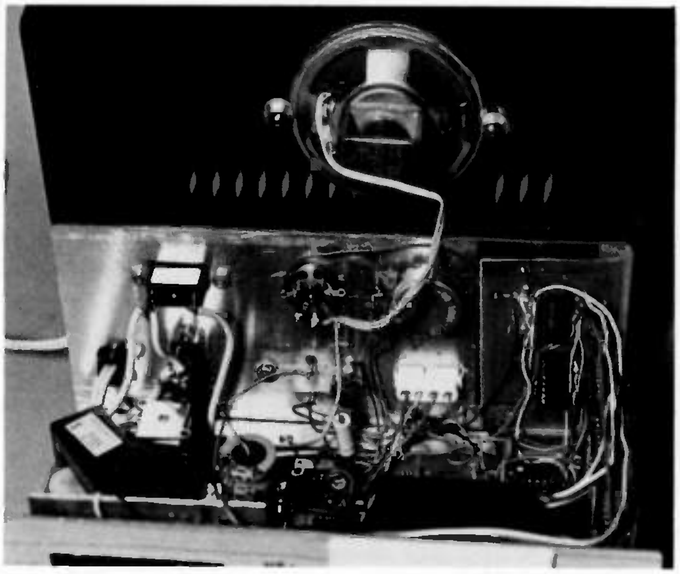


Fig. 3. Power supply.



Interior view of the timer showing the speaker mounted on the top of the cabinet. The power supply components and 115 V ac connections are shown on the left side. The small board at the right was added after the project had been designed and the main circuit board etched. With better planning, the 2 ICs could have been mounted on the main board.

ity, I installed 3 push-button switches in a small box and connected them in parallel with the front-mounted start, stop, and reset buttons. I used a 4-pin socket on the cabinet back and a piece of 4-wire cable from the junk box.

I used FND-510s for the readouts. They are large (.5") and can be bought for $1.00 or less. The 510 is a common-anode device. Almost any 7-segment LED could be used. Common-cathode devices would require 7446 drivers and ground connections instead of +5 V dc.

All parts were readily available at local Radio Shack stores and from firms advertising in *73*. There is considerable variation of prices, so it pays to do some comparison shopping.

I used circuit board construction. Perfboard or wire-wrap probably would have worked, but I wanted the neater appearance of circuit boards. I ended up with 4 boards. The FND-510s, the hours/minutes, and the minutes/seconds LEDs were on one. Because of the many interconnections with other ICs, it seemed simpler to mount the 7485s and 7405s on a separate board. After the main board was etched, I made a design change which required the addition of the 7404 hex inverter and different connections to the 7400 NAND gate. A separate small board was made for those two ICs. They could have been included on the main board with proper planning. The 7805 regulator, alarm volume control, alarm duration pot, 115-V ac sockets, and the remote-control socket were all mounted on the rear of the cabinet. All other components were mounted on the main circuit board except the front-mounted switches. There is nothing especially critical about parts placement, although a little care and planning are needed to reduce the need for jumpers.

Supply connections are not shown on the schematic, Fig. 2. Ground and +5-V dc connections must be provided to all ICs, as shown in Fig. 4.

This project has been a lot of fun. In it, as my first attempt to design a project, or at least to make major modifications to others' projects, I have learned a great deal about TTL. *And*, the completed timer has even proven useful! I have

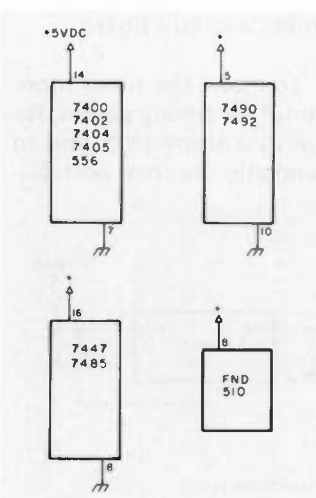


Fig. 4. Supply connections.

Parts List

Diodes
- 2 1N914 or 1N4148
- 3 1N4001

Capacitors
- 6 .01-uF ceramic disc
- 1 10-uF tantalum
- 1 10-uF 16-V electrolytic
- 1 22-uF 16-V electrolytic
- 1 2200-uF 16-V electrolytic

Integrated Circuits
- 1 U1—SN7404
- 1 U2—SN7400
- 3 U3,U5,U10—SN7492
- 4 U4,U6,U9,U11—SN7490
- 1 U7—SN7402
- 1 U8—NE556
- 3 U12,U13,U14—SN7447
- 3 U15,U16,U17—SN7485
- 2 U18,U19—SN7405
- 1 U20—7805 regulator

LEDs
- 3 .2" discrete LEDs
- 3 FND-510 displays

Resistors (all ¼ Watt)
- 7 330 Ohm
- 23 470 Ohm
- 3 2.2k Ohm
- 1 6.8k Ohm
- 1 10k Ohm
- 1 1k linear pot
- 1 50k linear pot
- 1 100k PC-board pot

Sockets
- 2 ac sockets (Radio Shack 270-642)
- 13 14-pin IC sockets
- 6 16-pin IC sockets

Switches
- 3 NO push-buttons (S1,S2,S3)
- 1 SPST miniature toggle (S4)
- 1 SPDT miniature toggle (S5)
- 1 DPST miniature toggle (S6)
- 1 SPST standard toggle (S10)
- 3 *BCD thumbwheel switches (S7,S8,S9)

Other
- Cabinet (Radio Shack 270-269)
- Relay—SPDT, 6-V coil (Calectro D1-066)
- Speaker—8-Ohm, 2-inch
- Transformer—12.6-V c-t, 1 A
- Transistor—2N2222A

*Thumbwheel switches are available from Jameco. This installation required:
3 SR21 BCD switches
1 SRBB blank body
1 pr. SREP end plates

actually used it as an ID reminder when rag chewing on 15 meters. My family enjoys a variety of games which have time limits varying from a few seconds to several minutes. The timer works well for them. One son is supposed to practice on the organ for 30 minutes. Sometimes he has to interrupt that practice for more important business such as petting the dog, going to the bathroom, etc. Now the rule is that he has to set the timer for 30 minutes, stop it whenever one of those diversions occurs, restart it when returning to the organ, and continue until 30 minutes of actual practice have been completed.

If you build this timer, you will no doubt want to make changes. Some variations have already occurred to me. I have already mentioned the use of a 7408 for U2. The timer limit could easily be extended to 99 minutes or 99 hours. The counter/driver/comparator chain could easily be expanded by adding another 7490, 7485, 7447, readout, and thumbwheel switch. The timer could be made to display tenths of seconds by feeding the counters from the output of U3. No doubt there are also more efficient or effective ways to accomplish some of the same functions. I will be interested in hearing about your results.

Incidentally, etched and drilled circuit boards and parts kits are *not* available. You are on your own! You will probably want to make modifications to suit your own needs. Anyway, getting there is at least half the fun.

My thanks to my colleague, Joe Woelfel, for the photography, and to those mentioned in the opening paragraphs who got me into this. ■

✓ Reader Service—see page 226

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Direct Printing FAX

—part II: constructing the facsimile recorder

In part II of this three-part article, I will cover construction of the facsimile recorder. Construction is probably the most critical part of the project, as considerable mechanical tinkering is involved and the various parts must function smoothly in relation to one another if quality results are to be obtained.

Recorder Mechanics

The easiest approach is to use the FX-2E minikit available from METSAT Products, Box 142, Mason MI 48854. This kit contains drilled and plated circuit boards for the electronics circuits and a complete set of parts, most fully assembled, for the fax mechanics. The mechanical assembly, illustrated in Fig. 1, is made up of a series of parts machined out of brass, aluminum, and stainless steel and it is built like a battleship. It is quite heavy and massive and provides the rigidity and precision required for a smoothly operating system. The parts are drilled and tapped to permit assembly and disassembly with machine screws, and the kit includes all of the mechanics components including the motors. About 15 minutes of additional assembly work is required to get the assembly ready for operation. The cost for this package is $500 plus shipping. This is more than you will pay for the home-built alternative but does eliminate virtually all of the work associated with the mechanical part of the project, and you also get circuit boards for the electronics.

The second approach is to build the mechanics yourself. To this end, I have documented a modified (and improved) version of the fax mechanics described in the first edition of the *Weather Satellite Handbook*. This assembly will do an excellent job, but you will have to build it and do considerable fine-tuning to get it operating properly. Once it is set up, it should require very little ongoing maintenance.

The Drum. The drum (Fig. 2) is fabricated from a plastic rolling pin—a "Pastry Pin" manufactured by the Housewares Division of the Foley Manufacturing Company of Minneapolis. This item is sold in housewares departments and discount stores across the country and costs between $1.60 and $2.00 depending upon the source. The drum is just over 2 inches (5 cm) in diameter and is perfect for this application. Other materials may be used for the drum, but you should stick close to this figure for the diameter to avoid distortion of the image aspect ratio.

The plastic handles of the rolling pin are twisted off and the shaft removed. A fine saw is used to cut the drum down to a length of 8 inches. True the cut end by using a fine file or sandpaper, and insert the end piece removed from the short length that was cut from the drum. The steel shaft should be cut down to 11.25 inches (save the piece you cut off as we will use it for the stylus). Deburr the ends with a fine file, and use steel wool or emery cloth to remove any corrosion from the steel shaft. Use a cyanoacrylate adhesive (Super Glue™, Eastman 910™, or other brands) to cement the shaft into place as indicated in Fig. 2.

Now comes the part which is harder to describe than it is to do. The paper we will use is a front-grounding paper. This means that the ground return must be provided from the paper surface. This is accomplished via an aluminum foil strip attached to the drum surface and connected to the drum shaft for grounding. Drill a #2 pilot hole at the right end of the drum and place the small end of the angled piece of foil over this hole. Use a small sheet-metal screw to attach a small solder lug so that it is in contact with the foil strip. The 7-inch length of foil is folded in half lengthwise along the dotted line and laid along the precise center line of the drum so that the right end of the strip is in contact with the piece of foil already in place. A long piece of transparent tape is then used to attach the *lower* side of the folded tape to the drum surface. The upper folded side must be free so that the paper can be inserted under it when it is fastened to the drum. The transparent tape should extend all the way to the back of the fold so that the entire lower half of the foil strip is covered, and should be wide enough to extend past the foil on three sides as indicated in the figure. Additional tape then can be used to cover the exposed parts of the angled piece of foil so that it will not pull loose.

Next, break two brass inserts out of standard plastic panel knobs. Set one of these aside for stylus construction and slide the other over the right end of the drum shaft, using its set screw to secure it up against the right end of the drum. Prior to this step, however, you should solder a short length of hookup wire to the outside of the brass insert. When the insert is locked in place, cut and strip the wire and solder it to the small solder lug mounted previously. Do this operation quickly to avoid melting the plastic of the drum. A small magnet should be cemented to the drum as indicated in the figure. This completes the drum assembly. It should be set aside carefully to avoid spoiling your handiwork.

Motors. The drum and traverse motors which are recommended are manufactured by the Hurst Manufacturing Company of Princeton IN. Other synchronous motors of identical speed and similar power rating or torque may be substituted. Motors of other speeds might also be usable if suitable gearing is provided to produce the proper speed at the output shaft of the gearing assembly.

The drum motor is a 240-rpm type-GA motor, rated at 10 W, with 600-inch-oz. torque at 1 rpm. This speed is not a normally stocked option, but can be obtained on special order with a lead time of 4-6 weeks. The traverse motor selection is based on the class of service for which the recorder is intended. For GOES WEFAX, you should obtain a 40-rpm type-CA motor. This selection also will work well for METEOR display. TIROS N display will require a 20-rpm type-CA motor. Both the 40- and 20-rpm motors are available as stock items. It should be noted that all of the motor speed ratings given are referenced to 60-Hz ac drive. In 50-Hz countries, you should obtain motors designed to operate from 50-Hz mains. Do not do this for the drum motor as the sync system is designed to provide 60-Hz drive, and if you use a 240-rpm motor designed for 50 Hz, the drum will be too fast. The motor wiring should be followed carefully, or the motors may not turn in the proper direction—something that will lead to some rather unusual pictures.

Mechanics Assembly. Fig. 3 shows some general views of the relationship of parts for the home-built version of the fax mechanics. Precise measurements are

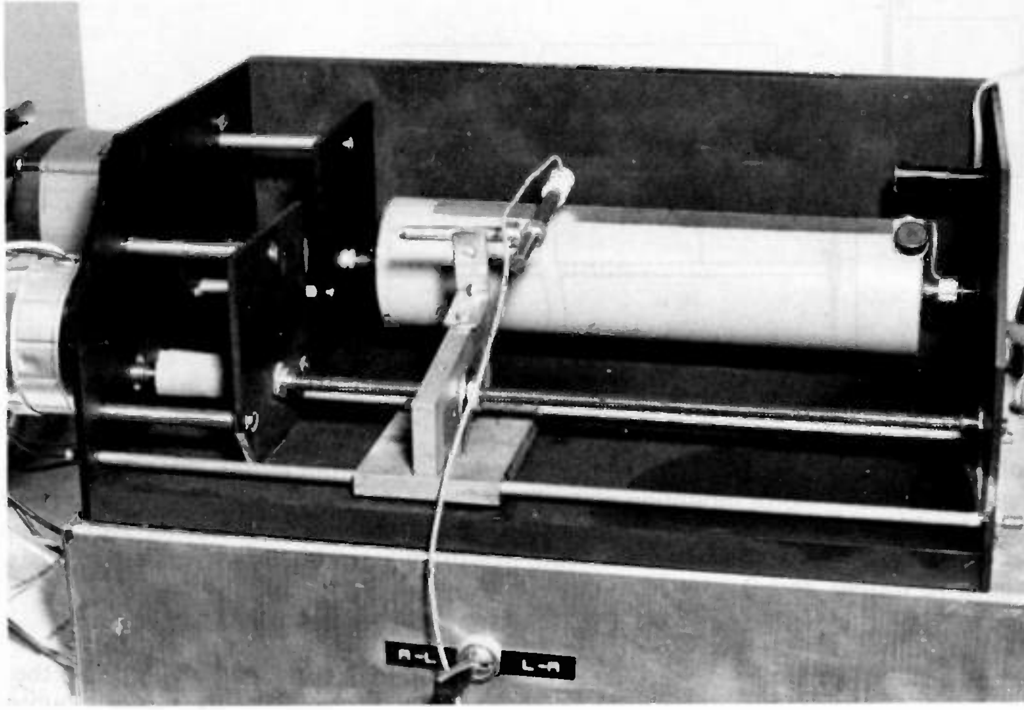

Fig. 1. A photograph showing the METSAT version of the facsimile mechanics. The home-built version described here operates on the same principles, but some features have been changed to facilitate home construction. In the METSAT version, the base and backplate are 1/2" aluminum with 1/8" aluminum side plates. The motors are to the left and the stylus carriage and the stylus itself are visible. In the illustrated version, the machined brass carriage base plate rides on two brass rails. The drum shows the foil grounding strip, magnet, and grounding wire and shaft collar. The magnetic reed switch that helps control WEFAX phasing is shown on the right end plate.

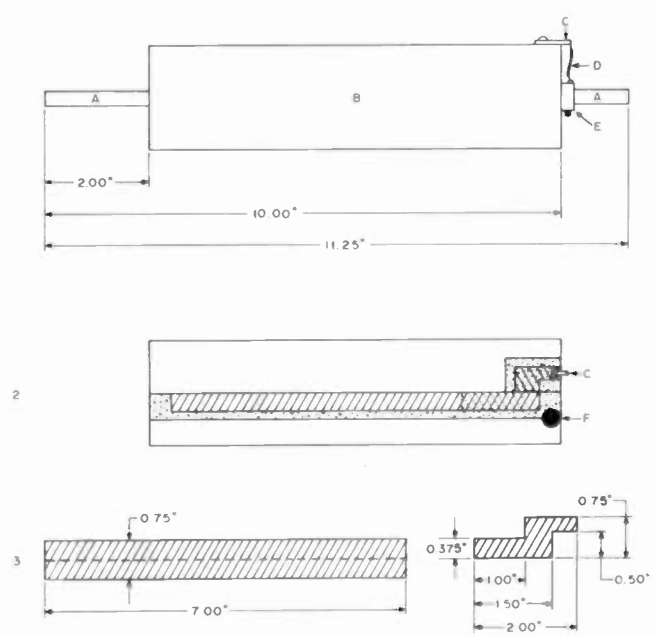

Fig. 2. (1) General drum configuration. (A) 1/4" steel shaft. (B) Drum. (C) Small solder lug. (D) Piece of insulated hookup wire soldered to C and E. (E) Brass insert from a 1/4" control knob secured to the drum shaft with its setscrew. (2) Layout of aluminum foil strips (crosshatched) and transparent tape (stippled) on the drum. (F) is the small magnet attached to the drum surface with double-sided adhesive foam tape. (3) Dimensions of aluminum foil strips (see text for assembly).

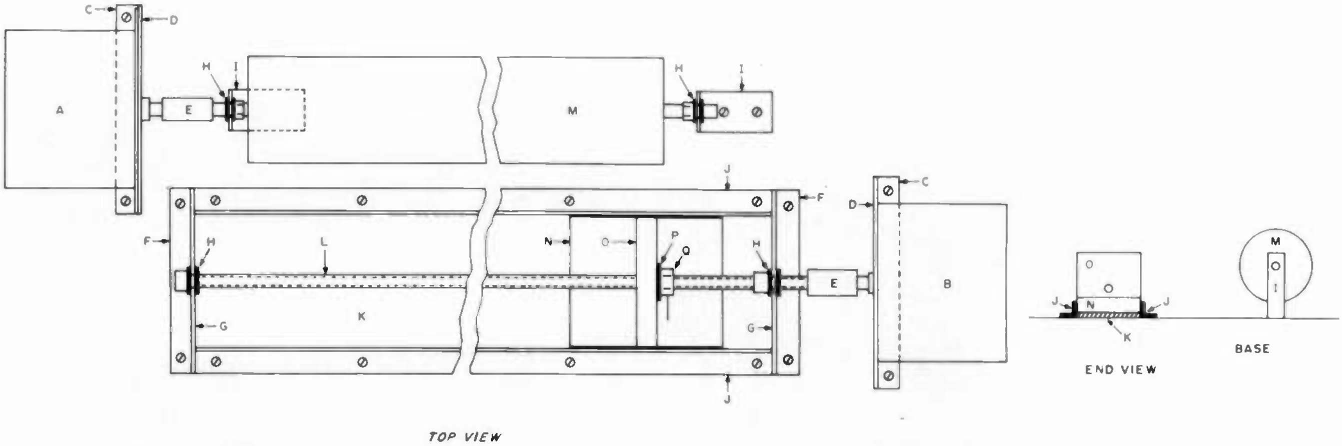

Fig. 3. The facsimile recorder mechanical assembly. A—Drum motor; B—traverse motor; C—motor mounting plate angle bracket; D—motor mounting plate; E—rubber-tubing shaft coupling; F—drive-rod support plate angle bracket; G—drive-rod support plate; H—3/8" panel bushing; I—drum support bracket; J—carriage track bracket; K—glass-plate track surface; L—1/4-20 threaded drive rod; M—drum assembly; N—stylus-carriage base; O—stylus support; P—carriage-drive washer, and Q—1/4-20 carriage-drive nut.

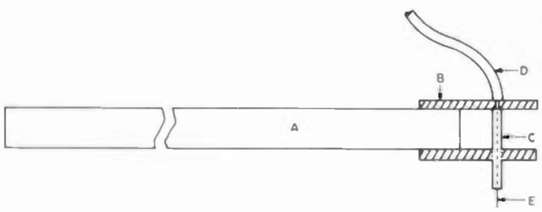

Fig. 4. Stylus holder details. (A) 3-1/4" piece of 1/4" steel rod stock (left over after the drum shaft has been cut to size). (B) 3/4" piece of 3/8" o.d. plastic tube stock. (C) 1/2" piece of 1/16" tube stock (stylus holder). (D) length of hookup wire soldered to one end of (C). (E) Wire stylus inserted into (C).

of little use since the details of layout will depend upon the locally available materials. I will, however, provide some general notes, trusting in your ability to improvise.

The base of the unit is best made with a piece of 3/4" plywood. The surface should be covered with formica, masonite, or some other smooth material. The recorder will produce some fine black ash that accumulates after a time and needs to be wiped off the surface. This is quite difficult if the natural rough wood porous surface is retained. The recorder mechanics utilize standard 3/8" panel bushings for 1/4" control shafts as bearings for the drum and drive rod. The drum is supported by two such bushings mounted at the top of the upright section of two standard steel or brass right-angle brackets available from local hardware stores. The brackets should have the standard screw holes enlarged to 3/8" to accommodate the bushings.

Mount the right bracket to the base with wood screws and orient the left bracket so that the drum will turn freely when the bracket is screwed in place. Occasionally, these brackets are not completely true so that some bending with a pair of heavy pliers may be required after mounting to true up the bushings so that the drum will turn freely. The drum motor is mounted to a plate of G-10 fiberglass board stock, 1/8" aluminum sheet stock, or other rigid material. This mounting plate is secured to the base with a piece of 1/2" aluminum angle stock cut to the width of the motor mounting plate. The hole for the motor shaft bushing is drilled so that the motor shaft will line up precisely with the drum shaft when the plate/bracket assembly is screwed to the plywood base.

Once the shaft bushing hole has been drilled correctly, you can mark and drill the holes for the motor mounting lugs. Final positioning and securing of the mounting plate to the base is done while checking the alignment of the motor and drum shafts. The motor and drum are coupled with a piece of thick-walled tubing of the type used for vacuum lines in laboratories or automobile engines.

The stylus carriage is assembled from hardwood. The base piece should be about 3 inches square, and the vertical upright should be cut so that it is at or slightly above the centerline of the drum. A long piece of aluminum angle bracket is laid out parallel to and about an inch out from the drum face to define one edge of the carriage track. The positioning of the other edge is based on the width of your carriage base piece. The second rail should be positioned to provide a smooth sliding fit for the carriage base piece. It should be tight enough to eliminate any shifting of the base but no so tight that it binds. Once the second track rail has been mounted, you should measure the track width (between the rails) and have a piece of window glass cut to fit between the rails. It should be epoxied in place.

The next job is to prepare the support plates for the 1/4-20 threaded drive rod. The rod must run down the center of the track at a height that will place it about 1/2" above the top surface of the carriage base. The rod is supported by two 3/8" bushings in small plates of G-10 board stock or metal secured to the base with strips of aluminum angle stock. Drill the plates so that the 3/8" holes are at exactly the same height. Install the bushings and secure the plates to the base so that the rod runs down the center of the track.

The traverse motor mounting arrangements are essentially identical to those of the drum motor, with alignment and mounting adjusted to keep the traverse drive shaft in alignment with the threaded drive rod.

A 3/8" hole should be drilled in the vertical member of the carriage assembly so that the carriage can be moved along the length of the track without coming in contact with the drive rod. Remove the carriage and paint it with several coats of epoxy paint or other oil-resistant finish. While the carriage is drying, take a 1/4-20 nut and drill a small hole part way through one of the flat faces on the edge of the nut. Solder a 3/4" wire brad or nail into this hole.

A small quantity of talcum powder should be sprinkled onto the track to serve as a dry lubricant. Place the carriage at the center of the track and thread the drive rod through the left support bushing, continuing to extend the rod until the right end protrudes through the hole drilled in the vertical carriage member. Slide the 1/2" flat washer over the exposed end of the drive rod and thread the prepared nut over the end of the rod. Run the nut down the rod (to the left) while extending the rod until it passes through the support bushing on the right end of the track. Couple the right end of the threaded drive rod to the traverse motor shaft using another piece of thick-walled rubber tubing.

Rotate the drive nut until the brad is horizontal, and move the carriage up against the drive nut/washer assembly. Note that if the drive rod is rotated in either direction, the nut will rotate until the brad comes into contact with the carriage base. At this point the nut can no longer rotate and must move along the shaft. If the shaft is rotated in a counterclockwise direction (viewed from the front of the traverse motor), the nut will move away from the carriage and toward the motor. This is what will occur when you are resetting the recorder. If the shaft is rotated in a clockwise direction, the nut will move away from the motor, pushing the carriage ahead of it. Misalignment or wobble in the shaft will cause the nut to slide around in contact with the washer but will not result in axial movements of the carriage; the only motion transferred to the carriage is a smooth push down the length of the carriage track. This particular drive system is much superior to systems where the nut is directly attached to the carriage assembly.

The final step in the assembly of the main mechanics package is to fabricate a small aluminum bracket that will attach to the right drum-mounting bracket and hold the magnetic reed switch above the right end of the drum. Wire leads should be soldered to the switch terminals and a covering of electrical tape placed over the entire switch assembly. The aluminum support bracket and the attachment of the switch assembly to this bracket should be adjusted so that the small magnet on the drum will close the switch once during each drum revolution. This can be checked with an ohmmeter connected to the switch leads. Although aluminum is specified for the switch mounting assembly, almost any non-ferrous metal can be used. Steel should be avoided as it will gradually become magnetized in the field of the drum magnet, exerting a pull on the switch elements that will gradually make the switch less sensitive.

Stylus Assembly. The details of the stylus assembly are shown in Figs. 4 and 5. The stylus holder is made up from the scrap piece of 1/4" steel rod cut from the drum shaft. To insulate the stylus from the support arm, a small piece of plastic tubing is cemented to the end of the steel rod, using cyanoacrylate glue. A small

Pin	Function
1	Ground
2	Phase sensor reed switch (S203)
3	Stylus
4	M2 black lead (both)
5	M1 white lead
6	M1 black lead
7	M2 red lead
8	M2 white lead

Table 1.

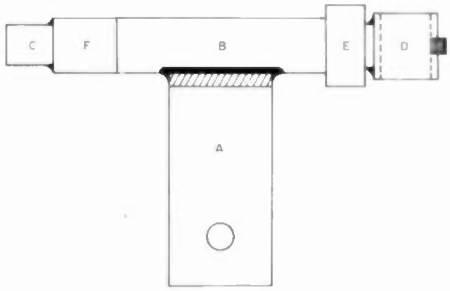

Fig. 5. Stylus support details. (A) 1" brass angle bracket. (B) 1" piece of 1/4" (o.d.) brass tubing soldered to the top of the vertical leg of the angle bracket. (C) 1-3/4" piece of 3/16" (o.d.) brass tube soldered at one end to the side of the brass insert from a 1/4" control knob (D). (E) 3/16" (i.d.) wheel collar. (F) 5/16" piece of 1/4" (o.d.) brass tube stock soldered to (C) so that the latter extends beyond (F) on the right side.

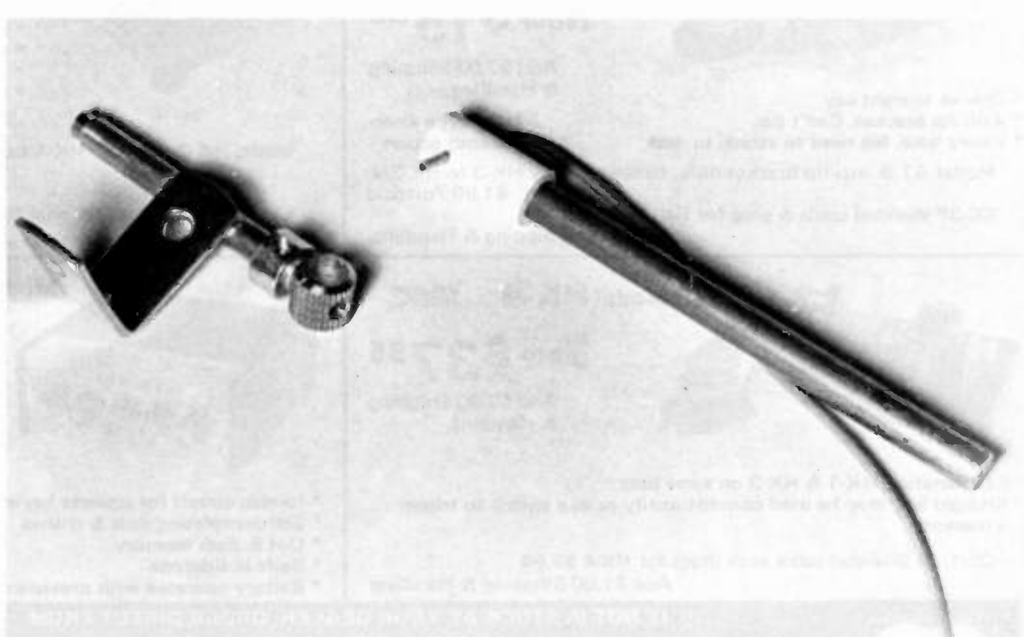

Fig. 6. Stylus pivot and stylus arm assemblies. The stylus support bracket and pivot assembly are shown to the left, while the stylus arm is on the right.

piece of 1/16" brass tubing (this and other sizes of brass tubing are available in your local hobby shop) serves to hold the small, steel stylus wire. A piece of lightweight hookup wire is soldered to one end of the brass tube which then is mounted in a hole drilled in the plastic end piece and secured with cyanoacrylate cement.

For the stylus wire, you will need one of the small wire brushes designed to operate in an electric drill. (We will get to that during final checkout.) The stylus arm is supported by a brass pivot/bearing assembly formed of small pieces of brass tubing. The bearing assembly is soldered to a small brass angle bracket screwed to the vertical support of the carriage assembly. The precise size of the various pieces of tubing used for the bearing assembly is unimportant as long as the pieces nest smoothly.

The second brass knob insert, which you had set aside earlier, is soldered to the long piece of tubing (C) which serves as the axle of the support structure for the stylus arm. The bearing for the support of this axle (B) is soldered at the top of the vertical extension of the brass angle bracket. An aluminum "wheel collar," available from the same hobby shop where you get the tubing, serves as a stop at the brass insert end of the shaft, while a small piece of tubing (F) is slipped over the shaft and soldered at the *outside* end to provide the second stop. The tubing pieces should be deburred and the ends filed true prior to assembly. When completed, the inserted knob should rotate very freely but with no excess play in any other axis. Fig. 6 shows the assembled stylus parts to give you some idea how they look when assembled.

The stylus pivot assembly is mounted to the carriage upright using wood screws. It should be oriented with the bearing tube facing the drum. The free end of the stylus arm is inserted in the brass knob insert, and the support arm is oriented so that the protruding brass tube is facing directly down at the top center of the drum. The set screw of the insert then can be tightened to secure the stylus arm. The small brass tube used to hold the wire stylus should now be resting in contact with the top of the drum along the centerline. The weight of the stylus arm will supply the needed stylus pressure. You should be able to lift the stylus arm, folding it back away from the drum, and there should be no binding in the pivot assembly.

The connection between the control electronics and the mechanics assembly is via an 8-conductor cable. The cable is anchored to the base of the mechanics assembly and is equipped with an 8-conductor plug (P3) that mates with an 8-conductor socket on the rear apron of the electronics cabinet. The P2 and P3 pin assignments, as indicated in the schematics, are shown in Table 1.

Heat-shrink tubing, tape, or other insulating steps should be taken for all connections (including the M1 starting capacitor, C301) to eliminate the possibility of shorting leads or creating a shock hazard.

If you've managed to get the electronics constructed and working already, completing this mechanical phase should keep you busy until part III of this article arrives. In part III, we'll put the whole system together, test and calibrate it, and (hopefully) enjoy the results. ■

✓ Reader Service—see page 226

A 600-MHz Universal Counter

—you'll freq out over this one

	Function	Digit
Function Input Pin 3	Frequency	D_0
	Period	D_7
	Frequency Ratio	D_1
	Time Interval	D_4
	Unit Counter	D_3
	Oscillator Frequency	D_2
Range Input Pin 14	0.01 s/1 cycle	D_0
	0.1 s/10 cycles	D_1
	1 s/100 cycles	D_2
	10 s/1k cycles	D_3
Control Input Pin 1	Blank Display	D_3 and Hold
	Display Test	D_7
	1 MHz Select	D_1
	External Oscillator Enable	D_0

Table 1.

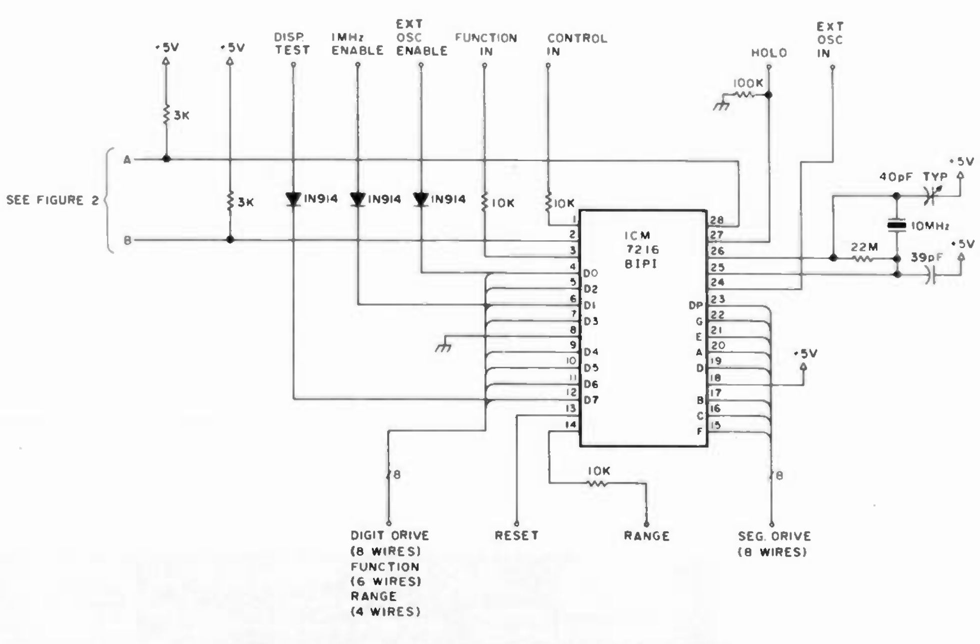

Fig. 1. Counter section part of main board.

E. E. Buffington W4VGZ
2736 Woodbury Drive
Burlington NC 27215

This is truly a one-chip counter. The Intersil ICM7216 BIPI counter chip does it all. It is a frequency counter, period counter, frequency ratio counter, time interval counter, or a totalizing counter. It uses a 1- or 10-MHz timebase and has facilities for an external timebase input. For period and time interval, the 10-MHz timebase gives 0.1-microsecond resolution. In the frequency mode, the user can select accumulation times of 0.01, 0.1, 1, and 10 seconds. With a 10-second accumulation time, the frequency can be displayed to a resolution of 0.1 Hz in the least significant digit. There is 0.2 seconds between measurements in all ranges.

This universal counter chip has a high-frequency oscillator, a decade timebase divider, 8-decade data counter with latches, a 7-segment decoder, digit multiplexers, and 8-segment and 8-digit drivers which can directly drive large LED displays. The counter has a maximum input of 10 megahertz and, with the prescaler, this is extended to over 600 megahertz.

Intersil has an excellent 16-page data brochure describing this and other counters in a series. I have quoted from this brochure in many instances in this article. The A, C, and D versions of this counter have other characteristics and require a different circuit board layout, so beware.

Signal Conditioning

Front-end design is a

thorny problem since not enough gain means that there are many instances where a measurement cannot be made. Too much gain and you will be counting 60 Hertz, 120 Hertz, the local radio station, and whatever trash is there. I think the front end given here is a good compromise, with 50- to 100-millivolt rms sensitivity. The low frequency end has coverage to less than 5 Hz.

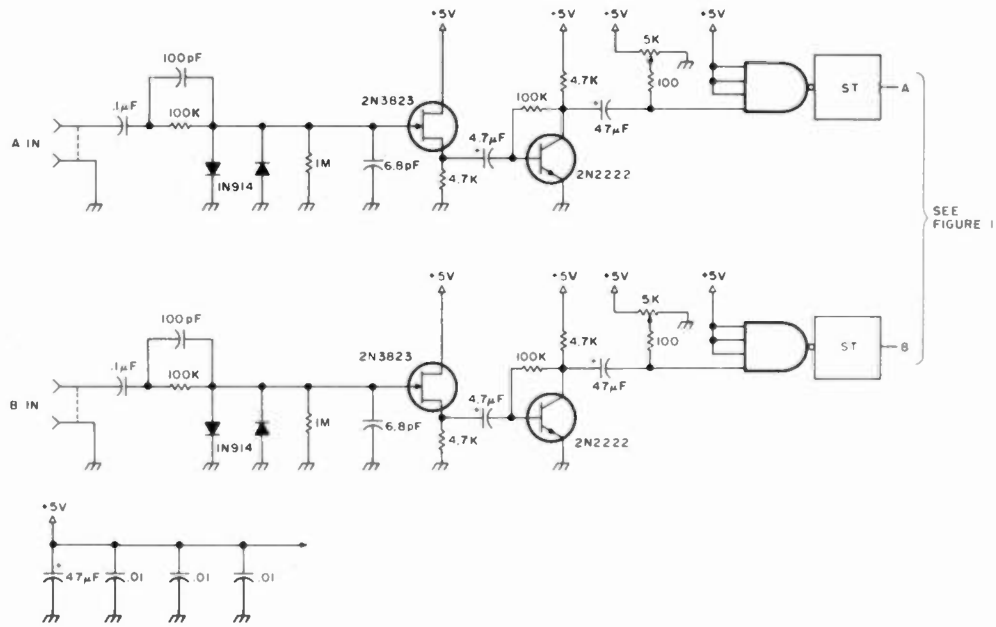

Fig. 2. Signal conditioner part of main board.

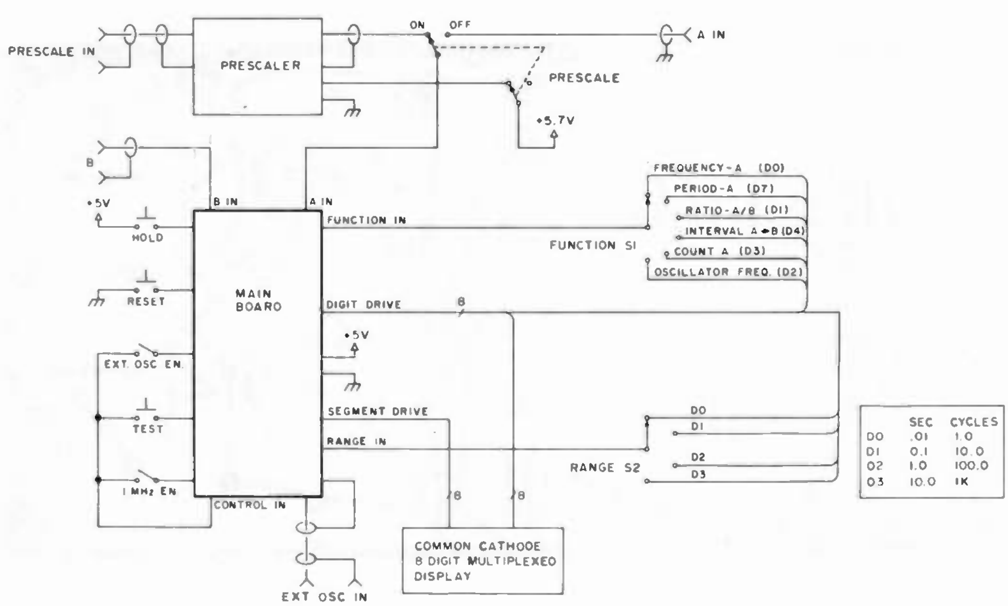

Fig. 3. External connections.

Multiplexed Inputs

The function, range, control, and external decimal point inputs are time-multiplexed to select the input function desired. This is achieved by connecting the appropriate digit driver output to the inputs. The input function, range, and control inputs must be stable during the last half of each digit output (typically 125 μs). The multiplex inputs are active low for the common cathode ICM7216B.

Table 1 shows the functions selected by each digit for the multiplexed inputs. You will note that some possible functions are not implemented in my circuit board.

Control Input Functions

Display Test—All segments are enabled continuously, giving a display of all 8s with decimal points. The display will be blanked if Display Off is selected at the same time.

Display Off—To enable the Display Off mode, it is necessary to input D3 to the control input and have the HOLD input at V+. The chip will remain in the Display Off mode until HOLD is switched back to V−. While in the Display Off mode, the segment and digit driver outputs are open. During Display Off, the oscillator continues to run with a typical supply current of 1.5 mA with 10-MHz crystal and no measurements are made. In addition, inputs to the multiplexed inputs will have no effect. A new measurement is initiated when the HOLD input is switched to V−. The Display Off feature is not implemented in my circuit board layout.

1-MHz Select—The 1-MHz select mode allows use of a 1-MHz crystal with the same digit multiplex rate and time between measurements as with a 10-MHz crystal. The decimal point is also shifted one digit to the right in period and time interval, since the least significant digit will be in microsecond increments rather than 0.1-μs increments.

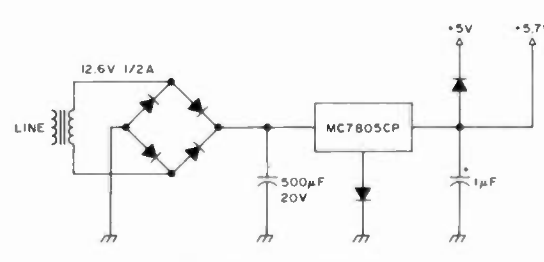

Fig. 4. Power supply.

External Oscillator Enable—In this mode, the external oscillator input is used instead of the on-chip oscillator for timebase input and main counter input in period and time interval modes. The on-chip oscillator will

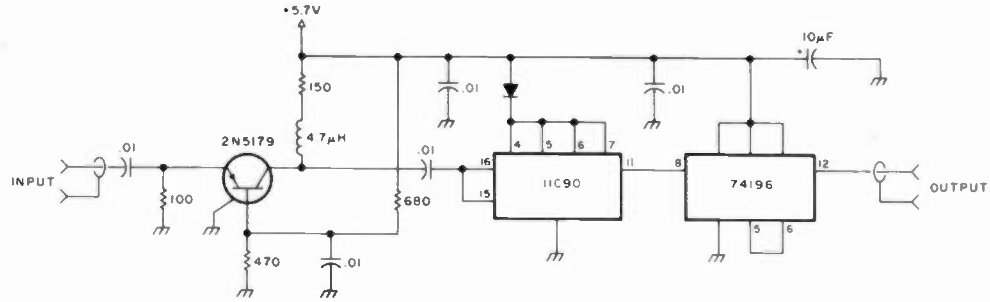

Fig. 5. Prescaler. This divide-by-one-hundred prescaler has a grounded-base input stage and gives good performance to over 450 MHz.

continue to function when the external oscillator is selected. The external oscillator input frequency must be greater than 100 kHz or the chip will reset itself to enable the on-chip oscillator.

Hold Input—When the hold input is at V+, any measurement in progress is stopped, the main counter is reset, and the chip is held ready to initiate a new measurement. The latches which hold the main counter data are not updated, so the last complete measurement is displayed. When hold is changed to V−, a new measurement is initiated.

Reset Input—The reset input is the same as a hold input, except that the latches for the main counter are enabled, resulting in an output of all zeros.

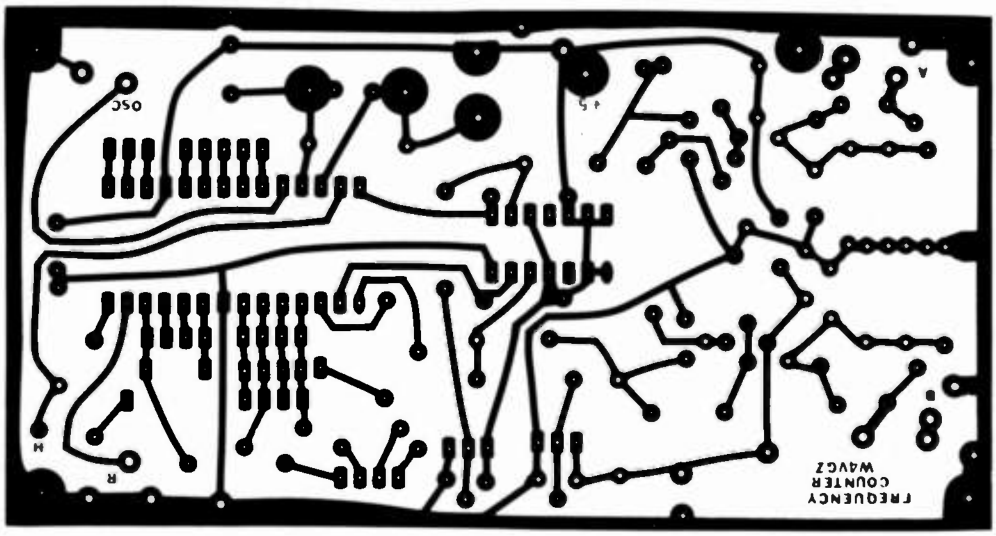

Fig. 6(a). Main counter board.

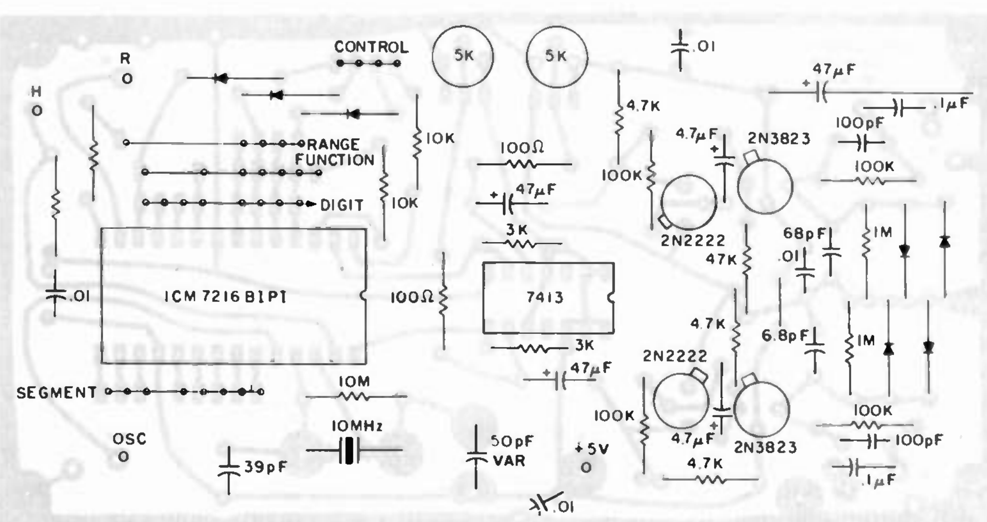

Fig. 6(b). Component layout, main counter board.

Range Input—The range input selects whether the measurement is made for 1, 10, 100, or 1000 counts of the reference counter. In all functional modes except unit counter, a change in the range input will stop the measurement in progress without updating the display and then initiate a new measurement. This prevents an erroneous first reading after the range input is changed.

Display Considerations

The display is multiplexed at a 500-Hz rate with a digit time of 244 μs. An interdigit blanking time of 6 μs is used to prevent ghosting between digits. The decimal point and leading zero blanking have been implemented for right-hand decimal point displays. Any zeros following the decimal point will not be blanked. Also, the leading zero blanking will be disabled when the main counter overflows.

The ICM7216B is designed to drive common cathode displays at peak current of 15 mA/segment using displays with V_f = 1.8 V at 15 mA. Resistors can be added in series with the segment drivers to limit the display current in very efficient displays if required.

To get additional brightness out of the displays, V+ may be increased up to 6.0 V. However, care should be taken to see that maximum power and current ratings are not exceeded.

The display consists of 8 digits of multiplexed, common-cathode LEDs. A circuit board for the popular MAN 74 is given. Calculator displays are available at super savings—8 or 9 digits on a circuit board for a dollar. You can't beat that!.

Crystal Characteristics

The circuit board has facilities for HC-33 or HC-18 crystal holders. The oscillator is implemented as a high-gain complementary MOS inverter. An external 10- or 22-megohm resistor is used for biasing. The oscillator is designed to work with a parallel resonance, 10-megahertz crystal calibrated with 22 pF and having a series resistance of less than 35 Ohms. You should not try to save money here since the accuracy of your counter is directly dependent upon the accuracy of this oscillator. You should specify: A-T cut, optimum angle, and commercial quality and accuracy.

Prescaler

The prescaler uses a grounded-base amplifier driving an 11C90 600-MHz divide-by-ten followed by a 74196 divide-by-ten, resulting in a divide-by-100 circuit. The grounded-base amplifier yields a sensitivity of 20- to 50-millivolts rms and will respond to a 1-Watt handie-talkie several yards away with a quarter-wave antenna connected to the prescale input jack. Slightly better frequency response from the 74196 was obtained by using 5.7 volts. The voltage is reduced to 5 V for the 11C90 by the silicon diode. The prescaler draws about 200 mA from the 5.7-volt supply.

Power Supply

As the total current is only 300 mA or so, the simple power supply shown will be OK. Turning off the prescaler results in a savings of 200 mA, so battery power is a reasonable option by using a 9-volt transistor radio battery for portable use.

Construction

This is where the satisfaction of home-brew electronics really comes forth. Your workmanship will be there for all to see, so a few dollars spent for a good-looking box will buy much as far as satisfaction goes. You may not want to implement all six functions or all four ranges; this would simplify the front panel. The use of rainbow or ribbon wire will simplify the segment, digit, function, and range wiring.

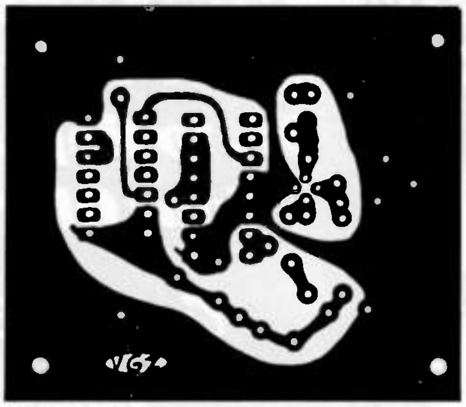

Fig. 7(a). Prescaler board.

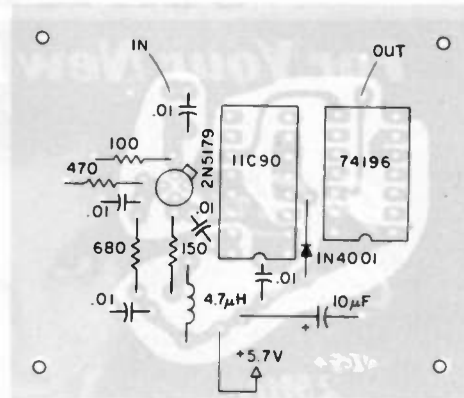

Fig. 7(b). Component layout.

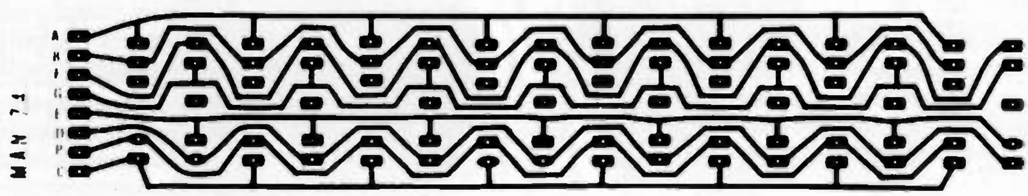

Fig. 8. Display board.

Conclusion

Two of these counters were constructed, and good results were obtained with both. This is a fun project with little chance for problems. Circuit boards can be obtained from O. C. Stafford, 427 S. Benbow Road, Greensboro NC 27401. Write Ozzie at that address for a price list of both circuit boards and any other parts you're having trouble finding.

I will gladly correspond if you will send an SASE with your questions. I hate to be this way, but: no SASE, no reply! ■

Parts List

Main Board

Resistors	Qty.
100 Ω, ¼ W	2
3k Ω, ¼ W	2
4.7k Ω, ¼ W	4
10k Ω, ¼ W	3
100k Ω, ¼ W	5
1 megohm, ¼ W	2
10 megohm, ¼ W	1
5k (TO-5) pot	2
Capacitors	
6.8-pF disc	2
39-pF disc NPO	1
100-pF disc	2
.01-μF disc	4
0.1-μF disc or tantalum	2
4.7-μF tantalum	2
47-μF tantalum	2
47-μF axial tantalum	1
50-pF variable	1
Semiconductors	
1N914	7
2N2222	2
2N3823	2
SN7413	1
ICM7216 BIPI	1
10-MHz crystal	(see text)

Prescaler

Resistors	Qty.
100 Ω, ¼ W	1
150 Ω, ¼ W	1
470 Ω, ¼ W	1
680 Ω, ¼ W	1
Capacitors	
.01-μF disc	5
10-μF tantalum	1
Other Parts	
1N4001	1
2N5179	1
11C90DC	1
SN74196	1
4.7-μH coil	1

Counter

Common-cathode display	(see text)
Function switch	1P6T
Range switch	1P4T
Prescale switch	2P2T
Hold switch	1P-NO
Reset switch	1P-NO
1 MHz En. switch	1P1T
Ext. osc. en. switch	1P1T
Display test switch	1P-NO
Coax jack (BNC)	4 each
Power supply	(see text)

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Top-Banding the DX-60B

—part II: a companion vfo

Part I of WB1ASL's 160-meter conversion for the DX-60B appeared on page 44 of the July 1980 issue of 73.

I recently converted the Heathkit® DX-60B to 160 meters. The transmitter works fine on that band, with one drawback: It is crystal controlled. This fact adds inconvenience to the operation even though there are four crystal positions provided. The ability to move at will around your allocated portion of the band not only eases operation, but also cuts down on operator frustration caused by unanswered responses to CQ calls. With many operators using transceivers nowadays, they do not bother to tune after a call, but expect a response only on their own frequency. After many such unanswered calls, I decided to add a vfo to my newly-converted rig.

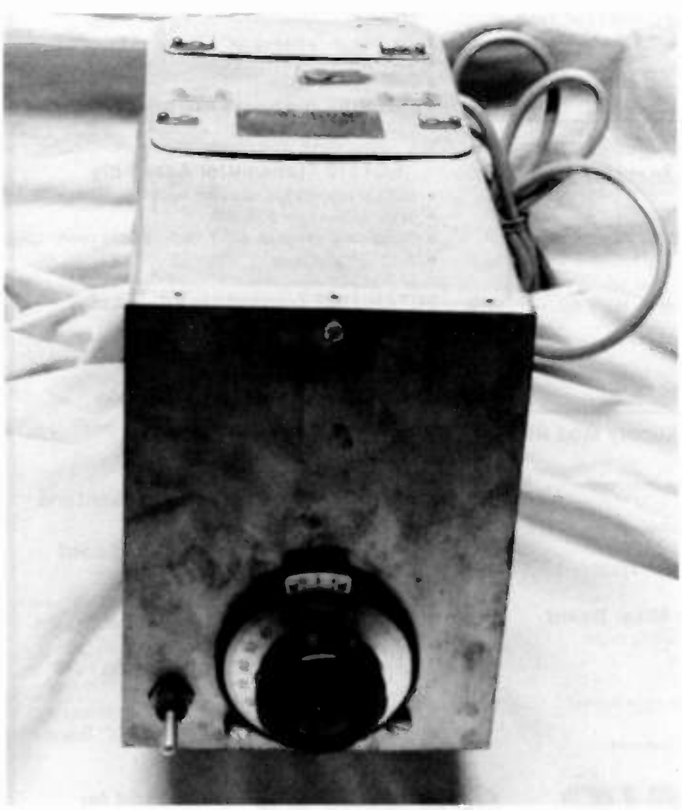

Photo A. Front view of the vfo showing use of the ARC-5 cabinet. The front is covered by a copperclad plate for appearance's sake and for dial mounting.

The DX-60B transmitter was originally designed to be used with the Heathkit HG-10B vfo on 80-10 meters. In fact, the unit comes with a vfo accessory power socket provided on the back, as well as a vfo input and a vfo position on the crystal switch. The accessory socket has pins for ground, 6.3 volts ac, 300 volts, keying bias, and a 110-volt ac line for powering a relay for antenna change-over.

With these facts in mind, I decided to use the existing provisions and design a vfo similar to the HG-10B to be used with the DX-60B on 160 meters. This vfo would be compatible with the power and switching circuits provided.

Because the HG-10B is a vacuum tube vfo, it seemed only reasonable to use vacuum tubes in the new design. The tubes I selected are, however, very easy to obtain even in this age of solid state.

The circuit is straightforward and operates on the fundamental frequency of 1.8-2 MHz. The 6AU6 tube operates as a Hartley oscillator on this fundamental frequency. Grid-block keying is used, with the keying bias provided from the accessory socket of the DX-60B. The bias, which is applied to the grid of the 6AU6 through the NE-2 neon lamp and R2, is sufficient to cut off the oscillator during standby. When this bias is removed through keying the transmitter, the oscillator resumes oscillation.

The 6C4 tube acts as a buffer. This tube, by the way, can be replaced by one-half of a 12AU7 or 12AT7 or even by a 6J6 if the 6C4 cannot be found. The circuit helps to maintain the stability of the oscillator by establishing a fixed load for the oscillator output.

Of course, the 0A2 tube is a voltage regulator to ensure that the voltage to the vfo remains at 150 volts.

As can be seen from the photographs, I made use of a surplus ARC-5 transmitter. I used the chassis, cabinet, and the coil form from the oscillator section. The coil form was used for L1 in the new vfo. All frequency range models of the ARC-5 use the same coil forms, so any ARC-5 unit will have the needed form.

This coil form is made of ceramic, which is a very good material for the winding of oscillator coils. Another coil form and chassis can, of course, be substituted if you do not have a surplus ARC-5 transmitter lying around the house. (They're getting rarer all the time, but are still available from some surplus outlets—although at a cost much too prohibitive for an oscillator coil and a cabinet.)

Be very selective about the coil form material to ensure stability in the transmitter. Ceramic is best, but whatever material you use for the form, make sure the wire is wound tightly over the form and cemented in place with Q-Dope. Avoid toroid cores! They are very susceptible to frequency drift, especially in vacuum tube environments where there can be a high degree of change in the ambient temperature. Also avoid slug-adjustable core forms. If you must change the diameter of the coil, experiment with the number of turns until you get the right resonant frequency range. You also can resort to a coil chart or coil design formula, but in all cases keep the coil Q quite high.

As for the chassis, you can see from the photographs that there is plenty of extra space in the ARC-5, so a different chassis and cabinet could actually reduce the size considerably.

Mechanical stability in construction as well as heat shielding are, of course, of paramount importance as they are in all oscillator construction. By mounting the coil below the chassis, it is shielded from drafts and variations in temperature after initial warm-up.

A sturdy bracket was fabricated for the mounting of capacitor C3. This helps ensure that an accidental jarring of the cabinet will not change the frequency of the oscillator. Also, keep component leads as short as possible for the same reason and to cut down on lead inductance.

All frequency-determining capacitors should be either silver mica or polyester types for stability.

The inclusion of the 0A2 regulator keeps the voltage to the oscillator rock steady, which is needed for stability purposes.

By following these good construction practices, I can, after initial warm-up, zero-beat the vfo to a stable receiver and come back an hour later and still be on zero beat. The amount of drift is infinitesimal.

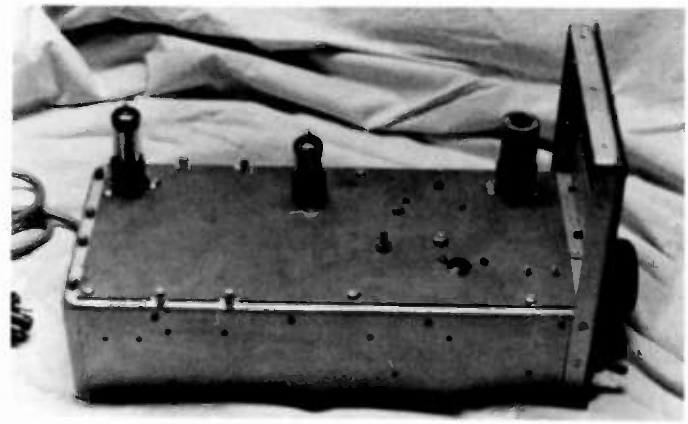

Photo B. Top view of the vfo. The copperclad board is used to cover holes in the chassis and to mount vfo parts. The 6AU6 tube is in the front, the 6C4 is in the center, and the 0A2 is in the rear.

After constructing the vfo, tune-up and testing are simple matters. First, check all your wiring to make sure it is correct. Especially check to see that the power connections are wired to the power plug correctly. If you are like most of us, you probably haven't used octal sockets in years and the numbering of the pins might not be fresh in your mind. Check, and check again. Tubes are expensive, and they don't like to have 110 or 300 volts on their filaments.

One preliminary adjustment can be made before the vfo is connected to the DX-60B. If a grid-dip oscillator is available, the vfo tuned circuit can be dipped to the 160-meter band. Do this by setting the main vfo tuning capacitor, C3, to the center of its range. Set the grid-dip oscillator to 1.9 MHz. With the grid-dip oscillator coil coupled to L1, tune trimmer capacitor C2 for a dip on the meter. Now the oscillator is tuned for approximately the center of the 160-meter band. (If you do not have a grid-dip oscillator, an alternative method follows.)

After all is checked out,

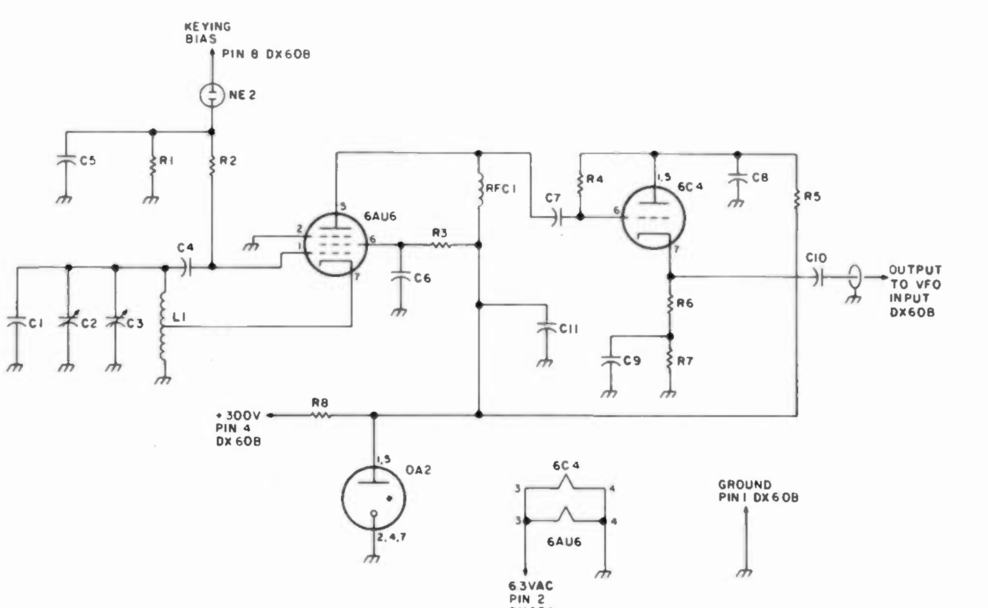

Fig. 1. Vfo schematic.

Photo C. Bottom view of the vfo, showing coil L1 at the left center and C3 mounted on the bracket at the left. As can be seen, there is an excess of space.

plug the vfo power cord into the DX-60B power-accessory socket and the rf output from the vfo into the vfo input socket on the back.

Turn the Function switch to "Standby," check to see that the tubes in the vfo are lighting, and let the unit warm up for at least one-half hour.

Set the controls on the front of the DX-60B as follows: Drive Level to 0, Xtal to vfo, Drive Tune to 1, and Band to 80 (which is now the 160-meter position).

The next step will need the services of a good, accurate communications receiver which covers the 160-meter band. Set the receiver, after warm-up, to the center of the 160-meter band. Run a wire from the receiver's antenna terminal to a point near the vfo to ensure the receiver will pick up the signal from the vfo.

Now, turn the Function switch to the "Tune" position. Tune the vfo main tuning capacitor, C3, through its range while listening for the signal in the receiver.

If the signal is not heard and the receiver is a general coverage receiver, leave the vfo capacitor set to the center of its range and tune the receiver both above and below the 160-meter band until the signal is found. If the signal is higher than the band, capacitor C2 will have to be adjusted to add more capacitance to the circuit to bring the oscillator within the band. If the signal is below the band, C2 will have to be adjusted to decrease the capacitance.

If the signal is not heard and the receiver only covers the 160-meter band, set capacitor C3 to the center of its range and the receiver to 1.9 MHz. Adjust capacitor C2 until the signal is heard. If it is still not heard, keep alternating capacitor adjustments on C2 and C3 until it is heard.

If the signal cannot be found at all, either the oscillator is not oscillating or its frequency range is completely out of the range of the receiver. Check all components and voltages. If an absorption wavemeter is available, use it to determine if the oscillator is oscillating. Once it is determined that the oscillator is functioning outside the desired frequency range, a few minor changes will have to be made to the oscillator to bring it into line. This will entail either increasing the amount of capacitance in the tuned circuit by adding a small silver mica capacitor across C1 to lower the frequency, or by removing turns from coil L1 to raise the frequency. This situation should occur only if L1 was redesigned incorrectly because of the use of a different coil form.

After the signal is found, one way or another, listen to the signal for purity of tone (no hum or hash). Turn the vfo off and on by turning the Function switch to "Standby" and then to "Tune" again several times to make sure oscillation begins immediately. After these observations, check for drift by zero-beating the signal on the receiver (with the receiver vfo turned on) and letting the oscillator sit for awhile to see how far it drifts from zero beat. A better alternative method to check drift would be to use a frequency counter. If excessive drift occurs, a bad capacitor or L1 may be the cause. Check voltage stability and drafts also.

If all checks out all right, you may then proceed to the next step, that of calibration. Set the main tuning capacitor, C3, to maximum capacitance. Tune the receiver to the bottom of the 160-meter band. Using trimmer capacitor C2 only, zero-beat the oscillator to the receiver. Mark the dial. Now, by tuning the receiver up the band to set intervals and adjusting the main vfo tuning capacitor, C3, to zero beat and then marking the dial, the vfo can be calibrated.

After calibration, final testing is at hand. With the antenna output of the DX-60B fed into a dummy load, set the vfo to an allocated part of the band. Proceed to tune up the DX-60B. If you do not get enough grid drive, check the buffer stage in the vfo.

If all is operating correctly, you should have no trouble tuning up the DX-60B. It should tune exactly as it did when it was crystal-controlled.

To zero-beat a signal or to locate your frequency, simply turn the Function switch to "Tune" with the Drive Level control turned down and use the vfo main tuning capacitor to zero-beat the signal.

With the use of the vfo, your number of QSOs should increase dramatically. No longer will the other guy have to look for you. You'll be right there on frequency with your DX-60B.

This completes the second phase of my conversion of the DX-60B to 160 meters. It has been great fun doing the conversion and operating on the "top band." I hope these two pieces will give many an opportunity to operate on this interesting segment of the amateur spectrum. ■

Parts List

C1—270-pF polystyrene or silver mica
C2—3-30-pF mica trimmer
C3—30-pF air variable (Hammarlund HF-30)
C4—100-pF polystyrene or silver mica
C5, C6, C8, C9, C11—.02-uF disc ceramic
C7—.001 uF
C10—150 pF
L1—35 turns #18 AWG enamel on a 1-3/8" ceramic form (see text)
R1—47k, ½ W
R2, R4—150k, ½ W
R3—33k, ½ W
R5—1000, ½ W
R6—2700, ½ W
R7—10k, ½ W
R8—5.6k, 7 Watt
RFC1—2.5-mH rf choke
NE-2—Neon lamp

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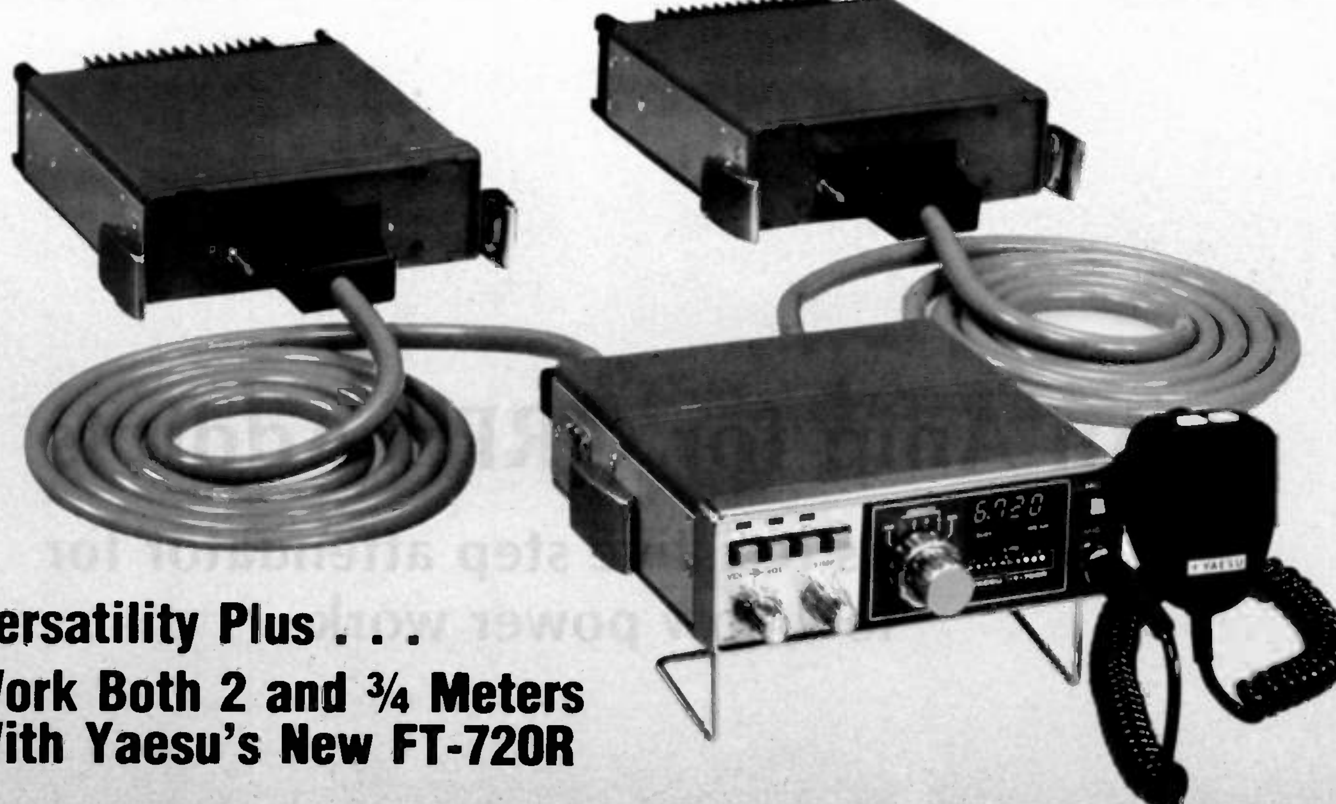

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±6 kHz (—6dB) ±12 kHz (—60 dB)	Selectivity	±12 kHz (—6dB) ±24 kHz (—60 dB)

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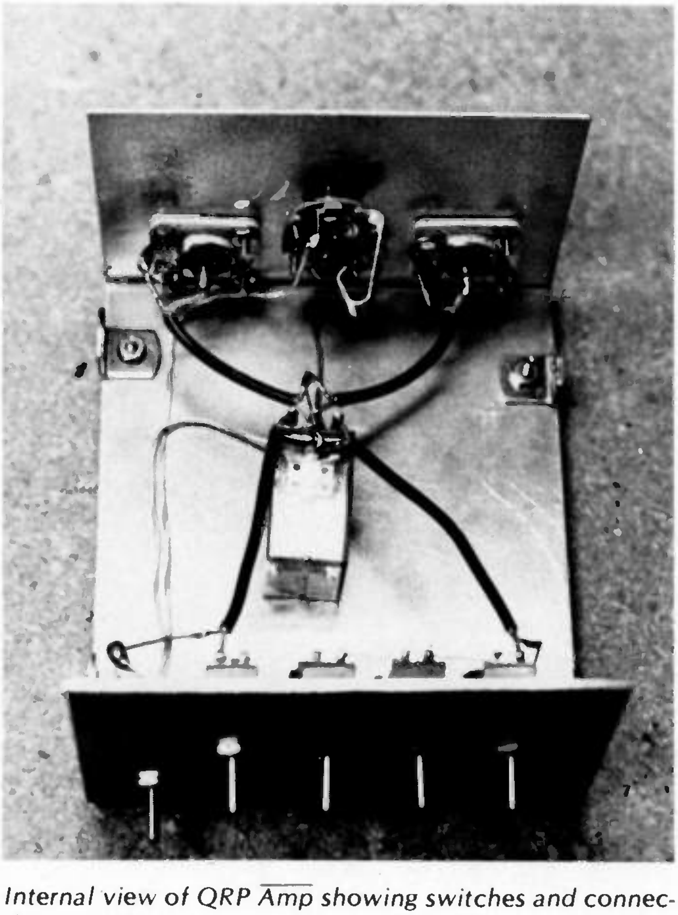
An Amp for QRPp Addicts

—build this resistive step attenuator for low, low power work



Internal view of QRP Amp showing switches and connections.

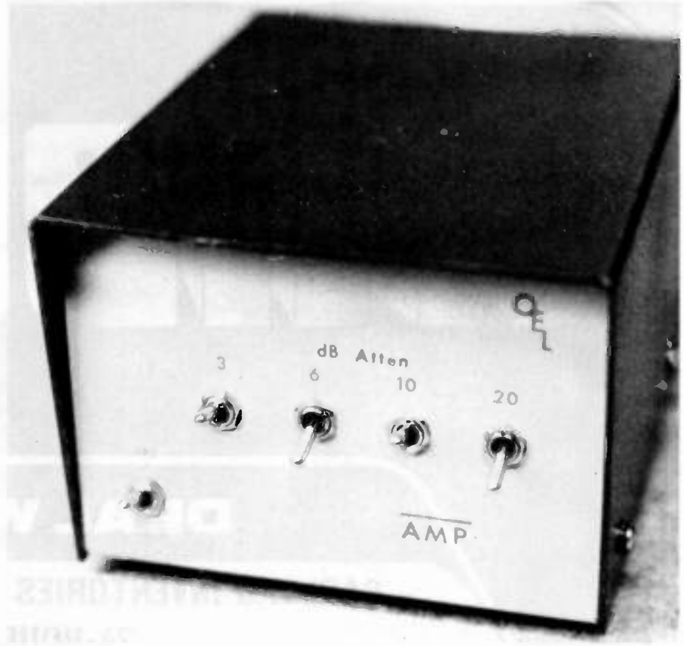
After having enjoyed QRP operation and its 2-Watt world for a period of time, it was decided that a new frontier was needed for a challenge. An amplifier was designed and constructed which provided 25 Watts on 160 through 10 meters. Increased signal reports did result, but just about anything you can work on 25 Watts can be worked on 2 Watts. So I felt that a new and somewhat different kind of challenge was still needed—why not an amplifier (an "inverse amplifier")? Rather than increasing the input signal, it "inversely amplifies," or decreases, the input (in a logarithmic manner).

The QRP Amp definitely re-instills the challenge into the sometimes repetitious world of ham radio. It also can be used to allow QRP/QRPp operation with medium-powered transceivers. Better yet, it can be constructed and in use in a few hours with locally purchased parts, for $15 or less. If you have slide or toggle switches in the junk box, then the price is reduced even further. It requires no tune-up or adjustment and is nearly guaranteed to work the first time.

The Amp is actually a step attenuator which provides from 3 to 39 dB of attenuation to your already low-power signal. What this means is that your 2-Watt signal, after passing through the QRP Amp, now becomes anywhere from 1 Watt down to about 200 microwatts! Twenty milliwatts of output power can and does produce plenty of solid contacts, and it opens up a whole new world to ham radio.

Since the QRP Amp is a resistive step attenuator, it requires no tuned circuits, no active circuits, and works on any mode. Referring to Fig. 1, it can be seen that four switches are used

View of QRP Amp shown with 10 dB of attenuation and switched IN.



View of QRP Amp shown with 13 dB of attenuation and switched IN.

in conjunction with half-Watt standard value carbon resistors to produce the necessary attenuation. The double-pole, double-throw switches are set up to produce 3, 6, 10, and 20 dB of attenuation by either switching in the resistors or bypassing them. These switches can be miniature toggle type or, to reduce costs, miniature slide switches.

The desired attenuation is selected in an "additive" manner. To select 13 dB of attenuation, for example, switch in the 3-dB and 10-dB switches. A DPDT 12-V relay purchased at Radio Shack is used to automatically switch the attenuator out during receive. It is controlled by the transceiver driving the Amp. Switch S1 is used to bypass the Amp, if desired.

The Amp can be built in just about any enclosure available to the builder. Small coax (RG-174/U) is used for rf runs between connectors, the relay, and the switches. The resistors should be soldered directly to the switch contacts with their leads kept short to minimize their inductance. Spray paint and dry transfer lettering add a final touch to the simple project.

The only setup required is to supply +12 V and a relay control. Both can be obtained from the driving transceiver. Run a lead from the control side of the transceiver relay to a plug to mate with J1. Verify that K1 closes when your transceiver is in transmit and S1 is in the IN position. Actual attenuation values were verified to be within .5 dB of the calculated values with a Hewlett-Packard 180 oscilloscope. After you have verified that K1 and S1 are operational, apply drive to the box (with dummy load attached). With no switches IN (no attenuation), you should see the same output power as input power. Switch in 3 dB and the output should be decreased by one-half. Remember that most, if not all, power meters become inaccurate below 1 Watt and are usually unreadable below 100 mW, so don't fret when the needle doesn't budge with 10 dB or more of attenuation switched in.

If problems arise, about the only things that can be wrong are soldered connections or misplaced resistors. Also, recheck all wiring between switches, connectors, and relay.

For those who want to use a 200-Watt transceiver, an additional 20-dB attenuator is needed to prevent damage. Use high wattage (20 Watts or more) resistors in that portion of the attenuator.

Operation

Operating the QRP station, a portion of which was described in the December, 1978, issue of *Ham Radio*, has been greatly enhanced using this project. Before describing the results you can expect, you will be interested in a few observations concerning milliwatt operation. Assuming you are using a 2-Watt transmitter to drive the Amp and have switched in 20 dB attenuation, your output will

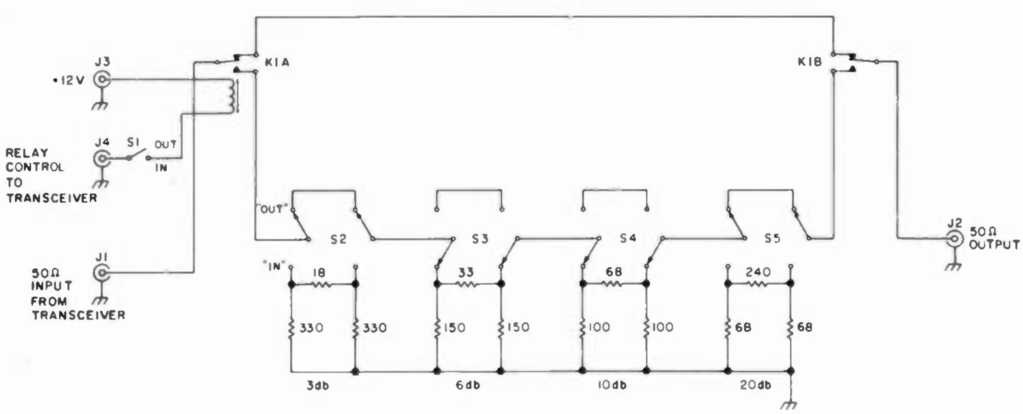


Fig. 1. Schematic, QRP Amp. QRP Amp is a classic pi-type step attenuator using four switches to provide from 3 to 39 dB of attenuation. With switches as shown, 16 dB of attenuation would exist when S1 is switched to "IN" and the transmitter is keyed. J1, J2—SO-239 rf connector. J3, J4—Phone or phone jack. K1—DPDT 12-V relay. S1—SPST miniature. S2-S5—DPDT miniature slide or toggle. All resistors ½ Watt or greater.

be 20 mW. This power level is 30 mW below the FCC specification for total harmonic radiation. Furthermore, a typical SSB transceiver running 200 Watts output might have 40 to 50 dB attenuation of carrier and opposite sideband. The carrier output will then be 2 to 20 mW, the power used with the Amp to make contacts.

A quick calculation reveals that if you can obtain an S9 report with a 2-Watt signal (easy!), then, theoretically, assuming no noise or QRM, an S1 signal would be produced by less than a 200-microwatt signal. This is my present goal with the QRP Amp.

Naturally, the purist will balk at the idea of wasting energy by dissipating power in a resistor, but it is the only practical way of generating QRPp levels. Single transistor rigs which would normally generate these levels are subject to chirp, FMing, drift, and a lack of convenience. With the Amp and your normal QRP transceiver, you retain those conveniences and avoid the aforementioned maladies. It also considerably reduces the expense of QRP operation if you already own a regular transceiver.

Both SSB and CW modes are used at my station, with SSB slightly preferred because an in-depth explanation can be made of the low-power experiments. This way, the other station invariably becomes enthused and he, too, wants to see at just what level of power he can hear you.

Contacts have been made, however, with stations who become indignant when told that your power level is 10 mW. Apparently, this pricks their conscience about that shiny, expensive linear sitting in front of them!

During the past three months, 10 states have been worked in casual operation, mostly on 10 meters, using 10 mW of output. A number of contacts have been made in Japan, Hawaii, Canada, and Mexico using 100 mW output. 100 mW on 10 meters provides plenty of in-USA contacts. Even 20 meters can be used for 10- to 20-mW CW contacts. Incidentally, the antennas used at my station are a dipole on 80/40 meters and a 2-element quad on 10-20 meters.

As with any QRP operation, patience is the key word. Not every station called will answer, with the ratio becoming worse as output power is reduced. With a little practice, you'll become familiar with the conditions and signals that will produce a solid contact.

The QRP Amp has provided the challenge that was sought. When you contact a station that is using a linear amplifier, you can reply that your newest homebrew accessory is a logarithmic de-amplifier, built for less than $15. That should make for plenty of interesting conversation! Plus, there is fun in working across the continent on a power level most rigs use to generate spurious harmonics! ■

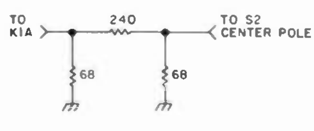


Fig. 2. 20-dB attenuator to enable 100-200-Watt transceiver to be used with QRP Amp. Resistors should be 20 Watts for 50-Watt output, 40-50 Watts for 100-Watt output, and 80-100 Watts for 200-Watt output. Use parallel combinations of smaller wattage resistors to reach these wattage ratings.

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The Center-Fed Bizarre

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More and more of us find that the acreage for that dream antenna farm with phased verticals, rhombics, and giant monoband yagis just isn't available on a lot size within the bounds of our meager earnings. Even when a tidy home on a reasonably roomy lot is found at an attractive price, city ordinances or deed restrictions may make it impossible to erect towers or any outside antennas at all. My situation falls into the second category. Not even TV antennas are permitted in my area.

After two years at this address, I finally decided that operating only on two meters with a magnetic-mount mobile antenna in a window wasn't my idea of the ultimate ham station. I grew up as a ham on the 80-meter band and wanted to keep in touch with the friends that I had made over the years. I did have access to the club station at my place of business, but

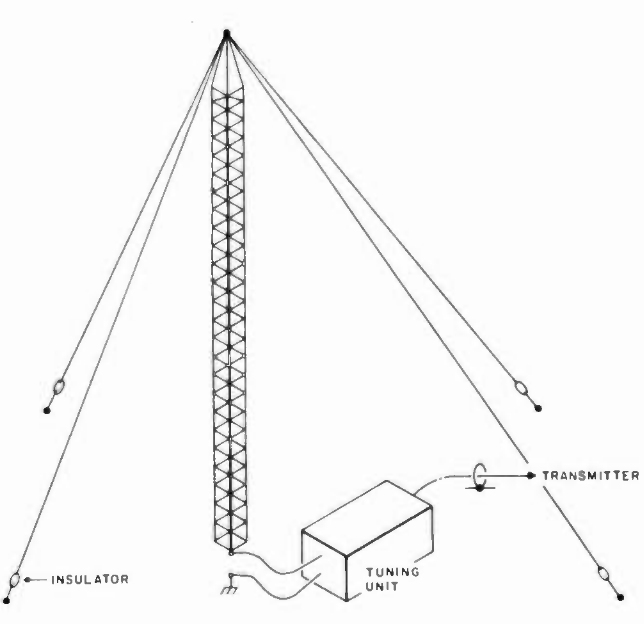


Fig. 1. A common configuration for a VLF antenna using the guy wires for top-loading capacitance.

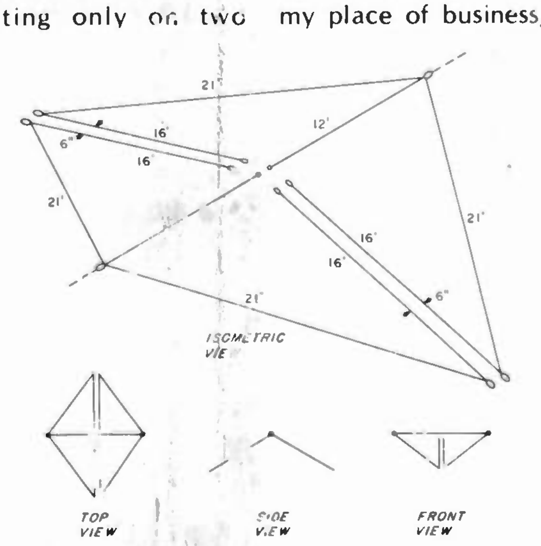


Fig. 2. Final configuration of the attic antenna.

that often proved to be an inconvenient arrangement.

There seemed to be three reasonable alternatives. Put up an inconspicuous outside antenna, load up a flagpole, or try to put something in the attic. The outside antenna was ruled out, since a leading figure in the local homeowners association was my next-door neighbor. Decent flagpoles aren't cheap, and I was advised by a lawyer that I still might be subject to legal action in which it would cost me hard-earned dollars to prove that it was a flagpole. So I crawled up my ladder and made friends with the spiders and the insulation.

Mobile Attenuators

I had acquired a well-respected mobile antenna with a 75-meter loading coil a few years ago, but never used it. As a result, my first attempt at an indoor antenna was to erect it in the center of the attic. Several wires were run around the rafters for a ground system. I was pleased when the swr meter read 1-to-1 near the frequency of interest. I was not at all pleased when most of the stations that I tried to work were barely capable of moving my normally hyperactive S-meter and seldom able to copy me. Some rough calculations showed that I really couldn't expect more than 2% efficiency, since the radiation resistance of the antenna had to be less than 1 Ohm and the other 49 Ohms came from the resistance in the loading coil.

I was generally leery of vertically-polarized antennas in the attic anyway. There were a large number of metal vent pipes and chimneys that were nearby. Most of them had friction joints which could certainly create harmonics or at least be lossy, further soaking up the meager radiated energy.

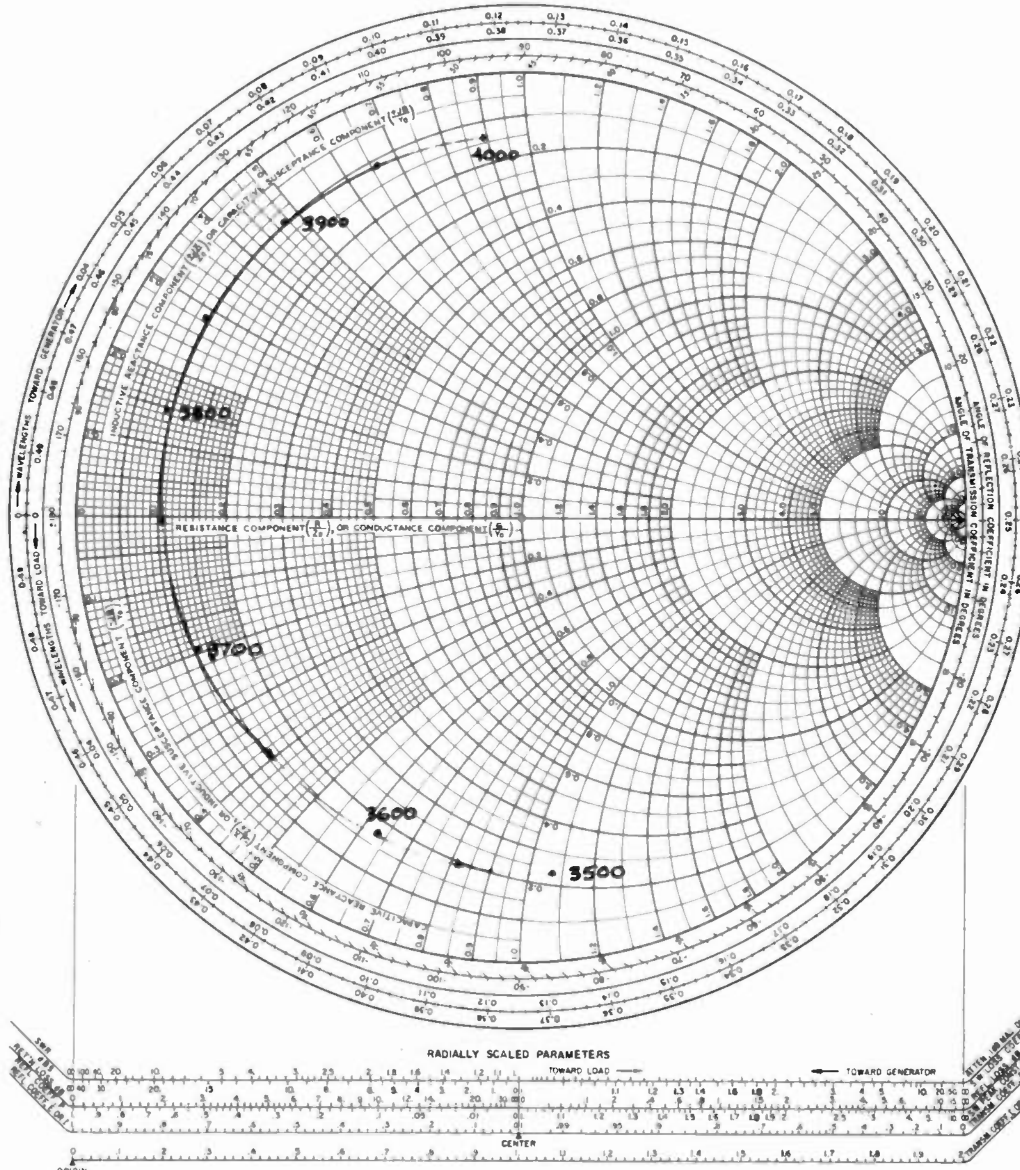


Fig. 3. Measured impedance of the attic antenna. Reference impedance for the Smith chart is 50 Ohms.

Taking a Lesson from the VLF Boys

Compact antennas are nothing new in high-power transmitting installations for use below 100 kHz. A quarter wavelength is well over 2000 feet in this part of the spectrum. Looking at the types of antennas used showed the popularity of top loading. This is no surprise. Placing the loading away from the feedpoint helps keep the base impedance up to reasonable values.

As a rough rule of thumb, the radiation resistance of a base-loaded antenna changes as the square of its length, when the antenna is less than a quarter-wavelength tall (for a vertical). For top-loaded antennas, it changes almost directly in proportion to the length. For example, if the antenna is one-fifth of full size, the base-loaded antenna impedance will look like about one twenty-fifth of its full-size impedance, or about 2 Ohms. The top-loaded antenna will be about 10 Ohms. For very short antennas, this can give a significant increase in efficiency and bandwidth.

One popular configuration for a VLF vertical antenna is shown in Fig. 1. The top guy wires are used as a capacity hat to increase the electrical length of the radiator. I saw no reason why this configuration couldn't be adapted to a balanced horizontal arrangement, since I wanted to avoid vertical radiators.

Wire Everywhere

My attic is about 24 feet wide across the highest part, which is where I wanted to place the main radiating portion of the antenna. The loading wires were bent back at about a 55 degree angle from the

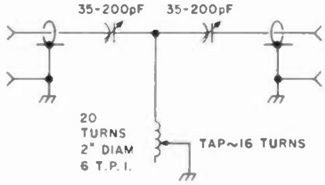


Fig. 4. Schematic of the impedance-matching network used to feed the antenna. This network is at the transmitter end of about 100 feet of RG-8 cable.

flat-top section. I didn't want to run them at right angles, since the walls of my house are stucco and contain wire mesh that could create problems.

As a starting point, I used a total of a half-wavelength of wire. I had to bend the ends of the loading wires back toward the feedpoint to get it to fit. The final configuration is shown in Fig. 2. As you can see, the total length of the wire exceeds a half-wavelength by about one-third. It is resonant near the center of the 80-meter band.

It should now be obvious why this antenna received its name. When I first put it on the air, I tried in vain to explain its configuration to W7ZUL. When it became apparent that he couldn't understand it without a picture, I told him that it was too bizarre to explain. He naturally replied, "Oh, so you're using a center-fed bizarre."

The wire used in the antenna was plastic-insulated #18 with stranded conductors. Three of these wires were laboriously braided together to increase the apparent conductor diameter in an attempt to reduce resistive losses and to help broadband the antenna. The three wires were kept separate everywhere but at the feedpoint. There are three joints at the ends of the radiating portion where the loading wires connect.

Single-wire conductors could have been used just as well, the larger the better. I used what I had available.

Care and Feeding

Upon first inspection of the antenna, I was somewhat alarmed at the magnitude of the feedpoint impedance. Using a noise bridge that was capable of measuring resistance and reactance through a known length of RG-8 coax, I found 5 Ohms of radiation resistance. That's right, the swr was 10 to 1. The Smith chart in Fig. 3 shows the results of my measurements.

The *actual* impedance of the antenna may be even less than 5 Ohms. I did not take into account the loss of the feedline when the measurements were made. I had predicted that the radiation resistance would be closer to 10 Ohms, but the effect of nearby household electrical wiring and the fact that the antenna was only about 0.1 wavelengths above ground could easily lower the impedance. Since the loading wires do not run at a 90-degree angle to the radiating wire, a partial cancellation of the field also results in a lower antenna impedance. In an antenna of this type, a high impedance is sure to indicate undesirable losses.

There certainly are hams who consider a 10-to-1 swr unthinkable. There is salvation for you, but first give thought to this: At 4 MHz, 100 feet of RG-8 (or RG-213) has a loss of about 0.3 dB and the additional loss caused by a 10-to-1 swr is 1.0 dB. A total of 1.3 dB or about 25% of your power is lost in the coax. Foam dielectric coax will be about 1.2 dB, and shorter lengths give proportionately less loss.

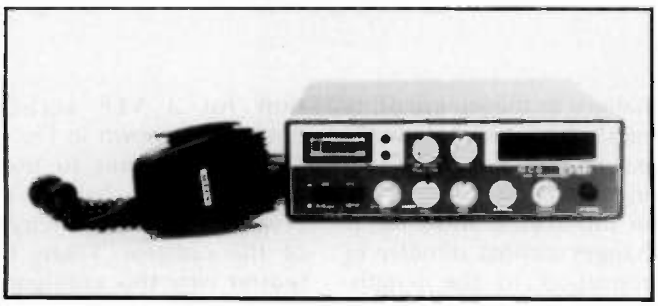
No one would think of trying to feed such a mismatch directly from the output of his transmitter. Almost any of the "universal transmatches" will reduce this to an acceptable level.

The matching network I use is shown in Fig. 4. The capacitors are from old ARC-5 equipment. They are adequate for power levels up to 400 Watts PEP or CW input. By the use of a logging scale on the capacitor dials, I can rapidly QSY anywhere within the 80-meter band and still present a 50-Ohm load to my transmitter.

A second method of matching may appeal to those of you who are squeamish about high swrs. There are several nice wideband impedance step-up transformers available that are designed for use with mobile antennas. Using one of them will raise the impedance to nearly 50 Ohms so that the main feedline operates with a reasonably low swr. The catch is that this will only allow operation over a narrow band of frequencies, since the antenna has a fairly high Q.

On the Air

Just because it looks funny, it doesn't mean that it works that way. Stations report respectable signals. Comparisons were made with one local station whose transmitter power is about 3 dB below mine. He uses a normal inverted vee about 40 feet high. No perceptible differences were noted in signal strength, both on close-in (30-mile) and longer-haul (1000-mile) paths. I found this hard to believe at first, too. However, repeated comparisons and several months of successful operation bear out the solid reliability of this indoor radiator.■



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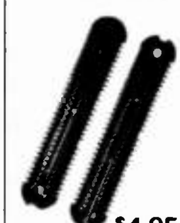

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FARIBAULT MN
DEC 6

The Handi-Ham System will hold its annual winter hamfest on Saturday, December 6, 1980, at the Eagles Club, Faribault MN. There will be a flea market, a dinner at noon, a program, and a prize drawing.

OAK PARK MI
JAN 11

The Oak Park ARC will hold its annual indoor Swap & Shop on January 11, 1981, at the Oak Park High School, Oak Park Boulevard (9½ miles west of Coolidge Highway), Oak Park MI. Doors will be open from 8:00 am to 3:00 pm and admission is $2.00 per person. Features will include an ARRL table, a door prize, a YLRL table, food, refreshments, and free parking. Talk-in on 146.04/.64 and 146.52. For more information, send an SASE to Rob Numerick, 23737 Couzens, Hazel Park MI 48030, or call (313)-398-3189.

CHESTERFIELD VA
JAN 11

The Richmond Amateur Telecommunications Society will hold Frostfest 1981 on Sunday, January 11, 1981, at the Chesterfield County Fairgrounds, Chesterfield VA, from 8:00 am to 4:00 pm. New and large facilities include spacious aisles, and plenty of on-site parking, with charter buses welcome. Admission is $3.00 for each four-foot-long flea market table, and $2.00 for each tailgating vehicle. Features will include commercial exhibitors, a flea market, an auction, and prizes consisting of a color TV, a Bird Wattmeter with slug, a digital VOM, and many more. Talk-in on 146.34/.94 and 146.28/.88. For further information, contact the Richmond Amateur Telecommunications Society, PO Box 1070, Richmond VA 23208.

LIVONIA MI
FEB 22

The Livonia Amateur Radio Club will hold its 11th annual LARC Swap 'n Shop on Sunday, February 22, 1981, from 8:00 am to 4:00 pm, at Churchill High School, Livonia MI. There will be plenty of tables available. Other features include door prizes, refreshments, and free parking. Talk-In on 146.52. For further information, send an SASBE (4" × 9") to Neil Coffin WA8GWL, c/o Livonia Amateur Radio Club, PO Box 2111, Livonia MI 48150.

VERO BEACH FL
FEB 21-22

The Treasure Coast Hamfest will be held on February 21-22, 1981, at the Vero Beach Community Center. Admission is $3.00 per family, in advance, and $4.00 at the door. Features will include prizes, drawings, and a QCWA luncheon. Talk-in on 146.13/.73, 146.52/.52, 146.04/.64, and 222.34/223.94. For information, write PO Box 3088, Beach Station, Vero Beach FL 32960.

DAVENPORT IA
MAR 1

The Davenport Radio Amateur Club will hold its tenth annual hamfest on Sunday, March 1, 1981, at the Davenport Masonic Temple, Highway 61 (Brady Street) and 7th Street, Davenport IA, from 8:00 am to 4:00 pm. Tickets are $2.00 in advance and $3.00 at the door. For advance tickets and table reservations, write Dave Johannsen WB0FBP, 2131 Myrtle, Davenport IA 52804.

HAM HELP

I need schematics/owner's manual for an Eico model 625 tube tester. I will pay the postage, copy, and return all material.

Also, I need any modifications for the Globe V-10 vfo. I recently purchased one at a hamfest and the 6CB6 plate circuit doesn't match the schematics. It has a very low output (approximately 0.5 V p-p).

I'm awaiting my Novice ticket; that's why there's no call in my address.

Tim Cook
4536 Knoll Drive
Woodbridge VA 22193

I recently obtained an Allied SX-190 reciever at a local hamfest, but I did not receive an operating manual. If anyone could supply me with a manual or a xerox copy of one (I believe the manual for the AX-190 ham receiver is the same), I would be happy to pay for it. The receivers were produced by Allied/Radio Shack in the early 70s. Thanks!

Gary Toncre WA4FYZ
13764 SW 54th Lane
Miami FL 33175

I would be interested in communicating with anyone who has used the Heathkit SB-610 and SB-620 at i-f frequencies higher than 6 MHz. For example, the Kenwood TS-820S has an i-f output at 8.83 MHz, and I would be interested in any modification which will accommodate the higher frequency.

J.O. Dickinson
1408 Monmouth Court West
Richmond VA 23233

I'm looking for a schematic or instruction manual for a Knight model KG-642-A ultrasonic intrusion alarm, circa 1970, and a schematic for a function generator using the XR-205 chip. I would be happy to pay for an original or a copy. Thanks.

Gene Smarte WB6TOV
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I need circuit diagrams and/or books, as well as information on a vfo and mods, for a Conar 400 transmitter and 500 receiver. I will pay for copies.

Nate Bushnell KA0DGN
7175 S. Grant St.
Littleton CO 80122
(303)-794-6956

I need all the information I can get on converting a J.C. Penney's Pinto SSB rig to 10m.

John Lynn
1456 Cheyenne Street
W. Fargo ND 58078

I need operating manuals and schematics for a Collins 75A transmitter and 75A-2 receiver. Can someone help? I will pay for copies.

Bill Morehouse
PO Box 214
Waukesha WI 53187

Does anyone have any information or a schematic for a Motorola T71GJT-1100? I will buy a manual for the above or pay for a copy. Thank you.

Fred Martin
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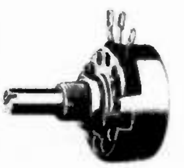

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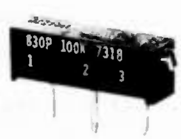

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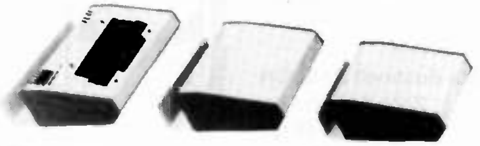
IN4744	2/.69	2N5951	2/1.29

DESK TOP ENCLOSURES



DTE-8 (Pictured)	$31.95
DTE-11 (Pictured)	34.95
DTE-14	36.95
DTE-HK (Case for JE600)	47.95
DTE-AK (Case for JE610) (Pictured)	52.95

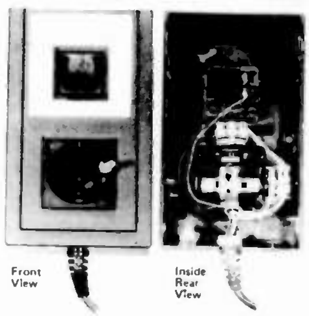
CMOS

4000	.69	4030	.79
4001	.69	4040	1.95
4002	.69	4044	1.39
4006	1.95	4046	2.49
4009	.89	4047	2.75
4010	.85	4049	.89
4011	.69	4050	.89
4013	.85	4051	1.95
4016	.85	4066	1.19
4017	1.49	4069	.79
4018	1.49	4070	.79
4020	2.19	4071	.79
4023	.49	4081	.69
4024	1.29	4093	1.19
4027	.89	4511	1.95

CAPACITORS

Dipped Tantalum		ELECTROLYTIC	
.1mfd@35V	2/.89	1mfd@50V	3/.69
.47mfd@35V	2/.89	4.7mfd@50V	2/.59
1mfd@35V	2/.89	10mfd@50V	2/.69
2.2mfd@25V	2/1.09	22mfd@50V	2/.79
3.3mfd@25V	2/1.19	47mfd@50V	2/.89
4.7mfd@25V	2/1.39	100mfd@50V	.59
10mfd@25V	1.19	220mfd@50V	.69
33mfd@25V	3.95	1000mfd@25V	1.19
100V MYLAR		2200mfd@16V	1.39
.001-.01mfd	4/.79	**50V CERAMIC**	
.022mfd	4/.89	10pf-.022mfd	4/.59
.047mfd	4/.99	.047mfd	4/.69
.1mfd	4/1.19	.1mfd	4/.79
.22mfd	4/1.29		

VIDEO CONTROLLER

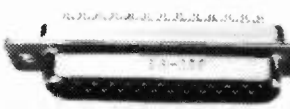


Front View — Inside Rear View

Ideal for all video games or remote control projects. Two mini. pots. 40K ohm each. SPST pushbutton control. Five-wire connection cable 5' long. Rugged plastic case — 1½"H x 2-3/8"W x 4-5/16"L

JVC-40 . . . . $5.95 each

CONNECTORS



DB25P	D-Subminiature Plug	3.95
DB25S	D-Subminiature Socket	4.95
DB51226	Cover for DB25P/S	2.25
22/44SE	P.C. Edge	2.95
UG88/U	BNC Plug	2.19
UG89/U	BNC Jack	3.95
UG175/U	UHF Adapter	.59
SO239	UHF Panel Recp.	1.49
PL258	UHF Adapter	1.95
PL259	UHF Plug	1.95
UG260/U	BNC Plug	2.39
UG1094/U	BNC Bulkhead Recp.	1.49

MICROPROCESSORS

Z80A	CPU (4MHz)	14.95
MC6800	8 Bit MPU	14.95
8080A	CPU	7.95
8212	8 Bit I/O Port	3.95
8216	Bi-Directional Bus Driver	4.49
2513/2140	Character Generator	12.95
8T97	Tri-State Hex Buffer	2.25
AY-5-1013	30K Baud UART	6.95
AY-5-2376	88-Key Keyboard Encoder	13.95
2114-3	4K Static RAM (300ns)	9.49
MK4116	16K Dynamic RAM (250ns)	9.95
2708	8K EPROM	10.95
2716	16K EPROM (+5V)	19.95

LINEAR

LM301N	.59	LM7805T	1.75
LM305H	1.39	LM7812T	1.75
LM307N	.75	LM7815T	1.75
LM308N	1.19	LM380N	1.49
LM309K	2.25	LM384N	2.49
LM310N	2.69	LM555N	.69
LM311N	1.49	LM556N	1.49
LM317T	2.29	LM565N	1.95
LM318N	2.95	LM566N	1.95
LM319N	2.95	LM567N	1.79
LM320K-5	2.25	LM723N	.79
LM7905T	1.75	LM741N	.65
LM7912T	1.75	LM1310N	2.95
LM7915T	1.75	LM1458N	.99
LM323K	5.95	LM1488N	1.59
LM324N	1.29	LM1489N	1.59
LM337T	2.29	LM1800N	4.49
LM339N	1.29	76477N	3.95

5

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✓ Reader Service—see page 226

Fred Gerken WB0LLP
7009 Knight Drive
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Lewisville TX 75056

Clean Sweep for the FT-221

—don't miss the action

SSB on two meters is becoming more popular in my area, and activity centers around the national calling frequency of 144.200 MHz. So, whenever I am in the shack, I turn on my FT-221 and position the vfo on that frequency. Several times I have listened for hours to the rush of the receiver, not hearing a peep, only to move the vfo dial when passing the rig on the way to the 807 locker and find a QSO in progress a few kHz away.

This half-hearted monitoring causes me to miss much of the local activity. In order to solve this problem, I have added a clarifier sweeper to the rig. This allows me to monitor 144.200 ± 8 kHz in a sweeping mode.

The Yaesu FT-221 has a broad clarifier which uses a varactor diode in the local oscillator module. By varying the voltage on the varactor from one to eight volts, the clarifier has over ± 8 kHz of tuning range. The circuit in Fig. 1 provides an inexpensive pseudo-triangle wave generator with an output of one to eight volts, and a sweep time of one complete sweep approximately every four seconds.

The circuit is designed to be both small and inexpensive. The 555 timer is wired as an astable square-wave generator, and R1C1 forms an integrator which converts the square wave into a triangular wave. See Fig. 2. For the purist, an op-amp integrator could be substituted for R1C1. See Fig. 3.

Once the sweeper is assembled, check the output voltage. The output should swing slowly towards Vcc and then slowly back to about 1.0 volt and start over again.

Installing the sweeper in the FT-221 is a matter of preference. A simple toggle switch could be used to control the sweeper, as shown in Fig. 4. If you are the type who hates to cut holes in a $600 rig, you might try substituting a new clarifier pot and SPST switch for the original pot. See Fig. 5. This method is my choice. Only the new pot and two diodes need to be added. When the clarifier knob is rotated fully until the switch clicks, the sweep mode is engaged. When the clarifier knob is in any other position, it functions normally.

The circuit itself is very small and mounts anywhere room is available. However, there is a good spot just in front of the crystal deck. The eight volts dc to run the sweeper is easily obtained from the clarifier pot itself. See Fig. 5.

Happy sweeping! ■

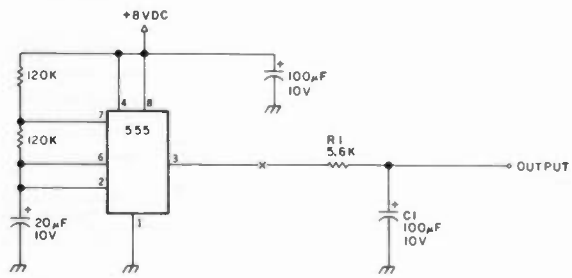

Fig. 1. Pseudo-triangle wave generator.

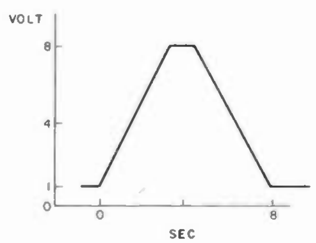

Fig. 2. Waveform from square-wave generator and R1C1 integrator.

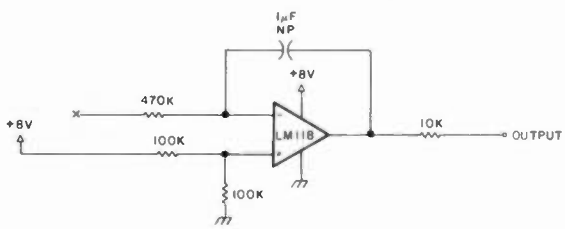

Fig. 3. Op-amp integrator using LM118.

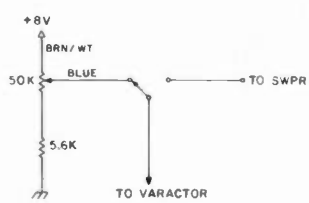

Fig. 4. Hookup using toggle switch.

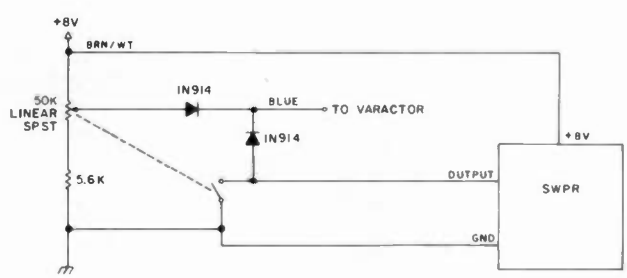

Fig. 5. Hookup using new clarifier pot with SPST switch.

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(and you don't have to be a computer expert to use it!)

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Built-in VSWR meter	CW output pulse shaping — hard or soft	Sophisticated Noise Blanker	Speech Processor	Exceptional Dynamics Noise Floor −132dBm 3rd order intercept +15dBm	RF/IF Gain Controls	Optional CW Narrow Crystal Filter

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With the optional 400Hz crystal filter installed, which cascades with one of the 8-pole I.F. filters and can be moved through the passband, along with QSK provisions, the ASTRO-103 is the CW operator's dream!

Performance under high cross mod conditions found in todays crowded bands is second to none. With dual independent high stability PTO's for split band DX and all its other features, the ASTRO-103 is the result of American Technology and American Quality combined to bring the best to the American Amateur.

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Cubic Corporation with over 3,500 employees world-wide, including more than 1200 scientists, engineers and technicians, has more than one million square feet under roof.

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Dave Ingram K4TWJ
Eastwood Village, #1201 South
Route 11, Box 499
Birmingham AL 35210

A New Frontier

—weekends were made for. . .10 FM!

During recent years, FM has become one of amateur radio's most popular and widely accepted modes of UHF communication. The convenience and flexibility of channelized, squelch-muted equipment continuously appeals to numerous amateurs.

The excitement of low-band DXing, however, embraces a unique pleasure which all amateurs cherish—a thrill as old and irreplaceable as ham radio itself. Wouldn't it be interesting to combine these two modes and enjoy intercontinental FM operations? Imagine an ample supply of remote-base setups and repeaters capable of practically worldwide communication in this vision and you have an accurate description of 10-meter FM—a frontier which is presently blowing wide open with excitement.

Photo A. Recipe for mountaintopping fun with 10 FM includes (left to right) a Cushcraft 10-meter FM Ringo, an MFJ antenna tuner with knapsack full of loose and long wires, Comtronix FM-80, and a 2-meter hand-held talkie.

Although FM communications have been taking place on the high end of our 10-meter band for several years, this mode only recently gained widespread popularity. Two of the prime reasons for this upsurge are the increasing sunspot activity and the availability of commercially-manufactured 10-meter FM equipment. The introduction of Yaesu's FT-901DM all-mode 160- through 10-meter deluxe transceiver and the Comtronix FM-80 10-meter FM transceiver substantially promoted 10-FM activity. During the period of a few

Repeater Inputs	International Direct Frequency	Repeater Outputs
29,520 kHz		29,620 kHz
29,540 kHz	29,600 kHz	29,640 kHz
29,560 kHz		29,660 kHz
29,580 kHz		29,680 kHz

Table 1. Ten-meter FM band plan. "Direct" operation on repeater output frequencies is acceptable provided deliberate interference isn't created.

months, 10 FM actually came alive with worldwide FM operations. This activity continues to grow each day, as innovative-minded amateurs clamor to join the fun.

Overview of 10-FM Operations

Although a number of in-band repeaters are operational on 10 FM, most of the activity is "direct" communications on the International Direct Frequency of 29,600 kHz or the repeater output frequencies of 29,620, 29,640, 29,660, or 29,680 kHz. Thus far, the use of direct communications on repeater output frequencies has proven quite acceptable on 10 FM, provided it doesn't interfere with the normal repeater activities on that channel. Due to the limited spectrum allocation for 10 FM, a tight-fitting and conscientiously adhered-to band plan is necessary. As this is being written, 29,600 kHz is being used for brief QSOs and as an international calling frequency with resultant additional communications being carried out on 29,620, 29,640, and 29,660 kHz. 10 FMers realize the long-distance propagation effects of this band, and during such times their gentlemanly procedures are generally beyond reproach. Several repeater groups are presently investigating ways of improving the 10-meter FM band plan, but it appears that the one shown in Table 1 will be retained for many more moons.

While 10 FM is alive and active almost every day and evening, this band's most exciting times usually occur during weekends. The fun starts early each Friday afternoon and continues full bore until the band closes each Sunday night. During these times, signals from European, South American, and Japanese amateurs have been heard working various stations through repeaters in the northwestern United States, and New Zealand stations have been heard transmitting through repeaters in the California area. It's not extremely unusual, either, to hear two or three European amateurs communicating with each other through a US-based repeater during a weekend on 10 FM—and this situation should also exist in reverse in the near future.

All of the US-based repeaters on 10 FM employ PL™ tone encoding to prevent unwarranted in-band interference. Right now, the most common PL frequency in use on 10 FM is 107.2 Hz. When the control operator is monitoring a system during the weekend, however, some repeaters switch to straight COR control to permit various forms of DX operations through their machine.

An uncounted number of remote base setups are operational on 10 FM. Some of these systems are permanent arrangements used by many amateurs, while other remote bases are private systems created by interconnecting one's 10- and 2-meter FM units as desired. Another possibility for the near future is that of mobile remotes, produced by interconnecting one's 10- and 2-meter mobile FM rigs. These units can be used separately while mobile, or the 10-meter unit can be 2-meter-accessed by the operator's HT when he leaves the car. An in-car rubber ducky 2-meter antenna will restrict the 2-meter access range of this system.

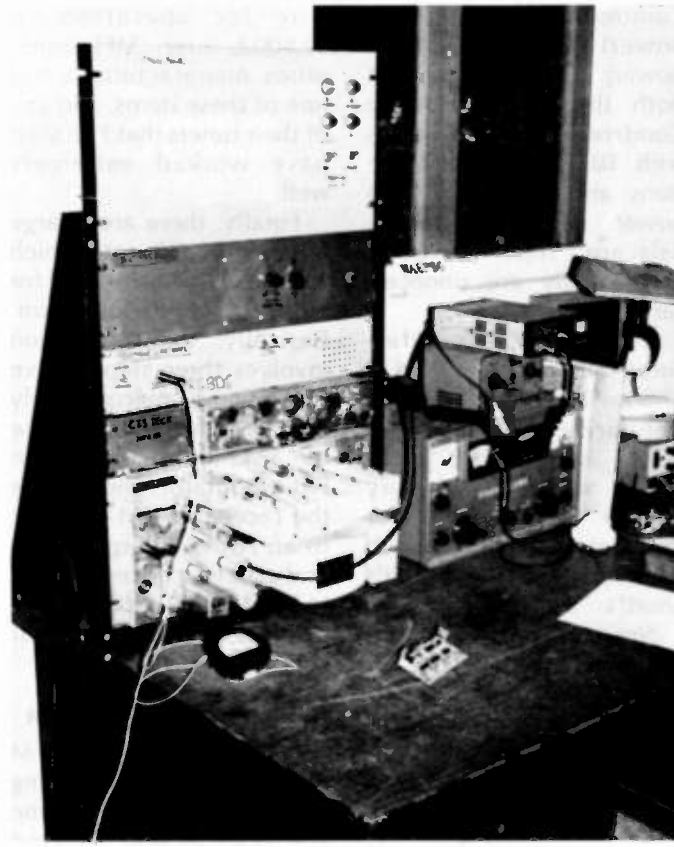

Photo B. Receiver section of WR6BDG, the 29,620-kHz FM repeater in Sierra Madre, California. This repeater is maintained by David Findley N6DF and John Portune WB6ZCT. During weekends, Dave and John occasionally switch this machine to straight COR function for "open" access. The transmitter of WR6BDG is approximately one mile away, at the QTH of WB6ZCT.

Equipment

As previously mentioned, the introduction of Yaesu's FT-901 series transceivers and Comtronix's FM-80 units has been a contributing factor in the recent growth of 10 FM. Prior to this evolution, the bulk of 10-FM equipment consisted of converted low-band (30 to 40 MHz) business radios. Both the Yaesu and the Comtronix are superb performers on 10 FM.

FM capability is standard on the FT-901DM and an available option on the FT-901D and DE transceivers. Power output is approximately 20 Watts in the FM mode. The unit's memory is perfect for programming repeater "splits," and its squelch circuit operates very smoothly.

The Comtronix operates 80 discrete channels of 10 FM, and the standard 10-FM repeater offset of 100 kHz is accomplished by a switch on the unit's squelch control. The rig's front-panel meter reads S-units on receive and relative output power on transmit. Additionally, a front-panel LED varies in intensity according to transmitted modulation, while another LED (bipolar) lights green during receive and red during transmit. Power output of the

Comtronix is 10 Watts (high power) or 1 Watt (low power). The low power of both the Yaesu and the Comtronix is synonymous with 10 FM. 50-Watt stations are considered high power, and 250-Watt signals are "super power"—and usually are unnecessary.

Commercially-manufactured antennas for 10 FM also are beginning to gain in polularity. Cushcraft recently introduced a 10-FM Ringo which looks very similar to their 2-meter Ringo except that it's much larger (17 feet tall—and it's great!).

Newtronics recently introduced their HOT 10 trunk-lip-mounted, center-loaded mobile antenna for 10 FM.

There are a number of antenna tuners which the 10-FM enthusiast will find beneficial when tuning a beam or random length of wire for operation on 29,600± kHz. MFJ Enterprises manufactures a full line of these items, and any of their tuners that I've tried have worked extremely well.

Finally, there are a large number of CB sets which may easily be converted for 10-meter FM operation. Basically, this conversion involves three steps: Move the unit up approximately 2.5 MHz in rf range, replace the AM modulation with an FM modulator, and change the receiver's AM detector to an FM counterpart. Several articles concerning CB-to-10-FM conversions have been published in amateur magazines recently.

Getting Started On 10 FM

Joining the fun of 10 FM will probably bear a striking resemblance to the time you first became involved with 2-meter FM. You'll probably locate and convert a business radio for 10 FM, convert a CB set to 10 FM, or purchase a Yaesu or Comtronix for 10 FM. Operating techniques may seem different from 10-meter SSB activity, but you'll get the hang of it within a couple of days—and wonder why you didn't try 10 FM sooner.

Remember to keep your transmissions short when there's any possibility of interfering with distant QSOs, and never conduct lengthy direct communications on a repeater input frequency. As with any new mode of communications, the prime key to successful operation involves listening extensively to learn the techniques of that mode. 10 FM doesn't hold a money-back guarantee of fun, but you can feel relatively confident that there will be numerous amateurs waiting to purchase your used 10-FM gear should you decide to sell out and return to SSB-only activities.

Conclusion

The amateur frontier of 10 FM is growing at a fantastic rate, and this mode has an extremely promising future. Long-distance communication via FM is a unique experience—and this aspect blends perfectly with today's frantic life-style and mobile operating techniques. This band is much smaller in rf spectrum than other FM bands, so considerate and sophisticated operating techniques are a vitally important consideration.

All aspects considered, 10 FM should prove an exciting experience for the progressive-minded amateur. Its DXing, casual operating, and mountaintopping pleasures add new life to an amateur's interests. Here's listening for you on twenty-nine six! ■

Tom French WA4BZP
All Systems Go
PO Box 915
Winter Garden FL 32787

Scanner Magic for Heath's 2036

—grab your October '79 issue for part I of this project

	Parts List
R1	90k (value varies, depending on level of threshold signal—see text)
R2, R3	1 meg
R4	1k
C1	0.01-μF disc
Q1	2N2222
IC1-3	SN74LS163
IC4	NE555
misc.	DPDT scan operate switch, push-to-scan switch, 2" x 3" perfboard

In the October, 1979, issue of *73*, an article entitled, "An LED Display for the HW-2036" really excited a number of Heathkit® 2036 and 2036A users. As mentioned in the article, a scan board circuit could be piggybacked to the 2036-DB Display Board. Below are a few hints on how to build this board and check it out.

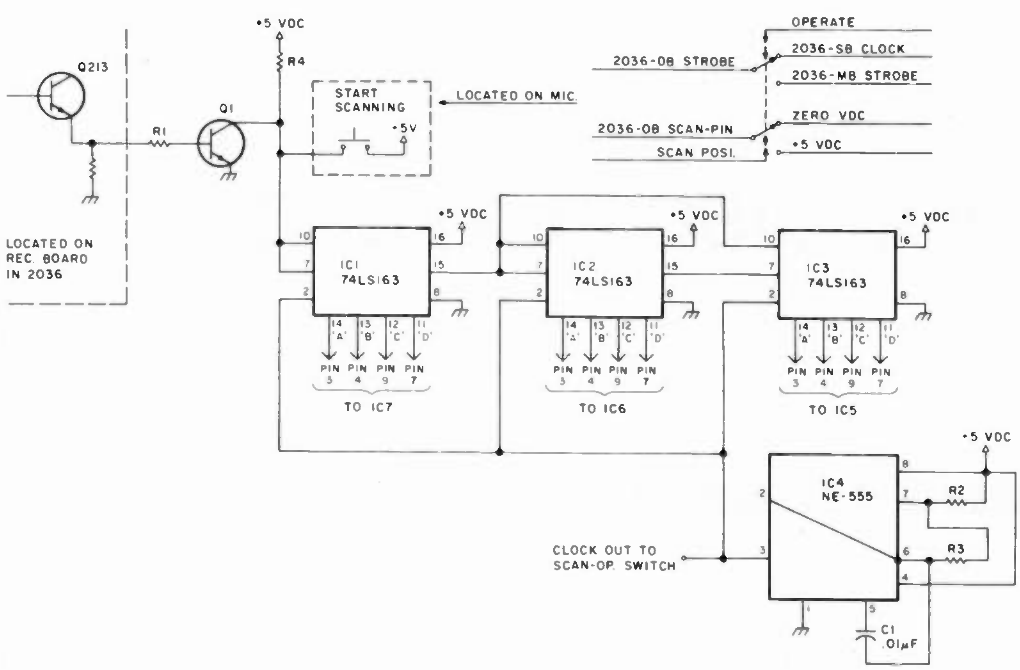

Fig. 1. 2036-SB Scan Board schematic diagram.

Acquire a 2" × 3" piece of perforated board and mount it for sizing on the forward 2¼" screw above the 2036-DB. With the board piggyback on the 2036-DB, position all three 74LS163 chips and also the NE555; don't forget to leave a little bit of room for Q1 and R1 through R3. After marking the parts locations, remove the board. The components then can be inserted, leads bent, and all required connections made with wire-wrap as shown in Fig. 1.

R1 is a threshold-setting resistor and its value is dependent on what signal strength you wish the scanner to lock. The higher its value, the more signal is required to lock the scanner on a carrier. A trimpot here would make adjustment easier.

Clock Out from the NE555 will go to the new scan operate switch (0/5 kHz), to provide a strobe pulse for the SN74LS298s. Install the push-to-scan switch on your mike at some place convenient (best location is on top) and use one of the extra wires in the mike cable for the signal back to the 2036-SB.

Next, install the respective wires to IC5 through IC7 from the 2036-DB to the 2036-SB (see Fig. 2). Remove the scan bridge on your 2036-DB and solder in the wire from the scan operate switch. Reassemble your unit and apply power. Throwing the scan operate switch to Scan should cause the display to count from .000 to .999 and cycle again. If this does not occur, check the 2036-SB to verify that the scan clock is active. Also read the signal at the 2036-DB on pin 10 of IC4 through IC7; these should also toggle.

To scan 147.000 to 147.999, key in 7-7-7-7, then switch to scan. The switch should be toggled slowly. This scan modification is used to enable the user to locate new repeaters in a new city, and by no means is it competitive with professional scanners.

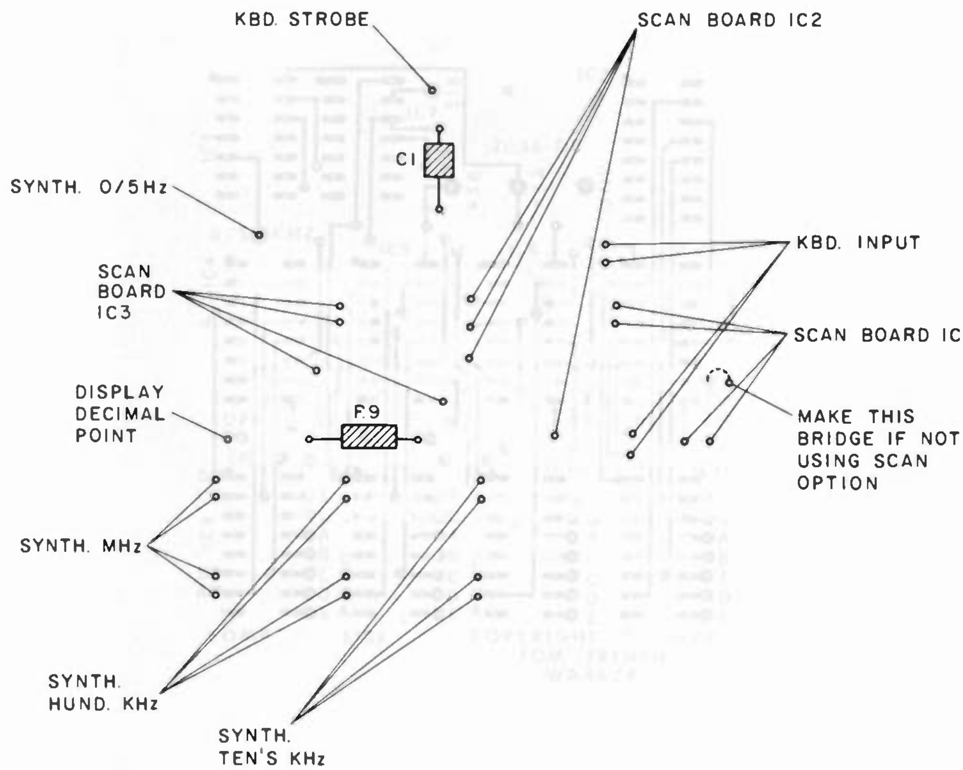

Fig. 2. 2036 Display Board connections.

If your synthesizer is not locking on frequency in the scan mode, it is recommended that the scan clock be slowed down. This is accomplished by increasing the value of the two 1-megohm resistors, R2 and R3 (see Fig. 1). ■

✓ Reader Service—see page 226

Steven D. Katz WB2WIK
24 Louis Drive
Budd Lake NJ 07828

HV Power Rectifiers

—amplifier builders should read this one

Hams seem to have a propensity for using general-purpose techniques in specialized applications. For example, a fellow may try to use an inch-and-a-quarter TV mast to hold up his TH6DXX beam because it is the only size that fits through the bearing in his tower. Lousy reason . . . and the result will be a perfectly good antenna strewn about his yard after the first real windstorm. Another ham may use an RG-58/U feedline to connect up his kW on two meters; after all, it handled the power just fine on 75. See my point?

One mistake hams nearly always seem to make is to use low-voltage technology applied to high-voltage circuits. This approach falls well in line with the mast and coax examples above. An amateur who designs his new kW plate supply using a long string of 1N4000-type plastic rectifiers is making a mistake which likely will remind him of his error just when he begins calling that FO8!

There are different technologies currently employed by the manufacturers of silicon power rectifiers, and only a few lend themselves to high-voltage applications. The always-available "1000-piv, 1-A" plastic diodes you find at flea markets and on retailers' shelves—usually priced at 15¢ each or so—just aren't. Aren't 1000 piv or 1 A, that is. These cheapie products nearly always are high-leakage commercial devices with weak reverse "knees" (V_R/I_R characteristics) and limited surge capabilities. After all, if these diodes were so good, why wouldn't their source sell them to high-reliability industrial houses, where the demand is high and supply is short, for much higher prices? Reason is, the manufacturers of these cheapie devices know the value of their product: nearly zero.

A ham may build just one kW amplifier in his lifetime; he'll look everywhere for Eimac tubes, Jennings tuning capacitors, Dow-Key relays, and the like—all high-quality products. Why endanger the usefulness of this major investment by using scrap power-supply components?

I have seen rectifiers which were marked "1500 piv, 2.5 A" for sale at a local electronics retailer priced at 6 for $1.00. Hmmm. I looked at them: They measured 0.125" in diameter, were 0.250" long, were made of plastic (epoxy), and had plated copper leads. I purchased 12 of these gems and made a few measurements on them when I brought them home. The very best diode of the lot "broke down" (exceeded 100-uA reverse current) at slightly over 700 volts. In the forward direction, at 2.5 A, they averaged 1.3 volts forward drop. This represents 3.25 Watts of power dissipated in only one direction. Add in the 100 uA of leakage at 700 volts in the other direction (70 mW) and we find that this diode would have to dissipate 3.32 Watts minimum in a 700-V ac application—an awful lot of power for a device the size of a ½-Watt resistor.

When you consider that these devices are soldered together, i.e., the leads are formed like nail-heads and soldered to the metallized silicon die inside the diode, it becomes very evident that the overall reliability of a device of such small volume dissipating over three Watts of power is questionable. Have you ever touched a ½-Watt resistor which was actually dissipating one-half Watt? *Ouch!*

Another limitation of the soldered-together approach is surge current capability. Ever turn on a piece of gear which immediately blew a fuse? Often, it is the power rectifiers which blew, from surge or inrush current. In a typical power supply, the rectifiers charge a capacitor which represents a very low impedance at the operating frequency (in a line-operated system, this is 60 Hz for half-wave, 120 Hz for full-wave designs). Before the capacitor charges up to its working dc potential, it may look like a

dead short, drawing, for the first few cycles of operation, considerably higher current than the rectifiers can withstand. In fact, it is not uncommon for (low-voltage) computer-grade electrolytics to be such effective shorts that they attempt to draw several hundred Amperes of inrush current, limited only by the resistance of the power transformer and the saturation effects of its core. This surge current may be a hundred times the normal operating output current of the supply and can cause rectifier failures in an otherwise sound design. The problems caused by surge currents are numerous, but one may be solder fatigue in the rectifiers: The solder bonds soften as the result of prolonged high-current operation, then harden when the power is removed. This thermal cycling weakens the bonds and may cause a failure.

So much for surge currents. How about avalanche characteristics? This term describes the manner in which the silicon junction breaks down in the reverse mode (in normal line rectifier applications, this mode occurs at a 60-Hz rate) and at what voltage the junction enters breakdown. Typical double-diffused junction rectifiers—the most common type used for commercial applications, due to the inexpensive process employed—can be built easily to block 500 volts or so in the reverse direction.

1000 volts is an entirely different story and requires higher-resistivity silicon and tighter process controls. It has been my experience, after testing many lots of devices, that most "1000-volt" double-diffused parts, like the 1N4007, break down well below their rated 1000 volts. What can we do? Sue the manuacturers? Nope. You see, unless one is very careful, the reverse-voltage test can be destructive, and most manufacturers accept no responsibility for devices which are field-tested unless tight testing controls are employed and proven acceptable.

Where does that leave us hams? Holding the bag, I'm afraid, unless we deal exclusively with sources which have high scruples and specialize in high-voltage technology.

Even if the rectifiers used actually meet or exceed their rated reverse voltage specifications, what happens if they're not matched for this characteristic? Absolutely nothing, *as long as no one diode in the string is approaching breakdown* or *avalanche*. We can assume that even a poorly-made power rectifier in the one-to-three-Amp region probably does not exceed 10-20-uA leakage at room temperature if operated *well below* its rated breakdown voltage. Except in extremely high-voltage (or low current) applications, this represents such a small amount of power (e.g., 500 V × 10 uA = 5 mW) that it is not worth worrying about.

Equalizing resistors wired across every rectifier in a string are, therefore, a waste of power and money and create an additional liability in the system: A resistor could fail.

By the way, the temperature coefficient of breakdown voltage for a silicon junction is positive—the hotter the junction, the higher the breakdown voltage. This is, of course, a positive feature of a silicon rectifier. An effect to consider, however, is the increase in leakage current with an increase in junction temperature. Silicon devices double in leakage about every 10° C,[1] and in many power-supply applications, the junction temperatures will exceed 100° C; often, power rectifiers will exceed 100-uA leakage at this temperature. At 500 volts V_R, this is 50 mW, not an insignificant value.

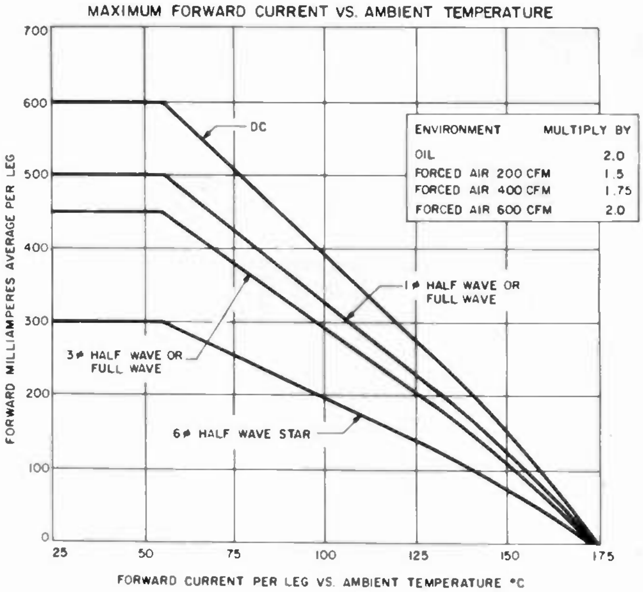

Fig. 1.

Matching rectifiers for forward characteristics can be important since it is in the forward—or conduction—mode that the rectifier will be dissipating real power. Fortunately, most silicon power devices built with the same technology will offer similar forward characteristics—roughly one-volt drop per junction at rated I_0 and 25° C. The temperature coefficient of this characteristic is negative, i.e., the hotter the junction, the lower the forward drop at a given current.

Packaging also is a consideration which will determine the reliability and life of a silicon rectifier. Many inexpensive devices are cased in epoxy, a hard plastic molded around the tiny silicon die to protect and insulate it and the fragile lead bonds. Some diodes use a glass sleeve to hermetically seal out contaminants which would gradually increase surface leakage of the silicon and lead to a failure; sometimes, the glass sleeve also holds the leads on. This is not a great way to build power semiconductors! Old-fashioned, "top hat" leaded rectifiers built in type DO-1, DO-2, and DO-3 cases are just that: old-fashioned. They rely on the thermal impedance of a soft-solder bond to just one side of the silicon die to conduct heat away from the junction; they also are "cavity" devices, whose characteristics can change as the result of mechanical shock. Not a great choice for that contest rig which gets bounced up the side of a rocky mountain.

As this discussion relates primarily to ac-line-operated linear-type power supply designs (direct conversion of 60-Hz power to dc power), we have intentionally avoided the subject of switching characteristics of rectifiers. These characteristics, called forward-recovery and reverse-recovery expressed in subsecond increments (or dv/dt expressed in volts per time interval, usually us), do not normally become important until operating frequencies far exceed 60 Hz. However, a considerable mismatch in t_{rr} (reverse-recovery time) characteristics, especially if one or more diodes in a string are very slow to recover from forward saturation, can

cause the fastest diode in that string to be overstressed for a lengthy enough period to cause its deterioration or destruction.[2] It is wise, therefore, to use at least medium-recovery rectifiers—typically rated 2 to 5 us—in reliable 60-Hz power supply designs where the devices are used in series.

So far, we've discussed a lot of "don'ts":

1. Don't use long strings of low-voltage rectifiers.

2. Don't use cheapie devices whose ratings are nearly always overstated.

3. Don't use miniature diodes which will dissipate excessive power in your application.

4. Don't use devices with limited or unknown surge current ratings.

5. Don't use "1000-V" diodes at this rating, but operate comfortably below their V_R capability when using in series.

6. Don't use equalizing resistors—they're just a cover-up for having selected the wrong semiconductors for the job.

7. Don't use power rectifiers which are built like small-signal devices, e.g., epoxy, glass-sleeved pressure-bonded, top-hat axials, etc.

8. Don't use devices of unknown or poor reverse-recovery characteristics, especially in a series string.

Well, what *should* we do? Thought you'd never ask.

When possible, use high-voltage rectifier assemblies manufactured by a reliable power rectifier house, rather than building your own assembly by wiring a string of discrete devices in series. These high-voltage assemblies are made of several rectifiers in series, of course—it is very difficult to manufacture a single junction which can block much over 1000 volts successfully and otherwise maintain the characteristics of a rectifier—but the manufacturers of these assemblies are much better equipped than the average ham to select the proper devices to use and then measure the overall results.

A conscientious manufacturer will use hermetically-sealed, internal heat-sink devices, which are high-temperature metallurgically bonded (not soldered) together, then screened and selected for characteristics which will allow trouble-free series operation, before assembling the finished product. This may sound like an expensive process, but manufacturers set up to build such assemblies in large quantities can do so quite economically.[3]

Calculate the piv requirement of the rectifier or assembly selected. For example, if the configuration is a full-wave center-tap, each rectifier has to block 2.82 times the rms voltage of half the transformer's secondary; for a full-wave bridge, each rectifier must block 1.41 times the rms voltage of the transformer secondary.

To further illustrate the examples in the last paragraph, if you have a plate transformer whose secondary voltage is 2000 V rms and you desire to use a full-wave bridge rectifier circuit, each leg of the bridge must be capable of blocking at least 2000 × 1.41 = 2820 volts with each half cycle. This assumes a nominal ac line voltage equal to and never exceeding the primary voltage rating of the transformer; this also assumes that under no-load conditions, the rms voltage delivered by the transformer doesn't rise above its full-load voltage (transformers are typically rated at some rms voltage at some load current, like 2000 V at 500 mA). These are poor assumptions!

Normally, a transformer rated at 1 kVA (equivalent of 1-kW resistive power)—say, 2000 V at 500 mA—will rise in secondary voltage under no-load conditions by about 10% or, in our example, to 2200 V. In addition, it is not uncommon for ac line voltage fluctuations to swing "upward" another 10% or so—say, from 117 V rms to 128.7 V rms—which transforms to 2420 V in our example. This would require a rectifier bridge rated at 3412 V per leg as a minimum, and even this value does not include any protection factor for short-duration transients.

So, you see that while our initial calculations led us to believe that a 2800-piv rectifier assembly might be used in each leg of the bridge described, in truth we should use at least 3500-piv assemblies as an absolute minimum; 5000-piv rated assemblies would not be overkill to afford us some protection against unexpected transients.

Next, estimate surge current requirements. I say "estimate" because there usually are unknown factors involved, like transformer efficiency, saturation effects of its core, and the discharged resistance of the input filter capacitor. However, one can make a worst-case surge current calculation based on transformer secondary resistance. If the resistance of your transformer secondary winding is 20 Ohms and the secondary voltage is 2000 V rms, the worst-case surge current is E_{pk}/R (2800/20), or 140 Amperes.

Actually, the surge current will not be quite this high. If your transformer secondary winding resistance measures very low or your input filter capacitor is very large, you may wish to add some series resistance in each input leg to the rectifier bridge to act as surge-current limiters.

A 35-Ohm, 10-Watt resistor in series with each ac input to a bridge as described above (2 kV rms secondary) will limit surge current to 40 Amperes maximum while dissipating only 8.75 Watts per resistor and degrading power supply regulation by about 1%. A compromise, surely, but not a bad one; surge protection may be switched "out" just a moment after turn-on if one wishes to conserve power and enhance regulation during normal operation.

Next, determine the continuous operating current requirements placed upon the rectifiers based on circuit configuration and operating habits. I always design a power supply for continuous duty unless size and weight restrictions are a consideration. AM, FM, RTTY, and SSTV are pretty much continuous-duty modes. SSB and CW may be low- or high-duty cycle modes, depending upon voice characteristics, audio processing, keying characteristics, etc. The thermal time constant of most rectifier assemblies in the low kilowatt region (say, ½ to 3 kW) is very short, which means the rectifiers will reach operating temperature from internal heating rapidly—probably in less than one minute of key-down time. Therefore, just because one keeps his transmissions reasonably short does not mean that the rectifiers aren't reaching their operating temperature.

Most kW-region, high-voltage supplies will never have to deliver more than one Ampere dc continuous. Those folks who are fortunate enough to own a pair of 4-1000s or 8877s may wish to design a power supply capable of delivering 2 A dc, but don't brag about this on the air, lest the FCC wonder why you need such a big supply!

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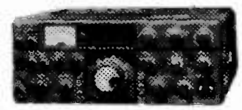

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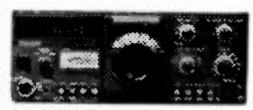

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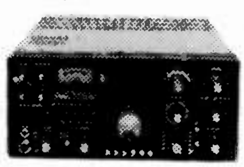

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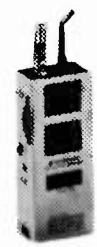

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only half the input wave, and therefore must handle only half the dc output current. Even a two-Amp supply can be built using rectifiers rated at one Amp I_o (continuous output current), as long as the rectifier rating is compatible with its operating temperature. It is wise to assume that under some conditions the rectifier junction temperature will be at least 100° C. This may sound very hot (and it is, for human beings), but silicon power rectifiers normally work in this region and they don't mind, as long as one derates them properly. The derating curves for one popular kW-level rectifier assembly are shown in Fig. 1.[4]

As you can see, the single-phase, full-wave current rating for this assembly is 500 mA from 25° C (77° F) to about 55° C (131° F); then it derates in a nearly linear fashion to zero current at 175° C (347° F). This represents a derating factor of about 4.17 mA/°C (2.31 mA/°F), calculated: $[(I_o \text{ @ } T_a) - (I_o \text{ @ } T_{max})]/(T_{max} - T_a)$ Amps/degree, where I_o is rated output current, T_a is ambient temperature (usually 25 or 55° C) and T_{max} is the maximum rated temperature of the device or assembly.

At 100° C, then, the "500-mA" rectifier assembly shown is actually rated at about 312 mA; at 125° C, it is rated at about 208 mA. Operating temperature equals ambient temperature plus thermal rise from junction heating and is sometimes difficult to calculate. To allow margin for error, it is best to use assemblies rated for your actual operating current at some rather high temperature (like 100° C).

It is wise to take manufacturers' data sheet ratings literally and not exceed them. Note that the temperatures expressed in Fig. 1 are ambient, for free air. There is a multiplier table shown which reveals that the current rating for this assembly is substantially higher if external (oil or forced-air) cooling is introduced, as is often the case in industrial or military designs.

Another consideration is insulation resistance across high-voltage terminals or from them to ground. At working voltages normally encountered in amateur amplifiers, even big ones, this is not a real problem, since most of us are working below 5 kV. A good rule-of-thumb dimension for high-voltage spacers or standoffs used to mount rectifiers and other high-voltage components is 0.10″ per 1000 volts minimum.

The same rule holds true for package length of high-voltage rectifiers. Beware of a ¼″-long diode rated at "5 kV." The silicon junctions inside may not break down until that level is reached, but what about the package itself or the air around it? Many subminiature high-voltage rectifiers were designed to be used in dielectric oil or fluorocarbon, *not in air*, and should be avoided for amateur applications.

Silicon high-voltage rectifier assemblies are available as complete center-taps and bridges as well as half-wave devices. In fact, it is a good choice indeed to use a commercially-manufactured complete rectifier assembly (such as a full-wave center-tap) when economically feasible, since the manufacturer has used well-matched devices therein, ensuring good balance and long life. A typical full-wave center-tap high-voltage rectifier assembly data sheet is reproduced in part here (Fig. 2[5]) as an example of a readily-available industrial product and its ratings. The SDHC-prefix devices asterisked are the center-tap assemblies and are, therefore, rated at twice the dc output current; the SDH- and SDHD-prefix devices are half-wave diodes and voltage-doubler configured arrays. (A doubler is two rectifiers in series with the center anode-to-cathode connection brought out for connection to external high-voltage capacitors.) Note the V_F—forward voltage—specified for each assembly; this is a clue to the number of junctions contained in each.

Type No.	Peak Inverse Voltage Per Leg	Average Rectified Current	Maximum Forward Voltage @500 mA/Leg	One Cycle Surge Current	Reverse Current/Leg @ PIV	Case Length
	55°C	55°C Mtg.	25°C	55°C	25°C	A
	Volts	Amps	Volts	Amps	uA	Inches
SDH5KM	5 kV	1.0	7	50	1.0	3.36
SDH10KM	10 kV	1.0	14	50	1.0	3.36
SDH15KM	15 kV	1.0	20	50	1.0	4.04
*SDHC5KM	5 kV	2.0	7	50	1.0	4.72
SDHD5KM	5 kV	1.0	7	50	1.0	4.72
*SDHC10KM	10 kV	2.0	14	50	1.0	4.72
SDHD10KM	10 kV	1.0	14	50	1.0	4.72
*SDHC15KM	15 kV	2.0	20	50	1.0	6.09
SDHD15KM	15 kV	1.0	20	50	1.0	6.09

Fig. 2.

This discussion, lengthy as it is, leaves out much information; it is important to note that many of the rules outlined here do not apply to low-voltage, high-current designs. If there is enough interest generated by this article, I will follow up with articles on p-n power semiconductor junctions, assembly techniques, thermal impedance ratings, switching power designs, etc.

In the meantime, most amateurs who have absorbed the material presented here should have a better understanding of high-voltage power rectifiers and their applications and ratings. Next time you look inside a kW amateur-band amplifier, see what type of high-voltage rectifier system is used. It can tell you a great deal about how smart the amplifier's designer was . . . and how much he cared about building a reliable product. ■

References

1. W. Shockley, "Problems Relating to p-n Junctions in Silicon," *Solid State Electronics*, vol. 2, c. 1961.

2. H.W. Henkel, "Germanium and Silicon Rectifiers," *Proceedings of the I.R.E.*, vol. 47, c. 1958.

3. Semtech Corporation, 652 Mitchell Rd., Newbury Park CA 91320. Examples of construction and design technology used here are taken from ideas used in Semtech products. Other manufacturers of high-voltage rectifier assemblies include: Edal Industries, 4 Short Beach Rd., E. Haven CT 06512; Electronic Devices, Inc., 21 Gray Oaks Ave., Yonkers NY 10710; International Rectifier, 233 Kansas St., El Segundo CA 90245; Unitrode Corp., 580 Pleasant St., Watertown MA 02172; Varo Semiconductor, PO Box 676, Garland TX 75040; and Westinghouse Electric Corp., Semiconductor Div., Youngwood PA 15697.

4. Courtesy of Semtech Corporation.

5. Courtesy of Semtech Corporation.

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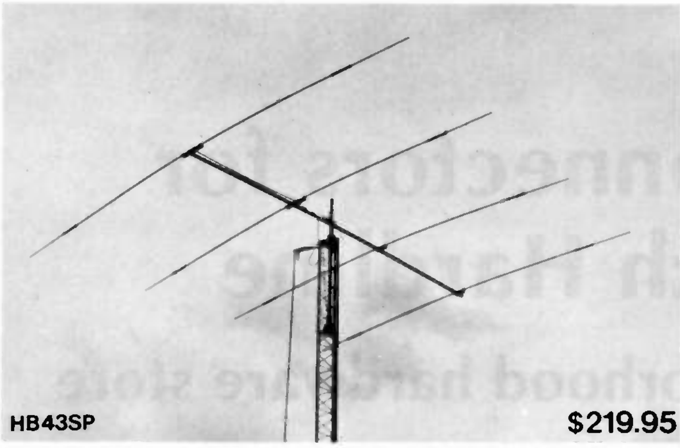

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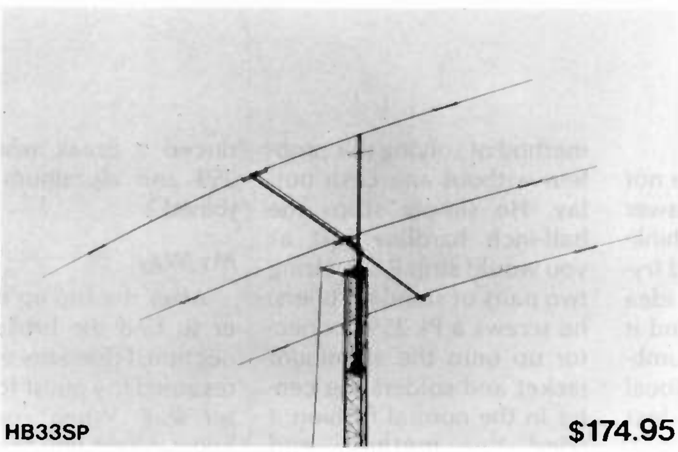

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You've just become the owner of some really nice half-inch, 72-Ohm CATV hardline, but where, oh where, will you find connectors for this prize? What will you do? What *will* you do? To make matters worse, you know that even if you had the money to purchase commercial connectors, they would not fit anything in your shack. And what if your fellow amateurs found out that you weren't innovative enough to come up with something as simple as a cable connector!

Don't despair; you're not alone. I found the answer after several weeks of thinking, looking, asking, and trying every harebrained idea that came along. I found it across town in the plumbing section of the local hardware store, for less than a dollar.

Another Way

WA4VYR, a good friend and the inspiration for my original idea, has successfully used the following method of solving this problem without *any* cash outlay. He simply strips the half-inch hardline just as you would strip RG-8. Using two pairs of standard pliers, he screws a PL-259 connector up onto the aluminum jacket and solders the center in the normal fashion. I tried this method—and tried, and tried, and tried, until I finally decided that there had to be an easier way. (The one I did get to work lasted only two weeks before Mother Nature produced a break where the 259 and aluminum jacket joined.)

My Way

After the trip up the tower to find the broken connection, I dried my eyes and resumed my quest for a better way. When you don't know where you're going, I had been told, make an outline. Just what did I need to do the job? I wanted a coupling that was compatible with the existing system, namely, with SO-239/PL-259 hardware. And the joint needed reinforcing, I decided, in the light of my previous experience. The coupling must be small and have no clamps or sharp edges. It also would be nice if it could be weatherproofed easily. And, above all, it must be simple and cheap.

As I mentioned, the solution to all this was found in the local hardware store. This particular store had a display of brass fittings used for the installation of copper gas and water lines. Among them was a *half-*

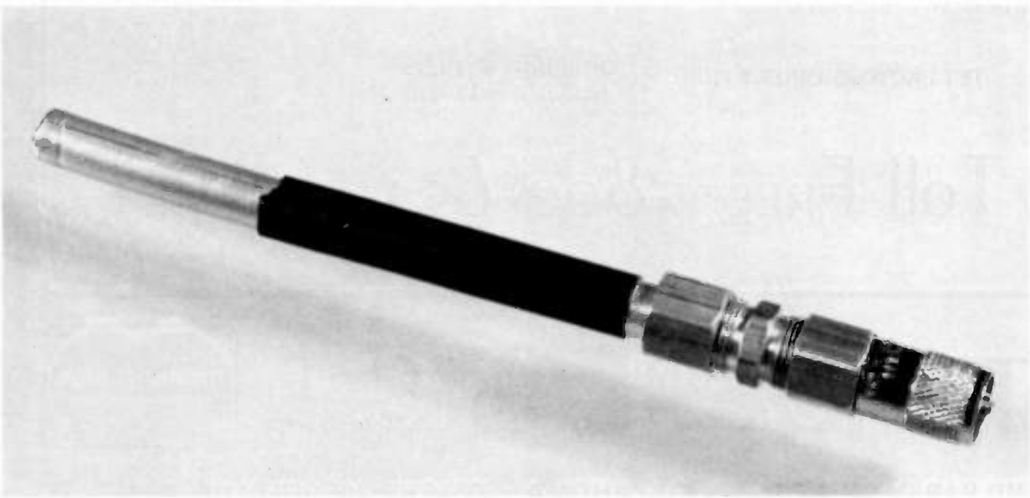

Photo A. The completed connector.

inch brass compression coupling.

This connector is a perfect adapter. It will fit almost perfectly over the aluminum jacket of the commonly-available, half-inch CATV hardline. It consists of the five parts shown in Photo B: the main body, two brass collets—one inserted into each end of the main body, and two brass caps. These collets constrict around the tubing being joined when tightened correctly and form an airtight, firm connection. To make matters even simpler, the main body has a rim centered inside. This allows the cable to be inserted and seated properly before tightening.

So much for the history and sales pitch. Get your parts up and follow me through the simple ten-minute assembly.

Assembly

Prepare the end of the hardline as shown in Photo C. Cutting is done best with a small tubing cutter because of its smooth cutting action. Loosely assemble the brass fitting and twist one end onto the prepared end of the CATV cable. This will be simple to do correctly since the cable will stop when it contacts the inner rim inside the brass fitting. Since the main body and end caps are machined for gripping with standard wrenches, use two wrenches and tighten this end very snugly. Be careful not to strip the brass threads, but do make sure you tighten the cap enough to compress the collet around the hardline jacket. Don't worry if the union crooks slightly. I said the fit was *almost* perfect!

Next, it is very important to scrape all the enamel coating from the center conductor. It won't solder if you don't. Now we are ready to slip a PL-259 onto the center by screwing it onto the foam insulation and up into the brass fitting. It probably won't go far enough to seat against the inner rim, but it will be far enough to allow the collet to tighten properly. Don't overdo the insertion bit here; remember, you'll need to be able to turn the cap of the PL-259! The rest should go without further detailed description.

Solder the center in the normal fashion and trim any excess length from it afterwards. Don't tin the inner conductor before insertion because you will find they fit very closely, and it probably wouldn't fit afterwards if you do. Presto! You now are back on familiar ground. The 259 connector should be readily adaptable to most of your amateur needs.

When I showed my discovery to KA4DPF, a close friend who is an engineer for the local power company, he remarked that this connector had a very important virtue that I had overlooked. Since direct connection of dissimilar metals always produces some corrosion, the power company uses brass intermediate connectors to prevent eventual problems. Hence, this configuration should provide years of trouble-free operation, especially if taped well when installed.

Installation

By now you should have surmised that I am relatively non-technical and am far from being an expert on antenna technology. However, some remarks about matching 72-Ohm cable with a 50-Ohm system are in order. I am told by those more knowledgeable than I am that the following conditions are found in this situation. Provided the antenna is an acceptable match to the transmitter and the 72-Ohm cable is *exactly* a multiple of one-half wavelengths long at the operating frequency, the transmitter will effectively "see" the antenna load at the other end regardless of the characteristic impedance of the line. Further, the expected loss from this line mismatch would be only around 1.6 to 1: probably a good tradeoff relative to a long run of RG-8, especially from a receive-loss standpoint.

I matched the system at K4QT/RPT and at my home station by inserting different lengths of RG-8/X between the hardline and the transmitter until I found one that made the total cable length appear to be the proper length. The reflected power shown on a 50-Ohm Bird 43 was less than one Watt with twelve Watts out of the transmitter. The flexible jumpers are a welcome addition also when moving and installing equipment.

I am certain that this method has its faults and I would welcome any constructive advice concerning better methods. The repeater, which was constructed from an old Heathkit® HW-202, has been operating on this system for about a year now without incident. This doesn't prove anything except that a solid-state transmitter can operate well when used in the manner described.

Perhaps these ideas will be of some help to you when you come across that old CATV cable someone else doesn't want or couldn't figure out how to use! ■

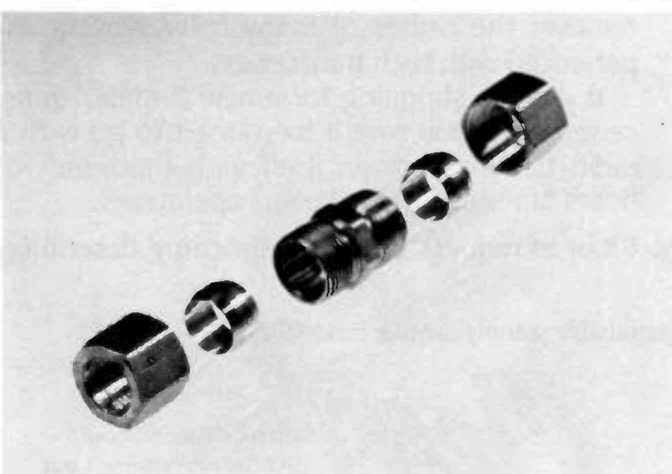

Photo B. The five-part brass adapter.

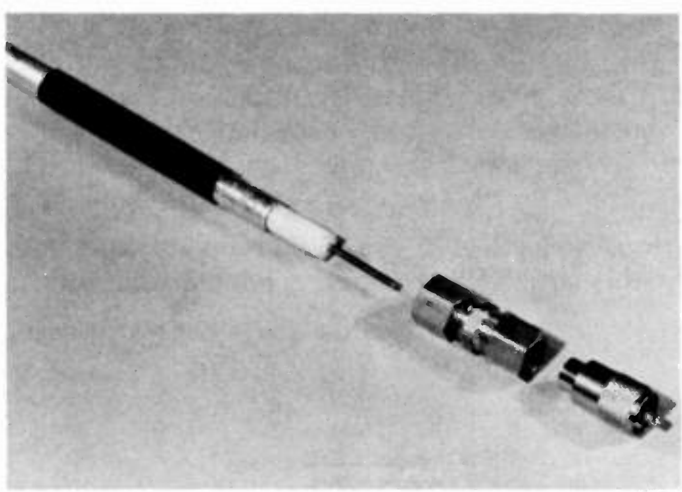

Photo C. Half-inch CATV hardline, adapter, and PL-259.

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The Microwave Midget

—this WEFAX converter features something different—an active mixer

Several years have passed since NOAA (National Oceanic and Atmospheric Administration) graduated from VHF WEFAX (Weather Facsimile) satellites to geosynchronous microwave satellites. True, some of the polar-orbiting satellites transmitted data on S-band, besides the low-frequency product usually found on 137.5 and 137.62 MHz, but only the bravest of souls attempted to track such a fast-moving target with a narrow beamwidth dish. Besides, I was content to extract weather pictures from the low-altitude polar orbiters and occasionally, for some real DX, from ATS-1 or ATS-3 parked some 22,500 miles above the equator.

In April, 1976, NOAA published Technical Memorandum NESS 54, by John Nagle, entitled "A Method of Converting the SMS/GOES WEFAX Frequency (1691 MHz) to the Existing APT/WEFAX Frequency (137 MHz)." This was followed up with an APT Information Note (76-W4) in September, 1976, advising all ground stations of the proposed S-band broadcasts and schedules. Clearly, the handwriting was on the wall, and many of us (some reluctantly) were dragged into the realm of microwaves.

Photo A. The six-foot dish and feedhorn.

The rush to 1691 MHz was not especially spectacular, and for most of us, it resembled a slow and laborious climb. Microcomm rose to the occasion with a line of inexpensive modules, and a fine article by WB8DQT[1] showed us how to use them, besides providing a wealth of data on dishes, gain figures, path loss and margins.

The annual gathering of weather-satellite buffs at the Dayton Hamvention in 1979 unearthed several home-brew devices, but I believe none has been described in print with the exception of one produced by G8FCD. He wrote about his METEOSAT (Europe's counterpart to GOES) Earth station in recent issues of *Wireless World*.[2]

The heart of my system is an *active* mixer—a mixer with conversion *gain* rather than the conversion loss associated with diode mixers. The expected ground-level signal of −134 dBm is not exactly an S-meter needle bender, so every bit of help you can get in the way of gain in the system is to

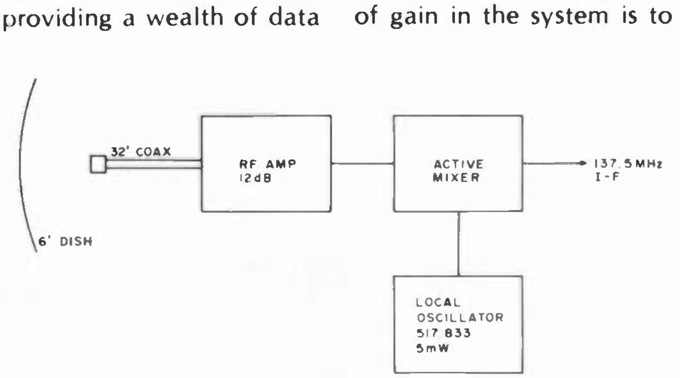

Fig. 1. System configuration for the active-mixer converter.

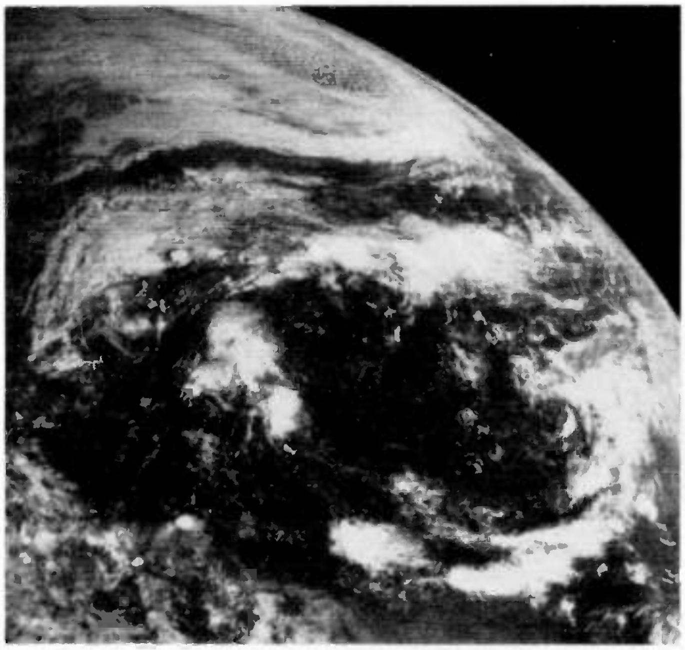

Photo B. *No land mass is visible in this photo of the NE quadrant. Placed above and overlapping Photo C, covering the SE quadrant, complete coverage of the eastern half of the hemisphere is obtained.*

Photo C. South America's west and east coasts are visible in this picture, at lower left.

your advantage (and of benefit to your wallet) because high-gain preamps and transistors at this frequency still cost a few bucks. I was convinced of the worth of an active mixer by W6KT through correspondence and because of his success with such a device—although his differs considerably from the one about to be described. I used an almost exact copy of an active mixer described by Larkin Crutcher WA5WOW[3] for 1296 MHz, with a few modifications necessary to achieve similar results.

Circuit Description and Layout

The active mixer consists of two half-wavelength lines of #10 soft-drawn copper wire grounded at both ends of their respective cavities and tuned at their center point with 10-32 brass screws. The brass nuts are soldered inside the cavities. At one end of the multiplier cavity, a signal from the local oscillator is injected at 517.833 MHz at 5 mW, which, in turn, is multiplied by 3 to 1553.5 MHz. The output signal from this cavity is coupled to an inductive link at the other end of this line. The input signal at 1691 MHz is coupled to the input cavity via a capacitive probe at one end of the line and taken off the other end of the line with a capacitive probe.

This probe and the inductive link of the multiplier cavity are composed of one piece of #14 wire bent into a U shape, 20 mm long with 12-mm legs. The difference signal, 137.5 MHz, is coupled to the mixer transistor by connecting a 100-pF disc ceramic capacitor from the center point (10 mm) of the U-shaped link to the base of the MRF901. The collector of this transistor uses a conventionally-tuned output circuit to the 137.5-MHz wideband FM receiver. No preamp was necessary.

The active mixer box is constructed entirely of double-sided PC board. The base is slightly longer than 88 mm × 54 mm, and the four walls plus the center partition are made from 1-inch-high strips. The actual box dimensions are 88 mm × 50 mm × 25 mm. The

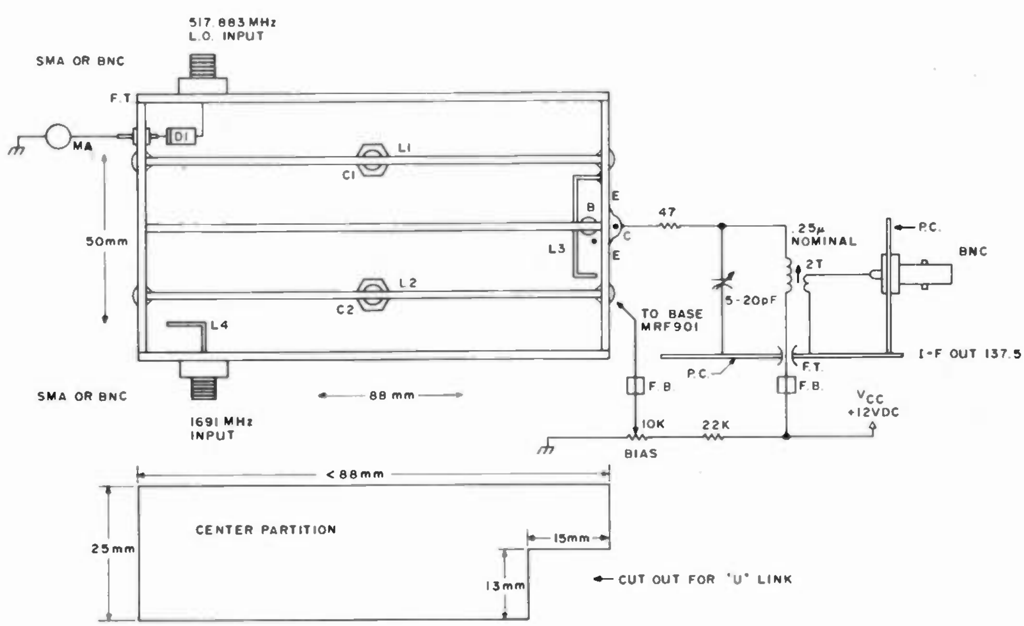

Fig. 2. Schematic of the active mixer. L1, L2—#10 wire; C1, C2—10-32 nuts and bolts; L3—20 mm × 14 mm U-shaped link, #14 wire; D1—MA4882 mixer diode; L4—12 mm × 7 mm × 2 mm tab.

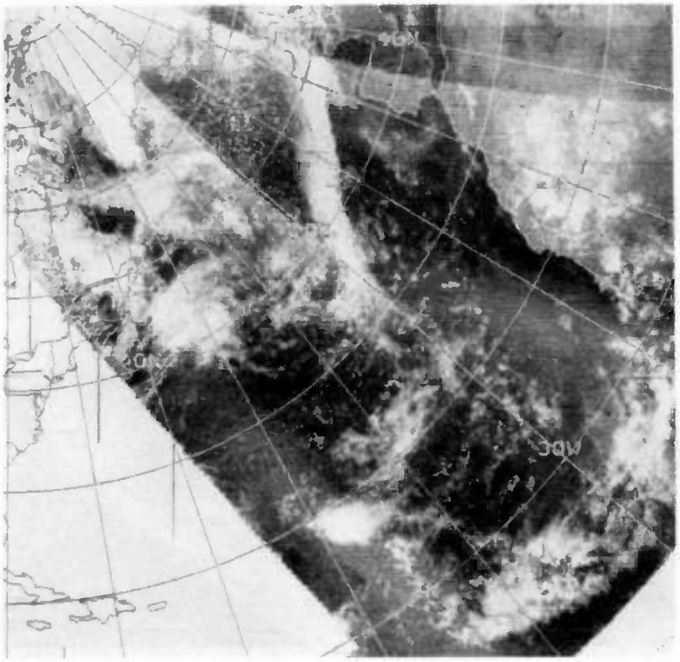

Photo D. NOAA product from low-altitude satellite Tiros N relayed from the ground through uplink.

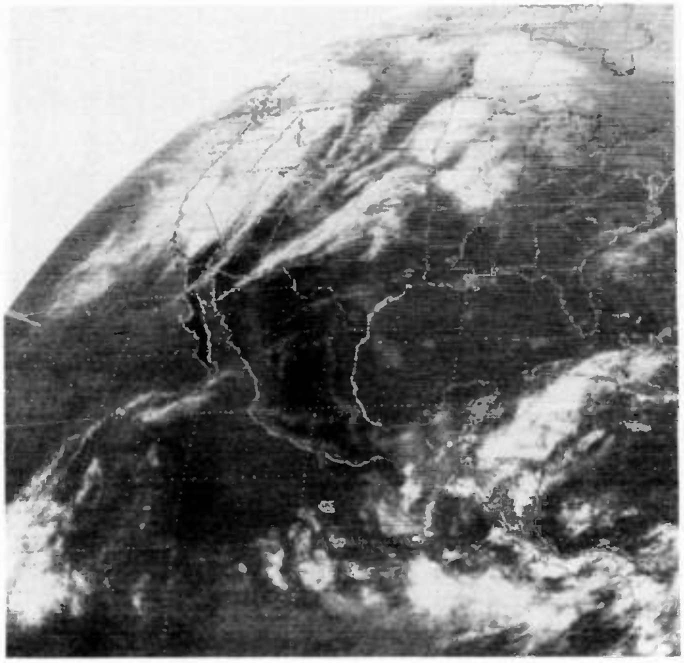

Photo E. Daytime infrared photo, NW quadrant.

center partition is slightly shorter than 88 mm to fit in the center of the box, and is notched at one end with a 13 mm × 15 mm cut out to accommodate the U-shaped link. A hole is drilled in the end wall adjacent to the link for mounting the MRF901.

A very small hole is drilled into the baseplate near the wall for a piece of #30 insulated wire to pass through and connect to the base of the transistor to provide the necessary bias. The rest of the transistor lives outside of the cavity. The low-frequency circuit for 137.5 MHz was built on a small piece of PC board and tack soldered to the back side of the baseplate for isolation. An additional one-inch strip was soldered to the baseplate parallel to the long walls and drilled for mounting on a 19-inch aluminum panel. SMA connectors were used for the input and output ports to match the Microcomm rf preamp and local oscillator, but BNC connectors should work as well.

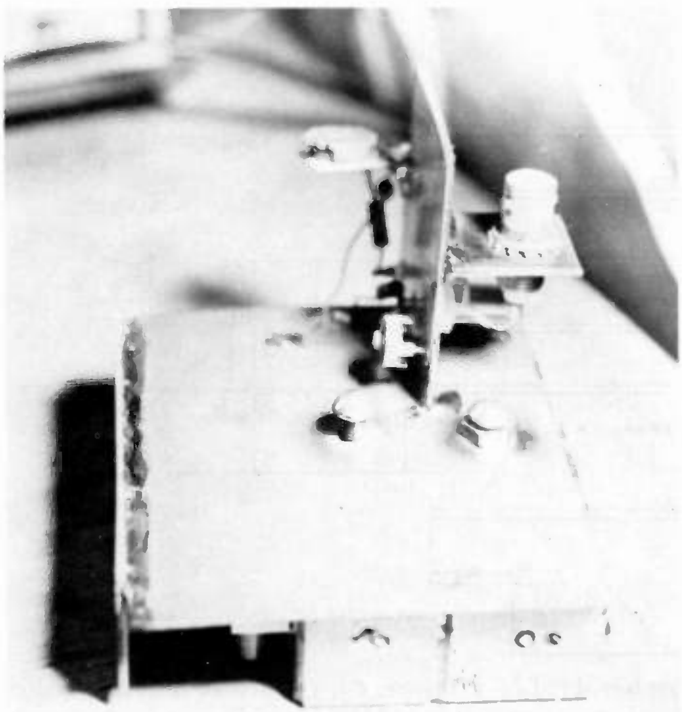

Photo F. Back side of the active mixer.

Tune-Up and Operation

I wish I could say that everything went as smooth as silk with this project, but I traipsed with Murphy down the garden path for several months until I finally discovered that I had the collector circuit tuned to about 300 MHz. The microwave portion of the mixer apparently worked well from the start. I used a Hewlett-Packard HP-614A signal generator for a beacon/signal source for testing. Initially, I biased the MRF901 for a collector current of about 800 microamps without oscillator injection, fired up the oscillator and tuned the multiplier cavity for maximum collector current which, at this point, was 1.2 mA. By bending the U-shaped link closer to the multiplier line, squeezing the multiplier diode closer to the line, and slightly deforming the line itself downward by about 2 mm, I picked up an additional 600 microamps of collector current.

Initially, I constructed the mixer with inductive links throughout, but in actual practice ended up with more gain by cutting the input link to the signal line from ground and also the signal line portion of the U-shaped link. I accomplished this tweaking by setting the signal generator to 1691 MHz and the power to 0 dBm and turning down the calibrated attenuator. The tuning screw in the signal cavity tunes with the 10-32 screw almost all the way out with about one thread left in the cavity. The multiplier screw needed a 12-mm disk of thin brass or copper soldered to the end of its 10-32 screw to tune the line since it is too short, but the disk, with its added capacity, nicely pulls it down lower in frequency.

With one 12-dB gain Microcomm preamp connected ahead of the mixer and a properly functioning output circuit attached to the MRF901, the attenuator was cranked into more than −125 dBm with plenty of signal showing on the receiver, so I moved everything outdoors. I attached the system to a 6-foot dish and a homemade feedhorn sporting an N connector through ten feet of RG-9 cable and picked up a full-quieting signal from SMS-GOES East. After optimizing the feedhorn for focus and polarization angle, I removed the preamp, and though the signal was a bit noisy through ten feet of cable, I think it would have made a useful picture.

Since most of the users have devised ways of mounting their converters and preamps at the antenna site, I assumed that it would be impossible to use only one preamp and expect to use the system indoors through a long run of cable. Taggart devised such a scheme using a Coleman insulated cooler and an incubator device. My dish is situated more than 25 feet from my shack and "looks" through an ancient sugar maple tree about 70 feet high with about 30 feet of leaves and branches in the way. I'm sure there is some signal absorption when the sap flows.

To satisfy my curiosity, I attached another 22-foot piece of RG-9 to the existing ten-foot piece and still received a full-quieting signal! I now have the entire system indoors except for the dish, feedhorn, and thirty-two feet of RG-9 cable and one foot of RG-142/U with a total of six connectors in the line: one SMA male, four series-N males, and a double-female N "barrel" connector. (I believe I have some loss there.) The pictures shown were made with this cable configuration, but someday I hope to replace it all with one piece.

Conclusion

For my money, the active mixer is definitely the way to go at these frequencies. I didn't use any bandpass filters in the front end because I live in a natural dish in a rural area. For a more hostile rf environment, their use probably will be necessary. The Microcomm LO is exceptionally clean, so I got away without one between it and the multiplier diode. If for some reason this local-oscillator module is not available in the future, you should be able to construct one from N6TX's article[4] or build your own. W6KT built a simple oscillator chain for 259 MHz and multiplied by six by replacing the multiplier diode with an MRF901.

I monitor the multiplier-diode current of the MA4882 with a 0-15-mA meter. Nominal current is between 4 to 7 mA. The collector current of the MRF901 also is monitored with a 0-10-mA meter. By varying the bias pot, a satisfactory operating point would be from 900 microamps to about 2 mA, with some mixer noise becoming evident above this figure. The current was brought up to 7 mA without a tendency to oscillate, but the noise was objectionable and the gain started downhill.

Finally, NOAA, unlike the private sector of the satellite business, welcomes the use of their service by amateurs. Bob Popham,[5] the coordinator for the NOAA satellite service, has attended the weather satellite symposiums at Dayton for the last several years as one of the principal speakers.

The weather pictures for this article were produced on a facsimile device described in my previous articles.[6,7]

I think I'll get out my PC board and try for some converters for 1296 and 2304. ■

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3. Larkin Crutcher WA5WOW, "An Active Mixer for 1296," *QST*, August, 1974.
4. Paul Schuch N6TX, "A UHF Oscillator for the Purist," *Ham Radio*, July, 1979.
5. U.S. Department of Commerce, NOAA, NESS, Washington DC 20233, Attn: Popham OA/S131.
6. Eugene Ruperto W3KH, "Weather Satellite Pix Printers," *73 Magazine*, January, 1978.
7. Eugene Ruperto W3KH, "A Satellite Receiver for the Home," *Scientific American*, "The Amateur Scientist," January, 1974.

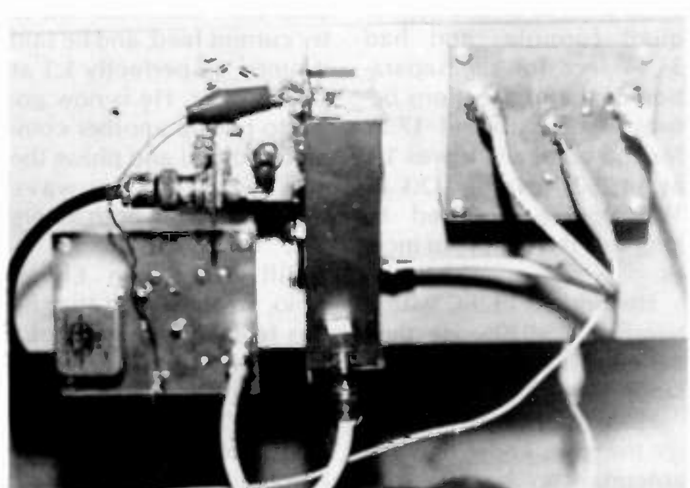

Photo G. From left to right: the oscillator, active mixer, and preamp.

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The Amazing Bobtail ...Our Readers Respond

—more ideas for using and modifying this easy-to-build antenna

The first week after the Bobtail article was published (May, 1980, *73 Magazine*, page 44), four hams wrote me that they had built the antenna and agreed with my evaluation.

The first was Jim Gray W1XU, who tried the idea which I had failed to try completely—feeding it with coax at a high-current point. He said it worked perfectly.

He used 984/f, the normal quad formula, and had 34.44 feet for the separation of the top sections between verticals and 17.22 for the verticals. It was 1:1 at 14.250 MHz and 2:1 at 14.000. He planned to lengthen it a couple of inches.

He worked EI2EC with a barefoot TS-820S. He then called "CQ Pacific" and landed VK1DH.

He wrote, in part, "Now let the guys know that the antenna can be fed with coax—with low swr, too. It saves wear and tear on tuners and tuning. I like it, and so does the DX." More later on the feedpoint.

Ron Chiappari N6AUV put the antenna up with three elements on 40 meters and fed it at the top with coax; he phoned me from California to tell me about it. He said it tuned up easily and was 1:1 at the design frequency.

Merl W9ZSI built the antenna with voltage feed and wrote me that it was a great antenna. I then told him to try current feed, and he said it tuned up perfectly 1:1 at 14.250 MHz. He is now going to put up another complete Bobtail and phase the pair with quarter-wave spacing, driving both antennas.

Bill W8YFB in Elyria, Ohio, wrote to say that he was feeding the center element voltage-fed with open-wire ladder line on 80/20/15/10 and then tied the two feeders together for a Bobtail on 40.

Dave W7TO wrote me that he had talked one evening to Bob K8FN in Troy, Ohio, who had the strongest signal from the east one night while running only 25 Watts. Of course I wrote Bob, and he said his Bobtail was suspended from three towers, and he had hung old tires at the bottom of the vertical wires so that he could mow under them. How about that?

I also received a letter from "Judge" Ganzer K7SCO who has written books on antennas. He said he calls this type of current top-fed antennas "blacktop antennas" because they do not have to use buried radials in the ground.

You may have guessed—there are no grounds on the top-fed antennas. The center of the coax goes to the top of the vertical in the center, or at one end (as I do), and the shield goes to the flat-top horizontal section.

I received a surprising number of letters from people merely telling me that they had used the antenna and that I was right about it. All agreed that it was a quiet antenna, and some wondered why. Verticals are not usually quiet.

It is a long-range antenna and is at its best when the path exceeds 2500 miles.

This is important—when you feed it, connect the center of the coax to the vertical. I first thought I would run the coax up the center of the quarter-wave tubing and feed the top section, with the shield going to the vertical as in the case of the balun. This might work, but it would change the phasing. The three verticals are in phase because the two top sections are cancelled out when center-fed.

I am using mine with the coax to the top of the end vertical because it is more convenient. I believe that the pattern is skewed toward the west (driven) vertical and that this method is related to a full-wave longwire. I get strong reports from both the SW Pacific area and the NE European area. This happens to suit me fine. I think my pattern is a four-leaf-clover pattern with the accent on the western lobes, but I cannot prove this by driving around locally with a field-strength meter for a pattern measurement.

Most of the hams who wrote to me used the usual formula and made the top sections 33′ long and the verticals 16′ 6″. I used 34′ at the top for each section, as Jim Gray did, and tried the verticals at 17′ 3″, but I had to cut the verticals back to 16′ 6″ to get the swr to 1:1. In the usual manner of phased verticals, I believe that the length of the top sections is uncritical, as in the spacing of phased verticals. It affects the pattern but not the resonance. The antenna is tuned to resonance with the vertical radiators.

Now you know the rest of the story. No grounds; top-fed with coax; tune the vertical sections. However, Ron N6AUV said that no verticals worked well at his location in California because of poor grounds. I told him to try a method which I advised a friend in Connecticut to use one time: Lay a roll of fence wire under the antenna. He used chicken wire and it worked beautifully. No connection to the antennas —just a reflecting surface. You can buy green vinyl-covered fence wire now and lay it on the grass. It blends with the grass and you can mow over it.

I noticed one thing—most of the letters were from very experienced hams, not newcomers. I hope some new people will try it and let me know, now that voltage feed is not necessary. ■

Single-Tone Paging for Wilson HTs

—simple circuit should work with many rigs

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The small size of the new generation of two-meter HTs permits them to be carried almost anywhere, giving instant communications capability either direct or through repeaters. In my specific application, my wife and I use Wilson MK IIs to keep in touch on an unused simplex frequency, and the channel can be monitored constantly for any calls to each other. Sometimes we are too far apart for reliable simplex communications, however, and must switch over to one of the local repeaters. Naturally, the wide-coverage repeaters are fairly busy, and monitoring all the repeater activity for a specific call is very distracting, especially in a business meeting or restaurant. What we each needed was a way to be alerted to an incoming call without constant attention to the HT.

Selective Calling

Commercial users solved this problem many years ago by the use of selective calling. Selective calling permits a receiver to monitor a frequency for calls and unsquelch only when specifically addressed. Thus, a user can go about his business without any conscious attention to the receiver and yet immediately be alerted to any incoming call. The most common form of selective calling used in commercial paging applications is some form of two-tone sequential encoding-decoding. This is accomplished by transmitting an rf carrier which is modulated by a series of two audio tones. Each paging recipient carries a receiver that responds to a particular sequence of different audio tones. The receiver remains muted until the proper tones are received, after which an audible alert tone is produced. In the case of a tone-only page, this alert tone is a signal for the paged person to perform some prearranged action, such as calling a telephone number or reporting to a specific location. For a tone and voice page, the alerting tone is followed by a voice message. The decoders in the receiver are immune to false alarms by virtue of the sequencing requirement, decoder bandwidth, and slow response time. Typically, over 100 different codes are available on any given frequency.

Adding a suitable high-performance sequential tone decoder to an already crowded HT is not easy, unfortunately, and the problem is further complicated by the need for a compatible encoder when the signaling of another unit in the network is required.

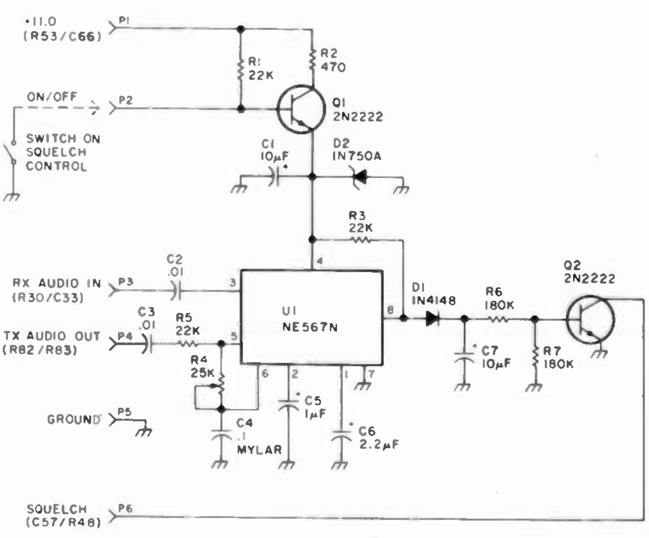


Fig. 1. Single-tone encoder-decoder for the Wilson MK II/IV.

Single-Tone Paging

For many amateur applications, large numbers of different signaling codes on any given channel are not required and a simpler form of selective calling can be used. Encoding and decoding a *single* audio tone can be implemented with a minimum amount of circuitry and can provide very effective results if certain precautions are taken. As in the case of sequential tone decoding, the response time of the decoder must be slow so that voice or other momentary in-band signals do not trigger the squelch. Additionally, the frequency separation of the different tone frequencies must be compatible with low-cost decoders. Close frequency spacings allow more individual codes, but require tighter bandwidth control in the decoder and encoder, complicating the design and increasing the size and cost.

While researching this problem, I noticed that the eight frequencies used in touchtone™ signaling (assuming 16 digits) use 10% frequency spacing for each of the 4 high-group and 4 low-group tones. Using this as a starting point, the group of tones shown in Table 1 was developed. Note that all the frequencies have a 10% offset from each adjacent frequency, except for the 1075-Hz tone. This was arbitrarily chosen to be midway from the 941-Hz and 1209-Hz touchtone frequencies. Eighteen different audio tones within the normal voice band permit up to 18 different paging networks to operate on any given channel. By using tones in the voice band, as opposed to subaudible tones, repeaters may be used as the paging transmitter since the originating tone can be transmitted by any station capable of accessing the repeater. Of course, the system will also work on simplex channels.

There is no advantage in using the 8 touchtone frequencies in this plan, since in normal autopatch use any specific tone is usually transmitted for less than 1 second, and a 3-second response time on the single-tone decoder allows it to effectively ignore the single tone associated with the dual-tone touchtone signal. Actually, there is some advantage to using touchtone frequencies in this tone plan since any of the 8 users of these frequencies can be paged by anyone equipped with a touchtone HT or by use of a touchtone phone on a reverse autopatch. Repeater groups might want to assign these tones to key individuals in the organization such as members of the engineering committee or emergency coordinators.

Tone Coordination

In order for this tone plan to be successful, some form of tone coordination on any given channel is necessary. Since most repeaters are operated by well-organized groups, the 18 available tones can be assigned and their use administered in any manner that suits the group. The main consideration is to avoid duplication of tones so that users of the service are not bothered by unwanted pages.

Circuit Design

I have had excellent results using the single tone encoder-decoder shown in Fig. 1. The circuit uses an NE567 tone-decoder chip to detect one of the 18 different tones. The filter bandwidth is compatible with the 10% tone separation, and the operating frequency can be set to any of the 18 tones by the adjustment of R4. In addition, the circuit also generates the exact frequency which it decodes, permitting the encoder to alert any other receiver in the same network. The circuit is insensitive to voltage variations from 7.5 to 16 volts and varies less than 1% in frequency over the −10°-to-60°C temperature range.

Operation and Circuit Description

As installed in my Wilson MK II, the decoder is activated whenever the squelch control is switched to the Tone position. This tone feature was intended by Wilson to activate a subaudible tone squelch, but it works fine for this application. With the squelch control in this position, the normal carrier squelch is disabled, but the receiver remains squelched by the saturated output from Q2 in the decoder. Whenever a signal appears on frequency modulated by the correct tone, the output of U1 goes low. After about 3 seconds, as determined by C6 and R6, the collector of Q2 goes high and the MK II unsquelches. Once unsquelched, the activating tone is heard in the speaker indicating a page. The receiver squelches as soon as the rf input or tone is removed. Once the alert tone is heard, the squelch control is rotated to the normal carrier squelch position and the frequency monitored for information from the paging station, and two-way contact can be carried out if desired. If paging of another station in the same tone network is desired, one first checks for a clear channel, identifies, and then transmits a 5-second tone by switching back to the Tone position while keying the MK II. The 5-second tone transmission allows about 2 seconds of the tone to be heard in the paged receiver.

Construction

The entire encoder-decoder fits on one single-sided PCB. A full-size layout of the board is shown in Fig. 2 and the parts list is shown in Table 2. All the parts are available from advertisers in *73* or most Radio Shack stores. I've also made arrangements for

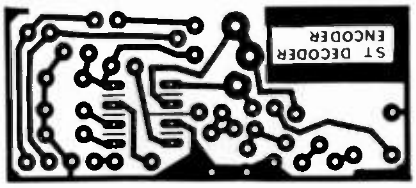


Fig. 2. Full-size layout of PCB for the single-tone encoder-decoder.

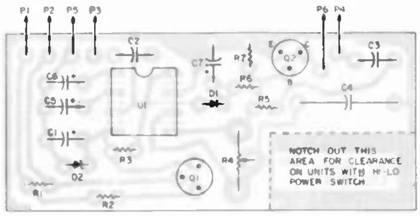


Fig. 3. Component layout.

Tone Channel	Frequency	
1	515	
2	570	
3	630	
4	697	Low-group touchtone
5	770	Low-group touchtone
6	852	Low-group touchtone
7	941	Low-group touchtone
8	1075	
9	1209	High-group touchtone
10	1336	High-group touchtone
11	1447	High-group touchtone
12	1633	High-group touchtone
13	1805	
14	1995	
15	2205	
16	2437	
17	2694	
18	2977	

Table 1.

the PCB alone, or a complete kit, to be made available from a source listed in the parts list. Mention the ST Encoder-Decoder when ordering.

All the parts are mounted as shown in Fig. 3. Note that the resistors are mounted vertically to save space. If your MK II or MK IV has the Hi-Lo power switch, it will be necessary to notch out the rear corner of the PCB to provide clearance. The solid copper area bordering the board name provides the proper guidelines for this operation. Six #26 stranded wires about 7" long are connected to the unit for testing and eventual connection to the MK II or MK IV PCB.

Testing

To avoid any extra trouble, I recommend testing the encoder-decoder externally and then connecting it to the MK II or MK IV. Referring again to Fig. 1, connect +12 volts to P1 and ground to P5. Connect a frequency counter to P4 and adjust R4 for the desired tone frequency. Then apply a 100-mV rms audio signal at the desired tone frequency to P3. Before the tone is applied, the base of Q2 should be at .7 volts. This should drop to 0 volts about 3 seconds after the tone is applied. Verify that the on/off switch works by grounding P2. The transmit output signal at P4 should disappear, and the base of Q2 will go to 0 volts. Once the board has been tested, insulate the entire bottom of the PCB with electrical or vinyl tape to prevent shorts when it is installed in the MK II or MK IV.

Installation

The first step is to remove the top and bottom covers from the MK II or MK IV to gain access to the switch contacts on the squelch control. Run a jumper from one of the switch contacts to the ground plane on the main PCB of the MK II or MK IV. Next, connect the wire from P2 to the other switch contact. Note that this wire must be routed from the backside of the PCB to the switch contact on the squelch control. The connections of each of the leads from the encoder-decoder to the MK II is shown in Fig. 1. In each case, the reference designator shown on the schematic beside each lead number refers to the connection point on the MK II. These points are best located by referring to the circuit board overlay on page 18 of the Operating and Service Manual for the MK II/MK IV.

The encoder-decoder is secured inside the radio by pressure from the top cover. Now, carefully reinstall the top and bottom covers and check for proper operation. If you have a deviation meter, check for about 3-kHz tone deviation. This is more than adequate since the decoder will function with deviations from transmitters as low as 1.5 kHz. Have someone transmit a signal with the correct tone frequency and check for proper receiver operation. The receiver should unsquelch about 2.5 seconds after the tone is transmitted.

How Does It Perform?

I can monitor a busy repeater all day and never once hear the squelch break, yet as soon as I am paged, the paging tone comes through loud and clear. I've had the opportunity to try the page feature through a number of different repeaters and it has never failed to work. When readable signals are present, the encoder-decoder works every time.

Incidentally, when switched On, the encoder-decoder adds about 6 mA of additional current drain. This is of no consequence since the average drain in the Tone position is much less than in normal squelch because battery life is directly proportional to the amount of audio coming from the speaker. With the decoder turned on, *nothing* is ever heard except the desired paging tone.

Use of Encoder-Decoder in Other Equipment

I haven't had the chance to investigate the use of the encoder-decoder in other equipment, but aside from physical constraints, the unit should work with most negative-ground solid state equipment. I will be glad to answer any specific questions on interfacing it with your rig if you include a copy of the schematic and an SASE.■

Parts List

R1, R5, R3	22k, ¼ W	
R2	470, ¼ W	
R4	25k Pot	Radio Shack 271-336
R6, R7	180k, ¼ W	
C1, C7	10 µF, 16 V	Radio Shack 272-1411
C2, C3	0.01 ceramic	
C4	0.1 mylar™	Radio Shack 272-1053
C5	1 µF, 35 V	Radio Shack 272-1406
C6	2.2 µF, 35 V	Radio Shack 272-1407
D1	1N4148	
D2	1N750A	
U1	NE567N	
Q1, Q2	2N2222	

A complete parts kit, including drilled and plated PCB, is available from Coggin Mfg., P.O. Box 44, Cedar Rapids IA 52404, $15.95 (postpaid). The PCB alone is $3.50 postpaid.

Table 2.

Have you ever wondered why the best ham bargains are advertised in 73?

You'll find a wider selection of ham bargains . . . and lower prices in 73, because 73's readers buy far more than readers of other ham magazines.

Wayne Green

THE LEADING EDGE

That shouldn't come as a surprise to you . . . For twenty years we've been publishing more construction projects and articles than any other ham magazine, so it is natural for the active hams to read *73* . . . and buy from the ads.

The readers of *73* catch the leading edge, through sideband in the early 60's, then solid state in the mid-60's, FM and repeaters in the early 70's . . . SSTV, ATV, RTTY and all other special modes have received more coverage in *73* than all other ham magazines combined.

NEXT YEAR WE'LL BE PUSHING . . .

In the next year or so, we'll be pushing for amateur experimentation and pioneering with new modes of communications, via computer, automatic identification, satellite, wideband techniques, synchronous detectors, time slicing. Never before was a point in time so exciting to contemplate, and with *73* you can keep up with the new ideas and changes.

We'll also be pushing for increased pressure on the FCC for better and more responsive rules, for a return to a national growth and for amateur radio development in as many of the emerging nations as possible.

ALL OF THIS IS MADE POSSIBLE BY YOU

All of this is made possible by you reading *73* and getting your friends and club members to subscribe to *73*. I admit that we're not really pushing the radio relay of messages, since that is more geared to the 1920's than the 1980's and is more likely than other activities to cause troubles with foreign governments nervous about potential lost telephone revenues. We're looking toward the 1990's, with over one million hams in our country using state of the art communications techniques to keep in touch with hams worldwide.

YEAR 2000?

What will amateur radio be like in the year 2000? We can't really even imagine, except that we know it will be different from 1980 . . . probably as different as amateur radio is today from what it was in 1960, when FM and repeaters were all but unknown, and AM was still going strong on our phone bands. A frequency synthesizer required over a hundred tubes and radioteletype circuits were larger than the printers. You can be sure that *73* will be in the vanguard of the developments to come . . . reporting on them and giving you the information so you can participate.

☐ Bill me for one year of 73 at $25.00 ☐ New Subscription ☐ Renewal

Name ______________________________

Address ______________________________

City ______________________ State ______ Zip ______

Canadian $27.00/1 year only, US funds Foreign $35.00/1 year only, US funds

Please allow 4-6 weeks for delivery.

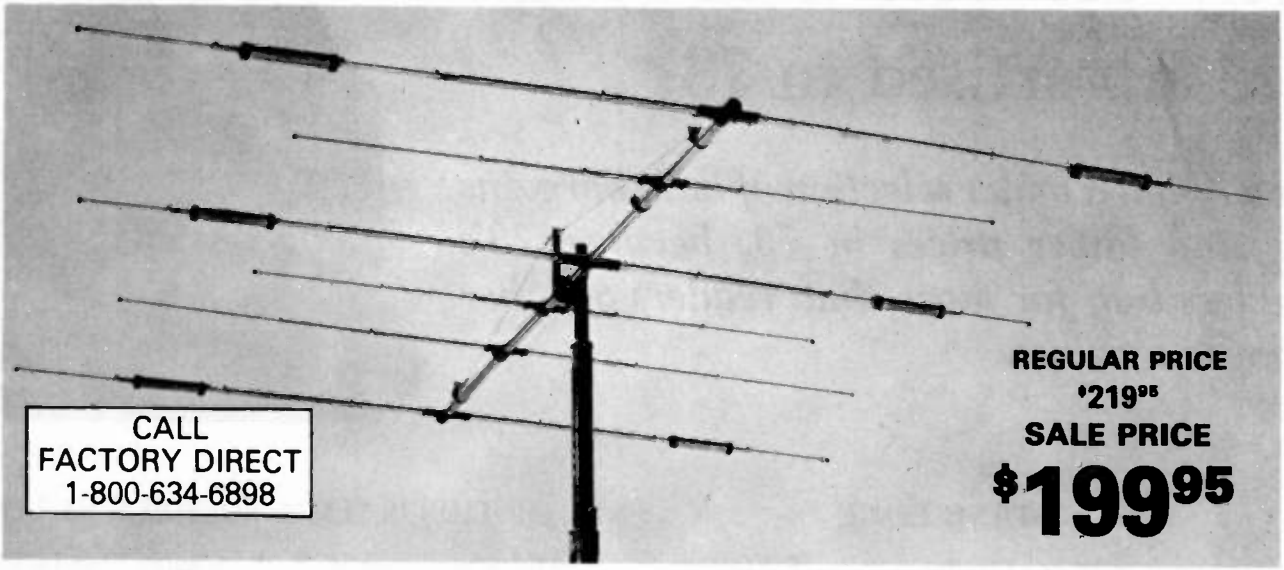
73 Magazine • PO Box 931 • Farmingdale NY 11737

30DB6

WILSON SYSTEMS, INC.

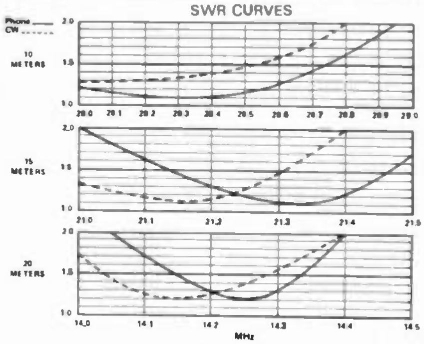
CHRISTMAS SPECIAL SALE

SYSTEM 36



A trap loaded antenna that performs like a monobander! That's the characteristic of this six element three band beam. Through the use of wide spacing and interlacing of elements, the following is possible: three active elements on 20, three active elements on 15, and four active elements on 10 meters. No need to run separate coax feed lines for each band, as the bandswitching is automatically made via the High-Q Wilson traps. Designed to handle the maximum legal power, the traps are capped at each end to provide a weather-proof seal against rain and dust. The special High-Q traps are the strongest available in the industry today.

SWR CURVES

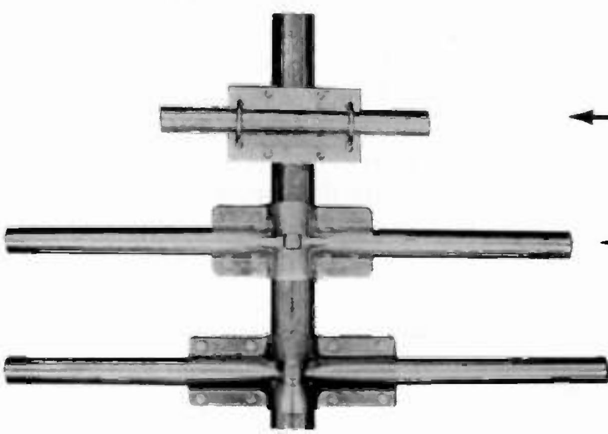


SY36

SPECIFICATIONS

Band MHz	14-21-28
Maximum power input	Legal Limit
Gain (dbd)	9 db
VSWR @ resonance	1.2:1
Impedance	50 ohm
F/B Ratio	20 db or Better
Boom (O.D. x Length)	2" x 24'2½"
No. of Elements	6
Longest Element	28'2½"
Turning Radius	18'6"
Maximum Mast Diameter	2"
Surface Area	8.6 sq. ft.
Matching Method	Beta
Wind Loading @ 80 mph	215 lbs.
Mfaximum Wind Survival	100 mph
Feed Method	Balun (Supplied)
Assembled Weight (approx.)	53 lbs.
Shipping Weight (approx.)	62 lbs.

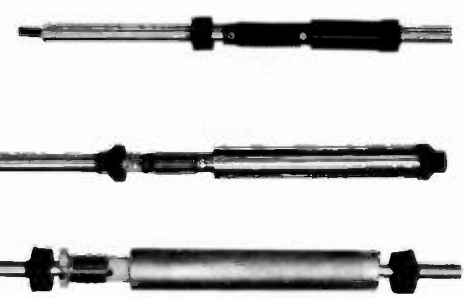
Compare the SY-36 & SY-33 with others...



BRAND CC

BRAND HG

WILSON SYSTEMS



Compare the size and strength of the boom to element clamps. See who offers the largest and heaviest duty. Which would you prefer?

Wilson Systems traps offer a larger diameter trap coil and a larger outside housing, giving excellent Q and power capabilities.

For Christmas Special

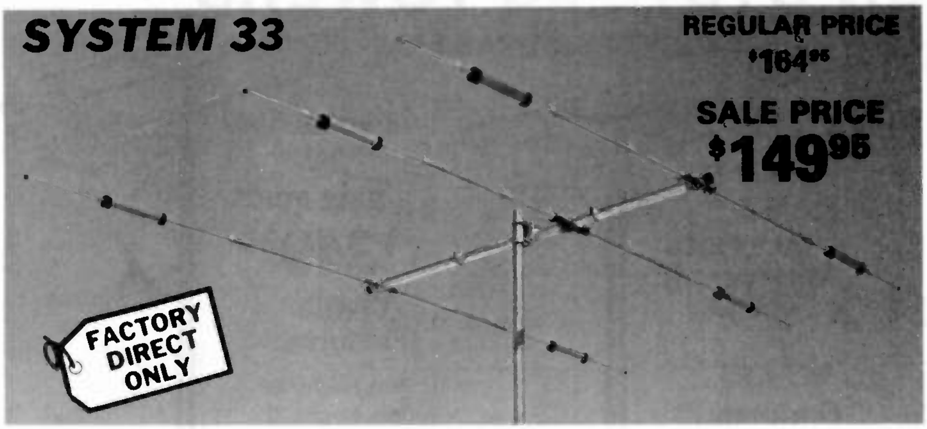
CALL
FACTORY DIRECT
1-800-634-6898

WSI WILSON SYSTEMS, INC.

4286 S. Polaris Ave., Las Vegas, Nevada 89103

Prices and specifications subject to change without notice.

WILSON SYSTEMS INC.



Capable of handling the Legal Limit, the *SYSTEM 33* is the finest compact tri-bander available to the amateur.

Designed and produced by one of the world's largest antenna manufacturers, the traditional quality of workmanship and materials excels with the *SYSTEM 33*.

The boom-to-element mount consists of two 1/8" thick formed aluminum plates that will provide more clamping and holding strength to prevent element misalignment.

Superior clamping power is obtained with the use of a rugged 1/4" thick aluminum plate for boom to mast mounting.

The use of large diameter High-Q Traps in the *SYSTEM 33* makes it a high performing tri-bander and at a very economical price.

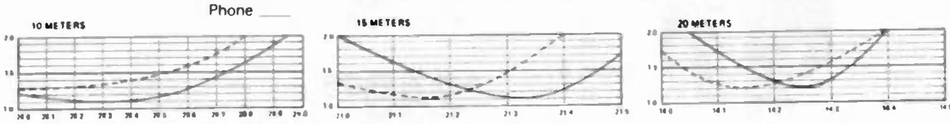
A complete step-by-step illustrated instruction manual guides you to easy assembly and the lightweight antenna makes installation of the *SYSTEM 33* quick and simple.

SPECIFICATIONS

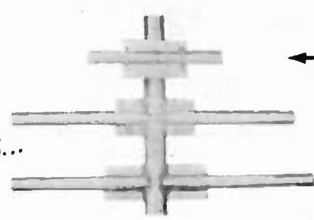
Band MHz 14-21-28	Boom (O.D. x length) 2" x 14'4"	Wind load @ 80 mph .. 114 lbs
Max. power input ... Legal limit	No. elements 3	Assembled Wt. .... 37 lbs
Gain (dbd) 8	Longest element .... 27'4"	Shipping Wt. .... 42 lbs
VSWR at resonance 1.2:1	Turning radius .... 15'9"	Direct 52 ohm feed
Impedence .... 50 ohms	Max. mast diameter ... 2" O.D.	no balun required
F/B ratio .... up to 20	Surface area .... 5.7 sq. ft.	Max wind survival ... 100 mph

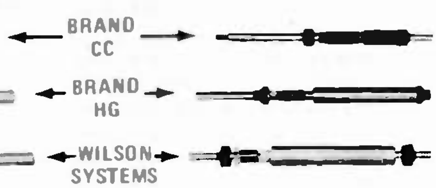
ACTUAL SWR CURVES

CW ......
Phone ____



COMPARE THE SY33 WITH OTHERS...





Compare the size and strength of the boom to element clamps. See who offers the largest and heaviest duty. Which would you prefer?

Wilson Systems traps offer a larger diameter trap coil and a larger outside housing, giving excellent Q and power capabilities.

REGULAR PRICE
$65.95
SALE PRICE
$59.95

WV-1A
4 BAND TRAP VERTICAL (10 - 40 METERS)

No bandswitching necessary with this vertical. An excellent low cost DX antenna with an electrical quarter wavelength on each band and low angle radiation. Advanced design provides low SWR and exceptionally flat response across the full width of each band.

Featured is the Wilson large diameter High-Q traps which will maintain resonant points with varying temperatures and humidity.

Easily assembled, the WV-1A is supplied with a base mount bracket to attach to vent pipe or to a mast driven in the ground.

NOTE:
Radials are required for peak operation or above ground mounting.
(See GR-1 below)

SPECIFICATIONS

- 19' total height
- Self supporting — no guys required
- Weight — 14 lbs.
- Input impedance: 50 Ω
- Powerhandling capability: Legal Limit
- Two High-Q traps with large diameter coils
- Low angle radiation
- Omnidirectional performance
- Taper swaged aluminum tubing
- Automatic bandswitching
- Mast bracket furnished
- SWR: 1.1:1 or less on all bands

ADD 40 METERS TO YOUR TRI-BAND WITH THE 33-6 MK
— IN STOCK —

REGULAR PRICE
$65.95
SALE PRICE
$59.95

Now you can have the capabilities of 40-meter operation on the *SYSTEM 36* and *SYSTEM 33*. Using the same type high quality traps, the 40-meter addition will offer 150 KHZ of bandwidth. The 33-6 MK will fit your present SY36, SY33, or SY3 and use the same single feed line.

The 33-6 MK adds approximately 15' to the driven element of your tri-bander, increasing the tuning radius by 5 to 6 feet. This addition will offer a rotatable dipole at the same height of your beam.

For Christmas Special Sale — Call
FACTORY DIRECT
1-800-634-6898

WSI WILSON SYSTEMS, INC.
4286 S. Polaris Ave., Las Vegas, Nevada 89103

Prices and specifications subject to change without notice.
Prices Effective 11-1-80 thru 12-31-80

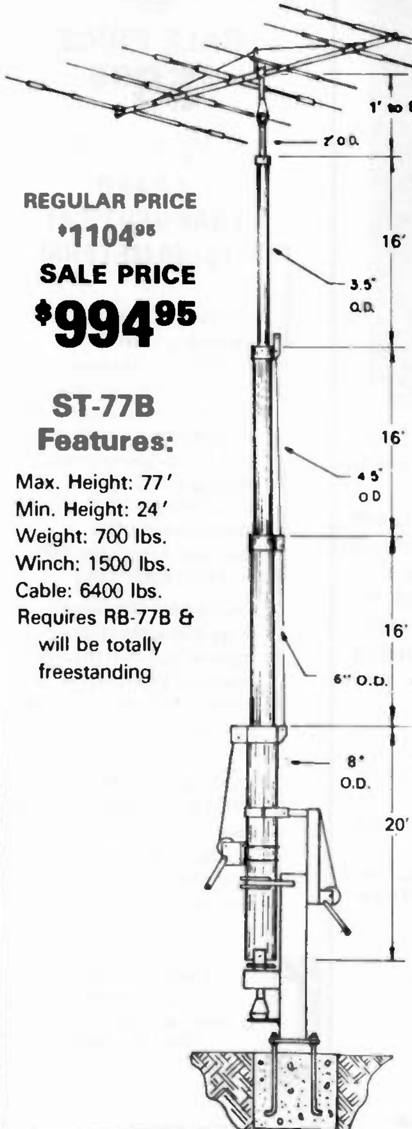
GR-1
GROUND RADIAL KIT

REGULAR PRICE
$14.95
SALE PRICE
$12.95

The GR-1 is the complete ground radial kit for the WV 1A. It consists of 150' of 7/14 aluminum wire, heavy duty egg insulators and instructions. The GR-1 will increase the efficiency of the WV-1 by providing the correct counterpoise.

WILSON SYSTEMS TOWERS

— FACTORY CHRISTMAS SALE —



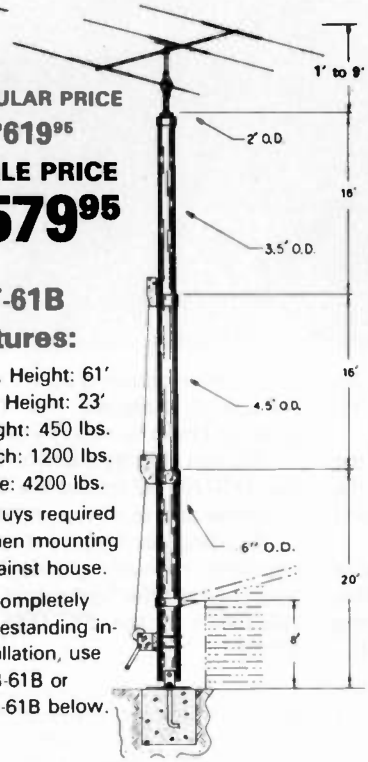
REGULAR PRICE 1104^{95}

SALE PRICE

994^{95}

ST-77B Features:

Max. Height: 77'
Min. Height: 24'
Weight: 700 lbs.
Winch: 1500 lbs.
Cable: 6400 lbs.
Requires RB-77B & will be totally freestanding



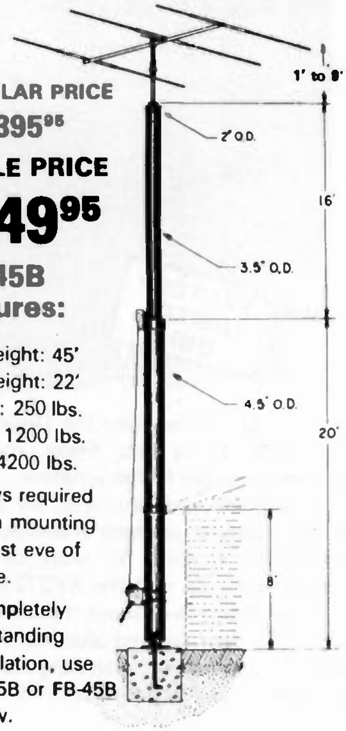
REGULAR PRICE 619^{95}

SALE PRICE

579^{95}

MT-61B Features:

Max. Height: 61'
Min. Height: 23'
Weight: 450 lbs.
Winch: 1200 lbs.
Cable: 4200 lbs.
No Guys required when mounting against house.
For completely freestanding installation, use RB-61B or FB-61B below.



REGULAR PRICE 395^{95}

SALE PRICE

349^{95}

TT-45B Features:

Max Height: 45'
Min. Height: 22'
Weight: 250 lbs.
Winch: 1200 lbs.
Cable: 4200 lbs.
No Guys required when mounting against eve of house.
For completely freestanding installation, use RB-45B or FB-45B below.

NEW! Wilson Electric Winch

Now you can raise and lower your Wilson Tower electrically. The electric winch will replace the hand operated winch. Available for use on the TT-45, MT-61 and ST-77 towers.

EW-45 (TT-45)
EW-61 (MT-61)
EW-77 (ST-77) **249^{95}**

Remote Switch . . . 24^{95}

BASE CHART

TOWER	WIDTH	DEPTH
TT-45B	12" x 12"	30"
FB-45B	30" x 30"	4½'
RB-45B	30" x 30"	4½'
MT-61B	18" x 18"	4'
FB-61B	3' x 3'	5½'
RB-61B	3' x 3'	5½'
ST-77B	See Below	
RB-77B	3½' x 3½'	6'

WIND LOADING

Tower	Height	Sq. Ft.	
ST-77B	69	16	Square Footage Based on 50 MPH Wind
	77	10	
MT-61B	53	18	
	61	12	
TT-45B	37	18	
	45	12	

Wilson Systems uses a high strength carbon steel tube manufactured especially for Wilson Systems. It is 25% stronger than conventional pipe or tubing. The tubing size used is: 2" & 3½"-.095; 4½" & 6"-.125; 8" -134. All tubing is hot dip galvanized. Top section is 2" O.D. for proper rotor and antenna mounting.

The TT-45B and MT-61B come complete with house bracket and hinged base plate for against-house mounting. For totally freestanding installation, use either of the tilt-over bases shown below.

The ST-77B cannot be mounted against the house and must be used with the rotating tilt-over base RB-77B shown below.

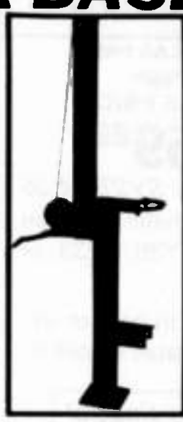
TILT-OVER BASES FOR TOWERS

FIXED BASE

The FB Series was designed to provide an economical method of moving the tower away from the house. It will support the tower in a completely free-standing vertical position, while also having the capabilities of tilting the tower over to provide an easy access to the antenna. The rotor mounts at the top of the tower in the conventional manner, and will not rotate the complete tower.

FB-45B...112 lbs...169^{95}

FB-61B...169 lbs...244^{95}



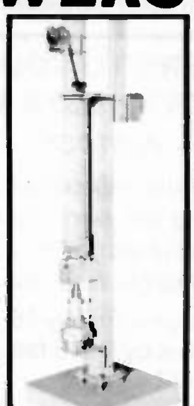
ROTATING BASE

The RB Series was designed for the Amateur who wants the added convenience of being able to work on the rotor from the ground position. This series of bases will give that ease plus rotate the complete tower and antenna system by the use of a heavy duty thrust bearing at the base of the tower mounting position, while still being able to tilt the tower over when desiring to make changes on the antenna system.

RB-45B...144 lbs...234^{95}

RB-61B...229 lbs...309^{95}

RB-77B...300 lbs...463^{95}



Tilting the tower over is a one-man task with the Wilson bases. (Shown above is the RB-61B. Rotor is not included.)

CHRISTMAS SPECIAL SALE
Call Factory Direct
1-800-634-6898

Order the CHRISTMAS SPECIAL!

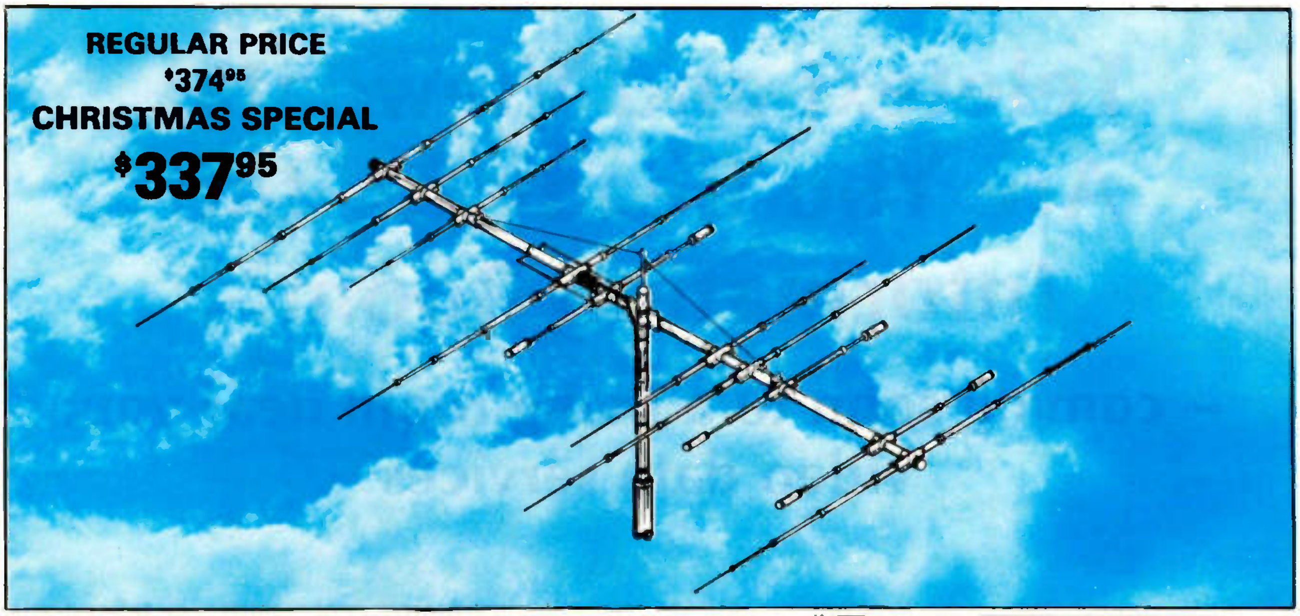
Prices Effective 11-1-80 thru 12-31-80

WSI WILSON SYSTEMS, INC.
4286 S. Polaris Ave. • Las Vegas, Nevada 89103

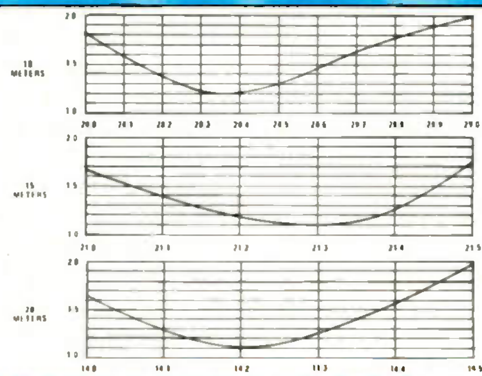
WILSON SYSTEMS, INC. PRESENTS

CHRISTMAS SPECIAL THE SYSTEM 40 TRIBANDER

3 MONOBAND ANTENNAS IN ONE — EACH WITH FULL MONOBAND PERFORMANCE



- FOR THE SERIOUS DXer WHO WANTS MONOBANDERS ON 10-15-20
- FOUR FULL SIZE 20 MTR ELEMENTS WITH 10 dbd GAIN AND 25 db F/B
- FOUR WIDE SPACED 15 MTR ELEMENTS WITH 10 dbd GAIN AND 20 db F/B
- FIVE WIDE SPACED 10 MTR ELEMENTS WITH 11.5 dbd GAIN AND 20 db F/B
- ONLY ONE FEED LINE REQUIRED
- HEAVY DUTY BALUN INCLUDED
- DESIGNED WITH NO INTERACTIONS BETWEEN ELEMENTS
- ALL DRIVEN AND DIRECTOR ELEMENTS ARE INSULATED FROM BOOM
- SAME QUALITY HARDWARE AS USED IN ALL *WILSON* ANTENNAS



—SPECIFICATIONS—

Max. Pwr. Input	Legal Lmit	Longest Element	36′
VSWR @ Res.	1.2:1	Turning Radius	22′6″
Impedance	50 ohm	Boom	26′
Feed Method	Balun Supplied	Surface Area	12.1 sq. ft.
Matching Method	Modified Beta	Wind Loading @ 80 mph	309 lbs.
F/B Ratio	See Above	Assem. Weight	75 lbs.
Gain	See Above	Shipping Weight	99 lbs.

WILSON SYSTEMS, INC. — 4286 S. Polaris
Las Vegas, NV 89103 — (702) 739-7401

FACTORY DIRECT ORDER BLANK

CHRISTMAS SPECIAL SALE

Toll-Free Order Number
1-800-634-6898

Qty.	Model	Description	Shipping	Price
	SY40	10 Ele. Tribander for 10, 15, 20 Mtrs.	UPS	337.95
	SY36	6 Ele. Tribander for 10, 15, 20 Mtrs.	UPS	199.95
	SY33	3 Ele. Tribander for 10, 15, 20 Mtrs.	UPS	149.95
	33-6 MK	40 Mtr. Mod Kit for SY33 & SY36	UPS	59.95
	WV-1A	Trap Vertical for 10, 15, 20, 40 Mtrs.	UPS	59.95
	GR-1	Ground Radials for WV-1A	UPS	12.95
	M-420A	4 Elements on 20 Mtrs.	UPS	174.95
	M-515A	5 Elements on 15 Mtrs.	UPS	139.95
	M-520A	5 Elements on 20 Mtrs.	TRUCK	224.95
	M410A	4 Elements on 10 Mtrs.	UPS	74.95
		ACCESSORIES		
	T²X	Tail Twister Rotor	UPS	274.95
	HD-73	Alliance Heavy Duty Rotor	UPS	109.95
	RC-8C	8/C Rotor Cable	UPS	18¢/ft.
	RG-8U	RG-8U Foam Coaxial Cable — Ultra Flex center conductor, 11 guage	UPS	28¢/ft.
	EW-45	Wilson Electric Winch for TT-45B	UPS	249.95
	EW-61	Wilson Electric Winch for MT-61	UPS	249.95
	EW-77	Wilson Electric Winch for ST-77	UPS	249.95

Qty.	Model	Description	Shipping	Price
	RM-1	Remote Switch for EW	UPS	24.95
	TT-45B	Freestanding 45′ Tubular Tower	TRUCK	349.95
	RB-45B	Rotating Base for TT-45B w/tilt over feature	TRUCK	234.95
	FB-45B	Fixed Base for TT-45B w/tilt over feature	TRUCK	169.95
	MT-61B	Freestanding 61′ Tubular Tower	TRUCK	579.95
	RB-61B	Rotating Base for MT-61B w/tilt over feature	TRUCK	309.95
	FB-61B	Fixed Base for MT-61B w/tilt over feature	TRUCK	244.95
	ST-77B	Freestanding 77′ Tubular Tower	TRUCK	994.95
	RB-77B	Rotating Base for ST-77B w/tilt over feature	TRUCK	463.95
	GK-46	Guying Kit for GT-46	UPS-TRK	74.95
	GK-45B	Guying Kit for TT-45B	UPS-TRK	69.95
	GK-61B	Guying Kit for MT-61B	UPS-TRK	79.95
	GK-77B	Guying Kit for ST-77B	UPS-TRK	99.95
	WTB-1	Thrust Bearing for Top of Rotating Towers	UPS-TRK	59.95

NOTE:
On Coaxial and Rotor Cable, minimum order is 100′ and 50′ multiples.
Prices and specifications subject to change without notice.
Ninety (90) Day Limited Warranty—Shipping Not Included in Above

Christmas Prices Effective Nov. 1-Dec. 31, 1980 — Nevada Residents add Sales Tax

Ship C.O.D. ☐ Check enclosed ☐ Charge to VISA ☐ MasterCharge ☐

Card No. ____________________ Expires ________

Bank No. ____________ Signature ____________

Name ____________________ Phone ________

Street ____________________

City ____________ State ______ Zip ______

Prices and specifications subject to change without notice.

William L. Thomas WB9KPT
3485 Bayberry Drive
Northbrook IL 60062

Teletext and Viewdata: Are You Ready for the Information Boom?

—coming soon to a living room near you: video data services

Specially equipped TV receivers are now available to provide us with current weather, sports, news headlines, tonight's television shows, local events of interest, and many other interesting bits and pieces of information. The magic word in this scenario is *information*. Almost anything of general interest can be formatted and sent to your home by the systems to be described in this article.

In England, a set-top adapter currently available for this service is priced at $250. The cost of the LSI integrated circuits that will form the heart of these adapters is less than $50. I feel that there is the possibility of adapting this hardware, which will be produced in large volume for consumers, for use on the ham bands.

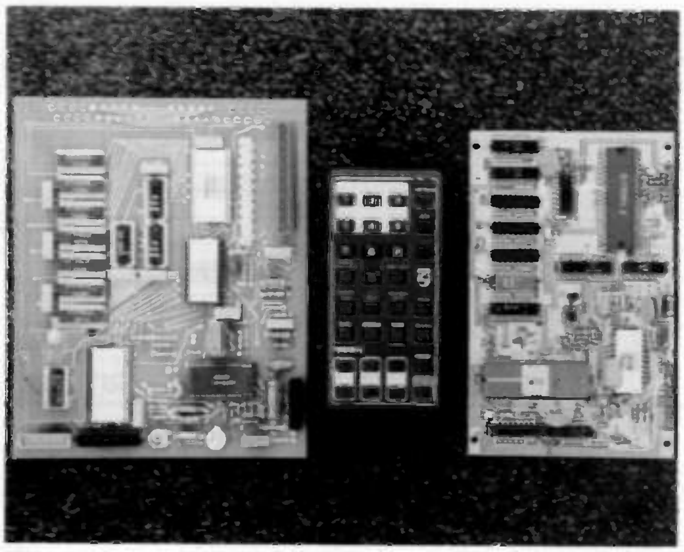


Photo A. Typical teletext hardware. Left to right: Mullard module, remote control, and Texas Instruments module.

Teletext is a generic term for television-based systems broadcasting pages of information along with the normal TV signal. This information is digitally encoded and sent during the vertical-retrace interval when the scan of your TV receiver is off screen. What the viewer sees on the screen of his teletext TV is a page of characters, 40 in a row, 20 to 24 rows, 800 to 960 characters per page. These characters can be presented in eight colors, including colored backgrounds. Included in the character set are all the letters of the alphabet (both uppercase and lowercase), numbers, punctuation marks, special symbols, and graphics. The graphics can be as simple as 64 special graphic symbols, called mosaic graphics, or higher density if one is willing to pay the price.

Each page is identified by a page number and typically will be displayed on the screen in less than a minute after the desired number is entered via the keypad. Several hundred pages can be transmitted in less than a minute in a serial fashion, one page after another. The teletext adapter grabs the appropriate page as it comes by and immediately displays the selected page on the screen. Index pages are provided to help the consumer determine pages of interest.

Where does all this information come from and why does the broadcaster want to transmit it to your home? One way to answer this question is to consider teletext as a new publishing medium. As advertising supports most mass-market publishing efforts, so would it play in this one. As an interesting example, the news headlines could be brought to you by your local paper in an effort to sell you today's edition containing more details on the stories. It is expected that most pages broadcast by commercial TV stations would include such advertising.

On the public TV stations, information would be financed by the same sources that contribute to their normal program funds. Obviously, most major corporations and many government agencies have much material that would be suitable for this system of distributing information. Many data bases already exist and are being made available to hobbyists with home computers via dial-up telephone networks. Much of this information is directly presentable on teletext systems. There seems to be no lack of available material, and there are many organizations willing to finance its presentation.

Now that we have the information, how does it get from the source to your home? To begin with, the desired page is composed within the display format specification previously highlighted. If this composing is not done directly in the broadcaster's studio, it probably will be sent to him either over the telephone line or in the form of a digital cassette or floppy disk (i.e., in computer-compatible form). At the station, this data is loaded into a piece of apparatus which encodes it into a digital *serial* data signal. This signal is appropriately filtered (bandlimited) and inserted in unused scan lines during the vertical retrace portion of the current video signal being broadcast. A decoding apparatus connected to your TV will accept this special signal and when the requested page is being transmitted, will grab it and load it into a television display memory. The pages are transmitted row by row, one page after another, and then the whole sequence is repeated. Hence, if the page you requested had just been sent, you will have to wait while all the other pages are sent—until the sequence cycles back to your page.

Photo B. Prestel page. Both teletext and viewdata pages will look like this.

Since the television broadcast system deals with analog and not digital signals, special precautions have to be taken with both the broadcast and reception equipment. The digital signal leaving the studio encounters many places where distortion can occur. Some of these are in the studio-to-transmitter link, the transmitter, in reflections caused by large objects, in your TV antenna and lead-in, and in the television receiver and decoder input circuitry. All these effects are being considered by the organizations trying to propose standards in this country.

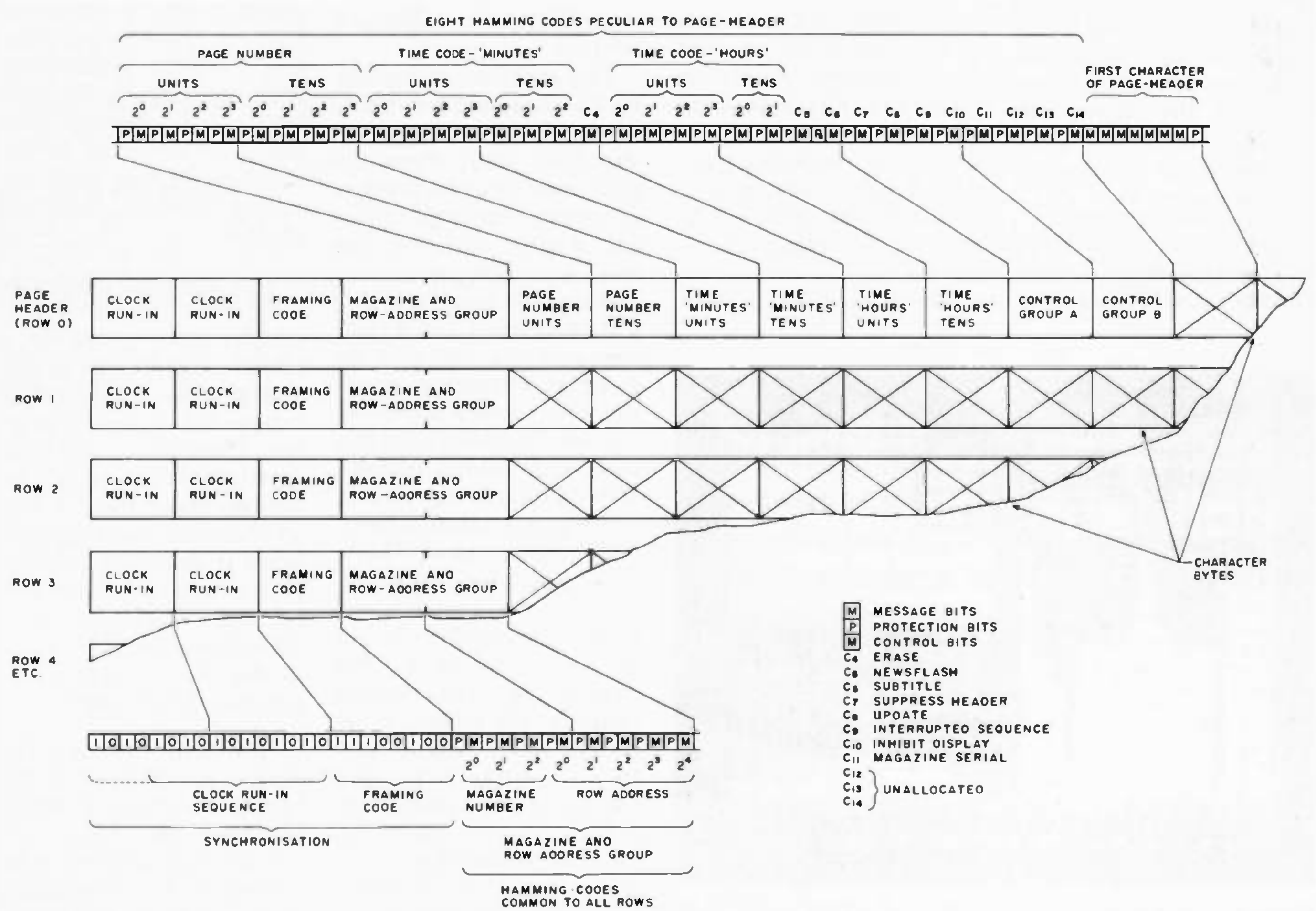


Fig. 1. Transmission format for British teletext.

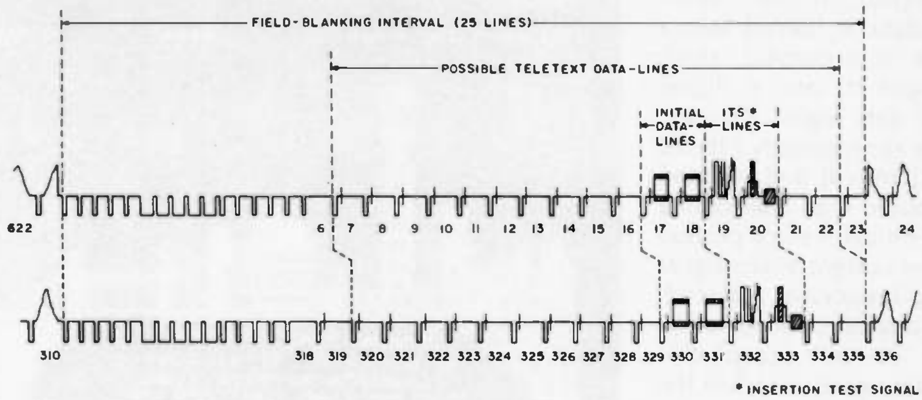


Fig. 2. Insertion of teletext signal in 625-line video signal.

Teletext: Current Systems Being Proposed for North American Use

At the present time, there is no standard for the broadcast of teletext in North America. In Europe, there are systems in place and regularly broadcasting, with the largest number of receivers in England. There currently are three major contenders for teletext standards in this part of the world: 1) British teletext, 2) French Antiope, and 3) Canadian Telidon proposals. Also, a system called Captions for the Deaf (CFD) should be mentioned since it shares some similar characteristics.

The British teletext system is probably the simplest because it has a fixed-transmission format. This is likely to lead to the cheapest decoder design, which is important in the consumer product marketplace. There are two names by which these systems are identified. The British Broadcasting Corporation (BBC) has called its system Ceefax. The Independent Broadcasting Authority (IBA) calls its version Oracle.

The French system, Antiope, is based on packets of data which are efficient representations of only the displayed characters on any page. On pages sparsely covered, the Antiope system requires less time to transmit than British teletext. On full pages, this is not the case.

The Canadian system, Telidon, proposes a generalized technique for transmitting higher resolution graphics displays. As mentioned earlier, the basic graphic character set is 64 mosaic symbols. Originally, this was proposed as a way of improving the appearance of the primarily text-oriented displays. However, as more experience has been gained, the graphics feature has been found to be a very useful and definitely desirable aspect of teletext.

The approach suggested by the Canadians is to transmit Picture Description Instructions (PDI). These instructions describe images in terms of basic geometrical shapes. Included are line, arc, polygon, point, and area. To describe a line, a starting point and a final displacement are sent instead of characters corresponding to each section of the line. Decoders could be built with various degrees of resolution in the display, with higher resolution being more costly. Most likely, these would have to be microprocessor based, since software algorithms would be needed to "draw" the shapes into the display memory. The minimum decoder, which would perform similarly to the 64-character mosaic approach, likely would be more expensive than a system which is tailored only for simple graphics. However, the appeal of high-resolution graphics is likely to influence system development in this country also.

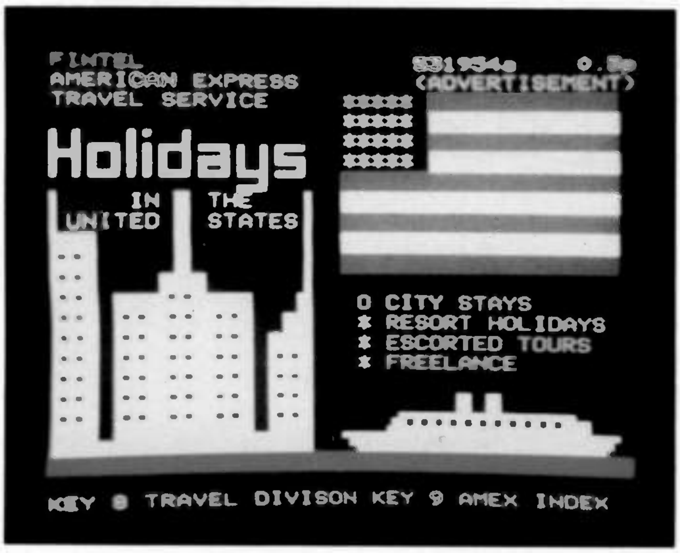


Photo C. Interested in a holiday? The cost of this page was .5 pence (about one cent).

Captions for the Deaf is a system intended primarily for sending captions for hearing-impaired viewers. As such, much lower data rates are adequate (about 10 times slower). As one provision of the system, called info-text, 15 lines of 32 characters can be displayed. Currently, the FCC has authorized the use of TV scan-line 21 for this purpose. All the teletext systems have provision for captioning services, including foreign language subtitles.

British Teletext: A Detailed Description

To make these systems affordable for the consumer, several LSI integrated circuits will be required. At the present, these chips are available only for the British teletext system. Several manufacturers including Mullard, Texas Instruments, and General Instruments offer chip sets for this purpose. To understand how these circuits work, a description of the page encoding scheme must be studied.

The standard character set is shown in Table 1. If you are familiar with ASCII coded symbols, you will notice a great similarity between the two character sets. There are several characteristics which should be noticed about this set. The 64-character, mosaic-graphic set is shown in columns 2a, 3a, 6a, and 7a. The digital code which represents these characters is the same as that for the symbols in columns 2, 3, 6, and 7.

How can this be? The answer is contained in the first two columns (0 and 1) of *control characters*. Each row of displayed text is assumed to be transmitted under an initial set of conditions shown in Table 1. The "alpha" control characters tell the decoder to use 2, 3, 6, and 7, or, for "graphics" characters, to use 2a, 3a, 6a, and 7a. Therefore, as an example, it is impossible to mix lowercase letters and mosaic graphics without sending a control character to switch the character set. All control characters are displayed as spaces.

In the British system, 24 rows of text are transmitted per page. The first row is special and is given the name *page header*. It includes 32 characters to be displayed and special page descriptors which are not displayed. All other rows have 40 characters. See Fig. 1, which shows the makeup of these rows. Each row starts with a *clock run-in* and *framing* code for hardware synchronization. Then the *magazine* (0-7) and row *address* (0-23) are sent. (The three-digit *page* number can be from 0 to 799 with the most significant digit being referred to as the magazine number.) Finally, 40 characters are sent. The page-header row has the page number, time code, and special control bits followed by 32 characters. The magazine, row address, page, time code, and control bits all are encoded with special protection bits forming a Hamming code. This code is made up of *message* and *protection* bits shown in Table 2. The other characters use a single bit, b8, to form *parity*. Parity refers to the number of bits which are equal to 1; in this case, an odd number is sent for protection purposes.

b7 b6 b5 →						0 0 0	0 0 1	0 1 0		0 1 1		1 0 0	1 0 1	1 1 0		1 1 1	
Bits	b4	b3	b2	b1	Col / Row	0	1	2	2a	3	3a	4	5	6	6a	7	7a
	0	0	0	0	0	NUL (1)	DLE (1)			0		@	P	—		p	
	0	0	0	1	1	Alpha^n Red	Graphics Red	!		1		A	Q	a		q	
	0	0	1	0	2	Alpha^n Green	Graphics Green	"		2		B	R	b		r	
	0	0	1	1	3	Alpha^n Yellow	Graphics Yellow	£		3		C	S	c		s	
	0	1	0	0	4	Alpha^n Blue	Graphics Blue	$		4		D	T	d		t	
	0	1	0	1	5	Alpha^n Magenta	Graphics Magenta	%		5		E	U	e		u	
	0	1	1	0	6	Alpha^n Cyan	Graphics Cyan	&		6		F	V	f		v	
	0	1	1	1	7	Alpha^n White (2)	Graphics White	'		7		G	W	g		w	
	1	0	0	0	8	Flash	Conceal Display	(		8		H	X	h		x	
	1	0	0	1	9	Steady (2)	Contiguous Graphics (2)	)		9		I	Y	i		y	
	1	0	1	0	10	End Box (2)	Separated Graphics (2)	*		:		J	Z	j		z	
	1	0	1	1	11	Start Box	ESC (1)	+		;		K	←	k		¼	
	1	1	0	0	12	Normal Height (2)	Black Background (2)	,		<		L	½	l		||	
	1	1	0	1	13	Double Height	New Background	-		=		M	→	m		¾	
	1	1	1	0	14	SO (1)	Hold Graphics	.		>		N	↑	n		÷	
	1	1	1	1	15	SI (1)	Release Graphics (2)	/		?		O	#	o		■	

(1) These control characters are reserved for compatability with other data codes

(2) These control characters are presumed before each row begins

Codes may be referred to by their column and row e.g. 2/5 refers to %

□ Character rectangle

Black represents display colour

White represents background

Table 1. Teletext character codes. Notice the similarity to ASCII.

From Fig. 1, you will find that there are 360 bits (or 45 bytes) per row. All these bits (one row) are transmitted on one horizontal scan line during the vertical blanking interval. As shown in Fig. 2, lines 17, 18, 330, and 331 are used by the British in their 625-line television system. Since only two lines are transmitted per field, it takes 12 fields (6 frames) to send a page of text. To transmit 360 bits, a rate of 6.9 Mbits/sec is used. This raises compatibility questions for use in this country where we have different TV standards.

The decoder chip set functions in real time as the data is received. On each line, bit synchronization is achieved using the clock run-in, and then word synchronization is determined with the framing code. Next, the magazine and row address are grabbed and Hamming decoded. In the page header row, additional Hamming encoded data are processed. For the character bytes, the parity is checked and, if correct, the character bytes are loaded into display memory. During the display time, these characters are read out of memory and, using a color-character generator, are shown on the screen. The user specifies the desired page by punching data into the chip set via a small hand-held keyboard.

Viewdata: Telephone Systems

A similar service is possible using telephone line, two-way communications. Instead of serially broadcasting a fixed set of pages, the user asks for specific

Photo D. Visiting New York? Check out some options for your stay.

pages from a large data base. In England, there are currently over 150,000 pages on their Prestel system. (See "The Ultimate Consumer Computer," by Derfler, *Kilobaud Microcomputing*, October, 1979.) The main difference from teletext is that only the pages you request are sent. This gives apparent immediate access to a very large amount of information.

The catch in using this system is a financial one. Since you are in direct communications with a computer, it is very easy to charge you for this information on a page-by-page basis. However, with each

MESSAGE BITS

b_8	b_7	b_6	b_5	b_4	b_3	b_2	b_1
0	0	0	1	0	1	0	1
0	0	0	0	0	0	1	0
0	1	0	0	1	0	0	1
0	1	0	1	1	1	1	0
0	1	1	0	0	1	0	0
0	1	1	1	0	0	1	1
0	0	1	1	1	0	0	0
0	0	1	0	1	1	1	1
1	1	0	1	0	0	0	0
1	1	0	0	0	1	1	1
1	0	0	0	1	1	0	0
1	0	0	1	1	0	1	1
1	0	1	0	0	0	0	1
1	0	1	1	0	1	1	0
1	1	1	1	1	1	0	1
1	1	1	0	1	0	1	0

HAMMING CODE BYTES

PROTECTION BITS (b_7, b_5, b_3, b_1 shaded)

Table 2. Hamming protection of four-bit binary values.

user having a unique access code, there are also advantages such as the possibility of having a complete shop-from-home service. With so many pages of information, a user normally would refer to a guide to locate pages of interest, or it would be possible to step through menu pages, narrowing the topic as you go. This is described as a tree searching method, where you *branch* into more specific areas.

The hardware for teletext and viewdata is similar. In fact, viewdata adapters are based on teletext systems with the addition of a microprocessor and telephone modem. Basically, this doubles the cost of the integrated circuits (over a teletext only system).

Prestel: The British Viewdata System

In England, the British Post Office controls all communications for the country. This has helped considerably in allowing them to develop both teletext and viewdata systems with similar standards. From the user's point of view, the text display looks identical for both systems.

The actual communications is accomplished using FSK modulation. The computer sends the characters at 1200 baud (1300 Hz for binary 1 and 2100 Hz for binary 0). The user responds at 75 baud (390 Hz for 1 and 450 Hz for 0) when the keypad is punched.

The character set is the same as that previously described in Table 1, with some additional codes. Some of these codes are cursor controls, page deliminators, and other computer symbols. Since two-way interaction occurs in this system, the keypad requires a few more buttons than the one solely for teletext. Two of these are * and #. These are used as page deliminators. As an example, if page 123 is desired, you would enter *123# directly instead of continuing with branching from page to page.

One nice feature of this system is the automatic dialing of the computer's telephone number. All you need to do is push the viewdata button and the system in the TV does the rest; when the access procedure is completed, the system is ready for your first page request. Many variations on this theme are possible, including a completely automated system that would access data in the middle of the night when phone rates are the lowest and store the information on inexpensive audio cassettes.

Amateur Radio: Possible Applications

Now that I have described these consumer systems, you may be asking yourself how to apply the technology from these systems towards our hobby. In all honesty, I don't have the answer. Even as this is being written, new circuits are being developed which might be applicable for use in an amateur radio system.

In the tradition of amateur radio experimentation, I expect that some pioneers will devise a way to send these pages of information using the ham bands. A system similar to viewdata could be envisioned, since it uses audio bandwidth channels which we already possess. This might be implemented similarly to slow scan, where pages of information (and graphics) are sent instead of pictures. Hopefully, we all can learn quite a bit and have a good time doing it.

Since teletext and viewdata are not yet widely available in this country, getting information normally requires correspondence to Europe. However, there are two publications which I can suggest for those who are anxious to learn more.

"Consumer Text Display Systems (Teletext and Viewdata)," *IEEE Transactions on Consumer Electronics*, July, 1979, volume CE-25, number 3, is available for $15 from IEEE Service Center, 445 Hoes Lane, Piscataway NJ 08854, or from your local library. It is composed of two hundred pages of general articles on the various systems. For the most part, these are not written at a high technical level.

Multitext Technical Information is available for $5, check or money order, from Signetics Corp., Publication Services—Bin 027 MTB, 811 Arques Ave., PO Box 409, Sunnyvale CA 94086. It is a fifty-page brochure describing the Mullard (Signetics) teletext and viewdata chip set and system operation. There are 35 color photographs including many sample text pages. (Only a limited quantity of these brochures is available.)

I would like to thank Neal Williams for arranging the availability of the Multitext brochure and Merv Cox for his photographic work. Several figures were obtained from the *Broadcast Teletext Specification*, jointly published by the BBC, IBA, and BREMA.■

Double-Duty CW Keyboard

—helps you on receive as well as transmit

Robert C. Spindel K1GN
Box 169
North Falmouth MA 02556

Morse code keyboards are a popular station accessory, as witnessed by the numerous designs available.[1] The beautiful, rhythmic sound of near-perfect CW is easy to achieve with these units. Merely striking the keys on a typewriter-type keyboard produces perfectly formed Morse characters.

But sending flawless CW is only half the battle. You have to be able to copy it as well. And with the speed attainable with keyboard units, that means copying at higher rates.

This keyboard has a unique feature to help you receive code accurately so that you can keep up with your ability to send at high speeds. With the flip of a switch, the Morse keyboard becomes, voilà, a tireless instructor sending a continuous stream of random letters or five-letter code groups at any speed.

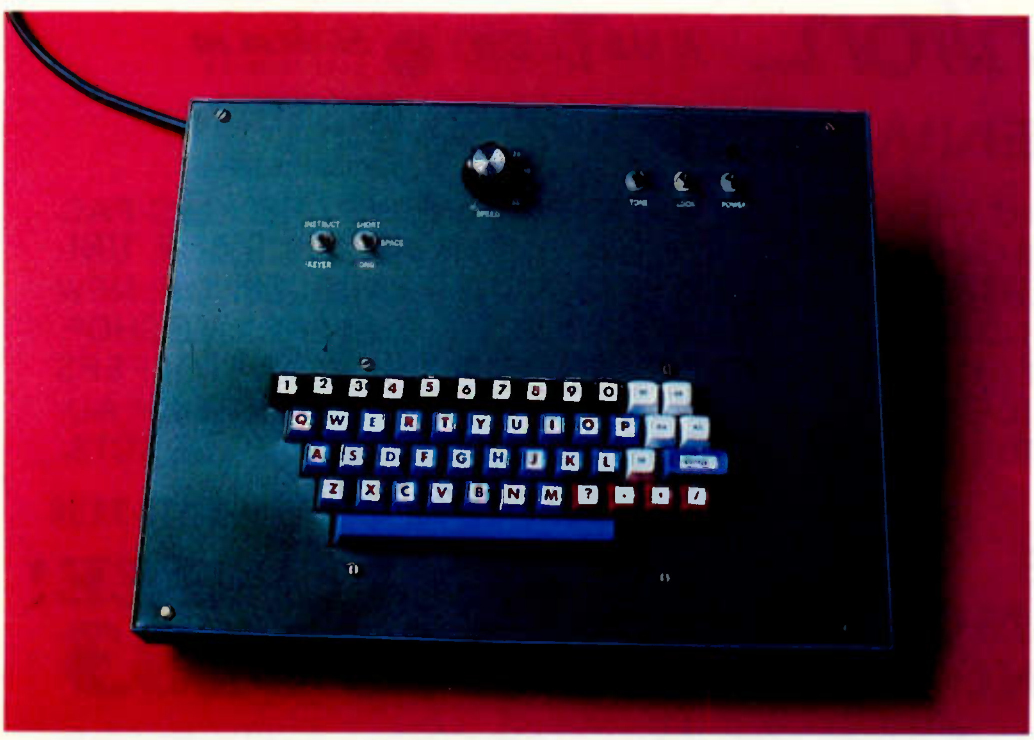


Photo A. The Instructor-Keyboard is built in a homemade case. The front panel is made of galvanized sheet metal painted with spray enamel. The keyboard keys have been relabeled with transfer letters. To the left are the Instruct/Keyer and Space switches; the speed control is in the upper center; to the right are the Tune, Sidetone on-off, and Power on-off switches.

The Instructor-Keyboard is also the perfect device for giving new Novices code practice. Someone who does not know Morse can type to the neophyte, or he can use the Instruct mode to copy random letters. It allows practice at times when W1AW cannot be heard or when a receiver is not available. Since it sends letters randomly, there is no danger of the memorizing of practice material which often limits the usefulness of tapes and records. Needless to say, its utility is not restricted to beginners. A little time spent copying high-speed, random code groups should have you copying W1NJM's transmissions with ease.[2] Switch to the Keyer mode, and you can send at that speed, too.

Although available keyboard designs differ in detail of execution—some employ scanned keyboards while others use diode matrices, some have character buffers and some have message memories—they all operate in the same fundamental way. A single switch closure is used to produce a logic signal. A separate switch is provided for each desired character (letter, number, punctuation, or special symbol such as $\overline{\text{AA}}$, $\overline{\text{AS}}$, $\overline{\text{AR}}$, $\overline{\text{BT}}$, etc.), and the switches are arranged in a standard typewriter format. The operator strikes a series of keys to generate a sequence of characters. The resulting logic signal is used to key a transmitter, FSK converter, sidetone oscillator, or other device. This keyboard uses a diode matrix to encode switch closures into logic signals, and in the Instruct mode it uses hard-wired CMOS digital logic elements to simulate switch closures in a random manner. Thus, the logic replaces the action of the keyboard. In fact, as will be pointed out below, it is quite simple to build the Instructor without the Keyboard, thereby yielding a simple code-practice machine.

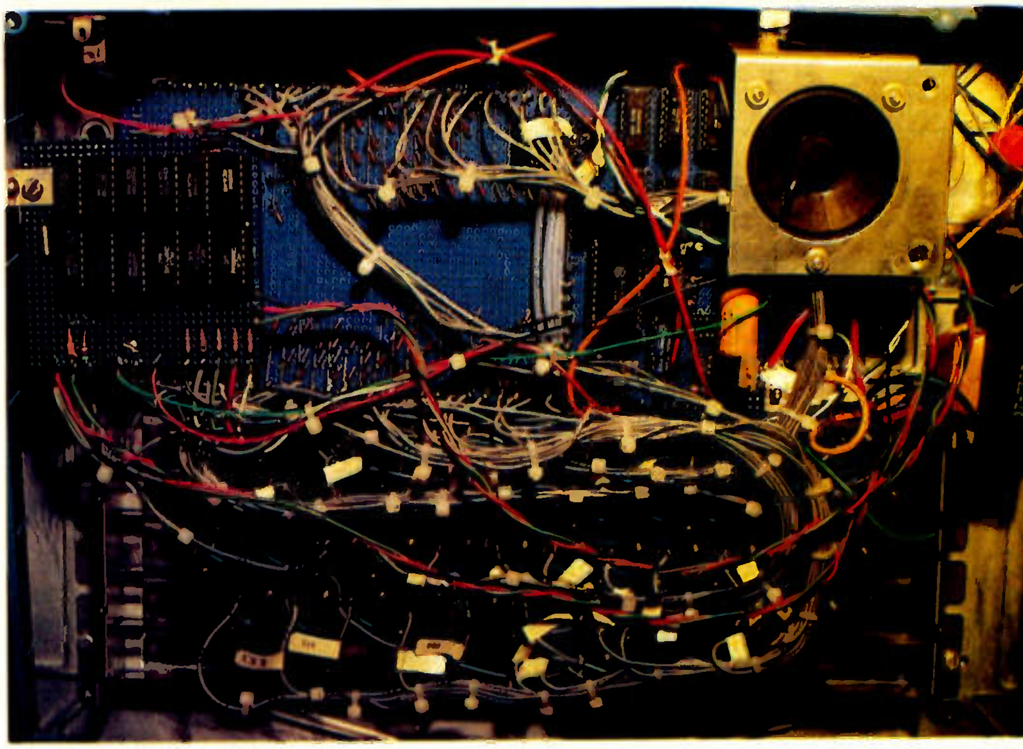


Photo B. Perfboard and wire-wrap sockets are used for the two electronic boards. The diode matrix and keyer are on the lower board. The Instructor electronics are on the smaller board on the left, partially obscuring the diode matrix.

Circuit Features

The Instructor-Keyboard has been designed without unnecessary frills. It is capable of sending all letters, digits from 0 to 9, common punctuation, and special symbols $\overline{\text{AR}}$, $\overline{\text{SK}}$, $\overline{\text{BT}}$, $\overline{\text{AA}}$, and $\overline{\text{AS}}$. It has two-key rollover, which means that a second key can be depressed while the first is held down and, provided the first is released, two successive characters will be sent with perfect inter-character spacing. Holding a single key down will cause that character to be sent repetitively, again with perfect spacing.

The keyboard is completely debounced so that only a single character is sent when a key is struck even though the switches themselves may bounce open and closed for several milliseconds after being struck. Furthermore, the Instructor-Keyboard is constructed from readily-available and inexpensive components. A perusal of the back pages of *73* indicates that the CMOS logic elements should cost less than $15 to $20. Keyboards are available from a number of surplus dealers at reasonable cost.

The digital logic for both Keyboard and Instructor is all CMOS, selected for its tolerance to power-supply variations and its high immunity to electronic noise. I have not observed any rf interference with the operation of the Keyboard even in the presence of my 1-kW linear amplifier.

There are three main subsections in the Instructor-Keyboard. The first is a diode matrix for encoding a switch closure into a unique digital signal representative of the desired character. This is fed to the second subsection, the digital keyer logic, that converts it into appropriate dots and dashes. The third subsection is the Instructor itself. It automatically generates digital signals identical to those created by switch closures so that letters are sent without striking keys. They are also sent without the need for a diode matrix so that an Instructor can be built without the keyboard-matrix combination. By the same token, the unit can be constructed without the Instructor electronics and used as a conventional keyboard.

In the Instruct mode, three spacing options are provided. The Instructor-Keyboard can be set to issue a continuous stream of random letters with the proper three-element intercharacter spacing. Alternatively, random five-letter code groups can be sent with either a long or short pause between groups. Letter spacing within groups is always precisely correct for the speed being sent.

As described below, the Instructor sends only letters. It was felt that sending letters only provided a cost-effective realization of an automatic Morse code generator easily adaptable to many existing keyboards. The unit can be altered to allow automatic generation of numbers and punctuation in the Instruct mode at the expense of an increased parts count.

The Diode Matrix

All characters are encoded into an eight-bit digital word by the diode matrix. The coding scheme is the same as that used by Bryant W4UX and Horowitz W1HFA. A diode is used for each dash, no diode for a dot, and a final diode to signify the end of the character. Diodes are used for dashes because there are fewer dashes than dots in Morse code, thus reducing the number of diodes needed. The first few letters and numbers are wired as shown in Fig. 1. The remaining pattern of diodes should be obvious if it is kept in mind that a diode is wired in place for a dash and also to terminate the character.

The bits in the code word are labeled B1 through B8. Note that with no keys depressed, all bit lines are held high (+12 volts) by a single 10k pull-up resistor on each bit line. Depressing a key (closing a switch) causes only those bit lines connected to the switch by di-

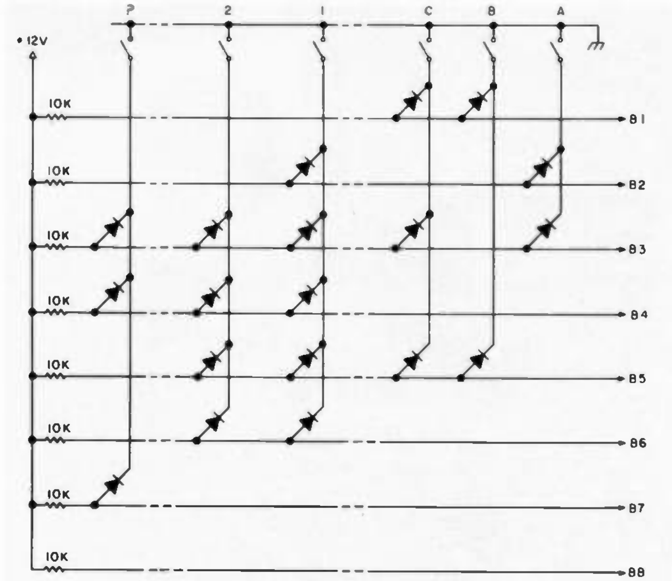


Fig. 1. Wiring diagram for diode matrix. All diodes are general-purpose switching diodes such as 1N914s. If constructed as an Instructor only, diodes are not needed, but the 10k pull-up resistors should be connected to all bit lines.

odes to be forced to ground (0 volts). Thus, the pattern of bits appearing on B1 through B8 for the letter A will be 10011111 where we have used a 1 to denote a high voltage level and a 0 to denote a low, or zero, level. Depressing the B key will create the pattern 01110111, and a question mark will be 11001101. These are the unique digital codes that the keyer portion of the unit translates into appropriate dots and dashes. Incidentally, these are the codes that the Instructor portion of the unit also must simulate.

The Keyer

The heart of the keyer consists of an 8-bit parallel-to-serial (P/S) shift register, IC9, dot-dash generator flip-flops IC7a and IC7b, and an end-of-character recognizer, IC6. Additional logic is used to debounce the keyboard and to insert a proper space between characters. This space is exactly three code elements long (a dot is two elements long) as required in Morse code. A dash is four elements long (three on and one off). Interword spacing is seven elements in length.

Detailed operation of the keyer logic can be deduced from one of the excellent manufacturer's data books on CMOS logic. The following is a brief explanation of the general sequence of events that occurs after a key is closed.

The bit pattern, or code produced by the diode matrix, is inverted by IC5 and part of IC1 so that the letter A becomes, for example, 01100000. The shift register accepts this code on its 8 input lines and immediately transfers it to its output lines if the P/S line is high and if the A Enable (AE) line is high. When AE is low, the input lines are disabled and information present on them is ignored. This feature is used to debounce the keyboard. Now, when the P/S line is low, input data is ignored similarly, but the register is converted to its serial mode. Data stored in the register then can be clocked out by pulses applied to the CLK input.

Each positive transition of the clock signal transfers the bit pattern one step through the register. Bits at the top (IC9-1) "fall out," while the empty spaces at the bottom of the register are filled with whatever signal is present on the serial-input (SI) line. Since this pin is grounded, as the bits are shifted through the register they are replaced by zeros at the bottom. The bit present on IC9-1 turns the dash flip-flop on and off depending on whether it is high or low, respectively. Meanwhile, IC6 constantly monitors the status of the output lines of the register in order to detect an end-of-character condition. When an end-of-character occurs, the lines monitored by IC6 are all low, its output goes high, thus terminating keyboard output through IC1 and IC3b. At this time, IC9-1 will be high since a diode has been inserted at the end of each character. One more clock cycle makes this low and IC3a turns the shift register back into its parallel mode allowing it to accept a new code word, the next character. This extra clock cycle ensures that there will be a three-element space between successive characters.

Note that in its idle state the keyer logic has the code word 00000000 on the output lines of IC9. The inputs to IC6 are low; its output is therefore high. Upon striking a key, at least one of the bits at the output of IC9 goes high so that the output of IC6 goes immediately low. This triggers the one-shot, IC4, and it responds with a 2-ms pulse which is applied to the AE input of IC9. It has the effect of disabling the input lines of the register for sufficient time to allow all contact bounce to subside.

The keyer clock is a simple oscillator made of two CMOS inverters. With the parts values shown, the speed is adjustable from about 5 to 50 wpm. Variation of speed in either direction can be achieved by changing the value of the 10k resistor or the 1-uF capacitor. The sidetone oscillator also is constructed with two inverters, and gives an approximate 700-Hz tone. The output of the sidetone oscillator is gated on and off by the keyer through IC3c and is then applied to Q1. Q2 drives a small relay to key a transmitter. S1 closes the relay for tune-up purposes. If desired, a solid-state keying circuit can be substituted for the relay; a reed relay, however, is fast enough to follow 60-wpm keying and allows the keyboard to be used with virtually any transmitter. To prevent relay sticking with those transmitter keying circuits that draw more than a few milliamps, it often is a good idea to place a 20- to 50-Ohm resistor in series with the output line.

The Instructor

A careful examination of the digital code words produced by the diode matrix for the 26 letters of the alphabet indicates that they use only bits B1 through B5. These five bits allow 32 combinations of zeros and ones. Now, a five-bit binary counter will count sequentially from 0 to 31 and in the course of doing so will present at its output every one of the 32 possible bit combinations. If we devise circuitry to select only the 26 output states corresponding to the letter codes, and then apply the output of the counter to the B1 through B5 input lines of the keyer, the counter will effectively act as a substitute for the keyboard and diode matrix. If the counter is clocked slowly, the keyer will generate a sequence of letters corresponding to the bit codes at the output of the counter and will repeat this sequence ad infinitum.

In order to generate letters in a random sequence with no repetitions, binary counter IC9 is clocked at a frequency that is high compared to keying speeds.

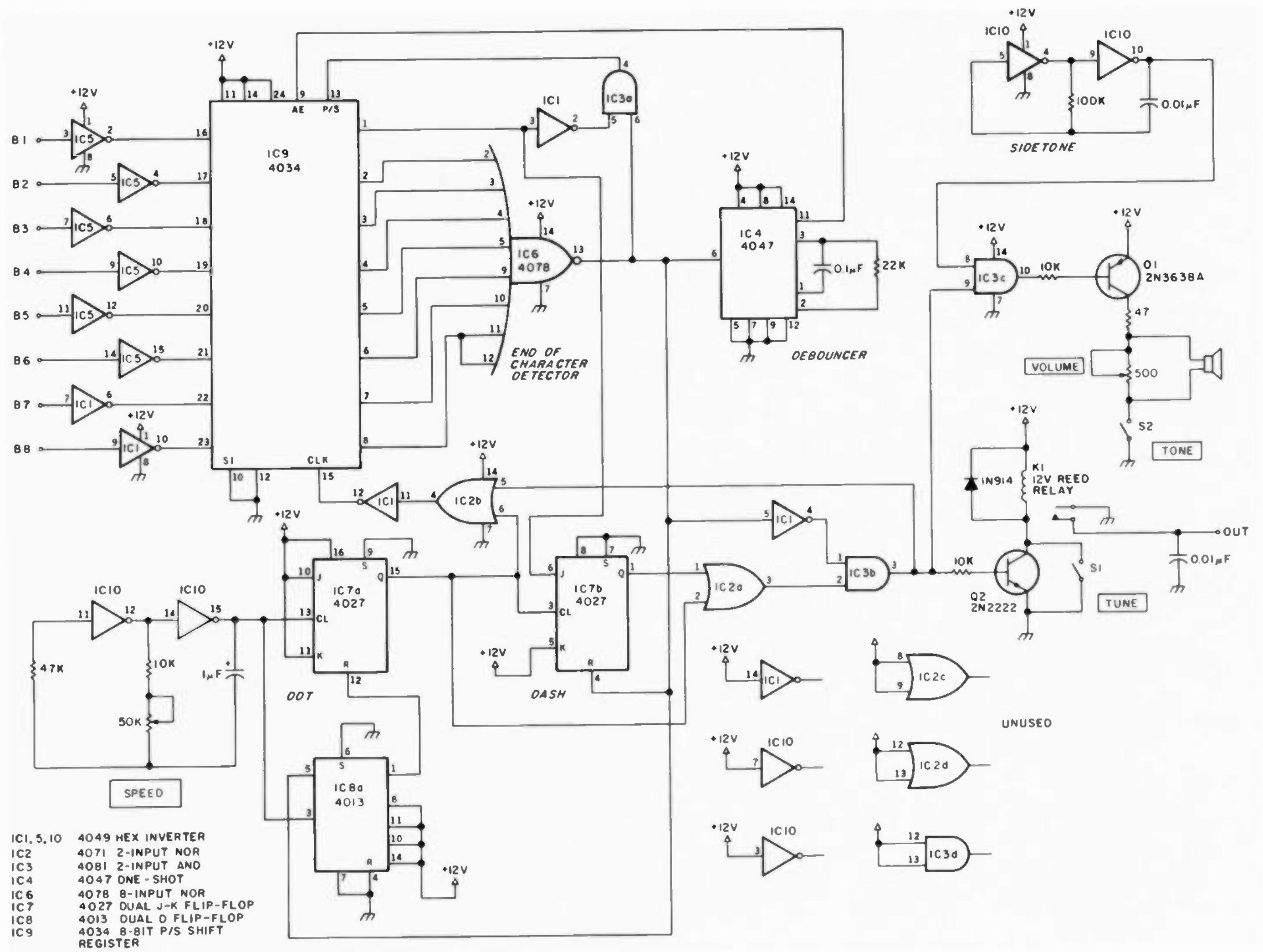


Fig. 2. The keyer subsection uses CMOS integrated circuits. All unused CMOS gate inputs are tied to 12 volts as recommended by the manufacturer. Q1 and Q2 are general-purpose transistors, and many substitutions will work.

NOR gates IC6a and IC6b are wired as inverters to form a CMOS oscillator running at about 700 Hz (60 wpm corresponds to about 25 Hz). Thus, a new bit code appears at the output of the counter every 1/700 of a second.

The keyer logic responds to whatever code is presented to it, generates the appropriate letter, and returns to its ready state. Because the generation of the letter is slow compared with the speed of the counter, the counter has counted from 0 to 31 many times during the time it takes for a letter to emanate from the keyer. The code present at the input of the keyer upon completion of the letter will therefore be a function of the letter length, the frequency of the counter oscillator, and the frequency of the keyer oscillator. Since these are unrelated quantities, the bit code present at the counter output when the keyer is ready to generate a new letter will be independent of the bit code of the previously generated letter. Thus, random letters are generated.

Only 26 of the 32 possible counter states represent valid letters. Rather than detect these 26 states, we detect only the 6 states that are invalid and disable the Instructor output if one of these should occur. In fact, we need detect only 5 illegal states since the state 11111 corresponds to the condition of the keyer with no keys depressed and no output will ensue. Logic gates IC2, IC3, IC4, and IC1a and IC1b comprise the unwanted-state detector. The output of IC2d goes high whenever one of the forbidden states occurs. This high is passed through IC6a and IC6b and holds the register, composed of D-type flip-flops IC10A, IC11, and IC12, in a set mode. That is, the output lines of the register are held high (11111), which is equivalent to having no keys depressed. No letter is generated. For all other combinations of B1 through B5, a letter is sent. There is no apparent pause in the output of the Instructor since new combinations of bits are created every 1/700 second.

Switch S1 in Fig. 3 allows the Instructor to be turned off by holding the register in a continuously high, or set, mode. The keyer may then be activated by the keyboard and diode matrix. When S1 is grounded, the Instructor sends random letters in a continuous sequence. In its middle position, S1 is connected to the output of one-shot IC7. IC8 is wired as a four-bit counter that is clocked by the P/S line of the keyer. Since the P/S line goes from low to high after the generation of each letter, IC8 is clocked one count. When four letters are counted, the one-shot is triggered and its output goes high for a period of time determined by R1, R2, and C1. This high disables the D flip-flop register by setting it. The fifth letter is completed, but a new one is not generated until IC7 goes low. This period of silence can be made long, short, or nonexistent depending upon the position

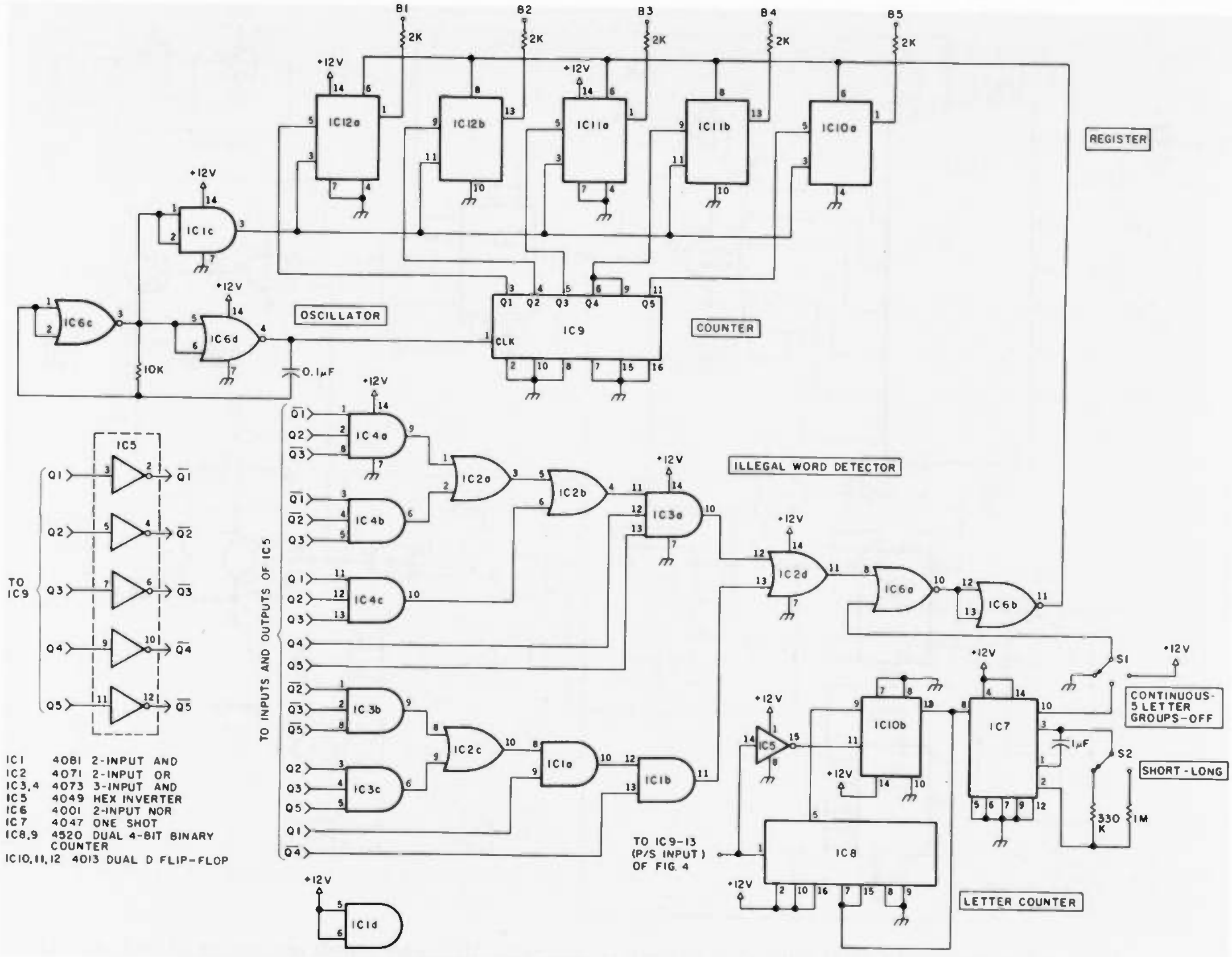


Fig. 3. The electronics of the Instructor. Not all connections are shown to avoid confusion in the diagram. All points labeled Q1 to Q5 are connected together. Similarly, all those labeled $\overline{Q1}$ to $\overline{Q5}$ are connected together. All unused CMOS gates are tied to 12 volts.

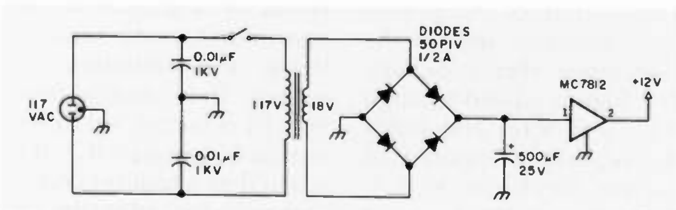


Fig. 4. The power supply is not critical, and any voltage from 5 to 12 will work.

of S2.

Construction

Parts placement and inter-component wiring are not at all critical. I prefer to use wire-wrap techniques for digital logic circuits because it is fast and reliable. All the wiring can be completed in an evening or two. Care should be exercised in construction of the diode matrix, if it is included. With so many diodes, it is easy to make an error. However, troubleshooting, if required, can be accomplished with simple equipment. A voltmeter will indicate high or low states or an LED driven by a transistor will serve the same purpose. One of these simple tools will allow diagnosis of almost any possible problem.

The power supply is not critical. I chose to use a 12-volt regulator (Fig. 4), but anything from 5 to 12 volts will work and regulation is not necessary. It is a good idea, though, to filter the power supply adequately. Oscillators like the keyer clock have a tendency to synchronize with power supply ripple. If this occurs, speeds will appear to jump from one to another as the speed control is rotated, rather than to vary smoothly.

Variations

The Instructor portion of the circuitry can be used as is with many existing keyboards, and can be adapted simply for use with others. If the coding scheme in your keyboard uses diodes for dashes and character termination and operates from 5 to 12 volts, just connect the Instructor directly to it. If you can identify a portion of your keyboard logic that produces a low-to-high transition after each letter, connect it to IC8-1. If you cannot find such a point, leave out IC7, IC8, and IC10b. Then switch S1 to ground for continuous letter generation or to 12 volts for resumption of normal keyboard operation.

With keyboards that use other coding schemes, the illegal-logic-state detector must be modified. This should not prove to be difficult once it is understood exactly how the detector works. If, for example, your existing keyboard uses diodes for dots instead of dashes, simply reverse all $\overline{Q1}$ to $\overline{Q5}$ and Q1 to Q5 leads. Other coding schemes will require similar simple changes.

As mentioned above, the Instructor-Keyboard also can be constructed without the keyboard or diode matrix and used as an Instructor alone. Simply construct keyer and instructor electronics as shown in the figures and attach 10k pull-up resistors to lines B1 to B8 of Fig. 2.

Numbers and punctuation can be added to the Instructor's vocabulary, if desired. However, this will require the addition of extensive detection circuitry to eliminate unwanted codes. In order to accommodate these additional characters, a total of 8 bits in a code word is needed. There are 256 combinations of zeros and ones in an 8-bit word, but the Instructor uses only a small number of them. Thirty-six are needed for letters and numbers. Adding a comma, question mark, and period gives 39; special symbols will add a few more. In this case, we would have to detect 217 illegal words (ignoring special symbols which are not really needed for practice). It would undoubtedly be easier to detect the 39 legal ones, allow them to be passed through the register to the keyer, and reject all the rest. To do this, one simply would invert the output of the detector logic at IC6b. IC9 would have to be wired as a full 8-bit counter and two more D flip-flops would have to be added to the register. ■

References

1. Bryant, "Touchcoder II," *QST*, July, 1969; Horowitz, "Compucoder," *QST*, June, 1975; Crom, "This Station Plays Beautiful CW," *73*, March, 1979; Helfrick, "An Inexpensive Morse Keyboard," *QST*, January, 1978. These articles contain additional references.
2. Hart, "High Speed CW, Anyone?" *QST*, June, 1979.

Sixteen Channels of Digital Delight

— do-it-yourself data acquisition

Chris Bowick WB4UHY
1498 Holland Street
Melbourne FL 32935

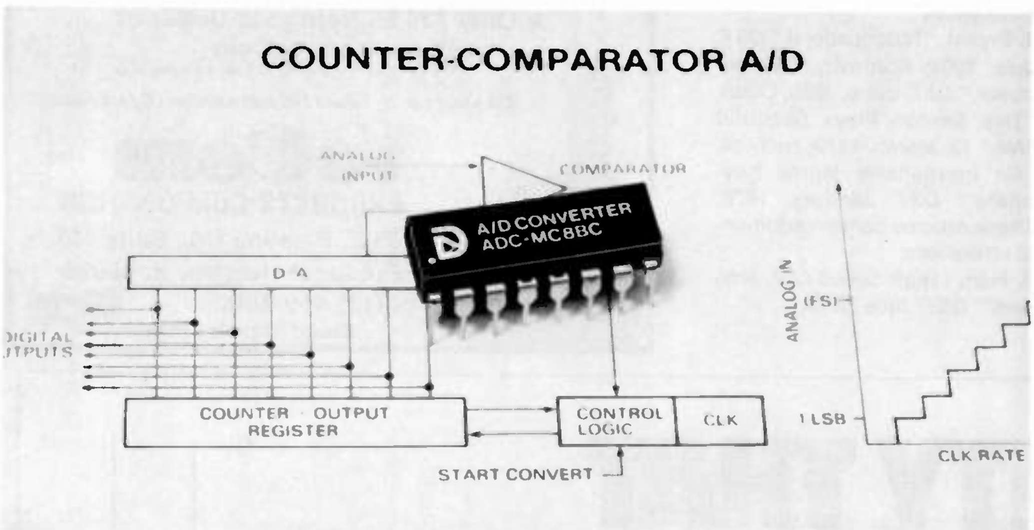


Photo A. A good, low-cost 8-bit A/D made by Datel. Its output coding is in binary, it runs off 5 volts, and it has a conversion time of only 500 µs. Its current selling price is about $8.00. (Photo courtesy of Datel)

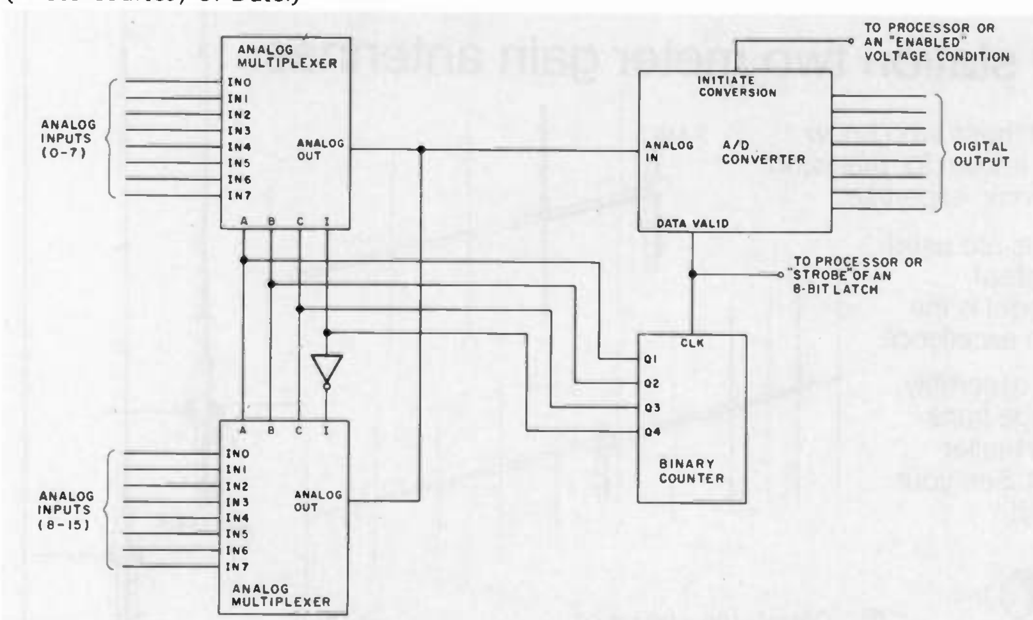


Fig. 1. A block diagram of a complete 16-channel DAS that you can build with almost any A/D converter on the market today.

In my last article on A/D conversion (November, 1980), I covered some theory to help you understand the principles. Now we'll put that knowledge to work and build a complete 16-channel Data Acquisition System (DAS—a 16-channel A/D converter).

Background

A portion of my last article dealt with the process of choosing the right A/D for a specific function. The gist of that section was that there are literally hundreds of A/D converters on the market today, and choosing the right one for your needs could be quite a difficult process if you don't know what to look for. The average hobbyist just does not need extreme accuracy or extremely fast conversion times. He is looking for an A/D which: (1) runs on common supply voltages, (2) covers the needed analog input range, and (3) has a digital output which is compatible with his interface circuitry.

There are quite a few low-cost A/D converters on the market which should satisfy most any hobbyist (see Photos A and B). But the purpose of this article is to show you how you can use that A/D to build a complete 16-channel DAS.

What is a DAS?

We know from my previous article that an A/D takes a single analog voltage and converts it to digital form. There are a lot of different conversion processes possible and a few different digital-coding techniques utilized in various A/D converters, but the end result is always the same—some kind of digital word representing the analog voltage level present at the A/D's input. This is just fine, but what if there were several different analog voltages which we wanted to digitize? Of course, if we had 16 different analog voltage levels to measure, we could go out and buy 16 A/D converters and wire

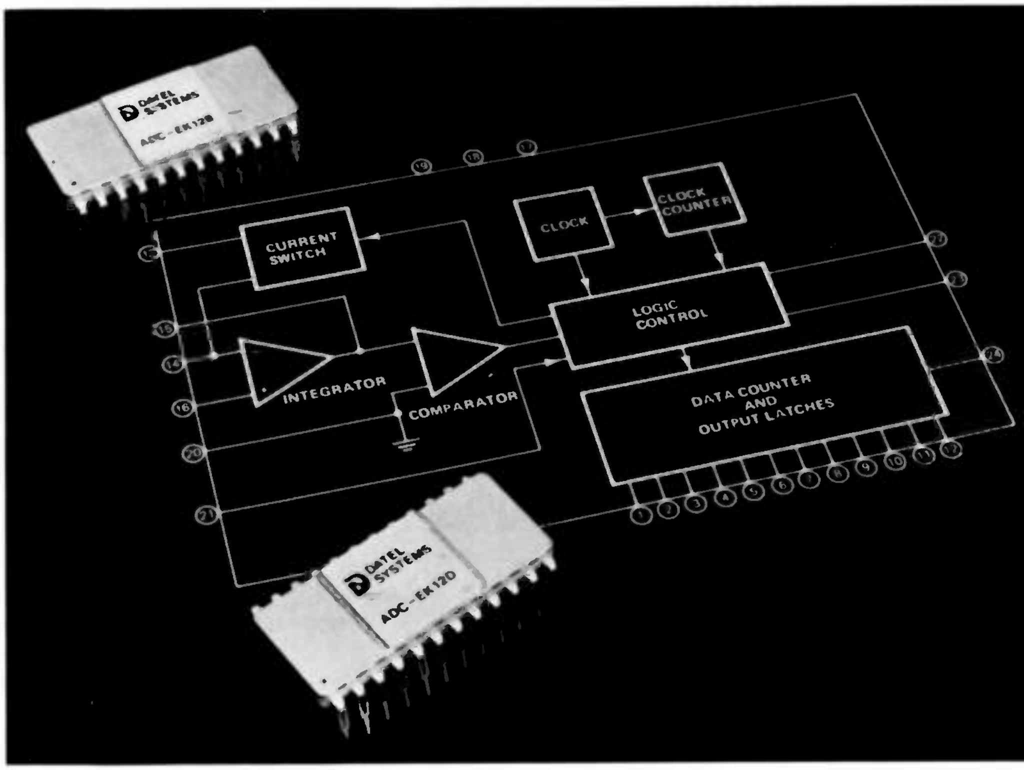


Photo B. Another Datel device which is a bit more expensive ($34.00). It is a 12-bit binary or 3½-digit BCD coded A/D converter, and it runs off ±5 volts and has a 20-ms conversion time. (Photo courtesy of Datel)

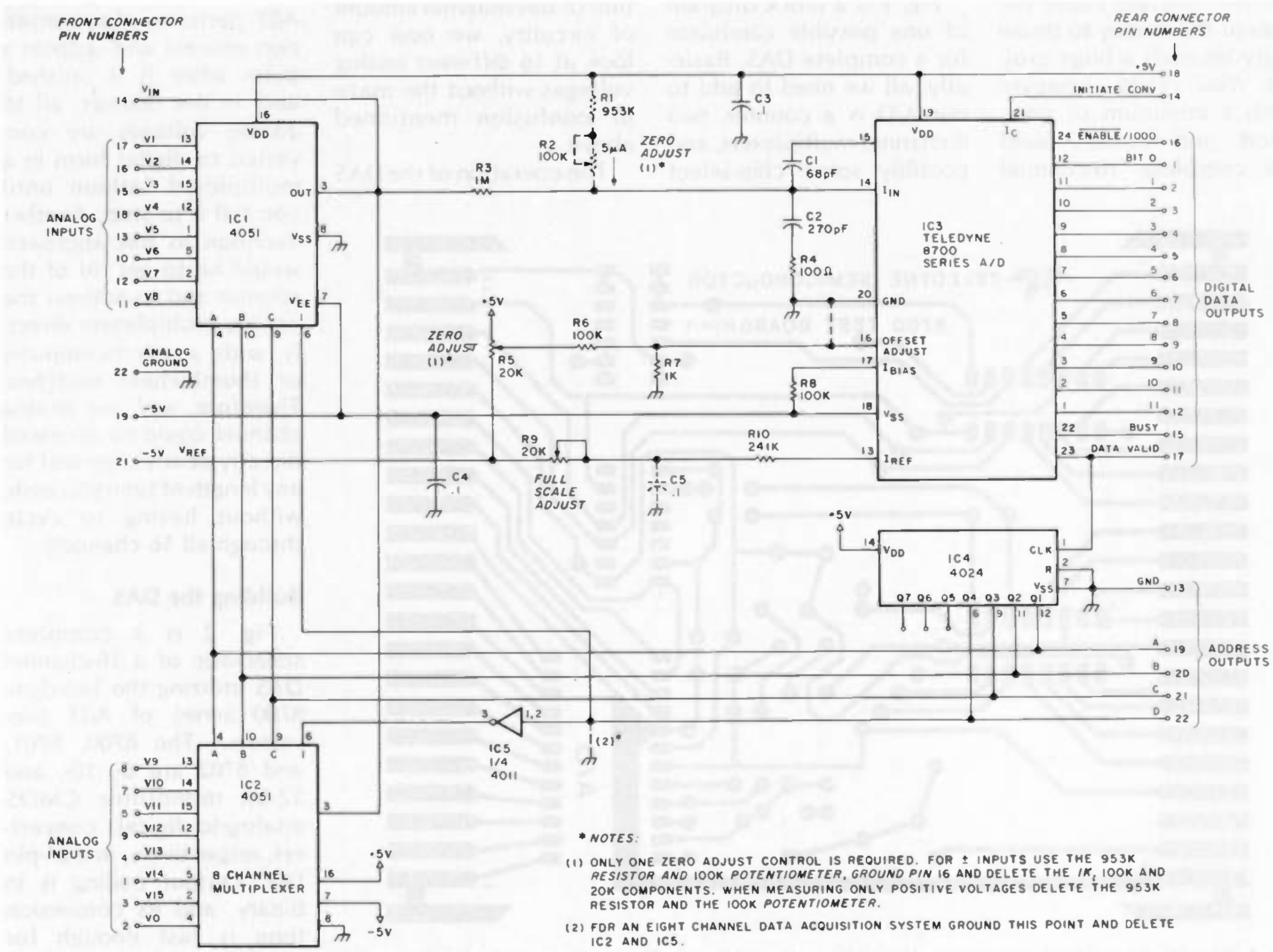


Fig. 2. The complete schematic for the 16-channel DAS utilizing the Teledyne 8700 series of A/D converters.

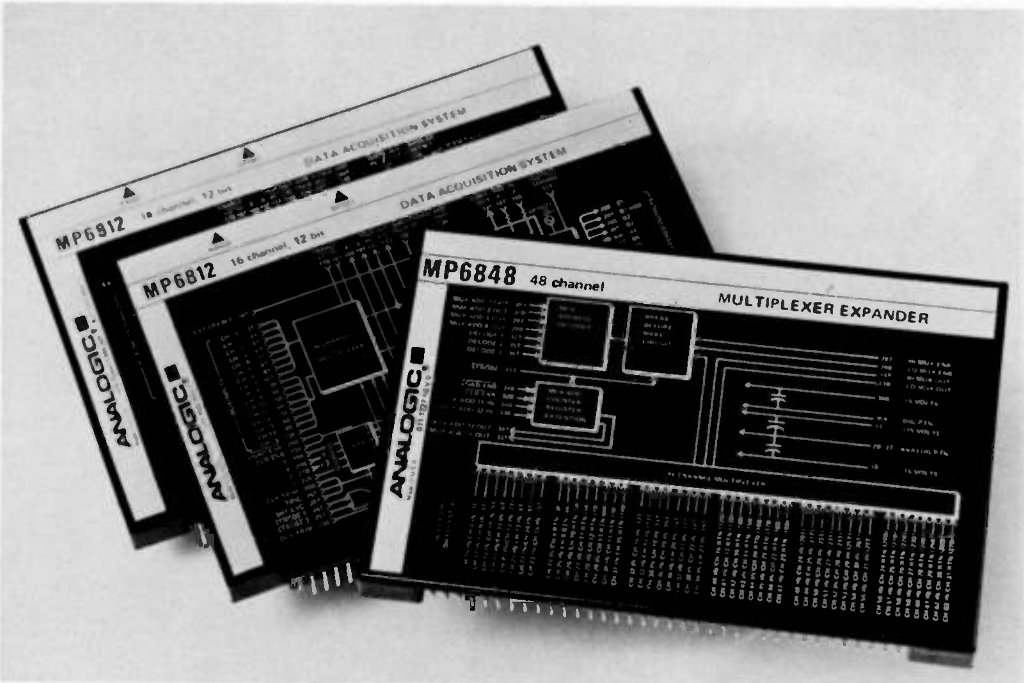


Photo C. This is what the big boys use for a 16-channel Data Acquisition System. The MP6812 can be had for a mere $200.00. (Photo courtesy of Analogic)

them up in a maze of confusion. But if you're anything like me, you don't have the time or the money to throw away on such a huge project. You could, however (with a minimum of time, effort, and money), build the complete 16-channel DAS described in this article.

Fig. 1 is a block diagram of one possible candidate for a complete DAS. Basically, all we need to add to our A/D is a counter, two 8-channel multiplexers, and possibly some chip-select circuitry for the analog multiplexers. With the addition of this minimal amount of circuitry, we now can look at 16 different analog voltages without the maze of confusion mentioned above.

The operation of the DAS is really very simple. Let's assume an initial starting point for the DAS with the counter set to binary zero. In this state, the address inputs to each analog multiplexer will also be at binary zero and the chip-select line will choose only one of the multiplexers to be active. Thus, the analog voltage at switch address zero will be connected to the A/D and the conversion process will begin. When the A/D has converted the analog voltage to digital form, it outputs a pulse from "Data Valid" to clock the counter and to let the output circuitry know that the digital data at the output of the A/D is ready for use.

When the counter is clocked, it is incremented to binary 0001, and the analog voltage at switch one is now connected to the A/D for conversion. Again, the A/D performs the conversion process and outputs a pulse when it is finished, and, in this manner, all 16 analog voltages are converted to digital form in a multiplexed fashion until you tell it to stop. Another variation to this approach would be to get rid of the counter and to address the analog multiplexers directly with a microcomputer or thumbwheel switches. Therefore, any one analog channel could be accessed directly at any time and for any length of time you wish, without having to cycle through all 16 channels.

Building the DAS

Fig. 2 is a complete schematic of a 16-channel DAS utilizing the Teledyne 8700 series of A/D converters.[1] The 8700, 8701, and 8702 are 8-, 10-, and 12-bit monolithic CMOS analog-to-digital converters, respectively, in a 24-pin DIP. Output coding is in binary, and its conversion time is fast enough for our purposes (1.8 ms for 8 bits). Its operation is exactly

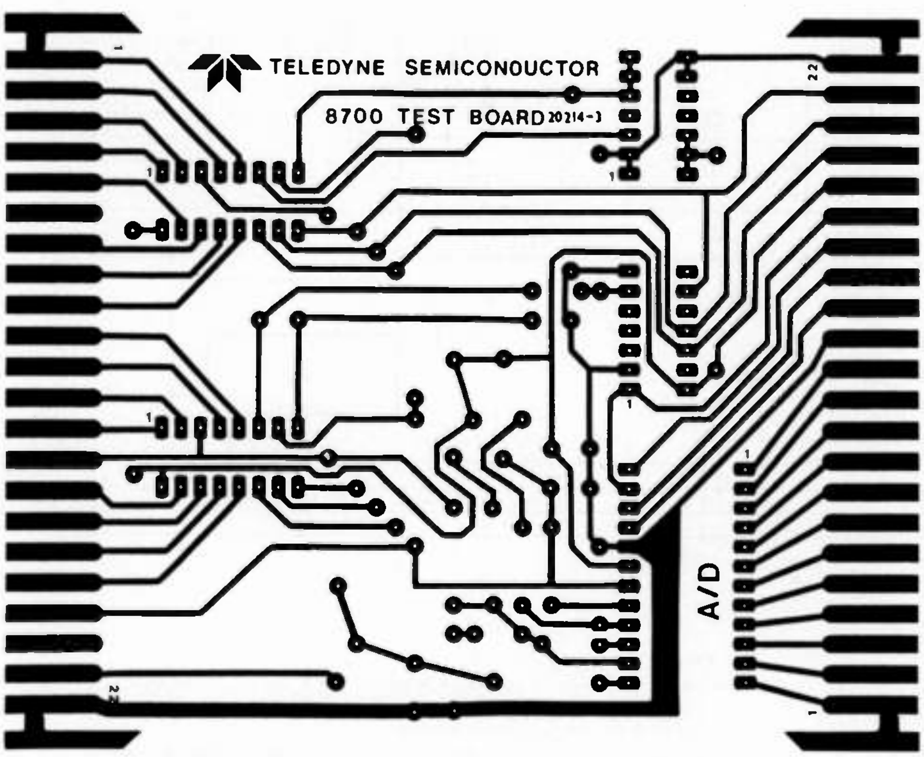


Fig. 3. The PC board foil pattern for the schematic of Fig. 2. The pattern is shown from the foil side.

as was explained for the block diagram in Fig. 1, so no other explanation should be necessary.

Figs. 3, 4, and 5 (which were graciously supplied by Michael Paiva, A/D Product Manager at Teledyne Semiconductor) show the foil pattern, pinout, and component layout for a single-sided PC board of the complete 16-channel DAS shown in Fig. 2.

For those of you who do not wish to make your own PC board, it is available directly from Teledyne or any of their distributors for $5.00. Just ask for the 8700 Test Board. Of course, a PC board makes things nice and neat, but you can build your own through wire-wrapping or direct wiring.

In the Parts List for the DAS, some components are marked with an asterisk. These are somewhat critical. The stability of the system is directly affected by the stability of these components. For standard hobby use, however, some substitutions could be made. For example, if an 8-bit A/D is used at room temperature, then 5% carbon resistors could be used in place of the 1% resistors because the resolution of an 8-bit A/D is only 0.4%. With a 12-bit A/D, however, these components will be very critical if full 12-bit accuracy is needed.

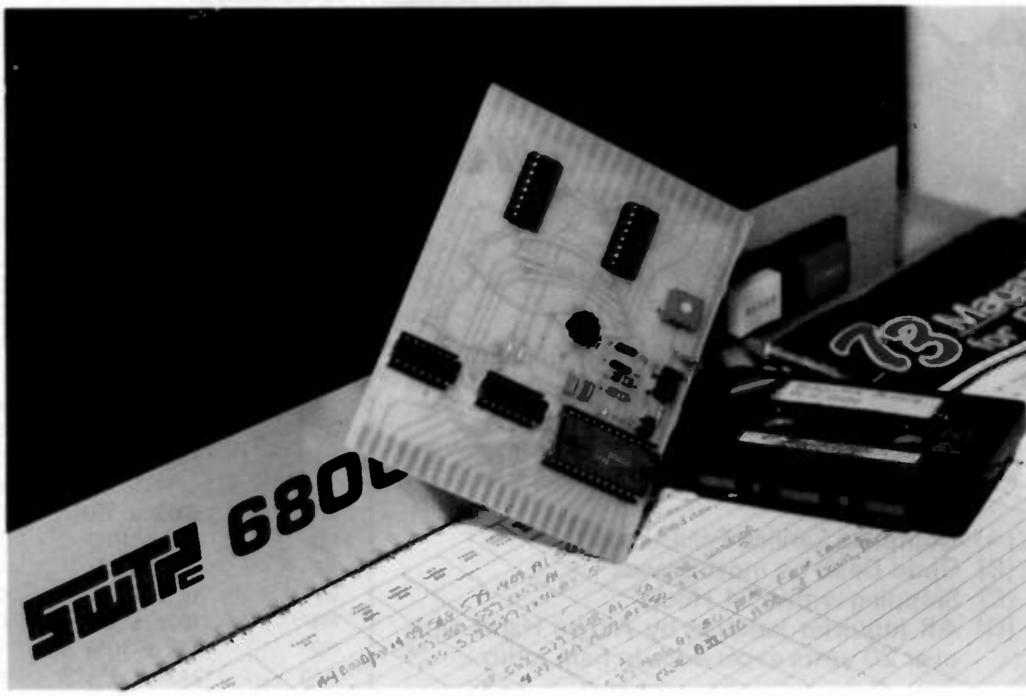


Photo D. Our finished product is propped up against my computer system.

Following are a few suggestions that you may want to consider before building your DAS:

First, as in any project handling both digital and analog signals, keep analog signals as far away from digital signals as possible. To avoid ground loops, isolate the analog ground from the digital ground by using the system ground as the only common point between the two. Use adequate bypassing of supply voltages and, finally, make sure your reference voltage, V_{ref}, is as stable as you can make it. For example, an 8-bit A/D should require

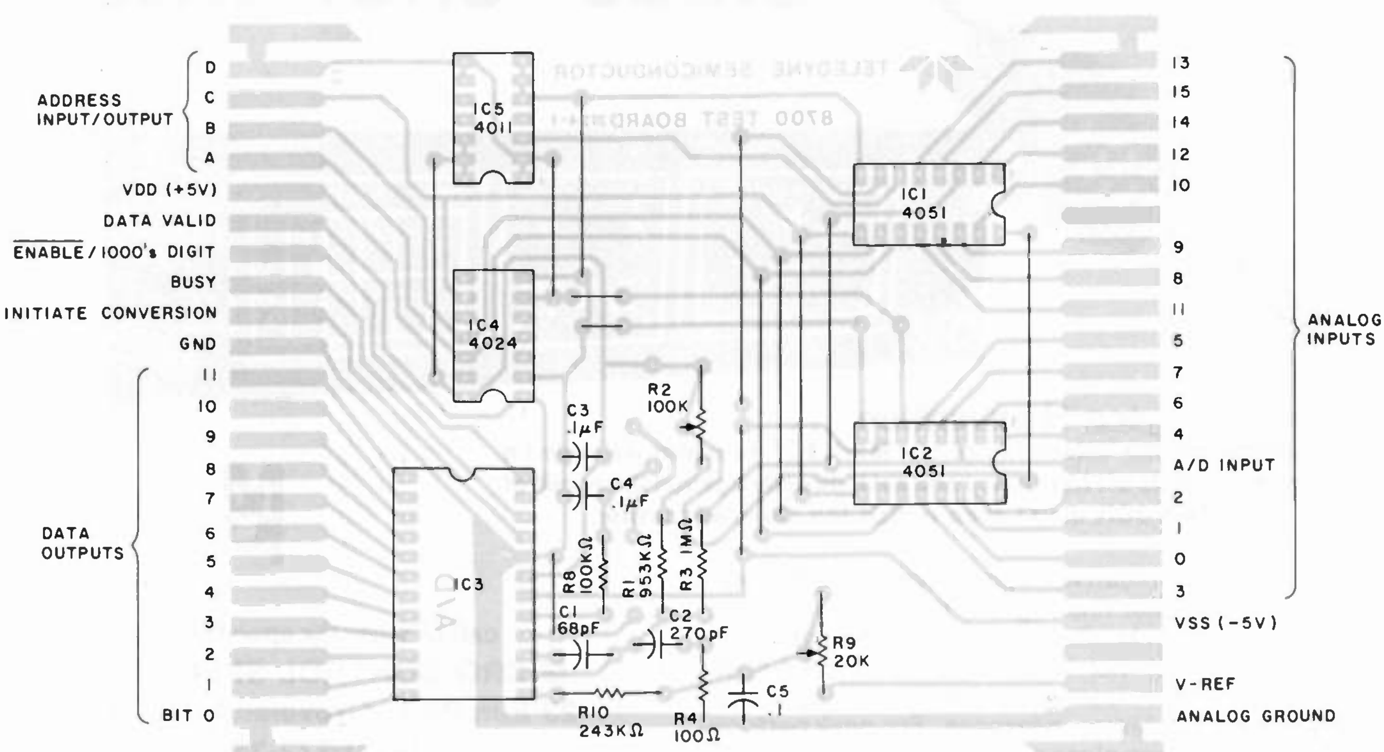


Fig. 4. Component layout and edge connector pin assignments. Look carefully for all jumpers.

Parts List

	Part Number	Description
IC1, IC2	4051	CMOS—8-channel analog switch
IC3	8700 type	CMOS—Teledyne A/D converter
IC4	4024	CMOS—7-bit binary counter
IC5	4011	CMOS—quad 2-input NAND gate
C1	68 pF ± 10%	Low leakage mica, ceramic, etc.
C2	270 pF ± 20%	Ceramic, mica, etc.
C3, C4, C5	0.1 µF ± 20%	Ceramic, mylar, electrolytic, tantalum, etc.
R1	*953k ± 1%	Carbon, carbon film, metal film, etc.
R2	*100k ± 10%	Trimmer resistor
R3	*1 megohm ± 1%	Carbon, carbon film, metal film, etc.
R4	100Ω ± 10%	Carbon resistor
R5	20k ± 10%	Trimmer resistor
R6	100k ± 5%	Carbon resistor
R7	1k ± 5%	Carbon resistor
R8	100k ± 10%	Carbon resistor
R9	*20k ± 10%	Trimmer resistor
R10	*243k ± 1%	Carbon, carbon film, metal film, etc.

*See text.

0.04% voltage regulation (one-tenth of its resolution). Photo D shows my completed DAS in front of my computer system. ■

Reference

1. Teledyne Semiconductor, AN-9, "Applications of the 8700 Series of CMOS A/D Converters."

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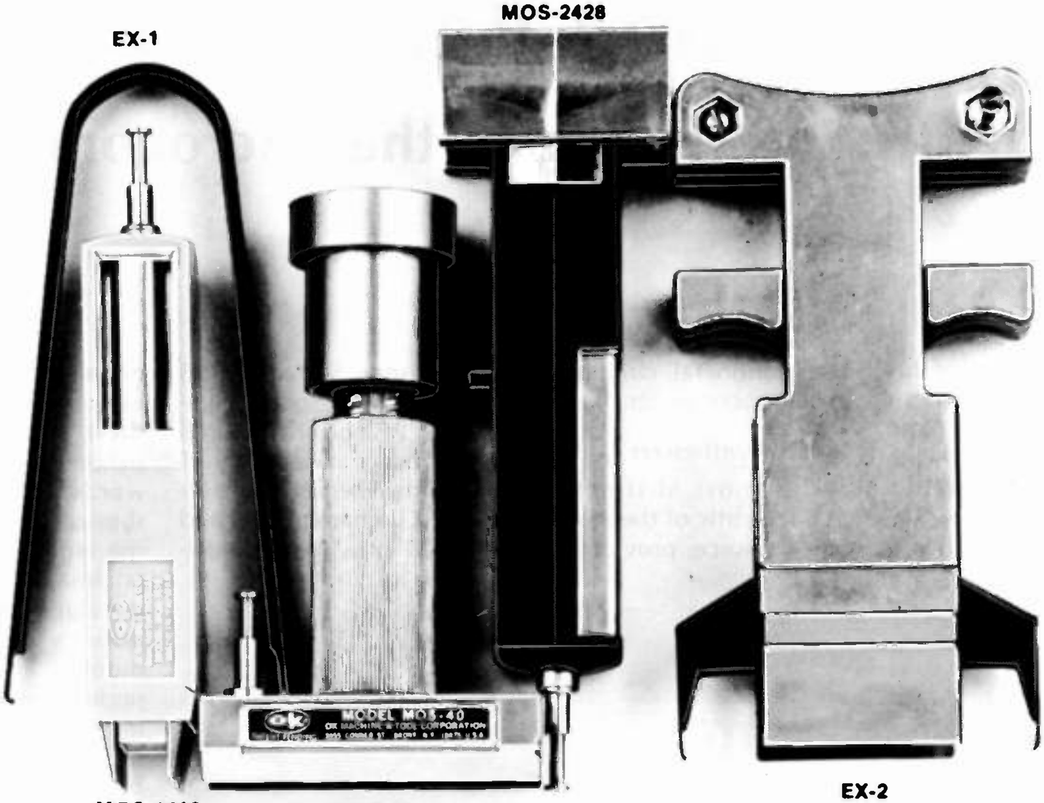

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Reader Service—see page 226

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A Computer-Controlled Talking Repeater

—part III: interfacing to the microcomputer

The first two parts of this article provided an overview of the project and microcomputer hardware and software nucleus details. This final part describes interfacing of various peripheral circuits to the microcomputer.

Speech Synthesizer

The most distinctive characteristic of the repeater is its voice, provided by Telesensory Systems' S2B and S2C Mini Speech Synthesis PC boards. Each board has a vocabulary of 64 words. The S2C contains the ASCII character set and the S2B provides 64 additional words such as ten, eleven, twenty, thirty, hundred, clear, Hertz, and other useful radio-type words. The speech synthesizer is used for IDing the repeater, reading back commands, and for reading out signal strength and frequency error measurements. The boards are perfect for countless other microcomputer-based applications including remote bases, home remote-control systems, and speech-response terminals.

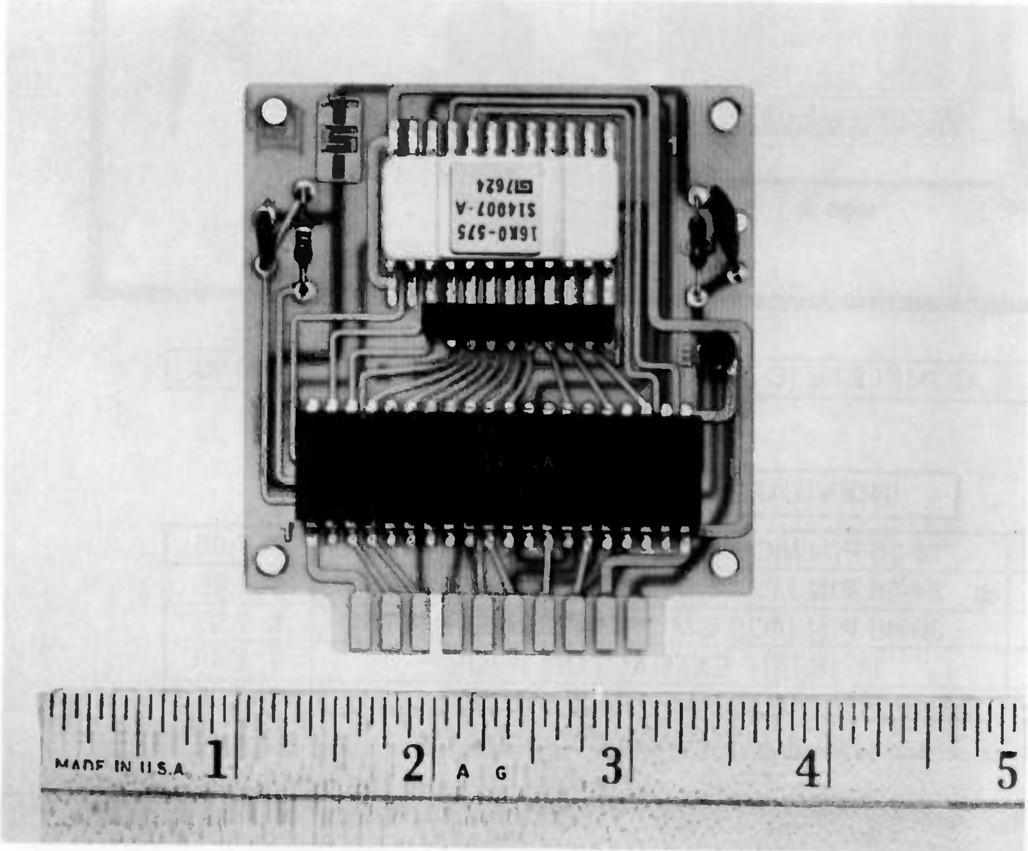

Photo A. Telesensory Systems speech synthesizer board.

Each board is about 3" by 3" with a 20-pin connector on one end. They contain a 40-pin LSI synthesizer chip, 24-pin ROMs containing the vocabulary, and a couple of resistors and capacitors. The internal clock frequency is controlled by an RC network, but if desired, the board can be driven by an external clock for more precise pitch control.

To generate speech, a six-bit binary code representing the desired word is applied to the board and the start input is pulsed. The busy output signal goes low, remaining low until the word is complete. The code for the next word can then

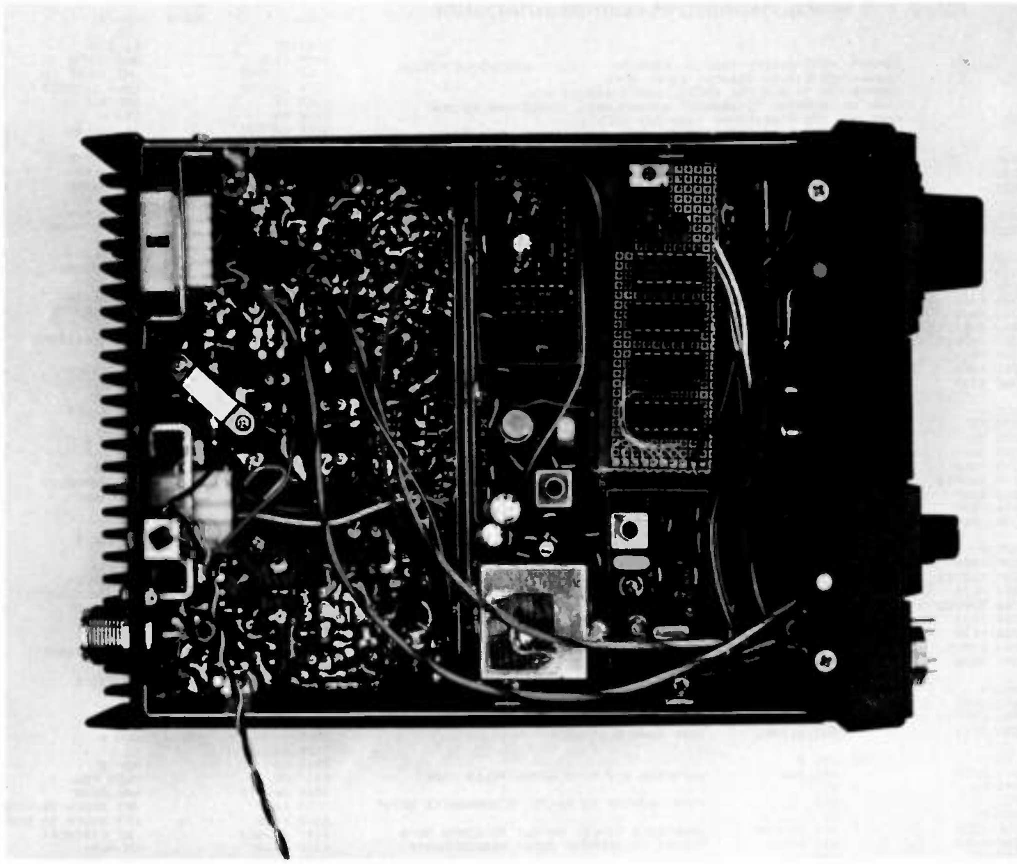

Photo B. IC-22S with interface board plugged into old diode programming board location. Molex connector on back carries all the signals.

be applied, the start input pulsed, etc. It couldn't be easier!

The Telesensory speech synthesizers are fundamentally different from synthesizers that have been available for hobby computers. Control requires only presenting the six-bit representation of the word desired. Other synthesizers require a complex construction of commands for each word, and it becomes a game to understand what the machine actually said. Such systems are really toys—not tools. If only a limited vocabulary is required, the Telesensory boards are the perfect solution. The voice sounds authoritative, rather than friendly like the voice of the TI Speak and Spell™, and is more intelligible and punches through any background noise.

Synthesizer Hardware Interface

The pitch of the speech output normally is determined by the board's RC oscillator circuit. By removing the resistor and capacitor, an external clock signal can be used to eliminate the possibility of frequency drift with time or temperature and to precisely match the pitch of the two boards. The clock signal is generated by a programmable counter/timer on the Pragmatic Designs CPU-1A microcomputer board, dividing the CPU's crystal-controlled clock frequency to 24 kHz.

The six-bit word-select code for both boards is provided by the computer's DACPORT output port, and the individual start strobes are provided by two bits of XPORT output port. To guarantee logic level compatibility, pull-up resistors to +5 volts are included for each synthesizer input line.

The synthesizers' busy output lines require a simple interface circuit to drive 5-volt logic. The signals are brought into the 8085A's interrupt 5.5 and 6.5 inputs, used as an input port—not really as interrupt inputs.

The speech output is a high-impedance (10k) couple of volts peak to peak. Telesensory recommends a filter network to shape the audio response, but we found that it sounded far better through the repeater with virtually no filtering. The audio from the two boards goes to the repeater's audio mixer circuits.

Synthesizer Software

Messages to be spoken are generally stored as strings in the microcomputer's ROM. Other messages

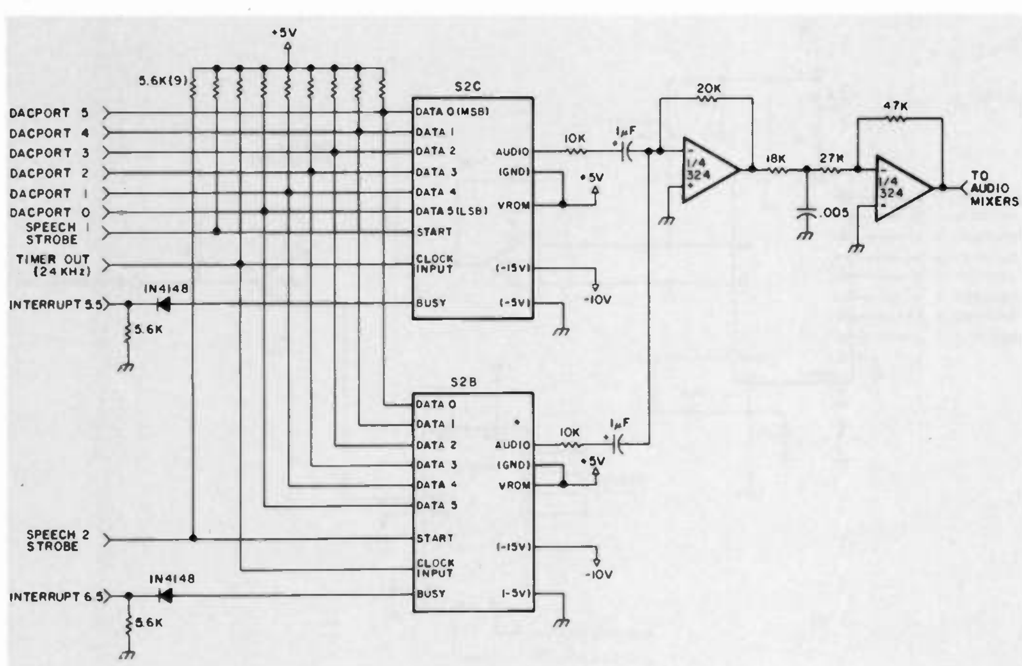

Fig. 1. Speech synthesizer hardware interface to microcomputer.

Table 1. Speech synthesizer control subroutine.

```
                ;SPEECH SYNTHESIZER CONTROL ROUTINE.  (HL)-> CHARACTER STRING.
                ;CHARACTER STRING TERMINATED BY OFFH.
                ;CODES 20H TO 5FH ARE ASCII. CODES 60H TO 9FH
                ;ARE TELESENSORY 'STANDARD' VOCABULARY.  CODES OOH TO OCH
                ;ARE BCD AND STAR/POUND (OAH NOT USED).
                ;IF 220 SPEECH IS INTERRUPTED, ROUTINE RETURNS WITH CY=1.
                ;
1D4C =          SPDELAY EQU 7500        ;INTER CHARACTER DELAY
7530 =          SPWORDELAY EQU 30000    ;INTER WORD DELAY
0032 =          TSPTIM  EQU 50          ;SPEECH MALFUNCTION TIMER=1.3 SEC
                ;
325C =          TALK    EQU $
325C C5                 PUSH B
                ;
325D =          TALK1   EQU $
325D F3                 DI              ;PROTECT CRITICAL AREA
325E DB12               IN XPORT        ;TAKE BOTH STROBES HIGH
3260 F60C               ORI SP1STB OR SP2STB
3262 D312               OUT XPORT
3264 CD4B31             CALL TTRCVRTEST ;TALKING TO RADIO OR PHONE?
3267 CA7032             JZ TALK1D       ;IF TO PHONE, DONT MUTE RB
326A DB1A               IN AUD1         ;XCOM RB AUDIO TO 220 XMTR
326C E6FD               ANI CRBRTO220
326E D31A               OUT AUD1
                ;
3270 =          TALK1D  EQU $
3270 FB                 EI
3271 7E                 MOV A,M         ;GET CHARACTER
3272 23                 INX H
3273 FEFO               CPI OFOH        ;CHAR FROM AUTODIAL MEM?
3275 DA7F32             JC TALK1C       ; (MS 4 BITS=1?)
3278 E60F               ANI OFH         ;IF YES, THEN MASK OFF MS BITS SO BCD
327A FEOF               CPI OFH         ;LAST CHAR? (CHARACTER FF?)
327C CA1533             JZ FINTALK      ;FINISHED IF YES
                ;
327F =          TALK1C  EQU $
327F FE20               CPI 20H         ;NOT FINISHED, SPACE?
3281 CA3533             JZ SPACETALK    ;IF YES, JUST DELAY
3284 FEOD               CPI ODH         ;BCD OR STAR/POUND?
3286 D29932             JNC TALK1A
3289 C630               ADI 30H         ;YES, CONVERT TO ASCII
328B FE3B               CPI 3BH         ;IS IT STAR?
328D C29232             JNZ TALK1B
3290 3E2A               MVI A,2AH       ;IF YES, USE TELES CODE
                ;
3292 =          TALK1B  EQU $
3292 FE3C               CPI 3CH         ;IS IT POUND?
3294 C29932             JNZ TALK1A
3297 3E23               MVI A,23H       ;USE NUMBER (POUND)
                ;
3299 =          TALK1A  EQU $
3299 EE20               XRI 20H         ;REVERSE BIT 5 TO MATCH TELES CODE
329B FB                 EI
329C 76                 HLT             ;SYNCHRONIZE TO RST75 TO GUARANTEE SETUP
329D F3                 DI
329E D311               OUT DACPORT     ;AND HOLD TIMES, OUTPUT TO SYNTH DATA
32A0 0632               MVI B,50        ;DELAY TO OBSERVE SETUP REQUIREMENTS
32A2 05                 DCR B
32A3 C2A232             JNZ $-1
32A6 EE20               XRI 20H         ;FLIP BACK BIT 5
32A8 FE60               CPI 60H         ;ASCII OR STANDARD VOCABULARY?
32AA D2B232             JNC TALK2
32AD 06FB               MVI B,SP1UNSTB  ;ASCII, BOARD 1 UNSTROBE
32AF C3B432             JMP TALK3
                ;
32B2 =          TALK2   EQU $
32B2 06F7               MVI B,SP2UNSTB  ;STANDARD, BOARD 2 UNSTROBE
                ;
32B4 =          TALK3   EQU $
32B4 DB12               IN XPORT
32B6 A0                 ANA B
32B7 D312               OUT XPORT       ;UNSTROBE IT
32B9 FB                 EI
32BA 76                 HLT             ;AND ALLOW DELAY OF BUSY LINE
32BB FB                 EI
32BC 76                 HLT
32BD E5                 PUSH H
32BE 213200             LXI H,TSPTIM
32C1 222F10             SHLD LGPT       ;STORE MALFUNCTION TIMEOUT IN
                ;                       ; GENERAL PURPOSE TIMER
                ;
32C4 =          TALK4   EQU $
                        RIM             ;SPEECH FINISHED?
32C4+20                 DB 20H
32C5 E630               ANI INT65
32C7 C22B33             JNZ TALK5       ;JMP IF DONE WORD
32CA 2A2D10             LHLD LTTBEEP    ;220 SQUELCH OPEN?
32CD 7D                 MOV A,L
32CE B4                 ORA H
32CF CAF532             JZ TALK4A       ;NO, CONTINUE
32D2 DB1A               IN AUD1         ;(YES), TALKING TO RADIO?
32D4 E608               ANI SSPTO220
32D6 CAF532             JZ TALK4A       ;NO, CONTINUE
32D9 3A4410             LDA MWARN       ;YES, MONOLOGUE WARN ANNC?
32DC OF                 RRC
32DD DAF532             JC TALK4A       ;YES, CONTINUE
32E0 3A4510             LDA PPTWARN     ;PATCH TIMER WARNING?
32E3 OF                 RRC
32E4 DAF532             JC TALK4A       ;YES, CONTINUE
32E7 3A4D10             LDA PCOVER      ;NO, COVER TONE?
32EA OF                 RRC
32EB DAF532             JC TALK4A
32EE 3A4E10             LDA TTCOVER     ;TT COVER TONE?
32F1 OF                 RRC
32F2 D2FD32             JNC TALKABORT
32F5 =          TALK4A  EQU $
32F5 2A2F10             LHLD LGPT       ;NO, MALF TIMER TIMED OUT?
32F8 7D                 MOV A,L
32F9 B4                 ORA H
32FA C2C432             JNZ TALK4
                ;
32FD =          TALKABORT EQU $
32FD F3                 DI              ;YES, ABORT
32FE DB1A               IN AUD1         ;XCOM SPEECH AUDIO
3300 E6F7               ANI CSPTO220
3302 D31A               OUT AUD1
3304 FB                 EI
                ;
3305 =          TALKABORT1 EQU $
                        RIM
3305+20                 DB 20H
3306 E630               ANI INT65       ;WAIT FOR END OF SPEECH
3308 C21333             JNZ TALKABORT2
330B 2A2F10             LHLD LGPT       ;CHECK MALF TIMER
330E 7D                 MOV A,L
330F B4                 ORA H
3310 C20533             JNZ TALKABORT1  ;LOOP UNTIL DONE
                ;
3313 =          TALKABORT2 EQU $
3313 37                 STC             ;SET CY FOR INTERRUPTED RETURN
3314 E1                 POP H
                ;
3315 =          FINTALK EQU $
3315 F3                 DI
3316 C1                 POP B
3317 F5                 PUSH PSW        ;RECONNECT RB AUDIO IF NECESSARY
3318 3A0110             LDA RBOR
331B E628               ANI SRBEN OR SRBRON
331D FE28               CPI SRBEN OR SRBRON
331F C22833             JNZ FINTALK1
3322 DB1A               IN AUD1         ;RECONNECT
3324 F602               ORI SRBRTO220
3326 D31A               OUT AUD1
                ;
3328 =          FINTALK1 EQU $
3328 F1                 POP PSW
3329 FB                 EI
332A C9                 RET
                ;
332B =          TALK5   EQU $
332B E1                 POP H
332C 014C1D             LXI B,SPDELAY   ;INTER CHAR DELAY
                ;
332F =          TALK5A  EQU $
332F CD9934             CALL DEL2
3332 C35D32             JMP TALK1
                ;
                ;
                ;DELAY WORD SPACE TIME
                ;
3335 =          SPACETALK EQU $
3335 013075             LXI B,SPWORDELAY
3338 C32F33             JMP TALK5A
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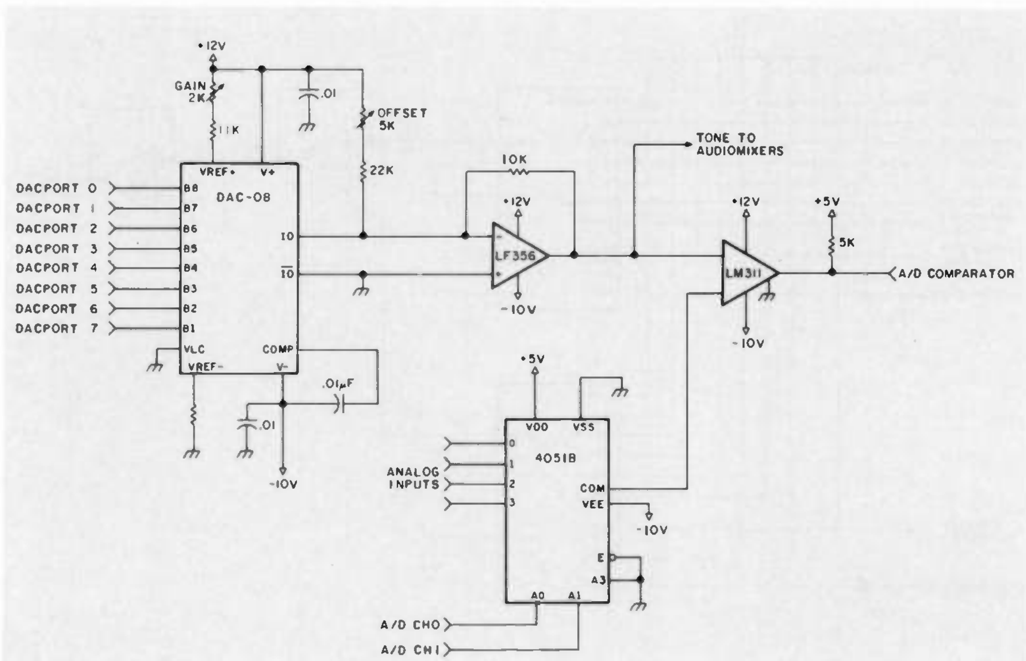

Fig. 2. A/D converter hardware for reading the meters.

are generated by computations made by the computer and are stored as strings in RAM. Prior to generating speech, the computer enables the synthesizer's audio mixer to the transmitter and/or phone line. The TALK subroutine expects the HL register pair to point to the character string in memory, and the string is terminated by a OFFH code. If speech to the transmitter is interrupted by a receiver squelch open, speech aborts and the subroutine returns with the carry flag set. There are certain exceptions to this rule, including timeout announcements and cover tone generation.

The TALK subroutine is

Table 2. Meter-read program extracted from the background module, TRAP interrupt module, and foreground module.

```
                ;
                ; *** BACKGROUND METER READ ***
                ;DATA ACQUISITION.  TICK COUNTER DETERMINES A CHANNEL TO BE
                ;MEASURED BY A/D CONVERTER.  VALUE ENTERED INTO PROPER
                ;LOCATION OF A/D TABLE.  TABLE CONTAINS LAST 16 MEASUREMENTS
                ;OF 4 CHANNELS.
                ;
01D3 =          DATAACQ EQU $
                ;
01D3 DB13               IN CHPORT       ;SELECT A/D CHANNEL
01D5 E6FC               ANI NOT ADMASK  ;CURRENT PORT VALUE
01D7 47                 MOV B,A
01D8 7E                 MOV A,M         ;TICK COUNTER
01D9 E603               ANI ADMASK      ;LS 2 BITS
01DB B0                 ORA B           ; OR IN A/D CHANNEL BITS
01DC D313               OUT CHPORT      ;AND SELECT
                ;
01DE 0600               MVI B,0         ;SUCCESSIVE APPROXIMATION A/D CONVERSION
01E0 0E80               MVI C,80H       ;B=CURRENT VALUE, C=MASK BIT
                ;
01E2 =          DATA1   EQU $
01E2 78                 MOV A,B         ;SET NEXT BIT
01E3 A9                 XRA C
01E4 47                 MOV B,A
01E5 D311               OUT DACPORT     ;AND SEND CURRENT VALUE TO DAC
01E7 00                 NOP             ;ALLOW OP AMP TO SLEW
01E8 00                 NOP
01E9 00                 NOP
01EA 00                 NOP
01EB DB19               IN RPORT        ;LOOK AT COMPARATOR
01ED E680               ANI ADCOMPB
01EF C2F501             JNZ DATA2       ;IF HIGH, LEAVE SET
01F2 78                 MOV A,B         ;IF LOW, CLEAR IT
01F3 A9                 XRA C
01F4 47                 MOV B,A
                ;
01F5 =          DATA2   EQU $
01F5 79                 MOV A,C         ;NEXT MASK
01F6 0F                 RRC
01F7 4F                 MOV C,A
01F8 D2E201             JNC DATA1       ;CONTINUE FOR 8 POSITIONS
                ;
01FB =          DATA3   EQU $
01FB 2A0610             LHLD CURRENTVALUE  ;A/D TABLE POINTER
01FE 70                 MOV M,B         ;PUT VALUE INTO TABLE
01FF 23                 INX H
0200 220610             SHLD CURRENTVALUE
0203 7D                 MOV A,L         ;WRAPAROUND?
0204 FEBA               CPI LOW FINADTABLE
0206 C2D900             JNZ FIN75       ;NO, DONE
0209 217A10             LXI H,ADTABLE   ;YES, WRAP AROUND TO BEGINNING
020C 220610             SHLD CURRENTVALUE
020F C3D900             JMP FIN75       ;NOW DONE
                ;
                ; *** TRAP ROUTINE, AVERAGE READINGS AND STORE ***
                ;
                ;
04E4 =          TRAPSMET EQU $
04E4 017A10             LXI B,ADTABLE   ;CHANNEL 0 (TICK 4) IS SMETER
04E7 C3ED04             JMP AVGIT       ;(BC)-> START OF SMETER RAM VALUES
                ;
                ;
04EA =          TRAPDMET EQU $
04EA 017B10             LXI B,ADTABLE+1 ;CHANNEL 3 (TICK 3) IS DMETER
                ;
04ED =          AVGIT   EQU $
04ED D5                 PUSH D          ;AVERAGE PREVIOUS 16 READINGS
04EE E5                 PUSH H
04EF 210000             LXI H,0         ;CUMULATIVE SUM
04F2 110000             LXI D,0         ;DE=NEXT VALUE
                ;
04F5 =          AVGIT1  EQU $
04F5 0A                 LDAX B          ;GET VALUE
04F6 5F                 MOV E,A         ;DE=VALUE
04F7 19                 DAD D           ;NEW SUM IN HL
04F8 03                 INX B
04F9 03                 INX B
04FA 03                 INX B
04FB 03                 INX B           ;NEXT VALUE
04FC 79                 MOV A,C
04FD FEBA               CPI LOW FINADTABLE ;DONE?
04FF DAF504             JC AVGIT1
0502 29                 DAD H           ;YES, NOW GET 8 MSB
0503 29                 DAD H
0504 29                 DAD H
0505 29                 DAD H           ;X 16 IN HL
0506 7C                 MOV A,H         ;MS BYTE IS AVERAGE
0507 320810             STA READING     ;STORE IT
050A 2A2510             LHLD LMT        ;STORE MONOLOGUE TIMER SO KNOW
050D 220910             SHLD READTIME   ; THAT MIKE HELD DWN LONG ENOUGH
0510 E1                 POP H
0511 D1                 POP D
0512 C9                 RET
                ;
                ; *** FOREGROUND SEQUENCE DECODE ROUTINE ***
;
                ; S-METER AND DISCRIMINATOR READ ANNOUNCEMENT.
                ;
0BD8 =          SSMETER EQU $
                ;
0BD8 21050C             LXI H,SMETABLE  ;POINT TO TABLE
0BDB 110600             LXI D,6         ;ADD CONSTANT
                ;
0BDE =          SSMETER1 EQU $
0BDE 3A0810             LDA READING     ;GET LAST AVERAGED VALUE
0BE1 47                 MOV B,A
                ;
0BE2 =          SSMETER2 EQU $
0BE2 7E                 MOV A,M         ;CORRECT VALUE?
0BE3 B8                 CMP B
0BE4 D2F40B             JNC METALK      ;IF YES, SAY VALUE
0BE7 19                 DAD D           ;IF NOT, TRY NEXT VALUE
0BE8 C3E20B             JMP SSMETER2
                ;
                ;D-METER ANNOUNCEMENT.
                ;
0BEB =          DDMETER EQU $
0BEB 21650C             LXI H,DMETABLE  ;POINT TO TABLE
0BEE 110800             LXI D,8         ;ADD CONSTANT
0BF1 C3DE0B             JMP SSMETER1    ;CONTINUE
                ;
0BF4 =          METALK  EQU $
0BF4 23                 INX H           ;POINT TO FIRST CHARACTER
0BF5 E5                 PUSH H          ;SAVE POINTER
0BF6 2A0910             LHLD READTIME   ;WAS MIKE HELD DOWN FOR
0BF9 11B6E5             LXI D,-(TMT-20) ; AT LEAST 1/2 SECOND
0BFC 19                 DAD D           ; SO HAVE VALID AVERAGE?
0BFD E1                 POP H           ;RESTORE POINTER
0BFE DA4F08             JC FINSEQ       ;ABORT IF NO
0C01 CD3B33             CALL TALKR      ;SAY IT
                        JMPFINSEQ       ;DONE
0C04+E7                 RST 4
                ;
                ;S-METER TABLE OF VALUE AND SPEECH
                ;
0C05 =          SMETABLE EQU $
0C05 825330FF00         DB 82H,'S0',0FFH,0,0
0C0B 845331FF00         DB 84H,'S1',0FFH,0,0
0C11 885332FF00         DB 88H,'S2',0FFH,0,0
0C17 905333FF00         DB 90H,'S3',0FFH,0,0
0C1D 985334FF00         DB 98H,'S4',0FFH,0,0
0C23 A05335FF00         DB 0A0H,'S5',0FFH,0,0
0C29 A85336FF00         DB 0A8H,'S6',0FFH,0,0
0C2F B05337FF00         DB 0B0H,'S7',0FFH,0,0
0C35 B85338FF00         DB 0B8H,'S8',0FFH,0,0
0C3B C05339FF00         DB 0C0H,'S9',0FFH,0,0
0C41 C853392B6A         DB 0C8H,'S9',PLUS,TEN,0FFH
0C47 D053392B74         DB 0D0H,'S9',PLUS,TWENTY,0FFH
0C4D D853392B75         DB 0D8H,'S9',PLUS,THIRTY,0FFH
0C53 E053392B76         DB 0E0H,'S9',PLUS,FORTY,0FFH
0C59 E853392B77         DB 0E8H,'S9',PLUS,FIFTY,0FFH
0C5F FF53392B78         DB 0FFH,'S9',PLUS,SIXTY,0FFH
0C65 =          FINSMETABLE EQU $
                ;
                ;DISCRIMINATOR METER TABLE OF VALUE AND SPEECH
                ;
0C65 =          DMETABLE EQU $
0C65 1F2D3E354B         DB 1FH,MINUS,GREATERTHAN,'5K',HERTZ,0FFH,0
0C6D 2C2D354B96         DB 2CH,MINUS,'5K',HERTZ,0FFH,0,0
0C75 442D334B96         DB 44H,MINUS,'3K',HERTZ,0FFH,0,0
0C7D 582D324B96         DB 58H,MINUS,'2K',HERTZ,0FFH,0,0
0C85 622D318335         DB 62H,MINUS,'1',POINT,'5K',HERTZ,0FFH
0C8D 6C2D314B96         DB 6CH,MINUS,'1K',HERTZ,0FFH,0,0
0C95 702D387C96         DB 70H,MINUS,'8',HUNDRED,HERTZ,0FFH,0,0
0C9D 742D367C96         DB 74H,MINUS,'6',HUNDRED,HERTZ,0FFH,0,0
0CA5 782D347C96         DB 78H,MINUS,'4',HUNDRED,HERTZ,0FFH,0,0
0CAD 7C2D327C96         DB 7CH,MINUS,'2',HUNDRED,HERTZ,0FFH,0,0
0CB5 843C327C96         DB 84H,LESSTHAN,'2',HUNDRED,HERTZ,0FFH,0,0
0CBD 882B327C96         DB 88H,PLUS,'2',HUNDRED,HERTZ,0FFH,0,0
0CC5 8C2B347C96         DB 8CH,PLUS,'4',HUNDRED,HERTZ,0FFH,0,0
0CCD 902B367C96         DB 90H,PLUS,'6',HUNDRED,HERTZ,0FFH,0,0
0CD5 942B387C96         DB 94H,PLUS,'8',HUNDRED,HERTZ,0FFH,0,0
0CDD 9D2B314B96         DB 9DH,PLUS,'1K',HERTZ,0FFH,0,0
0CE5 A82B318335         DB 0A8H,PLUS,'1',POINT,'5K',HERTZ,0FFH
0CED BC2B324B96         DB 0BCH,PLUS,'2K',HERTZ,0FFH,0,0
0CF5 D42B334B96         DB 0D4H,PLUS,'3K',HERTZ,0FFH,0,0
0CFD E12B354B96         DB 0E1H,PLUS,'5K',HERTZ,0FFH,0,0
0D05 FF2B3E354B         DB 0FFH,PLUS,GREATERTHAN,'5K',HERTZ,0FFH,0
0D0D =          FINDEMETABLE EQU $
                ;
```

listed in Table 1. Optimum selection of the synthesizer's pitch and inter-character delay is essential to achieving the best intelligibility.

Meter Read

The repeater's meter-read capability allows users to request S-meter and discriminator meter readings to check signal strength and frequency error. Analog voltages from the receiver are buffered and brought to the A/D converter on the CPU-1A microcomputer board. Provisions are made for four analog channels, although only two are used presently. The background module measures each channel every 26.6 ms, and the reading is stored with the 15 previous readings for that channel in RAM. When the proper touchtone™ key sequence is detected by the TRAP interrupt module, the 16 readings for the appropriate channel are averaged and stored, to be retrieved by the foreground sequence-detect branch routine which speaks the meter value over the air. When a meter-read command is entered, therefore, the average reading over the last half second is read, reducing the effect of noise and flutter.

The A/D converter consists of a DAC-08 8-bit digital-to-analog converter with a current-to-voltage converter, analog multiplexer, and comparator. The DAC is driven by DACPORT output port, the multiplexer by CHPORT output port, and the comparator is read through RPORT input port. A 300-μs total conversion time successive approximation algorithm is used.

The meter-read software consists of three routines in the background, TRAP interrupt, and foreground modules. The listings of each are shown in Table 2.

Remote Base

An Icom IC-22S two-meter synthesized transceiver serves as a remote base, commandable through the repeater. Command codes independently enable the remote-base receiver and transmitter, allowing monitoring only and talking over the two-meter signals. The IC-22S synthesizer is under control of the CPU-1A microcomputer, allowing users to pro-

Table 3. IC-22S remote-base frequency control routine. Touchtone command is decomposed and determines programming frequency.

```
                ;REMOTE BASE FREQUENCY LOAD SEQUENCE DECODE ROUTINE.
                ;POINTER TO START OF COMMAND STRING ON TOP OF STACK.
                ;INTERPRETS STRING OF FORMAT (1'S MHZ) (100'S KHZ)
                ;(10'S KHZ) (1'S KHZ) (1=-600KHZ,2=SIMPLEX,
                ;3=+600KHZ XMT OFFSET) AND PROGRAMS IC-22S.
                ;SAMPLE STRING FOR .34/.94 IS 69401.
                ;
0B7B =          RBLOADP EQU $
0B7B C1                 POP B           ;(BC)-> START OF STRING
0B7C 117108             LXI D,FINSEQ
0B7F D5                 PUSH D          ;PUT FINSEQ ON TOP OF STACK
0B80 3A0110             LDA RBOR        ;RB ENABLED AND ON?
0B83 E628               ANI SRBRON OR SRBEN
0B85 FE28               CPI SRBRON OR SRBEN
0B87 C0                 RNZ             ;RETURN (TO FINSEQ) IF NO
0B88 69                 MOV L,C         ;STRING START ADDRESS
0B89 60                 MOV H,B
0B8A 221310             SHLD TEMPAIR    ;SAVE ADDRESS
0B8D 0A                 LDAX B          ;TYP STRING=69401(FF)
0B8E FE08               CPI 8           ;CHECK FOR 145-147 MHZ
0B90 D0                 RNC
0B91 FE05               CPI 5
0B93 D8                 RC
0B94 D606               SUI 6           ;START FORMING VALUE
0B96 21E803             LXI H,1000
0B99 CAA50B             JZ RBLOAD1
0B9C 210000             LXI H,0
0B9F FAA50B             JM RBLOAD1
0BA2 21D007             LXI H,2000      ;5->0,6->1000,7->2000
                ;
0BA5 =          RBLOAD1 EQU $
0BA5 03                 INX B
0BA6 0A                 LDAX B          ;CONVERT BCD TO 0-2999 BINARY
0BA7 116400             LXI D,100       ;X100 (HUNDREDS)
                ;
0BAA =          RBLOAD2 EQU $
0BAA 3D                 DCR A
0BAB FAB20B             JM RBLOAD3
0BAE 19                 DAD D
0BAF C3AA0B             JMP RBLOAD2
                ;
0BB2 =          RBLOAD3 EQU $
0BB2 03                 INX B
0BB3 0A                 LDAX B
0BB4 110A00             LXI D,10        ;X10 (TENS)
                ;
0BB7 =          RBLOAD4 EQU $
0BB7 3D                 DCR A
0BB8 FABF0B             JM RBLOAD5
0BBB 19                 DAD D
0BBC C3B70B             JMP RBLOAD4
                ;
0BBF =          RBLOAD5 EQU $
0BBF 03                 INX B
0BC0 0A                 LDAX B          ;X1 (ONES)
0BC1 B7                 ORA A           ;SHOULD BE 0 OR 5 KHZ
0BC2 C2CB0B             JNZ RBLOAD5A
0BC5 3E20               MVI A,SPACE     ;IS 0, INSERT SPEECH SPACE
0BC7 02                 STAX B
0BC8 C3D00B             JMP RBLOAD6
                ;
0BCB =          RBLOAD5A EQU $
0BCB FE05               CPI 5
0BCD C0                 RNZ             ;INVALID FREQ
0BCE 5F                 MOV E,A         ;ADD ONES
0BCF 19                 DAD D
                ;
0BD0 =          RBLOAD6 EQU $
0BD0 116202             LXI D,610       ;ADJUST
0BD3 19                 DAD D
0BD4 11F1FF             LXI D,-15       ;HL=0-2999, MULTIPLE OF 5
0BD7 C5                 PUSH B          ;NOW DIVIDE BY 15
0BD8 0600               MVI B,0
                ;
0BDA =          RBLOAD7 EQU $
0BDA 19                 DAD D           ;KEEP SUBTRACTING UNTIL DONE
0BDB 04                 INR B
0BDC 7C                 MOV A,H         ;NEGATIVE? IF YES ERROR
0BDD 07                 RLC             ; (NOT MULTIPLE OF 15 KHZ)
0BDE DAE50B             JC RBLOAD8
0BE1 B5                 ORA L           ;ZERO? IF YES DONE!!!
0BE2 C2DA0B             JNZ RBLOAD7
                ;
0BE5 =          RBLOAD8 EQU $
0BE5 58                 MOV E,B         ;VALUE TO GO TO IC22 IN E
0BE6 C1                 POP B
0BE7 D8                 RC              ;RETURN IF NEG (ERROR-NOT MULT OF 15)
0BE8 03                 INX B
0BE9 0A                 LDAX B          ;GET OFFSET, 1=-600,2=SIMPLEX,3=+600
0BEA FE01               CPI 1           ;-600 KHZ?
0BEC C2FB0B             JNZ RBLOAD9
0BEF 3E2D               MVI A,MINUS     ;SAY 'MINUS'
0BF1 02                 STAX B
0BF2 7B                 MOV A,E         ;AND PROGRMAM 600 KHZ LOWER
0BF3 D628               SUI 40
0BF5 5F                 MOV E,A
0BF6 16DF               MVI D,NOT RBDUPA ;SET DUPLEX A
0BF8 C3100C             JMP RBTALK
                ;
0BFB =          RBLOAD9 EQU $
0BFB FE02               CPI 2           ;SIMPLEX?
0BFD C2080C             JNZ RBLOAD10
0C00 3E53               MVI A,'S'       ;SAY 'S', SIMPLEX
0C02 02                 STAX B
0C03 16FF               MVI D,NOT 0
0C05 C3100C             JMP RBTALK
                ;
0C08 =          RBLOAD10 EQU $
0C08 FE03               CPI 3           ;+600 KHZ?
0C0A C0                 RNZ             ;INVALID IF NOT
0C0B 3E2B               MVI A,PLUS      ;SAY 'PLUS', DUPLEX B
0C0D 02                 STAX B
0C0F 16EF               MVI D,NOT RBDUPB
                ;
0C10 =          RBTALK  EQU $
0C10 DB1B               IN AUD2
0C12 F630               ORI RBDUPA OR RBDUPB
0C14 A2                 ANA D           ;SET DUPLEX/SIMPLEX MODE OF IC22
0C15 D31B               OUT AUD2
0C17 7B                 MOV A,E
0C18 2F                 CMA
0C19 320028             STA IC22FREQ    ;WRITE FREQ TO IC22
0C1C 2A1310             LHLD TEMPAIR    ;ORIG (HL) POINTER
0C1F C33B33             JMP TALKR       ;SAY NEW FREQUENCY ON RADIO
```

gram the frequency and transmitter offset.

The interface signals to the IC-22S include transmit and receive audio, push-to-talk, receive carrier-operated switch, eight synthesizer frequency control lines, plus DUPLEX A and DUPLEX B control lines. The interface circuits simply convert the 5-volt logic levels of the microcomputer to the CMOS logic levels of the IC-22S. The pull-down resistors in the IC-22S are made pull-up resistors so that the open collector buffers can function properly. The IC-22S simplex/duplex switch must be kept in the simplex position. The circuit was built on a small board which plugs in directly, replacing the diode matrix board. Icom's molex® connector option mounts on the back to carry the signals.

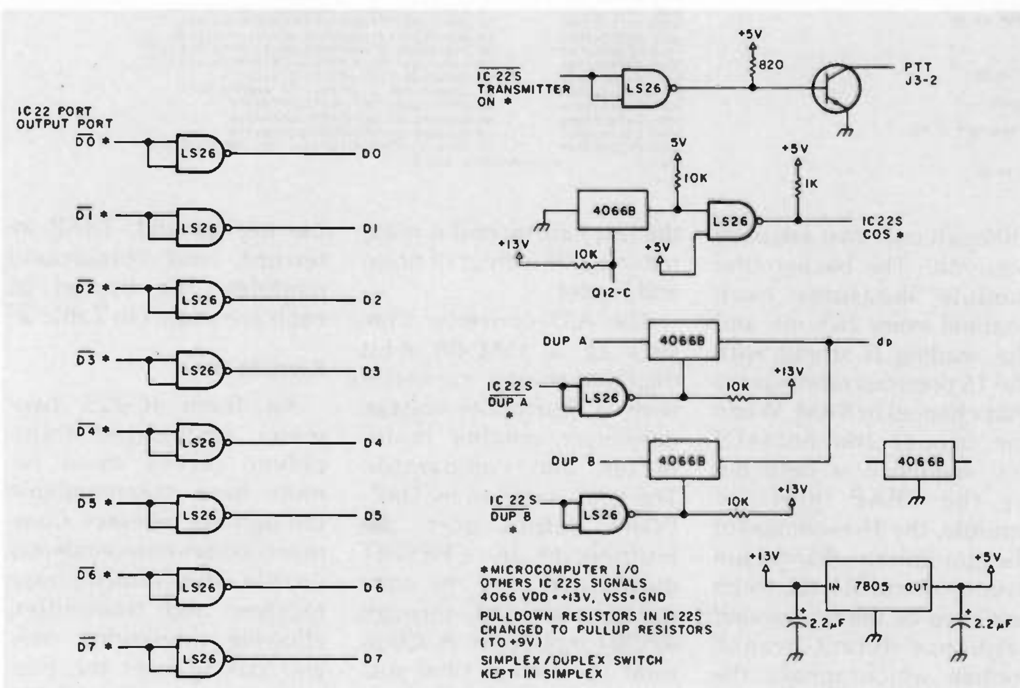

Fig. 3. IC-22S remote-base hardware interface to microcomputer. This hardware replaces the diode programming board. Note: R37 common taken to +5 V, R36 taken to +5 V, and dp resistor restored to pull-down.

The software listing is provided of the routine which programs the synthesizer's frequency and offset. The routine is executed by the foreground in response to detection of a remote-base frequency-programming command when the remote base is on. The command code consists of: (least significant MHz), (100s kHz), (10s kHz), (0 or 5 kHz), and (1 for −600-kHz offset, 2 for simplex, 3 for +600-kHz offset). For example, the 146.34/.94 pair may be selected by keying

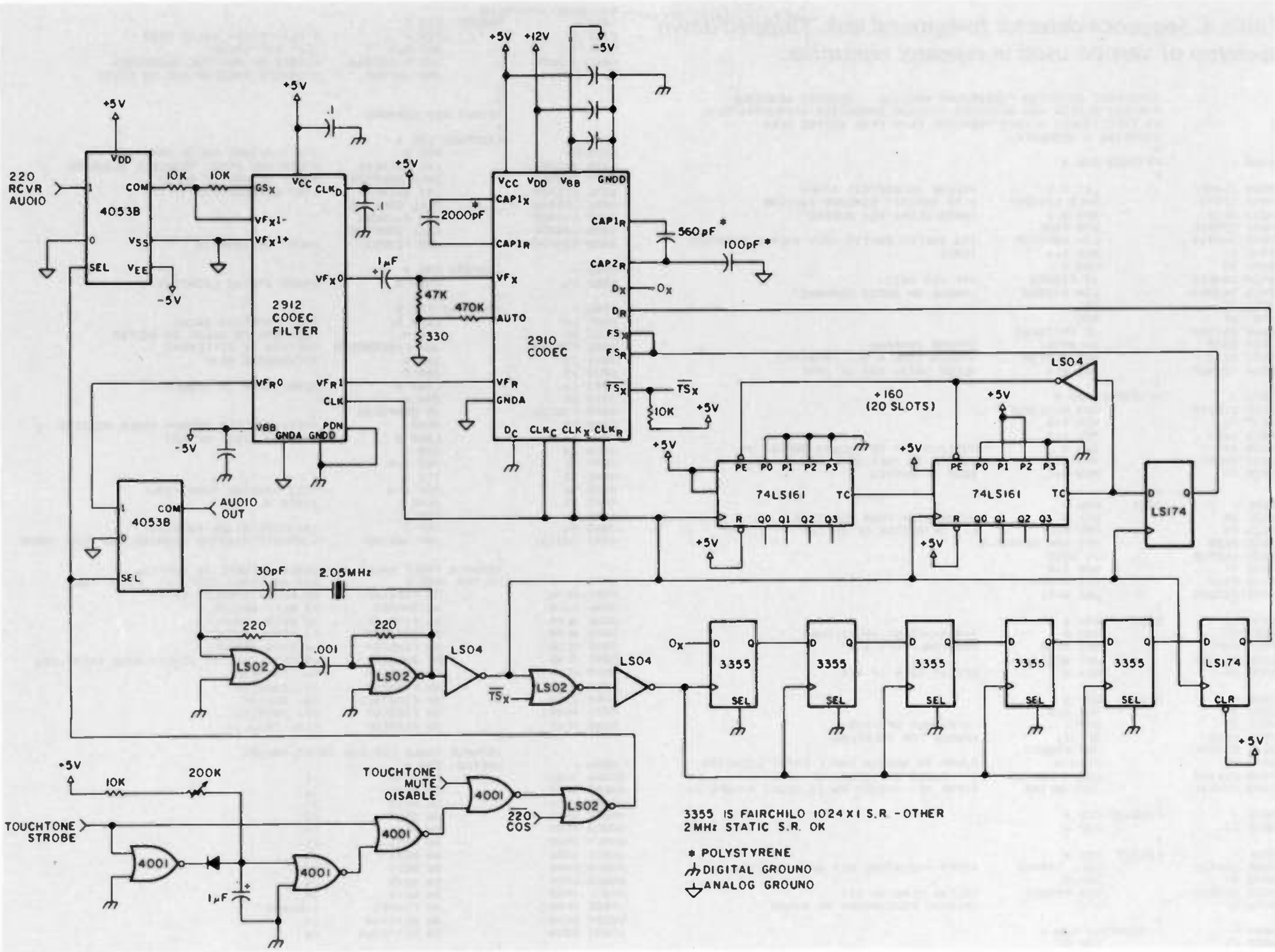

Fig. 4. Audio delay line schematic. Audio output is delayed 50 ms from the input, with squelch tails and touchtone chopped off.

in touchtone command 69401. The routine listed decomposes the command stored in the key buffer in RAM and programs the frequency synthesizer. The frequency then is read back by the speech synthesizer.

Sequence Detector

The sequence detector is a foreground task routine. Its task-pending bit is set by the timeout of the "220 only beep timer," so the task routine executes after every 220 transmission. Usually, the sequence detector finds an empty buffer and simply cleans up and returns to the foreground nucleus. If touchtone data keys have been placed in the key buffer by the TRAP input routine, meaning that commands have been sent, the sequence detector analyzes the command and, if valid, branches the program to the appropriate command routine.

A listing of a stripped-down sequence detector program is shown in Table 4. Since the # key can be used as a "clear" to cancel previous keys during a transmission, the routine scans down from the top of the used part of the buffer to either the bottom of the buffer or to a # key—whichever is found first. That point is the start of the command to be recognized.

The sequence detector is table driven—command routine addresses are stored in tables and are retrieved by the sequence detector to determine the branch location.

The first branch is based on the number of keys in the sequence—much information on the meaning of the command is provided by its length. For example, the remote-base frequency-change command may be the only valid five-digit command. The program can branch immediately to the remote-base frequency change routine to evaluate and act upon the command.

When the number of keys in the command does not uniquely identify the command, further processing occurs. If single-digit commands are used, the key value can be used to find its routine address in the ONETAB address table. For multiple-digit commands, a routine (COMPSEQ) compares each digit of the command up to the last digit to a valid string stored in the program. If the command sequence is valid, one of ten command routines is branched to based on the last digit of the command.

This approach to sequence detection is extremely flexible, easily changed, and is expandable. Special cases also can be handled easily outside the table-driven structure.

Audio Delay Line

The loudness and duration of the squelch tail in FM receivers varies, but some "chunk" exists in virtually all of them. Circuitry was built which eliminates the squelch tail and also allows total muting of touchtone command signals. By delaying the received audio on the way to the transmitter, squelch tails and touchtone can be headed off at the pass, before they go out the transmitter. The delay im-

Table 4. Sequence detector foreground task. Stripped down skeleton of version used in repeater controller.

```
                ;SEQUENCE DETECTOR FOREGROUND ROUTINE.  DECODES SEQUENCE
                ;IN KEY BUFFER AND BRANCHES PROGRAM EXECUTION APPROPRIATELY.
                ;# EFFECTIVELY CLEARS PREVIOUS KEYS FROM BUFFER WHEN
                ;SENDING A SEQUENCE.
                ;
0800 =          FPTTSEQ EQU $
                ;
0800 210000             LXI H,0         ;CLEAR INTERDIGIT TIMER
0803 222710             SHLD LSEQDET    ; TO INHIBIT TIMEOUT ROUTINE
0806 3E01               MVI A,1         ;HARD CLOSE KEY BUFFER
0808 325010             STA KBHC
080B 3A0410             LDA KBPOINT     ;IS BUFFER EMPTY? (KEY BUFFER POINTER)
080E 47                 MOV B,A         ;SAVE
080F B7                 ORA A
0810 CA4F08             JZ FINSEQ       ;IF YES QUIT
0813 3A3D10             LDA PTTSEQ      ;PHONE OR RADIO COMMAND?
0816 0F                 RRC
0817 0F                 RRC
0818 DA2208             JC FPTTSEQ1
081B DB19               IN RPORT        ;PHONE COMMAND
081D E640               ANI TTSTBB      ;TOUCH TONE STILL PRESENT?
081F C21B08             JNZ $-4         ;LOOP UNTIL END OF TONE
                ;
0822 =          FPTTSEQ1 EQU $
0822 215910             LXI H,KEYBUF
0825 58                 MOV E,B
0826 1600               MVI D,0
0828 19                 DAD D           ;(HL)-> TOP OF FILLED BUFFER +1
0829 36FF               MVI M,0FFH      ;STUFF IN TALK/DIAL TERMINATOR
082B 45                 MOV B,L         ;END OF BUFFER
                ;
082C =          SEQ1    EQU $
082C 2B                 DCX H           ;SCAN DOWN FROM TOP TO #
082D 7D                 MOV A,L         ;   OR BOTTOM OF BUFFER
082E FE58               CPI LOW KEYBUF-1
0830 CA3908             JZ SEQ2
0833 7E                 MOV A,M
0834 FE0C               CPI KPOUND
0836 C22C08             JNZ SEQ1
                ;
0839 =          SEQ2    EQU $
0839 23                 INX H           ;(HL)->FIRST VALID CHAR
083A FEFF               CPI 0FFH        ;WAS ONLY KEY A #?
083C C24008             JNZ SEQ3
083F 2B                 DCX H           ;POINT TO # IF YES
                ;
0840 =          SEQ3    EQU $
0840 78                 MOV A,B
0841 95                 SUB L           ;A=NUMBER OF KEYS
0842 FE0B               CPI 11          ;CHECK FOR OVERFLOW
0844 D24F08             JNC FINSEQ
0847 E5                 PUSH H          ;JUMP TO BRANCH TABLE ENTRY LOCATION
0848 21A408             LXI H,KBLTAB    ;   BASED ON NUMBER OF KEYS
084B C34131             JMP JMPTAB      ;(POP RP)->FIRST VALID CHAR, R=KBPOINT
                ;
084E =          FINSEQP EQU $
084E E1                 POP H
                ;
084F =          FINSEQ  EQU $
084F CD6131             CALL TTOPEN     ;OPEN TOUCHTONE KEY BUFFER, ETC.
0852 AF                 XRA A
0853 323D10             STA PTTSEQ      ;CLEAR PENDING BIT
0856 37                 STC             ;RESYNC FOREGROUND TO BKGND
                ;
0857 =          FINCOMPSEQ EQU $
0857 E1                 POP H
0858 C9                 RET
                ;
0859 =          VALIDSEQP EQU $
0859 E1                 POP H
                ;
085A =          VALIDSEQ EQU $
085A 217C33             LXI H,VMARK     ;ACKNOWLEDGE VALID SEQUENCE
085D 3A3D10             LDA PTTSEQ      ;  WITH SPEECH (SAY 'MARK')
0860 0F                 RRC             ;PHONE OR RADIO COMMAND?
0861 0F                 RRC
0862 DA6908             JC VALIDSEQR
0865 CD4733             CALL TALKP      ;TALK ON PHONE
                        JMPFINSEQ
0868+E7                 RST 4
                ;
0869 =          VALIDSEQR EQU $
0869 CD3B33             CALL TALKR      ;  OR RADIO
                        JMPFINSEQ
086C+E7                 RST 4
                ;
                ;DECIDE ON TYPE OF SEQUENCE BASED ON NUMBER OF CHARS
                ;
                ;ONE KEY COMMAND
                ;
086D =          ONEDEC  EQU $
086D E1                 POP H           ;(HL)->FIRST VALID CHAR
086E 7E                 MOV A,M         ;GET KEY VALUE
086F 21BA08             LXI H,ONETAB    ;TABLE OF ROUTINE ADDRESSES
0872 C34131             JMP JMPTAB      ;COMPUTE ADDRESS AND GO THERE
                ;
                ;
                ;EIGHT KEY COMMAND
                ;
0875 =          EIGHTDEC EQU $
0875 E1                 POP H           ;(HL)->FIRST VALID CHAR
0876 111009             LXI D,LSEQ1     ;TEST FOR FIRST POSSIBLE SEQUENCE
0879 CD8B08             CALL COMPSEQ    ;DONT RETURN IF VALID
087C 111A09             LXI D,LSEQ2     ;TRY SECOND, ETC
087F CD8B08             CALL COMPSEQ
0882 112409             LXI D,LSEQ3
0885 CD8B08             CALL COMPSEQ
0888 C34F08             JMP FINSEQ      ;MUST BE INVALID
                ;
088B =          COMPSEQ EQU $
088B E5                 PUSH H          ;SAVE STRING LOCATION
                ;
088C =          COMPSEQ1 EQU $
088C 1A                 LDAX D          ;GET EXPECTED VALUE
088D BE                 CMP M           ;COMPARE TO VALUE IN BUFFER
088E C25708             JNZ FINCOMPSEQ  ;RETURN IF DIFFERENT
0891 23                 INX H           ;OTHERWISE NEXT
0892 13                 INX D
0893 1A                 LDAX D          ;LAST CHAR IN SEQUENCE?
0894 B7                 ORA A
0895 F28C08             JP COMPSEQ1
0898 EB                 XCHG            ;YES, NOW GET BRANCH TABLE ADDRESS
0899 1A                 LDAX D          ;A=LAST DIGIT OF SEQ
089A 23                 INX H
089B 5E                 MOV E,M
089C 23                 INX H
089D 56                 MOV D,M         ;GET ADDRESS FROM TABLE
089E EB                 XCHG            ;INTO HL
089F D1                 POP D
08A0 D1                 POP D           ;RESTORE STACK POINTER
08A1 C34131             JMP JMPTAB      ;COMPUTE ROUTINE ADDRESS AND JUMP THERE
                ;
                ;BRANCH TABLE BASED ON NUMBER OF KEYS IN BUFFER
08A4 =          KBLTAB  EQU $           ;AT ROUTINE, (POP RP)->FIRST CHAR
08A4 4E08               DW FINSEQP      ;0 KEYS, INVALID ENTRY
08A6 6D08               DW ONEDEC       ;1 KEY, DECIDE
08A8 4E08               DW FINSEQP      ;2 KEYS, INVALID
08AA 4E08               DW FINSEQP      ;3 KEYS, INVALID
08AC 4E08               DW FINSEQP      ;4 KEYS, INVALID
08AE 310B               DW RBLOADP      ;5 KEYS, MAY BE REMOTE BASE FREQ LOAD
08B0 4E08               DW FINSEQP      ;6, INVALID
08B2 4E08               DW FINSEQP      ;7, INVALID
08B4 7508               DW EIGHTDEC     ;8, DECIDE
08B6 4E08               DW FINSEQP      ;9, INVALID
08B8 4E08               DW FINSEQP      ;10, INVALID
                ;
                ;BRANCH TABLE FOR ONE ENTRY BUFFER
08BA =          ONETAB  EQU $
U08BA 0000              DW KEY0         ;0
U08BC 0000              DW KEY1         ;1
U08BE 0000              DW KEY2         ;2
U08C0 0000              DW KEY3         ;3
U08C2 0000              DW KEY4         ;4
U08C4 0000              DW KEY5         ;5
U08C6 0000              DW KEY6         ;6
U08C8 0000              DW KEY7         ;7
U08CA 0000              DW KEY8         ;8
U08CC 0000              DW KEY9         ;9
 08CE 4F08              DW FINSEQ       ;(BLANK)
U08D0 0000              DW KEYSTAR      ;*
U08D2 0000              DW KEYPOUND     ;#
                ;
                ;
                ;1234567X BRANCH TABLE
08D4 =          T123TAB EQU $
08D4 4F08               DW FINSEQ       ;0
08D6 4F08               DW FINSEQ       ;1
08D8 4F08               DW FINSEQ       ;2
08DA 4F08               DW FINSEQ       ;3
08DC 7409               DW CWID         ;4
08DE 5C09               DW VOICEID      ;5
08E0 1031               DW AUTOPATCHON  ;6
08E2 4F0D               DW RBRCVRON     ;7
08E4 7F0D               DW RBRCVROFF    ;8
08E6 4F08               DW FINSEQ       ;9
                ;
                ;LONG SEQUENCES - FIRST 7 OF 8 OF COMMAND CODE
                ;  AND BRANCH TABLE ADDRESS
                ;
 0910 0102030405LSEQ1:  DB 1,2,3,4,5,6,7,0FFH
 0918 D408              DW T123TAB
 091A 0706050403LSEQ2:  DB 7,6,5,4,3,2,1,0FFH
U0922 0000              DW T765TAB
 0924 0203040506LSEQ3:  DB 2,3,4,5,6,7,8,0FFH
U092C 0000              DW T234TAB
```

plemented was 50 ms, allowing the audio to be muted gently just prior to the squelch tail or touchtone reaching the transmitter.

Audio delays can be implemented with bucket-brigade devices—particularly short delays—but the approach used here for the relatively long delay was an Intel Codec chip plus digital shift registers. The Codec is a complete two-way data acquisition system, primarily intended for use in telephone equipment. It converts an incoming audio signal to a digital bit stream, and an incoming bit stream to an audio output signal, for a two-way pulse code modulation system. As used here, however, the digital bit stream is simply delayed through the shift registers and returned to the Codec. The audio output is therefore a delayed version of the audio input. Any delay length can be accomplished by selection of the size of the shift register, but five 1024-by-1 shift registers used here provide the desired 50-ms delay.

Audio Mixers

The various audio sources in the repeater are connected to the 220 transmitter and to the phone line under computer control. AUD1 and AUD2 output ports select one or more audio sources to be enabled into the two mixers. The audio switching is solid state and is quite simple considering that there is no detectable click or pop when switched and no detectable feedthrough in an open switch. 4053B single-pole, double-throw CMOS analog switches are used. When the audio switch is open, the output is shunted to ground to eliminate any signal feedthrough. Good grounding and isolation of the CMOS switch power supply from the computer logic are important to keep out noise. The low-power Schottky control line buffers ensure clean logic levels to the CMOS, even in the presence of possible crosstalk on an interconnect cable.

Repeater Performance

No significant problems were encountered in bring-

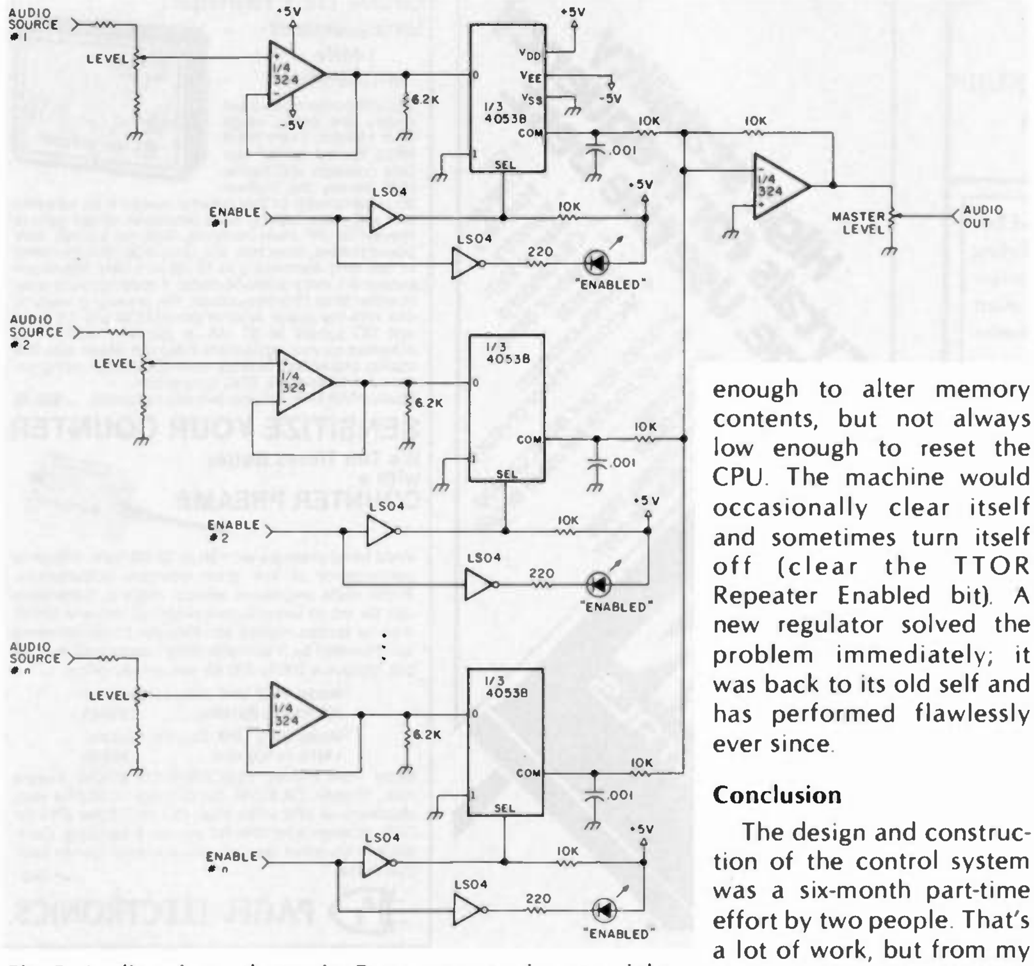

Fig. 5. Audio mixer schematic. Repeater contains one eight-input and one four-input mixer.

ing up the control system. We were concerned about rf interference from the computer's high-speed digital logic, but since the 220 receiver is very well shielded, there were no problems. The IC-22S remote base required feedthrough capacitors to be placed on all control lines leaving the repeater cabinet to keep rf off certain two-meter frequencies. RFI is something to be concerned about, but it isn't necessarily a serious problem.

When the repeater went back on the hilltop with the new controller, it worked very well. Some minor software changes were made after eight weeks—the ROMs were simply changed.

There was one failure in the system, occurring after eleven weeks. The three-terminal regulator on the computer board became intermittent—probably a high resistance internal bond, definitely not thermal shutdown. The computer's supply voltage occasionally dropped low enough to alter memory contents, but not always low enough to reset the CPU. The machine would occasionally clear itself and sometimes turn itself off (clear the TTOR Repeater Enabled bit). A new regulator solved the problem immediately; it was back to its old self and has performed flawlessly ever since.

Conclusion

The design and construction of the control system was a six-month part-time effort by two people. That's a lot of work, but from my viewpoint it was well worth it. Use of the computer in the controller allowed building in really useful features that would not have been possible without it. The software intensive approach was extremely educational and is the only practical approach for a system of this complexity. The project was the most satisfying microcomputer project I've been involved in.

Sincerest thanks go to Bruce Martin WA6EQS who shared half the work of this project. Bruce is the father of the three-year old repeater and had many of the ideas for features and their implementation in the new control system.

Don Pezzolo K6OZH contributed to the project as a resource for bouncing ideas back and forth throughout the development. His continuing encouragement throughout the project was a big factor in its successful completion. Don also manages the repeater site and keeps the machine happy in its home.

Behind the repeater is the rf expert Werner Vavken WB6RAW, who, with WA6EQS and Ray Maxfield WA6VAB, is responsible for the rf portion of the machine. Bill Melody WA6YBD installed and maintains the antenna systems.

Parts and equipment were contributed by WA6EQS, W6LVY, W6YJL, WA6VAB, and WB6WDP. ■

	Standard			ASCII	
zero	forty	dollars	space	six	J
one	fifty	cents	x-point	seven	K
two	sixty	pounds	quote	eight	L
three	seventy	ounces	number	nine	M
four	eighty	total	dollars	colon	N
five	ninety	please	percent	semicolon	O
six	hundred	feet	and	less than	P
seven	thousand	meters	apostrophe	equals	Q
eight	plus	centimeters	left paren	greater than	R
nine	minus	volts	right paren	mark	S
ten	times	ohms	star	at	T
eleven	over	amps	plus	A	U
twelve	equals	hertz	comma	B	V
thirteen	point	DC	minus	C	W
fourteen	overflow	AC	point	D	X
fifteen	clear	down	slash	E	Y
sixteen	percent	up	zero	F	Z
seventeen	and	go	one	G	lowercase
eighteen	seconds	stop	two	H	tone
nineteen	degrees	tone (low)	three	I	upper case
twenty		tone (high)	four		up arrow
thirty		oh	five		control

Table 5. Telesensory Systems Mini Speech Synthesis PC boards vocabulary.

✓ Reader Service—see page 226

Make a Microcomputerist Smile

—build him this EPROM eraser

Herbert M. Rosenthal AL7G
2941 Brandywine
Anchorage AK 99502

One of my friends, who is deep into the home-computer hobby, had a difficult time locating an eraser for his 2716 EPROM. He finally located one that was built into a plastic tape-cartridge storage box and it worked fine. A quick look inside the box revealed that the manufacturer simply epoxied a pair of sockets to the edges of the box, bolted a small fluorescent ballast to it, drilled a hole for the line cord, and included the usual 4-wire fluorescent starter switch. El Cheapo at its best, but we wondered about the safety of the device as we had heard of the potential injury to eyes and skin from exposure to ultraviolet (UV) rays. The tube used in the device was a Sylvania G8T5—remember this, as it's important.

The next EPROM eraser we saw was built by someone with a much better concept. It had an all-metal case with a drawer that held the EPROM in conductive foam. The drawer had to be in place before a switch was operated to complete the circuit. No UV leakage, no unintentional viewing of UV. This one also had a 60-minute timer built in. It appears that the bulb used by the latter device has a much stronger output, for the suggested erasing times were in the area of 20-30 minutes. The bulb has a house number and no doubt is made by or for that company and thus would not readily be available to the home constructor.

Tube: G8T5
Nominal Watts: 8
Nominal length: 12"
Tube diameter: 5/8"
Approx. lamp Amps: 0.160
Approx. hours of life: 7500
Effective UV length: 8½"
UV output @ 2537 angstroms at 100 hours, Watts: 1.3
Average UV output through life: 0.98 Watts
Max. intensity perpendicular to bare tube:
Watts/Square Foot at:
1 ft—0.14
8"—0.315
4"—0.86
2"—0.75
These are averages at 100 hours life; initial ratings about 20% higher, decreasing to an average of 0.75 ratings above, through life.

Fig. 1. Useful data if you "roll your own." Source: General Electric TP-122, Large Lamp Department.

The next chapter in this story comes from a 14-page General Electric manual, "Germicidal Lamps," TP-122, from their Large Lamp Department. I obtained a copy of this from the local industrial dealer for these lamps. An inquiry to them on the Sylvania number revealed that GE and others (Norelco) also make this lamp for air irradiation and other germicidal devices. We joked about the UV bulb in the electric razor at the airport (ten minutes, two bits) . . . all along my friend could have erased the EPROM while he was shaving! (Also used at the bowling alley to sterilize the rental shoes.)

But something good did come of this pursuit. Whereas the electric dealer would order the bulbs only in quantities of 24 or more, we found that the local barber and beauty supply house had them in stock and would sell them at retail for about ten dollars. Click. A small 6- to 8-Watt fluorescent tube ballast and switch are another six or seven dollars; everyone has a microswitch in his junk box for the absolutely mandatory interlock switch. Click. LMB and others make metal boxes; plywood is cheap; the tube is nominally 12" long, and the EPROM should end up *under* the lamp, about 1" from it, centered along the bulb, and impressed in the black conductive foam it came in. *Under* the bulb is specified so that the UV rays and not the heat from the bulb work on the EPROM. The effective length of the UV radiation is 8½", so cluster the EPROMs from the center of the bulb.

Back to the GE manual. To allay any fears about the use of UV at all, I quote, "... Prolonged exposures or exposures to high intensities of ultraviolet energy can cause conjunctivitis (inflammation of the outer membrane of the eyes) and a reddening, or burns, of the skin. The glass used in conventional eyeglasses affords adequate protection. However, care should be taken that the UV energy does not enter the eyes from the side, nor is reflected into the eyes from the back side of the glass. To protect the face, clear plastic face shields are available... General practice is to consider 0.5 microwatts per square centimeter of 2537-angstrom energy in a 7-hour period to be the maximum safe exposure without protection. An equivalent amount of exposure will be obtained from a bare 30-Watt lamp in one minute at 18 inches or in one hour at 12 feet."

Most of the rest of the manual describes the use of the family of germicidal lamps—from a 2¼" length to the largest, which is 64"; the lamps are used in everything from air cleaners to meat-cooling rooms to pharmaceutical manufacturing. But what should interest us the most is that the spectral response of these mercury vapor lamps peaks at 2537 angstroms, the exact wavelength called out for *all* EPROM erasures.

Fig. 1 is a compilation of data that will be of use to you if you choose to "roll your own." Fig. 2 shows typical wiring for a unit. Note in this latter drawing that the fluorescent switch, a 4-wire unit, performs the function of on-off and start, without a starter. If this switch is not available, one could use two separate ones, an SPST on-off switch and an SPST normally-open push-button for the momentary depress-to-start.

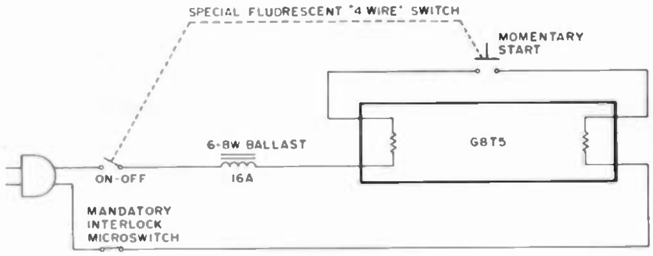

Fig. 2. Typical wiring.

It probably wouldn't hurt to fabricate a reflector from soft cardboard and then cover it with shiny aluminum cooking foil. Place this a couple inches above the lamp; it can only increase the UV intensity to the EPROM. Provide a small hole (¼" will do) covered with milky white plastic to act as a pilot lamp. Try a one-hour exposure as a beginning point.

In summary, you *can* have an ultra EPROM eraser, violet, for about $20, some ingenuity, and a lot of fun... but only if you promise to observe the strict cautions from the GE manual, which suggests that all products using germicidal lamps bear a prominent, highly legible CAUTION warning that no one should look directly at a lighted lamp or work near it without adequate eye (and skin) protection. Don't forget that interlock switch, be it on a tray or door! ■

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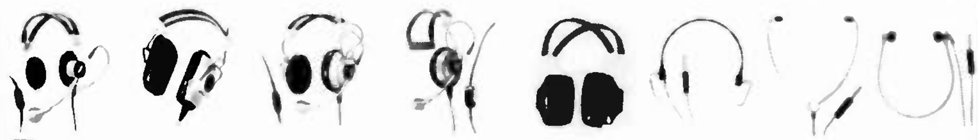

CM-610 CM-1210 CM-1320 CM-1320-S PC-100 HTC-2 HMC-2 HTC-91

MODEL	C-610	SWL-610	C-1210	C-1320	CM-610	CM-1210	CM-1320	CM-1320S	PC-100	HTC-2	HMC-2	HFC-91
Headphone Sensitivity Ref 0002 Dynes/cm² @ 1mW Input, 1kHz	103dB SPL ±5dB	103dB SPL ±5dB	103dB SPL ±3dB	105dB SPL ±5dB	103dB SPL ±5dB	103dB SPL ±3dB	105dB SPL ±5dB	105dB SPL ±dB				
Headphone Impedance	3.2 20 ohms	2000 ohms	3.2 20 ohms	3.2 20 ohms	3.2 20 ohms	3.2 20 ohms	3.2 20 ohms	3.2 20 ohms	8 200 ohms	3.2 20 ohms	3.2 20 ohms	3.2 20 ohms
Microphone Frequency Response					50 8000 Hz	50 8000 Hz	50 8000 Hz	50 8000 Hz	50 1200 Hz	100 3000 Hz	100 3000 Hz	100 3000 Hz
Microphone Impedance					High	High	High	High	Low	Low	Low	Low
Microphone Sensitivity Below 1 volt/microbar at 1 kHz					51 dB ±5 dB	51 dB ±5 dB	51 dB ±5 dB	51 dB ±5 dB				
PRICE:	$10.45	$12.25	$29.70	$41.80	$47.20	$62.75	$75.25	$59.95	$16.95	$24.50	$15.50	$9.90

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12V4	$19.95	104R	$ 59.95
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107	36.95	108RM	99.95
103R	42.95	109R	159.95

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NPC 4 Amp Power Supply, 6 Amp Max Solid State, Overload Protected

Functions silently in converting 115 volts AC to 12 volts DC 4 amps continuous 6 amps max Enables anyone to enjoy CB radio, car 8-track cartridge, cassette player or car radio in a home or office

Continuous Current (Full Load)	4 Amp
Output Voltage (No Load)	16 V max
Output Voltage (Full Load)	12 V min
Filtering Capacitor	10,000 uF
Ripple (Full Load)	5 V RMS
Short Circuit Protection	Thermal Breaker

Case 3" (H) × 4⅝" (W) × 5⅝" (D) Shipping Weight 5 lbs

MODEL 12V4

$19.95

NPC 1.75 Amp Power Supply, 3 Amp Max.

Functions silently in converting 115 volts AC to 12 volts DC Ideally suited for most applications including 8-track stereo, burglar alarm, car radio and cassette tape player within power rating

Continuous Current (Full Load)	1.75 Amp
Output Voltage (No Load)	16 V max
Output Voltage (Full Load)	12 V min
Filtering Capacitor	5,000 uF
Ripple (Full Load)	4 V RMS
Short Circuit Protection	Thermal Breaker

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Extra heavy duty unit quietly converts 115 volts AC to 13.6 volts DC ± 200 millivolts 10 amps continuous 25 amps max All solid state Features dual current overload overvoltage and thermal protection Ideally suited for operating mobile Ham radio and linear amplifier in your home or office Excellent bench power supply for testing and servicing of mobile communications equipment

	Typical	Maximum
Output Voltage	13.6 ± .2VDC	13.6 ± .3VDC
Line/Load Regulation	50 mV	100 mV
Ripple Noise	5 mV RMS	10 mV RMS
Transient Response	20 uSec	
Current Continuous	10 Amp	
Current Limit	26 Amp	
Overvoltage Protection	14.5 V	15 V
Thermal Overload	180 F	

Case 4⅝ (H) × 9" (W) × 8⅞ (D) Shipping Weight 15 lbs

MODEL 108RM

$99.95

NPC 12 Amp Regulated Power Supply Solid State 3 Way Protected Current Meter

This heavy duty unit quietly converts 115 volts AC to 13.6 volts DC ± 200 millivolts 8 amps continuous 12 amps max All solid state Features dual current overload and overvoltage protection Ideally suited for operating mobile Ham radio 2 meter AM FM SSB transceivers in your home or office Can also be used to trickle charge 12 volt car batteries

	Typical	Maximum
Output Voltage	13.6 ± .2VDC	13.6 ± .3VDC
Line/Load Regulation	20 mV	50 mV
Ripple/Noise	2 mV RMS	5 mV RMS
Transient Response	20 uSec	
Current Continuous	8 Amp	
Current Limit	12 Amp	
Current Foldback	2.5 Amp	
Overvoltage Protection	14.5 V	15 V

Case 4½ (H) × 7½ (W) × 5 (D) Shipping Weight 9.5 lbs

ALSO AVAILABLE AS MODEL 108RA WITHOUT METER AND OVERVOLTAGE PROTECTION.

MODEL 104R

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NPC 6 Amp Power Supply Regulated Solid State, Dual Overload Protection.

Converts 115 volts AC to 13.6 volts DC ± 200 millivolts Handles 4 amps continuous and 6 amps max Ideally suited for applications where excellent DC stability is important such as CB transmission small Ham radio transmitter and high quality eight track car stereos Can be used to trickle charge 12 volt car batteries

	Maximum	Typical
Output Voltage	13.6 ± .2 VDC	13.6 ± .3 VDC
Line/Load Regulation	20 mV	50 mV
Ripple/Noise	2 mV RMS	5 mV RMS
Transient Response	20 uSec	
Current Continuous	4 Amp	
Current Limit	6 Amp	
Current Foldback	2 Amp	

Case 3 (H) × 5 (W) × 6 (D) Shipping Weight 6 lbs

MODEL 103R

$42.95

NPC 4 Amp Regulated Power Supply, Solid State, Dual Overload Protection.

Converts 115 volts AC to 13.6 volts DC ± 200 millivolts Handles 2.5 amps continuous and 4 amps max Ideally suited for applications where no hum and DC stability are important such as CB transmission small Ham radio transmitter, and high quality eight-track car stereos Can also be used to trickle charge 12 volt car batteries

	Typical	Maximum
Output Voltage	13.6 ± .2 VDC	13.6 ± .3 VDC
Line/Load Regulation	20 mV	50 mV
Ripple/Noise	2 mV RMS	5 mV RMS
Transient Response	20 uSec	
Current Continuous	2.5 Amp	
Current Limit	4 Amp	
Current Foldback	1 Amp	

Case 3 (H) × 4 (W) × 5 (D) Shipping Weight 4 lbs

MODEL 102

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NPC 2.5 Amp Power Supply, 4 Amp Max. Solid State, Overload Protected.

Functions silently in converting 115 volts AC to 12 volts DC 2.5 amps continuous 4 amps max Enables anyone to enjoy CB radio, car 8 track cartridge, cassette tape player or car radio in a home or office

Continuous Current (Full Load)	2.5 Amp
Output Voltage (No Load)	16 V max
Output Voltage (Full Load)	12 V min
Filtering Capacitor	5,000 uF
Ripple (Full Load)	6 V RMS
Short Circuit Protection	Thermal Breaker

Case 3" (H) × 4½ (W) × 5½ (D) Shipping Weight 4 lbs

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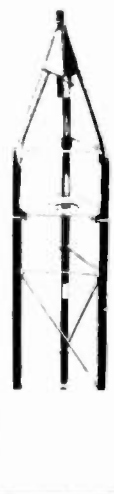

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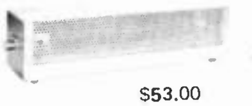

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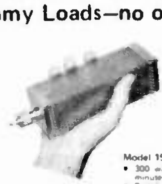
Model 1551 Drake DL-1000
- 1000 watts for 30 seconds with derating curve up to 5 minutes. Designed to accept Drake FA-7 cooling fan for extended high power operation
- VSWR of 1.5:1 max 0-30 MHz
- Provided with SO-239 coax connector, and rubber feet for desk or bench use
- Size 14" x 3.6" (35.6 x 8.1 cm) Wt. 2 lbs (910 g)



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Model 1550 Drake DL-300
- 300 watts for 30 seconds with derating curve to 5 minutes
- Built in PL-259 coax connector for direct connection to rear of transceiver or transmitter — no jumper coax necessary
- VSWR or 1.1:1 max, 0-30 MHz 1.5 max, 30-160 MHz
- Ideal as bench test device for amateur or commercial hf and vhf gear
- Small size fits conveniently in any field service tool box, 6.7" x 2.08" (17.0 x 5.3 cm). Wt. 11 Oz (310 g)

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MODEL NUMBER	MODEL	DESCRIPTION	PRICE
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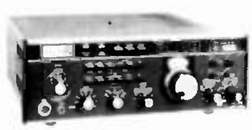
1240	R7-/DR-7	0-30 MHz General Coverage, Digital Synthesized Receiver	1449.00
1548	R-7/TR-7	Cable Interface Kit	24.50
1532	NB-7A	Noise Blanker for R-7	90.00
7021	SL-300	300 Hz CW Filter for 7-line	55.00
7022	SL-500	500 Hz CW Filter for 7-line	55.00
7023	SL-1800	1800 Hz RTTY Filter for 7-line	55.00
7026	SL-4000	4000 Hz AM Filter for R-7	55.00
7024	SL-6000	6000 Hz AM Filter for 7-line	55.00
1531	MS-7	Speaker for 7-line	39.00
1217	4-NB	Noise Blanker for R-4C	74.00
7011	FL250	250 Hz CW Filter for R-4C	55.00
7013	FL-500	500 Hz CW Filter for R-4C	55.00
7015	FL-1500	1500 Hz RTTY Filter for R-4C	55.00
7017	FL-4000	4000 Hz AM Filter for R-4C	55.00
7019	FL-6000	6000 Hz AM Filter for R-4C	55.00
VHF-FM TRANSCEIVERS AND ACCESSORIES			
1330	UMK-3	Remote Trunk Kit for UV-3	69.95
1339	————	Extra Control Head for UV-3	90.00
1525	1525EM	Encoder Microphone for UV-3	49.95
AMPLIFIERS			
1528	L-7	160-15m Amplifier, Power Supply	1090.00
1578	L-7E	160-10m Amplifier, Power Supply	1090.00
ANTENNA TUNERS AND ACCESSORIES			
1538	MN-7	250W, 160-10m Tuner	175.00
1539	MN-2700	2KW, 160-10m Tuner	299.00
1510	B-1000	4:1 Balun for MN-7/MN-2700	26.95
1533	CS-7	Remote Controlled Antenna Switch	169.00
1514	WH-7	1.8-54 MHz 20/200/2000 Wattmeter	99.00
1550	DL-300	300W Dummy Load	26.95
1551	DL-1000	1000W Dummy Load	53.00
1529	FA-7	Fan for DL-1000/TR-7/PS-7	29.00
HF TRANSCEIVERS AND ACCESSORIES			
1336	TR-7/DR-7	Digital HF transceiver 160-10m (receives 1.5-30MHz)	$1549.00
1537	NB-7	Noise Blanker for TR-7	90.00
7021	SL-300	300 Hz CW Filter for 7-line	55.00
7022	SL-500	500 Hz CW Filter for 7-line	55.00
7023	SL-1800	1800 Hz RTTY Filter for 7-line	55.00
7024	SL-6000	6000 Hz AM Filter for 7-line	55.00
1536	AUX-7	Auxiliary Range Program Board for TR-7 (for out of band coverage)	45.00
1546	RRM-7	Range Receive Modules	8.50
1547	RTM-7	Range Transceive Modules	8.50
1529	FA-7	Fan for TR-7/PS-7/DL-1000	29.00
1338	RV-7	Remote VFO for TR-7	195.00
1531	MS-7	Speaker for 7-line	39.00
1335	MMK-7	Mobile Mount for TR-7	49.95
7073	7073	Dynamic Mobile mic. w/Plug TR-7	24.50
7077	7077	Dynamic Desk mic. w/Plug TR-7	49.00
7037	7037	TR-7 Service Kit	50.00
POWER SUPPLIES AND ACCESSORIES			
1501	AC-4	Power Supply for 4-line, 110/220V	S 150.00
1505	DC-4	12 VDC Power Supply for 4-line	195.00
1504	PS-3	Power Supply for UV-3, 110/220V	89.95
1502	PS-7	Power Supply for TR-7, 110/220V	299.00
1529	FA-7	Fan for PS-7/TR-7/DL-1000	29.00
LOW PASS AND HIGH PASS TVI FILTERS			
1605	TV-42LP	100W Low Pass Filter	14.60
1608	TV-3300LP	1000W Low Pass Filter	26.60
1603	TV-300HP	High Pass Filter for 300 Ohm Twin Lead	10.60
1610	TV-75HP	High Pass Filter for 75 Ohm	13.25
ACCESSORY CRYSTALS			
		Crystals for 2C/R4B/R4C/SW4A/SPR4/ML2/T4XB/T4XC/TR4C/TR4CW	9.50
		Crystals for fixed frequency operation of tunable units/2NT	10.50
		Crystals for TR22/TR22C	9.50
		Crystals for TR72/TR33C	9.50

Drake L-7
2kW Linear Amplifier

10m-160m coverage. 2kW PEP, 1kW CW, RTTY, SSTV operation — all modes, full rated input, continuous duty cycle. Accurate built-in rf wattmeter, with forward/reverse readings, is switch selected. By-pass switching for straight through, low power operation without having to turn off amplifier. Bandpass tuned input circuitry for low distortion and 50 Ohm input impedance. Operates from 120/240 Vac, 50/60 Hz primary line voltage.

TR7/DR7 TRANSCEIVER



In the past few years, several amateur transceivers have appeared on the market boasting features and techniques considered to be "state-of-the-art" in regards to communications technology. More often than not, these features and techniques have been incorporated without the initial expense of the development time necessary to assure that the resulting equipment represented an advancement in communications technology with respect to both performance and operator convenience.

The Drake TR7 Transceiver represents a unique blend of proven state-of-the-art techniques culminating in the first truly state-of-the-art transceiver presently available.

A product of the Drake "anything worth doing is worth doing right" philosophy, the TR7's many new techniques and operational features complement each other producing performance and convenience which will remain unexcelled for many years to come.

DRAKE

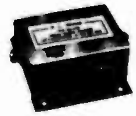
Drake UV-3
UHF-VHF FM Transceiver
- Fully synthesized on each band, 5 kHz steps, digital readout.
- FM coverage on complete 144, 220 and 440 Amateur bands, depending on model purchased. Completely band-switched from front panel.
- Four extra diode programmable fixed channels, with offsets, available for each band, in addition to the synthesizer.
- Diode programmable non-standard offsets available for each band.
- Separate SO-239 Antenna Connector for each band.
- Scan a programmed fixed channel from any synthesizer frequency. Scan any synthesizer frequency from a programmed fixed channel. Scan a specific programmed fixed channel from another programmed fixed channel.

UV-3 OPTIONAL ACCESSORIES:
- Removable control head will operate radio in trunk compartment from driver's seat.
- PS-3 — companion ac power supply.
- Drake 1525EM Encoding Mike.

High Pass Filters for TV Sets

provide more than 40 dB attenuation at 52 MHz and lower. Protect the tv set from amateur transmitters 6-160 meters.

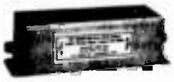
DRAKE TV-300-HP
Model No. 1603
For 300 Ohm twin lead. New terminals for easy installation.



DRAKE TV-75-HP
Model No. 1610
For 75 Ohm tv coaxial cable; tv type "F" connectors installed.

Low Pass Filters for Transmitters

have four pi sections for sharp cut off above the hf amateur bands and to attenuate transmitter harmonics falling in any tv channel and FM band. 52 Ohm. SO-239 connectors built in.



DRAKE TV-3300-LP
Model No. 1608
1000W max. below 30 MHz. Attenuation better than 80 dB above 41 MHz. Helps tv i-f interference, as well as harmonic interference.

DRAKE TV-42-LP
Model No. 1605
A four section filter designed with 43.2 MHz cut-off and extremely high attenuation in all tv channels for transmitters operating in 30 MHz and lower. Rated 100W input.

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PALOMAR ENGINEERS

$299.95

ANTENNA TUNER

Here is a new tuner that puts more power into your antenna, works from 160m–10m, handles full legal power and then some, and works with coax, single wire and balanced lines. And it lets you tune up without going on the air.

All tuners lose some rf power, mostly in the inductance coil and the balun core. To avoid this we switched from No. 12 wire for the main inductor to ¼" copper tubing. It can carry ten times the rf current. And we've moved the balun from the output, where it almost never sees its design impedance, to the input where it always does. Thus more power to your antenna.

The biggest problem with tuners is getting them tuned up. With three knobs to tune on your tranceiver and three on the tuner and ten seconds to do it (see the warning in your transceiver manual) that's 1½ seconds per knob. We have a better way; a built-in 50 Ohm noise bridge that lets you set the tuner controls without transmitting. And a switch that lets you tune your transmitter into a dummy load. So you can do the whole tuneup without going on the air. Saves that final; cuts QRM.

TEMPO
the first in synthesized portables gives you the broadest choice at the lowest price

TEMPO

PRICE LIST

Tempo S-5	$299.00
Tempo S-5 with touch tone pad	339.00
12 Button touch tone pad (not installed)	39.00
16 Button touch tone pad (not installed)	48.00
Tone burst generator	29.95
CTCSS sub-audible tone control	29.95
Rubber flex antenna	8.00
Leather holster	16.00
Cigarette lighter plug mobile charging unit	6.00
Matching 30 watt output 13.8 VDC power amplifier (S30)	89.00
Matching 80 watt output power amplifier (S80)	149.00
Tempo S-2	349.00
Tempo S-2 with touch tone pad	399.00
Tempo S-1	259.00
Tempo S-1 with touch tone pad	289.00

... the new S-5

* The only synthesized hand-held offering 5 watts output. (Switchable for 1 or 5 watt operation)
* The same dependability as the time proven S-1. Circuitry that has been proven in more than a million hours of operation.
* Heavy duty battery pack.
* Telescoping whip antenna.
* Ni-cad battery pack, charger.
* External microphone capability.

the Tempo S-2

Tempo is first again. This time with a superior quality synthesized 220 MHz hand-held transceiver. With an S-2 in your car or pocket you can use 220 MHz repeaters throughout the U.S. It offers all the advanced engineering, premium quality components and exciting features of the S-1. The S-2 offers 1000 channels in an extremely lightweight but rugged case.

If you're not on 220 this is the perfect way to get started. With the addition of the S-25 (25W output) or S-75 (75W output) Tempo solid state amplifier it bcomes a powerful mobile or base station. If you have a 220 MHz rig, the S-2 will add tremendous versatility. Its low price includes an external microphone capability, heavy duty ni-cad battery pack, charger, and telescoping whip antenna.

Tempo S-1

* The first and most thoroughly field tested hand-held synthesized radio available. 800 channels in the palm of your hand.
* Simple to operate. (You don't need a degree in computer programming).
* Heavy duty battery pack allows more operating time between charges.
* External microphone capability.

R-X NOISE BRIDGE $55.00

* Learn the truth about your antenna.
* Find its reasonant frequency.
* Find R and X off-resonance.
* Broadband 1-100 MHz.
* Simple to use. — Self contained.

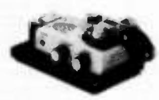
VLF CONVERTER $59.95

* New device opens up the world of VLF radio.
* Converts VLF to 80 meters. For use with any shortwave receiver covering 3.5-4 MHz.
* Advanced design for simple operation, high performance.
* Gives reception of the 1750 meter band.
* Also covers navigation radiobeacons, WWVB, ship-to-shore, and LF broadcast band.

LOOP ANTENNA
Loop Amplifier $67.50
Plug-in loops $47.50 ea.

* Plug-in loops available for:
  1600-5000 KHz (160/80 meter amateur bands)
  550-1600 KHz (Broadcast Band)
  150-550 KHz (VLF, 1750 meter band)
  40-150 KHz (WWVB, Loran)
  10-40 KHz (Omega)
* Nulls out interference

IC KEYER $117.50

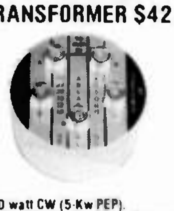


* Sends Manual, Semi-Automatic, Full Automatic, Dot Memory, Dash Memory, Squeeze and Iambic.
* More Features than any other keyer. Built-in sidetone, speaker, speed and volume controls.
* Fully Adjustable contact spacing and paddle tension. The perfect paddle touch will Amaze you.
* Battery Operated. Heavy shielded die-cast metal case. 3-lb. steel base.
* By the World's oldest manufacturer of electronic keys.

FREQUENCY STANDARD $42.50

* 100, 50, 25, 10 and 5 Khz. Markers selectable by panel switch.
* Crystal controlled. A true secondary frequency standard.
* Square Wave Signal. Rich harmonics usable from 5 kHz to 50 MHz.
* Sharp Clear Output. Exclusive circuit suppresses unwanted markers.
* Battery Operated. No line cord. Self contained battery.

RF TRANSFORMER $42.50



* Full 2000 watt CW (5-Kw PEP).
* Matches 32, 28, 22, 18, 12, 8, 5 ohm antennas.
* For all verticals and mobile whip antennas.
* Smaller size. Higher efficiency.
* RF ferrite toroid core.

500 W. RF TRANSFORMER $35.00

* Full 500 watt CW capability. No time limit.
* Convenient switch selection of impedance taps.
* Small size. High efficiency.
* RF ferrite toroid core.

CW FILTER $39.95

* Steep skirts. No ringing.
* Simulated stereo technique filters QRM, improves copyability of CW signals.
* 80 Hz bandwidth.
* Eight pole IC filter.

ALL BANDS PREAMPLIFIER $89.50

* Tunes 1.8 to 54 MHz. Covers ALL amateur bands 160 to 6 meters. ALL shortwave broadcast bands.
* For receivers AND transceivers.
* Up to 20 db gain.
* Peps up that tired receiver.
* Reduces image and spurious response.

BEAM BALUN $47.50

* 3 Kw CW, 6 Kw PEP Input power.
* U bolt for 2" boom.
* 1.7 - 30 MHz.
* 1:1 or 4:1 ratio available.
* All stainless steel hardware.

MODEL 2K BALUN $42.50

* 3 Kw CW, 6 Kw PEP input power.
* Replaces center insulator.
* 1.7 - 30 MHz.
* 1:1 or 4:1 ratio available.

MODEL 1K BALUN $22.50

* 1.5 Kw CW, 3 Kw PEP input power.
* Replaces center insulator.
* 1.7 - 30 MHz.
* 1:1 or 4:1 ratio available.

PALOMAR ENGINEERS

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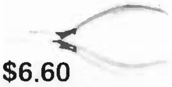
Tools, Parts, Accessories

Diagonal Pliers



$6.60

*54CG
Midget 4" size for close quarter work

$7.13

*55CG
5" Plier for most cutting needs

$8.87

*64CG
4" long for fast, clean, easy tip cutting of fine wires in close quarters

$7.48

*66CG
6" all-purpose diagonal plier

$7.33

*67CG
7" diagonal pliers for heavy duty cutting

Needle-Nose Pliers

$8.37

*56CG
6" size. Long, slim serrated jaws permit entry inaccessible to regular long nose plier

$8.27

*57CG
5 1/2" size with fine serrated jaws and coil spring for firm gripping and looping of wire

Long-Nose Pliers

$6.85

*41CG
Midget 4" pliers serrated jaws without side cutters

$7.92

*51CG
6" long-nose pliers with side cutters

$6.37

*52CG
6" long-nose pliers without side cutters

Xcelite®

XST-5 — Super-Tru Tip (phillips type) Screwdriver Set

Contains 5 pieces — all Phillips.

$13.97

SDS-44 — Square Blade Screwdriver Set

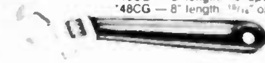
$14.76

Contains 5 Square Blade Screwdrivers for slotted screws. Catalog Nos S-141, S-3164, S-144, S-5166, S-388

Adjustable Wrenches

Xcelite's exclusive thin-pattern design permits access where regular adjustables will not fit. Rugged construction, chrome-plated, polished heads, with quick one-hand adjustment and Cushion-Grip (CG)

*44CG — 4" length 1/2" opening $6.38
*46CG — 6" length 3/4" opening $6.45
*48CG — 8" length 15/16" opening $7.28

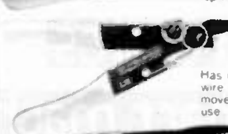


Wire Strippers & Cutters

With Cushion Grip Handles

*100-X $2.63
Has adjustable screw stop for different wire sizes, and cushion grips. Cuts and strips both solid and stranded wire cleanly, neatly. Hardened with ground blades

*101-S $3.32
Specifications same as 100, except with spring-equipped self-opening handles



*103-S $4.12
Has unique cam stop adjustment for different wire sizes. Cam adjustment stays put, won't move, even with screw loose. Fine for industrial use

104CG Wire Stripper and Cutter

Cutter, stripper and crimper for all types and sizes of wire, with a wide-size-range bolt cutter. Features scissor action-up front wire cutting and wire stripping, bolt cutters, cushion grips, plier nose, hardened pivot joint bushing and crimp stations

$10.08

Quality Coaxial Cable for All Applications

- LOW LOSS CABLE
- NON TARNISHING CONNECTORS
- FACTORY ASSEMBLED, TESTED FOR 100% RELIABILITY

RG 58/U Type

RG 8/U Low Loss Type

RG58/U Type

PART NUMBER	DESCRIPTION	APPLICATIONS
581-58018 * $3.20	18" length with UHF CB plugs on both ends	Used as patch cords for mobile & base station SWR & power meters, antenna switches, and SWR matchers.
581-583 * $3.70	3' length with UHF CB plugs on both ends	
581-5851 * $4.10	5' length with UHF CB plug & spade lugs	Used to connect mobile CB sets to trunk, mirror, gutter or bumper mount antennas using spade lug terminations to the antenna.
581-5812L * $4.10	12' length with UHF CB plug & spade lugs	
581-5820L * $4.99	20' length with UHF CB plug & spade lugs	
581-5812 * $4.99	12' length with UHF CB plugs on both ends	Used to connect mobile CB sets to trunk, mirror, gutter or bumper mount antennas requiring a UHF CB plug termination to the antenna
581-5820-259 $5.49 *	20' length with UHF CB plugs on both ends	
581-5850-420 $7.25	50' length with UHF CB plugs on both ends	Used where smaller diameter cable is required and signal loss is not critical
581-5875-420 $9.29	75' length with UHF CB plugs on both ends	
581-58100-420 $10.99	100' length with UHF CB plugs on both ends	

RG8/U Low Loss Type

PART NUMBER	DESCRIPTION	APPLICATIONS
581-83 * $4.10	3' lengths with UHF CB plugs on both ends	Used as patch cords for mobile and base station SWR and power meters, antenna switches & SWR matchers.
581-820 $8.50	20' length with UHF CB plugs on both ends	Used to connect mobile or base stations with antennas requiring a UHF CB plug termination at the antenna
581-850-420 $14.99	50' length with UHF CB plugs on both ends	Used to connect base station CB sets with base antennas. Where loss is critical these cables will out perform RG 58/U cables of the same length
581-875-420 $22.50	75' length with UHF CB plugs on both ends	
581-8100-420 $26.50	100' length with UHF CB plugs on both ends	

LAB QUALITY CABLES

BNC Test Voltage

1500 vac; Frequency: 0-4 GHZ; Impedance: 50 Ohms nominal; Cable Retention Force: 60 lbs. minimum (RG-58C/U)

UHF Test Voltage

1500 vac; Frequency: 0-500 MHz; Impedance: Non Constant; Cable Retention Force: 60 lbs. minimum (RG-58C/U)

50 ohm UHF Plug to UHF Plug

No. 651	3 feet	$ 6.52
No. 652	5 feet	$ 7.05
No. 653	10 feet	$ 8.34

50 ohm BNC Plug to UHF Plug

No. 657	1 foot	$ 7.20
No. 658	3 feet	$ 7.72
No. 656	5 feet	$ 8.24

50 ohm BNC Plug to BNC Plug

No. 668	3 feet	$ 8.91
No. 662	5 feet	$ 9.43
No. 666	10 feet	$10.73

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Panasonic

$179.00
Panasonic RF-2200 International Band
Eight-band worldwide shortwave radio. AC or battery power. Includes AM, FM and six short-wave bands. Combination 2-stage selectivity and AFC switch. RF gain control. Separate bass, treble, and volume controls. FM/SW telescoping antennas. Four "D" batteries, AC power cord, and earphone included.

$239.00
Command Series RF-2600
Six-band portable shortwave radio with all-band, five-digit fluorescent frequency display. SW frequencies from 3.9-28 MHz. FM/AM radio. Battery/signal strength meter. AFC on FM. RF gain control. 4" dynamic speaker. Comes with AC power cord, shoulder belt and earphone. Operates on 6 "D" batteries (not included).

$249.00
Command Series RF-2900
Portable 5-band shortwave radio. Five-digit fluorescent display. SW from 3.2 to 30 MHz. RF gain control. BFO pitch control. Comes with AC power cord, shoulder belt, dial hood and earphone. Operates on 6 "D" batteries (not included).

$399.00
Command Series RF-4900
Ten-band communications receiver with 5-digit, all-band fluorescent display. SW from 1.6 to 30 MHz. FM and AM frequencies. FET RF amplifier. BFO pitch control. RF gain control. Comes with earphone, AC power cord and headphone converter. Operates on 8 "D" batteries (not included).

Kantronics

Our smart machine reads sloppy copy.

NEW! INCLUDES 24-hour UTC Clock 110 and 300 baud ASCII, & tuning eye!

Kantronics **Field Day®** $399.00

If someone tells you they offer the same features we do, check them out with the list below.

- Morse copying ability
- 3 to 80 WPM Morse range
- Computer programs for improving sloppy Morse
- Radioteletype copying ability — 60, 67.75 and 100 WPM Baudot
- ASCII radioteletype ability — 110 and 300 WPM baud
- Copies any shift of RTTY
- 24-hour UTC clock available in any mode
- Entire unit contained in one package
- Automatic code-speed tracking
- Full 10-character, large-size display
- Displays code speed
- Tuning eye for faster tuning
- Full year limited warranty
- Internal speaker
- Requires no TV set for use
- Advanced demodulator circuits
- Internal 200 Hz bandwidth filter
- All leters, numbers and punctuation plus special Morse characters and 5 special RTTY characters

DRAKE

See back cover for specials!

Drake R-7 / DR-7
Synthesized, General Coverage Receiver

$1449.00

- Fully synthesized with a permeability tuned oscillator (PTO) for smooth, continuous tuning.
- Covers complete range 0-30 MHz. Both digital and analog readout.
- Special low distortion "synchro-phase" AM detector provides superior International shortwave broadcast reception.
- Tunable IF notch filter effectively reduces heterodyne interference from nearby stations.
- Multi-function antenna selector/50 Ohm splitter is switch-selected from the front panel. Provides simultaneous dual receive with the TR-7, making possible the reception of two different frequencies at the same time.
- Built-in power supply operates from 100, 120, 200, 140 Vac, 50/60 Hz, or nominal 13.8 Vdc.
- Much more!

YAESU

See back cover for specials!

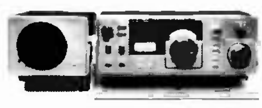
FRG-7000 $599.00
Digital Display Communications Receiver with CPU Digital Clock and Timer
- 0.25 Thru 29.9 MHz Coverage with 1 kHz Readout

Computer technology and convenience features are brought together in the FRG-7000, a digital-display general coverage receiver for the discriminating SWL. The digital clock and timer, controlled by a CPU (Central Processing Unit) chip, will read out both local and GMT time, and will control peripheral station equipment such as a tape recorder.

FRG-7 $299.00
General Coverage Receiver
- 0.5-29.9 MHz Coverage with 10 kHz Readout

The FRG-7 is a precision-built all-purpose communications receiver, featuring all solid state construction for long life and high performance. Utilizing the Wadley Loop drift cancellation system, in conjunction with a triple conversion superheterodyne circuit, the FRG-7 boasts high sensitivity along with excellent stability

KENWOOD
...pacesetter in amateur radio



$499.00
Kenwood R-1000
The R-1000 is a highly advanced communications receiver. Up-conversion, PLL circuitry and other new technology provide optimum sensitivity, selectivity, and stability from 200 kHz to 30 MHz. Featuring easy-to-operate single-knob tuning and digital frequency display. It's perfect for listening to shortwave, medium-wave, and long-wave bands. Even SSB signals are received perfectly. Included is a quartz digital clock and timer.

R-1000 FEATURES:
- Continuous frequency coverage from 200 kHz to 30 MHz.
- 30 bands, each 1 MHz wide.
- Five-digit frequency display and illuminated analog dial.
- Quartz digital clock and ON/OFF timer.
- Multi-modes . . . AM (wide and narrow), SSB (USB and LSB), and CW.
- Three IF filters . . . 2.7 kHz for SSB and CW, 6.0 kHz for AM narrow, and 12 kHz for AM wide.
- Effective noise blanker, built-in speaker, three antenna terminals, rf step attenuator, tone control, recording terminal.
- Remote terminal, for access to timer relay ON/OFF circuit and muting circuit.
- SSB sensitivity of 0.5 μV from 2 to 30 MHz.
- More than 60 dB IF image ratio.
- More than 70 dB IF rejection.

P.O. Box 27, Medford, Massachusetts, 02155 — TEL. 1-617-391-3200

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FINCO STINGER VHF/UHF Antennas

On this page Tufts brings you . . .
Finco Stinger *Hitachi*
Ham-Key *Alliance*

Sale–15% off Finco!

10 meter


$62.95

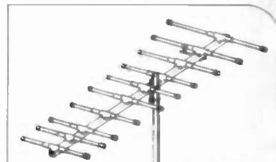
STINGER A 10 4 DESCRIPTION

The model Stinger A 10 4 is a wide spaced, full size, high gain four element 10-meter monobander designed for optimum DX performance. Utilizing the exclusive Stinger Series square boom construction, the A 10 4 is light enough to be easily stacked for an additional 3 dB gain yet strong enough to withstand the most adverse weather conditions. The highly efficient gamma match system easily withstands 2,000 watts P.E.P. of power and maintains a relatively low V.S.W.R. across the entire 10 meter amateur band.

SPECIFICATIONS – A 10 4

ELECTRICAL–		MECHANICAL–	
Forward Gain	10dB	Boom Length	16 ft.
Front-to Back Ratio	25dB	Longest Element	18.2 ft.
V.S.W.R. (at resonance)	1.1:1	Turning Radius	7.4 ft.
Half Power Beam Width	55°	Maximum Surface Area	4.4 sq. ft.
Bandwidth	28 to 30 MHz	Wind Load at 80 MPH	118 lbs.
Impedance	50 Ohms	Weight	12.5 lbs.
Matching System	Adjustable Gamma		

2 meter


$44.95

STINGER A 2-10 DESCRIPTION

The model Stinger A 2-10 is a high performance wide spaced ten-element 2-meter yagi designed for the serious VHF operator. Utilizing the Stinger construction features, the A 2-10 is almost indestructable no matter what weather conditions are encountered. Complete coverage of the 2-meter band and low V.S.W.R. is assured through the use of non linear spaced elements thus also achieving maximum forward gain. Power rating – 2,000 watts P.E.P.

The A 2 10 can be mounted for vertical polarization, there by making the antenna quite useful in repeater accessing, or mounted for horizontal polarization for station to station VHF DX work. Additional bays of the A 2 10 can be easily stacked for even greater gain and front to back ratio.

SPECIFICATIONS – A 2-10

ELECTRICAL–		MECHANICAL–	
Forward Gain	13.8dB	Boom Length	10 ft.
Front-to Back Ratio	25dB	Longest Element	42 in.
V.S.W.R. (at resonance)	1.1:1	Turning Radius	71 in.
Half Power Beam Width	40°	Maximum Surface Area	2.36 sq. ft.
Bandwidth	144 to 148 MHz	Wind Load at 80 MPH	26.2 lbs.
Impedance	50 Ohms	Weight	9.8 lbs.
Matching System	Adjustable Gamma		


$27.95

STINGER A 2-5 DESCRIPTION

The model Stinger A 2-5 is a five-element high gain antenna similar to the A 2-10 but having physically less of a profile. The A 2-5 finds excellent application as a portable antenna as it disassembles into a very compact package. Like the A 2 10, the antenna can be mounted for vertical or horizontal polarization for repeater or general coverage work. Constructed of the Stinger heavy duty materials, the A 2-5 is ideal for locations encountering adverse weather conditions. Power rating 2,000 watts P.E.P.

SPECIFICATIONS – A 2-5

ELECTRICAL–		MECHANICAL–	
Forward Gain	9.5dB	Boom Length	5.5 ft.
Front to Back Ratio	22dB	Longest Element	41 in.
V.S.W.R. (at resonance)	1.1:1	Turning Radius	42 in.
Half Power Beam Width	[illegible]	Maximum Surface Area	[illegible] 23 sq. ft.
Bandwidth	144 to [illegible] MHz	Wind Load at 80 MPH	13.3 lbs.
Impedance	[illegible]	Weight	6.5 lbs.
Matching System	Adjustable Gamma		


$46.50

STINGER A 2+2 DESCRIPTION

The model Stinger A 2+2 is a ten element, dual polarization 2-meter antenna designed for OSCAR communications or where switching from horizontal to vertical polarization is required. The A 2+2 can even be phased to operate on both horizontal and vertical polarization at the same time. This is not only ideal for OSCAR work but gives your station versatility for ground communications.

Wide non-linear element spacing gives the A 2+2 superior gain, however, since it is a five element beam in one given plane, the half power beam width does not make satellite tracking difficult because of sharp directivity. The dual gamma match assemblies provide for a very low V.S.W.R. and will withstand 2,000 watts P.E.P.

The Stinger construction features make the A 2+2 extremely heavy duty. Provisions are made for mounting the antenna at the end of the boom – for azimuth control – or at the middle of the boom for normal applications.

SPECIFICATIONS – A 2+2

ELECTRICAL–		MECHANICAL–	
Forward Gain	9.5dB	Boom Length	6 ft.
Circular Gain	10.5dB	Longest Element	41 in.
Front to Back Ratio	22dB	Turning Radius	
Half Power Beam Width		End Mount	5.5 ft.
Horizontal Polarization–		Center Mount	3.4 ft.
E Plane 52° H Plane	58°	Maximum Surface Area	1.51 sq. ft.
Vertical Polarization–		Wind Load at 80 MPH	13.4 lbs.
E Plane 58° H Plane	52°	Weight	11 lbs.
Circular Polarization–			
E Plane 52° H Plane	52°		
Bandwidth	144 to 148 MHz		
Impedance	50 Ohms		
Matching System	Adjustable Gamma		

6 meter


$46.50

STINGER A 6-5 DESCRIPTION

The model Stinger A6-5 is a highly directional 6 meter five element beam specifically designed for maximum forward gain with a "no compromise" front to back ratio. The elements are constructed of high tensile strength seamless aluminum tubing plus the exclusive Stinger square boom and bracket assemblies. For maximum power transfer and low V.S.W.R., a carefully designed gamma matching assembly capable of withstanding 2,000 watts P.E.P. is incorporated. Wide element spacing assures optimum DX performance and good operating efficiency across the entire 50 to 54 MHz 6 meter band. The square boom allows optional vertical mounting for accessing 6 meter repeaters.

SPECIFICATIONS – A 6-5

ELECTRICAL–		MECHANICAL–	
Forward Gain	11dB	Boom Length	13 ft.
Front-to Back Ratio	25dB	Longest Element	10 ft.
V.S.W.R. (at resonance)	1.1:1	Turning Radius	8.3 ft.
Half Power Beam Width	[illegible]	Maximum Surface Area	3.23 sq. ft.
Bandwidth	50 to 54 MHz	Wind Load at 80 MPH	40.2 lbs.
Impedance	50 ohms	Weight	11.5 lbs.
Matching System	Adjustable Gamma		


$30.00

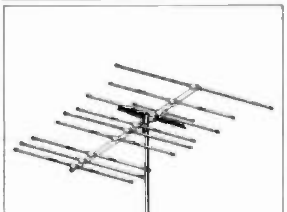
STINGER A 6-3 DESCRIPTION

The model Stinger A 6-3 is a 3 element high gain 6 meter beam [illegible] the A 6-5 but expressly designed for the casual 6 meter enthusiast. [illegible] also finds excellent application for portable use as it disassembles into [illegible] package. Due to the units light weight and minimal wind load the antenna [illegible] ideal for double stacked and quad stacked arrays for the [illegible] 6 meter DX[illegible]. The A 6-3 is rated at 2,000 watts P.E.P. and incorporates [illegible] square boom and high tensile strength aluminum elements.

SPECIFICATIONS – A 6-3

ELECTRICAL–		MECHANICAL–	
Forward Gain	[illegible]	Boom Length	6.0 ft.
Front-to Back Ratio	[illegible]	Longest Element	10 ft.
V.S.W.R. (at resonance)	[illegible]	Turning Radius	5.4 ft.
Half Power Beam Width	[illegible]	Maximum Surface Area	1.75 sq. ft.
Bandwidth	[illegible] MHz	Wind Load at 80 MPH	17.6 lbs.
Impedance	[illegible] Ohms	Weight	7 lbs.
Matching System	Adjustable Gamma		

6 and 2 meter


$74.95

STINGER A 62 DESCRIPTION

The model Stinger A 62 is a truly remarkable combination 6 and 2 meter beam designed for optimum performance on both bands yet only requiring ONE transmission line. This is accomplished through the use of exclusive phasing elements to accomplish dual band operation with no sacrifice to either band – NO SWITCHING REQUIRED!

On 2 meters, the A 62 has 6 collinear elements – equivalent to three 1/2 λ 6 element yagis stacked side by side – thus giving outstanding performance. Maximum forward gain is assured on 6 meters through the use of four wide spaced elements. The heavy duty Stinger construction is used throughout so that the antenna will withstand 100 mph plus wind loads.

The A 62 is ideal for mounting on the same mast as your tri bander or other antenna thus easily opening up the world of 6 and 2 meter VHF communication.

SPECIFICATIONS – A 62

ELECTRICAL–		MECHANICAL–	
Forward Gain	6 meters 9.5dB	Boom Length	10.1 ft.
	2 meters 12.0dB	Longest Element	10 ft.
Front to Back Ratio	6 meters 19dB	Turning Radius	6.7 ft.
	2 meters 22dB	Maximum Surface Area	4.48 sq. ft.
V.S.W.R. (6 & 2 meters)	1.1:1	Wind Load at 80 MPH	43 lbs.
Half Power Beam Width	40° to 55°	Weight	13.8 lbs.
Bandwidth	6 meters 50 to 54 MHz		
	2 meters 144 to 148 MHz		
Impedance	50 ohms		
Matching System	Adjustable Gamma		

1 1/4 meter


$32.95

STINGER A 1 1/4 – DESCRIPTION

The model Stinger A 1 1/4 is a ten element 1 1/4 meter (220 MHz) high performance yagi designed for all 220 MHz communication needs. Designed to be mounted in either the vertical or horizontal plane, the A 1 1/4 is adaptable for OSCAR, repeater, or general communication work. Incorporating the Stinger heavy duty elements, boom and boom to mast assemblies, the antenna easily withstands 120 mph wind loads under 1/4" ice conditions. A low loss gamma matching system assures a low V.S.W.R. and is power rated at 1,000 watts.

SPECIFICATIONS – A 1 1/4

ELECTRICAL–		MECHANICAL–	
Forward Gain	13.8dB	Boom Length	8 ft.
Front-to Back Ratio	25dB	Longest Element	28 in.
V.S.W.R. (at resonance)	1.2:1	Turning Radius	4.3 ft.
Half Power Beam Width	40°	Maximum Surface Area	1.32 sq. ft.
Bandwidth	220 to 226 MHz	Wind Load at 80 MPH	17.9 lbs.
Impedance	50 Ohms	Weight	8 lbs.
Matching System	Adjustable Gamma		

slinky

SLINKY! $43.95 Kit A LOT of antenna in a LITTLE space New Slinky® dipole* with helical loading radiates a good signal at 1/10 wavelength long!

This electrically small 80/75, 40 & 20 meter antenna operates at any length from 24 to 70 ft. ● no extra balun or transmatch needed ● portable – erects & stores in minutes ● small enough to fit in attic or apt. ● full legal power ● low SWR over complete 80/75, 40 & 20 meter bands ● much lower atmospheric noise pick-up than a vertical & needs no radials ● kit incl. a pr. of specially-made 4" dia. by 4" long coils, containing 335 ft. of radiating conductor, balun, 50 ft. RG58/U coax, PL259 connector, nylon rope & manual.

HAM-KEY™

Model HK-3M

$19.95

- Deluxe straight key
- Anti tip bracket. Can't tip
- Heavy base. No need to attach to desk
- Navy type knob
- Smooth action

CC 3P shielded cable & plug for HK 3M $2.49.
Add $ .50 Shipping & Handling
Model A1 B anti tip bracket only to convert any HK 3 to HK 3M $2.99

Model HK-4

$44.95

- Combination HK 1 & HK 3 on same base
- Straight key may be used conventionally or as a switch to trigger a memory

CC 1/3P Shielded cable with plugs for HK 4 $5.99

RADIO TELEGRAPH SENDING DEVICES

Model HK-1

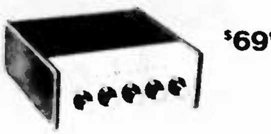
$29.95

- Dual lever squeeze paddle
- For use with all electronic keyers
- Heavy base with non slip rubber feet
- Paddles reversible for wide or close finger spacing

CC 1P shielded cable & plug for HK-1 $3.75

Model HK 2, same as HK 1 but less base for incorporation in your own keyer $19.95

Model HK-5A Electronic Keyer



$69.95

- Iambic circuit for squeeze keying
- Self completing dots & dashes
- Dot & dash memory
- Built in sidetone
- Battery operated with provisions for external power
- Uses Curtis 8044 keyer chip
- Grid block or direct keying
- Speed, volume, tone & weight controls on front panel
- Use with HK 1 or HK-4

DATONG

$219.95

MODEL FL1

Frequency – Agile Audio Filter

The Datong Frequency-Agile Audio Filter is intended primarily for post-detector signal filtering in RF and LF communications receivers for SSB and CW. It offers an unusually versatile combination of benefits to the user including:

For the SSB operator:

- Fast automatic suppression of interfering heterodyne whistles in the range 280-3000 Hz by a unique search-lock-and-track notch filter. The tracking notch can be left in circuit with no audible effect until a whistle appears in which case the whistle will 'disappear' within typically one second.
- A continuously adjustable audio 'window' or a variable-width notch to improve reception in the presense of other off-tune SSB, RTTY or SSTV signals.

For the CW operator:

- Continuously variable center-frequency (280–3000 Hz) and bandwidth (25-1000 Hz) for perfect matching of receiver passband to changing band conditions, sending speeds, and personal preference.
- Flat-topped, steep-skirted response shape for optimum ease of tuning combined with excellent noise rejection.
- Linear tuning law with bandwidth independent of frequency and gain independent of bandwidth for natural 'feel'.

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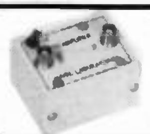
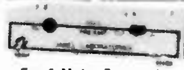
JANEL LABORATORIES



CLASSIC 2 METER PREAMP

This widely used 2 meter preamp is probably the most sensitive available today. One model provides a uniformly low noise figure across the full band. Equally applicable for DX, AM, SSB, FM and OSCAR. 18 dB gain, 2 dB noise figure, 12 vdc power (5mA). BNC connectors. Aluminum box is 1⅝x2⅛x2⅞
Model 144PB 144-148MHz

MODEL	DESCRIPTION	PRICE
	PREAMPS	
30PB	28-30 MHz (BNC)	$ 21.95
50PB	50-52 MHz (BNC)	21.95
53PB	52-54 MHz (BNC)	21.95
137PB	135-139 MHz (BNC)	21.95
144PB	144-148 MHz (BNC)	21.95
PM-1	2m Preamp Module (Solder Terminals)	16.95
QSA 5	144-148 MHz for Transceivers (SO-239)	41.95
QSA 6	50-52 MHz (SO-239)	43.95
220PB	220-225 MHz (BNC)	21.95
432PA	420-450 MHz (BNC) 3.5 dB maximum NF	33.00
432PC	420-450 MHz (BNC) 2.0 dB maximum NF	54.95
432PE	1.0 dB typical NF	90.00
PB	Any single frequency between 30 and 50, or 148-174 MHz (BNC)	27.00
	CONVERTERS	
144CF	144-146 MHz IN, 28-30 MHz OUT (BNC)	$ 79.95
	2nd crystal for 144CF (146-148 IN, 28-30 OUT)	12.00
432CF	432-434 MHz IN, 28-30 MHz OUT (BNC)	79.95
	2nd crystal for 432CF (434-436 IN, 28-30 OUT)	10.00
	(Also available with 434-436 MHz IN and 28-30 MHz OUT, (Oscar B, Mode J)	79.95
	OSCILLATORS	
01-A	Precision, Specify 4 or 10 MHz	$ 79.95
D1-A	10 to 1 Digital Divider	11.95
D8-A	Eight, 10 to 1 Dividers	27.95
	USEFUL ACCESSORIES	
17013	BNC to BNC, 36" RG-58C/U Cable	$ 6.00
17010	BNC to UHF, 36" RG-58C/U Cable	6.00
17014	BNC to RCA Phono, 36" RG-58C/U Cable	6.00
03005	Adaptor, BNC Plug to UHF Jack	4.00
03006	BNC Connector, UG-88/U for RG-58 size cable	1.25
	MISCELLANEOUS	
ISOLINE	Antenna Isolator, 144-174 MHz (SO-239)	$ 14.95
432FA	Cavity Filter, .5 dB loss	105.00
432FA .2	Cavity Filter, .2 dB maximum loss	115.00



For 6 Meter Transceivers

QSA5 PREAMP
For Transceivers

The QSA 5 preamp is a high performance, low noise preamp for improving the receiving sensitivity of 2 Meter transceivers. This preamp features easy installation with no modification to the transceiver required. This preamp can be used with virtually all 2 meter transceivers and on all modes — FM, SSB, CW or AM. Relays in the QSA 5 automatically bypass the preamp when transmit power is sensed. A LED indicator shows the status of the QSA 5. A front panel switch allows the preamp to be bypassed while receiving. The low noise figure of the QSA 5 provides for exceptional sensitivity. The gain has been set to optimize the performance with 2 meter transceivers.

Model PM-1

PREAMP MODULE

This low noise preamp is designed to be easily incorporated into new or existing 2 meter equipment. Solder pins are provided for mounting to a PC board or for connection to wire or coax. Uses low noise JANEL MOSFET circuitry. Each unit is fully tested for gain and noise figure. Quantity prices are available for OEM's.

6 METER PREAMP
Ideal for DX

This low noise preamp significantly improves the sensitivity of most 6 meter receivers. Available in two frequency versions to cover DX and FM portions of the band. 18 dB gain, 2 dB noise figure, 12 vdc power, BNC connectors.
Model 50PB 50-52MHz. Model 53PB 52-54MHz.

For 6 Meter Transceivers

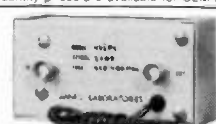
All of the features of our popular QSA-5 but for 6 meters. Fully compatable with transceivers running 30 watts or less. All mode use. Noise Figure 2dB. Gain 15dB. VSWR (transmit) 1.2. Available for 50-52 or 52-54MHz (specify when ordering). UHF connectors. **Model QSA-6.**

10 METER PREAMP
Oscar Special

Ideal for pulling weak satellite signals out of the noise. This preamp has been responsible for producing many "impossible" OSCAR QSO's. 18 dB gain, 2 dB noise figure, 12vdc power (5mA), BNC connectors. Aluminum box is 1⅝x2¼x2⅞.
Model 30 PB 28-30MHz.

220 MHz
Low Noise Preamp

1¼ Meters-Covers full 220-225 MHz range with 15 dB gain, 3 dB noise figure, 12 volt power and BNC connectors. **Model 220PB.**

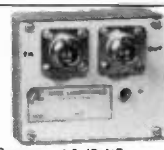


UHF PREAMPS
Model 432PA 420-450MHz
Low Cost All Around Favorite

This two stage amplifier provides high sensitivity across the full 420 to 450 MHz band. A low 3.5 dB noise figure makes this preamp ideal for most amateur applications. Can be used for all modes. 17dB gain, 12vdc power (10mA). BNC connectors (50 ohms), aluminum box 1⅝x4x2⅞.

Model 432PC 420-450MHz
Extremely Sensitive

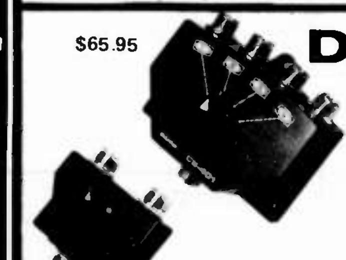
This preamp provides a low noise figure required for demanding applications. A premium state-of-the-art transistor is used to provide extremely high sensitivity. Two stages, 20 dB gain, 2 dB maximum noise figure (1.7 dB typical), 12 volt dc power BNC connectors.



Our Finest UHF Preamp—1.0 dB NF

This outstanding 432 MHz preamp provides the lowest practical noise figure. The finest transistors available today are combined with the ultimate in construction and alignment. Single stage. Gain 15dB (min) Noise Figure 1.2dB (max including measurement uncertainty), 0.8 to 1.0dB typical. Bandwidth 100 MHz, 12 volts at about 7 mA. Type N connectors. Size 1⅝x3x1⅝ inches. Center Frequency 400 to 512 MHz (specify when ordering). **Model 432PE.**

DAIWA



$65.95

$20.95

Coaxial Switches
2 Position/Model CS-201
4 Position/Model CS-401

RF-440 $135.95

RF Speech Processor
Models RF-400

Increases talk power with splatter free operation. RF clipping assures low distortion. Simply install between microphone and transmitter.
Talk Power: Better than 6 dB.
Frequency Response: 300-3000 Hz at 12 dB down.
Distortion: Less than 3% at 1 kHz, 20 dB clipping.

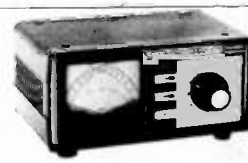
SWR & Power Meters
Models CN-720, CN-620 and CN-630
Professionally engineered cavity construction.
Power Rating: 2.5kW PEP, 1kW CW
Impedance: 50 Ohms
Connectors: SO-239
Insertion Loss: Less than 2 dB
VSWR: 1:1.2
Maximum Frequency: 500 MHz
Isolation: Better than 50 dB at 300 MHz; better than 45 dB at 450 MHz; adjacent terminal.
Unused Terminals grounded.

CN-720 and CN-620
Frequency Range: 1.8-150 MHz
SWR Detection Sensitivity: 5W min.
Power: 3 Ranges (Forward, 20/200/100W) (Reflected, 4/40/200W)

CN-720 $166.95

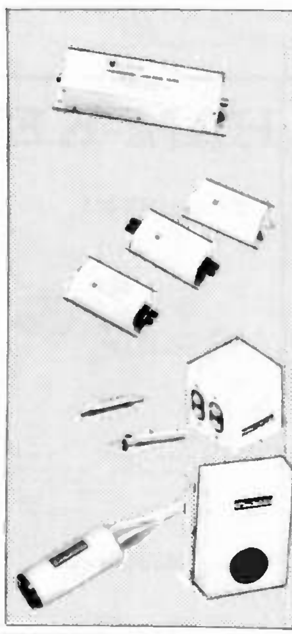
$140.50
CN-620

CN-630
Frequency Range: 140-450 MHz
Power: 2 Ranges (Forward 20/200W) (Reflected 4/40W)



CN-630
$139.00

Interference Filters from J. W. Miller



Low Pass Filters

Eliminate or greatly reduce interference to TV receivers by radio amateur staions when installed in antenna lines of those transmitters. Input and output impedance 50 ohms. Insertion loss .3 dB max.; VSWR 1.2:1. Attenuation greater than 75 dB above 41 MHz.
C-511-T: 25 W AM 50 W PEP SSB. $19.50
C-514-T: 1000 W AM 2000 W PEP SSB. $26.80

High Pass Filters

When installed in the antenna, eliminate or greatly reduce front end overload interference to TV or FM receivers caused by amateur radio transmitters and other high frequency radio services. Filter attenuates signals below 40 MHz by a power factor greater than 1,000,000:1. Impedance C-513-T 1: 75/300 ohm C-513-T2: 75/75 ohm; C-513-T3: 300/300 ohm
$10.18
$10.18

Audio Interference Filters

Eliminate interference caused in your audio equipment by radio amateur transmitters and other radio services. C-505-R installs in the input lines of audio equipment. Consists of 1 pair. C-506-R installs in speaker lines. Unit will take care of stereo speaker system.
$5.07
$6.67

AC Power Line Filters

Eliminate or reduce interference to radio amateur receivers, TV's and radios, and prevent radio signals from entering power line.
C-508-L: 3 section LC filter, 3 A max. $ 8.33
C-509-L: 5 section LC filter (for more severe interference), 5 A max. $18.35

P.O. Box 27, Medford, Massachusetts, 02155 — TEL. 1-617-391-3200

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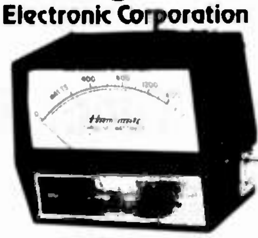
BIRD Electronic Corporation

$99 VHF model 4362 (140-180 MHz)
$99 HF model 4360 (18- 30 MHz)



The 4360, 4362 HAM-MATE Directional Wattmeters are insertion type instruments for measuring forward or reflected power in 50-ohm coaxial transmission lines. They are direct descendants of the model 43 THRULINE® Wattmeter — the professional standard of the industry—and will accurately measure RF power flow under any load condition. Each wattmeter is made up of a precisely machined section of 50-ohm line, a rotatable sensing element and meter calibrated in watts, all mounted in a high-impact plastic housing. It is this type of solid construction and the directional THRULINE coupling circuit, **without toroids**, that account for the superiority of the HAM-MATE Wattmeters.

the indispensable BIRD 43 THRULINE WATTMETER

Power Range	Frequency Bands (MHz) 2-30	25-60	100-250	200-500	400-1000
5 watts	—	5A	5C	5D	5E
10 watts	—	10A	10C	10D	10E
25 watts	—	25A	25C	25D	25E
50 watts	50H	50A	50C	50D	50E
100 watts	100H	100A	100C	100D	100E
250 watts	250H	250A	250C	250D	250E
500 watts	500H	500A	500C	500D	500E
1000 watts	1000H	1000A	1000C	1000D	1000E
2500 watts	2500H				
5000 watts	5000H				

MODEL 43 $135.00
Elements (Table 1) 2-30 MHz 50.00
Elements (Table 1) 25-1000 MHz 42.00
Carrying case for Model 43 & 6 elements 28.00
Carrying case for 12 elements 17.00

READ RF WATTS DIRECTLY! (Specify Type N or SO239 connectors) 0.45 — 2300 MHz, 1-10,000 Watts ±5%, low insertion VSWR — 1.05. Unequalled economy and flexibility. Buy only the element(s) covering your present frequency and power needs, add extra ranges later if your requirements expand.

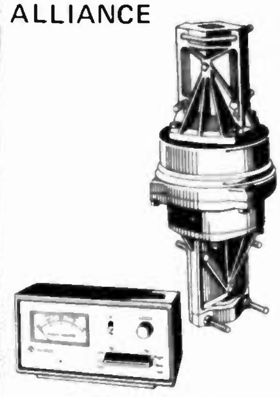
HITACHI OSCILLOSCOPES

SPECIAL! 15% OFF ALL HITACHI SCOPES

Single and dual trace, 15 and 30 MHz. All four high sensitivity Hitachi oscilloscopes are built to demanding Hitachi quality standards and are backed by a 2-year warranty. They're able to measure signals as low as 1mV/division (with X5 vertical magnifier). It's a specification you won't find on any other 15 or 30 MHz scope. Plus: Z-axis modulation, trace rotation, front panel X-Y operation for all four scope models, and X10 sweep magnification. And, both 30 MHz oscilloscopes offer internal signal delay lines. For ease of operation, functionally-related controls are grouped into three blocks on the color coded front panel.

- V-302 30 MHz Dual Trace $850.50
- V-301 30 MHz Single Trace $670.50
- V-152 15 MHz Dual Trace $625.25
- V-151 15 MHz Single Trace $490.50

ALLIANCE



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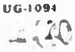

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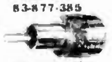

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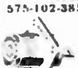

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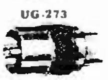

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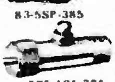

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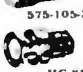

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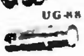

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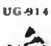

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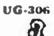

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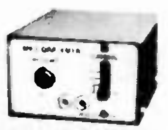

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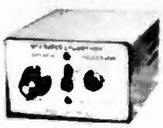

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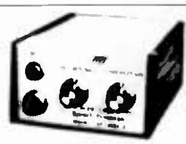

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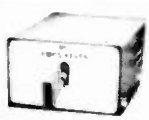

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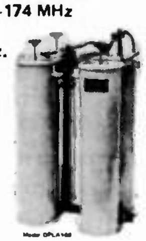

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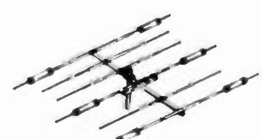

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Build a Talking Digital IDer

—K2OAW redesigns his IDer at last

When my CW identifier and repeater control circuit article appeared in the February and March, 1973, issues of *73 Magazine*, I thought that those circuits were about as modern and simple as they could get. Over the years, I've heard of printed circuit boards and kits being sold at hamfests, and several ham repeater manufacturers have used the CW identifier circuit in their systems. The identifier also has been used in RTTY stations to provide Morse code identification.

But times do change; several articles have appeared in *73 Magazine* giving circuits which modified or expanded the original design. I finally decided that it was time for a new identifier design.

Here is an identifier circuit which should renew interest in identifiers for a while. It uses six ICs, the same as the 1973 version, but this identifier talks.

Yes, you read it right. It doesn't whistle or hum your call—it says it right out loud, in plain English, for the whole world to hear. A little muffled, perhaps (after all, what can you expect from six commonly-available ICs?), but clear enough to understand.

I'm having some fun with mine right now. It's sitting on my office desk (with a little IC timer setting it off about once a minute) quietly mumbling "Bah, humbug!" to anyone within earshot!

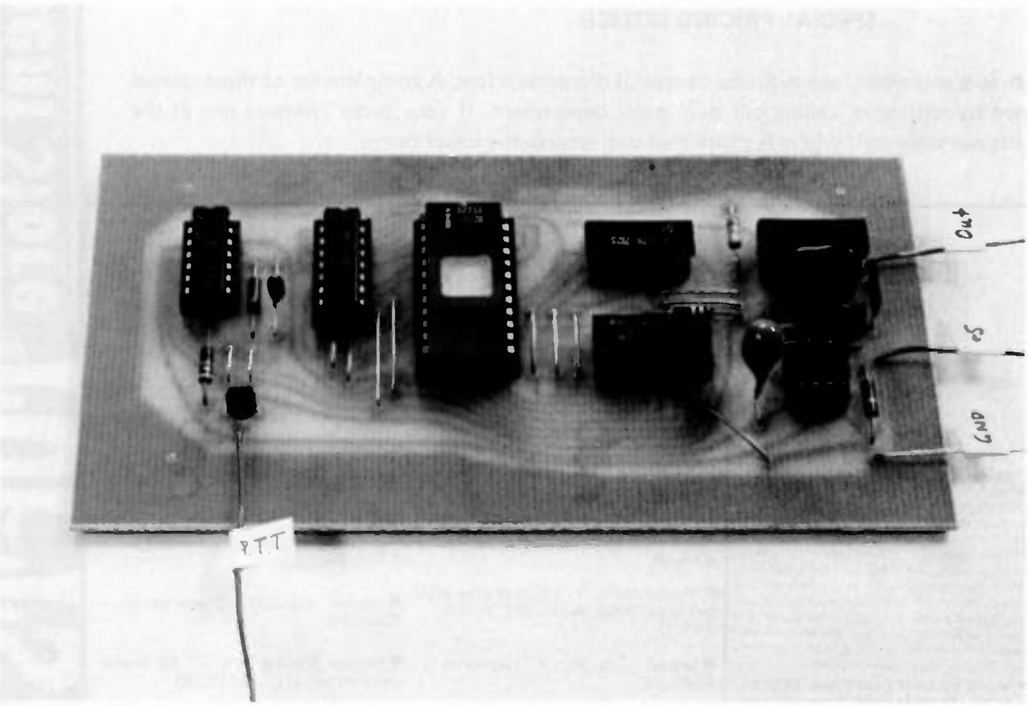

Photo A. Talking identifier.

Although it makes a great conversation piece, that is not its main purpose. I started designing this identifier while driving on a long vacation trip last summer. Every half hour or so, I would remember to key up my 2-meter rig on .52, hoping that somebody would come back. In the meantime, a hundred hams could have passed me by going in the opposite direction. But unless I picked up the mike and gave my call every minute or two, the chances of either one of us knowing about the other were slim. Wouldn't it be nice (I thought) to have an automatic IDer which would key up the rig every minute or so and announce itself? If there were anybody around, they surely would

hear me. And voilà—necessity was the mother of invention.

The identifier uses an EPROM (Erasable Programmable Read Only Memory) to store the voice data to be spoken. The secret, of course, is in knowing how to program this EPROM. I do the programming on my SWTP 6800 computer system, but it could be done on another computer just as well. This article includes the programs and a PC board layout to make your job easier. (Etched and drilled PC boards as well as preprogrammed EPROMs are available from Star-Kits, PO Box 209, Mt. Kisco NY 10549.)

How It Works

There are many ways either to store a real sound recording in a digital memory or to synthesize a fake voice. Quite a few voice synthesizers are available today, ranging from the Texas Instruments Speak and Spell™ to the Computalker synthesizer available for S-100 computers and the Radio Shack synthesizer for the TRS-80. Unfortunately, most of these are fairly complex, require some custom-integrated (and often secret) circuits, and are difficult to program.

Simply storing a digital image of a real voice and playing it back from memory turns out to be much easier and cheaper. That is how this identifier works. Its EPROM contains a digitized "recording" of a voice (which had been digitized previously on a computer), and a fairly simple circuit then scans the memory and "plays" it back. The only problem is to store the voice recording in such a way that it doesn't exceed the capacity of the EPROM.

If memory capacity were not a problem, then the voice pattern could be stored with voice fidelity better than any commercial hi-fi recording. In fact, digital stereo recording is the latest technique on the hi-fi scene because it can provide frequency response and distortion figures beyond anyone's wildest dreams of just a few years ago. But there is a price to be paid—very large amounts of digital data are involved. Digital recording often is done with videotape recorders which can record and play back millions of bits per second. Squeezing two seconds worth of voice into an EPROM which contains just 16,384 bits obviously requires some compromises, and it results in audio quality which is far from hi-fi. But it works.

To see how voice can be digitized, look at Fig. 1(a). Here we see a typical sound waveform such as might be picked up by a microphone. In order to digitize that waveform, we sample it at fixed, periodic intervals, and digitize the voltage that that waveform has at those instants of time.

For instance, suppose we measure the waveform voltage at the points marked with a dot, convert the value of that voltage to a binary number, and store it. If that is later "played" back, we get the waveform shown in Fig. 1(b). The result is a square waveform which changes to a new value at each of the sampling points.

Although the square wave doesn't look anything like the original audio signal, if it is fed through a low-pass filter the sharp corners will be chopped off and the signal will look a bit better.

If, on the other hand, we were to sample the audio signal more often—not only at the dots but also at the intermediate points marked with an X—and digitize that, the resulting waveform, shown in Fig. 1(c), would be a better approximation.

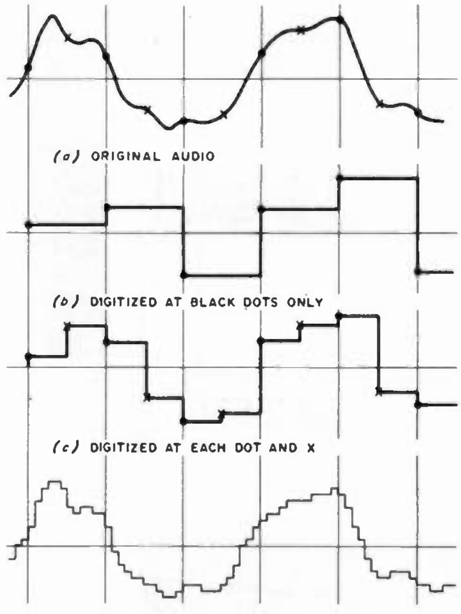

Fig. 1. Digitizing audio at various sampling rates.

Fig. 1(d) shows that when we digitize very often, we get the best waveform yet. Although this waveform does have some sharp corners, they occur at a very high frequency and would be removed very easily with a filter.

How often must we digitize to get an acceptable digitized waveform? There is a rule called the "sampling theorem" which says that the sampling rate must be at least twice the frequency of the highest frequency component in the audio signal. In other words, a hi-fi signal with a frequency response to 20,000 Hz would have to be sampled at least 40,000 times per second. A communications-quality voice signal with a response to 4000 Hz would require sampling at least 8000 times per second.

We can get an idea of this from Fig. 1(b). Sampling at the black dots is enough to get a waveform which follows the large swings of the audio waveform which have a low frequency but cannot capture the small squiggles that have a high-frequency component. To get those, we need a high sampling rate.

Fig. 2 shows a block diagram of the circuitry which would be needed to do the digitizing. Starting with the audio signal, the signal is amplified and sent through a low-pass filter. The purpose of the filter is to remove those frequencies which are too high to be digitized (that is, more than half the frequency of sampling). These components have to be removed to avoid further distortion during the digitizing.

The filtered signal is now sent to a sample-and-hold circuit. This circuit takes a sample of the waveform and holds it in a capacitor while the analog-to-digital (A/D) converter converts the resulting voltage to a binary number. This is necessary because most A/D converters require a steady input voltage while they are converting; if the voltage is changing, then they will probably convert the voltage to the wrong value. Both the sample-and-hold circuit as well as the A/D converter are driven by a

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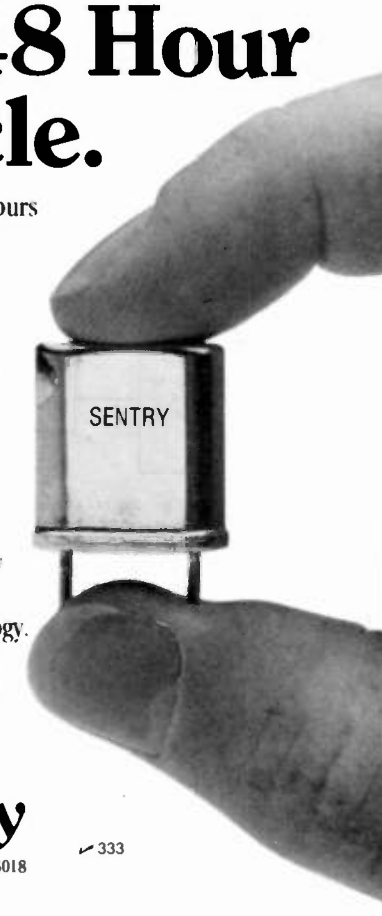

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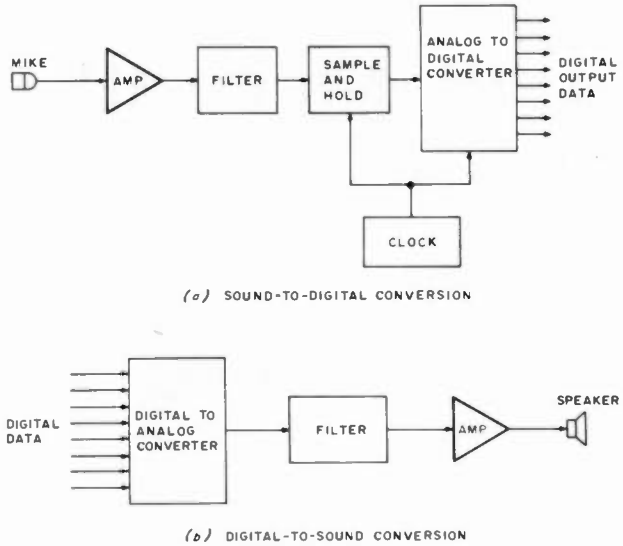

Fig. 2. Circuitry needed to digitize audio.

clock oscillator which sets the rate at which the input signal is sampled.

The output of the A/D converter is now a binary number which can be stored in memory or recorded on tape. When the digitized data is played back, as shown in Fig. 2(b), the binary data is converted back to an analog signal with a digital-to-analog (D/A) converter, passed through a low-pass filter to remove the sharp corners from the wave, amplified, and fed to a speaker.

Now that we know how often a sample should be taken of the input wave, we have another question: How accurately must it be digitized in the A/D converter? This is related to the number of bits produced by the converter for each sample.

A binary number consisting of just one bit can take on only one of two values—either 0 or 1. A binary number consisting of two bits can have values of 00, 01, 10, or 11, a total of four different values. In general, a number which consists of n bits can take on 2^n different values. For instance, ten bits allow 1024 different numbers.

Suppose the converter produces a binary number consisting of just one bit. That one bit is not enough to indicate the precise voltage of the input. With one bit, we can tell only whether the input was positive or negative. This obviously will lead to a very distorted wave, since we cannot hope to keep all the little squiggles in the audio signal.

On the other hand, a ten-bit number can represent 1024 different numbers. Thus, we could measure and encode 512 different positive voltage levels and 512 different negative voltage levels. Thus, the more precise we want our measurements of the sample voltages to be, the more bits we need for each measurement.

In a hi-fi system, we often try to get a signal-to-noise ratio (S/N) of 60 dB or more. 60 dB is a voltage ratio of 1000 to 1, so that we must be able to reproduce two signals even if one is 1000 times larger than the other. This requires being able to measure at least 1000 different positive voltage levels and 1000 different negative voltage levels, for a total of 2000 different voltage levels. Since $2^{11} = 2048$, we need at least 11 bits for this. By the time you add a few more bits to allow these signals to be reproduced with low distortion and to give a little "headroom" so that an occasional burst of extra volume can get through, you are close to 14 bits per sample.

The digital systems being proposed in the hi-fi industry use between 14 and 18 bits per sample; 14 bits are used in consumer products and up to 18 bits are used in the studio-quality recorders which produce the master tapes.

How many bits per second (bps) does this add up to? For pure hi-fi, we need at least 40,000 samples per second, each with at least 14 bits, for a minimum of 560,000 bps (and up to 2 MHz in studio-quality systems). At a rate of 560,000 bps, a 16,384-bit EPROM would provide hi-fi for about 0.03 second. Not enough for a grunt, let alone a ham call.

So we must limit the number of bits per second. This is done by drastically reducing the sampling rate and also reducing the number of bits from the A/D converter.

To squeeze a two-second call into this ROM, we can store 8192 bps. At a sampling rate of 8000 Hz or so (to cover the communications audio range to 4000 Hz), that gives us about one bit per sample. This means that we don't need a complex sample-and-hold circuit, an A/D converter, or even a D/A converter. All we need is some circuit which can tell whether the input audio is positive or negative at the sampling intervals, and which produces a one-bit output—1 if positive, 0 if negative. That turns out to be very simple to do.

The disadvantage is that our voice recording will be very distorted. But by heavily filtering the output with a low-pass filter, we can remove some of that distortion and make the result quite understandable.

The Talking Identifier

Let's leave for a moment the question of how you "record" the voice and store it in the ROM, and look at the circuit of the talking IDer itself, Fig. 3.

The voice pattern is stored in a 2716 EPROM. This is a memory IC currently selling for about $10-$15. It is organized as 2K × 8, meaning that it has 2K storage locations (which is 2048), each holding an 8-bit number.

Each of those 2K locations has an address, a binary number which ranges from 00000000000 to 11111111111. This 11-bit address is fed to the EPROM via the A10 through A0 address pins shown at the bottom of the IC. Each time we give the EPROM an address, it outputs the contents of the addressed location on the eight data lines, D7 through D0, shown on the right side of the EPROM.

The eight bits in the location come out in parallel, meaning all at the same time. But we want the bits one at a time, roughly 1/8000 of a second apart, since each bit represents one sample of the recorded voice pattern. (Over a space of two seconds there is a total of 16,384 samples or bits, which are stored in consecutive locations on the EPROM. The first eight bits are in memory location 00000000000, the next eight bits are in location 00000000001, and so on, up to the last eight bits, which are in location 11111111111.)

The job of splitting up the eight bits in one location into individual bits is handled by the 74LS151 multiplexer. This IC behaves like an SP8T switch which is continuously rotating, scanning the eight bits coming in from the EPROM

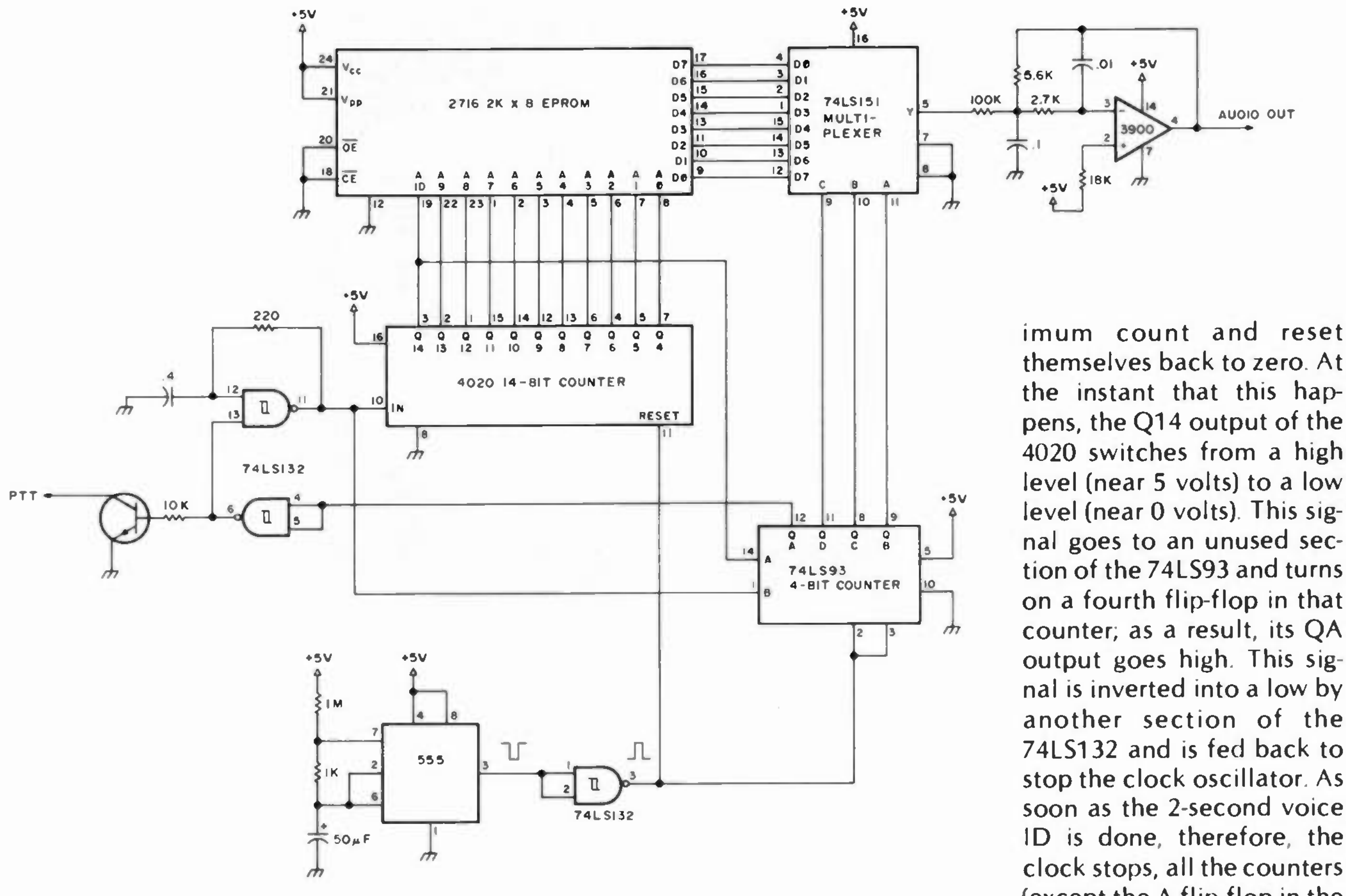

Fig. 3. Talking identifier diagram.

much like the distributor in a V8 car engine. It changes the parallel data coming into the multiplexer into serial data. The result, on pin 5 of the multiplexer, is a square wave which carries the frequency components of the voice but, of course, doesn't have any amplitude information because amplitude was never digitized. This signal is fed into an active low-pass filter which uses an LM3900 Norton op amp, and which cuts off at just under 4000 Hz. This provides the audio output.

The rest of the circuit simply provides different addresses to the EPROM to scan through its memory and also drives the multiplexer.

This part of the circuit starts with one section of a 74LS132 quad, two-input NAND, Schmitt-trigger IC which, along with a 220-Ohm resistor and 0.4-uF capacitor, forms an oscillator which oscillates at about 8 kHz. The output of this oscillator is sent to pin 10 of a 4020 CMOS counter.

The 4020 is a 14-stage ripple counter which contains fourteen flip-flops. Since $2^{14} = 16,384$, this counter can count off 16,384 clock pulses. Since the clock frequency is about 8 kHz, if we start this counter at a count of 0, it will take approximately two seconds to count up to its maximum count. As it does so, it's counting off the 16,384 data bits which are being converted into an audio signal.

We really need 14 outputs from that counter to drive the EPROM address lines and the multiplexer. Unfortunately, to save on pins the 4020 provides only the 11 outputs from the 4th flip-flop (Q4) through the 14th flip-flop (Q14); the outputs of the first three flip-flops are not accessible. So, we have a second counter, which is a 74LS93 binary counter. The oscillator signal which goes to the 4020 goes also to the B input, pin 1, of the 74LS93. Three of the flip-flops in this IC (called B, C, and D) count in parallel with the first three flip-flops of the 4020, and give us the missing signals.

These three signals, on pins 11, 8, and 9 of the 74LS93, change very rapidly and continuously drive the multiplexer which, therefore, scans the output of the EPROM at a high speed (one bit every 1/8000 second).

The eleven bits from the 4020 have a lower frequency and, therefore, drive the address lines of the EPROM at a slower rate (one address every 1/1000 second). Thus, the EPROM feeds out a new group of eight bits every 1/1000 second. Since there are 2K such groups, this again takes about two seconds.

When the two seconds are up, the 4020 and 74LS93 counters reach their maximum count and reset themselves back to zero. At the instant that this happens, the Q14 output of the 4020 switches from a high level (near 5 volts) to a low level (near 0 volts). This signal goes to an unused section of the 74LS93 and turns on a fourth flip-flop in that counter; as a result, its QA output goes high. This signal is inverted into a low by another section of the 74LS132 and is fed back to stop the clock oscillator. As soon as the 2-second voice ID is done, therefore, the clock stops, all the counters (except the A flip-flop in the 74LS93) freeze at zero, and the IDer stops.

The IDer is restarted by resetting all counters to zero with a positive pulse coming out of pin 3 of still another section of the Schmitt trigger NAND. This start signal could be generated externally, but for use with a 2-meter FM rig on 146.52 we have a 555 timer which automatically generates a very short reset pulse every 30 seconds or so. This pulse resets the A flip-flop in the 74LS93, which releases the clock and starts the ID process all over again.

Connected to the clock control line is an NPN transistor. When the clock is running (that is, when the IDer is identifying), that transistor is turned on; when the IDer is off, so is the transistor. By connecting the collector to the push-to-talk (PTT) line of the rig, the IDer automatically keys the transmitter while it is identifying. This circuit is suitable only for

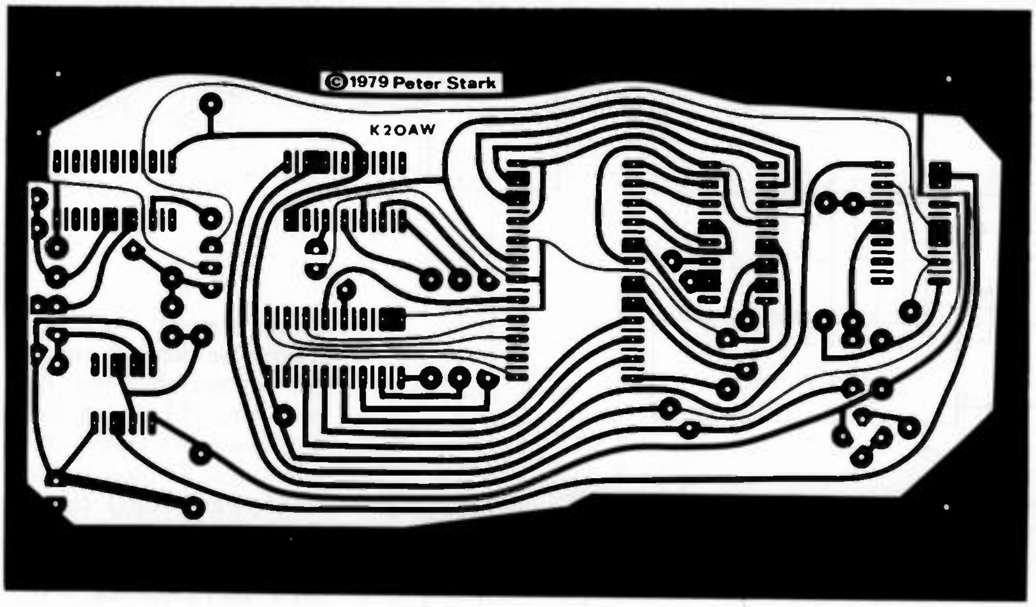

Fig. 4. PC board, copper side.

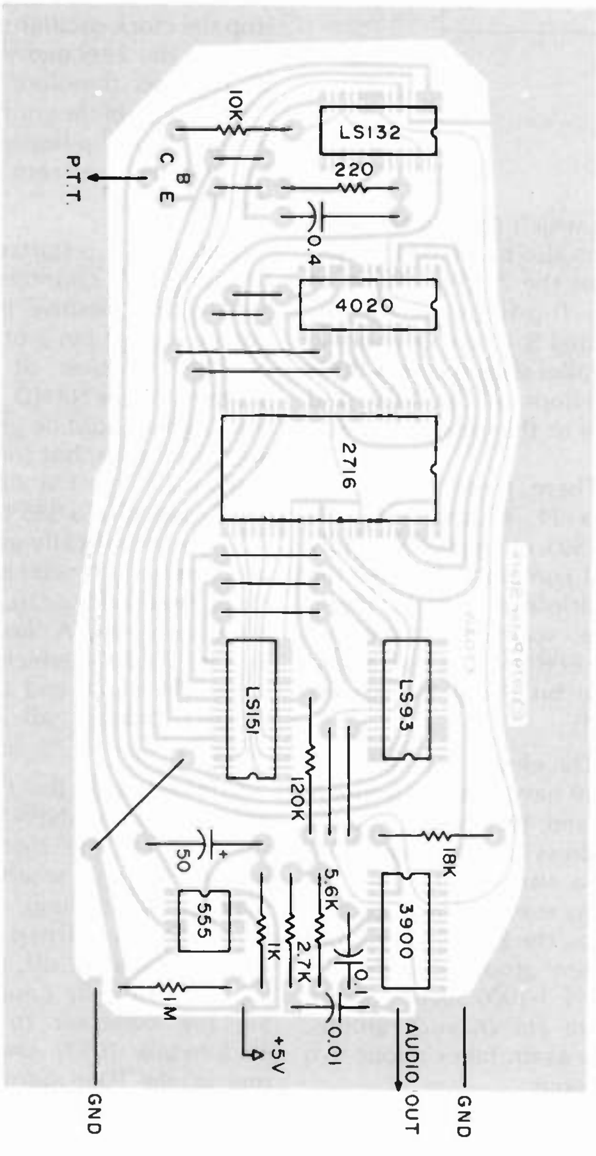

Fig. 5. Parts layout.

driving the PTT line in small, transistorized transceivers. Those rigs which require large currents to drive a PTT relay may require an additional buffer transistor.

Although there are no potentiometers in the circuit, there are several components which may require adjustment. The 100k resistor in the active filter is chosen to provide a fairly small output audio level; if more audio signal is needed, it can be reduced to as low as 5k. Incidentally, do not use disc capacitors in the active filter circuit. Use good quality polystyrene or dipped mica caps.

The oscillation frequency of both the 74LS132 oscillator and the 555 timer depends on the tolerance of the resistors and capacitors used. Since capacitors, especially, tend to have very wide variations, some trimming may be needed to get the right results. To vary the spacing between IDs, you may want to increase or decrease the capacitor value in the 555 timer circuit.

If the 74LS132 oscillator runs too fast or too slow, the voice pattern in the EPROM will be scanned too fast or too slowly, with the same result as when a record is played too fast or too slow. You may like the Donald Duck quality this gives, but for best results you should trim the RC values in this oscillator for the most natural speech sound.

The circuit layout is not critical, and almost any construction method will work, including wire-wrap and temporary prototype socket hookup. If desired, you can use the printed circuit board shown in Fig. 4. Fig. 5 shows the parts layout for the PC board.

The identifier needs approximately 100 mA of +5 volt power. This is provided easily by a three-terminal regulator. If you use the IDer in your mobile, simply include the regulator circuit of Fig. 6. Assuming a load current of 100 mA and a worst-case auto battery voltage of 16 volts, the regulator must drop 11 volts for a power dissipation of 1.1 Watts. With a good heat sink, all this can be dropped in the three-terminal regulator itself; by adding a 39-Ohm, 2-Watt resistor as shown in the circuit, however, we drop 3.9 volts across the resistor. This removes almost .4 Watts of heat from the regulator and dissipates it in the resistor instead.

For applications that require even lower power (such as for battery-powered applications), total circuit power can be reduced even more by lifting the chip enable pin (pin 18) of the 2716 from ground and connecting it instead to pin 12 of the 74LS93. This disables the 2716 when the circuit is not identifying. The circuit still draws around 100 mA when identification is in progress, but cuts it down to less than half during other times.

"Recording" the EPROM

To digitize the audio signal, we need a filter to remove high-frequency components above 4000 Hz and a comparator circuit to

✓Reader Service—see page 226

sense the polarity of the input audio. This circuit uses another LM3900 quad Norton op amp and is shown in Fig. 7.

One op-amp in the LM3900 is used as an active low-pass filter with a cutoff frequency of just under 4000 Hz. This amplifier/filter has a small amount of gain but not enough to accept the weak signal from a microphone. It is designed for use with an external mike preamp or with the higher-level output of a tape recorder. I generally record the desired message on tape first and then feed the speaker output of the recorder to the audio input of this circuit.

A battery-operated recorder is best in this case, since with a high gain it is possible for hum to be digitized between words. Hum gets swamped out during speech, but when there is silence, the circuit works much like a volume compressor by boosting low-level sounds. Thus, a good S/N ratio is essential. The 10k volume control on the input helps to cut down excessive signal; its correct adjustment is important.

The output of the filter is sent to another op-amp section of the LM3900, which is used as a slicer or comparator. The signal coming from the filter is sent to one input of this op amp while a reference current from the 10k zero-set pot is fed to the other. As the filtered audio output goes above or below the reference signal, the digital output from pin 9 switches between 0 and +5 volts.

The 10k zero-set pot should be adjusted so that with the audio input shorted to ground, the output is just on the verge of switching between 0 and +5 volts. With proper adjustment, positive audio peaks will clip the digital output one way while negative peaks flip it the other way.

For testing purposes, an audio amplifier/speaker combination can be connected to the digital output to monitor the signal after it has been digitized; I use an inexpensive Radio Shack signal tracer for this purpose. The digitized signal is supposed to be filtered before being heard, so this signal will sound excessively harsh, but it is good enough to give you an idea of whether the circuit is working.

Once we have the one-bit digital output, we must sample it at intervals of about 1/8000 second, convert the samples into 8-bit bytes, and store them. Before burning them into the EPROM, however, it is very convenient to be able to "play" them back to make sure that the volume controls have been set right and that we have the right voice segment. It also would be very convenient if in some way we could edit the digital code to eliminate any noise just before and after the call. In other words, it would be very convenient if we could store the message in RAM and read or modify it before it is permanently stored in EPROM.

Building a special piece of hardware for just this purpose is difficult and expensive. Fortunately, most home or personal computers have an input and output port which could be used to input or output this one-bit digital signal and also have RAM which could be used to store the code temporarily. This makes the job almost trivial.

To do this, you need a program which will input data, group bits together in sets of 8, and store them. In most cases, this program has to be written in machine or assembly language since most BASIC systems are not fast enough to take 8000 samples per second and process them.

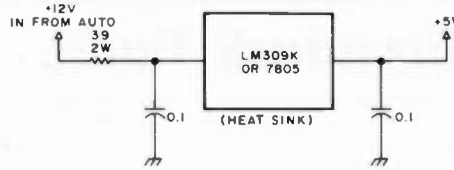

Fig. 6. Voltage regulator for mobile use.

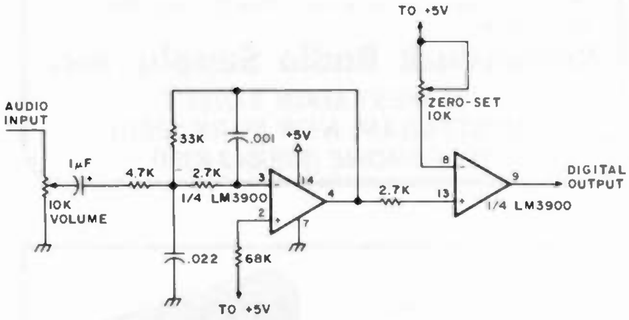

Fig. 7. Audio-to-digital conversion circuit.

Obviously, the program will depend on the particular computer used, but as a starter, I'm including here three programs written for an SWTP 6800 system which are very useful.

Parallel input/output on 6800 systems is usually handled by an IC called a PIA or Peripheral Interface Adapter. Although this IC has twenty input/output pins, only two are used in this application—bit 0 of port A gets the input from the circuit of Fig. 7, while bit 1 of the same port feeds an audio amplifier/speaker combination which is used to listen to the recorded sound.

Program 1 is an echo program which is used only for testing. It inputs via bit 0, outputs the bit right back to bit 1 of the input/output port, and then waits for a short while to simulate the delay between samples. When everything is running correctly, the audio coming out of the computer will sound very similar to the audio you could hear directly at the output of the circuit of Fig. 7. (It, too, will sound harsh because of the lack of filtering.)

The program starts by initializing the PIA to set up the correct bits for input and output. The main part of the program (starting at

```
                *********************************************
                *                                           *
                * THIS PROGRAM INPUTS DATA FROM PORT A BIT 0 *
                * OF A PIA IN PORT 7, AND ECHOES IT TO BIT 1 *
                *                                           *
                *********************************************

 (801C)         PIADAT EQU   $801C     PORT A DATA/DIRECTION REG
 (801D)         PIACTL EQU   PIADAT+1  PORT A CONTROL REGISTER

 (0100)                ORG   $0100
0100 7F 801D    START  CLR   PIACTL    RESET PIA
0103 86 02             LDA A #$2       SET BIT 0=INPUT, BIT 1=OUTPUT
0105 B7 801C           STA A PIADAT
0108 86 04             LDA A #$4       RESET BACK TO DATA
010A B7 801D           STA A PIACTL
010D B6 801C    LOOP   LDA A PIADAT    LOAD DATA FROM PORT A BIT 0
0110 48                ASL A           SHIFT LEFT INTO BIT 1
0111 B7 801C           STA A PIADAT    OUTPUT TO PORT A BIT 1
0114 8D 02             BSR   WAIT
0116 20 F5             BRA   LOOP      GO BACK AND REPEAT

                * FOLLOWING WAIT ROUTINE INTRODUCES A DELAY
                * WHICH PERMITS SAMPLING RATE TO BE CHANGED

0118 CE 0010    WAIT   LDX   #$0010    INITIALIZE INDEX REGISTER
011B 09         WAIT1  DEX             DECREMENT INDEX
011C 26 FD             BNE   WAIT1     REPEAT IF NOT YET ZERO
011E 39                RTS             OTHERWISE RETURN
```

Program 1. Echo test.

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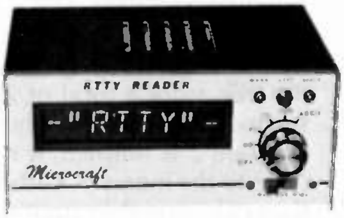

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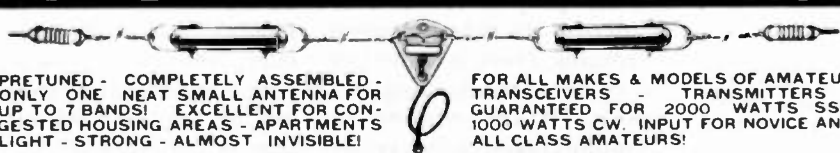

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```
***************************************************
*                                                 *
* THIS PROGRAM INPUTS DATA FROM PORT A BIT 0      *
* OF A PIA IN PORT 7, PACKS 8 BITS PER BYTE,      *
* AND STORES THE DATA IN MEMORY LOCATIONS 1000    *
* TO 7FFF.                                        *
*                                                 *
***************************************************

  (801C)        PIADAT EQU   $801C      PORT A DATA/DIRECTION REG
  (801D)        PIACTL EQU   PIADAT+1   PORT A CONTROL REGISTER

  (0100)               ORG   $0100
0100 7F 801D   START   CLR   PIACTL     RESET PIA
0103 86 02             LDA A #$2        SET BIT 0=INPUT, BIT 1=OUTPUT
0105 B7 801C           STA A PIADAT
0108 86 04             LDA A #$4        RESET BACK TO DATA
010A B7 801D           STA A PIACTL
010D CE 1000           LDX   #$1000     POINT TO MEMORY BUFFER ADDRESS
0110 C6 08     LOOP1   LDA B #$08
0112 F7 0132           STA B BITCTR     COUNT 8 BITS PER BYTE
0115 4F                CLR A            ERASE A ACCUMULATOR
0116 F6 801C   LOOP2   LDA B PIADAT     READ DATA INTO B ACCUMULATOR
0119 C4 01             AND B #$01       MASK OFF EVERYTHING EXCEPT BIT 0
011B 48                ASL A            SHIFT A ACCUM LEFT
011C 1B                ABA              ADD NEW BIT FROM B TO A
011D C6 10             LDA B #$10       SET UP COUNTER FOR SAMPLING DELAY
011F 5A        WAIT    DEC B            DECREMENT B
0120 26 FD             BNE   WAIT       REPEAT IF NOT YET ZERO
0122 7A 0132           DEC   BITCTR     DO FOR 8 BITS
0125 26 EF             BNE   LOOP2      GET NEXT BIT
0127 A7 00             STA A 0,X        STORE BYTE WHEN COMPLETED
0129 08                INX              INCREMENT INDEX REGISTER POINTER
012A 8C 7FFF           CPX   #$7FFF     CHECK FOR END OF MEMORY
012D 26 E1             BNE   LOOP1      REPEAT IF OK
012F 7E E0D0           JMP   $E0D0      RETURN TO MONITOR WHEN DONE

0132           BITCTR RMB    1          BIT COUNTER TO COUNT 8 BITS
```

Program 2. Input.

```
*****************************************
*                                       *
* THIS PROGRAM GETS DATA FROM MEMORY    *
* LOCATIONS 1000-7FFF, UNPACKS IT INTO  *
* INDIVIDUAL BITS, AND OUTPUTS TO PORT A *
* BIT 1 OF A PIA IN PORT 7.             *
*                                       *
*****************************************

  (801C)        PIADAT EQU   $801C      PORT A DATA/DIR REGISTER
  (801D)        PIACTL EQU   PIADAT+1   PORT A CONTROL REGISTER

  (0180)               ORG   $0180
0180 7F 801D   START   CLR   PIACTL     RESET PIA
0183 86 02             LDA A #$2        SET BIT 0=INPUT, BIT 1=OUTPUT
0185 B7 801C           STA A PIADAT
0188 86 04             LDA A #$4        RESET BACK TO DATA
018A B7 801D           STA A PIACTL
018D CE 1000           LDX   #$1000     POINT TO MEMORY BUFFER ADDRESS
0190 C6 08     LOOP1   LDA B #$08
0192 F7 01B4           STA B BITCTR     COUNT 8 BITS PER BYTE
0195 A6 00             LDA A 0,X        GET NEXT BYTE FROM MEMORY
0197 16        LOOP2   TAB              TRANSFER IT TO B REGISTER
0198 48                ASL A            SHIFT A ACCUM LEFT 1 BIT
0199 59                ROL B            ROTATE B LEFT 3 BITS TO MOVE THE CURRENT
019A 59                ROL B            BIT FROM BIT 7 (LEFT-MOST) INTO
019B 59                ROL B            BIT 1 (SECOND FROM RIGHT)
019C C4 02             AND B #$02       MASK OFF EVERYTHING EXCEPT BIT 1
019E F7 801C           STA B PIADAT     OUTPUT TO PIA
01A1 C6 08             LDA B #$08       SET UP COUNTER FOR SAMPLING DELAY
01A3 5A        WAIT    DEC B            DECREMENT B
01A4 26 FD             BNE   WAIT       REPEAT IF NOT YET ZERO
01A6 7A 01B4           DEC   BITCTR     DO FOR 8 BITS
01A9 26 EC             BNE   LOOP2      IF BIT COUNTER NOT ZERO
01AB 08                INX              INCREMENT INDEX WHEN BYTE IS DONE
01AC 8C 7FFF           CPX   #$7FFF     CHECK FOR END OF MEMORY
01AF 26 DF             BNE   LOOP1      REPEAT IF OK
01B1 7E E0D0           JMP   $E0D0      RETURN TO MONITOR WHEN DONE

01B4           BITCTR RMB    1          BIT COUNTER TO COUNT 8 BITS
```

Program 3. Output.

the statement labeled LOOP) loads a bit from the PIA, shifts it left from bit 0 into bit 1, and outputs it. Then it branches to a WAIT subroutine for a short delay, after which it branches back to LOOP.

For experimental purposes, it's important to be able to calculate how many samples are taken per second. This is done by computing how many computer clock cycles are required for each instruction in the loop. In Program 1, the main loop takes 31 clock cycles plus 8 cycles for each repetition of the WAIT1 loop. With the WAIT1 loop initialized (with the LDX instruction) to run 16 times (0010 hexadecimal), the total time between samples is 31 + (16) × (8) = 159 clock cycles.

In a typical SWTP computer running with a 900-kHz clock, each clock cycle takes 1.11 microseconds, so that the total delay between samples is 177 microseconds; this translates into a sampling rate of about 5600 samples per second, which is about the minimum that can be used for acceptable results. For 8000 samples per second, the LDX instruction should be changed to run the WAIT1 loop 10 times.

Once the echo test program reveals that the A/D conversion and the computer input/output circuitry is working correctly, Program 2 can be used to input data into the computer's memory, while Program 3 is used to output it back to the speaker. Both of these programs have a WAIT loop which provides some control over the delay between samples. There is some leeway here in adjusting this delay. If the number of samples taken per second is changed above or below 8000 (to increase playing time, for instance), the clock oscillator frequency in the identifier circuit of Fig. 3 also has to be changed to a similar value or the final output will have a pitch which is too high (like Donald Duck) or too low.

Both programs are located in low memory, with the input program starting at location 0100 (hex) and the output program at 0180. They do not overlap and, therefore, can be in memory at the same time. Thus, we can input audio, store it in memory, and then output it right back.

The programs are written for a 32K computer and use locations 1000 (hex) through 7FFF to store the resultant digital data. This is a total of 28K of memory; at the rate of 1K per second, this can store a total of 28 seconds of sound. When Program 2 is finished, it returns to the monitor. Rather than calculate the sampling rate by computing the number of cycles per loop, etc., an easier way to adjust the WAIT loop is to note how long the overall program runs. If it runs exactly 1 second per K of memory used, then it is running at 8192 samples per second.

By changing the starting address (1000 hex) or the ending address (7FFF) in Program 3, we can "play" back just selected portions of the input. In this way, we can pick one of several versions of the same call, choosing the one that sounds best. This allows us to edit the data before it is stored into EPROM. Once you find the portion which sounds best, burn that portion into the EPROM and keep the rest of the EPROM data empty (an erased 2716 EPROM has a hex FF in every location). This will assure that no noise or sounds are in the EPROM other than the actual call.

Conclusions

While this talking identifier won't win any awards for hi-fi quality, it is perfectly understandable and fulfills its purpose well. It also gives you a chance to experiment with speech reproduction via digital means. In addition, it's a lot more satisfying to build such a device from commonly-available ICs than to go out and buy an expensive synthesizer chip or system. Why don't you try it?

So, if you ever hear something grumble "K2OAW" on 146.52 as I speed by your house on the nearby Interstate, maybe you'll be able to turn on your own IDer and have it come back to me. ■

✓ Reader Service—see page 226

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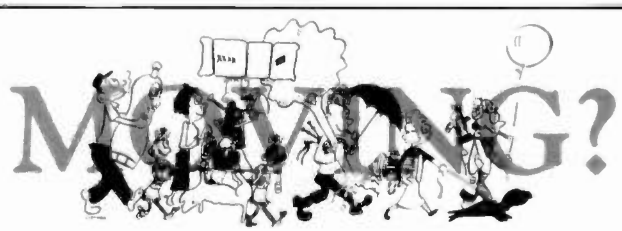
Debra L. Boudrieau
Circulation Manager



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CORRECTIONS

May, 1980
"A 'Short-Yard' Antenna for 40/75—fits where others won't"

The spacing between the length of vertical copper or aluminum wire shown in Fig. 1, page 78, should be 8 inches, not 8 feet!

June, 1980
"Down with Interpolation—a digital display for the Triton and others"

On page 36, Fig. 1, the pin 6 of the 74196 shown going to +5 V should be pin number 10. On page 39, column 2, line 2, pins to check on the 7490 should be 8, 9, and 11.

If the readout displays changing random figures, the crystal is probably not oscillating. When ordering crystals, it is always a good idea to send along a schematic of the circuit, with values indicated, in which the crystal will be used.

As stated in the caption for Fig. 3, page 38, there are frequencies other than 409.6 kHz which can be used. If your readout works on all bands except 28 MHz, it is probably the 74C925 which is at fault. This chip is specified for a minimum response of 2 MHz—typically 4 MHz. Since the mixer frequency for the 10-meter band is 2.1 MHz, your 74C925 may have a response of less than this.

Brooks Carter W4FQ
Irmo SC

July, 1980
"ADDSCAN—now you can be two places at once"

In Fig. 2, page 52, the polarity of C1 should be reversed from what is shown. We apologize for the error in the author's call. It should be WB9SFC.

"The Sweet Sounding Probe"

The reference designators for the ICs shown in Fig. 1, page 84, were omitted. The 555 is U1; 741 is U2; and 78L12 is U3.

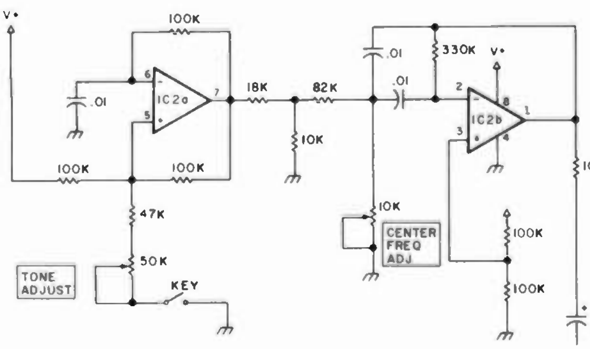
August, 1980
"On Ten FM—home of the free, land of the brave"

I'd like to add a few words of clarification to my article. The best source I've found for the CB circuit boards is Surplus Electronics (Miami, Florida) who advertise in *73*. Specify the PTBMO36AOX CB circuit board with 40-channel switch. These boards contain the easy-to-work-with PLL02A frequency synthesizer PLL chip, rather than some odd-ball chip for which there is no readily available data, and are of better quality than other boards I've seen. Sam's CB series of Photofacts, Nos. CB-129 (Midland 13-888B) and CB-131 (Hy-Gain IX), are the best sources of schematics and technical information for these boards.

John F. Sehring WB2EQG
Oradell NJ

September, 1980
"The Penultimate CPO—a non-discrete LSI device"

Pin numbers for IC2b were inadvertently left out in Fig. 2, page 62. The missing numbers are shown in the accompanying diagram.



Revised Fig. 2, "The Penultimate CPO."

October, 1980
"NASA Satellites You Can Use—with permission, of course"

In the math box on page 52, the calculations for Washington DC should have indicated that X, the difference between satellite longitude and site longitude, was obtained using Washington DC's west longitude of 77.2 degrees.

Joseph D. Novak K4OVK
Vienna VA

Map of States Worked

A calming note to our readers in British Columbia and Michigan: No, Vancouver Island has not been traded for the Upper Peninsula.

November, 1980
"Direct Conversion Lives—excitingly simple receiver project"

There are three corrections to this article—the easy ones first:

On page 66, Fig. 3, pin 6 on the LM380 is shown in two places. The pin 6 shown as being grounded should be pin 4.

On page 68, column 3, 8 lines from the bottom, mH should be uH.

Now for the big one! Also on page 68, insert the following just before Audio Filters in column 1.

The VFO and Buffer

I used separate vfos for 80m and 40m and after trying several circuits, I chose the series-tuned Clapp oscillator because of its good stability. The output part of the vfos and the buffer are exactly like that used by PAØSE. His was a good design and I find no need to change it. It has one weakness, though: Because it is a broadband buffer, the second harmonics of the vfos also appear at the mixer. This is especially true of the 80m vfo where the second harmonic of, for example, 3.6 MHz mixes with a very strong commercial station on 7.2 MHz. I tried a 40m series-tuned trap from the drain of the FET in the 80m vfo, but it cured the problem only partially. (This also was the case without rf amplification at the front end.) I solved this problem by changing the single-tuned input circuit as used by PAØSE to a double-tuned one as shown in Fig. 3. The capacitors of this double-tuned circuit are two gang-tuned 350-pF variable capacitors (700 pF total) and the inductances are so chosen such that the 3.5-MHz resonance occurs with the plates nearly fully closed. Resonance at 7.0 MHz then occurs with the plates nearly fully open.

Audio Amplification

After some trials with other circuits, I agree with PAØSE that an FET audio amplifier is about the best device for a first audio stage after the mixer. The audio transformer, T2, is a 1k:10k, which is far from ideal, but it was the only one available locally. Far better would be one with a 50 Ω: 10k impedance ratio, as the output impedance of the MD108 is 50 Ω. The final audio amplifier, the LM380, provides plenty of audio and is better than the LM386 which I used at first.

"Tune In the Wind—a do-it-yourself hot-wire anemometer"

On page 81, column 4, line 3 would make more sense if "about" were to be replaced with "above."

"The Odd Couple—CASEY/1 tackles OSCAR's telemetry"

In column 4, page 110, the last two lines of the article refer to the article listed in reference 2. The reference number was omitted from the last line. Also, please note my new address.

Rich Casey WA9LRI
1818 Hemlock
Garland TX 75041

"Be Prepared!—30 meters for the FT-101B"

Please note a change in my address.

Mark H. Monson EL5G/KB8NO
Box 1046
Monrovia, Liberia

"New Weather Eye in the Sky—a primer on NOAA's TIROS"

In Table 1(b) on page 177, subpoint latitude for 76 minutes after crossing should be −81.1, not −91.1.

On page 181, column 1, the first sentence of step 3(A) should read, "Break the connection between the vertical size pot and the input line of the vertical deflection amplifier."

1980 INDEX

AMPLIFIERS

ANTENNAS

ATV

CB CONVERSIONS

CONSTRUCTION

CONTROL

CORRECTIONS AND FURTHER INFO

CW

EQUIPMENT MODIFICATIONS

GADGETS

HISTORY

HUMOR

I/O

MISCELLANEOUS

MOBILE/PORTABLE

NEW PRODUCT ARTICLES

NEW PRODUCT SECTION

OPERATING

HAM HELP

Help!!! I am having difficulty in locating a schematic or operating manual for the following piece of equipment. It looks like a modem but I want to be sure. It has a transmit and receive section. The model number on the receive section is 1CRCU-RS-1. The model number on the transmit section is 1CTCU-RS-1. It carries the Burroughs Trademark on the case but it was manufactured by Stelma, Inc. Burroughs and Stelma, Inc., have not been able to help. Any information would be greatly appreciated.

Terry Hazelett
2107 Capitol Dr.
Parkersburg WV 26101

I need a schematic and/or instruction manual for a Collins 310B-1 exciter. I will buy a copy or reproduce one and return it. I also need an ac power supply for a KWM-2A.

Herman F. Shnur K4CTG
115 Intercept Ave.
North Charleston SC 29405

I would like to correspond with people who have working models of computer-controlled or radio-controlled humanoid robots. Thank you.

Matt Beha N8BPI
3752 Lane Court
St. Joseph MI 49085

Our school amateur radio club is in need of the schematic and/or instructions for a Hammarlund four-20 transmitter. Payment for copies will be mailed or we will copy and send back if preferred.

Barringer High School
c/o F. Rice N2BVZ
90 Parker Street
Newark NJ 07105

FUN!

from page 26

17) Slow-scan television is permitted only on upper-sideband. ____ ____
18) Hertz rotation is an important factor in moonbounce communication. ____ ____
19) Amplitude-shift radioteletype is also called "make-and-break" keying. ____ ____
20) Color amateur television is permitted only above 1296 MHz. ____ ____

ELEMENT 4—SCRAMBLED WORDS

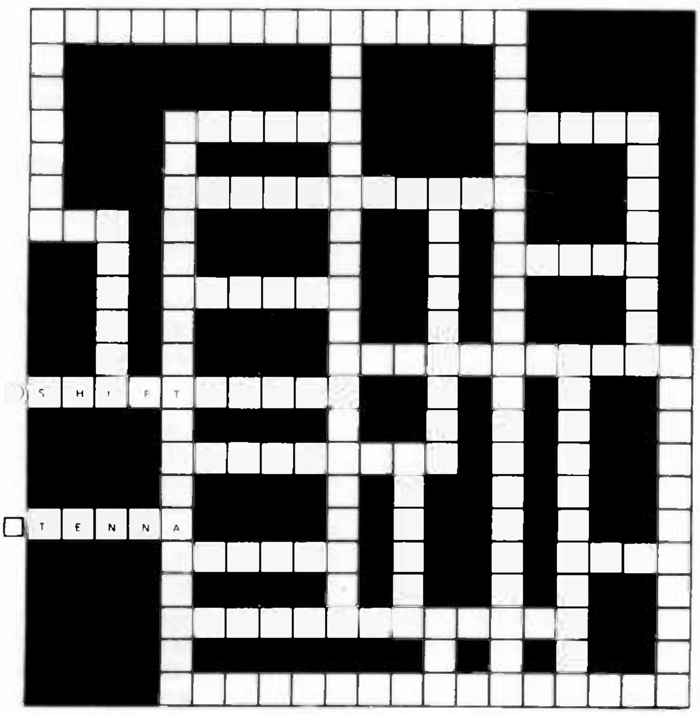
Unscramble these words dealing with specialized mode activities.

rswohe	hpcun	craos	cibsa
trenrip	ivode	anocbe	puknil
lebl	olop	ormci	xfa
iliadgt	lupes	cnsy	eramac
rtc	nisp	retmoe	nigp

ELEMENT 5—HAMAZE

Here's a new type of maze specifically geared to hams. The object is to start at the circle and trace your way to the square by filling in the answers to the clues given below. To help you on the way, we've already given you the first and last clue answers. All words read either vertically downward or from left to right. Each new word is on a *perpendicular* angle to the previous word. Words join on a common letter. Good luck.

1) Mark and space (given)
2) RTTY automatic monitoring
3) Phase III computer channel (abbr.)
4) Take antenna for a turn
5) Meteor and rain
6) Without pattern or a memory
7) Between short and long waves
8) Frequency above 1 GHz
9) Moonbouncer's reply
10) Thousand prefix
11) You type on one
12) CRT, digital, etc.
13) TV scale
14) Satellite protection band
15) WAS, DXCC, etc.
16) People who sank Phase III (abbr.)
17) Greek: at a distance
18) RTTY error
19) Highest point or radio company
20) OSCAR rotator: ______-el
21) Skyhook: an______ (given)



THE ANSWERS

Element 1:
See illustration.

Element 2:
1-I, 2-D, 3-E, 4-K, 5-C, 6-H, 7-G, 8-A, 9-J, 10-F.

Element 3:
1) True - Yes, but now there are many other funny noises to be heard on this band.
2) True - With Charles Krum he formed the Morkrum Company which was eventually bought out by AT&T. He got to keep the salt business, however.
3) False - No, F1 is. The only FCC designation AF2M has is his Extra ticket.
4) True - Like clockwork.
5) False - Only RTTY.
6) True - Many times.
7) True - With a little on 50 MHz and some activity above 432.
8) True - WB2IBE to K7OFT, November 20, 1979, on 50 MHz.
9) True - Still not quite television in the conventional sense, but an improvement beyond slow scan.
10) True - Write to Washington stating your reason.
11) False - Most awards require a real signature on them for credit.
12) False - That's really wideband! Kill the "k."
13) False - No, it stands for Narrow Band Voice Modulation. The meter, however, would probably be more useful.
14) False - Eighty and up.
15) False - All CW bands *but* Novice and 160.
16) False - Means "Earth-Moon-Earth."
17) False - Only by convention on 20 and up.
18) False - The polarization change of a signal passing through the Earth's ionosphere is known as *Faraday* rotation.
19) True - Old practice that was eliminated when FCC approved frequency-shift keying.
20) False - Color television, fast scan or slow scan, is allowed on any appropriate amateur TV frequency.

Element 4:
(Reading from left to right) shower, punch, oscar, basic; printer, video, beacon, uplink; bell, loop, micro, fax; digital, pulse, sync, camera; crt, spin, meteor, ping.

Element 5:
See illustration.

SCORING

Element 1:
See illustration. Twenty points for the complete puzzle, or 1/2 point for each question you got.

Element 2:
Two points for each mode you matched to its equipment.

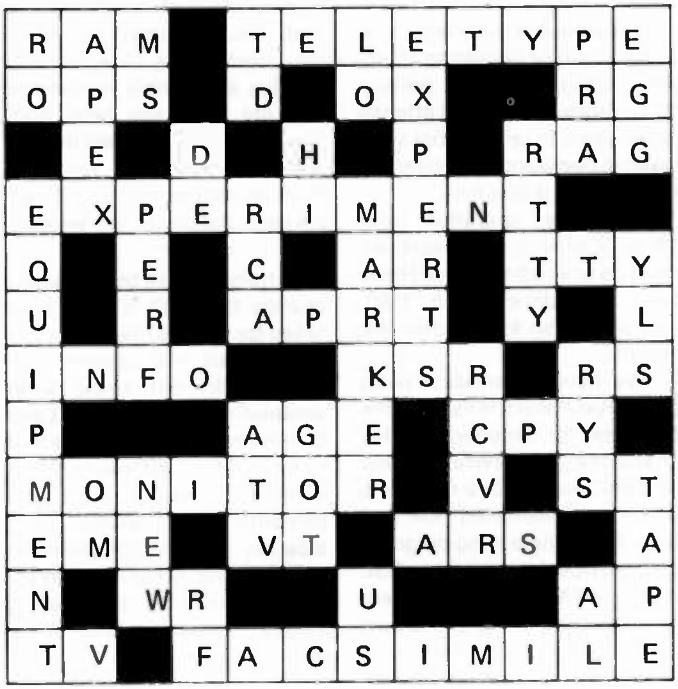
Element 3:
One point for each correct answer.

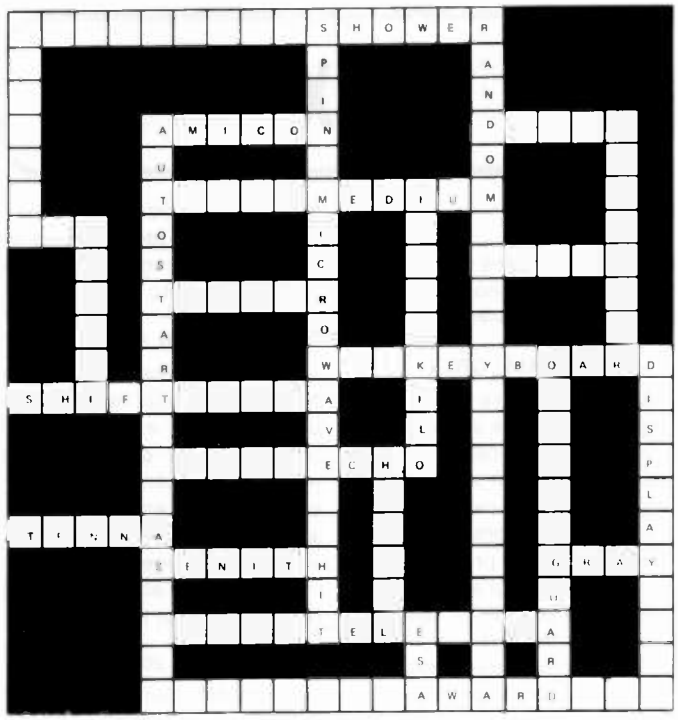
Element 4:
One point for each word successfully unscrambled.

Element 5:
Twenty points for complete puzzle, or one point for each word.

Total up your points and see the level of your technical expertise:

- 0-20 points - Lid
- 21-40 points - Physically-fit Conditional
- 41-60 points - KA
- 61-80 points - A pro
- 81 and up - A Technician in the full sense of the term





Next month: Ham History

REVIEW

RADIO EQUIPMENT AND SUPPLIES

It's been estimated that there are at least 8,000 collectors and enthusiasts of antique radio equipment in the United States. As is the case with all manner of antiquities, there's a great demand for literature on these old sets and the equipment that was used three generations back, when radio began to make itself known to the public.

Radio Equipment and Supplies is a 160-page catalog originally issued in 1922 by the Robertson-Cataract Company of Buffalo, New York, a major distributor in the field. It's full of pictures of receivers, transmitters, tubes, vario-couplers, tuning inductances, headphones, and all the apparatus that radio people of that day had to grapple with in order to "bring in the stations" or to "get on the air."

To serve the interests of the antique radio buffs of today, The Vestal Press has made a top-quality reprint of this 8½" × 11" book. With its contents including 30 pages of receivers, 74 pages of accessories for receivers, 30 pages on transmitting equipment, and 20 pages of basic "Radio Information and Data," there's something for every one of the present-day enthusiasts. It contains literally hundreds of photographs and drawings, and the 1922 prices would make anyone weep! It's certainly interesting, in the light of today's highly sophisticated electronics, to view the astounding changes that have occurred in the past 60 years.

Copies are available directly from The Vestal Press Ltd., Box 97, Vestal NY 13850, or through any bookstore, for $12.50 + 75¢ shipping (NY residents add sales tax).

CODING AND DECODING TELEVISION SIGNALS
Science Workshop

Everyone is talking about "those secret TV channels." If you have a fistful of money or a lot of technical expertise, you might build an earth satellite terminal. For a bit less cash an MDS microwave receiver capable of catching local pay TV signals can be had. A third source of limited access viewing is signals transmitted on conventional UHF TV channels but scrambled at least part of the time. As nonpaying "customers" become prevalent, more and more of these common carrier video signals will be encoded and, of course, more than a few hams will be busy trying to unscramble them. Now, much of the current scrambling technology is discussed in Science Workshop's book, *Coding and Decoding Television Signals*.

A video freak is likely to exclaim, "So that's how they do it!" after reading *Coding and Decoding* for the first time. Material for this book was gathered from a variety of public and private sources. Included in the contents is a word-for-word reproduction of a NASA report on the scrambling technique used for the Application Technology Satellite video signals. Later sections explain how some UHF signals are encoded with a 15-kHz pulse train and have special subcarrier audio. Block diagrams, oscillographs, and spectrum analyzer photographs supplement the descriptive text.

The editor of *Coding and Decoding Television Signals* states, "This is not a 'how-to' book. It does not contain any construction projects." However, an amateur knowledgeable about video and experienced in building rf circuits should be able to successfully reproduce the designs shown. You'll have to make your own parts lists and circuit board templates, though.

For some reason, beating the system at its own game has always been an attraction for electronics experimenters. As the issue of the freedom of the airways is discussed in high places, hundreds or even thousands of tinkerers will be using information from books like *Coding and Decoding Television Signals* to build their own units. Costing $9.95 ($1.00 postage), this 43-page softcover pay-TV primer for experimenters is available from Science Workshop, Box 393, Bethpage NY 11714.

Tim Daniel N8RK
***73 Magazine* Staff**

DX

from page 14

point of view on the subject, but there should be no doubt just what its point of view is.

FOR SALE: QSLS

As long as we are rampaging, might as well take up one additional subject recently beaten nearly to death in the amateur press. Maybe we can breathe a little life into it. Some have complained about the practice of requiring payment of a dollar for a QSL for an expedition contact. Actually, this is not new. W9WNV (and others) were doing it fifteen or more years ago, only then you paid for the contact *before* the expedition was undertaken. Those who anted up found that the DXpeditioner was able to hear them without difficulty; those who held out were just not heard or worked.

Grousing when required to supply a buck for a QSL shows little appreciation for the sacrifices made by expeditioners. When they moan in print about it, that constitutes almost a personal affront to the DXer who has made it possible for many to work a new country. As plane tickets are not free, we see little wrong with QSLing *only* to those who help with the expenses. Most expeditioners are not independently wealthy and are only practicing economic horse sense. If they recoup some of the expenses from one trip, they are more likely to make another.

ISTANBUL REPORT

The accompanying letter from an amateur in Turkey is printed in full, except that all references to callsigns and names have been deleted. Anyone wishing to act as QSL manager for the writer of the letter can make arrangements by writing to me at the address given at the beginning of this column.

"Istanbul, Aug. 26, 1980

Dear OMs: I am a subscriber to *73*, and I am very glad to see a DX column in your excellent magazine. The purpose of my letter is to provide you with some material and information for the section, and possibly seek your help on a subject.

Here in Turkey, for a long time there has been on-and-off operating by courageous local and by temporarily resident foreigners (mainly from the US). I am sure some of your fellow hams and subscribers do not know that ham radio in Turkey is still illegal due to a law dated 1937! I say TA is activated by courageous people because possession and operation of transmitters has severe penalties, including imprisonment of up to five years!

"Terrorism all over the world is well known, and we too have a fair share of it in TA Land. I am sure there would be far less of it if we had worthwhile hobbies like amateur radio to keep the young people occupied. We have martial law in certain parts of the country (including Istanbul), during which the penalty for the above mentioned offense is ten years in jail! Big risks are taken in operating, but you know ham radio is a bug and . . .

"Therefore, operation from TA is sporadic; at present we must be at an all-time low. I have been QRT since March, 1980, and will be so for another few months.

"We have an amateur radio club, TRAC, which is listed in the *Callbook* for incoming QSLs. That is the only service provided by TRAC except for a magazine which gets published now and then. Since there is no outgoing QSL service, I suspect the QSL record of TA stations is not very good, as everyone is on his own for sending cards. Having a 100% QSLing record is very important to me.

"One question which is often asked is how and by whom we get our calls assigned. The answer is that we do not get them assigned, we just pick them ourselves. The country was divided into call areas by the club when it was founded in the 1960s. Most of us pick our initials and we all know each other so duplicates are prevented. We watch out for newcomers, too.

"As far as equipment is concerned, it simply is not available. Transmitters and transceivers are illegal, and even receivers are almost nonexistent. I personally would be willing to pay twice the list price for a good receiver. We make do with whatever we can find in surplus, and that, too, is something which may come once in a lifetime. Surplus and simple homemade rigs are what you hear from Turkey. If our signals are drifting and we cannot hear you S9, I think we can be excused if people know the conditions we work in.

"Attempts have been made to change the 1937 law but have failed for various reasons, mainly because the people concerned did not know what amateur radio was about. Lately, the final word has been that to ensure the national security, monitoring stations tied to a computer center where 'exact location of any transmission can be found' is the only way for amateur radio to be legal in Turkey. Estimated cost of this is twenty million dollars!

"I hope *73* can find a manager for my QSLs when I return to the air. I am sure you have a heavy workload, so if you cannot spare the time I shall understand.

73,
TA2— —."

This is a somewhat abbreviated column due to things backing up at the editor's shop. The column will be back to its usual size in January. Your input of letters and pictures is appreciated.

CONTESTS

from page 16

couver, BC Canada V6J 1E3, postmarked before January 15th. Results will be published in *TCA*, the Canadian amateur magazine. Non-subscribers may include an SASE for a copy of the results.

ZERO DISTRICT QSO PARTY

Starts: 2000 GMT January 3
Ends: 0200 GMT January 5

Organized by the Mississippi Valley Radio Club. Stations outside of Zero District will work Zero stations only; Zeros may work any station. The same station may be worked once on each band and each mode. However, stations in the special mobile class may be worked each time they change counties.

EXCHANGE:

RS(T) and ARRL section. Zero District stations also must send county.

FREQUENCIES:

3560, 7060, 14060, 21060, 28060, 3900, 7270, 14300, 21370, 28570, 3725, 7125, 21125, 28125.

SCORING:

Add the number of Zero District ARRL sections worked plus the number of Zero District counties, then multiply by the number of contacts. Zeros score by adding ARRL sections, Zero District counties, and DXCC countries worked, and then multiplying by total contacts.

ENTRIES & AWARDS:

Awards will be issued to the high scorer in each ARRL section and DXCC country. Also to top Novice/Technician and top in special mobile class. Mail logs by February 15th to: WØSI, 3518 W. Columbia, Davenport IA 52804. Include an SASE for log forms or results.

2nd ANNUAL INTERNATIONAL 160-METER PHONE CONTEST

Sponsored by 73 Magazine
Starts: 0000 GMT January 17
Ends: 2400 GMT January 18

This is the second annual 160-meter contest sponsored by our magazine. The object is to work as many stations as possible on 160-meter phone in a maximum of 30 hours allowable contest time. Multi-operator stations may operate the entire 48-hour contest period. Entry categories include single- and multi-operator, both with single transmitter on phone only.

EXCHANGE:

Stations within the Continental USA and Canada transmit RS report and state or province. All others transmit RS report and

DX country.

SCORING:

All valid two-way contacts score 5 points per QSO. A station may be worked only once for contest credit! Multipliers are as follows: 1 multiplier point for each of the Continental US states (48 max.); 1 multiplier point for each of the Canadian provinces (13 max.); 3 multiplier points for each DX country outside the Continental US and Canada.

The final score is the total QSO points times the total multiplier points.

DX WINDOW:

Stations are expected to observe the DX window from 1.825 to 1.830 MHz as mutually agreed by Top Band operators. Stations in the US and Canada are asked not to transmit in this 5-kHz segment of the band.

AWARDS:

Contest awards will be issued in each award category in each of the Continental US states, each Canadian province, and each DX country.

DISQUALIFICATIONS:

Disqualifications may result if contestant omits any required entry forms, operates in excess of legal power authorized for his given area, manipulates operating times to achieve a score advantage, or fails to omit duplicate contacts which reduce the overall score more than 2%.

ENTRIES:

Each entry must include log sheet, dupe sheet for 100 or more contacts, a contest summary sheet, and a multiplier checklist. All entries must be postmarked no later than February 21st. To request contest forms or submit your entry, write: Dan Murphy WA2GZB, PO Box 195, Andover NJ 07821 USA. Please include an SASE!

SPECIAL CHRISTMAS EXPEDITIONS

With the Christmas holidays fast upon us, there are two special operations planned for the holidays. The Delaware-Lehigh Amateur Radio Club (W3OK) will have a special events station on the air as part of Bethlehem PA's Christmas City Celebration. The station will be on the air from 2300 to 0300 GMT starting December 15th and will continue to operate through January 1st. The operating hours will increase during the period whenever possible. Operation will be on the Novice CW and General phone bands. Suggested frequencies are: 15 kHz down from the top of the Novice band, and 15 kHz up from the bottom of the General phone band. Special QSO certificates will be sent from the Christmas City Station. QSLs or requests should be mailed with a business-size SASE to: W3OK, DLARC, 1719 Callone Avenue, Bethlehem PA 18017. SWL requests will also be honored.

The Indian River Amateur Radio Club of Cocoa FL will be operating from Christmas FL from December 20 through 27. Operating times will generally be from 1400 to 2000 GMT daily. The town of Christmas, located on the east coast of Florida, welcomes many visitors each year from around the USA. Christmas is celebrated each and every day of the year. There are fully lighted Christmas trees, wreaths, and decorations along with Santa and his helpers. The Indian River Amateur Radio Club, as a celebration of its 26th year of organization, will use the club callsign W4NLX/4. A special handsome certificate will be awarded to all worked stations. This certificate depicts some of the aspects of Christmas in Florida. Arrangements have been made to have a special cancellation at the US Post Office for this award. Please send a large SASE for the certificate. Operating frequencies on SSB will be 7280, 14280, 21380, and 28680. On CW, the club will operate 60 kHz up from the bottom edge of the 40-, 20-, 15-, and 10-meter bands. The 146.34/.94 repeater will also be operational for local contacts. QSL to Indian River Amateur Radio Club, W4NLX, PO Box 105, Christmas FL 32709.

AWARDS

from page 20

bands the same day (6 × 3 = 18) or work him on twenty meters three individual days (6 × 3 = 18), you will have qualified very easily for the Gold Sardinian Award. Sounds easy, doesn't it?

To be valid, all signal reports must be a minimum of 338 for CW and 43 for phone.

To apply, have your claimed contacts verified by at least two amateurs or a local radio club official. Enclose your application with an award fee of 15 IRCs or $4.00 US to: URS Club, via Sardegna 16, 07100 Sassari, Sardinia.

While in Europe, let's visit the United Kingdom, where last time I failed to include two very interesting awards.

HAMPSHIRE COUNTY AWARD

The Hampshire County Award is made available to amateurs worldwide who have established two-way contact with amateur operators of Hampshire County in England. The award is issued on a point basis in which all contacts count 1 point, with the exception that contacts with G3BZU, GB3RN, or any other special-event station count 2 points.

There are three award classes: Class I-UK/50 points; EU/20 points; DX/15 points. Class II-UK/30 points; EU/15 points; DX/10 points. Class III-UK/20 points; EU/10 points; DX/5 points.

To be valid, all contacts must be made after October 1, 1960. There is no mode or band restriction, but special band or mode recognition will be made if requested at the time of application.

To apply, have your list of claimed contacts verified by at least two amateurs or a local radio club official. Forward this application and an award fee of 50 pence or 6 IRCs to: F. D. Cawley G2GM, Award Manager, Bay Sound, Freshwater Bay, Freshwater, Isle of Wight, England, United Kingdom.

THE MERCURY AWARD

While in England, it is my honor to feature to our readers the very respectable Mercury Award, sponsored by the Royal Naval Amateur Radio Society. This award was initiated to encourage contact with the many members of the Royal Naval Society. The award is issued to any amateur who can meet the requirements of the program which are tabulated on a point basis. Contacts with RNARS members on the HF bands earn 1 point each, while two-way contacts established 30 MHz and above constitute 2 points apiece. In addition, any special-event station, such as GB3RN or G3BZU, counts double the normal point value.

To attain the award, stations within the United Kingdom must accumulate a total of 20 points, other European stations must total a minimum of 10 points, and stations outside Europe must gather a total of at least 5 points. Once an applicant earns 10 points (for US) or 20 points (for Europeans), stickers will be issued for each multiple of 10 points earned thereafter.

Contact must be made October 1, 1960, and after to be valid. There are no band or mode restrictions, but recognition will be given if special band or mode accomplishments are attained.

The Mercury Award also is made available to shortwave listeners who must meet the same criteria on a "heard-only" basis.

Do not send QSLs! Have your list of claimed contacts verified by at least two fellow amateurs or a radio club official. Enclose this application along with the award fee of 6 IRCs to: Awards Manager G3HZL, 153 Worple Road, Isleworth, Middlesex TW7 7HT, England, United Kingdom.

To be successful in confirming contacts with members of the Royal Naval Amateur Radio Society, it is advisable that you obtain a list of their members before attempting the challenge of this award. It is unfortunate that the list is so lengthy, as space does not permit the list to be printed at this time. As an alternative, however, the Mercury Award is featured in the *DX Awards Guide* published by Chuck Ellis WØYBV. The entire list of RNARS members is contained within this publication. This DXer's award guide, featured in last month's column in detail, is available for a very modest price of $14.95 (plus 1-lb. postage for DX shipment) by enclosing payment to Chuck Ellis, PO Box 1136 Welch Station, Ames IA 50010. Be sure, if that is the reference you plan to use, that you tell Chuck you read about it here in the *73 Magazine* Awards column.

If you are like many of us on the west coast and are looking for a real toughie, try your hand at working toward the Worked All Gozo Award.

WORKED ALL GOZO AWARD

The WAG Award, as it is called, is open to amateurs and SWL stations and has no band or mode restrictions. To be valid, all contacts for this award must be made on or after August 1, 1972.

To qualify, European stations must confirm 8 individual stations from Gozo Island (9H4). Now, if you are considered a DX station like we are in the USA, you only have to work 5 different Gozo Island stations. And, of course, if you are like me, you'll be happy to settle for just an SWL Heard Only Award which also is available under the same requirements.

Do not send QSL cards, please! Have your list of claimed Gozo Island contacts verified by at least two amateurs or a radio club official. Forward this verified application and an award fee of $3.00 or 12 IRCs to: Joe Cauchi 9H4L, 20 P. P. Hili Street, Victoria, Gozo Island, Malta. All award fees are contributed to aid the blind and handicapped operators; we all should apply for this award if for no other reason than to aid this cause.

OUR AWARDS PROGRAM

By the time this magazine reaches your hands, the hundreds of certificates already earned via the *73* Awards Program will be on their way to amateurs around the world. Now, if you are one of the many who qualified for an award months and months ago, you're no doubt saying, "It's about time!" Right you are.

What caused the incredible delays? First of all, some of us underestimated the work involved in getting the certificates designed and produced. But more than that, we too often allowed the Awards Program to take a back seat to other projects which, at the time, seemed more important. Few of us at *73* wear only one hat, and it was all too easy to stop working on the awards when article titles needed to be written or when manuscripts needed to be read. After all, we had magazine deadlines to meet each and every month, and it always seemed that the awards could wait . . . and wait . . . and wait. In short, we blew it.

In retrospect, it's easy to see what we should have done. For starters, we should have had the awards printed and on the shelf before the Awards Program was even announced. Then, we should have assigned one person to stay on top of the program and keep it moving. The good news is that we have, at last, recognized these failings, and the Awards Program is finally up to speed. The debacle of the past 14 months is over, and the awards are going out.

Before proceeding any further, a note of commendation is in order. The man who writes this column each month and serves as manager of our Awards Program is Bill Gosney WB7BFK. Bill has been with the program from the beginning, and he has done an outstanding job under very difficult circumstances. He's done everything we have asked of him and more. If you've been waiting for an award, the delay was at our end, not his. Thank you, Bill.

To those of you who have earned awards through our program goes a special note of thanks for getting involved in our new and untried venture. Now that we're back on track, we hope you enjoy your awards and that you'll apply for others in the future. If you have never applied for a *73* award, please do so; the system is working, and it's our goal to handle all future applications quickly and efficiently.

As we move into the third decade of *73 Magazine*, we're looking forward, not back. There are exciting times ahead for amateur radio, and we want the *73* Awards Program to be a part of it.

Jeff DeTray WB8BTH
Assistant Publisher/Editor

73 AWARD WINNERS

NORTH AMERICAN CONTINENT AWARD

1 WA2GUM
2 WB8VPA
3 K4HRG
4 KE4E
5 N6TK
6 AA6TK
7 WA1SMI
8 WA9BBX
9 K8ZIP
10 WBØYMR
11 WB6VVI/9
12 WB3BAP
13 WD8MGQ
14 WB7BFK
15 WB1DQC
16 K4BQZ
17 KØJSY
18 KA5CQJ
19 K1TH
20 W7ULC
21 WB3ICM
22 K8WD
23 W9NAX
24 VE1BVD
25 WD9HRH
26 WD8MOV
27 K9PSN
28 AD1S
29 DA1MV
30 WBØLXM
31 KA9ACM
32 WB7TXY
33 WB3CIW
34 N6PV
35 F2YS/W2
36 W8CHV
37 AJ8L
38 WA2YEX
39 SM5AKT
40 AC3Q
41 WA2SRM
42 K9TI
43 WDØEPE
44 K4JYD
45 N8AC
46 JH1VRQ
47 WB3BVL
48 WD4DVZ
49 WØYBV
50 WB2FFY
51 W5TJQ
52 WD8DZO
53 KB4JA
54 WB4SXX
55 DJ2UU
56 WD4KRK
57 KA2EAO
58 K9MD
59 N7BZ
60 W2ODA
61 WB2MVC
62 K4BYK
63 KB8JF
64 WA2PIP
65 KB2DE
66 N9ADL
67 WB7PKD
68 S8AAT
69 HK4DUM
70 WDØAVG
71 WD9IIC
72 W1AGA
73 WB3JUK
74 WA2RVF
75 KA2K
76 PY8ZLC
77 K4LQ
78 DA1UO
79 IC8OGS
80 DA1QR
81 WD4IIU
82 AG5X
83 K9BIL
84 N4BQD
85 WA2LYF
86 WD9HWY
87 N4BQD
88 AI1Y
89 WB5SND
90 NØAMI
91 WD8QEO
92 VE3JGT
93 KA5CTZ
94 WD8DEL
95 WB6CDM
96 KB8LT
97 NØGP
98 AI6I
99 N4AKO
100 KB8DB
101 N8BJQ
102 K5BLV
103 DF9ZP
104 KB5OU
105 K8GAK
106 N1BCV
107 S8AAP
108 WB7RUV

SOUTH AMERICAN CONTINENT AWARD

1 WB8VPA
2 KE4E
3 N6TK
4 AA6TK
5 WA1SMI
6 VE1BVD
7 WD6EEQ
8 WBØYMR
9 WB6VVI/9
10 WB2BAP
11 WD8MGQ
12 WB7BFK
13 WB1DQC
14 KØJSY
15 KA5CQJ
16 K1TH
17 W7ULC
18 K8WD
19 K4HRG
20 WD9HRH
21 WD8MOV
22 AD1S
23 WBØLXM
24 WB3ICM
25 KA9ACM
26 WB7TXY
27 WB3CIW
28 K9PSN
29 F2YS/W2
30 K8ZIP
31 WA2SRM
32 AJ8L
33 WA2YEX
34 AC3Q
35 SM5AKT
36 WDØEPE
37 JH1VRQ
38 WB3BVL
39 WD4DVZ
40 W5TJQ
41 WD8DZO
42 WB4SXX
43 WD4KRK
44 K9MD
45 KB4JA
46 N7BZ
47 DJ2UU
48 W8CHV
49 K9TI
50 W2ODA
51 WB2MVC
52 KA2EAO
53 K4BYK
54 KB8JF
55 KB2BE
56 WA2PIP
57 WB7PKD
58 S8AAT
59 DA1MV
60 HK4DUM
61 WD9IIC
62 WØYBV
63 WB3JUK
64 W1AGA
65 PY8ZLC
66 KA2K
67 WA2RVF
68 K4LQ
69 DA1UO
70 N8AC
71 IC8OGS
72 DA1QR
73 AG5X
74 K9BIL
75 N4BQD
76 WA2LYF
77 WD9HWY
78 WB5SND
79 KBØOE
80 NØAMI
81 WD8QEO
82 VE3JGT
83 KA5CTZ
84 WD8DEL
85 WB6CDM
86 KB8LT
87 NØGP
88 N4AKO
89 KB8DB
90 N8BJQ
91 K5BLV
92 DF9ZP
93 KB5OU
94 N1BCV
95 WB7RUV
96 S8AAP
97 WD4LYA

Q-5 AWARD OF EXCELLENCE

1 WB8ZJL
2 WD8ONV
3 KA8HNR
4 K8IU
5 WB7QEP
6 KAØFPG
7 WL7ADX
8 WD5EHI
9 KA3DBN
10 KA3COP
11 KA3CGM
12 WD2AKK
13 WD8IDD
14 SM2COR
15 KØTBB
16 WD5ICQ/1
17 KA4KJI
18 N3ADF
19 K6TMB
20 WØCJG
21 KA8IGM
22 WD8NHN
23 WB3GSO
24 KAØHTU
25 KA8GXN
26 KA9CDR
27 KA1ESG
28 WD8QHN
29 WD4BLU
30 KA3ENQ
31 KA4JQS

SPECIALTY COMMUNICATIONS AWARD CLASS A-1

1 W2ODA (RTTY)
2 WBØQCD (SSTV)
3 WB7BFK (RTTY)
4 WBØQCD (RTTY)
5 WD9GRI (RTTY)
6 WB6CDM (RTTY)
7 N3AKO (RTTY)

DISTRICT ENDURANCE AWARD

1 AJ8L
2 WL7ACY
3 WB6CDM/7

EUROPEAN CONTINENT AWARD

1 WB8VPA
2 K4HRG
3 KE4E
4 N6TK
5 WA1SMI
6 WB3ICM
7 VE1BVD
8 WA9BBX
9 WB0YMR
10 WB6VVI/9
11 W0HMA
12 WB3BAP
13 WD8MGQ
14 WB7BFK
15 WB1DQC
16 WA2GUM
17 N9ND
18 K4BQZ
19 K0JSY
20 N6PV
21 KA5CQJ
22 W8CHV
23 K1TH
24 W7ULC
25 N9ADL
26 K8WD
27 W0YBV
28 W9NAX
29 WA2SRM
30 WD9HRH
31 WD8MOV
32 K9PSN
33 AD1S
34 DA1MV
35 KA3DBN
36 WB0LXM
37 WB7TXY
38 WB3CIW
39 F2YS/W2
40 K8ZIP
41 DK5WJ
42 WA2YEX
43 AJ8L
44 AC3Q
45 SM5AKT
46 WD0EPE
47 W4JYD
48 JH1VRQ
49 WB3BVL
50 K9TI
51 WD4DVZ
52 WB2FFY
53 W5TJQ
54 WD8DZO
55 KB4JA
56 WB4SXX
57 DJ2UU
58 WD4KRK
59 K9MD
60 N7BZ
61 JA1VDJ
62 K1KOB
63 W2ODA
64 WB2MVC
65 K4BYK
66 KB8JF
67 WA2PIP
68 KB2DE
69 WB7PKD
70 N8AC
71 S8AAT
72 WD4IIU
73 WD4IIU
74 KA1CBD
75 WD0AVG
76 WD9IIC
77 W1AGA
78 WB3JUK
79 WA2RVF
80 KA2K
81 PY8ZLC
82 K4LQ
83 DA1UO
84 IC8OGS
85 DA1QR
86 AG5X
87 K9BIL
88 N4BQD
89 WA2LYF
90 WD9HWY
91 WB6CDM
92 WD8DEL
93 KA5CTZ
94 VE3JGT
95 WD8QEO
96 N0AMI
97 W8EVH
98 WD0EPV
99 AI1Y
100 WB5SND
101 KA4KST
102 KB7Q
103 WD4BLU
104 KB8LT
105 N0GP
106 KB9OO
107 AI6I
108 N4AKO
109 N3AKQ
110 KB8DB
111 N8BJQ
112 K5BLV
113 DF9ZP
114 KB5OU
115 K8GAK
116 K8GAK
117 N7AHQ
118 KA4ITQ
119 W0OLL
120 N1BCV
121 WB7RUV
122 WD4LYA
123 DA2AL
124 S8AAP

ASIAN CONTINENT AWARD

1 WB8VPA
2 K4HRG
3 KE4E
4 WB3ICM
5 WB6VVI/9
6 WD8MGQ
7 WB7BFK
8 WB1DQC
9 K0JSY
10 W7ULC
11 K8WD
12 WD9HRH
13 WD8MOV
14 AD1S
15 DA1MV
16 WB0LXM
17 WB7TXY
18 WB3CIW
19 K1TH
20 F2YS/W2
21 K8ZIP
22 WB0YMR
23 WA2YEX
24 AJ8L
25 AC3Q
26 SM5AKT
27 WD0EPE
28 JH1VRQ
29 K9PSN
30 WD9DVZ
31 W5TJQ
32 WD8DZO
33 WB4SXX
34 DJ2UU
35 WD4KRK
36 K9MD
37 N7BZ
38 JA1VDJ
39 WB3BAP
40 W8CHV
41 K4BYK
42 KB8JF
43 KB2DE
44 WA1SMI
45 S8AAT
46 N8AC
47 HK4DUM
48 K9TI
49 WA2SRM
50 WD9IIC
51 W1AGA
52 WB3JUK
53 WA2RVF
54 KA2K
55 K4LQ
56 DA1UO
57 IC8OGS
58 DA1QR
59 WD0AVG
60 AG5X
61 KB4JA
62 K9BIL
63 N4BQD
64 WD9HWY
65 WB7PKD
66 N0AMI
67 WD8QEO
68 VE3JGT
69 WD8DEL
70 WB6CDM
71 KB8LT
72 N0GP
73 KB8DB
74 N8BJQ
75 K5BLV
76 DF9ZP
77 S8AAP
78 WB7RUV

AFRICAN CONTINENT AWARD

1 WB8VPA
2 K4HRG
3 KE4E
4 WA1SMI
5 WB3ICM
6 WB6VVI/9
7 WB3BAP
8 WD8MGQ
9 WB7BFK
10 WB1DQC
11 K0JSY
12 KA5CQJ
13 K1TH
14 W7ULC
15 K8WD
16 WD9HRH
17 WD8MOV
18 AD1S
19 DA1MV
20 WB0LXM
21 WB7TXY
22 WB3CIW
23 K9PSN
24 F2YS/W2
25 K8ZIP
26 WA2YEX
27 AJ8L
28 WB0YMR
29 AC3Q
30 WA2SRM
31 SM5AKT
32 W8CHV
33 WD0EPE
34 K4JYD
35 N8AC
36 JH1VRQ
37 WD4DVZ
38 WB2FFY
39 W5TJQ
40 WD8DZO
41 KB4JA
42 WB4SXX
43 DJ2UU
44 WD4KRK
45 K9MD
46 N7BZ
47 W2ODA
48 K4BYK
49 KB8JF
50 KB2DE
51 N9ADL
52 S8AAT
53 K9TI
54 HK4DUM
55 WD9IIC
56 W1AGA
57 WB3JUK
58 WA2RVF
59 PY8ZLC
60 K4LQ
61 DA1UO
62 IC8OGS
63 DA1QR
64 AG5X
65 K9BIL
66 N4BQD
67 WD9HWY
68 WB7PKD
69 WB6CDM
70 WD8DEL
71 KA5CTZ
72 VE3JGT
73 WD8QEO
74 N0AMI
75 KB8LT
76 N0GP
77 N4AKO
78 KB8DB
79 N8BJQ
80 K5BLV
81 DF9ZP
82 S8AAP
83 WB7RUV

OCEANIC CONTINENT AWARD

1 WB8VPA
2 K4HRG
3 KE4E
4 N6TK
5 AA6TK
6 WB3ICM
7 WD6EEQ
8 WB6VVI/9
9 WD8MGQ
10 WB7BFK
11 WB1DQC
12 K0JSY
13 N6PV
14 KA5CQJ
15 W8CHV
16 K1TH
17 W7ULC
18 K8WD
19 WD9HRH
20 WD8MOV
21 AD1S
22 WB0LXM
23 WB0YMR
24 WB7TXY
25 WB3CIW
26 K9PSN
27 F2YS/W2
28 K8ZIP
29 AJ8L
30 AC3Q
31 SM5AKT
32 WD0EPE
33 K4JYD
34 N8AC
35 JH1VRQ
36 WD4DVZ
37 W5TJQ
38 WD8DZO
39 KB4JA
40 WB4SXX
41 WD4KRK
42 K9MD
43 N7BZ
44 JA1VDJ
45 WB3BAP
46 K4BYK
47 KB8JF
48 KB2DE
49 WA1SMI
50 WB7PKD
51 DA1MV
52 HK4DUM
53 WD9IIC
54 W1AGA
55 WB2JUK
56 K9TI
57 KA2K
58 K4LQ
59 IC8OGS
60 DA1QR
61 S8AAT
62 AG5X
63 K9BIL
64 WD9HWY
65 N4BQD
66 N0AMI
67 WD8QEO
68 VE3JGT
69 KA5CTZ
70 WD8DEL
71 WB6CDM
72 KB8LT
73 N0GP
74 KB8DB
75 N8BJQ
76 N7AHQ
77 K5BLV
78 DJ2UU
79 WB7RUV
80 S8AAP

WORK THE WORLD AWARD

1 WB8VPA
2 KE4E
3 WB6VVI/9
4 WD8MGQ
5 WB7BFK
6 WB1DQC
7 K0JSY
8 W7ULC
9 K8WD
10 K4HRG
11 WD9HRH
12 WD8MOV
13 AD1S
14 WB0LXM
15 WB3ICM
16 WB7TXY
17 WB3CIW
18 K1TH/9
19 F2YS/W2
20 K8ZIP
21 AJ8L
22 WB0YMR
23 AC3Q
24 SM5AKT
25 WD0EPE
26 JH1VRQ
27 K9PSN
28 WD4DVZ
29 W5TJQ
30 WD8DZO
31 WB4SXX
32 WD4KRK
33 K9MD
34 N7BZ
35 WB3BAP
36 W8CHV
37 K4BYK
38 KB8JF
39 KB2DE
40 WA1SMI
41 DA1MV
42 HK4DUM
43 WD9IIC
44 W1AGA
45 WB3JUK
46 KA2K
47 K9TI
48 K4LQ
49 N8AC
50 IC8OGS
51 DA1QR
52 AG5X
53 S8AAT
54 KB4JA
55 K9BIL
56 WD9HWY
57 WB7PKD
58 WB6CDM
59 WD8DEL
60 VE3JGT
61 WD8QEO
62 N0AMI
63 N4BQD
64 KB8LT
65 N0GP
66 KB8DB
67 N8BJQ
68 K5BLV
69 DJ2UU
70 WB7RUV
71 S8AAP

WORKED ALL USA AWARD MIXED BAND

1 KA1CBD
2 WD8QMS
3 WD4RAF
4 KA3CBC
5 KA9DLI
6 KA4HEP
7 KL7EO
8 KA4DNW
9 N4ACS
10 N7AGD
11 KA3DBN
12 KB5NE
13 K2EQU
14 KA6FYQ
15 K4JYD
16 K6ARE
17 N8BKB
18 WL7AHL
19 WN5MBS
20 KA4GML
21 WB7RBH
22 WD8LCE
23 WB3BVL
24 WD6EQP
25 KB4NJ
26 WA0CED
27 WD9GFL
28 KA3CGM
29 KB7EY
30 AF8D

CENTURY CITIES AWARD

1 K2MF
2 WA2SRM
3 WD4RAF
4 KA0AZQ
5 K1TH
6 K4JYD
7 WA9WGJ
8 KA4HEP
9 JH8DSC
10 N8BKB
11 KB8JF
12 WD0EPE
13 W1AGA
14 KA2CLQ
15 KA8FOQ
16 KA4BNQ
17 WB6CDM
18 AK2H

10 METER DX DECADE AWARD

1 WB4WRE/M
2 AC3Q
3 W5TJQ
4 WD0AVG
5 DA2AL

TEN METER "10-40" AWARD

1 W6OLA/7
2 K4JSI/6

DX CAPITALS OF THE WORLD

1 WB1DQC
2 WB7BFK
3 K1TH
4 WD4KRK
5 DJ2UU
6 KB8JF
7 WD4DVZ
8 W1AGA
9 N0GP

73 DX COUNTRY CLUB AWARD 2X SSB

1 WB8VPA
2 WB3ICM
3 WB1DQC
4 N6TK
5 WA1SMI
6 WB6VVI/9
7 WD8MGQ
8 WB7BFK
9 WB9JBH
10 K0JSY
11 K8WD
12 WA2JCX
13 K1TH
14 K9PSN
15 W5TJQ
16 WD8MOV
17 DA1MV
18 WD4DVZ
19 WB3CIW
20 KB9IS
21 KL7EO
22 EA6ET
23 WA2YEX
24 N4AOJ
25 WA2SRM
26 W5ZKJ
27 WB7TXY
28 F2YS/W2
29 WA2GUM
30 KB4NJ
31 KB4JA
32 DJ2UU
33 K9MD
34 K4BYK
35 KB8JF
36 HK4DUM
37 S8AAT
38 IC8OGS
39 K9TI
40 SV1IW
41 WB3JUK
42 WA2RVF
43 KA2K
44 9G1LL
45 DA1QR
46 DA5CTZ
47 VE3JGT
48 WB6CDM
49 N4AKO
50 DF9ZP

73 DX COUNTRY CLUB AWARD MIXED MODE

1 W0ANZ
2 K4HRG
3 WD8DNG
4 K8ZIP
5 AA8Z
6 KA5CQJ
7 K1VKO
8 WD8DZO
9 AC3Q
10 WB0YMR
11 K4JYD
12 JH1VRQ
13 WB4SXX
14 N7BZ
15 W8CHV
16 WD0EPE
17 WA1GTQ
18 WD9IIC
19 PY8ZLC
20 K4LQ
21 W2XQ

73 DX COUNTRY CLUB AWARD 2X CW

1 AA8Z
2 W7ULC
3 SM5AKT
4 WD8MAS
5 WB7PKD
6 W0YBV
7 WB2FFY
8 WB3BVL

WORKED ALL USA AWARD

6 METERS

1 WB0ZKG
2 K6PHE

10 METERS

1 KL7IEN
2 W5ZKJ
3 VE1BVD
4 JH8DSC
5 VK7NBT

15 METERS

1 WD5DRB
2 WA0CEL
3 KA6ACO
4 WB6CDM

20 METERS

1 WA9BBX
2 WA9WGJ
3 K1TH
4 KB8JF
5 WD0EPE

40 METERS

1 WA2SRM
2 N8AZD
3 WD4DBJ
4 WD0BOS

75/80 METERS

1 KA0AZQ
2 WD0BOS
3 KA5AOP
4 KS4B
5 WB9UKS

NEW PRODUCTS

from page 32

sizes: Model DTE-8 (8" wide), Model DTE-11 (10.65" wide), and Model DTE-14 (14" wide). The overall height of the series is 3.15 inches and the depth is 8.25 inches.

For further information, contact *Jameco Electronics, 1355 Shoreway Road, Belmont CA 94002; (415)-592-8097.* Reader Service number 479.

HEATH CONTINUING EDUCATION INTRODUCES NEW IC TIMERS SELF-INSTRUCTION PROGRAM

Heath Continuing Education has announced a new self-instruction program which covers integrated circuit timers. The new program, Model EE-103, includes an introduction to the common types of IC timers, how each works, what they do, and where they are used.

Among the types of IC timers covered are the popular 555 and 556 series general-purpose timers, the 322 and 3905 wide-range, precision, monostable timers, and programmable timer/counters—including the 2240 binary programmable timer/counter, the 2250 BCD programmable timer/counter, and the 8260 seconds/minutes/hours BCD programmable timer/counter.

The program's self-teaching text, with the assistance of review quiz questions and lab experiments, completely covers how each timer works and how each is used—in logic functions, output drive circuits, time-delay relay circuits, wide-range pulse generators, phase-locked loops, universal appliance timers, and as precise clock sources.

All of the electronic components required to perform the experiments are included with the program. The Heathkit ET-3300 laboratory breadboard is a recommended option.

The EE-103 IC timers course is one of four Electronic Technology Series self-instructional programs. They are designed to provide detailed knowledge for engineers, technicians, and other technical people. Other programs in the series include Operational Amplifiers (EE-101), Active Filters (EE-102), and Phase-Locked Loops (EE-104).

For further information, contact *Heath Company, Dept. 350-230, Benton Harbor MI 49022.* Reader Service number 481.

NEW HAMTRONICS® VHF FM EXCITER KIT

Hamtronics has announced a new single channel VHF FM exciter called the model T51. Patterned after the popular T50 exciter, the new unit is rated at 2 Watts continuous output and is contained on a 3- × 5-inch PC board. It is available for the 28-, 50-, 144-, and 220-MHz bands and may be modified for use on adjacent commercial bands. It is ideal for control links, repeater service, telemetry, and other applications for which a small unit is required. A multichannel adapter is also available to extend operation up to 5 channels.

Features include low-impedance dynamic mike and high level audio inputs; crisp, clear modulation; low spurious output; pre-wound coils; adjustable output level; and built-in test points for easy alignment. A commercial grade frequency stability option is available.

For further information, contact *Hamtronics, Inc., 65F Moul Rd., Hilton NY 14468; (716)-392-9430.* Reader Service number 476.

CENTURION ANTENNAS

Centurion International has introduced a new line of heavy-duty telescoping replacement antennas. These antennas are full-length ¼-wave radiators providing increased efficiency for radios that are not normally available with a telescoping-type antenna.

Three models are offered, each fitted with one of the five connector configurations: a straight telescoping antenna, a flex-spring model, and right-angle mounting model. The right-angle model is suitable for radios with front- or rear-mounted connectors or test equipment applications.

The flex-spring model has a shock absorbing spring fitted to its base to provide the popular flexible feature. The spring is protected with a tight-fitting neoprene sleeve. The sleeve retains its flexibility from −55° C to 100° C.

All models are available with a choice of five different connectors: BNC, TNC, PL-259, F, and 5/16-32 threaded stud.

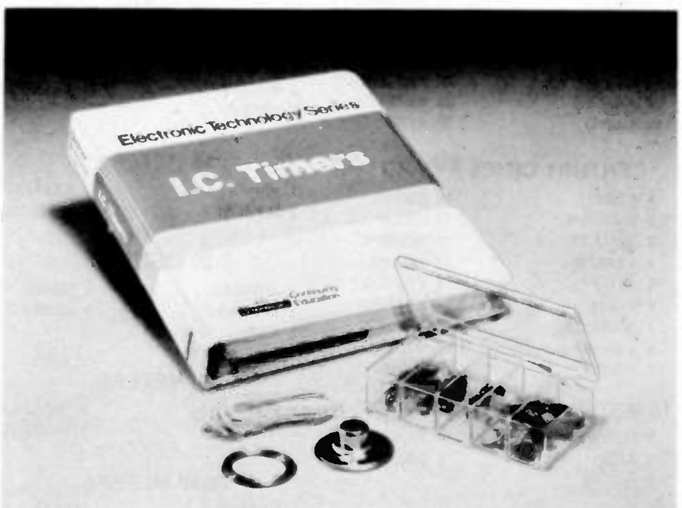
Centurion's telescoping antennas.

For further information, contact *Centurion International, PO Box 82846, Lincoln NE 68501; (402)-467-4491.* Reader Service number 477.

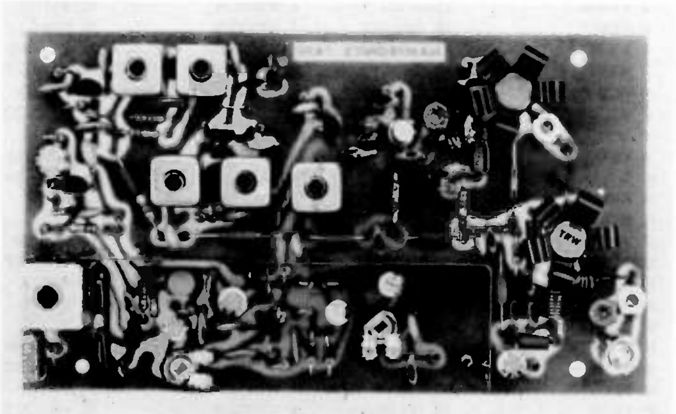
GILFER'S ALLBAND RECEIVER WITH 24-CHANNEL MEMORY OPTION

Gilfer Associates has just introduced in the USA the Japan Radio Company's NRD-515 communications receiver. The NRD-515 continuously tunes from 100 kHz to 30 MHz using a 100-Hz "step" photo-type encoder. Received frequencies are read to 100 Hz and the PLL-synthesized circuit can be locked to any frequency with assurance that the drift will be less than 50 Hz/hour. The rf/i-f circuit is a double conversion upverter (70.455-MHz first i-f).

The "kHz" tuning knob moves



Heath's IC Timer self-instruction program.



Hamtronics' T51 VHF FM exciter board.

10 kHz per revolution and a momentary "UP/DOWN" switch permits rapid frequency changes at 200 kHz/sec. There are no mechanical tuning stops and the all-electrical band-switching circuit automatically tracks from MHz to MHz. Also featured in the NRD-515 are passband tuning, AM broadcast preselection, noise blanker, 10- and 20-dB switchable attenuator, variable bfo, LSB/USB/RTTY offsets, and RIT. Four switchable selectivity options are available (two supplied).

The optional 24-channel memory unit eliminates manually re-tuning your favorite frequencies—just turn the channel selector switch and the receiver is automatically and completely re-tuned. The memory is non-volatile and the input/output data base is a 22-bit BCD code. Other optional extras include a matching loudspeaker and CW filters of 600- and 300-Hz selectivity.

For further information, contact *Gilfer Shortwave, Box 239, Park Ridge NJ 07656.* Reader Service number 478.

SONY ICF-2001 PROGRAMMABLE GENERAL-COVERAGE RECEIVER

In most cases a portable radio would be only casually interesting. But most cases aren't like the new ICF-2001 from Sony.

It is evident that frequency synthesis and scanning techniques are gradually winding their ways into the manufacture of reliable, inexpensive, consumer-oriented radio equipment. The little Sony package is an excellent example.

Approximately the physical dimensions of a cassette recorder (12" × 7" × 2"), the ICF-2001 features a liquid crystal display frequency readout. Coverage is 150 kHz through 30 MHz AM/SSB/CW, and 76-108 MHz FM. Frequency entries are made via a standard keyboard, registered to the nearest kilohertz (nearest 100 kHz on FM). Fine tuning of CW/SSB in the 150 kHz-30 MHz range is provided by an accurately-calibrated thumbwheel.

Frequency readout accuracy is excellent, fully reliable to a few hundred Hertz. Frequency stability is outstanding; CW and SSB signals are readily copyable from power-on until you get tired of listening! A series of slaps at the cabinet caused no shift in frequency.

A built-in four-foot telescoping whip antenna is adequate for casual worldwide reception. Relative signal strength is indicated by a light bar graph composed of 5 LEDs. Signals may be peaked by the use of an antenna-resonating thumbwheel.

A series of six push-button memory channels may be used to store and recall any six frequencies between 150 kHz-30 MHz, or 76-108 MHz, depending upon which band is switched in. The low-frequency FM band allows monitoring of channels 5 and 6 of TV audio as well. And for the paranoids among us, the common bugging frequencies between 86 and 92 MHz may be searched!

For the hunt-and-peck frequency hopper, the microprocessor is a dream come true. Merely load suspected channels into the six memory positions and punch up any one of them at any time. The non-volatile memory retains the frequency entries even with power disconnected.

The ICF-2001 also features a scanning function. Any limits within the passband being received may be programmed, and the receiver may be automatically or manually scanned. A slide switch may be activated for automatic stop when a signal is discovered.

Tuning is also accomplished by the push-button scanning method; any frequency displayed serves as a starting point from which up or down search begins.

Tuning or scanning speeds may be increased by another key, raising the rate from 1 kHz per increment to 10 kHz (approximately 4 or 40 kHz per second). On FM, the rate is either 400 kHz or 800 kHz per second, corresponding to 4 or 8 FM channels.

Power for the little Sony may be chosen from 3 internal D cells, 4.5 V dc (accessible from an automotive cigarette lighter using a Sony power plug accessory), or 120 V ac (power supply included). If you are tempted to use the receiver on batteries, use alkaline cells...current drain is a bone-crushing 400 milliamps! Yes, microprocessors still use a great deal of power!

But How About Specs?

The promotional and owner's literature give us little meaningful insight into the electrical specifications for the ICF-2001. A call to the factory was of little help, as even the product manager did not know. However, private measurements give us a little more information.

Image rejection averages −35 dB throughout the shortwave spectrum. The 6 dB/60 dB selectivity points are at 6 kHz and 17.5 kHz, making the 2001 a little broad for serious communications work. But it's about what could be expected from the custom 2-pole ceramic filter.

As far as intermodulation and spurious signals go, we found them no problem. In fact, we couldn't find them! Sure, they're there, but with an antenna connected and strong or weak signals being received, intermod and spurs were virtually absent.

A second i-f of 10.7 MHz (first and only i-f on FM) is used on both frequency ranges, with a first conversion i-f of 66.35 MHz on 150 kHz-30 MHz. Up-conversion is a standard technique in frequency synthesis to avoid in-band i-f images.

The 2001 sports 9 ICs, 11 FETs, 42 bipolar transistors, 24 diodes, 5 LEDs, and 1 large-scale IC microprocessor chip.

Swell, But Does It Work?

You bet! The ICF-2001 is an extraordinary performer for a portable. Our first experience with the little unit was with the self-contained whip antenna extended. Punching up 6 known SAC SSB channels into the memory banks, airborne and ground stations worldwide were received, solid copy. Step-tuning through the ham bands, single-sideband and CW stations were easily copied with excellent quality. No frequency drift was detectable over several minutes of portable handling, carrying the unit from room to room.

Attaching the 135-foot windom antenna, we fully expected that the receiver would come apart at the seams from signal overload. Surprisingly, although signals were much louder, the receiver behaved very respectively. Some signal bleed-through was detectable at night, but it was easily removed with the attenuator switch.

Gilfer's NRD-515 communications receiver.

Sony's ICF-2001 general-coverage receiver.

We haven't even discussed some of the other features . . . sleep switch, accessory jacks, LCD function displays.

In Conclusion

The new Sony ICF-2001 is meticulously designed, extremely functional, compact and flexible, and an outstanding performer. While it was never intended to compete with a Collins receiver, it makes one potent backup receiver and a fine vacation portable!

The Sony ICF-2001 lists for $329. For further information, contact *Sony Corporation, 4747 Van Damm St., Long Island City NY 11101.* Reader Service number 484.

Robert Grove WA4PYQ
Brasstown NC

B&W BROADBAND FOLDED DIPOLE ANTENNA

It would seem that after a century of experimentation with radiating wires, every possible configuration of single-wire antennas would have been explored and exploited. But new antennas keep popping up, proving that experimentation still is wide open in this aspect of communications.

During the 1950s, a series of articles by G. L. Countryman W3HH discussed the possibilities of the "tilted terminated folded dipole." The T2FD, as it was popularly called, was a cross between a resistively-terminated rhombic and a sloping folded dipole.

It seems that B&W is impressed enough with the commercial feasibility of such a contrivance to produce a similar antenna for both its military and its consumer market. The model 370-15 broadband folded dipole is the result.

The antenna comes fully assembled, wrapped around two cardboard tubes for shipping. It is designed for continuous frequency coverage, 3.5-30 MHz. The antenna dipole is constructed of #14 stranded 40% copperweld wire, the upper and lower dipole sections held apart by six spacers of rigid PVC pipe.

The antenna system is rated at 2.5 kW (5 kW PEP), enough to take the full power of any amateur-rated linear amplifier. All-weather construction ensures years of maintenance-free operation.

The antenna is coupled to a balun transformer and fed by approximately fifty feet of permanently-attached RG-8/U coaxial cable. A special impedance terminating network maintains the constant characteristics of the antenna throughout its usable frequency range.

Installation

All large dipole antennas are somewhat unwieldy to install. The 370-15 is no exception. It is recommended, although not mandatory, that two people cooperate in erecting the antenna. It is not particularly heavy, but it is ninety feet long, consisting of two wires, fifty feet of cable, and other accessory accoutrements along the way! Merely keeping the copperweld wire from kinking is important and requires attention while unrolling the dipole.

B&W recommends using the allband dipole in one of three configurations: a sloper, a flattop, or an inverted V. Among the three, the sloper is the best all-around antenna. It requires only one high and one low support and it is essentially omnidirectional. The manufacturer recommends an upper height of 24 to 40 feet, allowing six feet of clearance for the lower support.

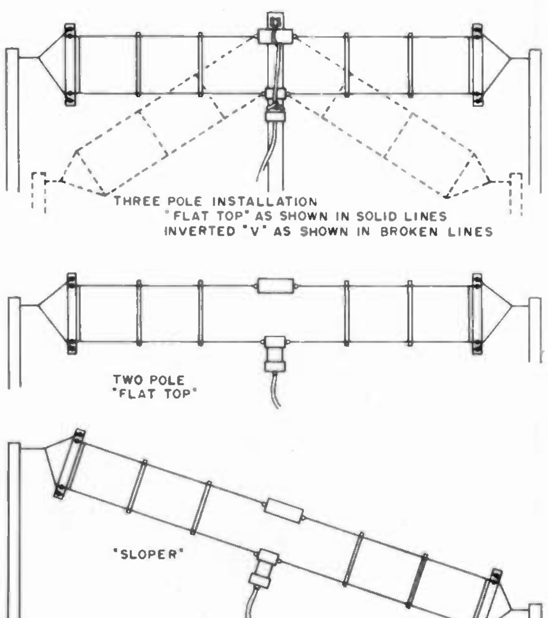


Fig. 1. Typical installations for B&W's 370-15 allband folded dipole.

Our Experience

The ninety-foot dipole posed no particular problem in installation even when erected by one individual. By anchoring the center of the antenna, the remaining lengths are easily unfurled, ready for elevation.

Although fifty feet of coax may seem like a lot, keep in mind that a ninety-foot antenna is an imposing length to permit the coax to come close to the shack. Add to that the fact that the antenna must be removed from metallic influences (siding, electrical and power line wiring, metal roofing, air-conditioning ductwork, automobiles, etc.), and you may very well need an additional length of feedline; I did.

Additional feedline at frequencies below 30 MHz is no liability. Even the smaller RG-58/U would be perfectly satisfactory for another fifty feet or more if power levels on the order of 200-300 Watts are all that will be used. Line loss is insignificant.

After erecting the folded dipole as a sloper, we loaded it with a Drake TR-7 for our field trials. Sure enough, the vswr curve on all bands was very close to that shown on a graph which accompanies the instructions. Curiously, there is a vswr hump on 40 meters, rising to nearly 3:1 at our location.

With one end of the dipole tied to a 35-foot tree, we moved the lower end around the yard, testing its response on all bands. Proximate metallic masses (a power line, a utility shed, the car) showed their deleterious effects on the antenna. Clearly, the antenna must be mounted as free from reactive materials as possible.

In the case of less-than-ideal environments, the use of an external matchbox is recommended. While the matchbox will not help the reflective and absorptive tribulations of nearby metal, it will keep the vswr at a respectable level.

Wind and ice characteristics of the antenna should prove adequate for most localities. With end supports only, 100-mph winds may be tolerated—150 mph with an additional center support pole. Ice accumulation of 40-50 pounds (80 pounds with center pole) is also endurable by the system.

While the antenna is designed to operate through 30 MHz, chances are that the ferrite materials in the balun would behave at frequencies somewhat higher. It would be interesting to find out how the antenna would perform on six meters. With ninety feet of dipole length, there are bound to be some directional lobes, as there are on ten meters.

The cost of the B&W antenna is substantial, but for allband performance with no external feedline tuning necessary, it is worth considering, especially with the advent of the new amateur band plan obsoleting many present-day antenna systems.

B&W's 370-15 allband folded dipole lists for $149.50. For further information, contact *Barker & Williamson, Inc., 10 Canal St., Bristol PA 19007.* Reader Service number 483.

Robert Grove WA4PYQ
Brasstown NC

SC-76 SCANNING MODULE

The SC-76 is a low-cost scanning module for the Kenwood 7600 and 7625. It installs in a matter of minutes, requires no soldering, and comes complete with detailed instructions. Once installed, it is placed in operation by turning the radio's mode switch to position "M". It then causes the radio to scan between the frequency in memory and the frequency on the dials. Either frequency becoming active will stop the scan. Normal operation is resumed by placing the mode switch to the simplex or offset positions.

For further information, contact *Karetron Engineering Co., PO Box 241, Middletown OH 45042.* Reader Service number 482.

W2NSD/1
NEVER SAY DIE
editorial by Wayne Green

from page 8

read guess-what magazine and talk mostly to other old-timers . . . all who have 20-year-old ham gear, factory made . . . all you have to do is take one look at the number of pages of ads in *73* for parts. Look here, if hams weren't building equipment, those firms wouldn't spend all that money to advertise parts.

One of the hottest microwave receivers on the market today was first designed by hams. It did so well they went into business making 'em . . . and these are the Cincinnati Microwave "Escort" radar detectors. The hams are a bunch of chaps who split from Drake and went into the detector business . . . and are cleaning up. Do you think they would be doing that if they hadn't been hams and learned about that through hamming?

KILL THE LAWYERS?

One of our readers (W2JTP) sent along a copy of *Industrial Communications*, a most interesting newsletter which covers the mobile radio field, among others. There was an article on the state of the art in spread spectrum (SS) communications such as was pioneered by John Costas in 1959, when I published an article by him on the subject in *CQ*. Much of the experimentation with these techniques is presently taking place in Japan.

Let me quote *Industrial Communications* on the subject of why the U.S. commercial sector has not pursued this: "It appears that the principle 'wet blanket' in this regard is the regulatory atmosphere that pervades the nation's capital. The present adversary structure and rigid rulemaking are so inconducive to innovative technologies that the prudent industrialist is obliged to shift his ground in miniscule steps or not at all.

Already this native American technology is being investigated more seriously in Japan than in the U.S. It would be sad indeed if a burgeoning new field were to become the patented reserve of another country. Perhaps as a first step in regaining world leadership in this area, we should look to Shakespeare's Henry VI: 'First we kill all the lawyers . . .' "

I see the fault lying not in the restrictions on the commercial field, but rather as a failure of amateur radio to provide the needed pioneering and inventing which is our responsibility . . . and to hell with the FCC lawyers. I don't think it is necessary to kill them, just find honest work for them . . . fixing roads or something.

IT'S LOBBY TIME

A bill (HR-7747) has been entered into the legislative logjams which could cause amateur radio one hell of a headache if we don't muster our forces to beat it to death in committee. This is a matter which should involve every amateur . . . individually and via action through ham clubs. If any ham club does not take action on this, they need restructuring quickly.

The bill is designed to protect the interests of the pay-TV people, who seem to be utterly paranoiac about a handful of experimenters managing to see their shows without helping to pay for the corporate jets.

Historically, the FCC has had a strict policy of protecting the availability of all radio frequencies against corporate privilege. Despite local regulations in some cities against listening to some frequencies, the FCC has stuck by their manifesto that the airwaves are the property of the people of our country, not those wishing to use them for making money or governing us. Thus it is and has been legal to tune any receiver to anything you wish.

In order to give some degree of protection to the users of radio channels, there is a rule which prohibits a listener from using information heard over the air for commercial gain or other such financial benefit.

This freedom to listen to the radio is constantly being threatened by firms which want to use our frequencies for making money and are fearful that even a tiny body of people will tune in without paying in full. Rather than using sophisticated protective measures such as coding of the signals, they have tried to use their lawyers and their lobbying money to get around the FCC through Congress. Congress reacts positively to money, as we know, so it is a logical approach. Congress reacts even more positively to an outcry by the people they need even more than the lobbyists—voters—and in this case this means you, your family, and your friends.

One ham should, with some motivation, be able to make one hell of a stink about something which is not only bad for the country, but in particular has very ominous portents for amateur radio. You know as well as I that once we let them start setting up laws prohibiting the use of the radio spectrum, it will be no time until we are not allowed to have all-band receivers or to even build experimental circuits.

WHAT WAS PURAC?

This was an advisory committee set up to work with the FCC and help them to cope with the growing CB problems of the mid-70s. It was made up of volunteers who worked at no cost to the FCC to solve the CB problems. The committee was broken into eleven subcommittees, each reporting on one aspect of the interlocking problems. The committee included quite a few hams and brought forth a report which was published in three volumes . . . a most authoritative report. Unfortunately, due to a shortage of funds, only ten copies of the report were ever printed. The part on RFI solving is considered by many in the FCC as definitive. The PURAC committee functioned from 1976 to 1978 and was decommissioned by the FCC when the new administration came in and decided that there should be no further advisory committees.

In fairness, I gather that this demolishment of PURAC was a case of overkill, resulting from a desire to end the FCC practice of giving out contracts for reports . . . and paying dearly for them. This was a juicy little business in the 70s and attracted a number of firms which had figured out how to get the contracts and how to fulfill them, all with a minimum of actual work and value of the end reports. Having participated in one aspect of this and having gotten a good look at how the whole system worked, I'd say it was a good move to put a stop to that boondoggle.

REPEATERS CAN SAVE LIVES

Perhaps you've read about the emergency locator transmitters (ELT) which planes have aboard. They are small VHF transmitters which are triggered in a crash to help locate the downed plane. Obviously, the sooner a downed plane can be found, the more chance there is that survivors can be saved, so every minute helps.

VHF being what it is, and planes which have crashed being on the ground in most cases, it figures that the higher you are when listening for these little low-powered ELT rigs, the better chance you will have of hearing them. So what is up in the air as high as we can put it? Repeater stations, of course.

It makes a lot of sense to me for every repeater site to have a receiver tuned to the ELT frequency so that any transmissions on this channel can be picked up as soon as they start. You still want to be able to use the repeater, so the ELT would not want to take complete control, but you might want to have the repeater stay on the air once an ELT signal was coming in, perhaps with a low-level tone modulation so you can talk over it for search coordination.

Advanced tinkerers might set up an omnidirectional antenna for normal ELT listening, with a remote switching system to change to a directional antenna which can be rotated via the repeater . . . and the peak signal direction (or null) indicated in some way. I'll bet we can drum up some interesting articles on how to do that! We need 'em anyway for eventual remote controlling of low-band beams via repeaters.

Every service we can supply with our repeaters is another merit badge for amateur radio. All of us should be thinking in terms of putting our expertise and equipment to the public good as often as possible . . . and then making darned sure the public knows about it. That's not being glory hungry or cynical about it, just being practical. If you want to attract more kids into hamming, you've got to be visible and make it seem like fun . . . which should not be much of a challenge.

All is not perfect with ELT transmitters either. Sometimes one will go off unintentionally due to being set wrong, bumped, or even jarred in a bad landing. If we have more people listening to the channel, we will put pressure on pilots and technicians to be sure that errant transmissions on the ELT channel are cut to a minimum and not just shrugged off.

You may be sure that I'd like to hear about any repeaters set up to help with the ELT situation . . . and so would the other readers.

RADAR JAMMING

During the time when Chuck Martin WA1KPS and I were making our tests of the 10-GHz ham gear . . . and running up our record of making contacts from here in New Hampshire to seven other nearby states . . . we did not entirely ignore the possibilities of using these little rigs to interfere with police radar.

The area out in front of our Elm Street building (with the *73 Magazine* ham shack) is a favorite haunt for both the local and state police. It is at the top of a hill rising from the center of town and just over the lip of the hill. The result is that cars come roaring up the wide highway and tend to ignore the 35-mile-per-hour speed limit . . . after all, it is a restricted entry road, so why drive that slowly? As they come over the top of the hill, there are the police, handing out speeding tickets.

On several occasions, I tried zapping these money makers with our 10-GHz ham rigs, but they never fazed them. After thinking about it, I realized that at 10 GHz the likelihood of being close enough in frequency to really interfere was remote. You have to get down to about 3 kHz and you just aren't going to be able to do that.

Upon reflection, I can see that those firms making radar-jamming rigs are just selling smoke. Sure, if you tuned one of them up exactly on the channel of a radar unit, you could get it to work. But as soon as another radar came along, you'd get into trouble if you expected to cause false readings on it.

Despite the come-on mph calibration of the bogus radar jammers, I suspect that the main value of these is for 10-GHz ham experimenting. I'm sure that many *73* readers would like to see more articles on 10-GHz equipment and tests, whether the stuff will jam radar or not.

THOSE SILLY EQUATIONS

One of the more serious wastes of my time in college was the time I spent learning enough to pass the courses on calculus. I've had a fundamental rule with *73* down through the years: Edit out the math equations unless they are absolutely necessary. They rarely are, so you've seen precious few equations in *73* during its twenty years of publication.

To give you an idea of how little calculus is really needed and what a waste of time it is in school, harken to my personal experience with it. I started in college in 1940 and went for two years, thus taking two damned years of calculus. Then, urged on by the government to cut out all this college nonsense and to get out there and fight, I joined the Navy (one lousy day before the Army was going to draft me . . . close call!).

After a year of schooling in the Navy, I was shipped out to the fleet and spent the rest of the war . . . or most of it . . . on a submarine, making five war patrols on the *USS Drum* (SS228). Managing to survive that, despite stubborn efforts by both the Japanese and our own Air Force to put me into the Silent Key columns, I eventually got discharged and went back to college.

Having finished all but one of the calculus courses during the first two years, all I had to do was breeze through that one remaining course. Easier said than done. I found myself with virtually a zero recollection of two years of calculus. It had never come up during the intensive Navy electronics school courses, so I'd managed to completely forget everything.

This put quite a strain on my first term back at school because I had to first go back over four terms of calculus so I could hack the fifth term. Boy, did I hate that!

Funny thing . . . I have a remarkable memory for songs, poetry, and operettas, being able to sing most of several Gilbert and Sullivan operettas, but I just had no recall on calculus.

In the over 30 years since college, I have had no occasion to use any calculus, despite a wide variety of work . . . and the editing of several thousand manuscripts. I remember enough of it now so I am not intimidated by the use of calculus and I know that I can just edit most of it out of articles without hurting them at all.

This came to a head recently when a reader sent in a copy of a letter he'd written to *Ham Radio* magazine complaining about their excessive use of math in a W2PV article series. The writer, who is quite familiar with the math involved, took the editor to task for letting the author snow the readers with the totally unnecessary math.

One of the reasons that the scientific calculators did not achieve more popularity was that there were no instruction books available for them to explain how to make use of the scientific calculations which they made possible. Few businessmen have the vaguest notion of what chi-squared represents . . . and none of the calculator instructions helped them. Most of these same people would have loved to have been able to use the calculator to find out statistical data, if there had been any simple instructions on the application.

The lack of such instructions has cost the calculator people dearly. I'll bet they could have made millions more in sales if such a book had been available.

The technical articles in *73* are the equal of any in ham magazines, but we do try to make them easier to understand by filtering out the math which some authors want to put in . . . mostly for ego purposes. We want to make it easy and fun to learn, not scare the hell out of you.

CROWD PLEASER

For a while it was beginning to look as if every newcomer to two-meter FM would eventually have his own repeater and sit there listening to it kerchunking every now and then with satisfaction. When the number of channels ran out in some areas, there were bitter fights . . . oddly enough, usually over the most active channels rather than those merely sitting there unused.

A recent report by Stanford University indicates that there are some new techniques which hams should be checking out . . . techniques which could provide us with three times as many two-meter channels as we already have. This would enable us to have three times as many unused repeaters as at present . . . and three times the number of happy repeater owners kerchunking away every now and then. And think of the joy in Japan when a whole new set of ham gear is needed!

The new technique, called Amplitude Compandored Sideband Radio (ACSB), has some similarities to the recently discredited Narrow Band Voice Modulation (NBVM) craze which the ARRL went through and then dropped. With this system, it is possible to have voice channels every 5 kHz on the VHF bands without interference. It also has a nice benefit in that it provides about a 10-dB improvement in reception over FM, which takes about 25 kHz or so . . . despite our attempts to contain it within 15 kHz.

The ACSB signal is a sideband type, but with some differences. It has a voice processor which boosts the low and high frequencies to bring up the average power of the voice . . . plus it has a pilot tone about 7 dB weaker than the peak voice which keeps the receiver on tune (AFC) and provides decoding of the compandoring, a standard signal for automatic gain control (AGC) to smooth out fading and the picket fence syndrome. The pilot also has a subaudible FM tone for selective calling. In some ways this system is quite similar to my proposed automatic identification system described recently.

Of course we would have to change over to sideband from FM, which would mean all new rigs. That should bring about $500,000,000 in joy to the manufacturers. It is not difficult to change present SSB rigs for the new system, but FM gear has receivers which are far too wide for the 5-kHz channels.

Needless to say, I would like to see some experimentation with this system by amateurs and some articles on it. The circuits necessary to do the pilot, the FM subcarrier, the AFC, the AGC, the compandoring, and all else involved are being integrated into an LSI chip, so our work may not be difficult.

The 5-kHz channel spacing would mean that we could fit 80 channels between 146.00 and 146.40, where we now have 26, none of which can do well if anywhere near an adjacent channel repeater. This would give us 160 channels in the 146- and 147-MHz repeater segments of the band. With more channels, we would not need as many simplex channels and could take at least half of them for one-MHz split repeaters, giving us 200 channels in the 146-148 segment alone. That might even take care of Los Angeles for a year or two.

The pilot carrier system would fit right in with my proposed identification scheme, making it simple to locate any individual station desired. Each station would continuously send out identification, allowing you to see instantly the call of anyone using the repeater. Good-bye kerchunking and bad language.

The doubling of the range of reception for repeaters and the elimination of most of the fading problems by the system would greatly improve our repeater coverage and value. This would also help with hand transceivers, which could be made smaller due to the lower power which could be effective. Ten dB is equivalent to ten times the power, so a one-watt HT would be about the same as a 10-Watt mobile rig in effectiveness... unless we throw the power away with a rubber duckie.

Let's see what we can do to pioneer this idea.

INFECTING THE ACNE SET

Now that it is no longer unpopular to be successful, it may be possible to carry the message about amateur radio into the high schools and turn on the students to hamming instead of pot or the development of a lifelong dependency on tobacco or booze.

The fact is that we have one hell of a message for the kids, for not only is hamming fun, but it also is one of the best keys one can find these days to getting an edge on the future. Is there any question in your mind that the electronics field is not going to keep right on growing at a healthy rate for the next 50 years? Every sign is that electronics is going to be more mixed into everything we do in the future than it is now...and that includes computers, obviously.

We're heading into a world full of micro communications devices which will put us in touch with each other at will and be able to gather information on a magnitude not even realized today. The bottom line in all of this is electronics...and how better to learn and be ahead of the pack than to get sucked into amateur radio? It happened to me and it happened to you.

Surveys show us that currently almost 90% of the teenagers who get hooked on amateur radio are going into electronics in some form. We also know that about 50% of the newly licensed amateurs are either 14 or 15 years old, so it is obvious that the growth of amateur radio is tied closely to the growth in the number of electronics oriented people...who are or will become technicians and engineers.

The Japanese took clever advantage of us when they instituted a code-free ham ticket and thus laid the groundwork for the incredible amateur population they have today. Next they got their amateurs to talk up amateur radio in the high schools and get ham clubs going. The result is that today amateur radio in Japan is known to everyone in the country and they have nearly one million hams, virtually all active. That's almost six times our active hams, and we have twice their population. Is it any wonder Japan is ahead of us in technology?

As I see it, the future of amateur radio as well as the future of our country depends on how much enthusiasm our ham clubs and repeater groups can put into developing interest in amateur radio in the high schools. We need to expose these kids to hamming and get them involved with ham clubs.

One approach to this is for your club to set up a demonstration ham station in the local high school and pass out literature about hamming which will explain the fun involved, the practical long-range advantages, and give details on how to get started. If you keep after 'em, you'll have plenty of kids in your classes at the club...and we'll start seeing some significant growth in amateur radio again.

If you have someone in your club who has some experience in public speaking, you might get them to go around to the local schools and explain the advantages and fun of amateur radio. From a practical standpoint, the kids could hardly ask for a better hobby since hamming will aim them at the pot of gold ahead in electronics.

When it comes to being a success in life, it is a lot easier to make it in a field which is growing than in one where the field is dying...such as education. I give a lot of talks to groups on the fundamentals of success and I usually start out by explaining that there are several time-proven ways of investing your life so that you will never be a commercial success...never be able to make much money. One is to go into teaching. Now this may be very rewarding in spirit, but it sure results in very few yachts and planes...or security. Then there is working for the government, which does have security, but at one hell of a price in salary and opportunity. Another big loser is working for a large corporation. Again there is a tight lid on salaries, though a mere handful do manage to work up into the 90% income tax bracket. It's a tough way to go...and you can get canned at any time.

So if the direction that our colleges and all the media push on us aims us at losing, how can we aim kids at careers which will give them the probability for making real money? The secret to being successful is to plan for it and work at things which will have a good chance of resulting in getting rich. Certainly, considering the growth which has come about in electronics (and computers), this is a lot better field to go into than English, art, or law. Just what we really need is more lawyers.

Hamming is particularly good because it gets kids into the habit of thinking about their life's work more than the usual eight hours a day. Hams never really stop thinking about their interest. Hundreds of hams get ideas for new products and start up small firms to make them... and a few of these pan out well and we have big firms such as Drake resulting...Electro-Voice, etc. Others go for a while and then fade away, but the experience gained by the entrepreneur is invaluable and will surface later. When I meet the heads of medium-sized firms in electronics, it is rare that I don't find a ham heading things up.

So get out there and spread the contagion...let's get the ham virus going in high schools. You'll enjoy seeing your handiwork...the kids will certainly benefit...amateur radio will grow and perhaps we can even get the leadership in electronic technology back from Japan.

THE CODE-FREE HASSLE

Some years ago, in response to the pressures from the CB industry, I could see a concerted move afoot to grab the ham 220-MHz band. I thought we might be able to fight this off with some stratagems, but I wanted to make sure that we were as well covered as possible so I came up with a no-code ham ticket proposal for the 220-MHz band.

My strategy was to give the CB manufacturers an out which would sell equipment for them ...possibly as well as making 220 into a CB band, but which would still leave it a ham band and thus not force hams out of it. The growth of hamming, which this would bring about, was needed...and still is. By starting people in as hams instead of CBers, I felt that we could exert ham influence on them to upgrade much more than we could if they were just CBers.

The license that I proposed was not a sign-it-and-own-it CB ticket, but one which would be granted by ham clubs only after people interested graduated from ham training classes and passed exams in very simple theory, operating techniques, and rules. I felt this would, at the same time, put the new licensees in touch with clubs where they could continue on to higher classes of license and experience the ham spirit.

The proposal I made also specified that the no-code license part of the band would be bordered by parts of the band open only to higher classes of license such as Technicians. I had in mind the use primarily by repeaters which would have to be operated by higher class licensees and would thus give the newcomers a good introduction to amateur radio and make sure that they did not think of it as CB. That, plus the ham club license classes, I felt, would get these new people aimed in a good direction.

If the band were set up with repeater inputs from, say, 220.5 to 222.0, and outputs from 223.0 to 224.5, this would provide a half meg on each end of the band for higher class operators (and repeaters) plus a full meg in the middle for higher class . . . or perhaps split with half of it for the new class simplex and half for higher class.

With 220 still not very much used in most areas of the country, this concept could still fly.

The plan did cause some weakening of the CB industry ranks and it helped us in that respect. I also got after my friends in Mexico and Canada to put on their pressures to stop the CB takeover of 220 and that had even more of an impact.

When I first proposed the no-code license, the ARRL was opposed to it. Then, as pressures from the industry mounted, they flopped over and were in favor of it. Now I understand that they are opposed again.

Seeing what a no-code ticket has done for Japan, with many benefits and no detectable drawbacks, I'm still very much in favor of the idea. I was more enthusiastic before Dick Bash started publishing his detailed cheat sheets on the FCC licenses, which essentially cancelled their effectiveness. Right now the only thing between anyone wanting a ticket and having it is the code or being too cheap to buy the Bash cheatos. Until we are able to resolve that mess, I'm not inclined to push for going to a purely written no-code ham test.

If we could set it up as I had proposed with ham clubs issuing the licenses to those people who had taken and passed their courses on being a ham, I would again favor a no-code situation. There are some problems to be resolved before clubs would be able to have the right to issue tickets. I would like to see amateur radio get more autonomous, having much more of a say in our regulations and the granting of licenses. We might be able to work out a system where we could get needed rule changes made in less than ten years, thus allowing amateur radio to keep up with technological developments instead of having to stay at least ten to twenty years behind.

If you have any well-thought-out ideas on a no-code license situation, please write in. None of us needs any emotional outburst or other red-neck responses . . . just good ideas.

LOOKING WEST

from page 12

Frankly, I have a feeling that this is where the problem in relation to this dismissal order comes from.

While I cannot speak for the Commission, I can surmise what transpired. Mr. Talley submitted his petitions under the assumption that the Commission understood amateur radio's internal interpretation regarding repeater categorization. He even told me that his opposition was toward repeaters that required one to become a member of some club or organization in order to use the repeating facilities. Again remember, we in amateur radio consider closed and private repeaters as those which restrict system access to club members. But the FCC did not read it that way. To the Commission, an open repeater is apparently one that offers no control over system operation, either technically or operationally. At least that's what seems to come to light when you read the dismissal order.

Therefore, if my guess is right, a system that has some form of control is looked upon as a closed or private repeater. It seems to have become a problem of semantics. They have never bothered to reseach what we in the amateur community accept on a day-to-day operational level. The Commission apparently looked upon Mr. Talley's request as one of removing all controls and guidance from repeater operation and reacted along those lines. Unfortunately, they may well have set an unwelcome precedent and started us on the road toward reregulation rather than continuing with deregulation.

Even more unfortunate is that in using the rationale they have, the Commission has overlooked the true intent and purpose of Mr. Talley's filings. In my view, Mr. Talley was actually raising a Constitutional issue. His contention is that amateur repeaters should be by law available to any qualified licensed amateur. I oppose this because it is my sincere belief that to force anyone operating a repeater to make it available to anyone is akin to forcing him to provide a service for another person that he may not wish to provide for that person. If you are going to open all repeaters to all qualified amateurs, then, by the same token, you also must make all Individual amateur stations available to all qualified amateurs, regardless of where such stations are located.

The concept of forcing one amateur to provide a service for another is what I object to, and this has nothing to do with either amateur radio's or the Commission's interpretation of repeater categorization. In my opinion, the defeat of RM-2844 was justified, but not for the reasons noted in the dismissal order. Had it been stated that the reasons I have outlined were the basis of their decision to deny, then I could agree with it. Maybe it's time that we in amateur radio begin to educate those who regulate our service, get them to understand our terminology and definitions in regard to our day-to-day operations. If this can be achieved, then we can really get on with things.

There is nothing wrong with the system by which regulations governing our hobby are generated. For the most part, it is people like you and I who generate them, for better or worse. We are very lucky: In most other places, rules are simply by government decree. There is nothing that the amateur can do but abide by them without recourse.

Here, in America, we can help generate and guide the destiny of amateur radio through the public rulemaking procedure. This is a liberty we must cherish and utilize for the good of our hobby. But we also must find a way to overcome the semantics problem so that when we talk about open repeaters, the FCC understands our meaning and we theirs. When we speak of modes, power levels, or anything else, each must know the meaning of the other's words. This will go a long way in developing more positive lines of interaction between those of us who comprise the amateur community and the agency that regulates our operations.

SHOULD THERE BE PRIVATE REPEATERS DEPARTMENT

In any discussion, we must first set some ground rules for understanding. In this case, I feel it is best that we begin by reviewing the definitions of the three categories of repeater operation as accepted within the amateur community. Over the years, the following definitions have developed:

Open Repeater: An amateur relay device placed into operation by an individual or group to serve the needs of all licensed and qualified amateurs in a given area. In most cases, no form of tone access is necessary to access such a system.

Closed Repeater: An amateur relay device which requires that one become a member of the sponsoring organization to gain use of the relay system facilities. However, membership in such organizations is open to any interested amateur licensee.

Private Repeater: An amateur relay device which, like the closed repeater, requires membership in the sponsoring organization. However, the availability of such membership is at the discretion of the system licensee. Both closed and private repeaters are usually tone accessed, and such access tones are considered to be proprietary information.

If we accept these as our definitions of operational categorization, then a question arises. Should the latter two be permitted to exist in today's amateur society? It probably depends upon where you reside, conditions of crowding on various bands, and, most importantly, your own personal taste. I cannot comment on the last, but in regard to the others, I have a number of words, some of which will not make the owners of closed and private repeaters too happy. What I have to say differs from earlier commentary that has appeared over the years in this column, but this is because of the ever-changing face of the amateur service itself.

If you live out in the boondocks where nobody cares, you can basically do your own thing and nobody will say boo. If there are only three or four repeaters in your area and a clear band, then I do not think anyone will really care what category of operation you choose. However, in crowded urban areas where one finds a repeater or two every 15 kHz between 146 and 148 MHz and the same condition every 20 kHz from 144.5 through 145.5 MHz, then the two-meter band is no place to start or continue a closed or private device. Two meters has become "the people's band" and, for the most part, "the people" want and demand access to the entire spectrum. While densely populated metro areas might have been able to tolerate a number of private repeaters on two meters only a few short years ago, with today's spectrum crunch it may be time for those wishing this category of operation to look toward greener, less occupied spectrum.

I have no qualms with closed and private repeaters. In fact, I freely admit to being a member of two such entities, but neither of these are on two meters. Over the past several years, I have been invited onto a number of private two-meter systems here in the Los Angeles area, but each time have declined such an invitation. Yes, there is a place in our society for those who want their privacy and there is nothing wrong with their wanting it. But the urban private repeater of today, operating within the crowded confines of the two-meter band, is somewhat akin to a case of the flu. Neither is very welcome anymore. As time progresses and the spectrum crunch tightens, they will probably become a definite liability within our amateur community.

On the other hand, there are bands with practically no utilization. This holds true even for areas where the two-meter band is saturated with 24-hour-a-day activity. Such spectrum would welcome any activity, private or otherwise. This is where such systems belong, out of the mainstream of today's amateur activity. Further, those wishing the luxury of operation on such a system should be prepared to spend the extra bucks for the necessary equipment, be it on 6 meters, 220 MHz, or 450 MHz. If you want the luxury, then be prepared to pay the price tag that comes with it. After all, the vast majority of those using the two-meter band are not that interested in getting on a private or closed system. For most, amateur radio is a recreation and not an avocation. I can see no reason to displace the masses in deference to the few. I do not condemn private or closed operations. They have their place within the structure of amateur radio society and as such serve a definite purpose. Many of the earliest systems had restricted access, and from them has come much of the open operation of today. However, in areas where the two-meter band is overflowing with activity, where the coordinator or coordination council has a waiting list a yard long for new open repeaters, the closed and private category system should take a back seat to the will of the majority.

SIX-METER BAND PLANNING, CONTINUED

The band plan outlined in the September issue on page 163 has begun to get some response. What I find very scary is that thus far I have not received any negative commentary. Some suggested changes, yes, but nothing that says "NO" emphatically. One important addition that I want to note concerns the existence of another Pacific DX corridor. It was not brought to my attention prior to the formulation of the band plan and therefore was not included.

A second Pacific DX corridor does exist from 51.0 through 51.1 MHz. It has been around for some time but never has been given very much publicity. So, if we were to obtain deregulation down to 51 MHz for FM relay operations, in some areas it might be wise to keep FM away from this small slot to protect weak-signal operations. Again, this would fall under a voluntary program and not be part of the amateur rules and regulations. It would be exactly the same as the Pacific DX corridor that exists from 52.0 through 52.1 MHz. I might suggest that you pencil this into the band plan for future reference.

For the moment, that's about it in regard to six meters. More on the subject will be included in future columns and as comments come in.

FINAL UPDATE ON STORY ONE

We opened this month's column by reporting on the dismissal order to RM-2844, an order that on the surface seems to eliminate open repeater operation. We also included a scenario on what we hypothesized as being the sequence of events leading up to it. Well, information we have gathered seems to point to this being similar to what really happened.

It appears as though the order was given to a member of staff to prepare the document. The person was not all that familiar with Part 97 as it governs repeater operation and wrote the document based upon his own understanding. After its release, a number of inquiries were made to its validity and it was brought to the attention of a senior member of the staff who agreed that its wordage was somewhat contradictory to the rules as written. A clarification has been promised. It should be forthcoming and we may have it for next month's column. I hope that it will clear the air.

LETTERS

from page 24

what about the other 99% of the time? Unfortunately, although they expect us to operate in the public interest, we really can't expect them to do likewise.

If the FCC doesn't resume testing in Germany, there is only one option left. That is to reinstate the Conditional class license which we had many moons ago. If this can't be done, then they should put the testing program in the hands of the Extras. The FCC would undoubtedly balk at a suggestion such as this because of past problems concerning "mail-order" Technicians. But I am sure that the Extra class hams can run an honest and sound testing system not only for amateurs, but also for the commercial applicants. I have already earned my Extra class ticket, but I am speaking for the hundreds of hams and those desiring their phone licenses. In closing, all I can add is that "the FCC giveth, the FCC taketh away."

Harry A. Schools KA3B/DA2AL
APO NY

Thanks for the letter, Harry; you are expressing what I heard everywhere I went in Europe a few months ago. Perhaps someone should petition the FCC to solve the problem with an overseas Conditional license arrangement? The major problem, both with lack of growth of the hobby and with the FCC problems, stems from our lack of a lobby to push for amateur radio in Washington... and in particular with the FCC. It is completely unfair to blame the FCC for acting like any other government bureau and reacting to lobbying pressures which are on them from all sides... except amateur.—Wayne.

IT'S A MESS

Every time I read an article or letters from readers regarding FCC decisions, which are usually negative, causing more government control of amateur radio and more restrictions, I wonder if the founders of the Federal Communications Commission were of this mind?

Amateur radio has been the victim of the Commission's inability to cope with their bum decisions on CBers. But the worst of all is the alphabet soup call letters of all descriptions. As I see it, it is further degradation of amateur radio. We used to be able to tell where a particular callsign would originate from, but not now; it's a mess! Possibly, they want to fracture this sacred organization, i.e., to make it like CB. I surely hope not.

I have been a licensed ham since 1939 and I still enjoy ham radio. This brings to mind a recent overseas contact on 20 CW with a ham in northern Norway. My comment that I had been an amateur since 1939 brought this response: "I, too, am an old-timer, receiving my first ticket in '38, and I dearly love my hobby."

Henry S. Mitchell
Seattle WA

Henry, a lot of us grumble about the FCC, and certainly some of the rules they put through are for political reasons and not in the best interests of the hobby . . . but then we have virtually no lobby there to deal with the FCC and guide them in a positive way, so we can expect no more than we get. When you are dealing with government, you have to do things the government way, and this means lobbying for your hobby. It is useless to get mad at the FCC for acting perfectly normal and hold blameless the real villains. . . the people we are paying to represent us.—Wayne.

ANTENNA CHOKES

I've received an interesting letter from Al Stahler AD6G commenting on my article, "Check Chirp with a Choke," which appeared in the June issue. Al comments as follows: "I've used a similar device in all of my antennas—but for a slightly different reason. The idea is to remove rf from the feedlines. King, in his book *Transmission Lines, Antennas and Wave Guides* (Dover, 1965), page 151, states that common mode currents, i.e., antenna currents on the outside of a coax or antenna currents on both conductors of a parallel feedline, can be de-tuned or eliminated by placing a high impedance to these currents at a point on the line where the current would be maximum.

"For a dipole antenna, the optimum location for the high impedance would be at the feedpoint where the current is maximum, or at λ/2 intervals from the feedpoint. I have found that a choke coil like yours placed at the feedpoint of a dipole is *much* more effective at eliminating rf on the feedline than a conventional balun. I no longer use a balun, just a choke.

"Field strength measurements have shown that the radiation pattern of a dipole antenna is drastically altered when there is rf on the feedline, but the addition of a choke at the feedpoint corrects this problem.

"I first found that I had rf on the feedline when I noticed that the swr was different at different points along the feedline. With the choke installed, this problem goes away.

"P.S. If you resonate the choke with a variable capacitor the results are even better!"

Thanks for the interesting feedback, Al. Resonating with a capacitor had not occurred to me, but for single-band operation, an improvement could certainly be obtained by this expedient. For allband operation, it would be best to stick with the choke method. Another application for choke isolation of undesired antenna currents comes to mind. This is the suppression of rf energy from the shack when necessary to eliminate rf burns resulting from contact with "hot" equipment.

Stanford J. Solms WA2MEL
Sunnyvale CA

FUN-PEDITIONS

Caribbean vacation spots are certainly *not* DXpeditions—they are DX operations or are sometimes called fun-peditions. Let's start putting DXpeditions vs. DX operations in true perspective. True DXpeditions include, but are not limited to, for example, Malpelo, Bouvet, Okino Torishima, Spratly, et al. My *new* show is *all* of these plus many others. Hope you can catch my show on the circuit. It's a great show.

Hugh G. Vandegrift WA4WME
Killeen TX

We'll be looking for you, Hugh, and be sure to take a lot of good color pictures for the write-ups on your trip. One of the problems with some of the earlier DXpeditions to many of the places you mentioned was that they were fakes. At least when someone says he is on a fairly rare island in the Caribbean, there is a good chance he is where he says he is. But remember one thing, Hugh: If I haven't worked a particular country, that's DX for me and the chap visiting is on a valid DXpedition. The bottom line is fun. . . the fun of working DX for us and the fun of being DX for you—Wayne.

OPERATOR'S LICENSE

With regard to the new flap over the tactics of Mr. Bash and his "educational services," I would like to add some additional comment.

Personally, I never could understand why someone *had* to have an understanding of the workings of electronics to become a ham. Frankly, it stems from the old days when you had to put things together (homebrew) to even get on the air. Today we are flooded with state-of-the-art rigs. Who needs home brew unless you are personally interested in doing that; why do I have to know the stuff?

Before someone jumps on me, I'd better mention that I have a background in electronics and work for an electronics firm here and was originally licensed in 1957.

Most everyone today is an appliance operator anyway. What we need is a test that makes all potential operators have a thorough knowledge of the rules of the road, proper operating procedures, proper use of radios and tuning up, and etiquette on the air. As far as I am concerned, it is no different than a license to own or operate a car, truck, gun, fishing rod, camper, or whatever. Look at all of the people out there that took a driver's test many years ago in a car and go out and buy a big camper, get behind the wheel, and create a menace on the highways. (This is not to say that many people don't drive campers well.) I fail to see a big difference. Who really cares what a MOSFET does, or a diode, or a spark plug, as long as the rig/car works. Some folks would not know a spark plug from a rotor.

I endorse and support Mr. Bash, will use his services, provide feedback, and do whatever else I can. To those that scorn him, I detect a note of jealousy (these services were not available to them) and a desire to maintain some elitist group. We should keep the code as it is, but all this theory is for the people that really like it. Heck, you can get a pilot's license without knowing how to fix the plane. Too many old folks reluctant to make change stagnate anything they are involved in. Let's wake up and revitalize ham radio. Now is the time.

Alan Davis KB7HM
Salt Lake City

Let's hear it for the code-free, theory-free license.—Wayne.

KEEP IT SHORT

I am pleased that you have seen fit to promote 10-meter FM in *73*.

As one who has been on 29.6 for many years (at the bottom of the sunspot cycle), I am disturbed at the new arrivals on 29.6 complaining about people who aren't QRP or running a converted CB. (Everyone else is using excessive power.) I welcome these newcomers and hope they will contribute to the band. The fact that most have converted a CB or old mobile rig places them among the few hams who are not merely appliance operators.

QRP contacts are an everyday thing on 29.6, but they are usually *brief*. I would hope that for the first few exchanges, the QRP operator would *keep it short*—QTH, handle, rig, signal report. As exchanges prove the band is holding up, then rag chew. Over 50% of my contacts were fading into the noise before I could get basic information, so I have stopped calling the marginal ones.

The newcomers are probably not aware that 1 kW and a 5-el beam on 29.6 will provide a fade margin for long, frequent contacts while they are fading into the noise.

Hopefully, everyone will be able to coexist on this small piece of 10 meters. QRP signals are great for studying propagation, and we all have lots to learn.

My hope is that some of these QRPers will see the value of power and gain before we hit a low in the sunspot cycle. There is a whole world of 600-1200-mile sporadic-E activity while 20/15 meters are closed, but a QRP will be unable to take advantage of it.

Les Whittaker Jr. WB0PXA
Miami FL

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11C06DC	UHF Prescaler 750 MHz D Type Flip/Flop	12.30
11C05DC	1 GHz Counter Divide by 4	50.00
11C01FC	High Speed Dual 5-4 input NO/NOR Gate	15.40

TRW BROADBAND AMPLIFIER MODEL CA615B

Frequency response 40 MHz to 300 MHz
Gain: 300 MHz 16 dB Min., 17.5 dB Max.
50 MHz 0 to − 1 dB from 300 MHz
Voltage: 24 volts dc at 220 ma max. $19.99

CARBIDE — CIRCUIT BOARD DRILL BITS FOR PC BOARDS

Size: 35, 42, 47, 49, 51, 52	$2.15
Size: 53, 54, 55, 56, 57, 58, 59, 61, 63, 64, 65	1.85
Size: 66	1.90
Size: 1.25 mm, 1.45 mm	2.00
Size: 3.20 mm	3.58

CRYSTAL FILTERS: TYCO 001-19880 same as 2194F

10.7 MHz Narrow Band Crystal Filter
3 dB bandwidth 15 kHz min. 20 dB bandwidth 60 kHz min. 40 dB bandwidth 150 kHz min.
Ultimate 50 dB: Insertion loss 1.0 dB max. Ripple 1.0 dB max. Ct. 0 + / − 5 pf 3600 ohms. $5.95

MURATA CERAMIC FILTERS

Models: SFD-455D 455 kHz	$3.00
SFB-455D 455 kHz	2.00
CFM-455E 455 kHz	7.95
SFE-10.7 10.7 MHz	5.95

TEST EQUIPMENT — HEWLETT PACKARD — TEKTRONIX — ETC.

Hewlett Packard:

491C	TWT Amplifier 2 to 4 Gc 1 watt 30 dB gain	$1150.00
608C	10 mc to 480 mc .1 uV to.5V into 50 ohms Signal Generator	500.00
608D	10 to 420 mc .1 uV to.5V into 50 ohms Signal Generator	500.00
612A	450 to 1230 mc .1 uV to .5V into 50 ohms Signal Generator	750.00
614A	900 to 2100 mc. Signal Generator	500.00
616A	1.8 to 4.2 Gc Signal Generator	400.00
616B	1.8 to 4.2 Gc Signal Generator	500.00
618A	3.8 to 7.2 Gc Signal Generator	400.00
618B	3.8 to 7.2 Gc Signal Generator	500.00
620A	7 to 11 Gc Signal Generator	500.00
623B	Microwave Test Set	900.00
626A	10 Gc to 15 Gc Signal Generator	2500.00
695A	12.4 to 18 Gc Sweep Generator	900.00

Alltech:

473	225 to 400 mc AM/FM Signal Generator	750.00

Singer:

MF5/VR-4	Universal Spectrum Analyzer with 1 kHz to 27.5 mc Plug In	1200.00

Keltek:

XR630-100	TWT Amplifier 8 to 12.4 Gc 100 watts 40 dB gain	9200.00

Polarad:

2038/2436/1102A
Calibrated Display with an SSB Analysis Module and a 10 to 40 mc Single Tone Synthesizer 1500.00

RF TRANSISTORS

TYPE	PRICE	TYPE	PRICE	TYPE	PRICE
2N1561	$15.00	2N5590	$8.15	MM1550	$10.00
2N1562	15.00	2N5591	11.85	MM1552	50.00
2N1692	15.00	2N5637	22.15	MM1553	56.50
2N1693	15.00	2N5641	6.00	MM1601	5.50
2N2632	45.00	2N5642	10.05	MM1602/2N5842	7.50
2N2857JAN	2.52	2N5643	15.82	MM1607	8.65
2N2876	12.35	2N6545	12.38	MM1661	15.00
2N2880	25.00	2N5764	27.00	MM1669	17.50
2N2927	7.00	2N5842	8.78	MM1943	3.00
2N2947	18.35	2N5849	21.29	MM2605	3.00
2N2948	15.50	2N5862	51.91	MM2608	5.00
2N2949	3.90	2N5913	3.25	MM8006	2.23
2N2950	5.00	2N5922	10.00	MMCM918	20.00
2N3287	4.30	2N5942	46.00	MMT72	1.17
2N3294	1.15	2N5944	8.92	MMT74	1.17
2N3301	1.04	2N5945	12.38	MMT2857	2.63
2N3302	1.05	2N5946	14.69	MRF245	33.30
2N3304	1.48	2N6080	7.74	MRF247	33.30
2N3307	12.60	2N6081	10.05	MRF304	43.45
2N3309	3.90	2N6082	11.30	MRF420	20.00
2N3375	9.32	2N6083	13.23	MRF450	11.85
2N3553	1.57	2N6084	14.66	MRF450A	11.85
2N3755	7.20	2N6094	7.15	MRF454	21.83
2N3818	6.00	2N6095	11.77	MRF458	20.68
2N3866	1.09	2N6096	20.77		
2N3866JAN	2.80	2N6097	29.54		
2N3866JANTX	4.49	2N6136	20.15	MRF502	1.08
2N3924	3.34	2N6166	38.60	MRF504	6.95
2N3927	12.10			MRF509	4.90
2N3950	26.86			MRF511	8.15
2N4072	1.80	2N6439	45.77	MRF901	3.00
2N4135	2.00	2N6459/PT9795	18.00	MRF5177	21.62
2N4261	14.60	2N6603	12.00	MRF8004	1.60
2N4427	1.20	2N6604	12.00	PT4186B	3.00
2N4957	3.62	A50-12	25.00	PT4571A	1.50
2N4958	2.92	BFR90	5.00	PT4612	5.00
2N4959	2.23	BLY568C	25.00	PT4628	5.00
2N4976	19.00	BLY568CF	25.00	PT4640	5.00
2N5090	12.31	CD3495	15.00	PT8659	10.72
2N5108	4.03	HEP76/S3014	4.95	PT9784	24.30
2N5109	1.66	HEPS3002	11.30	PT9790	41.70
2N5160	3.49	HEPS3003	29.88	SD1043	5.00
2N5179	1.05	HEPS3005	9.95	SD1116	3.00
2N5184	2.00	HEPS3006	19.90	SD1118	5.00
2N5216	47.50	HEPS3007	24.95	SD1119	3.00
2N5583	4.55	HEPS3010	11.34		
2N5589	6.82	HEPS5026	2.56		
		HP35831E/		TRWMRA2023-1.5	42.50
		HXTR5104	50.00	40281	10.90
		MM1500	32.20	40282	11.90
				40290	2.48

CHIP CAPACITORS

We can supply any value chip capacitors you may need.

PRICES

1 to 10	1.49
11 - 50	1.29
51 - 100	.89
101 - 1,000	.69
1,001 up	.49

1pf	27pf	220pf	1200pf
1.5pf	33pf	240pf	1500pf
2.2pf	39pf	270pf	1800pf
2.7pf	47pf	300pf	2200pf
3.3pf	56pf	330pf	2700pf
3.9pf	68pf	360pf	3300pf
4.7pf	82pf	390pf	3900pf
5.6pf	100pf	430pf	4700pf
6.8pf	110pf	470pf	5600pf
8.2pf	120pf	510pf	6800pf
10pf	130pf	560pf	8200pf
12pf	150pf	620pf	.010mf
15pf	160pf	680pf	.012mf
18pf	180pf	820pf	.015mf
22pf	200pf	1000pf	.018mf

HAMLIN SOLID STATE RELAYS:

120vac at 40 Amps.
Input Voltage 3 to 32vdc.
240 vac at 40 Amps.
Input Voltage 3 to 32 vdc.

YOUR CHOICE $4.99

ATLAS CRYSTAL FILTERS FOR ATLAS HAM GEAR

5.52-2.7/8
5.595-2.7/8/U
5.595-.500/4/CW
5.595-2.7LSB
5.595-2.7USB
5.645-2.7/8
9.0USB/CW

YOUR CHOICE $24.95

✓ Reader Service—see page 226

MHz electronics

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MOTOROLA Semiconductor

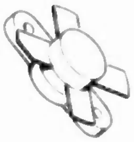
The RF Line

MRF454 $21.83

NPN SILICON RF POWER TRANSISTORS

. . . designed for power amplifier applications in industrial, commercial and amateur radio equipment to 30 MHz.

- Specified 12.5 Volt, 30 MHz Characteristics —
  Output Power = 80 Watts
  Minimum Gain = 12 dB
  Efficiency = 50%



MRF458 $20.68

NPN SILICON RF POWER TRANSISTOR

. . . designed for power amplifier applications in industrial, commercial and amateur radio equipment to 30 MHz.

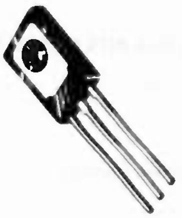
- Specified 12.5 Volt, 30 MHz Characteristics —
  Output Power = 80 Watts
  Minimum Gain = 12 dB
  Efficiency = 50%
- Capable of Withstanding 30:1 Load VSWR @ Rated P_{out} and V_{CC}

MRF472 $2.50

NPN SILICON RF POWER TRANSISTOR

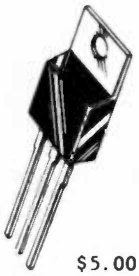
. . . designed primarily for use in large-signal output amplifier stages. Intended for use in Citizen-Band communications equipment operating at 27 MHz. High breakdown voltages allow a high percentage of up-modulation in AM circuits.

- Specified 12.5 V, 27 MHz Characteristics —
  Power Output = 4.0 Watts
  Power Gain = 10 dB Minimum
  Efficiency = 65% Typical



MRF475

NPN SILICON RF POWER TRANSISTOR



$5.00

. . . designed primarily for use in single sideband linear amplifier output applications in citizens band and other communications equipment operating to 30 MHz.

- Characterized for Single Sideband and Large-Signal Amplifier Applications Utilizing Low-Level Modulation.
- Specified 13.6 V, 30 MHz Characteristics —
  Output Power = 12 W (PEP)
  Minimum Efficiency = 40% (SSB)
  Output Power = 4.0 W (CW)
  Minimum Efficiency = 50% (CW)
  Minimum Power Gain = 10 dB (PEP & CW)
- Common Collector Characterization

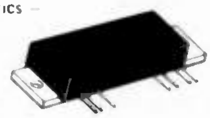
MHW710 - 2 $46.45

440 to 470MC

UHF POWER AMPLIFIER MODULE

. . . designed for 12.5 volt UHF power amplifier applications in industrial and commercial FM equipment operating from 400 to 512 MHz.

- Specified 12.5 Volt, UHF Characteristics —
  Output Power = 13 Watts
  Minimum Gain = 19.4 dB
  Harmonics = 40 dB
- 50 Ω Input/Output Impedance
- Guaranteed Stability and Ruggedness
- Gain Control Pin for Manual or Automatic Output Level Control
- Thin Film Hybrid Construction Gives Consistent Performance and Reliability



Tektronix Test Equipment

B	Wideband High Gain Plug In	$ 51.00
CA	Dual Trace Plug In	120.00
K	Fast Rise DC Plug In	63.00
N	Sampling Plug In	200.00
R	Transistor Risetime Plug In	116.00
W	High Gain Differential Comparator Plug In	283.00
TU-2	Test Load Plug In for 53D/540/550 Main Frames	50.00
1A2	Wideband Dual Trace Plug In	216.00
1S1	Sampling Unit With 350PS Risetime DC to 1GHZ	730.00
2A61	AC Differential Plug In	133.00
3S3	Dual Trace Sampling DC to 1GHZ Plug In	250.00
3S76	Dual Trace Sampling DC to 875MHZ Plug IN	250.00
3T77A	Sampling Sweep Plug In	250.00
3L10	Spectrum Analyzer 1 to 36MHZ Plug IN	1000.00
50	Amplifier Plug In	50.00
51	Sweep Plug In	50.00
53B	Wideband High Gain Plug In	25.00
53/54B	Wideband High Gain Plug In	45.00
53/54C	Dual Trace Plug In	112.50
53/54D	High Gain DC Differential Plug In	38.00
53/54G	Wideband DC Differential Plug In	68.00
53/54L	Fast Rise High Gain Plug In	68.00
84	Test Plug In For 580/581 Main Frames	75.00
107	Square Wave Generator .4 to 1MHZ	48.00
RM122	Preamplifier 2HZ to 40KHZ	63.00
123	AC Coupled Preamplifier	25.00
131	Current Probe Amplifier	50.00
184	Time Mark Generator	363.00
R240	Program Control Unit	150.00
280	Trigger Countdown Unit	84.00
455	Portable Dual Trace 50MHZ Scope	2000.00
465	Portable Dual Trace 100MHZ Scope	2500.00
503	DC to 450KHZ Scope Rack Mount	250.00
535A	DC to 15MHZ Scope Rack Mount	263.00
543	DC to 33MHZ Scope	300.00
561	DC to 10MHZ Scope Rack Mount	150.00
561A	DC to 10MHZ Scope Rack Mount	200.00

Scopes with Plug-in's

561A	DC to 10MHZ Scope with a 3S76 Dual Trace DC to 875MHZ Sampling Plug In and a 3T77A Sweep Plug In. Rack Mount	600.00
565	DC to 10MHZ Dual Beam Scope with a 2A63 Diff. and a 2A61 Diff. Plug In's	900.00
581	DC to 80MHZ Scope with a 82 Dual Trace High Gain Plug In	650.00

Tubes

2E26	$ 5.00	4CX350FJ	$116.00	6146W	12.00
3-500Z	102.00	4CX1000A	300.00	6159	10.60
3-1000Z	268.00	4CX1500B	350.00	6161	75.00
3B28/866A	5.00	4CX15000A	750.00	6293	18.50
3X2500A3	150.00	4E27	50.00	6360	6.95
4-65A	45.00	4X150A	41.00	6907	40.00
4-125A	58.50	4X150D	52.00	6939	14.75
4-250A	68.50	4X150G	74.00	7360	12.00
4-400A	71.00	5728/T160L	39.00	7984	10.40
4-1000A	184.00	6LF6	5.00	8072	49.00
5-500A	145.00	6LQ6	5.00	8106	2.00
4CX250B	65.00	811A	12.95	8156	7.85
4CX250F/G	55.00	813	29.00	8226	127.70
4CX250K	113.00	5894/A	42.00	8295/PL172	328.00
4CX250R	92.00	6146	5.00	8458	25.75
4CX300A	147.00	6146A	6.00	8560A/AS	50.00
4CX350A	107.00	6146B/8298A	7.00	8908	9.00
				8950	9.00

R F CONNECTORS COAX

TYPE	DESCRIPTION	PRICE EACH
UG-273	Female BNC to PL-259	$ 3.00
UG-146/u	SO-239 to N Male	10.00
UG-83a/u	N Female to PL-259	10.00
UG-318/u	PL-259 to N Male	10.00
874	N Female to General Radio	15.00
UG-394b/u	BNC Male to N Female	10.00
UG-255/u	BNC Male to SO-239	5.00
UG-21e/u	N Cable Connector Male	4.00
UG-58a/u or UG-58b/u	N Female Pannel	4.50
SO-239	UHF Female Pannel	1.00
UG-1094a/u or UG-625b/u	BNC Female Bulkhead	1.35
UG-290a/u or UG-185/u	BNC Female	2.50
PL-259	UHF Cable Connector	1.00
UG-175 or UG-176	Adapter for RG58 or RG59 Cable For PL-259	.50
UG-88/u or UG-260/u	BNC Male 50 or 75 ohm	1.50
SO-239BM	SO-239 to PL-259 Quick Disconnect	3.00
UG-57b/u	N Male to Male	4.50
UG-27d/u	N 90° Male to Female	6.50
UG-274a/u	BNC T Male Female Male	5.00
UG-636a/u	BNC Female to "C" Male	10.00
UG-564/u	"C" Female to N Male	10.00
UG-635/u	BNC Male to "C" Female	10.00
UG-565a/u	N Female to "C" Male	10.00
UG-201a/u	BNC Female to N Male	5.00
UG-306/u	BNC 90° Male to Female	3.00
M-358	UHF T Female Male Female	3.25
UG-491b/u	BNC Male to Male	5.00
UG-914/u	BNC Female to Female	3.00
PE9090	TNC Female to N Male	10.00
PE9089	TNC Male to N Female	10.00
PE9088	TNC Female to TNC Female	12.00
PE9087	TNC 90° Male to Female	20.00
PE9086	TNC Male to Male	12.00
PE9085	TNC Female to Female	20.00
PE9084,9083,9082	TNC Panel and Bulkhead	3.00
PE9081	BNC Male to F Female	5.00
PE9080	BNC Male to TNC Female	10.00
PE9079	N Female to SMA Female Panel	30.00
PE9078	BNC Female to SMA Female Panel	30.00
PE9077	"C" Female to SMC Female Bulkhead	30.00
PE9076	SMA Male for .141 semi-ridg	3.00
PE9075	SMA Male for .085 semi-ridg	3.00
PE9074	SMA Flange Female	5.00
PE9073	SMA Flange Male	5.00
PE9072	SMA Female Short	7.50
PE9071	SMA Male 50 ohm load	10.00
PE9070	SMA Female to Female	10.00
Tektronix 011-0049-01	50 ohm 2 watt term. BNC Female to Male	15.00
FXR AH-A92	0.5dB SMA Male Female Att.	15.00
FXR AH-A93	1.0dB SMA Male Female Att.	15.00
FXR AH-A94	1.5dB SMA Male Female Att.	15.00

****

COAX CABLE SPECIAL SALE

Microdot RG-174
miniature 50 ohm coax cable for small jobs.This cable was made to meet military spec.(PRICE PER FOOT)

1 to 25 foot .15 ¢ / 26 to 50 foot .12 ¢ / 51 to 100 foot .11 ¢ / 101 up .10 ¢

Microdot RG-402U
.141 miniature 50 ohm hard line / semi-ridg coax for use with SMA/SMC ect. miniature coax connectors. This cable is very low loss and is used for High Frequency projects. (PRICE PER FOOT)

1 to 10 foot $5.00 / 11 to 25 foot $4.00 / 26 to 50 foot $3.00 /

Microdot RG-402U with two Male SMA Connectors Assembled.
Aprox. 10 to 15" . $ 5.00

Microdot RG-402U with two Male N Connectors Assembled.
Aprox. 10 to 20". $15.00

CRYSTALS

$4.99

KC/KHZ	MC/MHZ	MC/MHZ	MC/MHZ	MC/MHZ	MC/MHZ
15.75	2.148875	2.65075	3.067	4.0457	6.380416
24	2.151	2.6545	3.074	4.096	6.380833
26.25	2.153125	2.65825	3.1	4.1153	6.381041
32	2.15375	2.66	3.1125	4.1299	6.381666
49.71	2.15525	2.662	3.126	4.26	6.382291
70	2.157375	2.66575	3.137	4.335	6.382916
81.9	2.1595	2.6695	3.13975	4.6895	6.383541
96	2.16375	2.677	3.1435	4.6965	6.384166
100 (note)	2.165875	2.68075	3.144	4.7175	6.384791
114.1666	2.170125	2.681	3.145	4.7245	6.385416
153.6	2.17225	2.6845	3.1545	4.7315	6.42963
250	2.1765	2.68825	3.158	4.765	6.43104
285.714	2.17925	2.69575	3.1585	4.89	6.45926
327.82	2.18475	2.702	3.1615	4.9037	6.47
576	2.18575	2.704	3.1625	4.93333	6.47111
600	2.194125	2.71075	3.166	5.	6.48889
980	2.198	2.715	3.16975	5.13125	6.537
998.4	2.207063	2.716	3.177	5.139583	6.567
MC/MHZ	2.208313	2.723	3.181	5.147917	6.57778
	2.209563	2.73	3.1825	5.164583	6.582
1	2.21812	2.7315	3.18475	5.1755	6.612
1.024	2.210813	2.73225	3.1885	5.1768	6.627
1.05145	2.212063	2.732625	3.2035	5.25926	6.6645
1.065158	2.214562	2.733	3.20725	5.3037	
1.077368	2.214563	2.737	3.2165	5.33333	6.673
1.092105	2.215625	2.73975	3.2175	5.34815	6.693
1.125263	2.217938	2.742125	3.2315	5.3484	6.705
1.136316	2.21975	2.7425	3.23275	5.426636	6.723
1.165789	2.222125	2.744	3.2365	5.436636	6.7305
1.197368	2.22325	2.7445	3.23775	5.456	6.738
1.3	2.22675	2.74475	3.2385	5.4675	6.75
1.3065	2.23725	2.746875	3.238875	5.499	6.75125
1.6896	2.2395	2.751	3.23925	5.5065	6.753
1.6525	2.24075	2.754	3.24025	5.1111	6.7562
1.7	2.241	2.75525	3.2405	5.5215	6.7605
1.76375	2.246	2.762375	3.241	5.544	6.7712
1.77125	2.2475	2.7735	3.2425	5.5515	6.77625
1.773125	2.264	2.776625	3.244	5.559	6.7833
1.78675	2.2925	2.78	3.248875	5.5665	6.81482
1.81875	2.2975	2.814	3.24925	5.574	6.87407
1.845125	2.3	2.817	3.24975	5.5815	6.9037
1.845625	2.32	2.8225	3.2515	5.58519	6.844444
1.84575	2.326	2.835	3.253625	5.589	6.88
1.846	2.32625	2.85	3.255	5.604	6.91
1.84825	2.3525	2.854	3.256125	5.6115	6.92
1.84975	2.35256	2.854285	3.258625	5.619	6.933333
1.8575	2.368	2.865	3.261	5.6265	6.94
1.908125	2.374	2.868	3.261125	5.62963	6.96296
1.925	2.375	2.8725	3.263625	5.6415	7.01
1.925125	2.38725	2.876875	3.266125	5.6715	7.125
1.927	2.394	2.887	3.268625	5.68	
1.932	2.395	2.889	3.271125	5.7037	7.225
1.982	2.396875	2.894	3.273625	5.7105	7.25
1.985	2.42	2.92545	2.33	5.733333	7.255555
1.9942	2.4375	2.931	3.4045	5.74815	7.275
1.995975	2.44275	2.94375	3.4115	5.80741	7.3435
1.96475	2.4495	2.945	3.4325	5.83704	7.35
1.999659	2.45	2.94675	3.4535	5.85185	7.36296
2.	2.482	2.952	3.4675	5.8968	7.3728
2.0285	2.486	2.966	3.4815	5.92593	7.39
2.05975	2.5	2.97125	3.541	5.9525	7.42222
2.078	2.51375	2.973	3.579545		7.443
2.082	2.581	2.98	3.64	6.	7.4585
2.125	2.604	2.981	3.656		7.4615
2.126175	2.618	2.98325	3.745	6.21	7.4685
2.12795	2.6245	2.987	3.8	6.22222	7.4715
2.1315	2.62825	3.	3.803	6.25185	7.473
2.133275	2.633125	3.001	3.805	6.254167	7.4785
2.13505	2.63575	3.0235	3.860	6.28146	7.4815
2.1425	2.639	3.049	3.908	6.31111	7.4985
2.144625	2.64325	3.053	3.9168	6.321458	7.62963
2.14675	2.647	3.062	4.	6.37037	7.65926

NOTE 100KC is $9.99 each

BULLET ELECTRONICS

✓12

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Special Buy!

RF POWER TRANSISTORS

2N5591 25 W @ 13.6 VDC to 240 mhz. minimum gain 4.4 db.
6.95

Limited Qty. Limit 5 of each type per customer

2N6081 / MRF221
15W @ 13.6 VDC to 240 mhz. Minimum gain 6.3 db.
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Units are marked with special mfg's. part number, however, all are new and guaranteed.

ULTRASONIC RELAY KIT

Invisible Beam Works Like A Photo Electric Eye. **COMPLETE KIT**. All Parts & PC Board. Use Up To 25 Ft. Apart.
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Optional entry delay and Alarm Timeout Circuit will source or sink up to 200 MA DC.
$3.95

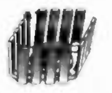
AUTO/VAN CLOCK KIT

- 12 Hr. Format
- 6 Digit ½" LED Readouts
- Quartz XTAL Timebase
- Alarm & Snooze Options
- Noise Filtering
- Easy Assembly • 12 VDC
- 4 5/8" x 3" x 1 1/2"
- All Parts!

$16.95

TO-3 P.C. BOARD HEATSINK

Perfect for power transistors, or 309 and 340K series voltage regulators.
3/1.10



Thermoloy H6014 Black Anodized

X-RATED! ZULU II CLOCK KIT

X-TRA VALUE: All the components and high quality plated G-10 PC Boards are provided.
X-TRA CARE IN OESIGN: Easy Assembly! Large open layout.
X-CELLENCE IN IOEAS: 5 years of designed products for the amateur radio market.
X-CELLENCE IN INSTRUCTIONS: Clear step-by-step instructions with quality illustrations and schematic.
X-TRA FEATURES: There has never been a clock kit with so many features — at any price!

- Unit operates on either **12 VAC** or **12 VOC.**
- On board **QUARTZ XTAL TIMEBASE** or 60Hz AC line freq. can be used.
- Automatic **BATTERY BACKUP***
- Reads true **24 HOUR TIME** and **31 OAY CALENOAR.**
- Unique **NOX™ CIRCUIT activates readouts with a handclap followed by the date for 4 seconds. Or they can be turned on constantly.**
- When used mobile readouts blank whe ignition is off.
- Special **NOISE SUPPRESSION** and battery reversal circuits.
- Bright 1/2" LED's show hours, minute and seconds.

WITH CALENDAR AND NOX™ CIRCUIT

19.95

LESS CASE

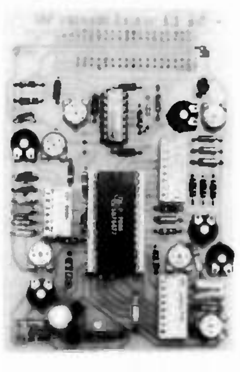
ACCESSORIES

Custom High Impact Molded Case with Ruby Lens. Available in Blue or Tan.
$6.50

117 VAC to 12 VAC Transformer.
$1.35

*9V Battery Not Included

LM395 High gain power transistor with built in current limiting, power limiting and thermal overload making it virtually impossible to destroy with overload. VCEO = 36V IC = 2A HFe 3000. Will drive directly off TTL and CMOS. **1.65**



Sound Effects Kit $18.50

The **SE-01 Sound Effects Kit** is a complete kit; all you need to build a programmable sound effects machine except a battery and speaker. Our kit is designed to really ring out the **TI 76477** Sound Chip. Only the SE-01 provides you with additional circuitry that includes a **PULSE GENERATOR, MUX OSCILLATOR and COMPARITOR** to make more complex sounds a snap. We help you in building the kit with a clear, easy-to-follow construction manual and we show you how to easily program the unit. Other dealers will sell you the chip or a "kit" of parts but you are on your own to do the most difficult part...make neat sounds! Within a short time after you build the SE-01 you can easily create **Gunshots, Explosions, Space Sounds, Steam Trains** and much more. We think the Bullet SE-01 is the best deal on the market but don't ask us. — ask the **15,000** happy SE-01 owners!

Complete Kit With Quality Plated PC Board **$18.50**
(Less battery & speaker)

Users Group Notes: Includes additional programming charts plus quarterly updates **$5.00**

7 WATT AUDIO AMP KIT

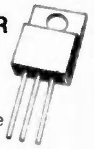
SMALL SINGLE HYBRID IC AND COMPONENTS FIT ON A 2" x 3" PC BOARD (INCLUDED) RUNS ON 12VDC GREAT FOR ANY PROJECT THAT NEEDS AN INEXPENSIVE AMP LESS THAN 3% THD @ 5 WATTS. COMPATIBLE WITH SE-01 SOUND KIT **$5.95**

TRANSFORMER

A good transformer for TTL, linear, and smaller computer sytems.
Primary: 117VAC Sec #1: 15V@1A
Sec #2: 15V@1A Sec #3: 8V@2A
Size: 2x3x2.25 Wt. 1.5 lbs
Construction: Open Frm w/Mt flang; wire leads
Order BET-0005
$2.95

200V 4A SCR

Sensitive Gate
7/$1.00
Special Purchase
Order BES-0025



THE PERFECT TRANSFORMER

117VAC primary. 12VAC secondary @ 200ma Great for all you CMOS, or low power TTL projects. PC board mount.
99¢ ea. 3/$2.50
Size: 1.5" W x 1.25" D x 1.25" H

AY3-8910 PROGRAMMABLE SOUND GENERATOR

The AY3-8910 is a 40 pin LSI chip with three oscillators, three amplitude controls, programmable noise generator, three mixers, an envelope generator, and three D/A converters that are controlled by 8 BIT WORDS. No external pots or caps required. This chip hooked to an 8 bit microprocessor chip or Buss (8080, Z80, 6800 etc.) can be software controlled to produce almost any sound. It will play three note chords, make bangs, whistles, sirens, gunshots, explosions, bleets, whines, or grunts. In addition, it has provisions to control its own memory chips with two IO ports. The chip requires +5V @ 75ma and a standard TTL clock oscillator. A truly incredible circuit.

$14.95 W/Basic Spec Sheet (4 pages)
60 page manual with S-100 interface instructions and several programming examples, **$3.00 extra**

OVP-2 OVERVOLTAGE PROTECTOR 6.95

Provides cheap insurance for your expensive equipment. Trip voltage is adjustable from 3 to 30 volts. Overvoltage instantly fires a 25A SCR and shorts the output to protect equipment. Should be used on units that are fused. Directly compatible with the PS 12 and PS-14. All electronics supplied. Drilled and plated PC board.

PARTS

LM3046	(CA3046) Xistor Array	.75
RCA 40430	400V 6A TRIAC TO-66	.75
LM567	Tone Decoder	.99
CO4046	PLL CMOS	.99
LM3302	Quad Comparator	.89
2SC 1849	High Freq. NPN TO-92	6/1.00
MPS A 20	NPN General Purpose	8/1.00
TL490	Bar/Graph Driver w/specs	2.50
7812	12V 1A Regulator	.99
7805	5V 1A Regulator	.99
78M05	5V ½A Reg. TO-5 (Hse #)	.60
LM3911	Temp. Transducer w/specs	1.10
555	Timer IC	.49
2N6028	P.U.T. w/specs	.50
IL-1	Ooto Isolator w/specs	.60
LM380	2W Audio IC w/specs	.50
LM377	Dual LM380 w/specs	1.09
TIP-30	PNP Power TO-220	3/1.00
SCR	Sensitive Gate 200V 4A	7/1.00
SCR	Sensitive Gate 600V 4A RCA	3/1.00
LM317	Variable Reg. 3-35V 1A w/specs	1.69
OIAC	Trigger diode for triacs in AC phase control operation	.29

NEW! MUSIC FOR YOUR EARS

Bullet's **Electronic Music Machine™ Kit** has a single **28 Pin Microprocessor Chip with ROM** that has been programmed to play the first 6 to 10 notes of the **25 popular** tunes listed below. Each tune can easily be addressed individually or played sequencially at the push of a button. The 3 chime sequences are activated at any time by separate switch closures so when used as a doorbell, one door can play songs while two others will play different chimes. The unit has a **5 watt audio Amp and will run on either 12VAC or 12VDC.** Optional 117VAC transformer is available. Construction is very simple, works with any 8 or 16 ohm speaker, or horn speaker. (Not Included.) Tunes can be remotely programmed using a single rotary switch. (not included), if desired.

Complete Kit $16.95 **Transformer $1.35**
For Operation on 117VAC

Tunes: Toreador * William Tell * Hallelujah Chorus * Star Spangled Banner * Yankee Doodle * America, America * Deutschland Leid * Wedding March * Beethoven's 5th and 9th * Hell's Bells * La Vien En Rose * Star Wars Theme * Clementine * Augustine * Jingle Bells * God Save The Queen * Colonel Bogey * Marseillaise * O Sole Mio * Santa Lucia * The End * Blue Danube * Brahms Lullaby * Westminister Chime * Simple Chime * Descending Octave Chime.

★ CALL OR WRITE TODAY FOR FREE CATALOG ★

POLICIES

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- ADD 5% FOR SHIPPING
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- TEX. RES. ADD 5% TAX
- FOREIGN ORDERS (EXCEPT CANADA) ADD 10% (20% FOR AIRMAIL).

NEW RADAR DETECTOR BOARDS

#1 - Includes 3 - 741 op amps. 1NE555 Timer, and 1 - LM311 — **$ 2/1.00**

#2 - Includes 1 - NE567 PLL. 1NE555 Timer, 1 - 5634 Low Noise op amp for high quality audio, 2 - 741 op amps, and 1 - 78M08 voltage Regulator: 8V. 500MA. — **$ .75 Each or 3/2.00**

Each of these boards contain many other parts too numerous to list.

CUSTOM IC #17564-4

Has a C-MOS oscillator, Decade Counter Decoder/Driver. At the push of a button will flash a LED 24 times. At the end of which it will display the number of times it has gone through the cycle, up to 99. Variable speed pulses - Perfect for timing. FULL DATA — **$1.00**

★ ★ ★ ★ ★ ★ CABLE TIES ★ ★ ★ ★ ★ ★

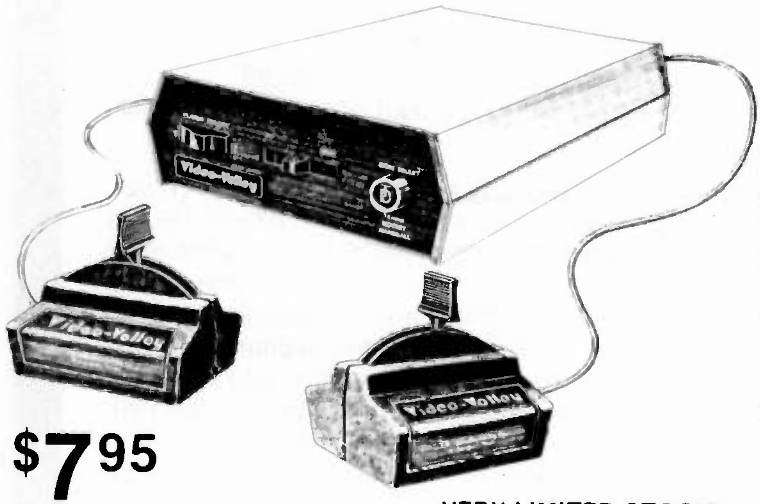
MAKE YOUR PROJECTS "NEAT & TIDY." 4" CABLE TIES AT A FANTASTIC PRICE. GET THIS BARGAIN AND "TIE" IT DOWN. **$2.00 for 100 or better yet $15.00 for 1000**

Video-Volley™

SEND FOR CATALOG WITH SUPER SAVINGS!!

Introductory Offer

BRAND NEW!



$7.95

VERY LIMITED STOCK!

A Full Color* TV Game For The Family

Six exciting TV Games — Hockey, Tennis and Handball with one or two player capability for each game. Ball velocity doubles after the fourth player hit for an increasingly competitive game.

Adjustable paddle size for each player allows for handicapped play if desired. Paddles can give automatic ball spin with seven possible angles of ball deflection.

Automatic digital scoring appears after each point is scored. Game ceases automatically after one player scores 15 points. Serving is from the paddle of player who scored the last point, thus server can "place" his shot.

Video-Volley is designed to be installed, with a minimum of effort, to any standard television receiver, either color or black and white. Batteries are not required.

Small hand-held player modules with 15 foot cord length provides more comfort and versatility for players.

The compact command module sits atop the television receiver and has front panel control allowing effortless change from normal television reception to game play. Easy disconnection of the player hand-held modules facilitates easy set-up and take-down for storage.

OPCOA CLOCK #R1200 AC

12 Hour Format. 12 Volt Operation. .3 Inch Display. Has Radio (Alarm) Output. Complete with On-Board Switches and 4 Pin connection for easy hook up. With Data.

Add 60Hz Time Base for DC Operation.

SUPER SPECIAL 2/8.00 or $4.28 each

Plug in transformer and all parts to make clock operational $2.20.

M3-6501

256 By 4 CMOS Ram. By Harris. Super Low Current Drain! Data retention Voltage 2 Volts. Great for battery power or back-up.

$1.99 each

5 VOLT REED RELAY

An ablsolutely fantastic item. Compare this price with any advertiser. **While They Last!** Normally Open. SPST. Turns on at 10 MA. Drops out at 5 MA.

***SUPER SPECIAL!* 2/1.20 or 10/4.00**

LAB-BENCH VARIABLE POWER SUPPLY KIT

$12.00 KIT SUPER SALE

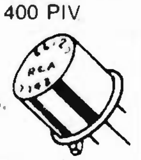
5 to 20 VDC at 1 AMP. Short circuit protected by current limit. Uses IC regulator and 10 AMP Power Darlington. Very good regulation and low ripple. Kit includes PC Board, all parts, large heatsink and shielded transformer. 50 MV. TYP. Regulation.

RCA SENSITIVE GATE TRIAC

TO-5 CASE. HOUSE #40531 ALSO SAME AS T2300D. 2.5 AMPS 400 PIV

5/$1.19

Perfect for Dimmers, Color Organs, etc. PC LEADS



SPECIAL 1 MONTH ONLY! $3.95

60 Hz CRYSTAL TIME BASE
(Complete Kit)

Uses MM5369 CMOS divider IC with high accuracy 3.579545 MHZ Crystal. Use with all MOS CLock Chips or Modules. Draws only 1.5 MA. All parts, data and PC Board included. 100 Hz. same as above except $5.95.

D.C. HORN

VERY LOUD! 6-12 VDC Like Used In Smoke Alarms. FANTASTIC SAVINGS. Compare this true value.

.60 ea. 4 For $2.00

PMD-11K-60 (Darlington)

60 Volts. HFE 800-20K 12 Amps. PNP TO-3 150 Watts. By Lambda.

$1.50 BRAND NEW!

Crystal Super Savings

4.433618 MHZ

2/$1.10

NATIONAL SEMICONDUCTOR

"COLOSSUS JR." JUMBO CLOCK MODULE

MA1013 BRAND NEW!

$8.50 (2 FOR $15)

(AC XFMR $1.95)

- Bright 4 digit 0.7" LED Display
- Complete-Add only Transformer and Switches
- 24 Hour Alarm Signal Output
- 12 Hour Real Time Format
- 50 or 60 Hz Operation
- Power Failure Indication
- LED Brightness Control
- Sleep and Snooze Timers
- Alarm "on" and PM Indicators
- Direct Drive - No RFI
- Direct Replacement for MA1012
- Comes with Full Data

ASSEMBLED! NOT A KIT!

MANUFACTURER'S CLOSEOUT!

PERFECT FOR USE WITH A TIMEBASE.

REPEAT OF A SELL-OUT!

VECO PRECISION THERMISTOR. GLASS TYPE. VECO #41A72. 8.2K OHMS AT ROOM TEMP. **VERY** SENSITIVE. INDIVIDUALLY PACKAGED IN PLASTIC VIALS. $3.00 VALUE

$1.00 each or 3 FOR $2.50

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(OF TEXAS)

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4027	4K x 1 Dynamic Ram	2.99
2117/4116	16K x 1 Dynamic Ram	5.00
2732-6	32K Eprom	39.95

C.P.U.'s, Etc.

MC6800P	Microprocessor	9.99
MC68B21P	PIA	6.99
MC6845P	CRT Controller	25.00
MC6850P	ACIA	4.99
MC6852P	SSDA	5.00
8008-1	Microprocessor	5.00
8080A	Microprocessor	5.00
Z80A	Microprocessor	10.99
Z80	Microprocessor	8.99
Z80A	PIO	9.99
Z80	SIO/0	22.50
Z80	SIO/1	22.50
8212	8 Bit input/output part	3.99
8251	Communication Interface	6.99
TR1602/AY5-1013	UART	6.99
TMS1000NL	Four Bit Microprocessor	4.99
PT1482B	PSAT	5.99
8257	DMA Controller	8.99
3341	64 x 4 FIFO	3.00
MM5316/F3817	Clock with alarm	5.99
8741		60.00
8748	8 Bit Microcomputer with programmable/ erasable EPROM	60.00
MC1408L/6	6 Bit D/A	3.25
COM2502		9.99
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CRYSTAL FILTERS
TYCO 001-19880 Same as 2194F
10.7 MHz narrow band
3 dB bandwidth 15 KHz min.
20 dB bandwidth 60 KHz min.
40 dB bandwidth 150 KHz min.
Ultimate 50 dB insertion loss 1 dB max.
Ripple 1 dB max. Ct. 0+/-5 pf 3600 Ohms
$3.99 each

MRF454, same as MRF458 12.5 VDC, 3-30 MHz
80 Watts output, 12 dB gain $17.95 each

MRF472
12.5 VDC, 27 MHz
4 Watts output, 10 dB gain
$1.69 each

CARBIDE CIRCUIT BOARD DRILL BITS
for PCB Boards
5 mix for $5.00

MURATA CERAMIC FILTERS

SFD 455D	455 KHz	$2.00
SFB 455D	455 KHz	1.60
CFM 455E	455 KHz	5.50
SFE 10.7 MA	10.7 MHz	2.99

ATLAS CRYSTAL FILTERS FOR ATLAS HAM GEAR
5.52 - 2.7/8
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YOUR CHOICE $12.99 each

J310 N-CHANNEL J-FET 450 MHz
Good for VHF/UHF Amplifier,
Oscillator and Mixers 3/$1.00

AMPHENOL COAX RELAY
26 VDC Coil SPDT #360-11892-13
100 Watts Good up to 18 GHz
$19.99 each

78M05 Same as 7805 but only ½ Amp @ 5 VDC 49¢ each or 10/$3.00

NEW TRANSFORMERS

F-18X	6.3 VCT @ 6 Amps	$6.99 ea.
F-46X	24 V @ 1 Amp	5.99 ea.
F-41X	25.2 VCT @ 2 Amps	6.99 ea.
P-8380	10 VCT @ 3 Amps	7.99 ea.
P-8604	20 VCT @ 1 Amp	4.99 ea.
P-8130	12.6 VCT @ 2 Amps	4.99 ea.
K-32B	28 VCT @ 100 MA	4.99 ea.
E30554	Dual 17V @ 1Amp ea.	6.99 ea.

EIMAC FINGER STOCK #Y-302
36 in. long x ½ in. $4.99 each

NO ORDERS UNDER $10

ramsey the first name in Counters !

9 DIGITS 600 MHz $129.95 WIRED

PRICES

CT-90 wired, 1 year warranty	$129.95
CT 90 Kit, 90 day parts warranty	109.95
AC-1 AC adapter	3.95
BP-1 Nicad pack + AC Adapter/Charger	12.95
OV-1, Micro-power Oven time base	49.95
External time base input	14.95

The CT-90 is the most versatile, feature packed counter available for less than $300.00! Advanced design features include: three selectable gate times, nine digits, gate indicator and a unique display hold function which holds the displayed count after the input signal is removed! Also, a 10mHz TCXO time base is used which enables easy zero beat calibration checks against WWV. Optionally, an internal nicad battery pack, external time base input and Micro-power high stability crystal oven time base are available. The CT-90, performance you can count on!

SPECIFICATIONS:

Range:	20 Hz to 600 MHz
Sensitivity:	Less than 10 MV to 150 MHz Less than 50 MV to 500 MHz
Resolution:	0.1 Hz (10 MHz range) 1.0 Hz (60 MHz range) 10.0 Hz (600 MHz range)
Display:	9 digits 0.4" LED
Time base:	Standard-10.000 mHz, 1.0 ppm 20-40°C. Optional Micro-power oven-0.1 ppm 20-40°C
Power:	8-15 VAC @ 250 ma

7 DIGITS 525 MHz $99.95 WIRED

SPECIFICATIONS:

Range:	20 Hz to 525 MHz
Sensitivity:	Less than 50 MV to 150 MHz Less than 150 MV to 500 MHz
Resolution:	1.0 Hz (5 MHz range) 10.0 Hz (50 MHz range) 100.0 Hz (500 MHz range)
Display:	7 digits 0.4" LED
Time base:	1.0 ppm TCXO 20-40°C
Power:	12 VAC @ 250 ma

The CT-70 breaks the price barrier on lab quality frequency counters. Deluxe features such as: three frequency ranges - each with pre-amplification, dual selectable gate times, and gate activity indication make measurements a snap. The wide frequency range enables you to accurately measure signals from audio thru UHF with 1.0 ppm accuracy - that's .0001%! The CT-70 is the answer to all your measurement needs, in the field, lab or ham shack.

PRICES:

CT-70 wired, 1 year warranty	$99.95
CT-70 Kit, 90 day parts warranty	84.95
AC-1 AC adapter	3.95
BP-1 Nicad pack + AC adapter/charger	12.95

7 DIGITS 500 MHz $79.95 WIRED

PRICES:

MINI-100 wired, 1 year warranty	$79.95
MINI-100 Kit, 90 day part warranty	59.95
AC-Z Ac adapter for MINI-100	3.95
BP-Z Nicad pack and AC adapter/charger	12.95

Here's a handy, general purpose counter that provides most counter functions at an unbelievable price. The MINI-100 doesn't have the full frequency range or input impedance qualities found in higher price units, but for basic RF signal measurements, it can't be beat! Accurate measurements can be made from 1 MHz all the way up to 500 MHz with excellent sensitivity throughout the range, and the two gate times let you select the resolution desired. Add the nicad pack option and the MINI-100 makes an ideal addition to your tool box for "in-the-field" frequency checks and repairs.

SPECIFICATIONS:

Range:	1 MHz to 500 MHz
Sensitivity:	Less than 25 MV
Resolution:	100 Hz (slow gate) 1.0 KHz (fast gate)
Display:	7 digits, 0.4" LED
Time base:	2.0 ppm 20-40°C
Power:	5 VDC @ 200 ma

8 DIGITS 600 MHz $159.95 WIRED

NEW READ RECEIVER FREQUENCY

SPECIFICATIONS:

Range:	20 Hz to 600 MHz
Sensitivity:	Less than 25 mv to 150 MHz Less than 150 mv to 600 MHz
Resolution:	1.0 Hz (60 MHz range) 10.0 Hz (600 MHz range)
Display:	8 digits 0.4" LED
Time base:	2.0 ppm 20-40°C
Power:	110 VAC or 12 VDC

The CT-50 is a versatile lab bench counter that will measure up to 600 MHz with 8 digit precision. And, one of its best features is the Receive Frequency Adapter, which turns the CT-50 into a digital readout for any receiver. The adapter is easily programmed for any receiver and a simple connection to the receiver's VFO is all that is required for use. Adding the receiver adapter in no way limits the operation of the CT-50, the adapter can be conveniently switched on or off. The CT-50, a counter that can work double-duty!

PRICES:

CT-50 wired, 1 year warranty	$159.95
CT-50 Kit, 90 day parts warranty	119.95
RA-1, receiver adapter kit	14.95
RA-1 wired and pre-programmed (send copy of receiver schematic)	29.95

DIGITAL MULTIMETER $99.95 WIRED

PRICES:

DM-700 wired, 1 year warranty	$99.95
DM-700 Kit, 90 day parts warranty	79.95
AC-1, AC adaptor	3.95
BP-3, Nicad pack +AC adapter/charger	19.95
MP-1, Probe kit	2.95

The DM-700 offers professional quality performance at a hobbyist price. Features include; 26 different ranges and 5 functions, all arranged in a convenient, easy to use format. Measurements are displayed on a large 3½ digit, ½ inch LED readout with automatic decimal placement, automatic polarity, overrange indication and overload protection up to 1250 volts on all ranges, making it virtually goof-proof! The DM-700 looks great, a handsome, jet black, rugged ABS case with convenient retractable tilt bail makes it an ideal addition to any shop.

SPECIFICATIONS:

DC/AC volts:	100uV to 1 KV, 5 ranges
DC/AC current	0.1 uA to 2.0 Amps, 5 ranges
Resistance:	0.1 ohms to 20 Megohms, 6 ranges
Input impedance:	10 Megohms, DC/AC volts
Accuracy:	10.1% basic DC volts
Power:	4 'C' cells

AUDIO SCALER

For high resolution audio measurements, multiplies UP in frequency.

- Great for PL tones
- Multiplies by 10 or 100
- 0.01 Hz resolution!

$29.95 Kit $39.95 Wired

ACCESSORIES

Telescopic whip antenna - BNC plug	$ 7.95
High impedance probe, light loading	15.95
Low pass probe, for audio measurements	15.95
Direct probe, general purpose usage	12.95
Tilt bail, for CT 70, 90, MINI-100	3.95
Color burst calibration unit, calibrates counter against color TV signal	14.95

COUNTER PREAMP

For measuring extremely weak signals from 10 to 1,000 MHz. Small size, powered by plug transformer-included.

- Flat 25 db gain
- BNC Connectors
- Great for sniffing RF with pick-up loop

$34.95 Kit $44.95 Wired

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INTRODUCING SONY'S NEW DIGITAL DIRECT ACCESS RECEIVER!

A Whole New Breed Of Radio

Innovative design. Advanced technology. Digital key-touch tuning. The ICF-2001. It's a whole new breed of radio. A receiver that supplants the conventional multi-band concept, receiving a wide amplitude-modulated frequency range–shortwave, mediumwave and most longwave broadcasts. Plus FM, SSB and CW. Even more important, the 2001 replaces the ordinary tuning knob and dial with a direct-access tuning keyboard and a Liquid Crystal Display (LCD) for digital frequency readout. Which make the unit as easy to use as a pocket calculator. Instant, direct-access tuning modes and six memory-station presets assure maximum ease of use. And the quartz-crystal, frequency-synthesized circuitry behind them assures outstanding reception. Reception of local broadcasts and exciting news, music, sports, entertainment and information from around the world. You'll get the inside, local news stories from foreign countries ... exclusive coverage of world sports events ... plus everything from informal "ham" to marine communications. All at your fingertips.

Key-Touch Tuning

To tune a station manually, you simply punch in the station frequency numerals on the direct-access, digital tuning keyboard. Press the "Execute" key and the command is entered, the station is received and LCD readout confirms tuning. If you punch in an incorrect frequency by mistake, the ICF-2001 tells you to "Try Again" by flashing those words on the display. The instant, fingertip tuning provides total accuracy and convenience. And the LCD digital frequency display confirms the exact, drift-free signal reception.

Automatic Scanning

In auto-scan mode, the tuner can be set for continuous scanning of a given frequency range, which you set by means of upper and lower limit keys designated "L_1" and "L_2." You may want to scan an entire frequency range. For instance, the 76 to 108 MHz FM spectrum. If you want scanning to stop at any strong signal–one that reads "4" or "5" on the LED signal-strength indicator– switch on "Scan Auto Stop." For continuous scanning, leave the switch off, and just press the "Start/Stop" key to listen to a station or resume scanning.

Manual Tuning

Like the auto-scanning mode, manual tuning is useful for quick signal searching when you don't know particular station frequencies within a given range. You simply press the "Up" or "Down" key, and the tuner does the searching for you. And if you press the "Fast" key at the same time, the scanning rate increases for especially rapid station location. When you hear a broadcast you want to receive, just release the keys for instant reception, presssing the "Up" or "Down" key again if necessary for exact tuning.

Memory Presets

After you've tuned a station using punch-in, key-touch tuning or either scanning mode, you can enter it in the 2001's memory for instant, one-touch preset reception. Which means no retuning hard-to-find foreign broadcasts. Plus instant access to your favorite local stations for music and news. Six preset buttons allow up to six stations–in any wave range–to be memorized. And there's LCD digital readout of the memory buttons being used on each band. What's more, the upper and lower limit keys can be used as memory presets when they're not being used for scanning, allowing a total of eight frequencies to be memorized for instant, one-touch reception.

Frequency Synthesis

The 2001's direct-access tuning and outstanding reception quality are made possible by the unit's all-band quartz-crystal, PLL frequency synthesis. Instead of the conventional analog tuning system, with its variable tuning capacitor, the 2001 incorporates an LSI and a quartz-crystal reference oscillator. Which means that the local-oscillator frequencies used in superheterodyning are locked to the "synthesized" quartz reference frequencies. The result is the utmost in tuning stability, without a trace of tuning drift. In addition, dual-conversion superheterodyning for AM assures exceptionally clean, clear reception across the entire 150-to-29,999kHz spectrum.

Features

- FM/AM/SSB/CW/wide spectrum coverage
- Dual-conversion superheterodyne circuitry of AM assures high sensitivity and interference rejection
- Quartz-crystal, phase-locked-loop frequency synthesis for all bands assures the utmost tuning stability, without a trace of tuning drift
- Direct-access, digital tuning keyboard and LCD digital frequency readout for quick, key-touch station selection–maximum accuracy and ease of use
- Manual tuning and automatic scanning for effortless signal searching, easy DXing
- 6-station presets, plus 2 auxiliary presets, for instant reception of memorized stations on any band–plus LCD memory indication.
- 5-step LED signal-strength indicator
- Local/Normal/DX sensitivity selector for AM
- SSB/CW compensator for low-distortion reception
- Telescopic antenna, plus external antenna included
- 4" speaker for full, rich sound
- Slide-bar bass and treble controls
- Sleep timer–with LCD readout–can be set in 10-minute increments for up to 90 minutes of play before automatic radio shut-off

Only $299 95

Plus $5.00 S&H (Cont'l U.S.A. Only)

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SPECTRONICS, INC. — 1009 GARFIELD ST., OAK PARK, ILL.-60304

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MICROCOMPUTER CONTROLLED

SUPERIOR COMMERCIAL GRADE

10 METER

FM TRANSCEIVER

FALL SALE 239.00

COMPARE THESE FEATURES WITH ANY UNIT AT ANY PRICE

- **FREQUENCY RANGE:** Receive and transmit: 28.000 to 29.995 MHz, 10KHz steps with built-in + 100 KHz repeater offset.
- **ALL SOLID STATE-CMOS PL DIGITAL SYNTHESIZED.**
- **SIZE:** UNBELIEVABLE! ONLY 6 3/4" x 2 3/8" x 9 3/4". COMPARE!
- **MICROCOMPUTER CONTROLLED:** All scanning and frequency-control functions are performed by microcomputer.
- **DETACHABLE HEAD:** The control head may be separated from the radio for use in limited spaces and for security purposes.
- **SIX-CHANNEL MEMORY:** Each memory is re-programmable. Memory is retained even when the unit is turned off.
- **MEMORY SCAN:** The six channels may be scanned in either the "busy" or "vacant" modes for quick, easy location of an occupied or unoccupied frequency. AUTO RESUME. COMPARE!
- **FULL-BAND SCAN:** All channels may be scanned in either "busy" or "vacant" mode. This is especially useful for locating repeater frequencies in an unfamiliar area. AUTO RESUME. COMPARE!
- **INSTANT MEMORY-1 RECALL:** By pressing a button on the microphone or front panel, memory channel 1 may be recalled for immediate use.
- **MIC-CONTROLLED VOLUME AND SQUELCH:** Volume and squelch can be adjusted from the microphone for convenience in mobile operation.
- **DIRECT FREQUENCY READOUT:** LED display shows operating frequency, NOT channel number. COMPARE!
- **TEN (10) WATTS OUTPUT:** Also 1 watt low power for shorter distance communications. LED readout displays power selection when transmitting.
- **DIGITAL S/RF METER:** LEDs indicate signal strength and power output. No more mechanical meter movements to fall apart!
- **LARGE ½-INCH LED DISPLAY:** Easy-to-read frequency display minimizes "eyes-off-the-road" time.
- **PUSHBUTTON FREQUENCY CONTROL FROM MIC OR FRONT PANEL:** Any frequency may be selected by pressing a microphone or front-panel switch.
- **SUPERIOR RECEIVER SENSITIVITY:** 0.28 uV for 20-dB quieting. The squelch sensitivity is superb, requiring less than 0.1 uV to open. The receiver audio circuits are designed and built to exacting specifications, resulting in unsurpassed received-signal intelligibility.
- **TRUE FM, NOT PHASE MODULATION:** Transmitted audio quality is optimized by the same high standard of design and construction as is found in the receiver. The microphone amplifier and compression circuits offer intelligibility second to none.
- **OTHER FEATURES:** Dynamic Microphone, built in speaker, mobile mounting bracket, external remote speaker jack (head and radio) and much, much more. All cords, plugs, fuses, microphone hanger, etc. included. Weight 6 lbs.
- **ACCESSORIES:** 15' REMOTE CABLE....$35.00 FMPS-4R A/C POWER SUPPLY....$39.95. TOUCHTONE MIC. KIT....$39.95. EXTERNAL SPEAKER....$18.00.

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We now have available a bunch of goodies too good to bypass. Items are limited so order today

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TERMS: Satisfaction guaranteed or money refunded. C.O.D. add $2.00. Minimum order $6.00. Orders under $10.00 add $1.50. Add 5% for postage, insurance, handling. Overseas add 15%. N.Y. residents add 7% tax.

MINI KITS - YOU HAVE SEEN THESE BEFORE NOW HERE ARE OLD FAVORITE AND NEW ONES TOO. GREAT FOR THAT AFTERNOON HOBBY.

FM MINI MIKE

A super high performance FM wireless mike kit! Transmits a stable signal up to 300 yards with exceptional audio quality by means of its built in electret mike. Kit includes case, mike, on-off switch, antenna, battery and super instructions. This is the finest unit available.

FM-3 Kit $14.95
FM-3 Wired and Tested 19.95

Color Organ

See music come alive! 3 different lights flicker with music. One light each for, high, mid-range and lows. Each individually adjustable and drives up to 300 W. runs on 110 VAC.

Complete kit, ML-1
$8.95

Video Modulator Kit

Converts any TV to video monitor. Super stable, tunable over ch 4-6. Runs on 5-15V, accepts std. video signal. Best unit on the market! Complete kit, VD-1 $7.95

Led Blinky Kit

A great attention getter which alternately flashes 2 jumbo LEDs. Use for name badges, buttons, warning panel lights, anything! Runs on 3 to 15 volts.
Complete kit, BL-1
$2.95

Super Sleuth

A super sensitive amplifier which will pick up a pin drop at 15 feet! Great for monitoring baby's room or as general purpose amplifier. Full 2 W rms output, runs on 6 to 15 volts, uses 8-45 ohm speaker.
Complete kit, BN-9
$5.95

CPO-1

Runs on 3-12 Vdc 1 watt out, 1 KHZ good for CPO, Alarm, Audio Oscillator. Complete kit $2.95

CLOCK KITS

Your old favorites are here again. Over 7,000 Sold to Date. Be one of the gang and order yours today!

Try your hand at building the finest looking clock on the market. Its satin finish anodized aluminum case looks great anywhere, while six .4" LED digits provide a highly readable display. This is a complete kit, no extras needed, and it only takes 1-2 hours to assemble. Your choice of case colors: silver, gold, black (specify).

Clock kit, 12/24 hour, DC-5	$24.95
Clock with 10 min. ID timer, 12/24 hour, DC-10	$29.95
Alarm clock, 12 hour only, DC-8	$29.95
12V DC car clock, DC-7	$29.95

For wired and tested clocks add $10.00 to kit price.
SPECIFY 12 OR 24 HOUR FORMAT

FM Wireless Mike Kit

Transmits up to 300' to any FM broadcast radio, uses any type of mike. Runs on 3 to 9V. Type FM-2 has added sensitive mike preamp stage.

FM-1 kit $3.95 FM-2 kit $4.95

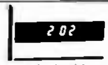
Whisper Light Kit

An interesting kit, small mike picks up sounds and converts them to light. The louder the sound, the brighter the light. Includes mike, controls up to 300 W, runs on 110 VAC.
Complete kit, WL-1
$6.95

Tone Decoder

A complete tone decoder on a single PC board. Features: 400-5000 Hz adjustable range via 20 turn pot, voltage regulation, 567 IC. Useful for touch-tone burst detection, FSK, etc. Can also be used as a stable tone encoder. Runs on 5 to 12 volts.
Complete kit, TD-1 $5.95

Car Clock



The UN-KIT, only 5 solder connections

Here's a super looking, rugged and accurate auto clock, which is a snap to build and install. Clock movement is completely assembled — you only solder 3 wires and 2 switches, takes about 15 minutes! Display is bright green with automatic brightness control photocell — assures you of a highly readable display, day or night. Comes in a satin finish anodized aluminum case which can be attached 5 different ways using 2 sided tape. Choice of silver, black or gold case (specify).

OC-3 kit, 12 hour format $22.95
DC-3 wired and tested $29.95

Universal Timer Kit

Provides the basic parts and PC board required to provide a source of precision timing and pulse generation. Uses 555 timer IC and includes a range of parts for most timing needs.

UT-5 Kit $5.95

Mad Blaster Kit

Produces LOUD ear shattering and attention getting siren like sound. Can supply up to 15 watts of obnoxious audio. Runs on 6-15 VDC.

MB-1 Kit $4.95

Siren Kit

Produces upward and downward wail characteristic of a police siren. 5 W peak audio output, runs on 3-15 volts, uses 3-45 ohm speaker.
Complete kit, SM-3 $2.95

60 Hz Time Base

Runs on 5-15 VDC. Low current (2.5ma) 1 min/month accuracy TB-7 Kit $5.50
TB-7 Assy $9.95

Calendar Alarm Clock

The clock that's got it all: 6-.5" LEDs, 12/24 hour, snooze, 24 hour alarm, 4 year calendar, battery backup, and lots more. The super 7001 chip is used. Size: 5x4x2 inches. Complete kit, less case (not available)
DC-9 $34.95

Under Dash Car Clock

12/24 hour clock in a beautiful plastic case features 6 jumbo RED LEDS, high accuracy (.001%), easy 3 wire hookup, display blanks with ignition and super instructions. Optional dimmer aluomatically adjusts display to ambient light level.

OC-11 clock with mtg. bracket $27.95 kit
OM-1 dimmer adapter $2.50
Add $10.00 Assy. and Test

Video Terminal

A completely self-contained, stand alone video terminal card. Requires only an ASCII keyboard and TV set to become a complete terminal unit. Features are: single 5V supply, XTAL controlled sync and baud rates (to 9600), complete computer and keyboard control of cursor. Parity error control and display. Accepts and generates serial ASCII plus parallel keyboard input. The 6416 is 64 char. by 16 lines, with scrolling, upper and lower case (optional) and has RS-232 and 20ma loop interfaces on board. Kits include sockets and complete documentation.

RE 6416 terminal card kit (add $60.00 for wired unit)	$189.95
Lower Case option	$13.95
Power Supply	$14.95
RF Modulator kit	$7.95

PARTS PARADE

IC SPECIALS

LINEAR

301	$ .35
324	$1.50
380	$1.50
555	$ .45
556	$1.00
565	$1.00
566	$1.00
567	$1.25
741	10/$2.00
1458	$ .50
3900	$ .50
3914	$2.95
8038	$2.95

TTL

74S00	$ .40
7447	$ .65
7475	$ .50
7490	$ .50
74196	$1.35

SPECIAL

11C90	$15.00
10116	$ 1.25
7208	$17.50
7207A	$ 5.50
7216D	$21.00
7107C	$12.50
5314	$ 2.95
5375AB/G	$ 2.95
7001	$ 6.50

CMOS

4011	.50
4013	.50
4046	$1.85
4049	.50
4059	$9.00
4511	$2.00
4518	$1.35
5639	$1.75

FERRITE BEADS

With info and specs 15/$1.00
6 Hole Balun Beads 5/$1.00

READOUTS

FND 359 .4" C.C.	$1.00
FND 507/510 .5" C.A.	1.00
MAN 72/HP7730 .33" C.A.	1.00
HP 7651 .43" C.A.	2.00

Sockets

8 Pin	10/$2.00
14 Pin	10/$2.00
16 Pin	10/$2.00
24 Pin	4/$2.00
28 Pin	4/$2.00
40 Pin	3/$2.00

TRANSISTORS

2N3904 NPN C-F	15/$1.00
2N3906 PNP C-F	15/$1.00
2N4403 PNP C-F	15/$1.00
2N4410 NPN C-F	15/$1.00
2N4916 FET C-F	4/$1.00
2N5401 PNP C-F	5/$1.00
2N6028 C-F	4/$1.00
2N3771 NPN Silicon	$1.50
2N5179 UHF NPN	3/$2.00
Power Tab NPN 40W	3/$1.00
Power Tab PNP 40W	3/1.00
MPF 102/2N5484	$.50
NPN 3904 Type T-R	50/$2.50
PNP 3906 Type T-R	50/$2.50
2N3055	$.80
2N2646 UJT	3/$2.00

Diodes

5.1 V Zener	20/$1.00
1N914 Type	50/$1.00
1KV 2Amp	8/$1.00
100V 1Amp	15/$1.00

25 AMP 100V Bridge
$1.50 each

Mini-Bridge 50V 1 AMP
2 for $1.00

Resistor Ass't

Assortment of Popular values - ¼ watt. Cut lead for PC mounting, ½" center, ½" leads, bag of 300 or more. $1.50

Crystals

3.579545 MHZ	$1.50
10.00000 MHZ	$5.00
5.248800 MHZ	$5.00

Switches

Mini toggle SPDT $1.00
Red Pushbuttons N.O. 3/$1.00

AC Adapters

Good for clocks, nicad chargers, all 110 VAC plug one end

8.5 vdc @ 20 mA	$1.00
16 vac @ 160mA	$2.50
12 vac @ 250mA	$3.00

Earphones

3" leads, 8 ohm, good for small tone speakers, alarm clocks, etc.
5 for $1.00

Mini 8 ohm Speaker

Approx. 2¼" diam. Round type for radios, mike etc.
3 for $2.00

Solid State Buzzers

small buzzer 450 Hz, 86 dB, sound output on 5-12 vdc at 10-30 mA, TTL compatible $1.50

Slug Tuned Coils

Small 3/16" Hex Slugs turned coil. 3 turns. 10 for $1.00

AC Outlet

Panel Mount with Leads
4/$1.00

CAPACITORS

TANTALUM Dipped Epoxy		ALUMINUM Electrolytic		DISK CERAMIC	
1.5 uF 25V	3/$1.00	1000 uF 16V Radial	$.50	.01 16V disk	20/$1.00
1.8 uF 25V	3/$1.00	500 uF 20V Axial	$.50	.1 16V	15/$1.00
.22 uF 25V	3/$1.00	150 uF 16V Axial	5/$1.00	.001 16V	20/$1.00
		10 uF 15V Radial	10/$1.00	100 pF	20/$1.00
				.047 16V	20/$1.00

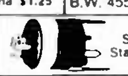
DC-DC Converter

+5 vdc input prod. -9 vdc @ 30ma
-9 vdc produces -15 vdc @ 35ma $1.25

Ceramic IF Filters

Mini ceramic filters 7 kHz B.W. 455 kHz $1.50 ea.

25K 20 Turn Trim Pot $1.00
1K 20 Turn Trim Pot $ .50



Trimmer Caps

Sprague - 3-40 pf Stable Polypropylene
.50 ea.

Crystal Microphone

Small 1" diameter ¼" thick crystal mike cartridge $.75

Mini RG-174 Coax
10 ft. for $1.00

Coax Connector

Chassis mount BNC type $1.00

9 Volt Battery Clips

Nice quality clips 5 for $1.00
⅜" Rubber Grommets 10 for $1.00

Parts Bag

Asst. of chokes, disc. caps, tant., resistors, transistors, diodes, MICA caps etc.
sm. bag (100 pc) $1.00 lg. bag (300 pc) $2.50

Connectors

6 pin type gold contacts for mA-1003 car clock module
price .75 ea.

Leds - your choice, please specify
Mini Red, Jumbo Red, High Intensity Red, Illuminator Red 8/$1
Mini Yellow, Jumbo Yellow, Jumbo Green 6/$1

Varactors

Motorola MV 2209 30 PF Nominal cap 20-80 PF - Tunable range -
.50 each or 3/$1.00

Audio Prescaler

Make high resolution audio measurments, great for musical instrument tuning, PL tones, etc. Multiplies audio UP in frequency, selectable x10 or x100, gives .01 HZ resolution with 1 sec. gate time! High sensitivity of 25 mv, 1 meg input z and built-in filtering gives great performance. Runs on 9V battery, all CMOS.

PS-2 kit $29.95
PS-2 wired $39.95

600 MHz PRESCALER

Extend the range of your counter to 600 MHz. Works with all counters. Less than 150 mv sensitivity, specify - 10 or -100

Wired, tested, PS-1B $59.95
Kit, PS-1B $44.95

30 Watt 2 mtr PWR AMP

Simple Class C power amp features 8 times power gain. 1 W in for 8 out, 2 W in for 15 out, 4W in for 30 out. Max output of 35 W, incredible value, complete with all parts, less case and T-R relay.

PA-1, 30 W pwr amp kit $22.95
TR-1, RF sensed T-R relay kit 6.95

MRF-238 transistor as used in PA-1 8-10db gain 150 mhz $11.95

RF actuated relay senses RF (1W) and closes DPDT relay. For RF sensed T-R relay
TR-1 Kit $6.95

Power Supply Kit

Complete triple regulated power supply provides variable 6 to 18 volts at 200 ma and +5 at 1 Amp. Excellent load regulation, good filtering and small size. Less transformers, requires 6.3 V @ 1 A and 24 VCT.
Complete kit, PS-3LT $6.95

OP-AMP Special

BI-FET LF 13741 - Direct pin for pin 741 compatible, but 500,000 MEG input z, super low 50 pa input current, low power drain.
50 for only $9.00 10 for $2.00

Regulators

78MG	$1.25	7812	$1.00
79MG	$1.25	7815	$1.00
723	$.50	7905	$1.25
309K	$1.15	7912	$1.25
7805	$1.00	7915	$1.25

Shrink Tubing Nubs

Nice precut pces of shrink size 1" x ⅛" shrink to ⅛" Great for splices 50/$1.00

Mini TO-92 Heat Sinks

Thermalloy Brand 5 for $1.00
To-220 Heat Sinks 3 for $1.00

Opto Isolators - 4N28 type $.50 ea.
Opto Reflectors - Photo diode + LED $1.00 ea.

Molex Pins

Molex already precut in length of 7. Perfect for 14 pin sockets. 20 strips for $1.00

CDS Photocells

Resistance varies with light. 250 ohms to over 3 meg 3 for $1.00

TAKE YOUR PICK SPECIALS

these prices are NOT misprints!

Here is a chance to stock up your lab at unprecendented prices... we've got to move these out to make room for our ever-expanding CompuPro™ division. **Limited quantities - first come, first served.** Sorry, at these low prices we cannot include spec sheets or accept COD/telephone orders. Part numbers **must** include the special -S suffix or you will be charged our regular prices. Parts may be house numbered or have dual markings. **This is your chance to save!**

TTL

7403-S	Quad 2 input OC	21/$2
7410-S	Triple 3 input NAND	21/$2
7413-S	4 to 16 line decoder/demux	6/$2
7438-S	Quad 2 input NAND OC	21/$2
7444-S	Gray to decimal decoder	8/$2
7450-S	And-or-Invert	21/$2
7472-S	JK M-S flip flop	21/$2
7493-S	4 bit binary counter	10/$2
7496-S	5 bit shift register	12/$2
74122-S	Retriggerable one-shot	18/$2
74151-S	8 channel mux	8/$2
74155-S	Dual 2/4 demux	8/$2
74159-S	4 to 16 line decoder/demux OC	4/$2
74161-S	Synchro 4 bit binary counter	8/$2
74163-S	Synchro 4 bit binary counter	8/$2
74164-S	8 bit shift register	6/$2
74190-S	Up/down decade counter	4/$2
74192-S	Up/down binary counter	4/$2
74194-S	4 bit bidirectional shift reg	4/$2
74195-S	4 bit parallel shift register	6/$2
74198-S	8 bit shift register	4/$2

CMOS

4012-S	Dual 4 input NAND	12/$2
4020-S	14 stage counter	4/$2
4023-S	Triple 3 input NAND	12/$2
4044-S	Quad R-S latch	4/$2
4046-S	Phase locked loop	2/$2
4071-S	Quad 2 input OR	12/$2
4093-S	Quad 2 in NAND Schmitt trig	4/$2
4507-S	Quad EX-OR	4/$2
4510-S	BCD up/down counter	2/$2

LINEARS

(package type: H = T099, M = minidip, D = dip, TK = T066)

201H-S	Improved 301 op amp	10/$2
308H-S	Micropower op amp	6/$2
703H-S	RF/IF amp	6/$2
723D-S	Voltage regulator	6/$2
741M-S	Compensated op amp	15/$2
1458M-S	Dual 741	10/$2
4558M-S	Dual 741	12/$2
4195TK-S	Dual track 15V reg w/data	2/$2

TO-220 NEGATIVE VOLTAGE REGULATORS

7906-S	-6V regulator	2/$2
7908-S	-8V regulator	2/$2
7912-S	-12V regulator	2/$2
79M15-S	-15V regulator	2/$2
7918-S	-18V regulator	2/$2
7924-S	-24V regulator	2/$2

OTHER SEMICONDUCTORS

- General purpose silicon signal diodes 50/$2
- GT5306 NPN darlington, min gain 17000, 25V 200 mA, T092 package 100/$8.95
- NPN transistor similar 2N3904 100/$7.95
- PNP transistor similar 2N3906 100/$8.95
- 4N28-S opto-coupler 6 pin minidip, MCT-2/IL-1 pinout 5/$2
- SN76477-S complex sound generator 1/$2.50
- Opto-Isolator Grab Bag — 50 mixed opto-isolators from a major manufacturer. Unmarked 6 and 8 lead minidips include single and dual types with diode, transistor, and darlington outputs. Test them yourself and save! Not recommended for beginners. 50/$4

SAVE!

SOLDERTAIL SOCKET SPECIAL

Now that you've got the ICs, get some sockets at a fantastic price!

14 pin:	50/$4.95	20 pin:	40/$4.95
16 pin:	50/$4.95	24 pin:	30/$4.95
18 pin:	50/$4.95	28 pin:	30/$4.95
		40 pin:	20/$4.95

74LS TTL

74LS00	$0.34	74LS154	2.10
74LS01	0.34	74LS155	1.87
74LS02	0.34	74LS157	1.57
74LS04	0.38	74LS160	2.20
74LS05	0.44	74LS161	2.18
74LS08	0.34	74LS162	2.20
74LS10	0.34	74LS163	2.18
74LS11	0.40	74LS168	3.75
74LS12	0.34	74LS169	3.75
74LS14	2.20	74LS173	2.08
74LS15	0.40	74LS174	2.05
74LS20	0.34	74LS175	1.95
74LS21	0.40	74LS181	3.50
74LS22	0.40	74LS192	3.05
74LS26	0.48	74LS195	1.87
74LS27	0.42	74LS221	1.70
74LS30	0.34	74LS240	2.50
74LS32	0.46	74LS241	2.50
74LS33	0.60	74LS244	2.50
74LS37	0.48	74LS257	1.95
74LS38	0.48	74LS258	2.02
74LS42	1.56	74LS266	0.69
74LS47	1.68	74LS273	2.91
74LS48	1.68	74LS283	2.02
74LS74	0.54	74LS365	0.88
74LS75	0.82	74LS366	0.88
74LS76	0.50	74LS367	0.88
74LS86	0.58	74LS368	0.88
74LS109	0.62	74LS386	0.69
74LS123	1.70	80LS95	0.88
74LS125	0.87	80LS96	0.88
74LS126	0.87	80LS97	0.88
74LS132	1.50	80LS98	0.88
74LS136	0.69	81LS95	2.10
74LS138	1.87	81LS96	2.10
74LS139	1.87	81LS97	2.10
74LS151	1.66	81LS98	2.10

MORE TRANSISTORS AND FETS

2N2221	NPN TO-18 unmarked	7/$1.00
2N2222	PNP TO-18 unmarked	5/$1.00
2N2907A	PNP plastic house #	5/$1.00
2N3055	NPN TO-3 house #	1/$0.75
2N3904	NPN TO-105 house #	5/$1.00
2N3906	PNP TO-105 house #	5/$1.00
2N4124	30V/350 mW TO-92	3/$1.00
2N4304	TO-18 plastic N-JFET gen purp	2/$1.00
2N4400	NPN plastic house #	5/$1.00
2N4917	PNP TO-106	5/$1.00
2N4946	NPN TO-106	6/$1.00
2N5227	PNP TO-92 30V	6/$1.00
2N5306	NPN TO-92 darlington	3/$1.00
2N5449	NPN	6/$1.00
2N5484	RF N-JFET	3/$1.00
D41D1	PNP TO-202 1A max	1/$0.50
D44C4	NPN TO-220 4A/55V	1/$0.75
D45C4	PNP TO-220 4A/55V	1/$0.75
D45H8	PNP TO-220 10A/60V	3/$2.00
MPS3694	NPN gen purp	4/$1.00
FPT100	Phototransistor	1/$0.50
FET-2	Dual N-JFET TO-18 sim 2N4416	3/$1.00
FET-3	Dual N-JFET lo noise audio	2/$1.00
FET-6	Gen purp dual gate MOSFET house #	3/$2.00

JUST IN!

2102 1K STATIC RAMS 99¢ ea.

10/$9.90!!!

16K DYNAMIC RAMS

NOW 8/$37.

Lowest price ever on one of our most popular items. Expands memory in TRS-80* -I and -II, as well as machines made by Apple, Exidy, Heath H89, newer PETs, etc. Low power, speed (4 MHz). Add $3 for dip shunts plus TRS-80* conversion instructions. **Limited quantity — first come, first served.** *TRS-80 is a trademark of the Tandy Corporation

CLOSEOUT H8 MEMORY 32K for $549!

Limited quantity: 32K of static memory in kit (not unkit) form. Includes all parts, sockets for all ICs, documentation, mounting bracket, etc. With solder-masked, double-sided, fully legended board for easy assembly. If you own an H8, this is your chance to obtain top-notch memory — without paying top-notch prices.

MA1003 CLOCK MODULE — $14.95

Our very best clock module operates from 12V DC and includes an internal timebase accurate to 0.01%, making it ideal for mobile applications in your car, van, or boat. Blue-green flourescent readouts don't wash out during the day, and look great at night. Easy to build; just hook up power, add two time-setting switches, and you've got one of the best clock modules on the road. With application note that shows you how to get the most out of your MA1003.

Also available: clock/case combination. For **$19.95**, we'll include a matching case, with mounting hardware and optical filter, along with the MA1003.

****

TERMS: Cal res add tax. Allow 5% for shipping; excess refunded. Orders under $15 add $1 handling. VISA®/Mastercard® orders ($25 min) call our 24 hour order desk at (415) 562-0636. COD OK with street address for UPS. **PLEASE NOTE: TELEPHONE ORDERS AND CODS ARE NOT ALLOWED ON SPECIALS LISTED ABOVE.** Sale prices good through cover month of magazine; other prices subject to change without notice.

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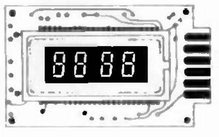
National Semiconductor Clock Modules



12VDC AUTOMOTIVE/ INSTRUMENT CLOCK

APPLICATIONS:
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- After-market auto/ RV clocks
- Aircraft-marine clks.
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Features: Bright 0.3" green display. Internal crystal time-base. ± 0.5 sec./day accur. Auto. display brightness control logic. Display color filterable to blue, blue-green, green & yellow. Complete—just add switches and lens.

MA1003 Module $16.95

MA1023	.7" Low Cost Digital LED Clock Module	8.95
MA1026	.7" Dig. LED Alarm Clock/Thermometer	18.95
MA5036	.3" Low Cost Digital LED Clock/Timer	6.95
MA1002	.5" LED Display Dig. Clock & Xformer	9.95

National Semiconductor

RAM SALE

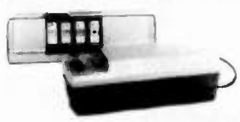
MM5290J-2 (MK4116/UPD416) . . . **$6.95 each**
16K DYNAMIC RAM (150NS)
(8 EACH $49.95) (100 EACH $550.00/lot)

MM5298J-3A . . . . **$3.25 each**
8K DYNAMIC RAM (LOW HALF OF MM5290J) 200NS
(8 EACH $23.95) (100 EACH $250.00/lot)

MM2114-3 . . . . **$5.95 each**
4K STATIC RAM (300NS)
(8 EACH $43.95) (100 EACH $450.00/lot)

MM2114L-3 . . . . **$6.25 each**
4K STATIC RAM (LOW POWER 300NS)
(8 EACH $44.95) (100 EACH $475.00/lot)

EPROM Erasing Lamp



- Erases 2708, 2716, 1702A, 5203Q, 5204Q, etc.
- Erases up to 4 chips within 20 minutes.
- Maintains constant exposure distance of one inch.
- Special conductive foam liner eliminates static build-up.
- Built-in safety lock to prevent UV exposure.
- Compact — only 7-5/8" x 2-7/8" x 2"
- Complete with holding tray for 4 chips.

UVS-11E $79.50

Jumbo 6-Digit Clock Kit

- Four .630"ht. and two .300"ht. common anode displays
- Uses MM5314 clock chip
- Switches for hours, minutes and hold functions
- Hours easily viewable to 30 feet
- Simulated walnut case
- 115VAC operation
- 12 or 24 hour operation
- Includes all components, case and wall transformer
- Size: 6¾" x 3-1/8" x 1¾"

JE747 .... $29.95

6-Digit Clock Kit

- Bright .300 ht. comm. cathode display
- Uses MM5314 clock chip
- Switches for hours, minutes and hold modes
- Hrs. easily viewable to 20 ft.
- Simulated walnut case
- 115 VAC operation
- 12 or 24 hr. operation
- Incl. all components, case & wall transformer
- Size: 6¾" x 3-1/8" x 1¾"

JE701 .... $19.95

Regulated Power Supply

Uses LM309K. Heat sink provided. PC board construction. Provides a solid 1 amp @ 5 volts. Can supply up to ±5V, ±9V and ±12V with JE205 Adapter. Includes components, hardware and instructions. Size: 3½" x 5" x 2"H

JE200 .... $14.95

ADAPTER BOARD —Adapts to JE200— ±5V, ±9V and ±12V

DC/DC converter with +5V input. Toriodal hi-speed switching XMFR. Short circuit protection. PC board construction. Piggy-back to JE 200 board. Size: 3½" x 2" x 9/16"H

JE205 .... $12.95

MICROPROCESSOR COMPONENTS

8080A/8080A SUPPORT DEVICES

INS8080A	CPU	6.50
DP8212	8-Bit Input/Output	3.25
DP8214	Priority Interrupt Control	5.95
DP8216	Bi-Directional Bus Driver	3.49
DP8224	Clock Generator/Driver	3.95
DP8226	Bus Driver	3.49
DP8228	System Controller/Bus Driver	4.95
DP8238	System Controller	5.95
INS8243	I/O Expander for 48 Series	8.95
INS8250	Asynchronous Comm. Element	16.95
DP8251	Prog. Comm. I/O (USART)	7.95
DP8253	Prog. Interval Timer	14.95
DP8255	Prog. Peripheral I/O (PPI)	9.95
DP8257	Prog. DMA Control	19.95
DP8259	Prog. Interrupt Control	10.95
DP8275	Prog. CRT Controller	49.95
DP8279	Prog. Keyboard/Display Interface	19.95
DP8300	Octal Bus Receiver	6.95
DP8303	System Timing Element	6.95
DP8304	8-Bit Bi-Directional Receiver	3.95
DP8307	8-Bit Bi-Directional Receiver	3.95
DP8308	8-Bit Bi-Directional Receiver	3.95

6800/6800 SUPPORT DEVICES

MC6800	MPU	14.95
MC6802CP	MPU with Clock and RAM	18.95
MC6810API	128x8 Static RAM	4.95
MC6821	Peripheral Inter. Adapt (MC6820)	7.49
MC6828	Priority Interrupt Controller	10.95
MC6830L8	1024x8-Bit ROM (MC68A30-8)	14.95
MC6850	Asynchronous Comm. Adapter	6.95
MC6852	Synchronous Serial Data Adapter	6.95
MC6860	0-600bps Digital MODEM	10.95
MC6862	2400bps Modulator	12.95
MC6880A	Quad 3-State Bus Trans. (MC8T26)	2.25

MICROPROCESSOR CHIPS

Z80 (780C)	CPU (MK3880N) (2MHz)	13.95
Z80A (780-1)	CPU (MK3880N-4) (4MHz)	15.95
CDP1802	CPU	19.95
2650	MPU	16.95
IDM2901ADC	CPU—4 Bit Slice (Com. Temp. Grade)	19.95
MC56802	MPU w/Clock (64K Bytes Memory)	11.95
INS8035N-6	MPU—8-Bit (6MHz)	16.95
INS8039N-6	CPU—Sgl. Chip 8-Bit (128 bytes RAM)	19.95
INS8040N-6	CPU (256 Bytes RAM)	24.95
INS8070N	CPU—64 Bytes RAM	24.95
P8085	CPU	19.95
INS8900	CPU—16 Bit	29.95
TMS9900JL	MPU—16 Bit	49.95

SHIFT REGISTERS

MM500H	Dual 25-Bit Dynamic	.50
MM503H	Dual 50-Bit Dynamic	.50
MM506H	Dual 100-Bit Static	.50
MM510H	Dual 64-Bit Accumulator	.50
MM1402	256-Bit Dynamic	1.95
MM5013	1024-Bit Dynamic/Accumulator	1.95
MM5016H	500/512-Bit Dynamic	.89
MM5034N	Octal 80-Bit	9.95
MM5035N	Octal 80-Bit	9.95
2504V(1404A)	1024-Bit Dynamic	3.95
2518N	Hex 32-Bit Static	4.95
2522V	Dual 132-Bit Static	2.95
2524V	512-Bit Dynamic	.99
2525V	1024-Bit Dynamic	2.95
2527V	Dual 256-Bit Static	2.95
2528V	Dual 250-Bit Static	4.00
2529V	Dual 240-Bit Static	4.00
2532N	Quad 80-Bit Static	2.95
3341PC	Fifo (Dual 80)	6.95

DATA ACQUISITION

AF100-1CN	Universal Active Filter 2.5%	5.95
AF121-1CJ	Touch Tone Low Pass Filter	19.95
AF122-1CJ	Touch Tone Low Pass Filter	19.95
LM308AH	Super Gain Op Amp	1.00
LM334Z	Constant Current Source	1.30
LM335Z	Temperature Transducer	1.40
LF356N	JFET Input Op Amp	1.10
LF398N	Sample & Hold Amplifiers	3.95
LM399H	Temp. Comp. Prec. Ref. (.5ppm/C°)	4.95
ADC0804LCN	8-Bit A/D Converter (1 LSB)	4.95
DAC0806LCN	8-Bit D/A Converter (0.78% Lin.)	2.25

DATA ACQUISITION (CONTINUED)

ADC0809CCN	8-Bit A/D Converter (8-Ch. Multi.)	5.25
ADC0817CCN	8-Bit A/D Converter (16-Ch. Multi.)	10.95
DAC1000LCN	10-Bit D/A Conv. Micro. Comp. (0.05%)	11.95
DAC1008LCN	10-Bit D/A Conv. Micro. Comp. (0.20%)	8.95
DAC1020LCN	10-Bit D/A Converter (0.05% Lin.)	8.49
DAC1022LCN	10-Bit D/A Converter (0.20% Lin.)	5.95
DAC1222LCN	12-Bit D/A Converter (0.20% Lin.)	9.95
CD4051N	8-Channel Multiplexer	1.19
AY-5-1013	30K BAUD UART	5.95

RAM'S

1101	256x1 Static	1.49
1103	1024x1 Dynamic	.99
2101 (8101)	256x4 Static	3.95
2102	1024x1 Static	1.75
21L02	1024x1 Static	1.95
2111 (8111)	256x4 Static	3.95
2112	256x4 Static MOS	4.95
2114	1024x4 Static 450ns	5.95
2114L	1024x4 Static 450ns Low Power	6.95
2114-3	1024x4 Static 300ns	7.49
2114L-3	1024x4 Static 300ns Low Power	7.95
2117	16,384x1 Dynamic 350ns (house marked)	4.95
MM2147J	4096x1 Fast 70ns	19.95
5101	256x4 Static	7.95
MM5261	1024x1 Dynamic Fully Decoded	.99
MM5262	2Kx1 Dynamic	.25
MM5280/2107	4096x1 Dynamic	4.95
MM5290J-2(4116)	16K Dynamic 250ns (UPD416)	6.95
MM5298J-3A	8K Dyn. 200ns (lower ½ of MM5290J)	4.95
7489	16x4 Static	1.75
UPD414/MK4027	4K Dynamic 16-pin	4.95
TMS4044-45NL	4K Static	14.95
TMS4045	1024x4 Static	10.95

PROMS/EPROMS

1702A	2K UV Erasable PROM	5.95
2708	8K EPROM	9.95
TMS2716	16K EPROM (-5V, +5V, +12V)	19.95
2716Intel(2516)TI	16K EPROM (Single +5V)	17.95
2732Intel(2532)TI	32K EPROM	49.95
2758	8K EPROM (450ns) (Single +5V)	7.95
5203	2048 PROM	14.95
82S23(74S188)	32x8 PROM (Open Collector)	4.95
82S115	4096 Bipolar PROM	19.95
82S123(74S288)	32x8 Tri-State Bipolar PROM	4.95
82S185	8K PROM	29.95

ROM'S

2513(2140)	Character Generator (Upper Case)	9.95
2513(3021)	Character Generator (Lower Case)	9.95
2516N	Character Generator	10.95
MM5230N	2048 Bit Read Only Memory	1.95

NMOS READ ONLY MEMORIES

MCM66710P	128x9x7 ASCII Shifted w/Greek	13.50
MCM66740P	128x9x7 Math Symbol & Pictures	13.50
MCM66750P	128x9x7 Alpha. Control Char. Gen.	13.50

MICROPROCESSOR MANUALS

M-Z80	User Manual	7.50
M-CDP1802	User Manual	7.50
M-2650	User Manual	5.00

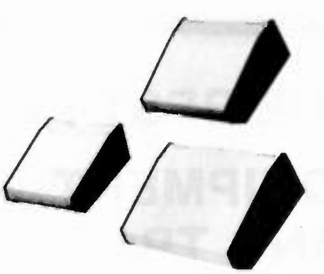
SPECIAL FUNCTION

DS0025CN	Dual MOS Clock Driver (5MZ)	3.50
DS0026CN	Dual MOS Clock Driver (5MZ)	1.95
INS1771N-1	Floppy Disc Controller	24.95
INS2651N	Communication Chip	19.95
MM58167N	Microprocessor Real Time Clock	8.95
MM58174N	Microprocessor Compatible Clock	11.95
COP402N	Microcontroller with 64-Digit RAM and Direct LED Drive	6.95
COP402MN	Microcontroller with 64-Digit RAM & Direct LED Drive w/N Buss Int.	7.49
COP470N	32-Seg VAC Fluor. Driver (20-pin pkg.)	3.25

TELEPHONE/KEYBOARD CHIPS

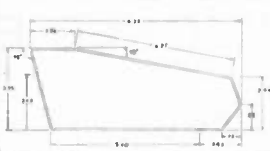
AY-5-9100	Push Button Telephone Dialer	14.95
AY-5-9200	Repertory Dialer	14.95
AY-5-9500	CMOS Clock Generator	4.95
AY-5-2376	Keyboard Encoder (88 keys)	11.95
HD0165-5	Keyboard Encoder (16 keys)	7.95
74C922	Keyboard Encoder (16 keys)	5.49
74C923	Keyboard Encoder (20 keys)	5.75
MM53190N	Push Button Pulse Dialer	7.95
MM5799N	96/144 Key Serial Keyboard Encoder	6.95

DESIGNERS' SERIES
Blank Desk-Top Electronic Enclosures



- High strength epoxy molded end pieces in mocha brown finish.
- Sliding rear/bottom panel for service and component accessibility.
- Top/bottom panels .080 thk alum. Alodine type 1200 finish (gold tint color) for best paint adhesion after modification.
- Vented top and bottom panels for cooling efficiency.
- Rigid construction provides unlimited applications.

CONSTRUCTION:
The "DTE" Blank Desk Top Electronic Enclosures are designed to blend and complement today's modern computer equipment and can be used in both industrial and home. The end pieces are precision molded with an internal slot (all around) to accept both top and bottom panels. The panels are then fastened to ¼" thick tabs inside the end pieces to provide maximum rigidity to the enclosure. For ease of equipment servicing, the rear/bottom panel slides back on slotted tracks while the rest of the enclosure remains intact. Different panel widths may be used while maintaining a common profile outline. The molded end pieces can also be painted to match any panel color scheme.



Enclosure Model No.	Panel Width	PRICE
DTE-8	8.00"	$29.95
DTE-11	10.65"	$32.95
DTE-14	14.00"	$34.95

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- Three 2½" holes provided in bottom of case for addition of fan if needed.
- Fan hole positioned above Apple motherboard location.
- Hookup cables can be run through other 2 holes.
- Case accommodates most B&W and Color uncased CRT monitors made by Motorola, Ball Bros., Zenith, Sanyo, Panasonic, Hitachi, etc. or any monitor that will fit into 10-3/8"H x 14½"W x 13¾"D space.
- Size: 15" x 15" x 15" O.D., 14½"H x 14½"W x 13¾" I.D.
- Weight: approximately 12 lbs.
- CRT monitor fan and disk drives not included.

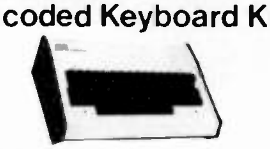
CUBE-1 .... $99.95

TRS-80 16K Conversion Kit

Expand your 4K TRS-80 System to 16K.
Kit comes complete with:
- 8 each MM5290-2 (UPD416) (16K Dynamic Rams) (250NS or less)
- Documentation for conversion

TRS-16K $49.95

JE610 ASCII Encoded Keyboard Kit



The JE610 ASCII Keyboard Kit can be interfaced into most any computer system. The kit comes complete with an industrial grade keyboard switch assembly (62-keys), IC's, sockets, connector, electronic components and a double-sided printed wiring board. The keyboard assembly requires +5V @ 150mA and −12V @ 10 mA for operation. Features: 60 keys generate the 126 characters, upper and lower case ASCII set. Fully buffered. Two user-define keys provided for custom applications. Caps lock for upper-case-only alpha characters. Utilizes a 2376 (40-pin) encoder read-only memory chip. Outputs directly compatible with TTL/DTL or MOS logic arrays. Easy interfacing with a 16-pin dip or 18-pin edge connector.

JE610 (Case not included) **$79.95**
K62 (Keyboard only) $34.95

Desk-Top Enclosure for JE610 ASCII Encoded Keyboard Kit

Compact desk-top enclosure: Color-coordinated designer's case with light tan aluminum panels and molded end pieces in mocha brown. Includes mounting hardware. Size: 3½"H x 14½"W x 8¾"D.

DTE-AK $49.95
SPECIAL: JE610/DTE-AK PURCHASED TOGETHER (Value $129.90) $124.95

JE600 Hexadecimal Encoder Kit

FULL 8-BIT LATCHED OUTPUT 19-KEY KEYBOARD

The JE600 Encoder Keyboard Kit provides two separate hexadecimal digits produced from sequential key entries to allow direct programming for 8-bit microprocessor or 8-bit memory circuits. Three additional keys are provided for user operations with one having a bistable output available. The outputs are latched and monitored with 9 LED readouts. Also included is a key entry strobe. Features: Full 8-bit latched output for microprocessor use. Three user-define keys with one being bistable operation. Debounce circuit provided for all 19 keys. 9 LED readouts to verify entries. Easy interfacing with standard 16-pin IC connector. Only +5VDC required for operation.

JE600 (Case not included) **$59.95**
K19 (Keyboard only) $14.95

Desk-Top Enclosure for JE600 Hexadecimal Keyboard Kit

Compact desk-top enclosure: Color-coordinated designer's case with light tan aluminum panels and molded end pieces in mocha brown. Includes mounting hardware. Size: 3½"H x 8¾"W x 8¾"D.

DTE-HK $44.95
SPECIAL: JE600/DTE-HK PURCHASED TOGETHER (Value $104.90) $99.95

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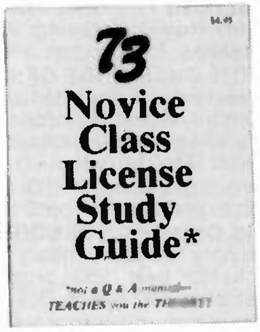

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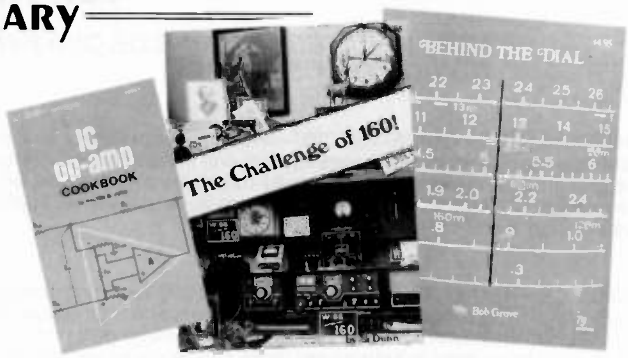

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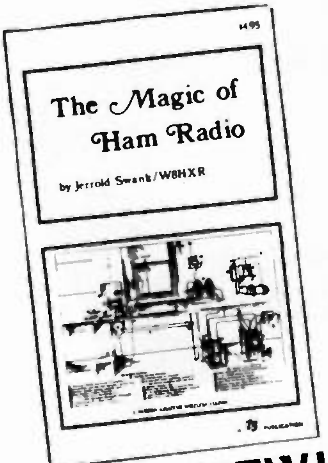

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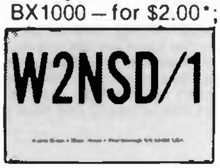

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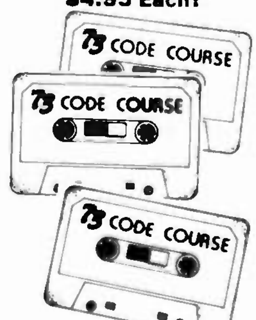

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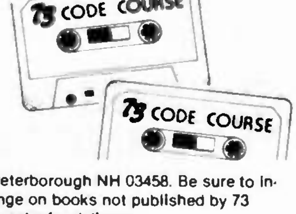

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ALASKA	14A	14	7	7	7	7	7	7	14	14A	21A	21A
ARGENTINA	14	7A	7	7B	7B	7	14A	21	21A	21A	21A	21A
AUSTRALIA	21	14	7B	7B	7B	7B	7B	14B	21	21	21A	21A
CANAL ZONE	14	7	7	7	7	7	14	21A	21A	21A	21A	21
ENGLAND	7	7	7	7	7	7	14	21A	21A	14A	14	7
HAWAII	21A	14	7B	7	7	7	7	7B	14	21A	21A	21A
INOIA	7	7	7B	7B	7B	7B	14	14A	14	7B	7B	7
JAPAN	14A	14B	7B	7B	7	7	7	7B	7B	7B	14B	14
MEXICO	14A	7A	7	7	7	7	7	14A	21A	21A	21A	21
PHILIPPINES	14A	14B	7B	7B	7B	7B	7B	14B	14B	14B	14B	14
PUERTO RICO	14	7	7	7	7	7	14	21A	21A	21A	21	21
SOUTH AFRICA	14	7B	7	7B	7B	14	21A	21A	21A	21A	21A	14A
U. S. S. R.	7	7	7	7	7	7B	14	21A	21	7B	7B	7
WEST COAST	21	14	7	7	7	7	7	14	21A	21A	21A	21A

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	21	14	7	7	7	7	7	7	14	14A	21A	21A
ARGENTINA	21	14	7	7B	7B	7	14	21	21A	21A	21A	21A
AUSTRALIA	21A	14	7B	7B	7B	7B	7B	7B	14	21	21A	21A
CANAL ZONE	14	7A	7	7	7	7	7A	21A	21A	21A	21A	21A
ENGLAND	7	7	7	7	7	7	7B	14A	21A	14A	14	7B
HAWAII	21A	14	7	7	7	7	7	7	14	21A	21A	21A
INDIA	7B	7B	7B	7B	7B	7B	7B	7B	14	7B	7B	7B
JAPAN	21A	14	7B	7B	7	7	7	7	7B	7B	14B	21
MEXICO	14	7	7	7	7	7	7	14	21	21A	21A	21
PHILIPPINES	21A	14	7B	7B	7B	7B	7B	7	14B	14B	14B	14
PUERTO RICO	14	7	7	7	7	7	7A	21	21A	21A	21	21
SOUTH AFRICA	14	7B	7	7B	7B	7B	14	21A	21A	21A	21A	14A
U. S. S. R.	7B	7	7	7	7	7B	7B	14A	14A	7B	7B	7B

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	21A	14	7	7	7	7	7	3A	7A	14	21	21A
ARGENTINA	21A	14	7A	7B	7B	7	7B	14A	21A	21A	21A	21A
AUSTRALIA	21A	21	14	7	7B	7B	7B	7B	14	21	21A	21A
CANAL ZONE	21	14	7	7	7	7	7	14A	21A	21A	21A	21A
ENGLANO	7B	7	7	7	7	7	7B	14B	21A	14A	14B	7B
HAWAII	21A	21	14	7A	7	7	7	7	14	21A	21A	21A
INOIA	7B	14	7B	7B	7B	7B	7B	7B	14B	7B	7B	7B
JAPAN	21A	14A	14B	7B	7	7	7	7	7	7B	14B	21A
MEXICO	21	14	7	7	7	7	7	7A	21	21A	21A	21A
PHILIPPINES	21A	14A	14B	7B	7B	7B	7B	7	14B	14B	14B	14
PUERTO RICO	21	14	7	7	7	7	7	14A	21A	21A	21A	21
SOUTH AFRICA	21	14	7	7B	7B	7B	7B	14	21A	21A	21A	14A
U. S. S. R.	7B	7	7	7	7B	7B	7B	7B	14	7B	7B	7B
EAST COAST	21	14	7	7	7	7	7	14	21A	21A	21A	21A

A = Next higher frequency may also be useful
B = Difficult circuit this period
F = Fair G = Good P = Poor
SF = Chance of solar flares

december

sun	mon	tue	wed	thu	fri	sat
	1 F/SF	2 F/SF	3 F	4 G	5 G	6 F
7 G	8 G	9 G	10 G	11 G	12 G	13 G
14 F	15 F	16 G	17 G	18 F	19 F	20 F
21 G	22 G	23 G	24 F/SF	25 P/SF	26 F	27 F
28 G	29 G	30 G	31 G			

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