PRODUCT REVIEWS

USING THE NEW DIGITAL MULTIMETERS—OUR BASIC COURSE,
Page 77

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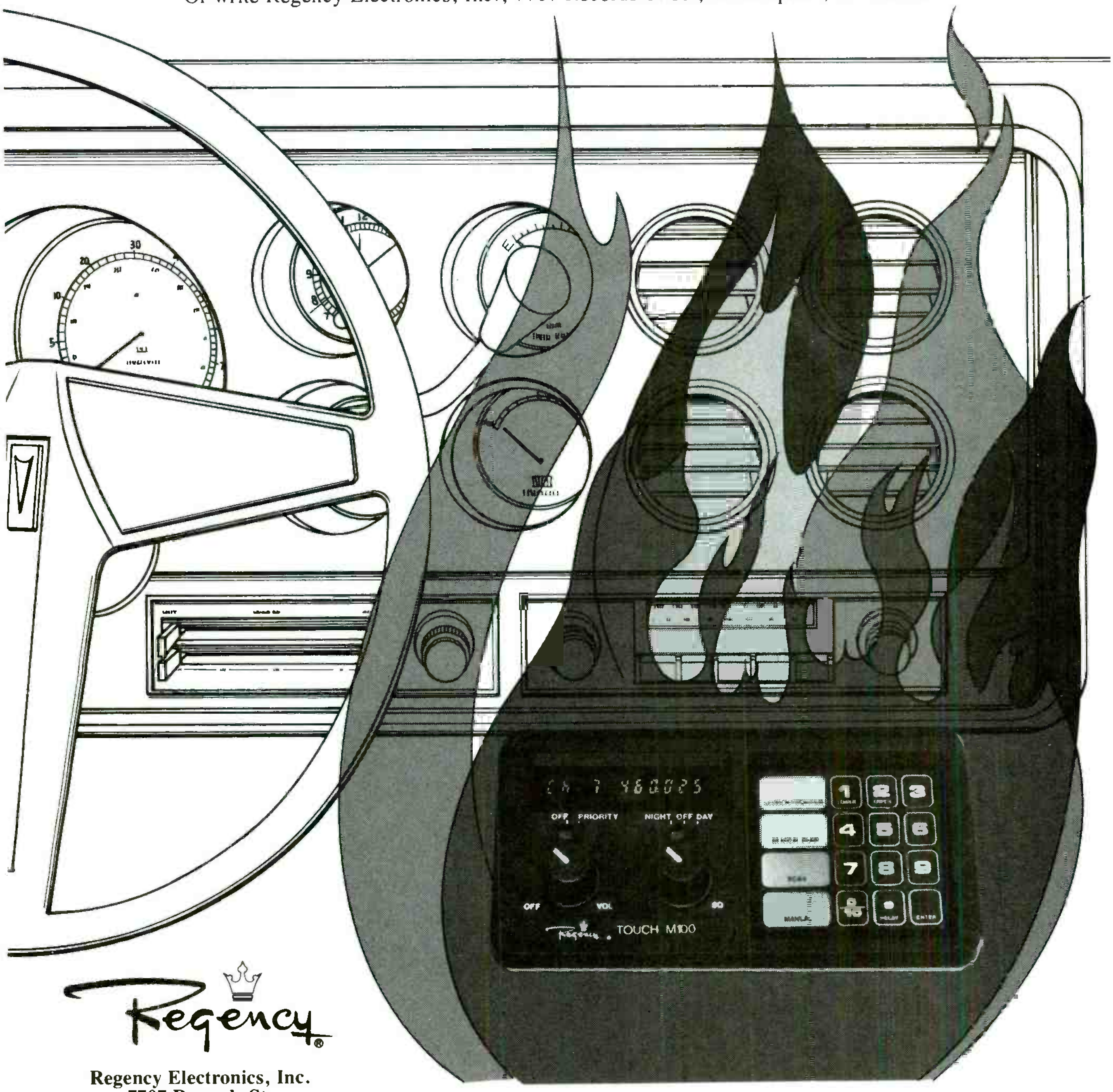

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CIRCLE 19 ON READER SERVICE COUPON

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elementary Electronics

January/February 1980
Volume 20, No. 1

CONSTRUCTION PROJECTS THAT KEEP YOUR HOME HUMMING

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REAPING REPAIRWORK REWARDS

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OUR REGULAR DEPARTMENTS

☆ Cover Stories.

AUTHORS IN THIS ISSUE

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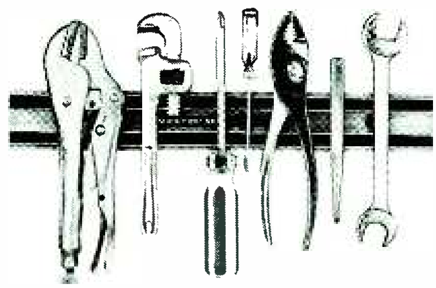
Hey, look me over

Showcase of New Products

Magnetic Storage Rack

A wall mounted magnetic tool and instrument holder for hobbyist and residential use has been introduced by Turotech. The Magnabar is a magnetized wall mounted rack that securely holds ferrous metal tools and instruments and keeps them within reach. Featuring a



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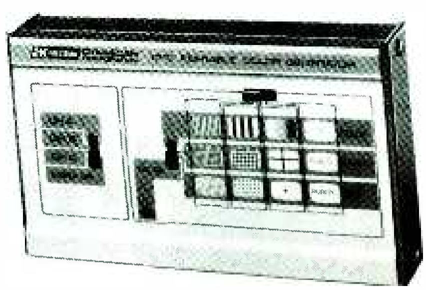
1-inch wide gripping track built into a natural hardwood base, the rack can be stained or painted to blend with any decor. Available in 12-inch, 18-inch, and 24-inch lengths, the Magnabar securely holds ferrous metal objects up to ½ lb. each. The Magnabar is priced at $8.75, $10.50 and $14.75, respectively. For more information contact Turotech, Inc., 44 Strawberry Hill Ave., Stamford, CT 06902.

Color Pattern Generator

A portable IC Color Pattern Generator, designed for easy and reliable operation at home, is available from B&K-Precision. The Model 1210 generates 10 stable patterns, including those re-



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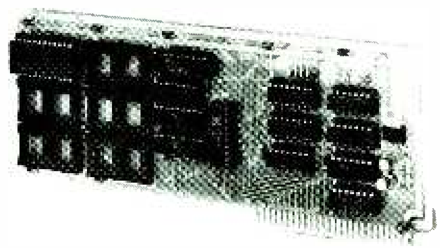
quired for static and dynamic convergence of any color TV set. Other patterns include crosshatch, gated and ungated rainbow and purity. Video and sync signals (blanking and color) are derived from and synchronized to a crystal-controlled master oscillator for stable, jitter-free patterns. A color level control permits level adjustments from 0 to 100% on all color patterns generated. The battery-powered Model 1210 generates any RF output level from 10,000 uV to 35,000 uV (adjustable) into a 75 ohm load for strong clear signals on any TV set. Five different output channels can be selected. The IC Color Pattern Generator is available from local distributors at $97.50. For further information on the Model 1210, write to B&K-Precision, Dynascan Corp., 6460 W. Cortland Street, Chicago, IL 60635.

Power to the Apple

With the trend toward firmware programming of microcomputers, Mountain Hardware has introduced its Romplus+ board for Apple Computers. The new board offers six individually addressable sockets for 2K ROM's or EPROM's plus scratchpad RAM. On-board firmware allows two or more 2K ROM's to be utilized simultaneously for programs longer than 2K. The board also provides two TTL input connections. Included in the $169 price and installed in one socket of the Romplus+ board is a 2K ROM program, "Keyboard Filter." Keyboard Filter offers upper/lower case for the Apple, multiple user-defined character sets, colored or inverse-colored letters, keyborad macros, improved cursor control, and other improved graphics and



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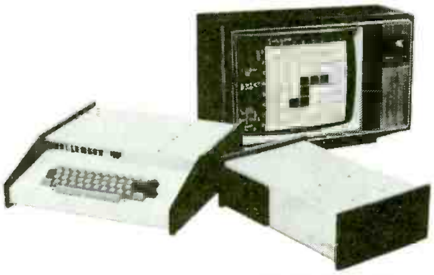
editing functions. Romplus+ and Keyboard Filter are compatible with Integer BASIC, RAM, or ROM Applesoft and DOS. For further information on Romplus+ and software support, write to Mountain Hardware, Inc., 300 Harvey West Blvd., Santa Cruz, CA 95060.

Personal Computer

The Ohio Scientific C4P MF Personal Computer is designed for the personal computer user as well as educational, scientific and other professional applications. The C4P MF features include a 32 x 64 character display with 16 colors and graphics resolution of 256 by 512 points. The C4P MF design offers a large memory capacity mini-floppy based computer with 24K static RAM. It can be expanded to 48K and two mini-floppies. The computer has a full 64 character display width, a line printer interface, modem interface, a full keyboard with lower case and advanced disk based software including an Information Management System, Word Processor and a library of program development tools. The C4P MF features instant program loading, spectacular color graphics, high speed animation, sound output, a D/A converter for music and voice output,



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joystick interfaces, and a large library of games, educational programs and personal finance aids. The C4P MF packs all this performance in a 14 lb. typewriter size package and has a suggested retail price of $1695. The computer is available through any of Ohio Scientific's authorized computer dealers. Information can be had by writing to Ohio Scientific, 1333 Chillicothe Rd., Aurora, OH 44202.

Home Computer

Designated the TI-99/4, the new Texas Instrument home computer uses Solid State Software command modules as ready-made computer programs which provide a wide array of capabilities for any family member. TI's home computer system consists of a console with 16K random-access memory (RAM), a wide range of sound effects, 16 colors for graphic display, a powerful extended BASIC programming language, and a 13-inch color video monitor. Priced at $1150.00, the heart of the TI-99/4 home computer system is a library of Texas Instruments-produced Solid State Software command modules ($19.95 to $69.95) that are unlike time-consuming, tape-recorded programs currently on the

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market. These command modules, each containing up to five read-only-memory (ROM) chips of stored data, allow users instant program accessibility without having to wait for a tape to unload. Among peripheral accessories offered is a Solid State Speech synthesizer with a suggested retail price of $150. TI BASIC is a full floating-point, 13-digit expanded

(Continued on page 10)

HEY, LOOK ME OVER

(Continued from page 9)

version of BASIC that is fully compatible with ASCII and the BASIC specification of the American National Standards Institute. TI BASIC includes a full complement of 24 BASIC statements, 14 commands, color graphics (16 colors), and sound and music over four full octaves. For a more complete description of the TI-99/4, write to Texas Instruments Inc., Consumer Relations, P.O. Box 53 (Attn, TI-99/4), Lubbock, TX 79408.

Speaker Kits

Speakerlab Inc. has introduced an exciting new 48-page four-color catalog. The catalog features a new active subwoofer system in addition to wave Aperture midrange and tweeter horns, and Mila Nestorovic's woofer system. Speakerlab is the exclusive producer of kit speakers using the patented Nestorovic Woofer System. In this system two woofers share a single enclosure and are selectively active or passive at different frequencies. A special network enables both woofers to work actively in upper bass frequencies and yet shift some signal input away from the lower ten-inch woofer at lower frequencies. The complete system is offered in the Speakerlab 30 speaker kit ($330 in walnut). Speakerlab products are available through seven retail outlets in the United States and Canada as well as through its Mail Order Department located at 735 No. Northlake Way, Seattle, WA 98103.

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10 NSEC Logic Probe

The new PRB-1 digital logic probe offers all the features of much more expensive probes yet costs less. The OK Machine and Tool Corp. probe detects pulses as short as 10 nsec (+ and −) and is fully compatible with all RTL, DTL, HTL, TTL, MOS, CMOS and microprocessor logic families. It also features 120K ohm impedance, power lead reversal protection and over-voltage protection to +70 VDC. Constant brightness LED's over full supply voltage range of 4-15V. The PRB-1 includes a 6 foot coiled power cord and tip protector. Neatly packed in a reuseable case with complete trouble shooting instruction booklet, it is available for $36.95 at local electronics distributors and retailers, or directly from OK Machine and Tool Corporation, 3455 Conner Street, Bronx, NY 10475.

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Juiced-Up RF

Siliconix, Inc. has introduced a new line of VMOS FET RF power transistors, featuring infinite VSWR protection, no thermal runaway, the ability to be used in

(Continued on page 12)

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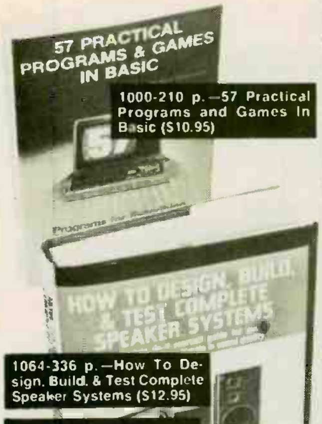

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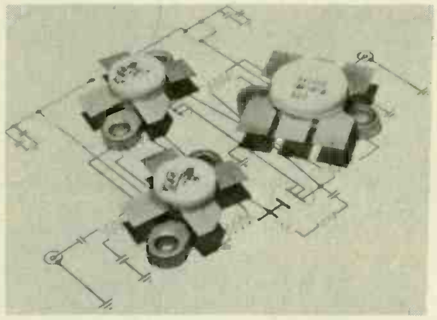
HEY, LOOK ME OVER

(Continued from page 10)

class A, B, or C amplifiers, and enough broadbandedness to be used at frequencies starting in the HF bands, and on through UHF. The DV-1006 is rated at 20-watts typical output, the DV-1007 is rated at 40-watts, and the DV-1008 is rated at 80-watts in broadband operation, with 100-watts peak output. For more information on this new line, contact: Siliconix, Inc., 2201 Laurelwood Rd., Santa Clara, CA 95054.



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Mini-Disk Ad-On for TRS-80

Percom Data has expanded its TFD line of add-on mini-disk systems for the Tandy Radio Shack TRS-80 computer to include a dual drive unit featuring double-density storage. Designated the TFD-1000, the unit provides 800K bytes of on-line storage. Two systems (four drives) may be used with a TRS-80 to provide 1.6M bytes on line. A TFD-1000 is supplied complete with an interconnecting cable (which accommodates either one or two units), a Peripheral Adapter Module (PAM) PC card, Percom's MICRODOS operating system, and support documentation. The PAM card replaces the RS-232-C card in the TRS-80 Expansion Interface and includes RS-232-C circuitry itself so that serial interfacing capability is retained. The TFD-1000 complete with cable, operating system, PAM card and documentation costs $2495.00. Two TFD-1000 units (four drives) costs $4950.00. Orders may be placed by dialing Percom's toll-free number, 1-800-527-1592, and may be paid by check or money order, COD, or charged to Visa or Master Charge accounts. For all the details and specs, write to Percom Data Company, Inc., 211 No. Kirby, Garland, TX 75042.

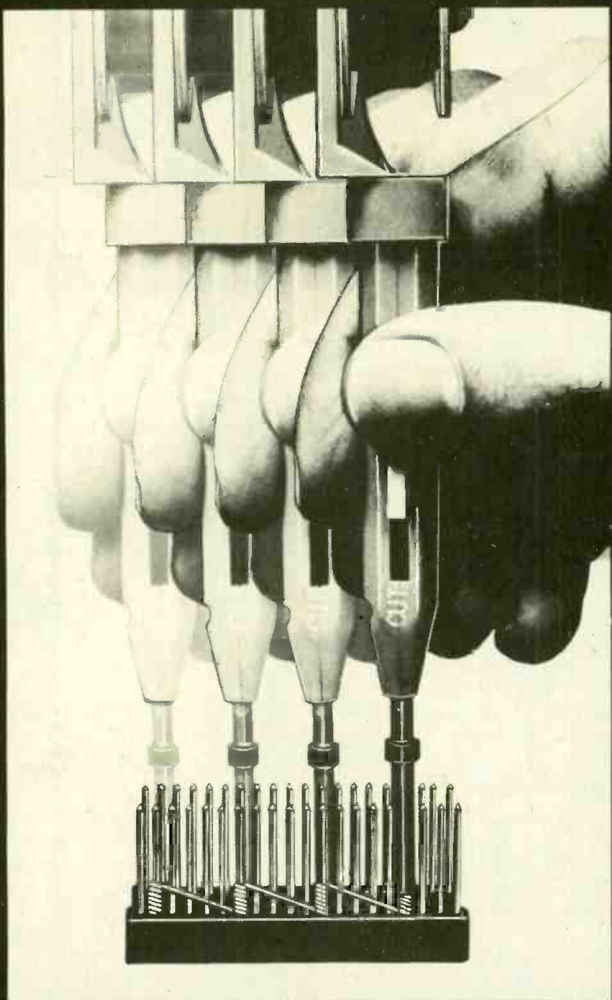
CIRCLE 45 ON READER SERVICE COUPON

Twice as Much

NCE/CompuMart is offering a computer and a terminal in one unit at a price lower than a terminal alone. The TC 2001 is available with 8K RAM and combines the PET computer and NCE's own design in a direct spinoff from the PET technology. It functions as a full duplex, dumb terminal which can be used in conjunction with remote time-sharing services, and also as an advanced personal computer. It incorporates today's most popular microprocessor, the MOS 6502 for fast and reliable operations. Available with 8K, 16K of RAM memory, the ROM memory size is 14K. The TC 2001 uses BASIC language (level II), and it is fully expandable through IEEE, TTL parallel, second cassette

(Continued on page 80)

NEW!



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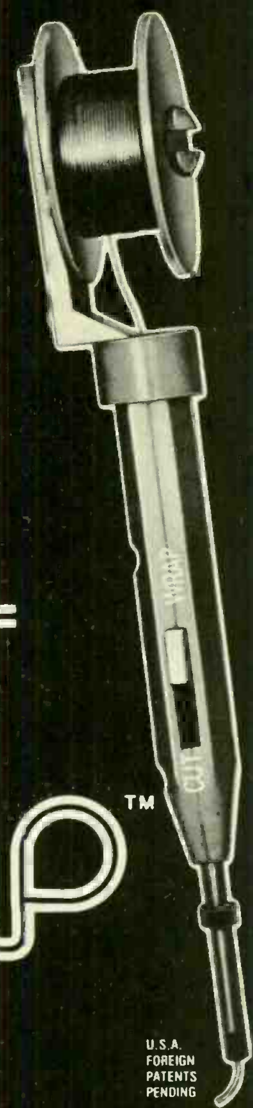

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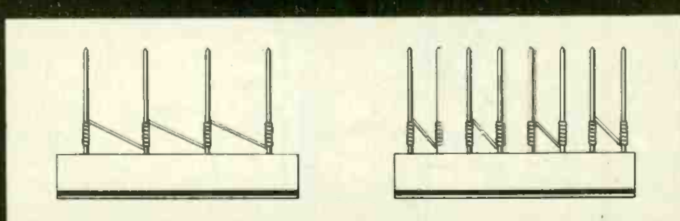

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CIRCLE 11 ON READER SERVICE COUPON

HI•FI REPORTS

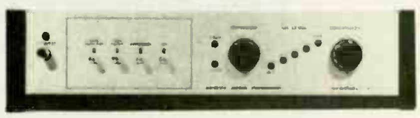
Signal Processors put distortion to work for you

by Gordon Sell

DISTORTION—that's a nasty-sounding word to the audiophile, but not all distorttion is bad. In fact, some hi-fi buffs are spending good money to add *good* distortion to the outputs of their speakers—the kind of distortion that is called signal processing.

Signal Processing. This impressive sounding term can be applied to a great many devices that are designed to make your system put out some pretty impressive sound. It is a deliberate alteration of sound to make the sound more pleasing and realistic. These devices range from click and pop removers, and graphic equalizers to dynamic range expanders and time delay processors. Here is a quick review of the types of signal processors.

Equalizers. An equalizer is essentially a fancy tone control, although no simple receiver tone control can hope to match even a cheap equalizer. This gadget fine tunes the frequency response of your system. If your speakers fall off at low and high frequencies you can boost either both ends, or only one end of the spectrum. A room can also have a bad resonance tuned out by cutting back at that frequency.



Heathkit's Active Audio Processor AD-1304 has noise reduction and dynamic range expansion circuitry. $199.95 (kit). Circle No. 1.

Choosing an equalizer is a matter of budget and need; you usually get more when you pay more. A very basic five-band graphic equalizer can be had for an economical price. It will have the capability to boost or attenuate specific center frequencies that have a fixed bandwidth. The number of frequencies you can vary and the amount you can vary them is the quality to look for. A five-band graphic equalizer is good for adjusting overall frequency response while ten-band units are more selective.

If you need to tune specific frequencies then you may need a parametric equalizer. This device is similar to a graphic equalizer but it allows the user to vary the center frequencies and roll-off of each of the bands. For example the low band might be centered anywhere from 20 to 1000 Hz and the boost or attenuation could be wideband or narrow band. To get the most out of any equalizer it takes a careful hand on the controls and an even more-careful reading of the instructions.

Technics SH-9010 is a paragraphic equalizer—each of the 5 bands can be adjusted for frequency and bandwidth. $500. Circle 57.

Click and Pop Eliminators. These super devices are for everyone who doesn't have a dust-free music room and who does scratch records. These machines detect the sudden transients that indicate noise and momentarily kill the audio for the duration of the noise. They then stretch the preceding sound to cover the gap. If you are rough on discs you'll wonder how you ever lived without one. Go to a good audio store and ask for a demonstration of SAE's Model 5000, Garrard's Music Recovery Module and Burwen's TNE 7000. Take enough money so you won't have to go home sad and empty handed.

Garrard's Music Recovery Module removes pops and clicks from damaged discs—intensity adjustable. $220. Circle number 54.

Dynamic Range Expanders. The dynamic range (range from the loudest sounds down to the softest sounds) of a live concert is roughly 100 decibels (dB). The best record albums have a dynamic range of about 70 dB and tapes about 60 dB so this is an area where a lot of musical realism is lost. Dynamic range expanders boost the peak sound levels and soften the quiet sections. The effect can be quite noticeable when you add an extra 7 to 10 dB of range. Most of these units are combined with other circuitry such as noise reducers and high filters.

The dbx II model 128 combines a dynamic range expander with dbx's noise reduction system. Costs about $450. Circle number 58.

(Continued on page 16)

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The "Edu-Kit" offers you an outstanding PRACTICAL HOME RADIO COURSE at a rock-bottom price. Our Kit is designed to train Radio & Electronics Technicians, making use of the most modern methods of home training. You will learn radio theory, construction practice and servicing. THIS IS A COMPLETE RADIO COURSE IN EVERY DETAIL.

You will learn how to build radios, using regular schematics; how to wire and solden in a professional manner; how to service radios. You will work with the standard type of punched metal chassis as well as the latest development of Printed Circuit chassis.

You will learn the basic principles of radio. You will construct, study and work with RF and AF amplifiers and oscillators, detectors, rectifiers, test equipment. You will learn and practice code, using the Progressive Code Oscillator. You will learn and practice trouble-shooting, using the Progressive Signal Tracer, Progressive Signal Injector, Progressive Dynamic Radio & Electronics Tester, Square Wave Generator and the accompanying instructional material.

You will receive training for the Novice, Technician and General Classes of F.C.C. Radio Amateur Licenses. You will build Receiver, Transmitter, Square Wave Generator, Code Oscillator, Signal Tracer and Signal Injector circuits, and learn how to operate them. You will receive an excellent background for television, Hi-Fi and Electronics.

Absolutely no previous knowledge of radio or science is required. The "Edu-Kit" is the product of many years of teaching and engineering experience. The "Edu-Kit" will provide you with a basic education in Electronics and Radio, worth many times the low price you pay. The Signal Tracer alone is worth more than the price of the kit.

THE KIT FOR EVERYONE

You do not need the slightest background in radio or science. Whether you are interested in Radio & Electronics because you want an interesting hobby, a well paying business or a job with a future, you will find the "Edu-Kit" a worth-while investment.

Many thousands of individuals of all ages and backgrounds have successfully used the "Edu-Kit" in more than 79 countries of the world. The "Edu-Kit" has been carefully designed, step by step, so that you cannot make a mistake. The "Edu-Kit" allows you to teach yourself at your own rate. No instructor is necessary.

PROGRESSIVE TEACHING METHOD

The Progressive Radio "Edu-Kit" is the foremost educational radio kit in the world, and is universally accepted as the standard in the field of electronics training. The "Edu-Kit" uses the modern educational principle of "Learn by Doing." Therefore you construct, learn schematics, study theory, practice trouble shooting—all in a closely integrated program designed to provide an easily-learned, thorough and interesting background in radio.

You begin by examining the various radio parts of the "Edu-Kit." You then learn the function, theory and wiring of these parts. Then you build a simple radio. With this first set you will enjoy listening to regular broadcast stations, learn theory, practice testing and trouble-shooting. Then you build a more advanced radio, learn more advanced theory and techniques. Gradually, in a progressive manner, and at your own rate, you will find yourself constructing more advanced multi-tube radio circuits, and doing work like a professional Radio Technician.

Included in the "Edu-Kit" course are Receiver, Transmitter, Code Oscillator, Signal Tracer, Square Wave Generator and Signal Injector Circuits. These are not unprofessional "breadboard" experiments, but genuine radio circuits, constructed by means of professional wiring and soldering on metal chassis, plus the new method of radio construction known as "Printed Circuitry." These circuits operate on your regular AC or DC house current.

THE "EDU-KIT" IS COMPLETE

You will receive all parts and instructions necessary to build twenty different radio and electronics circuits, each guaranteed to operate. Our Kits contain tubes, tube sockets, variable, electrolytic, mica, ceramic and paper dielectric condensers, resistors, tie strips, hardware, tubing, punched metal chassis, Instruction Manuals, hook-up wire, solder, selenium rectifiers, coils, volume controls, switches, solid state devices, etc.

In addition, you receive Printed Circuit materials, including Printed Circuit chassis, special tube sockets, hardware and instructions. You also receive a useful set of tools, a professional electric soldering iron, and a self-powered Dynamic Radio and Electronics Tester. The "Edu-Kit" also includes Code Instructions and the Progressive Code Oscillator, in addition to F.C.C. Radio Amateur License training. You will also receive lessons for servicing with the Progressive Signal Tracer and the Progressive Signal Injector, a High Fidelity Guide and a Quiz Book. You receive Membership in Radio-TV Club, Free Consultation Service, Certificate of Merit and Discount Privileges. You receive all parts, tools, instructions, etc. Everything is yours to keep.

FREE EXTRAS

• SET OF TOOLS
- SOLDERING IRON
- ELECTRONICS TESTER
- PLIERS-CUTTERS
- VALUABLE DISCOUNT CARD
- CERTIFICATE OF MERIT
- TESTER INSTRUCTION MANUAL
- HIGH FIDELITY GUIDE • QUIZZES
- TELEVISION BOOK • RADIO TROUBLE-SHOOTING BOOK
- MEMBERSHIP IN RADIO-TV CLUB: CONSULTATION SERVICE • FCC AMATEUR LICENSE TRAINING
- PRINTED CIRCUITRY

SERVICING LESSONS

You will learn trouble-shooting and servicing in a progressive manner. You will practice repairs on the sets that you construct. You will learn symptoms and causes of trouble in home, portable and car radios. You will learn how to use the professional Signal Tracer, the unique Signal Injector and the dynamic Radio & Electronics Tester. While you are learning in this practical way, you will be able to do many a repair job for your friends and neighbors, and charge fees which will far exceed the price of the "Edu-Kit." Our Consultation Service will help you with any technical problems you may have.

FROM OUR MAIL BAG

Ben Valerio, P. O. Box 21, Magna, Utah: "The Edu-Kits are wonderful. Here I am sending you the questions and also the answers for them. I have been in Radio for the last seven years, but like to work with Radio Kits, and like to build Radio Testing Equipment. I enjoyed every minute I worked with the different kits; the Signal Tracer works fine. Also like to let you know that I feel proud of becoming a member of your Radio-TV Club."

Robert L. Shuff, 1534 Monroe Ave., Huntington, W. Va.: "Thought I would drop you a few lines to say that I received my Edu-Kit, and was really amazed that such a bargain can be had at such a low price. I have already started repairing radios and phonographs. My friends were really surprised to see me get into the swing of it so quickly. The Trouble-shooting Tester that comes with the Kit is really swell, and finds the trouble, if there is any to be found."

SOLID STATE

Today an electronics technician or hobbyist requires a knowledge of solid state, as well as vacuum tube circuitry. The "Edu-Kit" course teaches both. You will build vacuum tube, 100% solid state and combination ("hybrid") circuits.

PRINTED CIRCUITRY

At no increase in price, the "Edu-Kit" now includes Printed Circuitry. You build a Printed Circuit Signal Injector, a unique servicing instrument that can detect many Radio and TV troubles. This revolutionary new technique of radio construction is now becoming popular in commercial radio and TV sets.

A Printed Circuit is a special insulated chassis on which has been deposited a conducting material which takes the place of wiring. The various parts are merely plugged in and soldered to terminals.

Printed Circuitry is the basis of modern Automation Electronics. A knowledge of this subject is a necessity today for anyone interested in Electronics.

Progressive "Edu-Kits" Inc., 1189 Broadway, Dept. 600-DJ Hewlett, N.Y. 11557

Please rush me free literature describing the Progressive Radio-TV Course with Edu-Kits. No Salesman will call.

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PROGRESSIVE "EDU-KITS" INC.

1189 Broadway, Dept. 600-DJ Hewlett, N.Y. 11557

CIRCLE 28 ON READER SERVICE COUPON

HI-FI REPORTS

(Continued from page 14)

Automatic Ambience. Audio time delay circuits and related ambience simulators can do wonders for your listening room. They work by recreating the acoustics of a concert hall. Using a pair of rear speakers these systems simulate the bouncing of sound off the rear wall of the concert hall by delivering the music to the rear speakers later than the front speakers. Since sound travels about one foot per millisecond, a 100-millisecond delay will make you think the front and rear speakers are 100 feet away and the concert hall is 200 feet long.

Advent's Sound Space Control allows up to 100 microseconds delay in stereo. Digial readout and reverb $595. Circle No. 61.

These units usually have reverberation controls to add width to the sound. The extra power amp need not be too large and the speakers don't have to perform well much over 8 kHz since the sounds from the rear are heard as subconcious reinforcement to the music from the front.

Sonic Hologram. I was recently treated to a demonstration of one of the hi-fi industry's more interesting signal processors, the Carver C4000 Sonic Hologram Generator. This unit is a preamplifier that works on the phase relationships of the sounds as they were originally recorded and emphasizes these relationships in the output to the amp and speakers. The result is a step beyond stereo. The sound no longer comes from the two speakers or a point in between; it appears to come from all over the room. A vocalist might be off to the left and forward of the left-most speaker while the bass guitar may appear to be further back and a little to the right. If you close your eyes, music is arriving from three dimensions rather than the flat plane of the speaker fronts. You'll find yourself pointing out various instruments. The effect only works when you are dead center on the speaker.

Carver's Sonic Hologram C-4000 creates a 3D listening environment when you are centered on the speakers. $850. Circle 63.

Phase Linear's Model 1000 Series II can expand dynamic range up to 7.5 dB on unencoded material. $349.95. Circle No. 60.

All this is accomplished without rear speakers. The unit also has a time delay feature with outputs for rear speakers, noise reduction circuitry, a dynamic range enhancer, infrasonic filter and selectable-crossover tone controls. It has a suggested retail price of $867.

MXR's ten octave-band graphic equalizer has ± 12 dB control over ten bands from 31 Hz to 16,000 Hz. Sells for $200. Circle 55.

There is not enough space here to discuss all the various models of signal processors. I have included photos of some of these units. Most of the companies make more than one type so get in touch with them to get the full story. If you circle the appropriate reader service numbers and send in the card you will receive pamphlets from the manufacturers. ■

DX central reporting

A world of SWL info!

By Don Jensen

WHAT HAPPENS WHEN you get 200 DX listeners together in one place over a weekend? A great time, that's what happens!

And that's just what happened in Minneapolis for three days last June when radio listening hobby enthusiasts got together for the 14th annual convention of the Association of North American Radio Clubs (ANARC).

ANARC is the umbrella organization linking all the major DXing clubs in the U.S. and Canada. Since ANARC affiliates itself with all types of DX clubs, those present at the gathering at Minneapolis' Radisson Hotel included SWLs, BCB medium wave listeners, utility shortwave and UHF/VHF "action band" monitors, FM and TV DX buffs and other specialists. Many of those attending were members of the various ANARC affiliated clubs, while some were not with any organization, but all were equally welcome.

Across the Globe. From California and Texas, New England and New York City, from the south, the midwest, and overseas they came to spend a weekend talking with fellow American and Canadian DXing fans. Especially exciting was the presence of a number of representatives of foreign shortwave broadcasters. There were a number of voices familiar on the air, there in the flesh.

From Swiss Radio International came Bob Zanotti. Roger Stubbe represented Quito, Ecuador's HCJB, and from Belgian Radio-TV was David Monson. Also on hand to discuss broadcasting with SWLs were Ekber Menemencioglu of the English language service of the Voice of Turkey and John L. Zakari, assistant chief engineer, external operations for the Voice of Nigeria. Representing the Voice of America was Stewart T. Spencer and Ian McFarland from Radio Canada International (RCI), whose voice is known to listeners of RCI's "DX Digest" program. Larry Magne, the North American representative of the Voice of Israel, was on hand too. And Rudy Espinal, popular host of the former "This Is Santo Domingo" program on Radio Clarin, Dominican Republic, was a special guest and featured speaker.

By the way, yours truly was at the ANARC convention manning the ELEMENTARY ELECTRONICS/COMMUNICATIONS WORLD booth, and it was a pleasure to be able to spend some time talking to some of you DX CENTRAL REPORTING readers!

ANARC Awards. After an informal mixer Friday, the program got into full swing on Saturday with informative programs and seminars during the day, and the convention banquet that night. A highlight of the banquet was the presentation of ANARC's annual awards. Robert Zilmer, a member of ANARC's Frequency Recommendation Committee and an active and well known SWL from Milwaukee, was selected to receive the ANARC Domestic DXer of the Year award. The Radio Broadcaster of the Year was Rudy Espinal, while the International DXer of the Year award went to Mike Hardester, now with the U.S. Navy at San Diego, California. For several years he provided SWLs with useful DXing information while stationed on Okinawa.

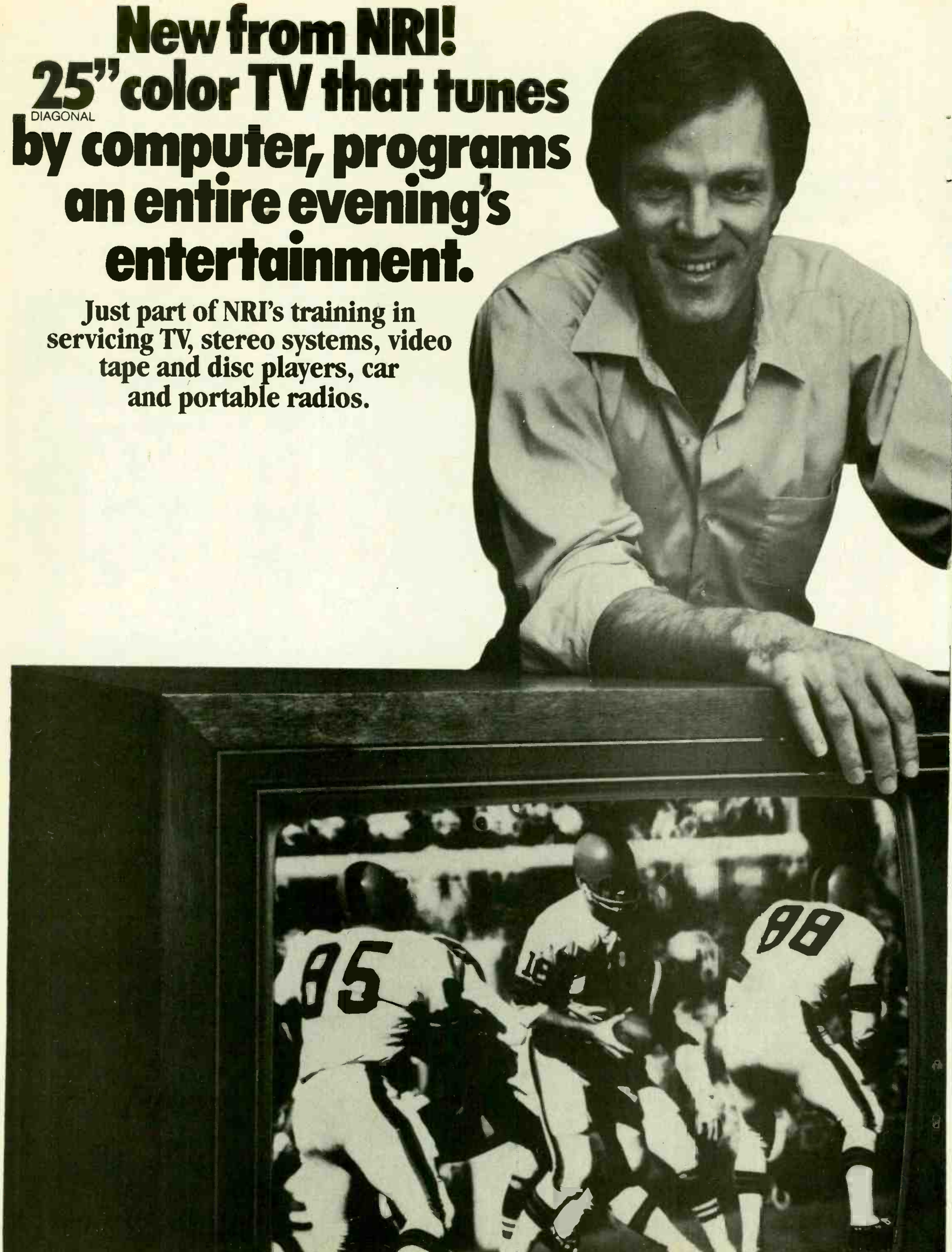
Sunday morning brought the by-now-famous HAP auction. HAP, the Handicapped Aid Program, is a DXer service to handicapped persons in the listening hobby.

The auction of a wide variety of collectables, including station pennants, mechanical pencils, bumper stickers, some radio gear and a mass of other station memorabilia and promotional material,

(Continued on page 82)

New from NRI! 25" DIAGONAL color TV that tunes by computer, programs an entire evening's entertainment.

Just part of NRI's training in servicing TV, stereo systems, video tape and disc players, car and portable radios.



Only NRI home training prepares you so thoroughly for the next great leap forward in TV and audio...digital systems. Already, top-of-the-line TV's feature digital tuning, computer programming is appearing, and new digital audio recording equipment is about to go on the market.

NRI is the only home study school to give you the actual "hands-on" training you need to handle servicing problems on tomorrow's electronic equipment. Because only NRI includes this designed-for-learning, 25" diagonal color TV with electronic tuning, built-in digital clock, and computer programmer as part of your training. With this advanced feature, you can pre-program an entire evening's entertainment... even key lock it in to control children's viewing.

As you assemble it, you learn how digital tuning systems work, how to adjust and service them. You work with the same advanced features used in the new programmable TV's and video tape recorders. It's exclusive NRI training that keeps you up with the leading edge of technology.

Exclusive Designed-for-learning Concept

The color TV you build as part of NRI's Master Course looks, operates, and performs like the very finest commercial sets. But behind that pretty picture is a unique designed-for-learning chassis...

the only such unit in the world. Rather than retrofit lessons to a hobby kit or an already-built commercial set, NRI instructor/engineers have designed this television so each step of construction is a learning experience.

As you build it, you perform meaningful experiments. You see what makes each circuit work, what it does, how it interacts with other circuits. You even introduce defects, troubleshoot and correct them as you would in actual practice. And you end up with a magnificent, big-picture TV with advanced features. One you can sell or use in your home.

Also Build Stereo, Test Instruments

That's just a start. You demonstrate basic principles and circuits on the unique NRI Discovery Lab,® then apply them as you assemble a fine AM/FM stereo receiver, complete with speakers. You also get practical experience as you build your own test instruments, including a 5" triggered sweep oscilloscope, CMOS digital frequency counter, color bar generator, and transistorized volt-ohm meter. Use them for learning, use them later for professional servicing of TV, audio, and video equipment.

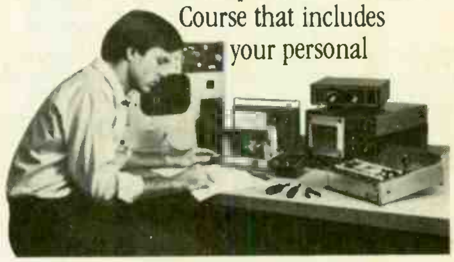
Complete, Effective Training Includes Video Systems

Using NRI's exclusive methods, you learn far more than TV servicing. You'll be prepared to work with stereo systems, car radios, record and tape players, transistor radios, short-wave receivers, PA systems, musical instrument amplifiers, electronic TV games, even video tape recorders and tape or disc video players. Your training covers just about every kind of electronic entertainment equipment available now or in the near future.

And because NRI has unmatched experience gained in over 60 years and a million students worth of training, your course is designed for ease of learning and practical utility. You need no previous experience of any kind. Starting with the basics, exclusive "bite-size" lessons cover subjects thoroughly, clearly, and concisely. "Hands-on" experiments reinforce theory for better comprehension and retention. And your personal NRI instructor is always available for consultation, ready with explanations, answers, and advice.

Send for Free Detailed Catalog... No Salesman Will Call

Get all the facts on this exciting course and its potential for you by mailing the postage-paid card today. Our free 100-page catalog includes color photos of all kits and equipment, complete lesson plans, convenient time payment plans, and information on other electronics courses. You'll also find out about NRI's new Computer Technology Course that includes your personal



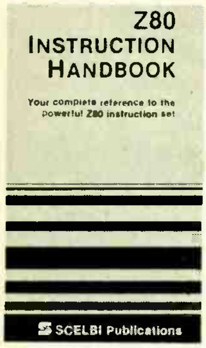
microcomputer. Or Complete Communications with 2-meter transceiver that gets you ready for opportunities in broadcasting, 2-way radio, microwave, and other growing fields. If card has been removed, write to:

NRI McGraw-Hill

NRI Schools
McGraw-Hill Continuing Education Center
3939 Wisconsin Ave.
Washington, D.C. 20016

BOOKMARK
BY BOOKWORM

For Microbuffs. This handy, compact reference, the *Z80 Instruction Handbook* by Nat Wadsworth, provides a clear explanation of the powerful Z80 instruction set. It's an ever ready instant reference that can be carried in your pocket. It explains the instruction set in meticulous



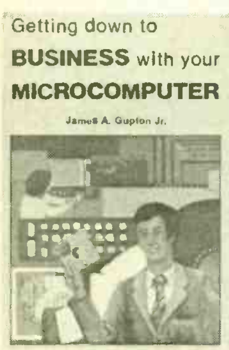
Pocket-sized reference manual

Soft cover
128 pages
$4.95

CIRCLE 35
ON READER SERVICE
COUPON

detail. Industry standard mnemonics are used throughout. Machine codes are presented in both octal and hexadecimal format. A convenient index lists all instructions alphabetically along with machine codes and timing information. Available at computer and electronics retail outlets or direct from the publisher (add 75 cents for postage/handling). Published by SCELBI Publications (a division of Scelbi Computer Consulting, Inc.), P.O. Box 133 PP STN, Milford, CT 06460.

Getting to Work. Here's a book that's a good introduction to what a microcomputer is, how it works, and how it can be used to solve practical problems. Entitled *Getting Down to Business With Your Microcomputer*, by James A. Gupton, Jr., it is written so it can be understood with-



How to make computers work for you

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245 pages
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CIRCLE 34
ON READER SERVICE
COUPON

out a technical background. It presents the basic concepts needed to understand microcomputers. Many small businesses buy a microcomputer to perform tasks such as accounting and inventory management, so the book contains several chapters on business applications written with the aid of a CPA. Microcomputers are suddenly appearing in many special applications. Typewriters combined with microcomputers offer the capability to store and manipulate words. Security systems offer more protection than before possible. Microcomputerized climate control systems make possible significant energy savings. To get a copy of this book by mail, add $1.35 for shipping and handling. Write to Sourcebooks, 18758 Bryant Street, Northridge, CA 91324.

More than 50 Years Old. Today we take such miraculous devices as computers, television sets, telephones, radios, and all our modern-day electronics devices pretty much for granted. It's hard to realize that radio, the forerunner of our great electronic age, burst upon the scene only three generations ago! In 1922 the Radio Corporation of America published a 128-page book that set the stage for its entry into the huge consumer market in a big way. Entitled *Radio Enters the Home*, it's subtitled *How to enjoy popular radio broadcasting, with complete instructions and description of apparatus.* "For those who desire to be entertained with radio concerts, lectures, dance music, and for the radio amateur and experimenter." Quaint scenes illustrate little tots listening to bedtime stories from the radio, a bearded farm-

Old time radio revisited

Soft cover
128 pages
$12.50

CIRCLE 33
ON READER SERVICE
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er listening to weather reports, a happy family listening to its new "Aeriola," Boy Scouts on "maneuvers" with their portable battery-pack equipment, and adults holding a dance (or perhaps a "radio party"). Jammed with pictures and drawings of apparatus made by RCA, General Electric, Westinghouse, and other great corporate names, it's a treasure trove of information for today's radio amateurs, radio collectors, and everyone interested in electronic matters. Copies of this 8½ x 11-inch book are available directly from The Vestal Press, P.O. Box 97, Vestal, NY 13850. Be sure to add 50¢ for shipping.

Take a Bus. The key to system expansion in a microcomputer is the bus through which the microprocessor communicates with the system components. So, *S-100 & Other Micro Buses* by Elmer C. Poe and James C. Goodwin, opens the lock to microcomputer understanding. Chapter 1 is a general discussion of bus basics to acquaint the reader with facts about buses. Then, the eleven most widely used bus systems are examined. Their mechanical data pinout designations, and bus signal definitions are explained so that the reader can understand the bus system of his or her own system, can evaluate the bus of another system, and can plan the interface of one bus to another. Besides the

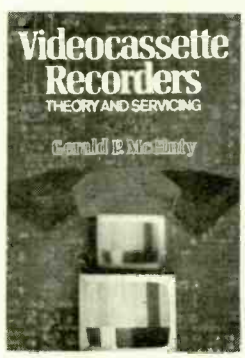
Examines most widely used bus systems

Soft cover
144 pages
$5.95

CIRCLE 36
ON READER SERVICE
COUPON

popular S-100 bus, the Benton Harbor Bus, Intel's Multibus, and the TRS-80 Bus are described in Chapters 3 through 5. The bus philosophy used in the Digital Group microcomputer is examined in Chapter 6. Then, Chapters 7 and 8 explain the workings of the SS-50 and the Exorcisor buses, while the KIM-1/KIM-4 systems are discussed in Chapter 9. Expansion boards for the Apple II (Chapter 10) and the PET (Chapter 11) microcomputers are then examined. Finally, the 48-line system bus that was developed by Ohio Scientific is explained. The last three chapters examine in detail the various ways to convert different bus signals to S-100 signals. Published by Howard W. Sams & Co., Inc., 4300 West 62nd St., Indianapolis, IN 46268.

VCR Repair. Here's a valuable text devoted exclusively to new home videocassette systems. *Videocassette Recorders: Theory and Servicing*, by Gerald P. McGinty is written especially for the repair technician and for students studying television servicing. The text focuses on



Soft cover
256 pages
$7.47

Repair your own VCR system

CIRCLE 38
ON READER SERVICE
COUPON

troubleshooting, repair, and maintenance of the basic videocassette formats currently on the market. The theory of video tape recording and the special features of modern home entertainment cassette recording systems are covered, in addition to the VCR electronic systems. For more information on *Videocassette Recorders: Theory and Servicing*, write to Gregg/McGraw-Hill, 1221 Avenue of the Americas, New York, NY 10020. ■

newscan

Electronics in the News!

Quarks Triggered Big Bang

Fundamental bits of matter called "quarks" may have triggered the so-called "big bang" evolution of the universe, according to a new theory published recently by an IBM scientist, Dr. Gordon Lasher. Quarks, whose long-suspected existence has only recently been generally accepted, strongly interact with each other to form nucleons—the family name for the protons and neutrons that make up the nucleus of an atom. It takes three quarks to form a proton or neutron.

Dr. Lasher, in a paper published in the June 11, 1979 issue of *Physical Review Letters*, theorizes that the universe began as an incredibly dense fluid of free quarks at a temperature at or near absolute zero and that the manner in which the quarks combined to make atomic nuclei ultimately led to the formation of the universe as we know it, with galaxies, stars and planets.

The big bang theory, Dr. Lasher says, "has no mechanism for generating the variations in density which lead to the formation of the galaxies, but rather assumes that these variations are present in the initial conditions.

"In my model, I'm proposing that the variations in density were generated during a transition from a state of free quarks to the present condition in which all quarks are bound into neutrons and protons. When this binding took place, a large amount of energy was released as heat. This produced the high temperature of the early universe which was the source of the cosmic background radiation.

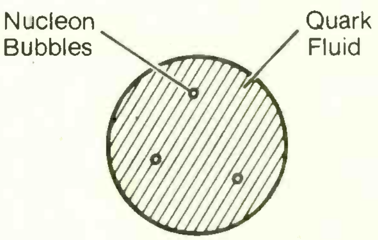
Dr. Lasher suggests that the transition from a universe filled with free quarks to one filled with nucleons began with the formation of microscopic bubbles of nucleons as early as one ten-thousandth of a second after the start of the universe. The bubbles appeared at random points in the quark fluid, each bubble expanding to contain a mass equal to that of a million suns.

The expansion occurred violently, the heat energy released by the binding of the quarks propelling a detonation, or shock, wave outward at nine-tenths the speed of light, causing the binding of more quarks into nucleons as each bubble grew. The bubbles expanded until they coalesced. Within a thousand seconds all the quarks had been formed into nucleons.

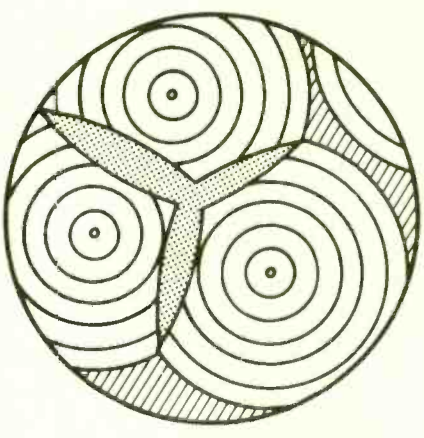
The nature of the process is such that more nucleons were formed near the center of the bubble than at the edges; resulting in the density variations needed to begin the process of gravitational collapse. Scientists believe gravitational collapse was responsible for the formation of all galaxies, including the one in which our solar system resides (the Milky Way). Only a two percent density fluctuation is needed to start gravitational collapse.

At the end of a thousand seconds, the temperature resulting from the quarks combining has reached the level calculated in the big bang theory, the conditions for gravitational collapse have been initiated, and the universe is expanding as we see it today.

"My model replaces the first thousand seconds of the big bang theory. Its aim is to explain the variations of density in the early universe by a physical process instead of just postulating them as a given condition," says Dr. Lasher.



Bubble Nucleation



Bubble Coalescence

An IBM scientist, Dr. Gordon Lasher, has published a new theory that fundamental bits of matter called "quarks" may have triggered the so-called "big bang" evolution of the universe. Quarks combine to produce the protons and neutrons (generically called nucleons) in atomic nuclei, releasing heat in the process. The drawings depict the formation of "nucleon bubbles" in a free quark "fluid." According to Dr. Lasher's theory, after the bubbles are nucleated, they grow as spherical detonation waves, causing the binding of more quarks into nucleons.

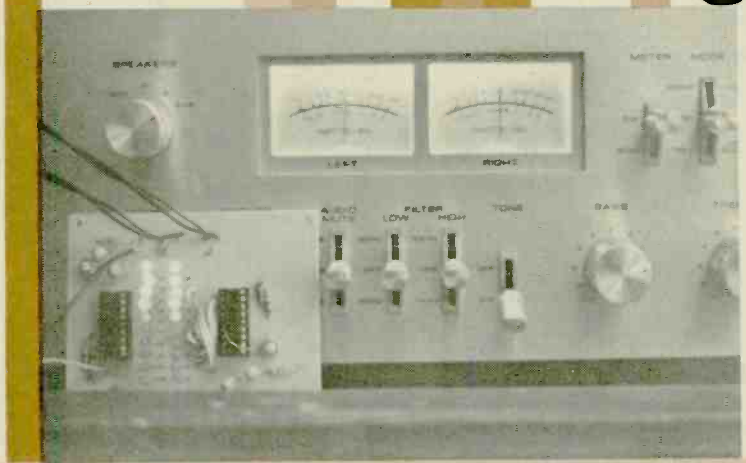
Catch a Shining Sun

"Let the sun shine in" is not just a song from *Hair*, but part of the thinking at Western Electric when it comes to solar

(Continued on page 84)

STEREO BAR GRAPH METER

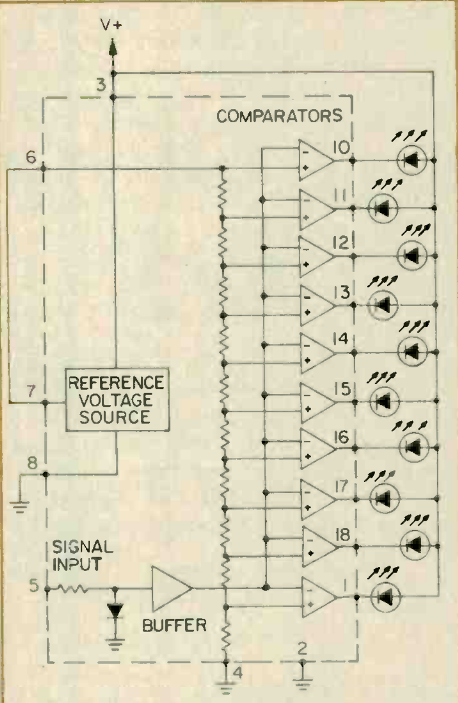
elementary Electronics Jan./Feb. 1980



Keep your watts RMS in balance with this simple project

by Anthony Caristi

IS YOUR STEREO SYSTEM delivering its full rated power into your speakers? Are you driving the amplifiers beyond their power rating, resulting in excessive distortion and possible damage to the amplifier or speakers? Is your balance control set for proper output from each side of your stereo system? There is no need to guess at the answers to these questions if you build and use this stereo power meter.



This is essentially a flow diagram of the LM 3914, with the LED output indicators in position (for reference). See the text for a more detailed explanation of the workings of the chip and the circuit as a whole.

Bar Graph Chip. National Semiconductor Corporation has developed a new integrated circuit which will drive up to ten LEDs in response to an analog voltage, and such a chip can be used to provide a visual indication of the instantaneous power being developed by an audio amplifier. By using two of these chips, you will be able to continuously monitor the audio output power of both sides of your stereo system. This will permit you to properly set the balance control for equalized outputs, and will alert you if there is a degradation of audio power due to a malfunction of the amplifier. It will also provide indication if you have set your volume control too high, resulting in excessive power being delivered to the speakers on audio peaks. The use of this instrument will provide positive indication of the status of your stereo amplifier, and is far superior to the human ear for power measurement.

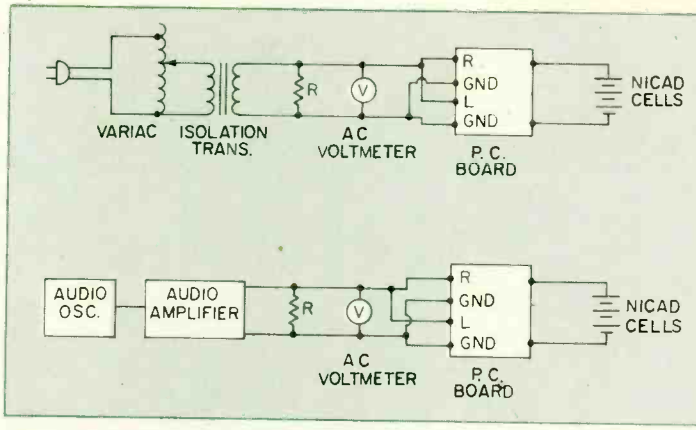
Most of the circuitry for this dual power meter is contained in the integrated circuits, resulting in an easy-to-build circuit with a minimum of external parts. It is not necessary to build the entire dual circuit if you are strictly interested in an audio power meter. By deleting about half the components you can have a simple, easy to use audio power meter which can be battery operated for complete portability and ease of use. Power measurement is attained by direct connection to the speaker terminals of the amplifier.

About the Circuit. The Stereo Power and Balance Meter consists of two identical circuits, each containing an LM3914 Dot/Bar display driver chip. Each integrated circuit consists of a precision ten step voltage divider, a voltage reference, and a set of ten voltage comparators with current limited outputs which are used to drive separate LEDs.

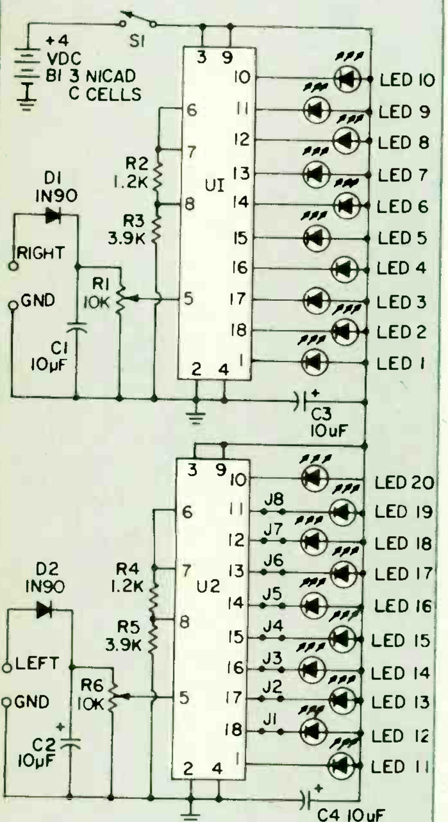
The ten step voltage divider network is connected between the built-in reference voltage source and ground. Each step of the divider provides a different sensing voltage for the positive input terminal of the comparators. The negative input of all comparators is driven by the signal input voltage applied to pin 5 of the chip, after being buffered by a resistor-diode network and amplifier. The output of each comparator feeds one LED of the display. It can be seen that this arrangement will result in any number of LED from zero to ten, being illuminated depending upon the level of voltage fed to the input, pin 5.

Since it is desired to drive the LM-3914 with only DC voltages at pin 5, a rectifying diode and storage capacitor has been provided to convert the audio voltage to DC. A potentiometer has been included so that the circuit can be calibrated to the proper power level for any audio system. The LM3914 will respond to audio voltages as low as 2.5 volts RMS, and is sensitive enough for the smallest of stereo systems. There is no limit to the maximum power range of the instrument, since the voltage divider action of the calibrating potentiometers will reduce the input driving voltage to the necessary value for the desired full scale range of the unit. A calibrating procedure is provided at the end of this article.

Power to drive the instrument is provided by a set of three NiCad cells connected in series which will deliver about 4 volts. The use of such cells allows the instrument to be completely portable. In addition, the excellent voltage regulation-characteristic of NiCad cells preserves the calibrated accuracy of the instrument. Any stable, 5 VDC power supply could be used with this unit. Just substitute it for the battery.



There hare two acceptable methods for calibrating the meter. The top diagram shows house current as a source, with an AC voltmeter in parallel with our meter for reference. At bottom, an AF generator is used as the AC current source.



STEREO POWER AND BALANCE METER PARTS LIST

- **B1**—Three, size C NiCad cells connected in series
- **C1, C2, C3, C4**—10 µF, 35-volt tantalum capacitor
- **D1, D2**—1N34/1N90 germanium diode
- **LED1 through LED20**—10 milliampere light emitting diode
- **R1, R6**—10K potentiometer
- **R2, R4**—1200-ohm, ¼ watt 10% resistor
- **R3, R5**—3900-ohm, ¼ watt 10% resistor
- **S1**—SPST switch
- **U1, U2**—LM3914 (Radio Shack 276-1707)
- **Misc.**—wire for jumpers and connections, printed circuit board, solder, mounting box, solder and hardware.

Construction. The entire circuit, with the exception of the power supply, is contained on a single sided printed circuit board measuring 2⅝ by 3½ inches. The set of 20 LEDs can be soldered directly to the board, taking advantage of the full lead length of each LED. This will permit the indicators to sit about ½ inch above the board so that the entire assembly can be mounted just behind the front panel of whatever enclosure you are going to use. You can cut two narrow openings in the enclosure, measuring about 1¾ by 3/16 inches, to accommodate the LEDs. Drill mounting holes in each corner of the printed circuit board and use ½-inch spacers to position the board away from the front panel. This type of construction avoids the problem of mounting twenty LEDs to the front panel, and makes the entire circuit easily removeable for service.

The LM3914 chips are supplied in 18-pin DIP plastic cases. It is strongly recommended that you use IC sockets instead of soldering the chips directly to the printed circuit board. It is almost impossible to remove a multipin IC that has been soldered to a printed circuit board without destroying the IC or printed circuit. Note that the orientation of the two integrated circuits are opposite to each other. Be sure to follow the proper layout as shown in the diagrams. Pin 1 of the IC is indicated by a small dot at one corner of the chip.

When mounting the LED's, capacitors, and diodes be sure to position these parts as shown. The circuit will not work if any of these polarized components are inadvertently placed in the board in the wrong direction. Double check before soldering them.

After you have mounted all components, you will note 16 unused holes in the board. To complete the circuit solder 8 jumper wires between U2 and one set of LEDs. Follow the schematic diagram and parts' location diagram for the correct location of the jumper wires.

External connections to the printed circuit board are accomplished by means of six wires. It is best to use different colors to avoid misconnections. Note that separate ground wires are used for each speaker connection, as well as the power supply negative lead. This is done to avoid ground loop problems which could cause unstable operation of the circuit. Follow the hookup as shown in the schematic diagram and you will have no trouble.

Checkout and Calibration. In order to calibrate the circuit you will need a source of AC power which can deliver up to 30 volts RMS into a low impedance load. For this purpose you can use your stereo amplifier driven by an audio oscillator, or you can use the AC power line and an isolation transformer. When using the power line for calibration you will also need a Variac to set the voltage to the proper level with an accurate voltmeter. It is not recommended to connect the circuit to the power line without the use of an isolation transformer. To do so would expose you to a shock hazard.

Before calibration determine the maximum power rating of your stereo amplifier, if you do not already know it. This will be the continuous power rating (RMS) of each amplifier. Then refer to the chart relating power to voltage in an 8 ohm system. If your power rating is not shown, or you have a system other than 8 ohms, you can easily compute the voltage for your system by the relationship

$E = \sqrt{P \times R}$

Where:

E = RMS voltage across the load in volts

P = Power in watts

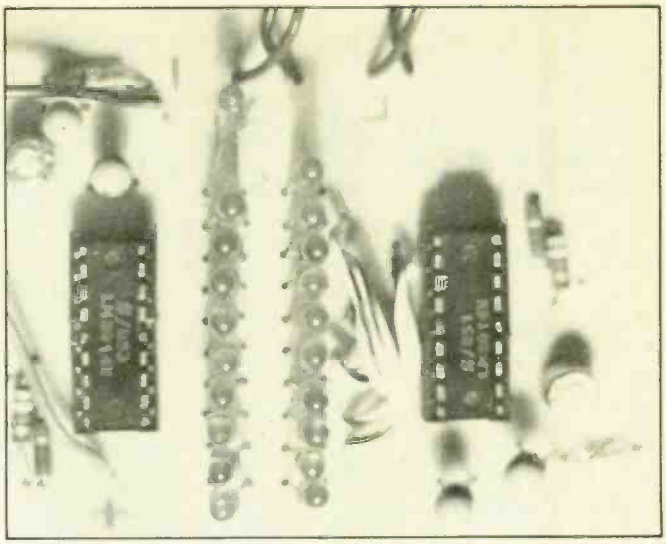
R = Speaker impedance in ohms

The diagrams here illustrate the proper connections to calibrate the unit using either the power line or audio amplifier as the source of power. Note that you will need a load resistor to simulate the speakers of your system, and an AC voltmeter to measure the voltage. The value of the resistor is not critical; you can use any value from 8 to about 50 ohms. What is important is to use a load resistor that has a sufficient power rating to handle the full power at which you will be calibrating the instrument. When using the audio amplifier as the source of power, the operating frequency can be anything in the low range. 100 Hz is recommended.

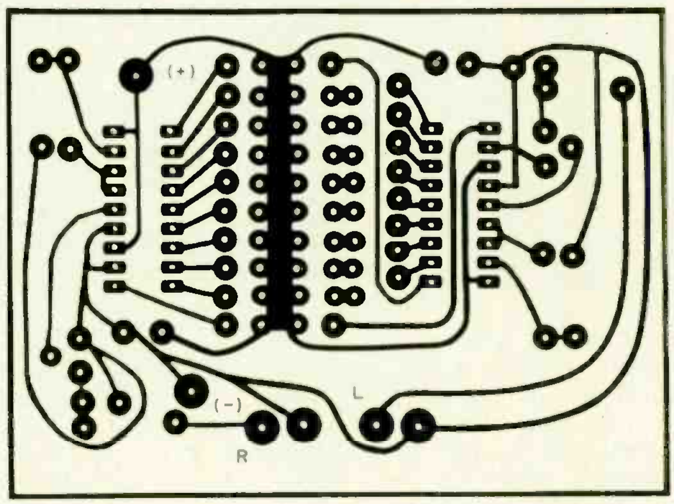
Adjust the Variac or audio amplifier so that the AC voltmeter reads the correct RMS voltage as indicated in the calibration chart (or your own calculation). Apply power to the printed circuit, using either the NiCad cells or AC power source. Note that as you vary R1 and R6 you will be able to illuminate some or all of the LEDs. The proper adjustment of both potentiometers will be the point at which the tenth LED of each set just becomes illuminated. You can check operation of the circuit by varying the level of the audio voltage fed to the printed circuit board. With zero volts drive, all LEDs will be extinguished. As you raise the voltage a pair of LEDs will light until you reach the full output power level at which time all 20 LED's will be illuminated. This completes calibration of the instrument.

Using the Meter. Connect the meter to your stereo system at the speaker terminals on the rear of the amplifier chassis. Be sure to use 4 wires for the connections and observe correct polarity of the leads as shown in the schematic diagram. Turn on your system and adjust the volume control for any desired volume level. If only 1 or 2 LEDs are illuminated it means that your power output at this listening level is very low. Increase the volume to illuminate more LEDs. Now you will be able to adjust the balance control of your system so that both sides of the system are delivering about the same output power. To test the maximum capability of your system, increase the volume level until the tenth LED of each set becomes illuminated on sound peaks. If the audio quality emanating from the speakers is still good, then your stereo amplifier is delivering the full power that was designed into it.

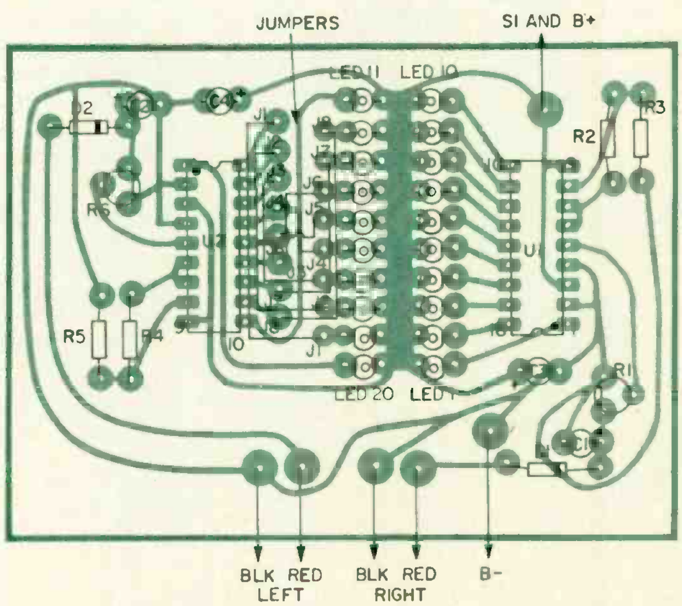
If it is desired to calibrate the power level of each LED, bear in mind that the circuit has a linear response to voltage, not to power. Thus, if only nine LEDs of each set are illuminated then the amplifier is delivering 90% of its rated voltage. This is equivalent to 81% of its rated power. The same square-law relationship holds for any number of illuminated LEDs. ■



This closeup of the meter shows the position of the jumpers and the LEDs. Small size allows you to build it into the cabinets of existing amps.



This is the full scale etching guide for the printed circuit board, seen foil side up. Check your finished board carefully for foil bridges and other errors.



The component placement guide for the meter also shows all off-board connections and the wiring of the jumpers. Pay careful attention to all of the jumper wiring.

SIMPLEX-A-THING

Stop missing those important phone calls

by Erik Hyypia

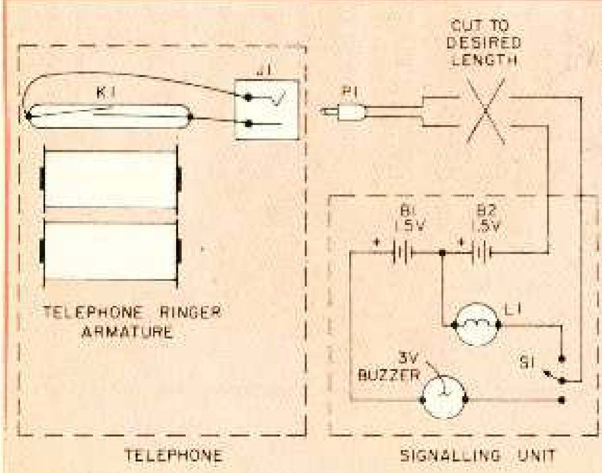
YOU WON'T MISS any more phone calls when out of hearing range of your telephone, if you add this simple remote signalling unit which alerts you to incoming calls by means of either a buzzer or blinker light. The unit is self powered for easy placement in any room in your home, or even outdoors where there are no AC outlets.

Now that you are permitted to own your own phone, you don't have to worry about the legality of add-on convenience devices, so long as you don't upset the phone company's circuits. This unit won't bother Ma Bell one bit because it is *not* electrically hard-wired to the telephone lines, and therefore cannot possibly cause voltage drops that could be detected at the phone company switching station. This gadget simply senses the normal ringing of the telephone with a magnetic reed switch placed near the telephone ringer armature. When the phone rings, the armature generates a strong electro-magnetic field, which trips the reed switch. The switch is triggered even if you turn the regular telephone bell off to provide completely silent signalling by means of a blinker light.

Construction. Solder a 14-inch-long insulated wire to each end of the reed switch and terminate these leads with a phone jack. Insulate the switch body before installation in the telephone, by means of a plastic sleeve or with electrical tape.

Open the telephone and remove the bell-clapper arm back to where it joins the armature-coil assembly.

Have someone call you on another dialer mechanism by gently lifting it off its mount. Find the ringer armature located just behind the dialer. You can recognize the armatur by following the telephone so that the regular bell rings. With the reed switch plugged into the signalling unit, and the selector switch thrown to the buzzer position, gradually move the reed switch close to the ringer armature. When the buzzer beeps in time with the telephone bell, the reed switch is correctly placed. If the buzzer sounds continuously, even when the phone stops ringing, back the reed switch off a little. In the telephone shown here, mounting was achieved easily by simply taping the reed switch to a large capacitor. ■



PARTS LIST FOR SIMPLEX-A-THING

- **B1, B2**—1.5-volt "D"-cell battery
- **J1**—subminiature phone jack, 2-conductor
- **K1**—miniature reed switch, SPST
- **L1**—1.5-volt flashlight lamp
- **P1**—subminiature phone plug, 2-conductor
- **S1**—SPDT toggle switch
- **MISC:** suitable mounting cabinet, 3-volt buzzer or screamer module, length of 2-conductor wire for extension, hookup wire, solder, tape, etc.

Innovations

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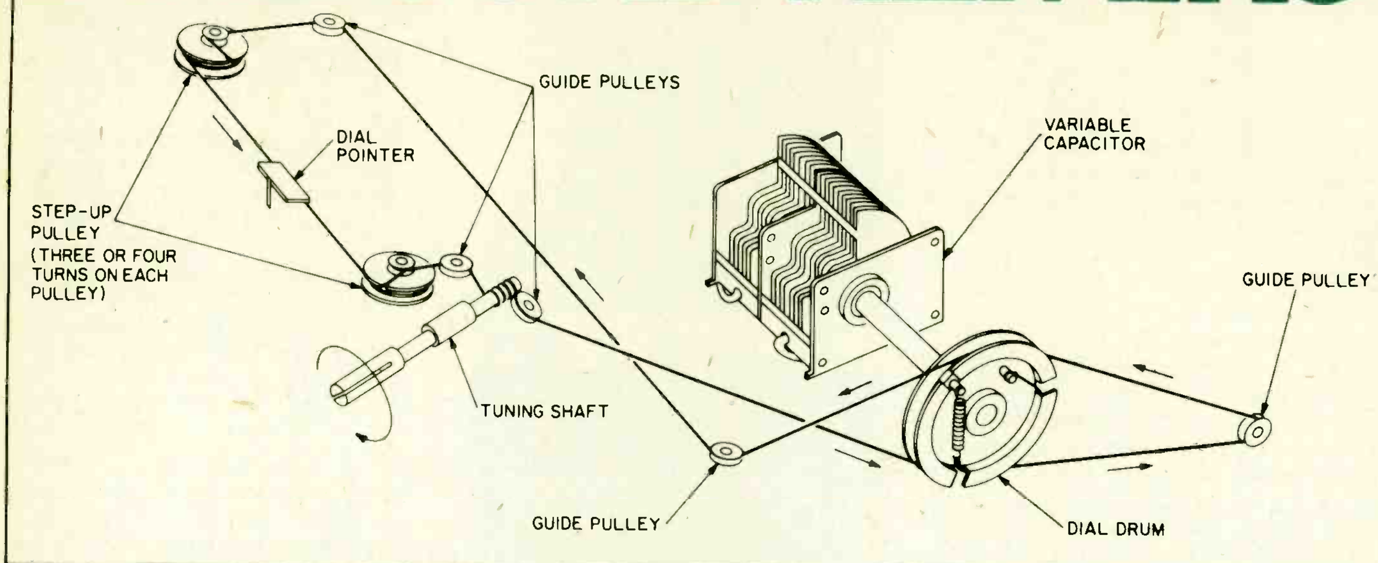
CIRCLE 1 ON READER SERVICE COUPON

DIAL CORD REPAIRS



The old pro shows how to get those radio dials back in line

by Homer Davidson

WHO EVER SAID THAT REPLACING a dial cord was quick and easy? Probably someone who has never had to do it. That simple little repair can quickly turn into a disaster, and if you want to avoid dial-cord disasters then read on. The photos and text should untangle just about any problem.

When you tune in a radio station the dial pointer should end up exactly at the right spot on the dial. To do this the dial pointer is linked to the variable tuning capacitor by a dial cord. When one moves 500 kHz so does the other. It's a simple, straightforward system but once in a while things go wrong.

Slip-Slide, Slipping Dial. Most dial cord slippage occurs at the tuning control knob and shaft (Fig. 1). If the dial cord sticks at one end and won't move or slides erratically across the dial assembly, suspect slippage at the tuning control shaft area. Either the dial cord has slipped off the tuning pulley, become stretched or is almost broken.

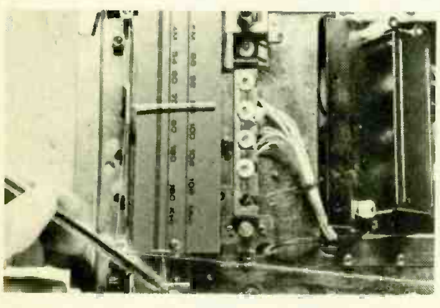


Fig. 1. The base of the tuning shaft is the best place to start looking for a source of slippage in the tuning dial cord assembly.

After removing the receiver chassis from the cabinet inspect the dial cord latch-up. Check the dial cord for broken or worn areas. Thumb the small dial spring for tightness and see if the cord is taut. Now turn the tuning shaft and notice where the cord is slipping or has stopped moving.

If the slippage occurs at the tuning shaft and the cord is only stretched, you may take up the slack by cutting off a turn or two on the dial spring. Replace the spring if necessary and rotate the tuning knob. This will snug up the dial cord. In case the dial cord is still slipping, check for at least three complete turns of cord around the tuning shaft. It's possible someone tried to rewind the dial cord and didn't put enough turns around the shaft. You can stop stubborn shaft slippage with liquid rosin (Fig. 2). In real difficult cases, apply a coat of phono dressing on the tuning shaft and let it dry. The cord may not slip again at this area but be real careful that you don't turn the dial assembly beyond either end or it's possible to snap the dial cord in two.

Repairing the Broken Dial Cord. Locating your favorite station with a broken dial cord is like trying to find a needle in a haystack. Sometimes the tuning capacitor will turn and then snag, but the dial pointer remains in one place. It's best to remove the radio from the cabinet and inspect it.

The dial cord can break almost anywhere (Fig. 3), but most dial cords wear out at the tuning shaft. The dial cord may also break or pull out at the plastic pulley. Sometimes the metal clips on the dial pointer will cut the cord when excessive pressure is applied. But, no matter where the dial cord breaks—replace it; don't waste your time trying to tie a knot.

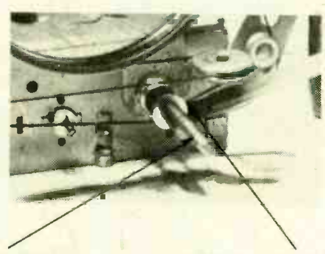


Fig. 2. An application of liquid rosin, usualy found in most TV repair supply shops will help to eradicate the dial cord slippage.

If a dial stringing guide is not handy, try to draw a schematic around and over the pulleys—just the way the dial cord is laying. Take a peek, you may have a dial stringing guide in your service literature. On large, deluxe dials,

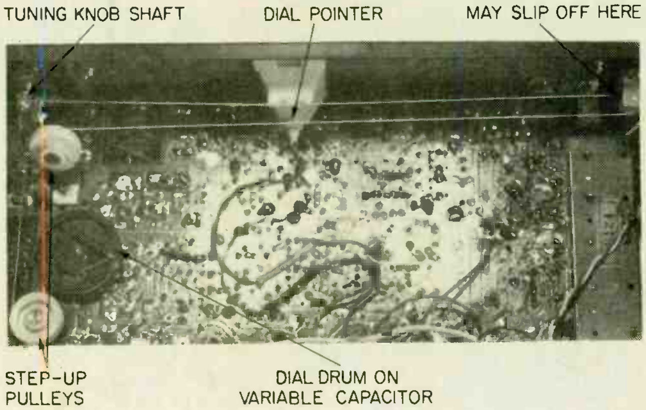


Fig. 3. No matter where the dial cord happens to part, don't waste time trying to tie a knot in the cord. Replace cord entirely with a new one.

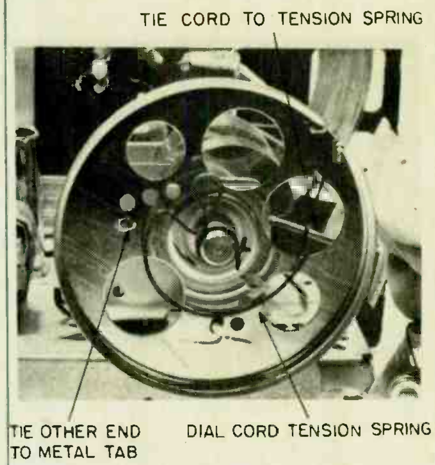


Fig. 5. Start the re-stringing by securing the cord to a tab or hole on the drum. End by securing the cord to the tension spring.

it's best to obtain a stringing guide before attempting the job.

Remember, when the tuning shaft is rotated the dial pointer must move in the same direction. If you start out wrong you may have to rewind the dial drum or reverse the dial procedure at the tuning shaft. Here (Fig. 4) is typical a dial stringing guide. Notice how the arrows and numbers indicate the method of restringing in the correct direction. Dial cord stringing is easy with these simple directions.

From Start to Finish. After a stringing dial guide or a drawing is made, select the correct size of dial cord. Most of the radio dial cords are either a medium or fine grade. They come in handy hanks or on spools. You may buy them at a radio supply store or local TV shop. Remove the broken dial cord pieces and lay them along side the new dial cord. Cut the dial cord about six inches longer than the two broken pieces. This will give you plenty of cord to complete the dial cord stringing procedure.

Start by tying a loop knot in the end of the cord and tying to a plastic hole or metal clip in the dial drum. Some technicians prefer to first tie the dial cord to the spring and keep it taut while stringing the whole dial assembly (Fig. 5). But I find it best to tie it to a solid point on the dial drum and then string the dial cord around the pulley guides.

On large dial drums, the dial cord may go half way around the drum before taking off to a guide pulley or tuning shaft. With a dial stringing guide, follow the numbers and proceed around the guide pulley, tuning shaft and dial drum assembly. If no direction arrows or numbers are shown on the dial schematic, start at the opposite end where the spring connects to the dial drum. Rotate the tuning capacitor to the end of rotation.

Make sure you have at least three turns around the tuning shaft area. If not, the dial cord may slip. Now finish going around the guide pulleys and at least half-way around the dial drum. If you have wound it correctly you should have about five inches of cord left. If not, double check the schematic.

Now, before tying the cord to the dial spring, hold it tight on the drum and slowly turn the drum and notice the direction of the cord movement. A small piece of masking tape placed upon the dial cord at the dial pointer area may help to show the correct direction. Remember the dial pointer will rotate in the same direction as the tuning shaft. Also, notice the dial pointer will go towards the higher dial number as the plates of the capacitor are unmeshed. When a station is found at 540 kHz the tuning capacitor plates are fully meshed.

With the dial cord moving in the right direction, all we have to do is stretch the dial spring and tie a knot or two. If the dial cord is not moving in the right direction, check the dial stringing guide to see if you started correctly at the dial drum and went around the tuning shaft in the right direction. Sometimes by reversing the direction at the tuning shaft you are back in business.

Now insert the end of the dial cord through the dial spring and pull it tight. Wrap about three turns inside the spring loop to prevent the spring from loosening up and tie a knot. Keep the cord and spring taut at all times. Check to see if the dial cord moves freely across the entire band. If so, tie another knot in the dial cord, at the spring loop, and place a dab of glue at both tied ends of the dial cord. Now install the dial pointer assembly.

Dial Pointer Assembly. Dial pointers

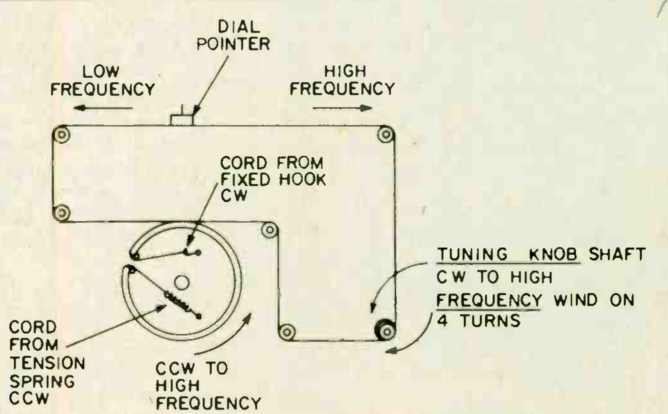


Fig. 4. This is a typical stringing guide. Of course, since almost every maker has its own layouts, this can only serve as a general guide.

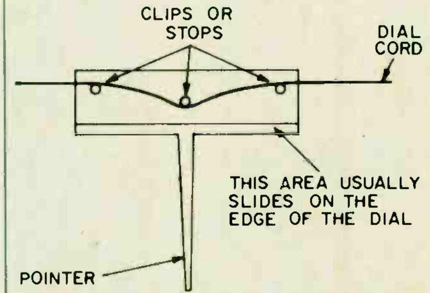


Fig. 6. A drop of plastic cement placed on the stops of the dial pointer will usually prevent the pointer from slipping around.

come in all sizes and shapes. Some plastic jobs just slip over the end of the dial shaft, while others connect to the dial cord and slide up and down the dial scale area. You may find the latter are either metal or plastic pointers. Generally, the dial cord is fastened at the back of the dial pointer with clips.

Clean the old grease and dirt from the top track of the dial pointer assembly with alcohol. Install the dial pointer after the dial cord stringing operation is completed. Pull or feed the dial cord around the metal or plastic stops. Then dab on a drop of cement to hold it in place (Fig. 6).

If the plastic dial pointer is broken you can repair it with epoxy cement. On long plastic pointers connect the two broken pieces with a stiff wire such as a single strand of guy cable. A small needle will also do the job by placing the wire or needle at the back of the plastic pointer and pressing it into the plastic pointer area with the tip of a soldering iron. Be careful not to apply a lot of heat or it's possible to damage the plastic pointer.

With long broken metal dial pointers, you can repair them with a stiff piece of number 14 copper wire. To straighten the copper wire, roll it over the work bench under a short piece of 2-by-4. Now scrape off the metal pointer area, apply rosin grease and solder the new pointer to the dial assembly. Smooth down the soldered area with a rat-tail file and touch up the pointer with red enamel spray paint. You may also use a piece of red spaghetti over the new dial pointer.

In case the one or more clips or plastic stops on the back of the dial pointer assembly are broken off, apply a coat of epoxy cement over the dial cord and let set up overnight. Before fastening the dial pointer into position, tune in a local station and clip the dial pointer in place. For instance, if you have a local station at 1400 kHz and another at 540 kHz tune in either station and fasten the dial pointer at the spot. Now, tune to the other station and see if it's right on the nose. You may have to jockey the pointer back and forth a little before cementing into position.

Keeping the Cord on Track. Keep the dial cord on track with masking tape when working upon the dial drum or servicing a component underneath it (Fig. 7). Here in a GE model C4332C radio, the AM oscillator transistor was replaced and the dial drum had to be disconnected to get to the soldered connections. Always apply the tape over the mouth or entrance where the cord enters at the dial drum. The dial cord will remain taut and will not unwind or fly off the guide pulleys.

Take note of the large dial spring. Here a large flat and curved spring keeps the dial cord taut in the dial assembly. Generally, you will find round-coiled springs in most dial cord drums.

(Continued on page 85)

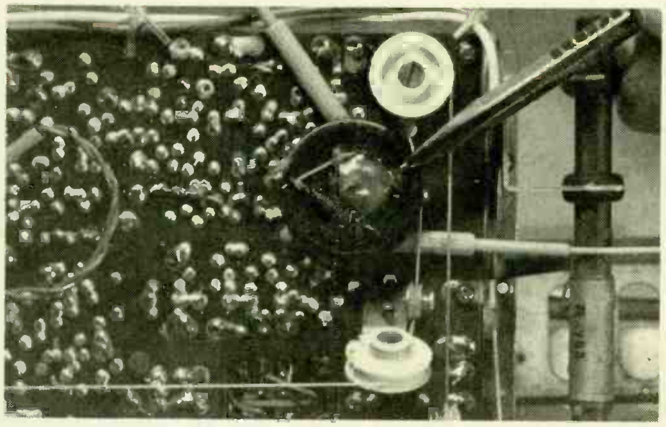


Fig. 8. You can repair a cracked drum without removing the cord by applying epoxy to the drum side facing you, and holding it as it becomes firmly set.

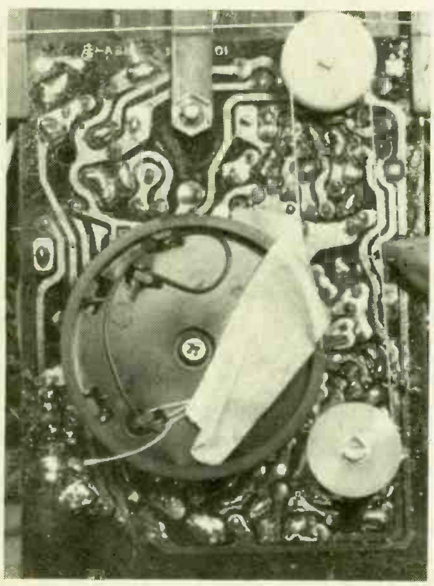


Fig. 7. If the dial drum must be moved during service, lock the cord onto the drum with tape to avoid unwinding the cord.

Fig. 9. If the original hole in the drum is broken, simply drill annother hole as close as possible to the location of the original.

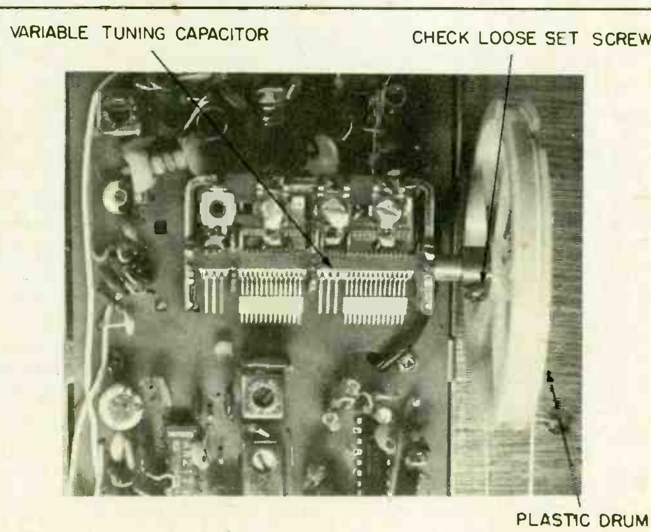
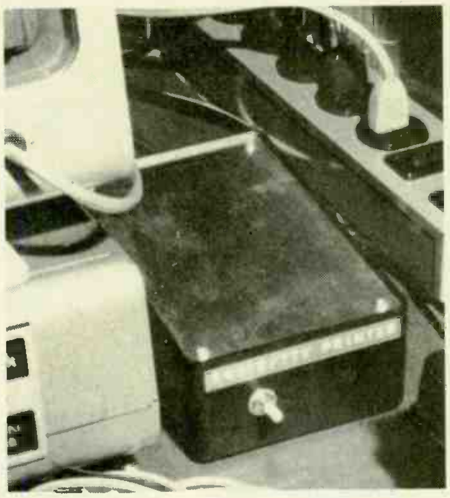


Fig. 10. If the dial pointer seems to hang up at random spots on the dial, suspect a loose set screw on the tuning drum. If the screw continues to work loose, apply a drop of Loctite™ to hold it securely on.

INEXPENSIVE TELETYPE INTERFACE

Add TTY capability to your RS232 I/O port and print for peanuts

by Herb Friedman



OUT IN THE REAL WORLD, away from the marketing pundits, are not to be found thousands of personal computer hobbyists waving thousand-dollar bills and screaming for line printers and DECwriters to interface with the RS232 output of their computers. The fact is, after paying for the basic computer, there aren't too many hobbyists who could afford to even think of purchasing a printer, in the near future, for something like $1000.

But the real world has thousands and thousands of model 33 teletypewriters and printers lying idle in schools, surplus dealer basements, and even in some computer hobbyists' homes. They make superb printers, whose copy is generally more readable than what you can get from most matrix (dot) printers. Out in the real world, you can pick up a surplus model 33 RO (printer only, no keyboard) for $150 to $300, or even less, assuming you can find some being scrapped by a school that converted from TTYs to DECwriters.

The problem is, how does one easily connect an RS232C computer output to a TTY, which requires a 20 mA loop for computer feed? The answer is an RS232C to TTY converter, which can be assembled for less than $1 to under $10, depending on whether you have a filament transformer lying around, or how fancy you want the cabinet.

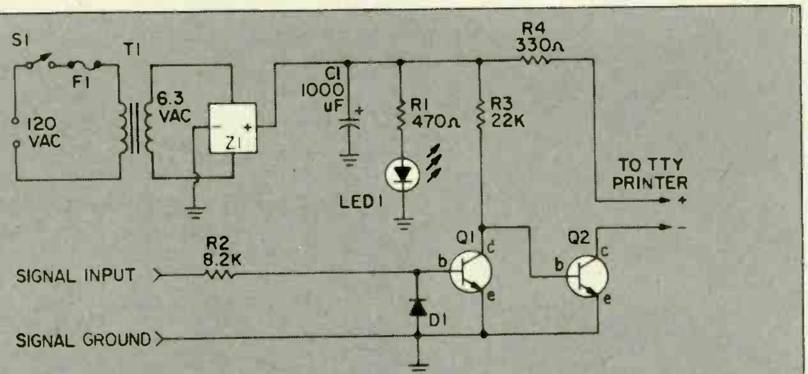
The converter takes the DC voltage output of an RS232C I/O port, and converts the computer signals to a 20 mA current loop. It is strictly a printing converter, hence its simplicity. (It does not need to handle the negative to positive 232C excursion, rather, it need only sense the negative "marking" voltage interruptions to convert to the TTY 20 mA current loop.)

Your only problem is to have the RS232 output at the 110 baud rate required by the TTY. If your computer's RS232 output is "locked" at 300 baud and higher, this converter won't work with a TTY. Most RS232 I/Os however, can be hardware or software programmed for 110 baud, as is true of the Heathkit and Radio Shack R232 I/Os, among others. You will also have to program the RS232 output for two stop-bits, though TTYs can work with one stop-bit if the printing speed isn't at maximum.

Using the Converter. Referring to the schematic, the output from the RS232 I/O connects to the converter input. Make certain that the I/O signal ground (or common) and the protective ground (if present) connect to the input ground. The TTY printer connects in series with Q2's collector—neither lead is grounded. Make certain that the positive (+) TTY printer connection connects to R3. The TTY's negative (–) connection does not mean *ground*, it isn't grounded to anything in the TTY; the (–) connection goes to Q2's collector. Set your computer's RS232 I/O for 110 baud, two stop-bits, and turn the TTY on to the LINE setting (not LOCAL). That's it. You'll get a TTY printout.

How It Works. Transistor Q2 is normally conducting (on), which is caused by bias applied through R2 to Q2's base. This allows current to flow through the TTY printer, holding it in the "marking" state. (If the TTY "runs wild," there is no current through Q2; either you have made a wiring error, failed to apply the power, or the RS232 I/O is not yet initialized—turned on.) Since the marking output from the RS232 I/O is negative, Q1 is held "open," and acts as a cut-off. When the RS232 I/O transmits characters, the "spacing" is sent as positive voltage bits, representing the characters. Each

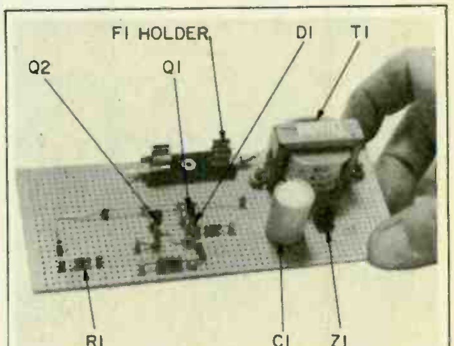
(Continued on page 83)



PARTS LIST FOR TTY INTERFACE

C1—1,000-uF electrolytic capacitor, 25-VDC
D1—silicon diode rated 25 PIV @ 1-amp
F1—¼-amp slow-blow fuse
LED1—small LED rated 1.75-VDC @ 20-ma
Q1, Q2—NPN switching transistor, MPS-3704 or equiv.
R1—470-ohm, ¼ or ½-watt resistor
R2—8,200-ohm, ¼ or ½-watt resistor
R3—22,000-ohm, ¼ or ½-watt resistor
R4—330-ohm, ¼ or ½-watt resistor
S1—SPST toggle switch
T1—transformer with primary rated 120-VAC @ 1A/secondary 6.3-VAC @ 300-ma
Z1—full wave rectifier bridge rated 50 PIV @ 1-amp

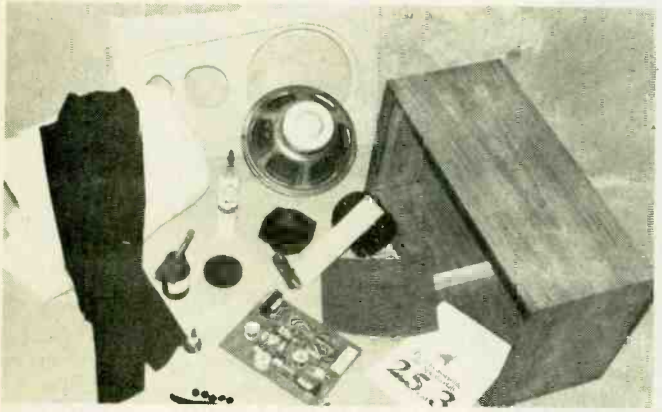
MISC.—cabinet, Molex connectors, perfboard, fuse holder, solder, hookup wire, etc.



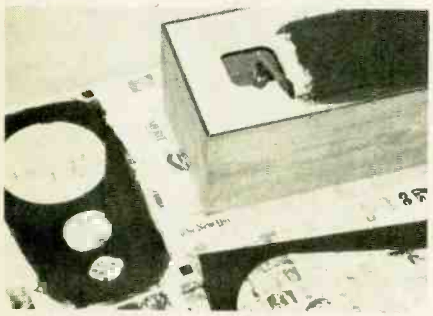
Breadboard offers the easiest method of construction for the TTY Interface.

Do-it-yourself speaker saves money and sounds like a million bucks

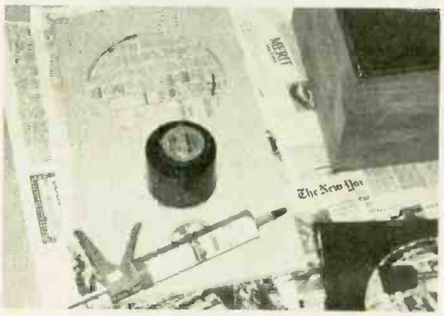
e/e assembles the...



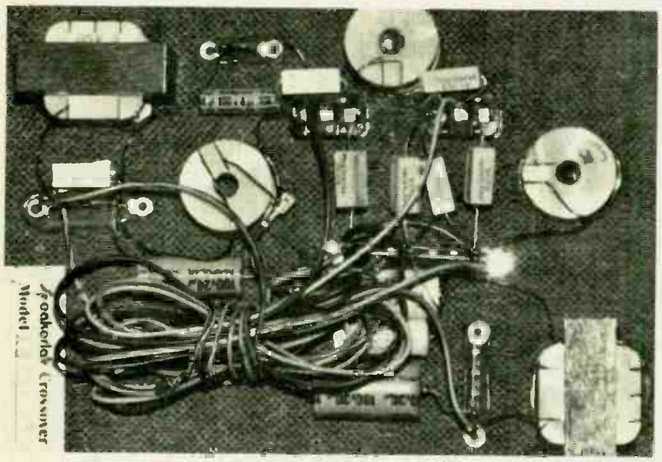
When the Speakerlab kit first arrives take a careful inventory of the parts. The kit includes everything from woofers to wet-and-dry sandpaper. Included are instructions for ordering any parts that may be missing.



Paint the front panel, grill frame and back panel with the black latex paint—two coats.



Glue the midrange enclosure to the back of the front panel. Be sure it's air-tight.



Next, glue the crossover network in place so that the control switches fit into the opening in the back panel. Untangle and separate the wires but don't pull any loose from the board. Be sure there are no air leaks around it.

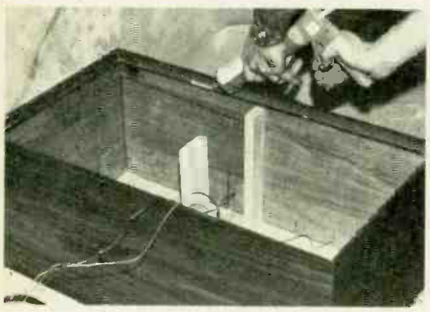
BACK IN THE EARLY DAYS of Hi-Fi enthusiasts used to build just about everything themselves, and the do-it-yourself audiophile was a respected member of the electronics hobbyist fraternity. They were skilled craftsmen who could not only work miracles with a few vacuum tubes and transformers, but also turn chunks of wood and metal into beautiful system cabinets. The speakers were often fantastic to look at even though, by today's standards, they were often acoustically primitive.

Nowadays the do-it-yourself audiophile has all but disappeared. Fantastic integrated circuit components and computer-designed speakers are next to impossible for the amateur to even think about matching. While electronics hobbyists have gained in terms of sound quality they have lost in terms of pride of craftsmanship.

Kit Building. Fortunately there is still a way to get great sound and the pride of being able to say "I built that . . ." and that is by building a kit. In addition, there is another good reason for building a kit—money. Kits usually cost about 25 to 50 percent less than a factory-finished product. A great example of what you can get in the way of kits is the Speakerlab 3 acoustic suspension speaker.

Speakerlab 3. As kits go this is one of the best. At $199-per-speaker, the kit comes with just about everything you'll need to put it together including paint, sandpaper, hook-up wire and oil for treating the wood cabinet. The only extras needed are clean rags for the oiling of the wood, a staple gun or a hammer if you use the grill cloth tacks, and a caulking gun which should cost no more than two-and-a-quarter at a discount hardware store—that's all!!

Even more impressive is what you do get. The Speakerlab 3 is a three-way acoustic suspension speaker; that means

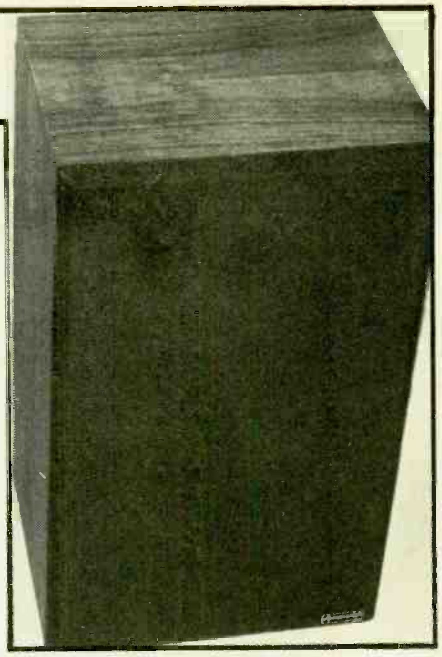


Glue around edge of cabinet, don't leave any gaps. Wire up the midrange enclosure.

Slip the front panel into place and allow the glue to dry. Add sound deadening material.

Wire up the woofer, midrange and tweeter and glue them into place. Let the glue set.

SPEAKERLAB 3



it has three speakers mounted in an air-tight cabinet. The low frequency woofer is 12 inches in diameter, there is a 8-inch midrange and a 1-inch dome tweeter. In terms of size (27¼x15½x 11⅞ inches) and appearance the speaker is impressive. Like all Speakerlab speakers it is available with a beautiful, thick walnut veneer finish that fooled our builder into thinking it was solid until he read the brochure. Speakerlab even uses the veneer on the inside of the cabinet, where you'll never even see it once it's built. As previously mentioned, the kit includes walnut finishing oil which works just like the old-time linseed oil and turpentine finishes. You apply a coat every now and then, and after a while it will develop a hard rich finish that will make it the pride of your listening room. If you want to save a bit of money you can order the Speakerlab 3 with vinyl, imitation walnut veneer for $30 less per speaker.

Quality and Quantity. The people at Speakerlab don't use nails or screws on their enclosures—everything is glued with space-age sealers so that there can be no sound destroying air leaks. The part of the kit that the buyer assembles also requires glue and the recommended glue is included.

Quantity is another thing that isn't lacking from these kits—There is more than enough glue, paint and what seems like a two-year supply of oil. Our assembler only used one speaker's supply of glue and just over one speaker's supply of paint to put together a pair of speakers.

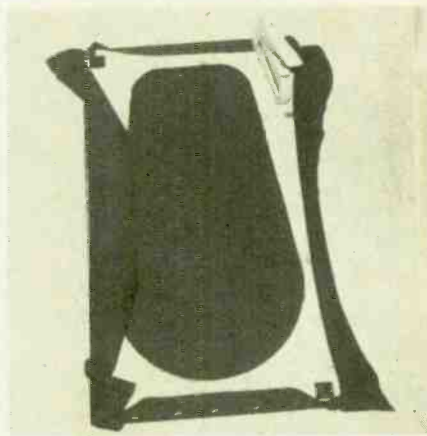
Putting It All Together. Assembly is easy with the step-by-step instruction booklet. You begin by painting the grill frame, front board and cabinet back with black latex paint. This is so that these parts won't show through the grill cloth. Use the paint generously and don't try to do it all with one coat. These parts are made of particle board and they tend to wear out the supplied, foam rubber, paint brush pretty fast, so do the smooth surfaces first and you won't have to go out and blow a whole 39 cents on a new brush.

The rest is easy—a little glueing and cutting. The crossover network, a very impressive looking piece of circuitry, is pre-wired so that all you have to do is connect the right wires to the right speaker's terminal lugs. The wires are pre-fitted with lug connectors, so you don't even have to solder anything. If the connector feels a little loose squeeze the flat side with a pair of pliers to make them grip better. This section was the only disappointment for our electronic hobbyist builder, who would have liked to solder a few resistors and chokes so he could better appreciate the excellent crossover electronics.

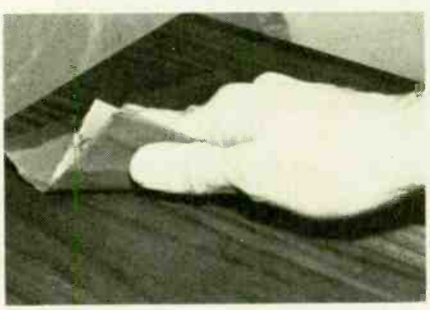
Mounting the grill cloth is the hardest part of the job. We followed the instruction book technique on one speaker and achieved good results although the thread lines were a little off. A member of our listening panel, who has had experience with building custom speakers, tried a different technique on the second grill with better results. Here is his technique:

First lay the grill frame face down, over the cloth and pull the bottom edge of cloth over to the backside of the frame. Stretch the cloth along the thread line and tack or staple the cloth

(Continued on page 85)



Familiarize yourself with the controls, and test the speaker out per the instructions.



Pour the walnut oil on the wood and sand it until smooth. Wipe off the excess quickly.

Staple or tack the grill cloth to the grill frame carefully. Good scissors needed here.

Trim off all the extra glue that squeezed out around the edges, and you're done.

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WILSON MARK IV HANDY TALKY

Superb VHF performance in a pocket-sized package

How do you spell "VHF FM?" Some folks spell it "M-O-T-O-R-O-L-A" and spend very large dollars. It can also be spelled "W-I-L-S-O-N." It sounds and looks like the high priced spread but doesn't cost like it. Let's take a look at one, find out what it does and whether it's what you want to use on 2-meter FM.

Pick up a Wilson Mark IV and you've got 5-watts of output power in a pound of "hand-held" or "clip-on-the-hip radio" that covers the entire 4 MHz of the 2-meter FM band. It is a six-channel, crystal-controlled rig with one channel supplied. You select the other five, putting in the crystals yourself, or having it done at the factory.

Rabbit Ears. The receiver is a dual-conversion superhet with two stages of filtering and is both sensitive and selective. Operating in the jungle of Manhattan, where there has to be more VHF radio activity than anywhere else on Earth, and where you expect all sorts of unwanted signals to sneak into innocent little radios, proved that this is not the case with the Wilson. We own three other 2-meter FM radios and this one keeps out unwanted signals the best. For the record, the numbers read like this: Sensitivity–0.25 uV for 20 dB quieting; Harmonic rejection–50 dB; Image rejection–60 dB; Selectivity– -80 dB at $\pm$12 kHz.

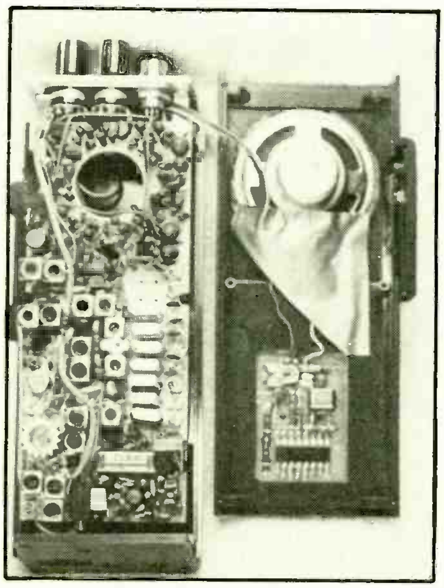
Big Talk. How Wilson gets that much receiver and 5-watts into that small case, and still leaves room for a touch tone pad and, in my case, two PL decks (sub audible encoders) is a small miracle. The 5-watts, by the way, is switchable to 2½-watts (there's a small switch on the bottom of the unit). It's nice to know you've got that much power when you need it, but use it sparingly since the transmitter draws 800 mA in the 5-watt transmit mode, which socks the single, fast-charge NiCad battery pack pretty hard. Using the Wilson in the 2½-watt position just about doubles the transmit time and draws about 500 mA. Transmit audio is crisp, and punches through on the other end. In receive, the Wilson eats like a bird, drawing about 15 mA in squelched standby, and about 100mA at its full-rated audio output, which is rarely needed. And, when it is needed, you'll hear it. Wilson is noted for excellent receive audio, so if you plan to spend time listening to your local repeater in the neighborhood disco, you won't miss any of the action. Be sure to show off the Mark IV while you boogie—it looks like a clone of the Motorola HT-220, so the spectators will think you're a cop, or even worse, a secret service agent; a great attention getting device better and cheaper than a Corvette.

Crystalling Up. The Wilson is easy to get into. Ten Phillips-head screws hold it together. Remove them, and everything is accessible as the case comes apart. As mentioned earlier, there is a lot of room in the case at the bottom for things like PL decks, and the documentation with the radio is excellent. You can get in there and play around if you've a mind to. There is a small circuit board that holds the receive crystals for 3 of the receive channels (D, E, & F). You have to remove the board to put the crystals in, and we would recommend that you have the factory do it, to save yourself the bother if you're not nimble-fingered.

Powering Up. A word about the battery pack (the BP-4). It is a sealed unit NiCad with a capacity of 500 mA/hr. It will accept a rapid charge of 110 mA/hr, and will top off in about 5-hours. As a rule, we like to use a slow charge rate on NiCads, because they live longer if not force-fed. The recommended charge rate for any NiCad is 10% of the battery's capacity, so the best rate for the Wilson battery would be 50 mA/hr. The Wilson WC-14 charger has a charge rate of 75 mA/hr, and this is the one we use most often. When a quick belt is needed, the BC-2 desk charger is used. If you use the BC-2, which has a charge rate of a 110 mA/hr, make sure that you don't overcharge, or you'll cook the battery to an early retirement.

When you first get the Wilson, slow-charge the battery, and then use the Wilson until the audio sounds distorted. This means that the battery is deeply discharged. Then give it aonther slow charge and discharge cycle. After 5 or so of these cycles, the battery will have developed a "memory" and will be broken in. This initial charge/discharge procedure should be followed with *all*

(Continued on page 85)



More compact than most units in its price and performance class, the Wilson can put you in "touch" with just about anyplace in the world with a few well-placed taps on the touchpad encoder for auto-patch.

MINI POWER MAXI FUN

Discover a whole new way to enjoy Amateur Radio

by Karl Thurber W8FX

Do you still get that "old thrill" out of hamming? Is the challenge gone, replaced with humdrum, "push-button" contacts made with 500-watt transceivers and multielement beams? There is nothing like trading *down* to low-power operation to restore that lost thrill, as many Amateurs both old and new have discovered.

Operation with low power, especially power levels under five-watts, presents a real challenge, both in eliciting the most from your equipment and from your operating skills, and the personal satisfaction and rewards are great. We're going to demonstrate that operating with very low power levels is indeed realistic and exciting, even under today's crowded band conditions, and we'll point out some of the equipment choices to make for best results.

Included are some tried-and-proven QRP operating tips that you can use for deriving the most enjoyable results from your gear. We'll also discuss some of the operating awards you can apply for, mention some of the contests you can enter, and tell you where you can get more information about a most interesting aspect of ham radio.

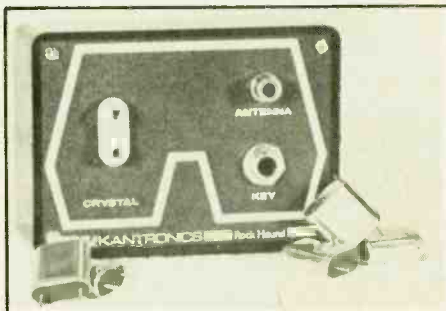
If you look up the Q-signal "QRP," you will see that it means "Shall I decrease power?" or "Decrease power" as a reply. But the term has also come to designate communications with lower power in general. Nobody has really defined low power, but for our purposes, consider "QRP" as being anything under 100-watts input; QRPp as 10-watts in, or 5 out; and "milliwatt power" as 2-watts in, 1-watt out. For simplicity, we will talk about QRP as collectively covering all three.

QRP? Why Should I? How important is transmitter power in the ham station? On the one hand, Amateurs are allowed to run power levels up to 1,000-watts input—yet many have good luck with extremely low-power, milliwatt-level stations. No doubt, the higher-powered station has a distinct advantage in "getting out" and making contacts. But one shouldn't *overestimate* the importance of high power—when propagation conditions are favorable, and good operating techniques are used, the advantage narrows and even the lowest-powered station has a chance.

A look at the mechanics of the decibel and its relationship to the familiar "S-unit" will help to place relative power levels into perspective. First of all, raising the strength of a received signal by one S-unit (6 dB) requires that *transmitter* power be upped by a factor of four. Expressed in decibels (dBs), a 4-to-1 increase in power is equivalent to a 6 dB increase, a 2-to-1 increase to 3 dB, and a 25% increase to but 1 dB. Relating S-units to transmitter power levels and received signal strength, assume that a 1 KW (1000-watt) transmitter is laying down a solid S-9 signal into your receiver. What happens—all other conditions being equal—when power is reduced? With power quartered to 250-watts, the S-meter would register around S-8; at 62-watts, S-7; at 16-watts, S-6; and at four-watts, S-5. Reducing power even further into the "QRPp" area, one-watt would yield an S-4 signal; ¼-watt, or 250-milliwatts, S-3; 62-milliwatts, S-2; and 16-milliwatts, S-1. From these figures, it's apparent that the effect on received signal strength isn't all that great even with large changes in transmitter power. In other words, it takes a very large power increase to cause a dramatically stronger signal to be received on the other end. On the other hand, if you can get through with medium or high power, your signal is likely to make it even with very low power; you'll just be weaker, and you won't cause so much QRM to other operators. Yes, QRP works!

QRP Equipment and Accessories. Getting your QRP station on the air

K4KJP is what you might term a "fair weather" QRPer. He uses photocells to convert sunlight into electrical power for his QRP rig. Since QRP power requirements are low, this isn't as hard to do as you might suspect.



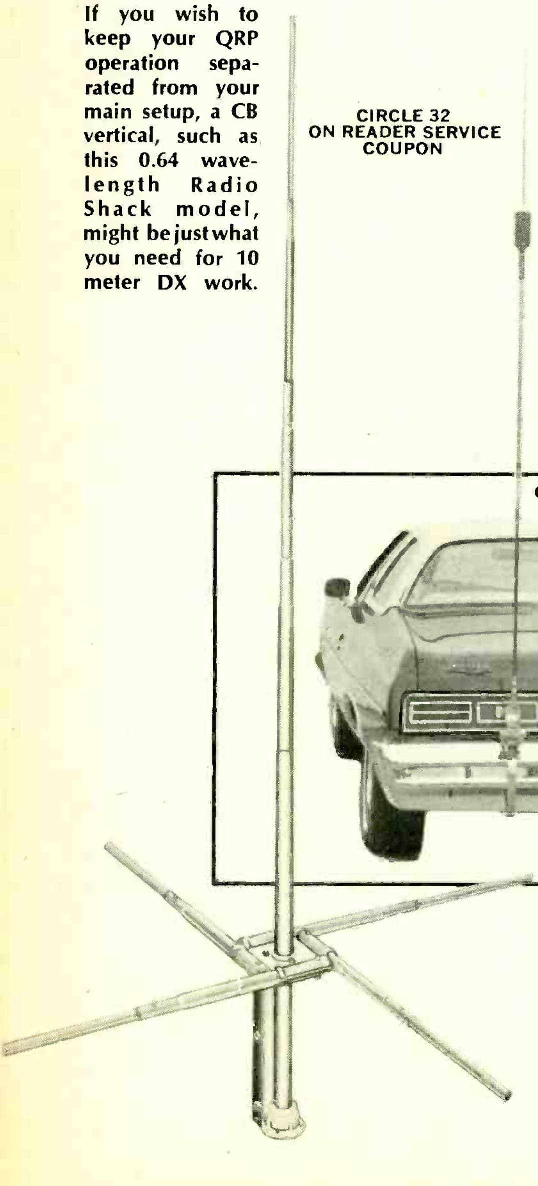
CIRCLE 65 ON READER SERVICE COUPON

Kantronics' popular Rock Hound crystal controlled transmitter will fit in your pocket or purse in case you ever feel the need to call CQ from your favorite restaurant. It goes without saying that this is an excellent emergency rig.

isn't difficult. Building the transmitter can be a particularly "fun" project, since QRP transmitters are usually simple, straightforward affairs and use a minimum of components. Construction plans for QRP transmitters (and some transceivers) abound in the pages of all the popular ham magazines, and are also found in the *ARRL Radio Amateur's Handbook* and the ARRL booklet, *Understanding Amateur Radio*.

If you lean toward "store-bought" equipment, several QRP transmitters and transceivers are available. The Ten-Tec Argonaut 509 is probably the most popular SSB and CW transceiver, while the Heath HW-8 is a good bet if you'd like to construct a kit. MFJ's ready-made MFJ-40T transmitter is a good selection for 40-meter single-band operation (especially when used in tandem with the accessory VFO, the MFJ-40V). A popular two-band transmitter is the new Kantronics RockHound (for 80 and 40) along with the matching "Freedom" VFO. If your taste runs to older equipment, the Heath HW-7 and Ten-Tec PM series are usually available at reasonable prices at hamfests and swap meets. All of these rigs are very portable—they can be powered by lantern or storage batteries and taken along on field days or used on vacation trips without recourse to AC lines—and most can be used mobile in a car, plane, boat, or RV. Also, if you shop for used QRP gear, seek out solid-state equipment; it will be lighter and more portable than older vacuum-tube gear and will draw much less current, a real consideration in portable operation from batteries. Also, transistor output circuitry is usually low-impedance and broadbanded, meaning that there is little time-wasting tuneup required when shifting frequency.

If you wish to keep your QRP operation separated from your main setup, a CB vertical, such as this 0.64 wavelength Radio Shack model, might be just what you need for 10 meter DX work.

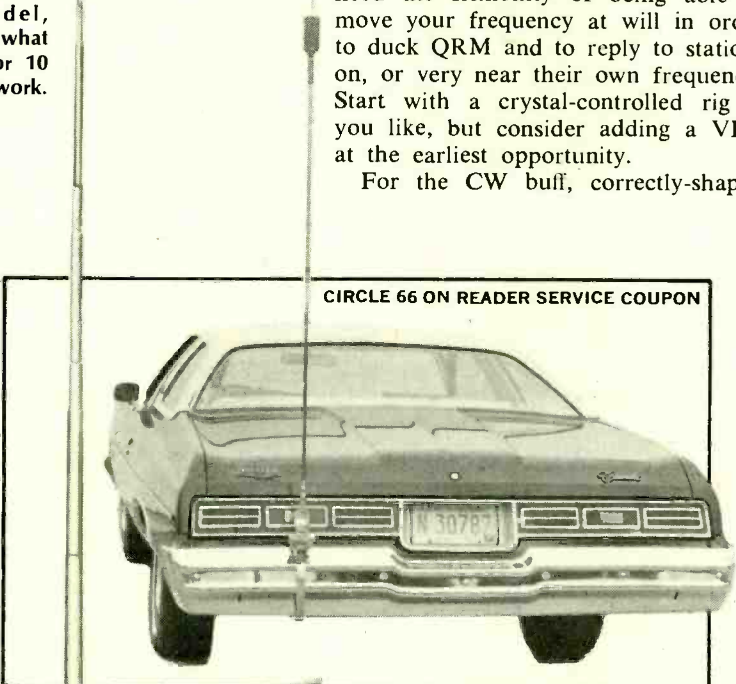


CIRCLE 32 ON READER SERVICE COUPON

An important point: A VFO is a near-must for satisfactory QRP work; crystal control is just too limiting to be useful. Much more so than when operating at higher power levels, you need the flexibility of being able to move your frequency at will in order to duck QRM and to reply to stations on, or very near their own frequency. Start with a crystal-controlled rig if you like, but consider adding a VFO at the earliest opportunity.

For the CW buff, correctly-shaped keying is especially important in effective QRP work. A weak but clean, crisp, and click-free QRP signal can often slice through interference better than far stronger signals with poor keying characteristics. A good keyer is a help, too, in sending easy-to-copy code and in reducing operator sending fatigue.

CIRCLE 66 ON READER SERVICE COUPON



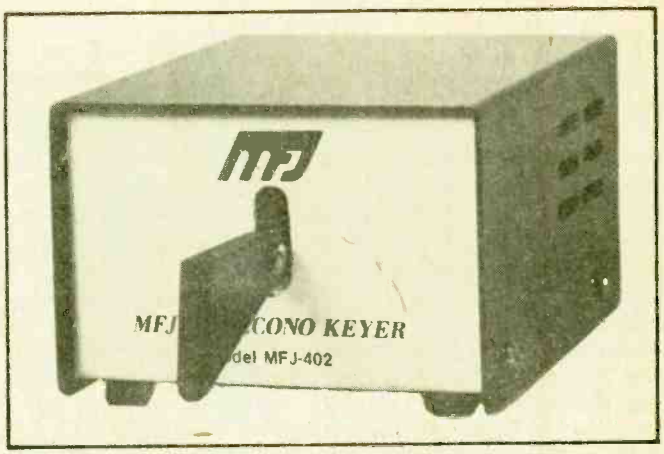
Newtronics' Hustler series of mobile whips provides the ham with another venue for QRP (or regular power) work. The execllent radiation patterns from these high-quality antennas make them highly suitable for QRP DX applications.

If you're really serious about QRP, you'll soon tire of the single-band transmitter, since if band conditions are poor on *that band*, you're stranded. It's better to purchase or construct a rig that works on two or more bands. In fact, depending on the gear you presently own, you may find it unnecessary to acquire separate QRP equipment. Many transmitters and transceivers can be scaled down to QRP power levels simply by adjusting the CW level, microphone gain, or final amplifier bias controls; the rigs will loaf nicely at such low power levels.

The other half of the QRP equation is the receiver. A stable, sensitive and selective receiver is especially important, since many of the stations you work will also be running QRP and they will be putting in relatively weak signals. And, when you make a QRP contact, you don't want to lose it because of some receiver fault. If your receiver lacks sensitivity, install a high-gain preamplifier or preselector (Palomar Engineers and Ameco both sell excellent units). If selectivity is a problem, consider the addition of an active audio filter; the Autek Research QF-1, and any of the half-dozen MFJ audio filters are worthwhile accessories and are relatively inexpensive. Not to be overlooked is the accuracy of receiver calibration, important since you will likely be using your receiver to cross-check your transmitter's frequency. If your receiver doesn't already contain one, a frequency calibrator that places known marker signals every 100, 50 and 25 kHz is a welcome addition for determining band and sub-band edges.

A costly, elaborate antenna system isn't necessary for satisfctory results. While directional beams and quads will have the same beneficial effect at QRP power levels, the effect is no more dramatic than the raw power differences discussed earlier. A full-size half-wave dipole at least 30-feet high, or a quarter-wave vertical will do a fine job. The keyword is *antenna system efficiency*, not elaborateness. For best results—to make every milliwatt count—the antenna should be resonant at the operating frequency and the feedline should be properly matched to the antenna and kept to a minimum length. A small antenna tuner, preferably one with a built-in RF wattmeter/SWR bridge, can

QRP operation connotes compactness and simplicity of equipment. A keyer and antenna tuner from MFJ fit this concept.



Don't be misled by size—it's just as easy to find quality in a compact unit as in a larger one. You just have to squint a little.

be used to "fine tune" your antenna system and match it to your transmitter or transceiver. The coupler also helps to reduce harmonic radiation from your rig, a common problem particularly with simple QRP gear.

Paying close attention to these small, but very important equipment and antenna details can make all the difference in the world to your overall QRP operating results.

QRP Operating Technique. The difference between success and failure in QRP work is largely dependent upon operating skill, technique and perseverance. The QRP operator must rely heavily on his skill, rather than on the brute force of high power. Besides such basics as having a clean signal and using a good antenna system, there are a number of things you can do to increase your operating effectiveness:

Determine when band conditions are best for low-power operation. Follow propagation reports closely, realizing that while poor band conditions may make the high-power station weaker on the other end, QRP signals may just not "make the trip" at all. For example, on 40 meters, probably the most popular QRP band, conditions for low-power operation are usually best during the daylight and early evening hours; later on, skip lengthens out and signal levels decrease somewhat. Watch the strength of received signals for a clue as to propagation conditions and go after DX when S-meter readings are up. Bear in mind, too, that operating activity and interference are greatest in the later evening hours and on weekends; your results may improve if you operate outside these periods. Having a bandswitching QRP rig helps too—you can pick and choose your band at will in order to take advantage of changing band conditions.

Choose your band carefully. Forty, fifteen and ten meters are the most popular bands with QRP'ers. Eighty's QRN (static) level is high, especially in the summertime, and this often overwhelms weak QRP signals. Twenty is kilowatt alley, and your chances of simply being overwhelmed by higher-powered stations are great. My personal favorite is ten, where even the lowest-powered stations can work the world with ease. Excellent conditions now existing on the band at the 11-year sunspot peak make for good low-power DX, both for Novices (in the 28.1-28.2 MHz CW band segment) and for QRP SSB'ers using converted Citizens Band sets on the phone segment. A rule I try to observe is to use the highest frequency band that is open for DX, and right now it's usually ten, at least during the daylight hours. However, many QRP'ers prefer 40 meters, especially for ragchewing; conditions are usually fairly predictable and reliable, with 400 to 600-mile contacts during the day the rule, and worldwide DX possible at night.

Know the right frequencies. Stay flexible, and know *where* to operate in the band. Many QRP'ers hang out on the "unofficial" QRP frequencies. Some popular CW spots are 1,810, 3,540, 3,560, 7,040, 7,060, 14,060, 21,040, 21,060, 28,040, and 50,360 kHz; Novice frequencies are 10 kHz inside each sub-band. On SSB, 1,810, 3,985, 7,285, 14,285, 14,340, 21,385, 28,885, and 50,385 kHz are popular calling and working frequencies. Although most QRP'ers frown on CQs as a way of making contacts, a "CQ QRP" on any of these frequencies will often bring a snappy reply from another flea-power station. Choose a part of the band that is not overly crowded; a good QRP signal can sometimes punch through QRM, but it is generally better to stay clear of interfering signals. If you operate on 40 meters, be especially careful to avoid the high-power foreign broadcast stations' frequencies; you can't compete with them!

Call the other fellow on his frequency. You will enhance your chances of working those whom you call if you can respond on or close to the other station's operating frequency. A crystal-controlled QRP transmitter is at a distinct disadvantage; a VFO (variable frequency oscillator) will greatly improve your rig's flexibility. In fact, a VFO is almost a necessity today, especially since even Novices are no longer limited to crystal control, and the habit of "tuning the band" for replies to one's CQs is fading rapidly. If you don't care to use a VFO, at least purchase a handful of "rocks" (crystals) to allow you to spot yourself across the band.

Listen before calling. Before calling a station, be sure no one else is; never strike out in the blind for a DX station that you can't hear, simply because you hear others calling. In fact, most experienced QRP operators do not waste their time calling CQ. They know that most hams won't reply to a weaker station if a scan of the band indicates that stronger ones are available to work. It's usually best to listen carefully for another station that is either finishing up a QSO (contact) or calling CQ. Zero-beat him with your VFO, or if you are using crystal control, call as close as possible to his frequency using your crystals. Two exceptions: When working on the QRP calling and working frequencies mentioned earlier, a CQ is often productive. Also, during contests, an occasional CQ is in order.

Watch your sending. Call and sign your own callsign a little longer than when running higher power and speak clearly and distinctly, using standard phonetics. On CW, take care to send at a comfortable speed, possibly a little slower than usual, to yield cleanly-spaced characters and words. Bear in mind that the fellow on the other end may be straining just to pull you in, so help him out with precision sending. A speed of 10-15 words-per-minute is probably best for QRP work.

Let them know you're running QRP. You may want to sign your call and add the fact that you are operating QRP. Many "big gun" operators will make a special effort to contact you if they know that you are running very low power. Also, identifying yourself as a QRP'er will let other low power stations know that another enthusiast is on the air; you will likely get a call from them as well.

Shoot for DX. There is probably no greater thrill in Amateur Radio than working halfway across the world using just a few watts; surely, the "DX bug" bites the QRP operator at least as hard as others. Successfully and consistently working DX is difficult and a real challenge. Nevertheless, many QRP'ers have qualified for DXCC (the DX Century Club), the WAS (Worked All States), and the WAC (Worked All Continents) awards using under five-watts; a few have claimed these trophies running all of *one*-watt! The odds are that you may not work the DX station you call on your first, second or even third call; *persistence* counts. Have patience in working DX, and don't be discouraged if it takes many calls to get a reply; too many new QRP'ers quit prematurely and eventually give up trying to work DX. When you finally *do* raise that DX station, the resulting satisfaction will make it all worthwhile.

Now that we have the basic techniques mastered, let's talk about how to go about testing your skills in QRP contests and in going after some operating awards.

Contests, Awards and the QRP Gang. A great way to build up your states-worked score, add countries to your DXCC list, or work stations you need to complete a particular operating award, is to participate in a contest. Contests tend to concentrate or "telescope" operating opportunities; enough stations are usually on the air to allow you to make continuous contacts. Some contests with a low-power multiplier have even been *won* by QRP'ers since the multiplier made up for the lower raw score caused by the low power used.

A few contest "tips" should help. First, avoid the first few "panic" hours of major contests; recognize that the "big guns" will be there and will likely swamp your signal. Second, make your calls short and snappy; start sending immediately when the other station finishes transmitting. Third, make frequent band changes; this will help you catch band openings to different areas, and will also help you to balance out between DX multipliers and QSOs per operating hour. Fourth, go where the activity is, but take care not to waste time calling in the midst of pileups

What are the popular QRP operating activities? They include several ARRL and QRP-ARC-I (QRP Amateur Club International) sponsored events, such as the Spring and Fall QRP QSO Parties; the QRPp Section of the *CQ Magazine* World-Wide WPX Contests; and the DL (Germany) QRP Activity CW Contest. The most popular and coveted QRP operating awards include the QRP-25 (working 25 club members); WAC-QRP; WAS-QRP; DXCC-QRP; and the KM/W (1,000 mile-per-watt) awards. There are also several special QRPp (5-watt) and milliwatt class awards you can compete for.

The various QRP QSO Parties sponsored by the QRP-ARC-I are especially exciting and rewarding operating events for QRP'ers, and they are open to both members and nonmembers alike. The scoring multipliers used in the formal QSO Parties become much more favorable as you compete with lower power levels. For example, running over 100-watts nets but a "1" for a scoring multiplier, while power levels between 1 and 5-watts carry a "3" multiplier; milliwatt stations yield a full "5" for a multiplier. Thus, the incentive is there for QRPp and milliwatt entrants to try their best, since they have a sporting chance at bringing home an award. In fact, a special certificate is presented to the station showing three "skip" contacts using the lowest power level of any entrant.

Besides these activities, QRP'ers enjoy many of the popular operating events and manage to be quite competitive, especially in those which have special QRP scoring multipliers or which otherwise encourage QRP entrants. The ARRL Field Day is ready-made for QRP operation, with its emphasis on portable and emergency power operations. The ARRL Sweepstakes, various 10-10 Club net QSO parties, the YL-OM Contest, the Forty Meter Contest, and the ARRL QSO Parties are all popular with flea-power participants. In addition, "QRP Net" members exchange information on 7,060 kHz at 1 PM EST each Saturday, and on 3,560 kHz at 9 PM (2100) each Wednesday.

QRP operators have banded together to form their own association of like-minded "under 100-watts" enthusiasts. The QRP Amateur Radio Club International (QRP-ARC-I), formed in 1961, is made up of several thousand QRP'ers throughout the world. The club sponsors various operating awards and activities, and it publishes a quarterly newsletter which is included in its $2 annual dues. You can obtain membership information from the club secretary/treasurer, Joseph Szempias, W8JKB, 2359 Woodford St., Toledo, Ohio 43605. Joining up with the group is an excellent way to acquire an up-to-date working knowledge of QRP activities.

CQ Magazine carries a popular monthly QRP column that presents timely flea-power operating reports and news, awards, club activities, DXpeditions, contests, parts sources, and individual accomplishments. News for the column can be sent to the *CQ* QRPp Editor, Adrian Weiss, K8EEG, 83 Suburban Estates, Vermillion, SD 57069.

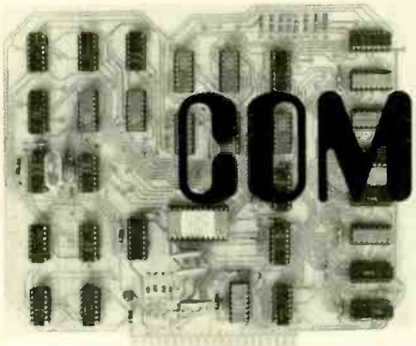
Note: When writing to any of the

(Continued on page 83)

Wondering what to do with that old CB now that you've upgraded? Convert it to 10 meters and you have instant QRP. The high receiver sensitivity of most CBs makes them acceptable for ham usage.

CIRCLE 1 ON READER SERVICE COUPON

Heath's HW-8, successor to the venerable HW-7, is a 4-band QRP transceiver which will dine lightly on your car battery, making it a good choice for field day or portable operations.



COMPUTER READOUT

by Tom Williams

Making computers listen (and talk back, too!)

THERE IS SOMETHING extremely enticing about bestowing the power of human speech on a machine. Images from the obedient, but no-nonsense computer aboard the *Enterprise,* to HAL-9000 of 2001, to menacing Cylons of *Battlestar Galactica* evoke an impulse to deal with these computers as intelligent entities. For the novice, it is easy to get the impression that the computer is a lot brighter than it really is if it seems to be speaking English.

The fact is that many computers today, even small personal computers, can indeed produce sounds similar to human speech, and can be programmed to arrange those sounds into meaningful words and sentences. To a limited extent computers can also be taught to recognize and react to human speech input. The latter is a great deal more difficult to accomplish, and for this discussion, we will distinguish between *speech synthesis* and *speech recognition.*

Machine Methods. There are a number of methods for accomplishing speech synthesis, and they range from "brute force" methods to extremely complex techniques of signal processing. Before examining them, however, it would be a good idea to have a look at the problem. Speech synthesis is similar to music synthesis in that digital information must be transformed into an analog waveform. Music synthesis is somewhat simpler than speech synthesis, because a musical tone consists of a fundamental frequency and a set of harmonics, each with its particular amplitude. Once an algorithm for a given musical tone has been developed, commands can be given to the computer to tell it how long and how loud to sustain that tone, and if that tone is to be produced along with other tones to form chords, etc.

Mother Nature's Way. While this is not meant to downplay the complexity of good music synthesis, even *more* is involved in human speech. Speech is produced by the body through the interplay of two mechanisms: the larynx, or vocal cords, and the mouth which shapes the sounds produced by the larynx through different positionings of the tongue, teeth, and lips. These parts subtly change position during formation of sounds, so that for any given particle of speech, a complex, nonrepetitive waveform is produced. This is quite different from the waveform of a G-sharp trumpet tone, for example, because the musical note need only be repeated as long as the note is held.

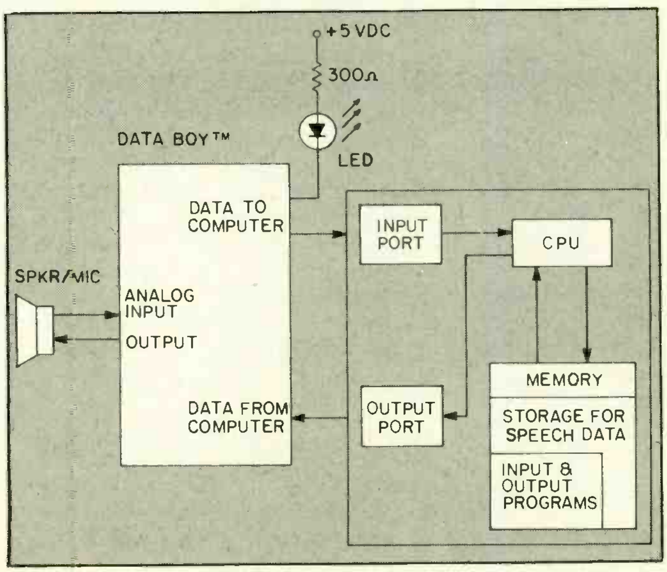
Radio Shack's Speech Synthesizer uses phoneme concatenation to form "real" speech.

When the vocal cords produce a sound, air is forced from the lungs through the larynx causing the vocal cords to vibrate; the frequency of the vibration depends on how tightly they are constricted by the muscles of the larynx. The more tightly the vocal cords are constricted, the higher the frequency of the emitted sound.

The sound produced by the larynx is then shaped, (given a certain resonance or tone) and sometimes given additional qualities such as the vibration of the tongue between the teeth, producing the "th" in the word "the." In addition, not all the sounds of speech are produced with the larynx; there are "voiced" and "unvoiced" sounds. The "th" in "the" is produced with the vocal cords while the "th" in "thought" is not. Try it—you'll see the difference.

One of the biggest problems in speech synthesis is the fact that some sounds are gradual combinations of others. The word "I" is not a single sound, but is the sound "ah" blending into the sound "ee" in a distinct interval of time. Because of these constraints, speech synthesis in computers has diverged in two directions: direct digital recording of spoken words which are then recalled and output in combinations selected by the program, and *phoneme concatenation,* or the combining of the basic sounds of speech to form words. The latter method is the more refined, but it has its own problems which we will discuss presently.

The "brute force" method of producing speech with a computer consists



This flow diagram illustrates the function of the Data Boy with the computer's central processor and memory storage. In effect, the Data Boy acts as an analog-to-digital and digital-to-analog converter. While this method is not perfect, it is the most economically feasible means of allowing for speech reproduction on the hobby computer level.

of using a microphone to input the sounds of a human voice to a computer port. An analog-to-digital converter is used to sample the waveform as a binary number, and then store it in a byte of memory. The faster the sampling rate, the truer the quality of recorded speech.

The big problem with digital recording is that it eats up memory at a ferocious rate. Four minutes of continuous speech, for example, would fill up the available storage space on a standard 8-inch floppy disk. On the other hand, digitized recording is the most economical way for a hobbyist to experiment with computer speech.

The Data-Boy,™ produced by Mimic Electronics (P.O. Box 921, Acton, MA 01720) is a speech input/output unit which uses signal processing and analog-to-digital conversion to record spoken words in computer memory. The sounds can then be played through a speaker using an output program. This method of recording and playing back speech can be used in a number of applications, but cannot be properly called "speech synthesis" because it does not produce speech from formulas or algorithms, but simply parrots back what has been spoken into it.

Gamesmanship. Nonetheless, a number of interesting programs are possible with this method. I have seen a Tic-Tac-Toe game run on an Apple-II that uses only verbal interchange between user and computer. It works like this: Before playing the game, a part of the program records in memory the words spoken by the player that correspond to the positions on the Tic-Tac-Toe board. Thus, the player will speak the words "one" through "nine" via a microphone into the Apple's memory. In addition, he will also speak words for various commands, "yes," "no," "I win," "you win," "cat," etc. These will be stored in specific locations in memory.

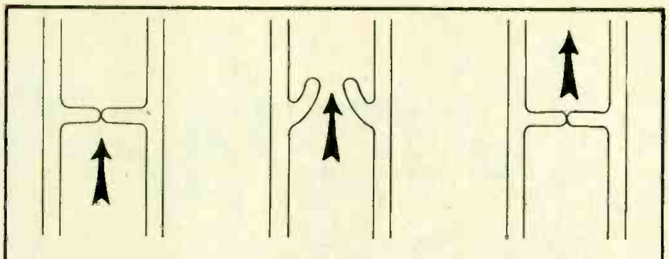
The game is played by each player (human and computer) naming the square he (it) will occupy. Thus, as a first move, the human says "three." The computer responds, "Three, correct?" If the human says "no," the computer goes back in its program and says, "your turn," and waits for human input. If the human says "yes," the computer places an X in the square named saying for example, "Seven. Your turn."

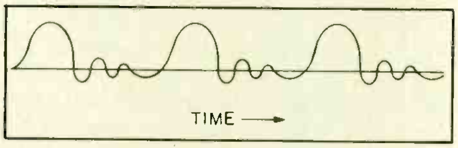
Within the context of the Tic-Tac-Toe game, the human and computer appear to be interacting intelligently. But it is only an appearance. What is really happening is that the computer is matching up a word spoken by the human with bit patterns of previously spoken words stored in its memory. The stored words correspond to commands for moves in the game. If the human word "eight" is matched up with a bit pattern of the stored word "eight," the program goes to a routine which places an X in square 8.

The human could just as easily have spoken "Gleep, glorp, goo . . . etc." into the computer and it would have acted accordingly on finding matches during the game. Such a program is a simple example of speech input and output and of speech recognition. It is not, however, an example of "natural language processing," which attempts to understand and act on verbs and nouns as they are used in natural language.

Speech recognition is one of the thornier problems in artificial intelligence research. The bit pattern produced by a given sound may not always be exactly the same; the sound may be louder or softer, muffled, of a higher pitch, or with a different accent. What the computer has to do in that case is figure out, on a statistical basis, which portions of the bit pattern are most significant and characteristic of the spoken word. That, as one can well imagine, involves some pretty exotic mathematical maneuvers.

The muscles of the larynx control pitch, and some other factors involved in human speech. The rest of the voicing is accomplished within the mouth by the tongue, teeth and lips.





This is the analog waveform of a vowel. It must be converted to a digital signal.

Se Habla Phonemes Aqui. There is, however, a speech synthesis method presently available to users of personal computers which is much more efficient in its use of memory than the direct storage method. This method is known as *phoneme concatenation.* Instead of storing individual words, phoneme concatenation systems contain program routines which will produce the basic elements of human speech, which are known as "phonemes."

Phonemes do not correspond to words or letters of the alphabet, but are sounds which linguists have isolated as being the basic blocks of language—the sounds that combine to form words and meaning.

It would be too much to ask of the average user to expect him to know how to use phonetics regularly. Several units now on the market made by companies such as Computalker Consultants (1730–A 21st St., Santa Monica, CA 90404), and Votrax (4340 Campus Dr., #212, Newport Beach, CA 92660), use a vocabulary building method. The unit comes with a minimum predefined vocabulary, and with some models, the user can define more words by putting together combinations of phonemes and assigning their value to a combination of letters. For example, the word "cough" could be assigned to a set of phonemes which would generate the sound of the spoken word. Then, when the word was typed on the screen, the voice unit would produce the spoken word.

One of the limitations of phoneme concatenation is that often the transition from one natural sound to another can sound unnatural. This is due to the fact that linguists have generalized, and true language is a flowing, inexact thing; it can't be rigidly defined as a limited set of sounds.

Texas Instruments has recently introduced its new home computer, the TI 99/4. This computer has a Solid State Speech module available which has a vocabulary of over 200 predefined words.

Use of the TI system has been made as easy as using a PRINT statement in BASIC. To have the computer speak a word, the program need only include a SAY statement, like SAY "DOG," and a very natural sounding "dog" will be produced. Given the advances in synthesized speech which are available to the consumer today, the hollow sound of *Battlestar Galactica*'s poor Cylons seems primitive indeed. ■

CRYDIT

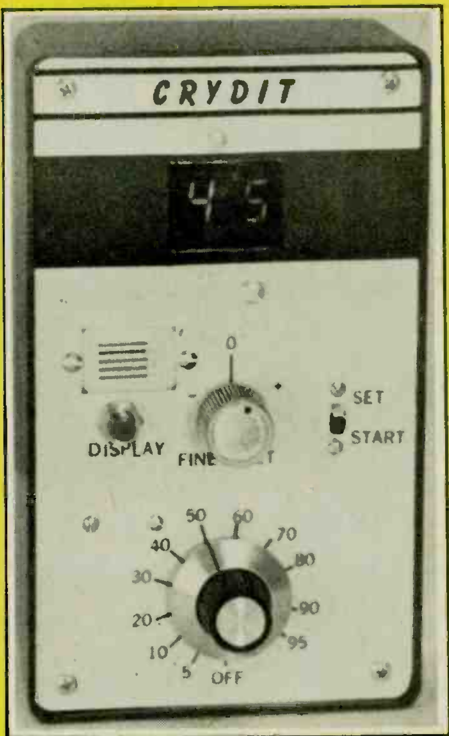
by Thomas R. Fox

In the kitchen or the lab, our quartz-locked timer is right at home

CRYDIT, AN ACRONYM FOR *CRY*stal-controlled *DI*gital *T*imer, is a neat little battery-operated timer loaded with an abundance of unique features. CRYDIT measures time periods of from 1 to 99-minutes with an accuracy that is unobtainable in mechanical-type timers, and it lets the user know when the time is up with a pleasant, seven-second buzzer. A feature of special interest to the frugal at heart, is that this pinpoint precision isn't achieved with an exotic, expensive crystal, for CRYDIT uses the common 3.58 MHz color TV burst crystal. This crystal isn't only cheap, but is also easy to get your hands on. In fact, it is possible to get this crystal for next to nothing by salvaging it from old, junked color TV sets. Check with TV sales and service shops, local dumps and neighbors. Mail order electronic dealers, such as Poly Paks also sell this crystal at a very reasonable price.

Features. One of CRYDIT's most unique features is the method used in setting it to the time-period desired. As you probably are aware, the most common method of setting digital clocks, watches, timers etc., is that of sequential counting, e.g. 1....2....3....As an aid to the user, most digital clocks have both a fast and slow set switch. While this method may be OK for clocks and watches, which you seldom have to set, it tends to become nerve-racking in timers, such as CRYDIT, which are frequently set several times a day. The method of sequential counting is especially hard on the nerves if you happen to miss the exact minute the first time around in the cycle and have to start all over. CRYDIT, on the other hand, can be set much quicker, and unlike the sequential counting method, it is almost fun to do. For instance, if you wish to time something for approximately 45 minutes, all you have to do is turn the knob so its pointer points to midway between 40 and 50 on the dial and then switch the SET/START switch to START.

Some of CRYDIT's other features include a long battery life (owing to its all-CMOS design), a bright LED display which aids in setting as well as



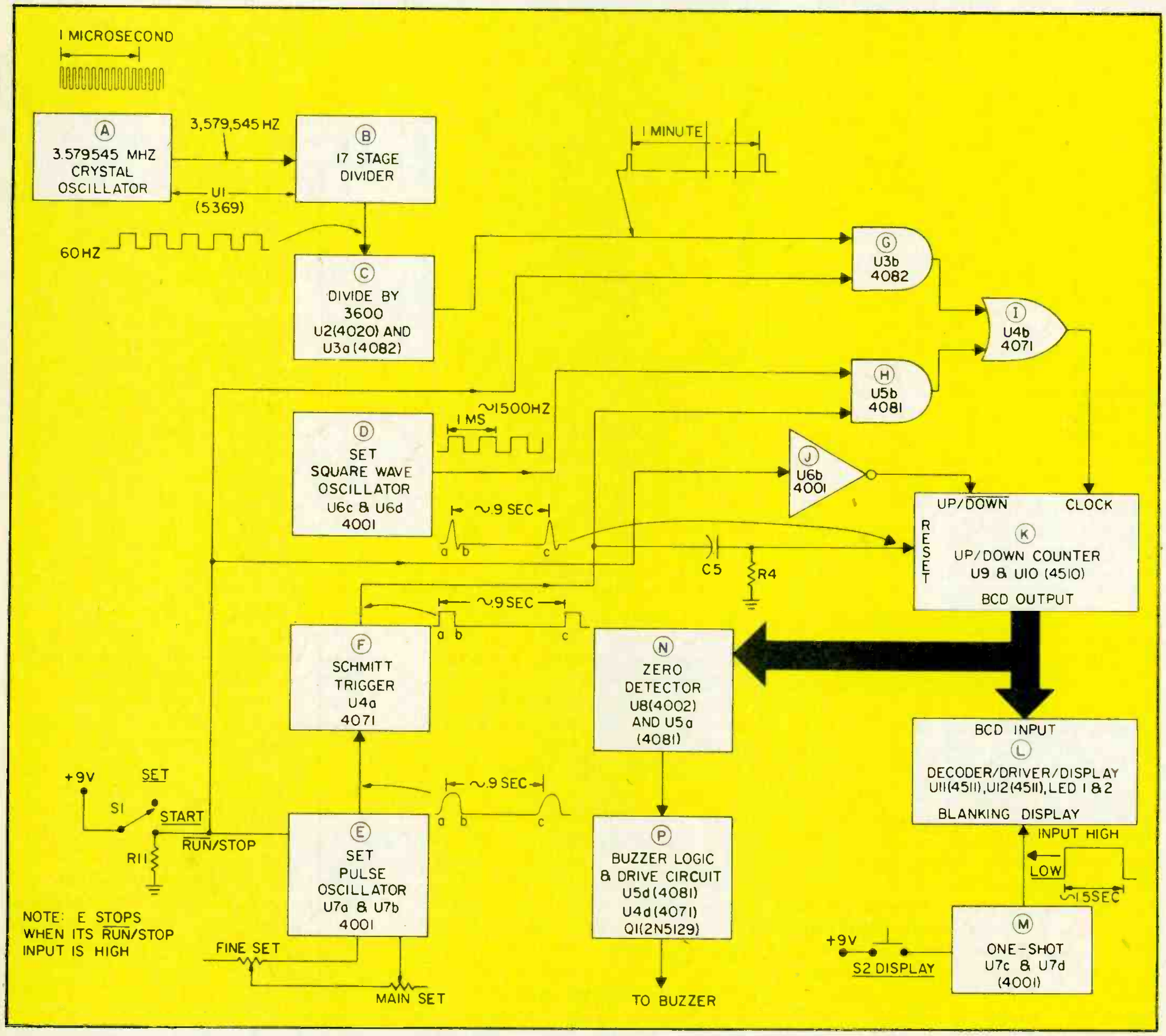
informing the user the number of minutes left, and a simple memory which reminds the user how long he had the timer originally set for.

In addition to being an ideal space-age handmade gift for that beautiful (or handsome) cook in your life, CRYLIT has a mutlitude of other uses. CRYDIT can be used as a darkroom timer, a timer for telephone calls, a timer for exercise (or nap) periods, and as a reminder to watch a special TV program, (e.g. NOVA) etc.

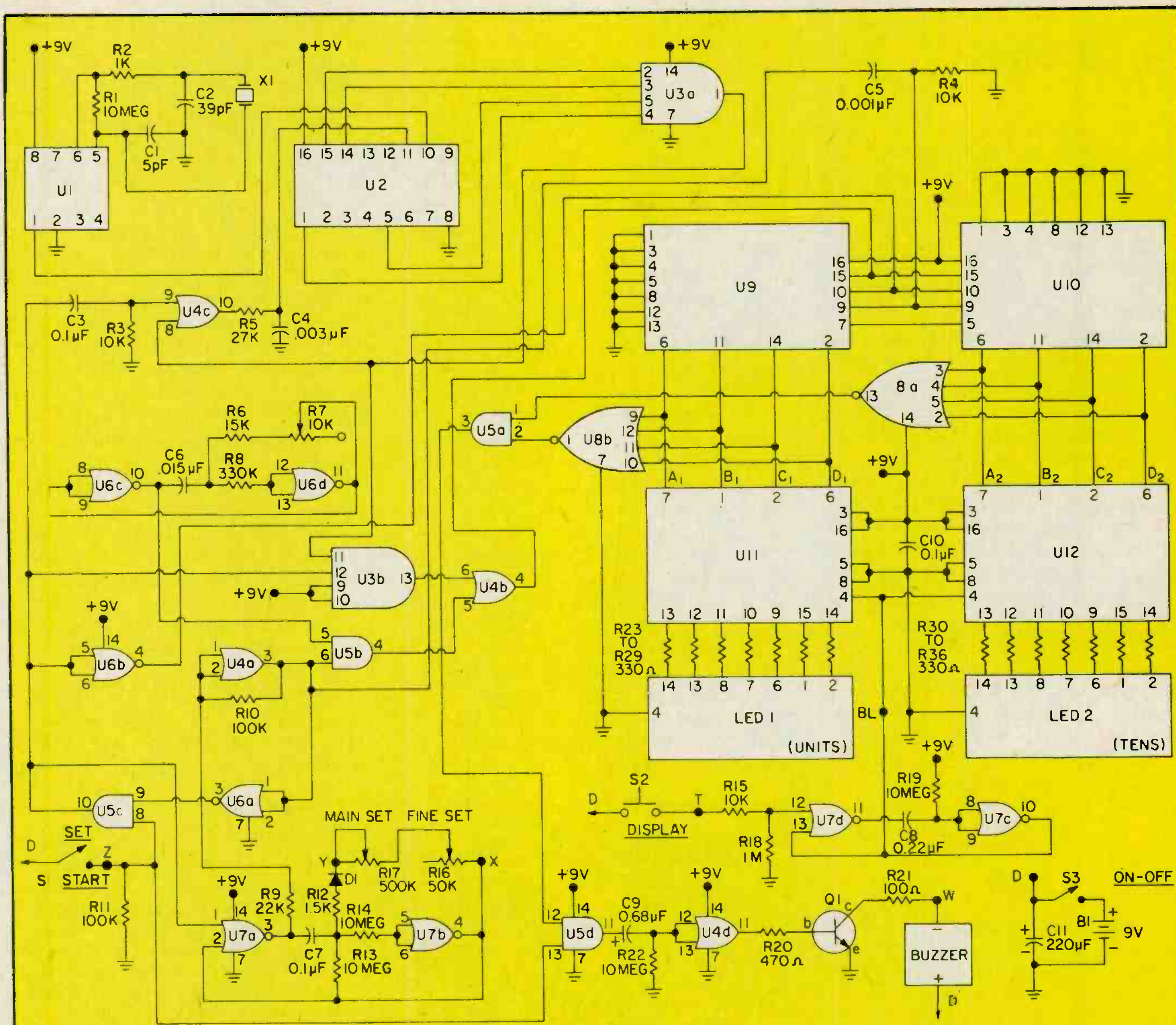
Another feature of CRYDIT, which should be especially interesting, is that CRYDIT isn't built around one huge LSI clock/timer chip. While these huge LSI chips are ideal for commercial timers, they are basically large black boxes, and the builder often gains little more than experience in soldering. In addition, it is difficult to do anything totally unique with these chips since their designers have built just about everything needed into them (except crystals, capacitors and switches). Since CRYDIT is designed around the more basic building blocks, such as gates, counters, decoders, etc., its theory of operation can be understood relatively easily. Understanding exactly how CRYDIT works isn't only rewarding because it is fun and educational, but also because it is practical. For, like any gadget, if you know how it works you can probably fix it if it happens to go haywire.

The Circuit. Referring to the simplified block diagram in Figure 1, block A is a 3.579545 MHz (also sometimes referred to as 3.58 MHz for short) crystal oscillator whose output goes to block B, a 17-stage binary divider. B divides down the 3,579,545 Hertz input to a 60 Hertz output. Note that both blocks, A and B, are contained in a single integrated circuit, U1, which is an MM5369 IC. This 60 Hertz next goes to C, a divide-by-3600 counter composed of a 14-stage binary ripple counter, U2, and a 4-input AND gate, U3. Referring to the schematic, note that the AND gate's output is high only when all its inputs are high. One of this AND gate's inputs is connected to pin 1 of U12, which has a value of 2048, another to pin 15, whose value is 1024, the third to pin 14, with a value of 512 and the last input to pin 5, with a value of 16. Thus when the 3600th pulse (248+1024+512+16) reaches U2, the AND gate's output goes high. This high output is transmitted through the OR gate U4c and through the integrating network, R5 and C4 (who purposes are to lengthen the divide-by-3600's output pulse so that the relatively slow counters, U9 and U10, can respond to them) and then to pin 11 of U2, which resets it back to 0. Thus it is obvious that there is one narrow pulse out of block C for every 3600 pulses in. Since there are 60 pulses coming into block C per second, there is 1/60 (60/3600 = 1/60) of a pulse out per second, which means one whole pulse per minute comes out of block C. The length of this pulse is extremely narrow (it's actually measured in microseconds) and thus is not significant. Note that the OR gate's (U4c) other input is connected, through the simple differentiating network C3 and R3, to the output of the AND gate, U5c. The purpose of this circuitry is to insure that U2 starts from zero (i.e. is reset) the instant S1 is switched to the START position. The one short pulse-per-minute output of block C next goes to AND gate G, which is U3b. G's other input is connected to S1. As can be seen by referring to the block diagram, this other input is low when S1 is in the SET position and high when it is in the START position. Thus it is obvious that the one pulse-per-minute can only get through the AND gate G when S1 is in the START position. Assuming that S1 is in the START position, this one pulse-per-minute goes to the input of the OR gate, I, which is U4b. The one pulse-per-minute output at I then goes to the clock input of the up/down counters (K) (actually to pins 15 of U9 and U10). Since K's up/down input is low, (it is connected through inverter J to S1, which is now assumed to be in the START (high) position) the counters will count down one with every input pulse at the clock input. 4510 ICs count up when their up/down input is high, and down when their up/down input is low. The BCD (binary-coded decimal) output of K goes to block L, which consists of the decoders, drivers and display. In effect, L lets those in the outside world "see" the state of the counters. Note that the display is normally blank. It only lights, for about 1.5-seconds at a time, when the display button, S2, is depressed. Depressing S2 triggers the one-shot multivibrator. (The NOR gates, U7c and U7d, are the heart of the one-shot.) This one-shot generates a high output pulse that has a width of approximately 1.5-seconds. This 1.5-second pulse goes to L's blanking input, which causes the LED displays to light. K's output is also connected to the zero detector (N), composed of U8 and U5a.

The operation of N is simple. Referring to the schematic, notice that when the BCD outputs of both 4510 counters are low (i.e. they both represent zeroes), the outputs of both 4-input NOR gates are high, and thus the output of the 2-input AND gate is also high. Also notice that if any input to either NOR gate is low, the output of



This block diagram depicts the flow of signals within CRYDIT. We have included the waveforms and time bases as well here to help relate the functions to the technical explanation which you will find in the text. This diagram can also serve as a troubleshooting guide (if you have an oscilloscope), allowing you to intercept the signals at various points and to compare with the specs.



PARTS LIST FOR CRYDIT

B1—9-volt transistor alkaline battery
C1—5-pF mica capacitor**
C2—39-pF mica capacitor
C3, C10—0.1-uF ceramic capacitor
C4—0.003-0.005 ceramic capacitor
C5—0.001-uF ceramic capacitor
C6—0.015-uF ceramic capacitor
C7—0.1-uF mylar capacitor
C8—0.22-uF ceramic capacitor
C9—0.68-uF tantalum capacitor
C11—220-uF electrolytic capacitor
D1—1N914 diode
LED1, LED2—MAN 4640 common-cathode display (see text for equivalent displays)
Q1—2N5129 general purpose NPN transistor
R1, R13, R14, R19, R22—10-megohm, ¼-watt resistor***
R2—1,000-ohm, ¼-watt resistor
R3, R4, R15—10,000-ohm, ¼-watt resistor
R5—27,000-ohm, ¼-watt resistor
R6—15,000-ohm, ¼-watt resistor
R7—10,000-ohm, PC-type trimmer potentiometer
R8—330,000-ohm, ¼-watt resistor
R9—22,000-ohm, ¼-watt resistor
R10, R11—100,000-ohm, ¼-watt resistor
R12—1,500-ohm, ¼-watt resistor
R16—50,000-ohm, linear-taper potentiometer
R17—500,000-ohm, linear-taper potentiometer
R18—1-megohm, ¼-watt resistor
R20—470-ohm, ¼-watt resistor
R21—100-ohm, ¼-watt resistor
R23 to R36—330-ohm, ¼-watt resistor
S1—SPST miniature slide switch
S2 — SPST momentary-contact pushbutton switch
S3—SPST switch (part of R17) TV-type control
U1—MM5369 17-stage divider
U2—CD4020 binary ripple counter
U3—CD4082 dual AND gate
U4—CD4071 quad OR gate
U5—CD4081 quad AND gate
U6, U7—CD4001 quad NOR gate
U8—CD4002 dual NOR gate
U9, U10—CD4510 BCD counter
U11, U12—CD4511—7-segment latch and driver
XTAL—3.579545 MHz color TV crystal
MISC.—cabinet, knobs, dry lettering kit, battery clip, hardware, 6-to-9-volt solid state buzzer, etc.
**Note: All capacitors have a working voltage of 25-VDC or better.
***Note: All resistors, except potentiometers, are 5% tolerance-rated.

Both printed circuit boards for this project, already drilled and etched, are available from Niccum Electronics, Box 271B, Stroud, OK 74079. The main board costs $5.50; the display board costs $4.50, postpaid. Please allow 3 to 4 weeks for delivery.

the respective NOR gates is also low, which means the AND gate is also low. N's output goes to a simple logic network and drive circuitry contained in block P (composed of U5d, U4d, Q1 and associated resistors and capacitors) which causes the buzzer to sound off for approximately 7-seconds after the output of N goes high.

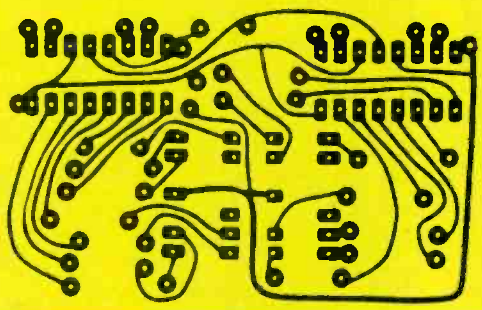
Hopefully, you should now have some idea of how CRYDIT knows when a time period is over. However, what happens when S1 is switched to SET? When S1 is switched to SET, block E starts into operation. E, which is composed of NOR gates U7a and U7b, is the circuit's SET pulse oscillator, which produces relatively short pulses, whose widths are determined by the MAIN SET and FINE SET controls (R16 and R17). The length of E's positive pulse varies from about 0.6-milliseconds, when both SET pots are at a minimum resistance position, to about 66-milliseconds, when both are at a maximum resistance position. The time between positive pulses is about 0.9 seconds. E's output goes to the Schmitt trigger (F), actually composed of R9, R10 and U4a, which shapes E's pulses to fine-looking, textbook-specimen square waves.

F's output first goes to a differentiating network consisting of C5 and R4, which resets the counters the instant F's output goes high. F's output also goes to one input of the AND gate (H) U5b. H's other input is the SET square wave oscillator, D, which consists of the two NOR gates (U6c and U6d). D has a nominal frequency output of 1500-Hertz. H's output then goes through OR gate I to the clock input of K. Note that the 1500-Hertz from D can only get through gate H when F's output is high. However, F's output is always low whenever S1 is switched to START, thus D's 1500-Hertz output can only get through H when S1 is switched to SET. This circuitry, consisting of blocks E, F, D and H, provides the means of loading the counters with the desired time period.

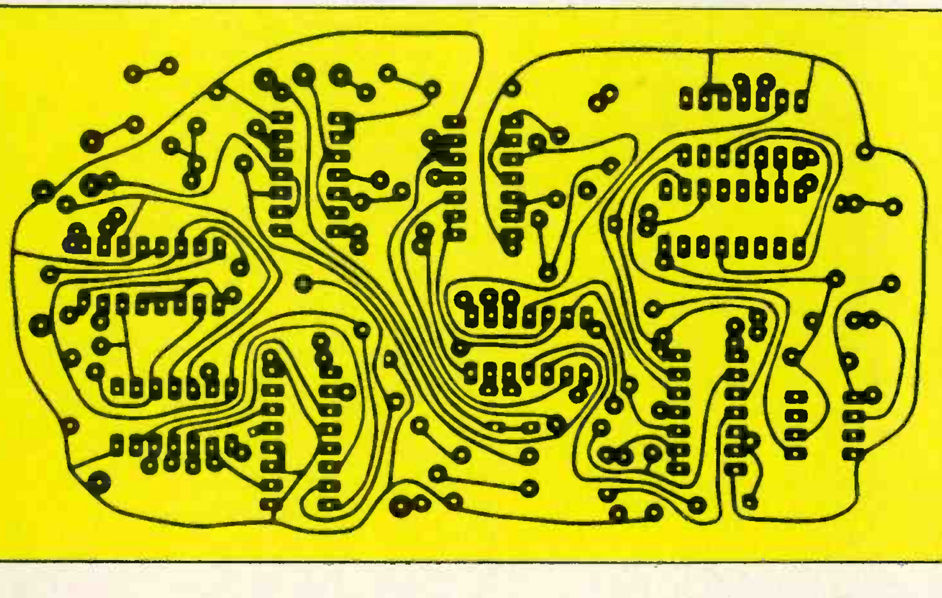
To illustrate this, assume that both SET controls are at their minimum resistance positions. F's output pulse length is then approximately 0.0006-seconds (0.6-milliseconds) long. Thus, only $1500 \times 0.0006 = 0.9$ of a pulse can get through H, which means the display will show 00 (or possibly 01, depending upon the exact timing and variation of components). When both SET controls are at their maximum resistance positions, F's pulse length is then approximately 0.066 seconds (66 milliseconds) long and $1500 \times 0.066 = 99$ pulses will get through H and the display will show 99. When the SET controls are between minimum and maximum, the display will show a number between 00 and 99. It can easily be shown that every number between 0 and 99 can be loaded into the counters by simply adjusting the SET controls.

This completes the basic description on how CRYDIT works. There is one detail that still should be mentioned. Referring to the schematic and the simplified block diagram, notice that E is composed of two NOR gates—U7a and U7b and that one input of the first NOR gate U7a is connected to the output of the AND gate—U5c. The oscillator (E) stops running when this input is high and when E stops, its output is low. Referring again to the schematic, notice that the AND gate's U5c output only goes high when S1 is on START *and* E's output is low. (E's output is first shaped by U4a and then inverted by U6a.) In other words, E keeps running, even when S1 is switched to START, until its output finishes completing its output pulse. This logic network keeps CRYDIT from being switched from its SET mode to its START mode in the middle of a counting period, even though S1 is switched from SET to START, and thus avoids the possibility (although slight) of a random number appearing on the display after S1 is switched from SET to START.

Construction. Except for the four front panel controls and the buzzer, all parts, including displays, are mounted on two circuit boards. While the author



This is the full-scale template for etching the printed circuit used on the display board. Cut the board itself to allow a 1/2-inch margin around the edges. This is done in order to accommodate different chassis mounting schemes, something which you can decide yourself in later phases of construction.



The main circuit board is one of the most complex you're likely to run up against, and we suggest that if you don't have all that much experience in etching PC boards, you avail yourself of the pre-etched boards being offered by Niccum Electronics. Ordering information will be found at the bottom of the parts list.

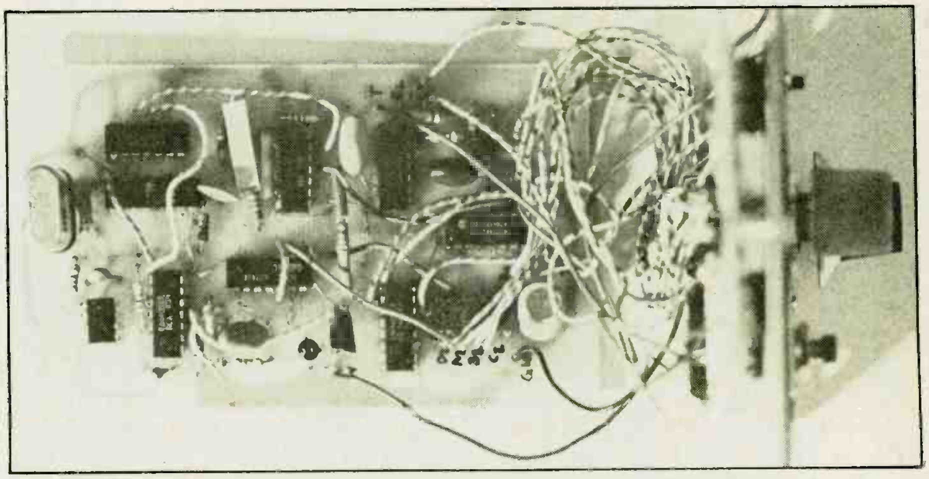
used a resist marking pen (a fine-tipped, permanent freezer-type marking pen can also be used) and Bishop Graphic's precision slit tape (available from GC Electronics) to make the printed circuit boards for his prototype, the photographic method of printed-circuit board fabrication is recommended for the reader to use, due to the many fine, close-together foil runs. (GC Electronics Positive Method Printed Circuit Kit, #22-310, is a good kit to use.) No matter which method you use, be sure to check out the completed circuit boards with an ohmmeter for shorts and possible breaks in the foil, *before* you mount and solder any components.

While it is usually good practice to use IC sockets, do not use sockets for U11, U12 or the two LED displays, since there may not be enough room between them and the front panel.

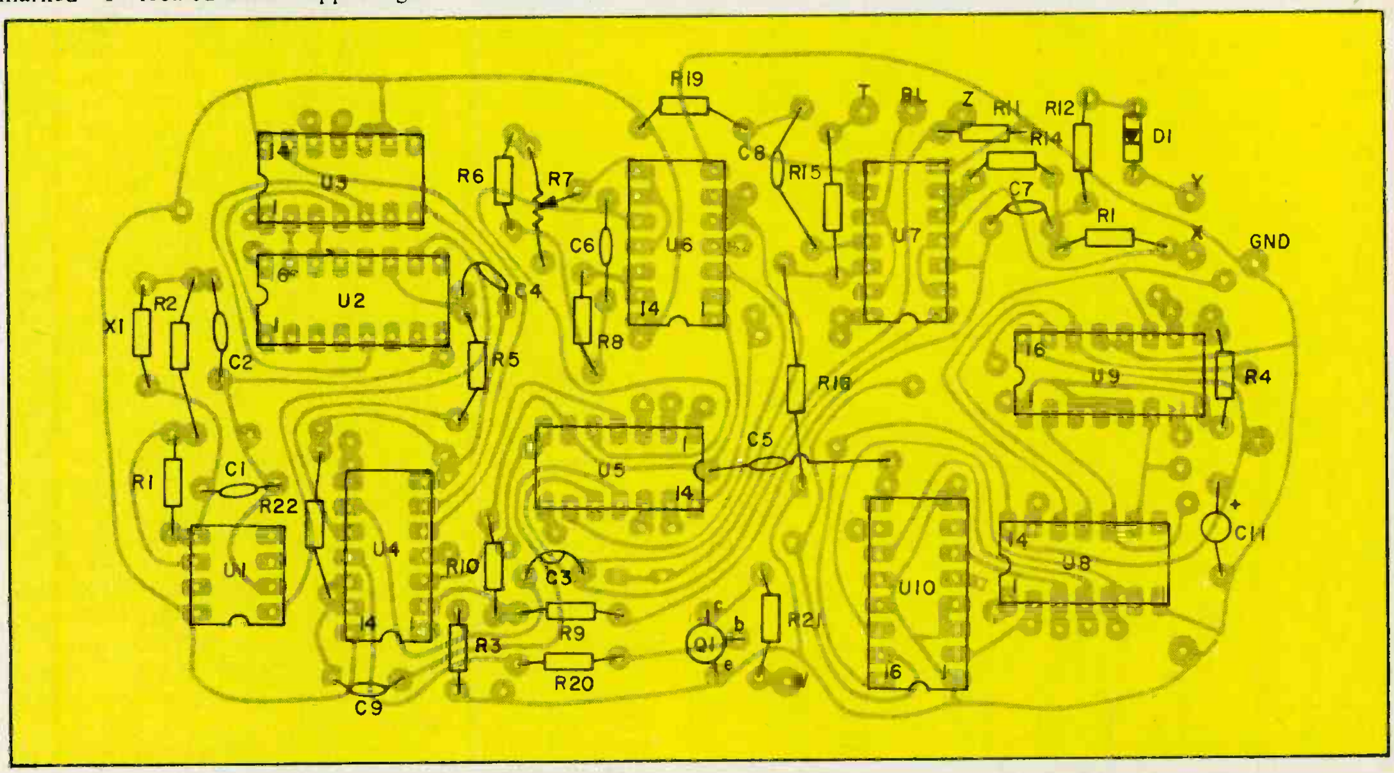
The main circuit board requires quite a few jumpers. Referring to the component mounting guide, note that the dashed lines marked "J," refer to bare wire jumpers. Be sure to connect these jumpers as shown. If there is any chance of a short, place sleeving on the bare wire before soldering. In addition to 12 bare wire jumpers, the main circuit board also requires 11 insulated wire jumpers. Referring again to the mounting guide, connect and solder one end of an insulated wire to the point marked "1" located in the upper right hand corner of the circuit board. Connect and solder the wire's other end to the other point marked "1" that is located approximately 1½-inches to the first point's left. Similarly, connect a wire between the two points marked "2." Do the same for the points marked "3," "4," "5," "6," "7," "8," "9," "10" and "11." Eleven insulated jumper wires are required all together. The display circuit board only requires one bare wire jumper and no insulated wire jumpers.

For the two common-cathode LED displays, (LED1 and LED2) the author used the MAN 4640. This 0.4-inch-high orange display produces a bright, clear readout. However, any other common-cathode display with identical pin arrangements can be substituted. In fact, most 0.3-inch or 0.4-inch common-cathode LED displays can be used. Some alternate displays that will work are: MAN74, MAN84, Data-Lit 704, and the XAN 3054 series.

After you have mounted and soldered all components and jumpers to the two circuit boards, use #22 or #24 solid



The photo above shows the assembled main board swung away from the chassis. Almost all of the wiring used to interconnect the two boards leaves from the right hand side, which allows plenty of flexibility and accessibility in assembly and checkout, if needed.

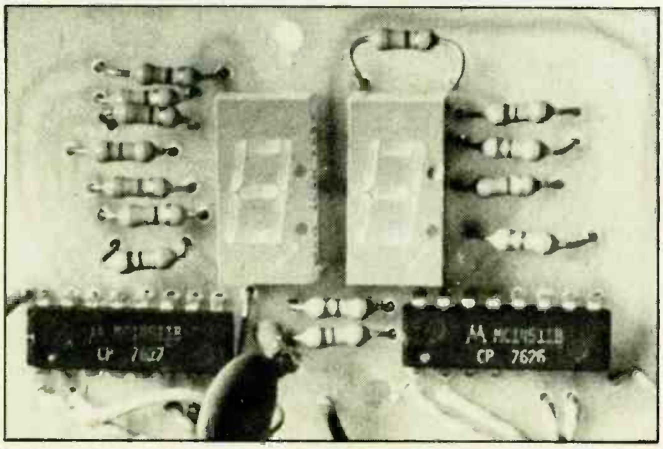


The component placement diagram above indicates the location of all parts on the main board. We suggest that you install the IC sockets last, because several components must be installed close enough to the sockets that there might be problems in fitting them in. After the components are installed, see the jumper location diagram two pages ahead to complete the board assembly.

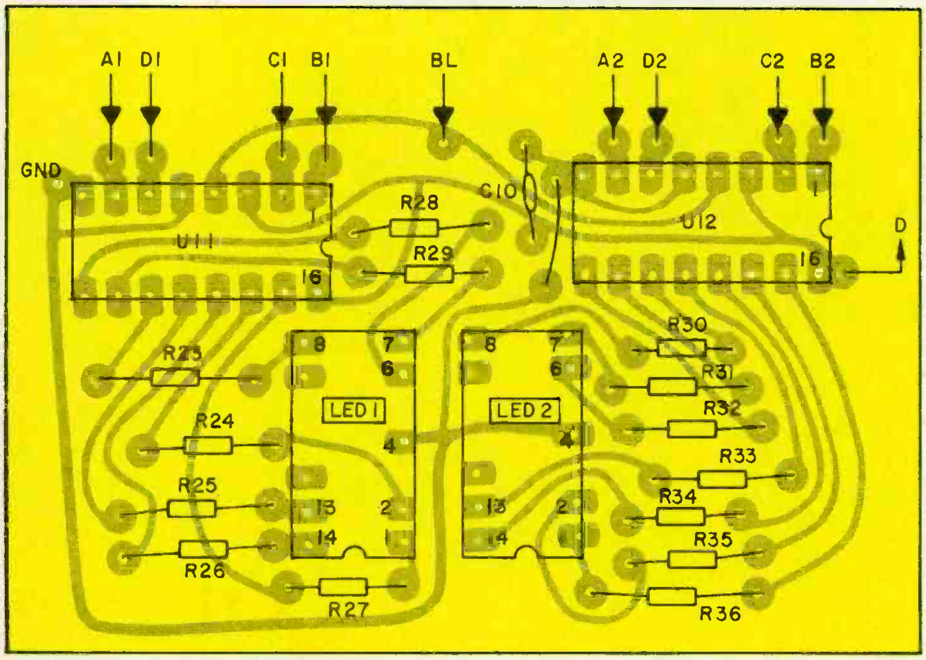
hook-up wires to connect the two circuit boards. Refer to the component mounting guides. Wires should be connected as follows: connect a wire from the point marked "BL" on the main board to point "BL" on the display board. Connect another wire between one point marked "GND" on the main board and the point marked "GND" on the display board. Connect another wire between the point marked "A1" on the main board and the point marked "A1" on the Display board. Do the same for the points marked "B1," "C1," "D1," "A2," "B2," "C2" and "D2." Notice that for clarity, wires between points A1 through D2 are not shown connected in the pictorial. Altogether, there should be 10 wires connecting the two circuit boards. These 10 wires do not merely serve as electrical connections between the two boards; they also mechanically connect the two boards, eliminating the necessity of spacers and screws. The space between the two boards serves as a convenient battery holder for the 9-volt battery.

Next, mount S1, S2, R16 and R17 (which includes S3) on the front panel. Refer to the pictorial wiring guide which shows the rear of the front panel. Note that for CRYDIT's case, the author used Radio Shack's #270-233 *Experimenter's* box, although a slightly larger cabinet can also be used.

For the wiring between the panel's components and the two circuit boards, again refer to the pictorial. First, solder the 9-volt battery clip's black lead to the main circuit board's unused "GND" point. Solder the clip's red lead to one connection of S3, the on-off switch. (The pictorial wiring guide assumes that the builder is using an SPST pot-mounted switch for S3. However, other types of SPST switches can also be used.) Connect wires from S3's unused terminal to the points marked "+9" on both the main and display circuit boards. Take two other wires and connect one end of each wire to this same S3 terminal. Solder the free end of one of these wires to one terminal of S2 and connect, but do not solder, the free end of the other wire to a terminal on S1. Connect the buzzer's red (positive) lead to the same terminal on S1, which has a wire coming from S3 connected to it. Now solder all unsoldered connections. Finally, solder a wire from the center terminal of R16 to the center terminal of R17. Be sure to refer to the pictorial wiring guide when making the above connections.



This is the finished display board, showing the two 7-segment LEDs in position. You may wish to utilize IC sockets (14-pin) for them as well, in order to provide additional clearance from the PC board to the front.



The component placement diagram for the display board also shows the attachment points for the wiring coming from the main board at top. Note the lone jumper used on this board, located between C10 and U12. Put it in first because it's very easy to forget.

Now finish the wiring between the circuit boards and the front panel. Solder the buzzer's black (negative) lead to the point marked "W" on the main circuit board. Solder one end of a wire to S2's unused terminal. Solder the wire's other end to the point marked "T" on the main circuit board. Solder the end of another wire to S1's unused terminal and solder the wire's other end to point "Z" on the main circuit board. Finally, solder one end of a wire to the right terminal of R16 (looking at R16 from the rear) and connect its other end to the point marked "X" on the main circuit board. Similarly, connect another wire from R17's right terminal to the point marked "Y" on the main circuit board.

For that professional touch, use epoxy cement to glue a piece of red-tint acrylic plastic to the back of the hole you have cut out of the front panel for the display to be seen. In addition to acting as a filter for the two LED displays, this plastic also acts as a spacer for the Display Circuit board. Refer to the display circuit board's component mounting guide for locations of the two holes for the mounting screws. Use two, 2-56 or 4-40, screws to attach the display circuit board to the front panel.

Ideally, B1 should be a 9-volt alkaline type battery, although other types of 9-volt batteries will also work. A high-quality 9-volt alkaline battery should last about a year with normal use.

Checkout and Operation. Switch the SET/START switch (S1) to the SET position and then turn on CRYDIT (i.e. switch S3 to the ON position). Adjust both SET controls (R16 and

R17), as well as R7, to their approximate midpoint. Next, press the DISPLAY switch (S2). The display should light for approximately a second and a half and show some number between 40 and 70. Notice that there is an updated reading about every 0.9-seconds. Immediately after the update, the display can change. For instance, the display might switch from 50 to 51 after one update and then back to 50 after another one. This is normal. If you want a constant reading, simply adjust the FINE SET control slightly.

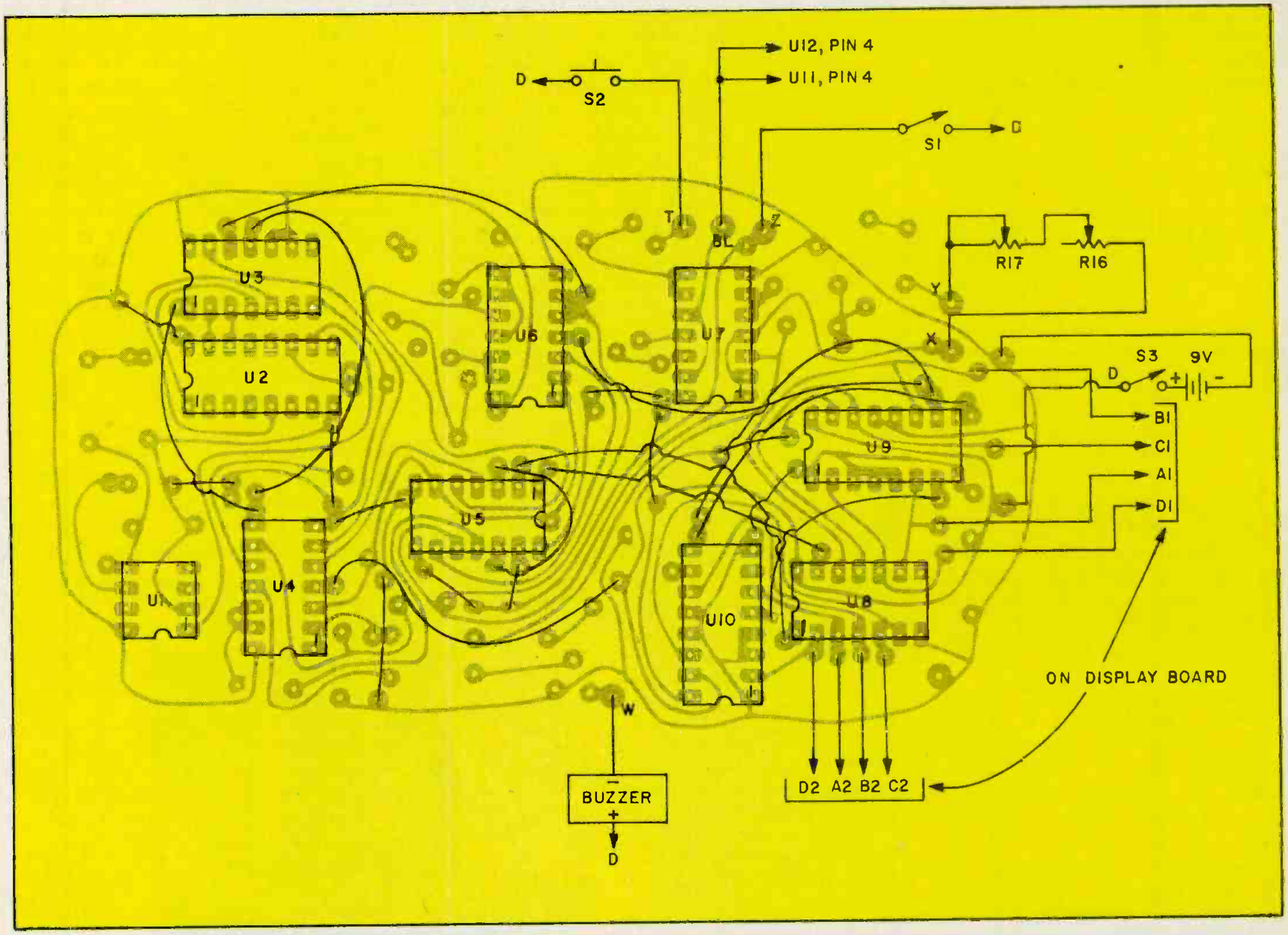
To check out CRYDIT's timing (countdown) circuitry, adjust the SET controls so the display shows 03. Exactly one minute after you switch S1 to START, the display should change from 03 to 02 (press the DISPLAY button to check this) and after exactly 3 minutes, the buzzer should sound off for about 7-seconds. If you want, check the display. It should now show 00.

If everything so far appears normal, it is time to adjust the SET circuitry. Switch S1 to SET and turn both the FINE SET (R16) and MAIN SET (R17) controls to their maximum clockwise positions. Now assuming you wish to have your CRYDIT measure time periods of from 1 to 99 minutes, as the author's prototype does, (For a 1-60 minutes model, see the final section in the article.) adjust R7, the 10K printed-circuit trimmer, so that 99 consistently shows on the display. This completes CRYDIT's adjustment.

In order to set CRYDIT to the desired time period, first switch S1 to SET and then turn the knob on the FINE SET control so that its pointer points to "0" on the dial. The next step depends upon whether you want to use CRYDIT for precise timing (e.g. in photography work) or for applications requiring only the approximate time (±2-minutes). If you can put up with a ± 2-minute error, simply turn the knob on the MAIN SET control to the point on the dial which corresponds to the desired time period, in minutes, and then switch S1 to START. That's it! You don't even have to press the DISPLAY button to look at the display.

If your timing requirements are exacting, all you have to do is add a simple second step to the above procedure. To measure exact time periods, set the MAIN and FINE SET controls exactly as before (i.e. set the FINE SET knob to "0" and the MAIN SET knob to the time desired), but now check the display *before* you switch S1 to START to check on the actual number stored in the counters. If the display doesn't agree exactly with the time period desired, adjust the FINE SET control until it does. When using the FINE SET control, use the divisions marked on the dial as a guide. For example, turn the FINE SET knob one division clockwise to increase the number on the display by one, and one division counterclockwise to decrease

(Continued on page 84)



The jumper location diagram above also includes the wiring connections for the remainder of the off-board components, as well as the interconnections between it and the display circuit board. Point D at S3 is a junction for several connections (hot side of buzzer, hot side of S1 and S2). Simply attach all incoming leads to the terminal on the switch back (switch S3) after mounting.

CIRCLE 47 ON READER SERVICE COUPON

e/e checks out the... MIZUHO SX-59 PRESELECTOR

Upgrade the performance of your inexpensive receiver dramatically

FOR MANY YEARS, a preselector was considered an important addition to any shack's receiver. In recent years, with the advent of improved receiver technology, it is no longer such a necessity. However, for those of you who still use your older receivers for SWLing, or as a standby for a newer rig, the preselector can add some valuable selectivity. In fact, with a CW or SSB filter added on also, you may find that your old HQ-110 can give the new rig a good run for the money.

In that light, you may also consider buying an older rig for much less money, as a starter unit, and then adding a preselector to it. Remember that the better-quality receivers of a decade or two ago weren't necessarily lacking in *sensitivity*, but rather in *selectivity*.

One of the better preselectors we have run across recently is the Mizuho SX-59, marketed by Gilfer Associates. But before we get into the review of this unit, let's begin by reviewing in detail what a preselector can do.

How It Works. A preselector will increase the strength of incoming signals on the frequency to which it is tuned. It will decrease the strengths of signals to which it is not tuned. In the attenuation mode, it will *decrease* signals on the frequency to which it is tuned, preventing overload from overly-strong stations.

A preselector will *not* improve adjacent signal selectivity. It will *not* provide a better impedance match for the antenna (only a transmatch will do that). It is of no use to a transmitter.

It is important that a preselector be properly adjusted, or it can aggravate existing problems. If not set correctly, it will reduce signal strengths considerably, and enhance image interference. If left on in the presence of a strong signal, overload of the receiver will occur, resulting in distortion and cross modulation.

Most modern, high-quality communications receivers will not benefit by the use of a preselector. Inexpensive receivers will. Since few of us can afford the luxury of commercial or military-grade receiving equipment, a preselector is probably a good investment.

The Circuit. The circuitry of the SX-59 is very straightforward. Three field effect transistors are used in a cascade amplifier/source-follower configuration. Input and output impedances are nominally 50-75 ohms. Used with a transceiver, the relay contacts will withstand 100 watts of RF power.

As shown in the accompanying illustration, the preselector is compact (6" by 2½" by 6") and neatly laid out. It is entirely enclosed by a metal cabinet, and finished in smooth gray.

Specifications. Mid-band gain of the SX-59 is on the order of 20 dB. Tuning range is 3 to 30 mHz in three bands. Noise figure is nominally 3 dB at 7 mHz. Bandwidth is ±200 kHz (−20 dB) and ±500 kHz (−50 dB).

The SX-59 is designed to operate from its own internal 120 VAC power supply. A front panel control allows a choice of variable gain up to 20 dB, or variable attenuation to −20 dB.

The SX-59 is useful for: (1) Boosting the strength of weak signals; (2) Improving poor receiver sensitivity (often by overriding internal noise); (3) Suppressing images caused by strong off-frequency signals; (4) Attenuating front-end overload from overly-strong signals.

The Mizuho SX-59 is a well-designed preselector. It is extremely easy to use with very little "get acquainted" time required. Hook-up directions are adequate, and a diagram identifies the controls.

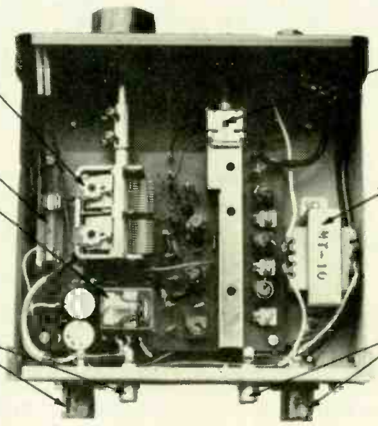
Features. Originally designed for use with ham transceivers operating in the 80-to-10-Meter range, an antenna bypass feature makes the unit suitable for receive-only applications as well.

An internal relay automatically switches the preselector in and out of the circuit. External switching or uncoupling the antenna cables is not necessary.

A pair of SO-238 coaxial antenna connectors on the rear apron accommodates the majority of coaxial cable transmission lines. Additionally, a pair of RCA phono jacks is included in parallel with the other connectors for convenience. A pair of binding-post terminals allows remote switching of

(Continued on page 85)

You may not have ever heard of Mizuho's products before now (we hadn't), but we expect you will in the future. The SX-59 is a quality piece of equipment that will complement almost any shack. Note shielded bandswitch and the convenient dual antenna jacks; one for coaxial line, one for shielded RCA - type connectors. Circle 47 on reader service coupon.



by Kathi Martin, KGK 3916

Kathi's CB Carousel

900 mhz CB—Can the FCC win?

I GET LETTERS about it, I read about it —and now the FCC is asking for opinions about what all you CBers will find yourselves involved in during the next five years.

900 MHz CB. As far as I'm concerned, the FCC's trial balloons concerning introductions of a new technology through CB comes down to this: The FCC would like to kick local communications upstairs to the 900 MHz range. This includes mobile phone, possibly much of what's now on the VHF hi-band, and anything else that comes along. There's a good reason for moving everything up, namely, we've just about run out of low frequencies.

Trouble is, there's presently no viable technology for 900 MHz in terms of reasonable cost; nor is there a thundering herd pounding through the research labs developing 900 MHz gear. It's just too expensive for present technology in view of the limited number of users.

The way I analyze it, if the FCC opens up 900 MHz to CB they think they can show the manufacturers there is a *potential* market in excess of 20 million users.

No Choice. Should the average CBer move to 900 MHz and go through the expense of new equipment? The 900 MHz band is not kid stuff; it is a billion dollar potential. Just as the FCC closed out 23 channel CB transceivers, turning a thriving industry into a disaster so too can the FCC close down 27 MHz CB. I give it five years maximum before the FCC opens up 900 MHz CB, and 10 years maximum before it closes down 27 MHz unless we do something about it. When the FCC opens the 900 MHz pot of gold, I doubt whether any present CB manufacturer, with perhaps one or two exceptions, will survive; just as I doubt the FCC will permit chit-chat on 900 MHz. Time will tell. Hope we're all around in ten years to see how it works.

The 1980s will be the era of high technology in CB as well as other forms of radio communication. The Midland 7001 has an advanced SWR indicator, bright green fluorescent LED readout, and combines AM and SSB operation in the same space as an old 23-channel AM rig.

Current News. Back here in the real world, where CB still is the most reliable emergency highway communication, there's big news. All the old CB hardware that was in the manufacturing pipelines has been used up, and new technology is being used in the CB transceivers available from brands still in existence. We're no longer seeing fancy new cabinets with 1975 circuits. The new gear is 1980 through and through, from cabinet, to digital readout, to design, to assembly itself. It's better looking, delivers better performance, and is even more reliable (if that can be imagined).

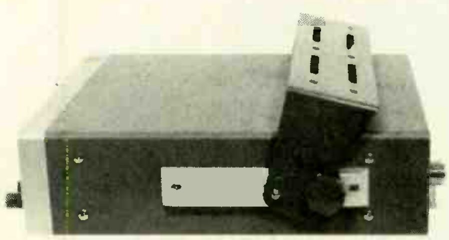
Midland 7001 AM/SSB. A case in point is Midland's model 7001 AM/SSB mobile transceiver. It starts out with a cabinet in "data processing" BIG SKY *blue,* and a *green* LED channel indicator that can be seen under any light conditions—no more dull red that gets lost in bright sunlight. Another plus is a quick-release mounting bracket. On each side of the cabinet is an extruded track. The gimbal bracket, which is secured to the dash, has tilt-clips that slide into the tracks, and a locking knob. To remove the rig you simply loosen the knobs and slide the transceiver out. To install the rig, just push the rig into the clips and tighten the knobs. The rig can be moved back and forth (the tracks are about six inches long) and/or tilted for best operating angle.

The front panel has an S/RF-output meter; controls for AF gain, squelch, RF gain, clarifier, AM/SSB modes, and MIC gain; switches for ANL and noise blanker, tone (high frequency attenuation), LED channel indicator dimmer, CB/PA, and RF ATT.

The RF ATT is an attenuator in the receiver input, before the amplifier, that's used to knock down a powerhouse local signal before it gets a chance to cause overload, which in turn will produce distortion.

Includes AWI. A really big feature, being seen on more and more new-design transceivers, is AWI—Antenna Warning Indicator. Basically, it's a built in SWR indicator that drives a front panel LED labled AWI. When

(Continued on page 86)



The special mounting gimbal and bracket allow for quick and easy installation and removal of the unit. Circle number 52 on the reader service coupon for more information.

e/e checks out...

Ithaca Audio's 16K Memory for the TRS-80

CIRCLE 62 ON
READER SERVICE
COUPON

Increase your memory capacity in minutes

For serious programming and/or a disk system, the Radio Shack TRS-80 needs both Level-II BASIC and 16K of memory. Sure, you can do a lot of heavy programming with Level-II BASIC and only 4K of memory, but it's sort of like having a $3000 hi-fi system with a $9.95 phono pickup: you can't get anywhere near optimum capability and performance. Even if you're convinced as to the necessity of upgrading already, the problem is that the 16K upgrade from Radio Shack is presently listed in their catalog for almost $300.

However, you can upgrade a TRS-80 yourself for about half of the usual cost, actually $140, and it takes no more than about 15 minutes time and a small screwdriver to do the job.

The secret behind 16K of RAM at a rock-bottom price, is a TRS-80 upgrading kit from an outfit known as Ithaca Audio. Where the "audio" comes in we don't know, but we do know that Ithaca Audio supplies some of the best documentation (instructions) we've seen for personal computing hardware.

Components. The Ithaca TRS-80 16K upgrading kit comes blister-packed on a large card. The back of the card contains the complete set of instructions and pictorials. The component kit itself consists of eight 16K RAMS which will replace the existing plug-in 4K RAMS, and a set of six pre-formed DIP shunts, two of which will replace the existing plug-in DIP shunts in the computer.

There's a reason why you're given six shunts when only two are needed. Firstly, different addressing shunts are needed by the Level-I and Level-II BASICs. Secondly, there are at least two versions of the TRS-80: One uses 14-pin shunts, the other 16 pin shunts. The "el-cheapo" kits usually give you a couple of 16-pin shunts with instructions on which connections to cut. This usually means hacking away at the shunts with a knife or screwdriver. Then, if your computer has a 14-pin DIP socket, you usually must figure out how to overhang the 16-pin shunt in the socket without creating shorts.

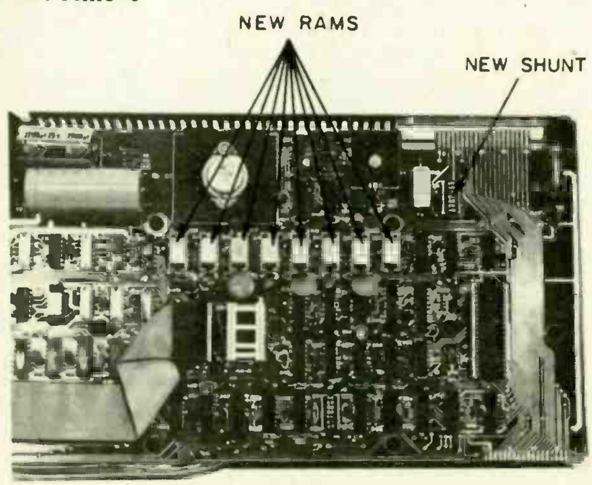
This annoyance is avoided with the Ithaca Audio TRS-80 kit. All the required shunts are pre-cut and correctly sized. A pictorial shows the six shunts and is mapped for both BASICs and both types of socket. You simply run your finger down the appropriate BASIC column, stop at the jumper size (14 or 16 pin), and there's a pictorial of the exact shunt needed. Simply pluck the shunt off the conductive foam, on which all the ICs and shunts are packaged, and install the jumper in the appropriate socket. How's that for trouble-free? But we're getting ahead of ourselves. Let's go back to the beginning and show how easy it is for the user to make the budget 16K RAM upgrading.

Installation. First off, do not remove any of the ICs from the conductive foam in which they are packed until you are ready to make the installation and not until you are grounded. An easy way to ground yourself is to solder a small alligator clip to a 1-megohm resistor, then solder the resistor's free end to a moderately long wire, and then secure the free end of the wire to an electrical ground. As a general rule of thumb, whatever the telephone company has used as the ground in your home is a reliable ground for working with semiconductors.

The reason *you* must be grounded is because CMOS devices, such as the RAMs, are extremely sensitive to the high static voltage a person can develop just by moving around in ordinary clothing. Simply touching a CMOS device when you're charged is all that's needed to instantly "blow" the device.

Attach the grounding alligator clip to your metal watchband, or the band's buckle, and then open the TRS-80 "keyboard" unit after first turning the

(Continued on page 83)



The callouts show the position of the new RAMs on the TRS-80's motherboard. With the new shunts already pre-wired by Ithaca Audio for you, the whole modification is really a plug-in operation. This is the most complete upgrading kit we have seen so far from an after-market manufacturer. Please circle number 62 on reader service coupon.

NOT ONLY IS AUSTRALIA Skylab's final resting place, and the world's smallest continent, but it also offers a wide variety of DX challenges. It is the home of the most distant SWBC station from eastern North America, there are major international broadcast sites, and even Medium Wave targets. No matter what kind of shortwave receiver you're working with, you can get in on the action.

First of all that most distant station from eastern NA is the Australian Broadcasting Commission's facility at Perth—the very same general area in which Skylab came down. The Perth SWBC station is a relay of ABC's home service for the remote areas of Western Australia but is probably the most easily heard Australian transmitter in North America. Try any morning around 1000 EST on 9610 kHz. Signals are not overpowering however the channel is usually clear at that hour.

Another Space Angle. About 150 miles north of Perth we find the Radio Australia (as ABC's international service is known) relay at Carnavon. ABC converted this former major U.S. satellite and missile tracking facility for international broadcast purposes after their relay at Darwin in Northern Australia was destroyed by a giant cyclone on Christmas day 1974. Originally a replacement site just outside Perth was considered but then the Australian government decided it would be faster to convert the recently vacated space station where power lines, buildings etc. were already available.


Australian Information Service photo

An international electronics firm hastily diverted two SWBC transmitters —of 250 KW and 100 KW each—previously ordered by other customers. The first test broadcasts from Carnavon were aired in December 1975, only a few months after the Vietnam war had come to an end. Carnavon has since provided good coverage of Southeast Asia, particularly southern China (which appears now to be its primary target), but doesn't equal Darwin's coverage of northern China. Incidentally, Darwin was once the southern hemisphere's most powerful station. Because of Carnavon's failure to cover the north, there have been repeated rumors that the Darwin station will be rebuilt in the next few years.

Carnavon is not anywhere near as easily received in North America as Perth. But anytime you can hear Radio Australia's North American service on 17795 kHz at 2000-2400 EST, you should tune up to 17870 kHz and look for English to Asia from Carnavon. The latter channel doesn't sign on until 2030 but continues all night (our time) till 0500 EST. You might also try for non-English broadcasts from Carnavon on 15410 at 0300-0530 EST.

DOWN UNDER DX

Tune in Australia—the biggest English-language broadcaster in the southern hemisphere

by C.M. Stanbury II


Australian Information Service photo

e/e DOWN UNDER DX

Pools 3-feet deep and 50-feet wide flank the entrance to the $14,000,000 Victorian Arts Centre in St. Kilda Road, Melbourne. The Arts Centre was opened in Aug. 1968.

More International Broadcasts. Radio Australia's main transmitter site is at Shepparton in Victoria state. It is used interchangeably with the original and much lower powered site at Lyndhurst, near Melbourne, also in Victoria. However for long haul paths, such as the North American beam, you can be pretty certain those signals are coming from Shepparton. In addition to 17795, other NA Service frequencies are 21740 (in the now suddently active 13 Meter band) at 2000-2400, and 9580 kHz at 0600-0800 EST.

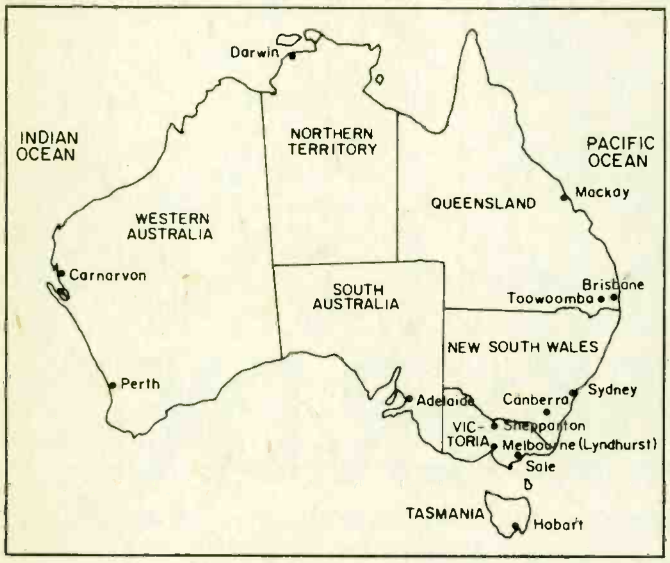
Shortly after Darwin's destruction, some international transmissions were made from the northeastern city of Brisbane in Queensland. These broadcasts are presently suspended but Brisbane home service relays can still be logged on 9660 kHz during the early AM hours. Another former international site is at Sydney in New South Wales from which Radio Australia was relayed during World War II (another time when Australian transmitters were also strategically situated). And, like Brisbane, Sydney home service relays can still be heard—on 6090 kHz.

Medium Wave. Yet a third site in Victoria, at Melbourne, relays the home service on 9680 kHz. Part of the time that BCB station relayed is 3L0, now widely heard by DXers in Western NA on 774 kHz. Throughout the 1950s and even into the early 1960s Australian BCB stations (including 3L0—then on 770 kHz) were often picked up on communications-quality receivers as far east as the Atlantic coast. But there were two important differences; most U.S. and Canadian stations were silent either Sunday or Monday AM between roughly 0100 and 0500 local time, and our stations did not modulate nearly so broadly as they do now. The interference grew progressively worse and by 1970 Australian BCB reception became almost impossible east of the Rockies, and even difficult on the Pacific coast itself.

But come the fall of 1978 a new era in "down under" reception began. Almost all Pacific stations (Hawaii is the major exception) switched to a new 9 kHz BCB channel plan which put many of them on what DXers call split frequencies. 3L0, for example, moved from 770 to 774 kHz—at least 4 kHz away from most of the interference in this hemisphere. MW DXers in western NA have been regularly logging Australians ever since (a few are listed in Figure IV). As this is being written, no one east of the Mississippi has yet reported reception. This could be due to the current, very high sunspot count which will slowly decline during the next few years.

All of the stations listed in Figure IV, except 4MK, are operated by the Australian Broadcasting Commission. When 9680 is not parallel 3L0 (and 3GI at Sale), it is relaying 3AR on 621 kHz. 4QS and 4RK will be parallel

(Continued on page 84)



This map of Australia indicates the states and principal cities in which most of the stations you're likely to hear are located. If you have a directional or rotatable antenna, locate these sites on a world map and "aim" for them at the proper times. You may remember Carnarvon as the site of one of the radar tracking stations for Project Mercury.

As you can see, all of the Australian MW stations are located on frequencies in between those of American and Canadian stations. With luck, you might hear some of them at certain times.

AUSTRALIAN MEDIUM WAVE TARGETS

kHz	Call	Location
621	3AR	Melbourne, Victoria
729	5CL	Adelaide, South Australia
747	4QS	Toowoomba, Queensland
774	3L0	Melbourne, Victoria
828	3GI	Sale, Victoria
837	4RK	Rockingham, Queensland
1026	4MK	Mackay, Queensland

AUSTRALIAN SHORTWAVE TARGETS

kHz	Location	Time (EST) and Notes
6090	Sydney, New South Wales	Early AM
9580	Shepparton, Victoria	0600 - 0800 English to Americas
9610	Perth, West Australia	Until 1100 Sign-off
9660	Brisbane, Queensland	Early AM
9680	Melbourne, Victoria	Early AM
15205	Carnarvon, West Australia	1730 - 2030
15410	Carnarvon, West Australia	0300 - 0530
17795	Shepparton, Victoria	2000 - 2400 English to Americas
17870	Carnarvon, West Australia	2030 - 0500
21740	Shepparton, Victoria	2000 - 2400 English to Americas

The shortwave broadcasters will undoubtedly be much easier for you to track down. Again, if you are using a directional antenna, try to aim right at your target's location.

ACTIVE AUDIO FILTER

Increase any receiver's selectivity with no internal modifications

by Walter Sikonowiz

PROBABLY THE BIGGEST HEADACHE for any ham—novice or oldtimer—is the extreme congestion of today's Amateur bands. Push and shove is the name of the game, with signals crammed sideband-to-sideband in the 3500 kiloHertz allotted to Amateur HF communication. For this reason, a receiver's selectivity—its ability to discriminate between signals close in frequency—is often more important than its sensitivity.

One way to get better selectivity involves the use of a crystal or mechanical IF filter, which is what you'll find in the better ham-band receivers and transceivers. With bandwidths of 2500 Hz for SSB (single sideband) and 400 Hz for CW (code), these IF filters certainly do improve selectivity. Often, however, the improvement is just not enough. In those tough situations, what you need is a highly selective audio filter like the one presented here.

Not only will this active filter help you to separate closely spaced signals, but it will eliminate most of the annoying background noise as well. It's a real pleasure to copy a clean CW signal without hissing or cracking, especially when headphones are being used. If you're a newcomer getting by with an old, inexpensive receiver, wait until you try this filter. But even with the fanciest rig around, you'll notice a dramatic improvement in selectivity.

Before examining details of the circuit, let's talk about the determining measure of a bandpass filter's sharpness or selectivity. Fig. 1 shows a graph of filter output voltage versus frequency. Here it is assumed that the input signal is a sine wave of varying frequency but constant amplitude. As you can see, the output voltage reaches a maximum at f_0, called the center frequency, and drops off as frequency is increased or decreased relative to f_0. At frequencies f_1 and f_2, the output has dropped 3 dB (decibels) below its maximum value, that is, to about 70% of the peak voltage at f_0. The filter is said to have a −3 dB bandwidth equal to f_2 minus f_1, as indicated on the graph. The narrower the bandwidth, the more selective the filter will be in operation.

All About "Q." Another more convenient measure of selectivity is Q. To specify our bandpass filter's Q, just divide its center frequency by its −3 dB bandwidth. For example, if the center frequency is 1000 Hz and the −3 dB bandwidth is 200 Hz, the filter has a Q of 5. Note that Q is a dimensionless number. Higher Qs will obviously result in more selective filtering, as can be seen from the graph of Fig. 2. While high-Q filters are desirable from the standpoint of selectivity, "ringing" will limit the amount of Q that can be used.

Electrical-circuit ringing is similar to the familiar mechanical ringing of a bell: Each time that a bell is struck, its sound lingers for a noticeable period of time after the blow that initiated it. In like manner, a high-Q filter continues to emit a tone (with frequency equal to f_0) whenever the input signal abruptly drops to zero. Since Morse code is a

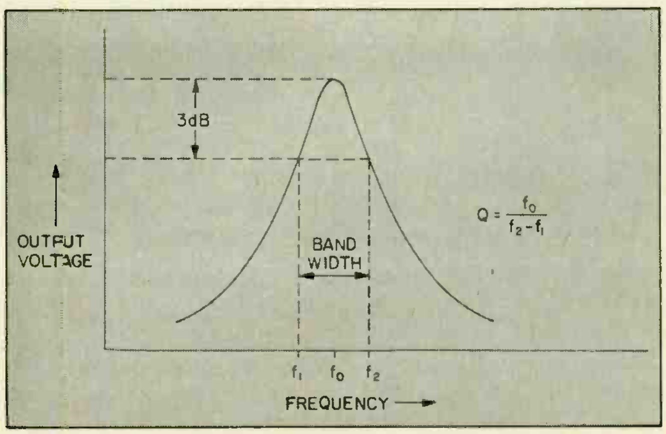


Fig. 1. Above is a sample graph depicting the bandpass curve for a theoretical filter derived from the formula at the left of the graph. This formula demonstrates the manner in which "Q" derives.

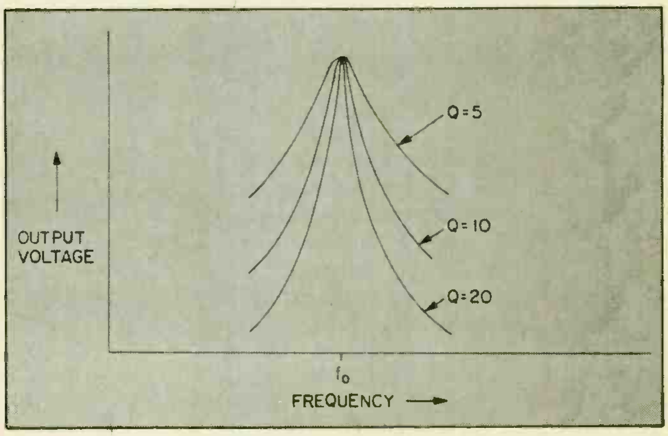


Fig. 2. The higher the "Q" value of the filter, the narrower the bandpass frequency width will be. Obviously, a filter with a "Q" value of 20 will exhibit a narrower width than one with a "Q" of 5.

sequence of sound bursts interspersed with silence, the ringing of a very-high-Q filter will be apparent after every dit and dah. This has the effect of slurring characters together, making them difficult to interpret. Therefore, we need to compromise and use only enough Q to improve selectivity without introducing noticeable ringing.

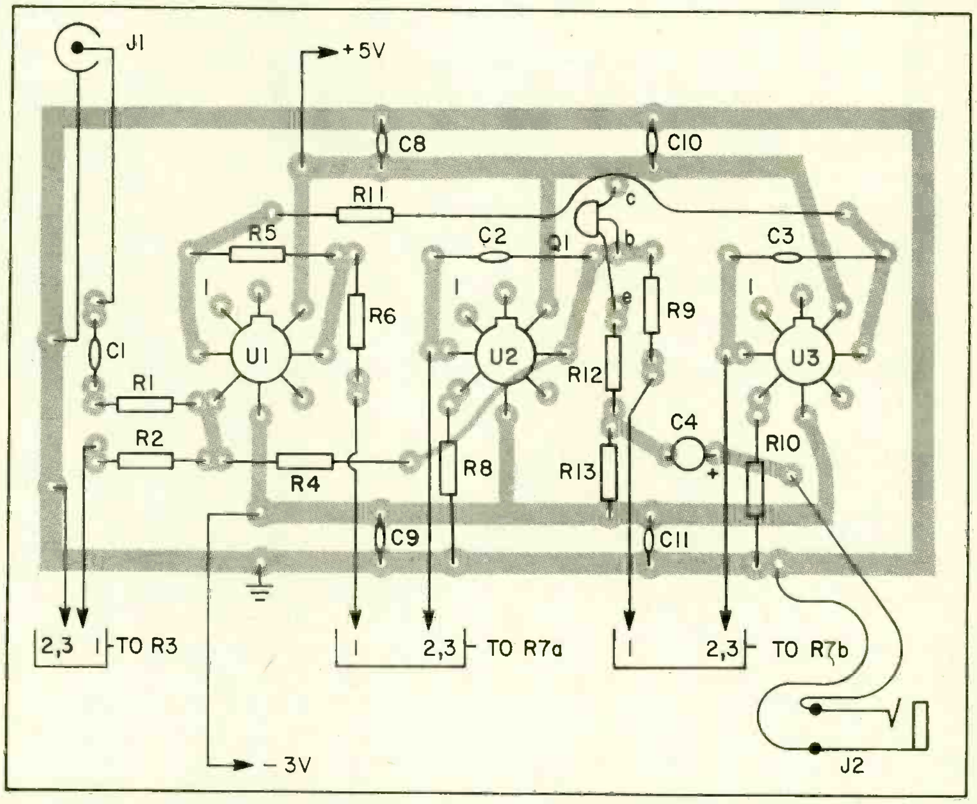
The bandpass filter presented here can be adjusted to Q values between 1.4 and 15. In addition, its center frequency may be adjusted independently of Q between 375 and 1500 Hz. Using signals from your receiver's headphone jack as input, the filter is capable of driving low-impedance (4- to 16-ohm) headphones directly. The maximum input signal should not exceed 2-volts peak-to-peak, a level sufficient to produce deafening headphone volume.

The Circuit. The type of bandpass circuit shown in the schematic goes by a variety of names: universal, bi-quadratic or state-variable. While there are simpler ways of constructing a band-pass filter, the state-variable approach works better than most. Note that this is an *active* bandpass filter. Instead of a resonant network of inductors and capacitors, this filter is composed of op amps together with resistors and capacitors. No inductors are necessary with this type of circuit.

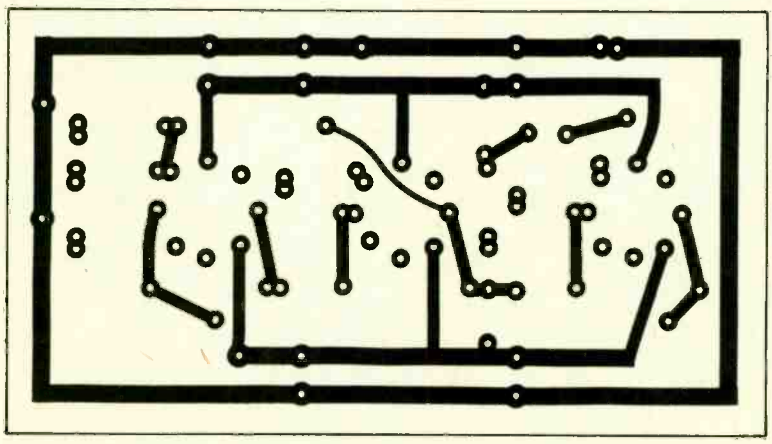
Signals from the receiver's headphone jack are coupled into the filter through C1 and R1. Potentiometer R3 controls the Q: minimum resistance produces maximum Q, and vice versa. R3 is an audio-taper device whose terminals (1, 2 and 3) must be wired exactly as specified in the schematic. This is necessary to produce a smooth, linear variation in Q as the potentiometer is rotated.

Wired as shown, the potentiometer will produce maximum Q when fully counterclockwise, and minimum Q when clockwise. This is contrary to the norm of having the maximum of any variable in the clockwise position, but you can easily live with it. Actually, a potentiometer with a reverse-logarithmic taper rather than the standard audio taper would produce maximum Q in the clockwise position, but such devices are very hard to find. (Note: If by some unexpected windfall you should locate reverse-log-taper pots, interchange the wiring of terminals 1 and 3 from what is shown in the schematic.)

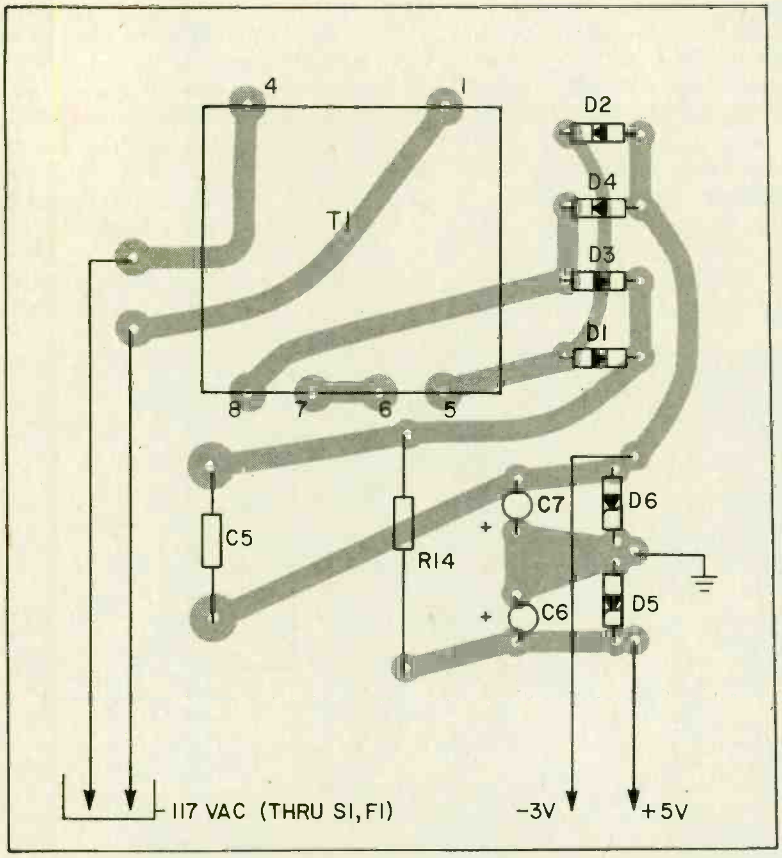
The three op amps are interconnected by several feedback loops to produce the desired bandpass response. First,



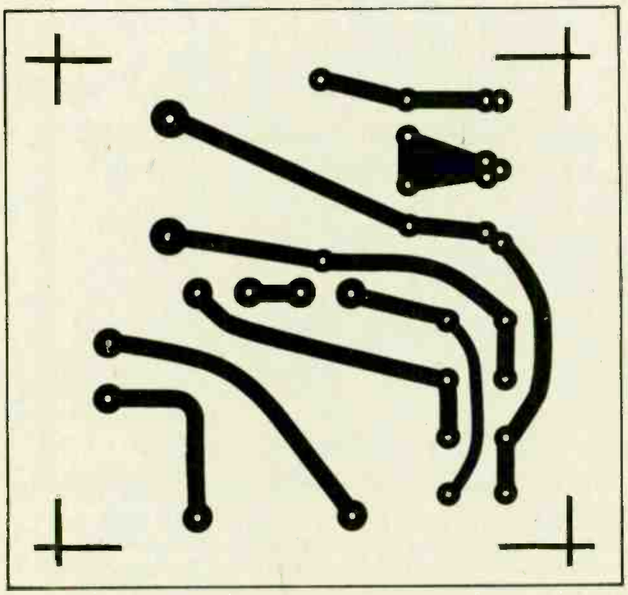
Here is the component layout diagram for the filter printed circuit board. Note the marked, off-board connections for R7a&b, R3, J1, J2 and V+. Make certain to match up the R7 connections exactly as shown on the schematic, or your filter will work only in reverse.



This is the exact scale template for etching the filter board. Leave at least ¼-inch around all four sides to allow for the drilling of mounting holes with which to secure the circuit board to the chassis. Use a number 67 drill bit for making the holes.



The component layout for the power supply board was deliberately made spacious to allow for the differences in component sizes of different manufacturers. Observe polarity of diodes and capacitors.



The etching diagram for the power supply PC board is shown at left. As with the filter board, allow room along the edges for drilling holes for the chassis mounting screws. There should be room for drilling holes (if needed) to secure the power transformer to the board.

there are three simple negative-feedback loops: R5 around U1, C2 around U2, and C3 around U3. Then two more negative-feedback loops connect U2 with U1 (through R4) and U3 with U1 (through R11). Needless to say, the intreaction among these op amps is very complex, and we won't dwell any further on it.

The center frequency of this filter can be adjusted by R7, a dual audio-taper potentiometer that, like *Q* control R3, must be wired exactly as specified in the schematic. Since maximum frequency occurs when both sections of the potentiometer have minimum resistance, fully clockwise rotation will produce a minimum center frequency, and fully CCW rotation will produce the maximum. Again, this is the reverse of the norm, but you'll get used to it.

The bandpass-filtered output, available at pin 6 of U2, is fed to buffer amplifier Q1. Low-impedance headphones plugged into J2 are driven by Q1 through DC-blocking capacitor C4.

During the design stage, it was decided that an AC power supply would be most economical in the long run, since the filter is likely to see a lot of use. In fact, once you get accustomed to using this audio filter, you'll probably never operate without it. Transformer T1 steps down the 117 VAC line voltage to 20-volts, and diodes D1 and D4 then rectify the AC. Electrolytic capacitor C5 filters the rectified AC to DC. Then, zener diodes D5 and D6, together with current-limiting resisto R14, split and regulate the DC, yielding +5V and −3V outputs. Finally, bypass capacitors C6 through C11 help to keep the supply's output impedance low.

Construction. Construction should be easy, but be careful nevertheless. An aluminum cabinet like the 4 by 4 by 2-inch LMB minibox used for the prototype is recommended for the sake of shielding. The chassis should be connected to circuit ground, and this is easily accomplished at the input or output jack. Because of the cabinet's small size, the circuit was laid out on two separate PC boards—one for the power supply and one for the filter. This allowed the cabinet's interior space to be used more efficiently. If you do not like working in tight quarters, however, feel free to use a larger cabinet. For those unable to fabricate their own printed circuits, suitable PC boards are available commercially (see parts list).

Note that a PC-mounting 20-VAC transformer was used for T1. This unit has the advantage of small size, and it may be ordered directly from the manufacturer. The transformer's pins are inserted into the printed circuit and soldered just as a resistor or capacitor's leads would be. Resistor R14 has a 2-watt rating; do not use a half-watt resistor because it will overheat. If you cannot locate a 470-ohm 2-watt unit, three 1500-ohm ½-watt resistors in parallel will yield an equivalent resistance of 500-ohms with a power rating of 1.5-watts. This is an acceptable substitute. Note the ¼-inch-diameter vent holes that were drilled into the back and bottom sides of the prototype's cabinet. These allow for the circulation of air so that the filter's components do not heat up. (A change in temperature could cause the filter's center frequency to drift, and that is undesirable.)

Note that ceramic capacitors C8 through C11 do not mount with the rest of the power supply components. Instead, they mount on the filter board, close to the ICs.

Be sure to use 5% resistors and polystyrene (5%) capacitors where called for. Also, be certain to get the proper orientation when installing the diodes, the electrolytic capacitors, Q1 and the ICs. Remember that the terminals of each potentiometer must be wired in accordance with the schematic.

From the PC layout, you'll note that R11 requires long leads because its mounting pads are quite far apart. It's probably a good idea to cover this resistor's leads with insulation. This will prevent a short circuit between the resistor and a nearby component.

Save installation of the ICs until all other soldering is finished. To be safe, it's probably best to use IC sockets. That's because these type 3140 op amps have MOSFET input transistors, which can be damaged by static discharge from your fingertips or leakage current from your soldering iron.

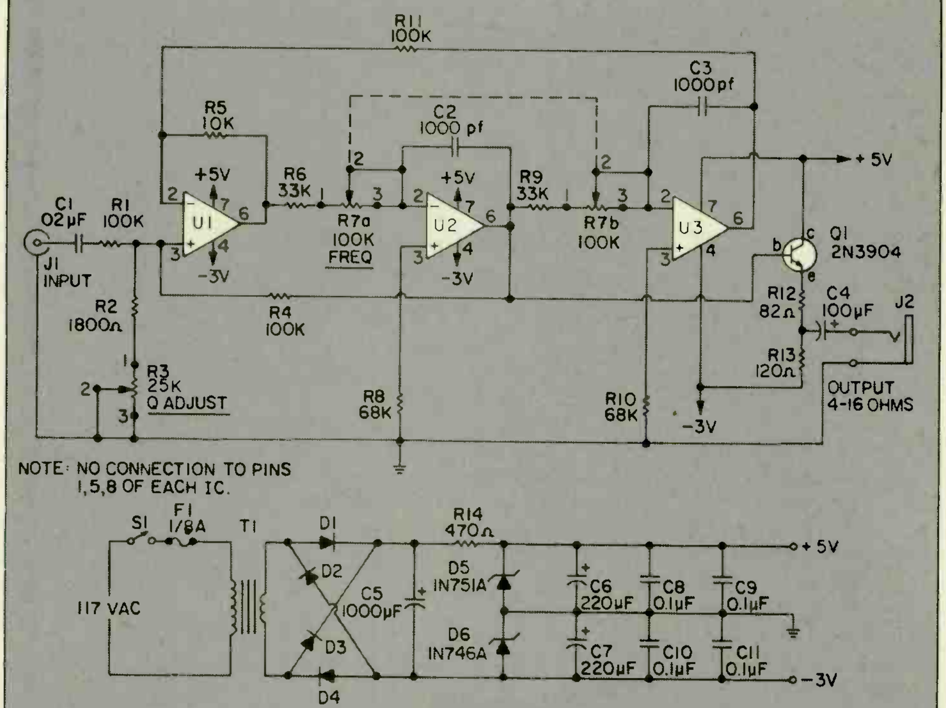
IC Tips. If you are an experienced and careful worker, however, it is possible to solder the ICs. First, ground yourself, and insert an IC into its holes on the board. Then, wrap about five turns of very thin, bare wire around the IC's leads so as to short them all together. You can now solder using a low-leakage, grounded iron. Do not unwrap the shorting wires until every last connection has been soldered. But don't forget to unwrap the wires, or your circuit will not work. If all this sounds complicated to you, stick with sockets. As a final note, be sure to use only resin-core solder and a small iron—*not a soldering gun*—to make all of your soldered connections.

Checkout. That wraps up construction. Double-check your wiring, and then apply power. With a VOM, measure the two supply voltages. If these are in the ballpark, proceed to apply a sine-wave signal of, say, 1000 Hz to the filter's input. Make sure that the peak-to-peak amplitude is less than 2-volts.

Plug your headphones into J2. Set R3 for minimum *Q*, and adjust R7 to maximize the volume of the 1000-Hz tone in your headphones. If necessary, reduce the amplitude of the input to produce comfortable headphone volume. Vary the frequency of your signal generator above and below 100 Hz, and note the gradual decrease in volume that occurs as the input deviates from 1000 Hz. Return your signal generator to 1000 Hz, then increase your filter's *Q* with R3. Once again, rock the signal generator's frequency control around 1000 Hz. With high *Q* you'll notice a much more rapid drop in volume as the input frequency is shifted. (Note: Those who don't own an audio signal generator can skip the above test. However, if the filter fails to improve receiver selectivity, as detailed below, you may need to troubleshoot the circuit. In that case, the above information will be helpful.)

Tuneup. If everything checks out OK,

(Continued on page 86)



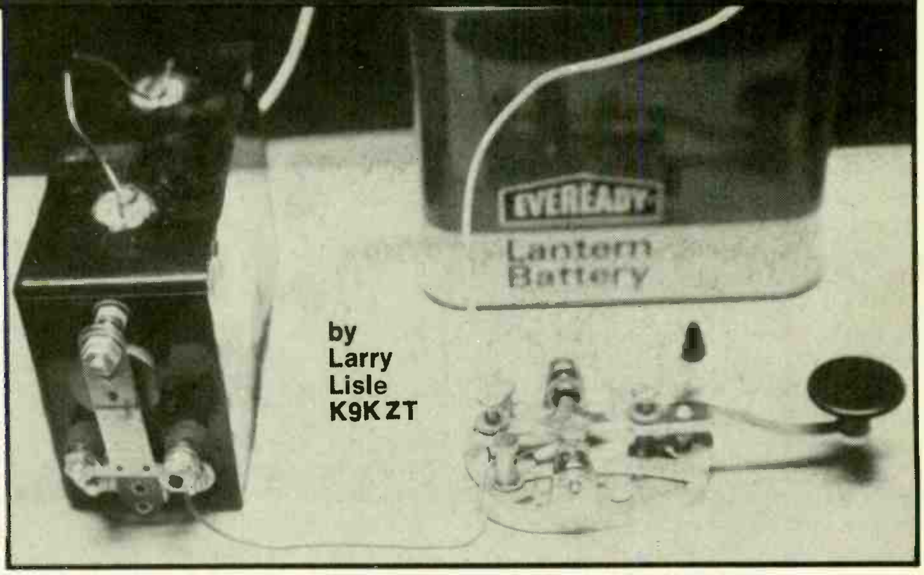
PARTS LIST FOR CW FILTER

C1—0.02 uF ceramic capacitor, 15 VDC
C2, C3—1000 pf polystyrene capacitor, 15 VDC
C4—100 uF electrolytic capacitor, 10 VDC
C5—1000 uF, electrolytic capacitor, 10 VDC
C6, C7—220 uF electrolytic capacitor, 10 VDC
C8, C9, C10, C11—0.1 uF ceramic capacitor, 15 VDC
D1, D2, D3, D4—1N4003 1A, 200 PIV rectifier diode
D5—1N751A 5.1-volt, ½-watt zener diode
D6—1N746A 3.3-volt, ½-watt zener diode
F1—⅛-amp slow-blow fuse
J1—phono jack (RCA type)
J2—phone jack (¼-inch size)
Q1—2N3904 NPN transistor
All Resistors ½-Watt, 5% Unless Noted Otherwise
R1, R4, R11—100,000-ohms
R2—1800-ohms
R3—25K audio-taper potentiometer
R5—10,000-ohms
R6, R9—33,000-ohms
R7—dual 100 K audio-taper potentiometer (Radio Shack #271-224)
R8, R10—68,000-ohms
R12—82-ohms
R13—120-ohms
R14—470-ohm, 2-watt, 10%
S1—SPST slide switch
T1—20-volt, 300 mA, PC-mount transformer (Signal #ST-3-20 available from Signal Transformer Co., 500 Bayview Ave., Inwood, NY, 11696, for $5.30 plus postage).
U1, U2, U3—RCA CA3140 op amp (available from Circuit Specialists, Box 3047, Scottsdale, AZ, for $1.15 each plus postage)
Misc.—aluminum cabinet, line cord, IC sockets, knobs, etc.

NOTE: Etched and drilled printed-circuit boards complete with instructions are available from LECTROGRAPHIX, P.O. BOX 537, Auburn, NY, 13021. Power supply board #FPS-9 costs $4.00; filter board #ACF-9 is $5.50 postpaid in the continental USA and Canada. All others please add $1.50 for postage and handling. Money orders or personal checks accepted on domestic orders. Foreign orders must be in the form of a money order for US funds only. Residents of New York State, please include 7% sales tax. Allow 2 to 3 weeks for delivery.

KING SPARK

How those early spark-gap transmitters got the message out



by Larry Lisle K9KZT

THE CRASHING SOUND of an open spark gap! The dancing shadows on the wall! The smell of ozone and the gentle breeze that came from the big rotary! Those were the days of king spark. The days when men communicated with electricity instead of electronics and the word was wireless in a world not yet used to wires.

How did those transmitters of the opening of our age work? What principles did they follow as they beat their messages on drums of thunder and lightning?

Radio Waves. Let's start near the beginning. The first man to generate radio waves and have a clear idea of what he was doing—an important distinction—was Heinrich Hertz. Hertz's transmitter consisted of an induction coil, spark gap and antenna. (Fig. 1) When the battery was attached to the induction coil current flowed through the primary winding and through the closed interrupter contacts back to the battery. When the current reached a certain level, the magnetic flux in the core was great enough to pull the movable arm of the interrupter away from the fixed contact, suddenly breaking the circuit. This induced a much higher voltage in the secondary, causing a discharge across the spark gap and the generation of high frequency radio waves—the wavelength being determined solely by the antenna.

The contacts of the interrupter would then close as the magnetism of the core subsided and the cycle would repeat, usually 10 to 50 times per second.

The purpose of capacitor C was to prevent arcing as the interrupter contacts opened, which would slow the effective speed of the "break."

Hertz's oscillator wasn't especially efficient or powerful—it didn't need to be. It *was* good enough to do the job he intended it to do—send electromagnetic radiation of a known wavelength across his laboratory so he could prove the existence of the waves and that their speed was the same as that of light, confirming Maxwell's theories. But, it was Marconi who put power in wireless.

First Transmitter. At first Marconi's transmitter, though more powerful, was quite similar to Hertz's. His great contribution at this stage was grounding one terminal of the spark gap and elevating the other. (Fig. 2)

Marconi's next great contribution was embodied in his famous "four sevens patent," British patent no. 7777 of 1900. In this invention Marconi added a tuned circuit between the induction coil and antenna in the transmitter and between the antenna and detector in the receiver. There were thus four

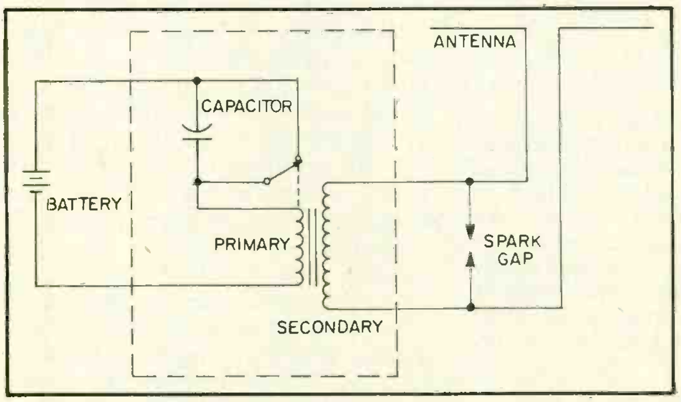


Fig. 1. This is the schematic of Hertz's original spark gap transmitter. There was no key, as it was set to oscillate continuously.

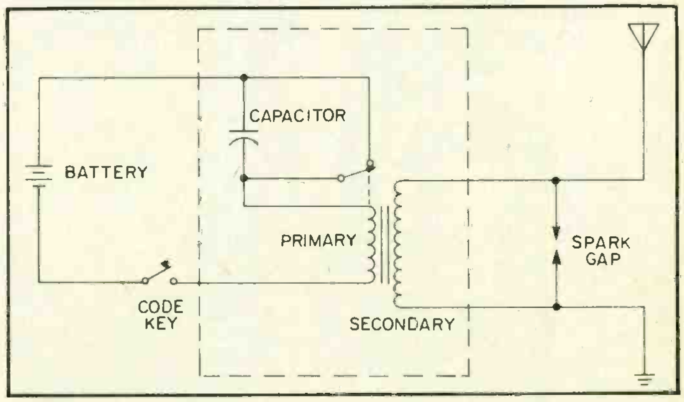


Fig. 2. Marconi's first transmitter, although remarkably similar to Hertz's, had the addition of a grounded spark gap and high antenna.

tuned circuits (counting the antennas) in the system— his "four circuit tuning system." A typical transmitter is shown in Fig. 3.

Though there were many improvements in the components, and circuits were often more complicated, this was *the* fundamental transmitter for the rest of the spark era.

How It Works. High voltage from the secondary of the induction coil charges capacitor C_1. When the voltage becomes great enough to overcome the resistance of the spark gap the gap fires and the capacitor discharges through the spark gap and coil L_1. The discharge of a capacitor is oscillatory if the resistance in the circuit is low enough, and the frequency is determined by the values of C_1 and L_1. The spark gap thus acts merely as a switch, periodically allowing the energy accumulated by the capacitor to discharge through the coil, creating radio frequency alternating current.

The energy that may be stored in a capacitor is given by the formula, $W = CV^2/_2$, where W is the energy in Joules, C the capacity in Farads, and V is in volts.

Therefore it was desirable to make the capacity of C_1 and the voltage across it as large as possible. This explains why spark transmitters typically used very large, high-voltage capacitors; a value of .002 to .01 μF not being unusual in the vicinity of the broadcast band. It also explains, together with other factors, why spark transmitters were usually used at low frequencies.

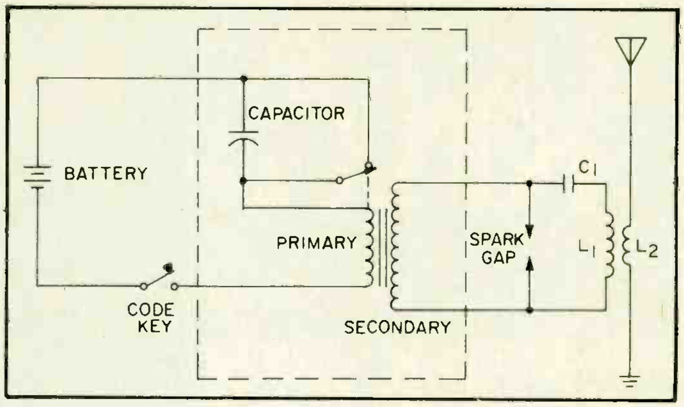


Fig. 3. Marconi's "four sevens" patent incorporated the design of a tuned circuit as shown in the schematic at right. As you can see, it now begins to resemble a radio as we are familiar with.

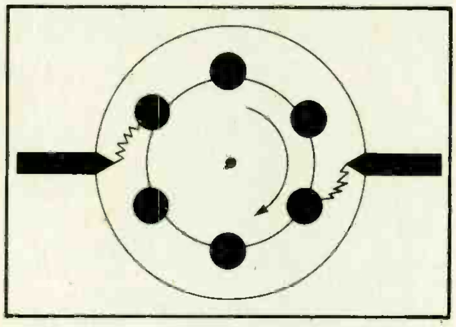


Fig. 4. The rotary spark gap mechanism was the first method used to increase the spark frequency in the later spark gap units.

The voltage across the capacitor was determined by the length of the spark gap, which was in turn limited by the voltage that could be generated by the induction coil with the capacitor across it. The break-down voltage of the capacitor also had to be considered.

A voltage of 10,000 to 15,000 was often used in shipboard installations and small land transmitters. Capacitors were usually made of glass and tinfoil, either in the form of Leyden jars or in sandwiches of plate and foil. Mica and oil were sometimes used as dielectrics.

Since power is equal to Joules per second, the power available in a spark transmitter in Watts is given by the formula, $P = NCV^2/_2$, where N is the number of sparks per second.

Boosting Power. One way to increase power would have been to increase the frequency of the interrupter, but mechanical problems made this difficult. In any case, induction coils were soon supplanted by transformers using 110 volt A.C. house current—at least for those whose house *had* house current and could afford a transformer.

With 60-cycle (as it was then called) A.C., the spark frequency in a properly adjusted, plain spark gap was 120 per second—one spark on each voltage peak.

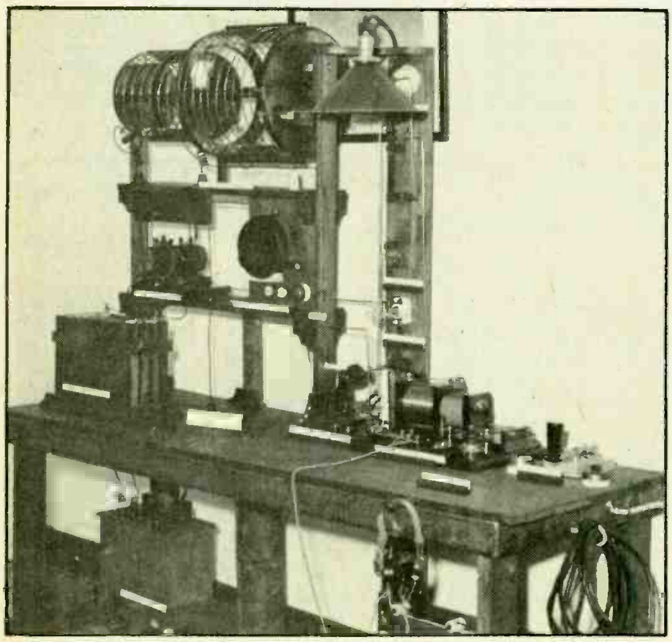
To increase the spark frequency a rotary gap was used. The rotary gap consisted of a motor which turned a disc with six or more studs on it. The studs were all connected together and fixed electrodes were placed near the disc. When two of the rotating studs were opposite the fixed electrodes a spark would jump from one of the fixed electrodes to a stud on the disc, through the disc to the other stud to the fixed electrode. (Fig. 4)

A fraction of a second later the rotating disc would carry the studs out of position and the spark would cease, only to appear again as the next pair of studs were in the correct position.

The rotary gap gave plenty of sparks per second and solved the power problem. An added benefit was that the system prevented a continuous low frequency arc that sometimes plagued the plain gap.

When used with 60 cycle A.C. the rotary gap was usually not synchronized with the alternating current cycle and sparks appeared at random. This gave the note a rough character, which was sometimes deliberately increased by removing one or two studs to make the

(Continued on page 83)



This is a working replica of Marconi's one-sixth-inch transmitter. It was assembled by James Wilson and Frank Caswell, and is on permanant display at the National Park Service headquarters near the original site.

The Daily Spark

NEW YORK, SUNDAY, JANUARY 24, 1909

STEAMSHIPS COLLIDE IN ATLANTIC OFF MASSACHUSSETTS

Fog Blamed in Collision, Rescue Efforts Proceeding

BY HARRY MILLER

NEW YORK, Jan. 24—Perhaps no other event in the short history of wireless telegraphy at sea has more graphically demonstrated its worth than the collision yesterday morning between the liners *Republic* and *Florida*, off the Massachussetts coast.

The *Republic*, under the command of Capt. Inman Sealby, departed New York late Friday afternoon bound for Gibraltar. Shortly after clearing Sandy Hook, she became enveloped in the thick fog which had blanketed the Northeastern seaboard for most of the day. Radio operator Jack Binns sent a routine message to the Siasconsett wireless station on Nantucket Island, reporting position and fog conditions.

At the same time, the liner *Florida*, inbound to New York carrying refugees from the massive earthquake in Messina, Italy, was approaching Sandy Hook from the Southeast, preparing to enter the lower harbor. The *Florida* was not carrying wireless equipment.

Only moments after the *Florida's* fog horn was heard on the bridge of the *Republic*, the *Florida's* bow plowed into the *Republic's* side, just forward of the bridge, instantly killing three passengers and two crewmen.

Awakened by the crash, Radioman Binns went to the radio compartment in an attempt to transmit a distress message to Siasconsett. Unfortunately, the *Republic's* electrical generator was damaged in the collision, and Binns had to rely upon his emergency batteries to transmit. Although wireless transmission is possible using storage batteries, the range of such transmissions is only 50 to 60-miles.

Binns began to tap out the standard distress call, "CQD" in the desperate hope that the Siasconsett station was monitoring the air, and that even with the limited range of the battery-operated set, he would be able to get the message across.

After many anxious minutes of trying, Siasconsett finally answered Binns' call. Even though the batteries were weakening, Binns managed to get the message completed, informing Siasconsett that both ships were damaged and in immediate danger of sinking.

Siasconsett told Binns to stay by his radio as long as he possibly could, and that the nearest ship equipped with radio would be contacted, and sent to their assistance.

At this time, the *Republic* was sinking at the rate of one foot per hour, and Captain Sealby feared that help might arrive too late to save his passengers and crewmen.

He ordered that all of the passengers be transferred to the *Florida* which, despite its damaged bow, was not in immediate danger, and was more likely to remain afloat the longer of the two.

Meanwhile, the powerful Siasconsett station was sending a CQ to all ships within radio range, hoping to find at least one that would be able to reach the two damaged liners in time.

Both the *Baltic* and the *La Tourraine* were within the approximate area, and they immediately set course for the last reported position of the *Republic*.

The *Baltic*, at a distance of approximately 64-miles stood the best chance of reaching the scene first, but able to make only 22-knots through the fog, her captain doubted that he would be able to arrive in time. Even at that, there was a very strong possibility that the *Baltic* might pass within a few hundred yards of the *Republic* but still miss her in the fog.

However, this is the age of wireless, and when both ships were within range of their wireless sets, they were able to gauge distance by the strength of the radio signals.

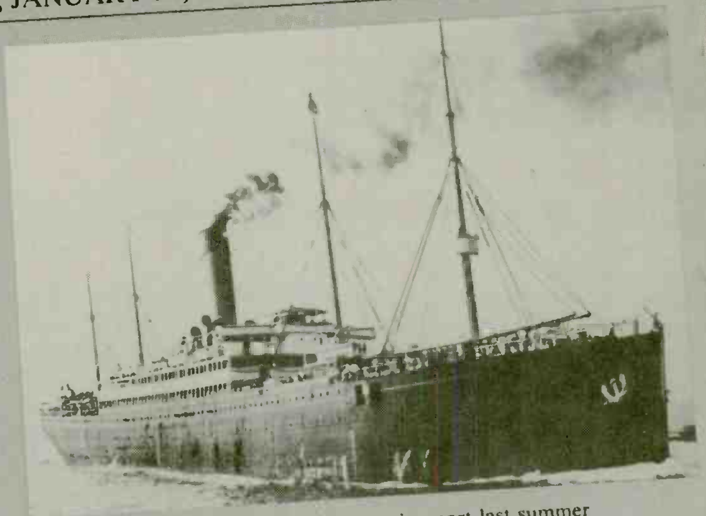
It was decided to guide the *Baltic* in by detonating small explosive charges and judging distance and direction from the sound of the explosions.

The two ships were able to synchronize their chronometers via the wireless, so that the time required for the sound of the explosion to travel from one ship to the other could be judged with greater accuracy.

With the *Baltic* judged to be within ten miles, the first series of bombs were set off, but they could not be heard on the *Republic*.

Finally, with all but one bomb exhausted, radioman Binns was called up on deck to put his trained ears to use. Luckily, this strategm paid off, as Binns thought he detected a muffled thud.

Based on this, he radioed directions to the *Baltic*, and within fifteen minutes, the crew of the *Republic* began transferring to the *Baltic*, their lives saved by the use of wireless.

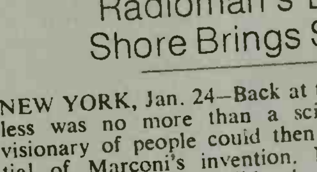


The liner *REPUBLIC* entering port last summer

NEW WIRELESS SAVES LIVES

Radioman's Distress Call to Shore Brings Speedy Rescue

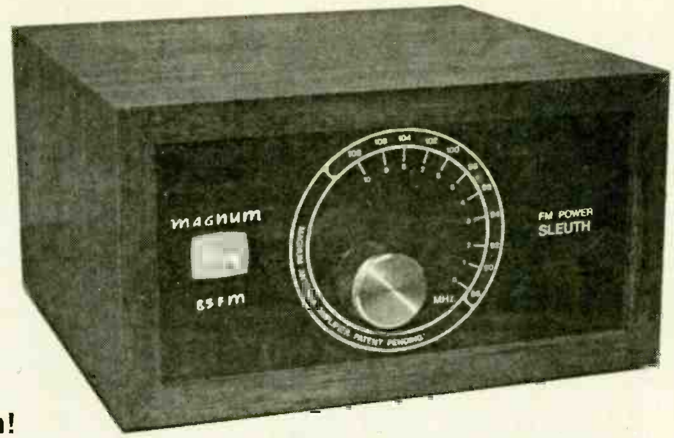
NEW YORK, Jan. 24—Back at the turn of the century, when wireless was no more than a scientific curiousity, only the most visionary of people could then only begin to imagine the potential of Marconi's invention. Now, only a few years later, it has proven itself possibly the most important of all shipboard equipment. As of today, the wireless can no longer be considered a luxury for a steamship passenger wishing to send a message to shore. It is now a necessary piece of emergency equipment capable of saving countless lives in maritime disasters.



Wireless operator Jack Binns

e/e checks out the...

MAGNUM 85 FM ANTENNA AMPLIFIER



Add 35 dB of gain to any FM antenna system!

CIRCLE 79 ON READER SERVICE COUPON

NOT EVERYONE CAN ENJOY the benefits of strong-signal metropolitan FM listening. Most of us install our FM receivers, hoping that reception will be adequate with an inside antenna. For those apartment dwellers and fringe listeners whose FM reception is marginal at best, the Magnum 85 FM Antenna Amplifier, from a Canadian firm called Magnum Electronics may be the answer.

Warmly styled in a walnut-grain cabinet the model 85 measures 8-inches wide, by 4½-inches high, by 7½-inches deep. The front panel is satin black, accented with white lettering. The frequency dial is clear, permitting back-illumination from an amber LED to highlight the frequency to which the amplifier is tuned. The LED rotates with the gear mechanism, thus tracking the appropriate frequency setting. Frequency readout is accurate.

Circuitry. Internally, the Magnum 85 contains 3 RF amplifier stages, tuned by a ganged variable capacitor. A standard AM/FM variable is used, but the high-capacitance AM sections are not connected. The phenolic PC board is hand-soldered. Discrete transistors are used in all stages. One junction FET and three bi-polar silicon devices complement the RF circuitry.

The antenna input and output circuits are balun-matched for a choice of 300-ohm twinlead, or 75-ohm coax. RF gain of the amplifier is rated at 35 dB (±5 dB maximum deviation). This is a considerable amount of gain. Such gain has both advantages and disadvantages which will be discussed shortly. The noise figure is 7 dB maximum. Spurious signals are rejected at least 90 dB, and images are down at least 85 dB. Since the model 85 is an amplifier, and not a converter or receiver, we assume that the reference to image suppression is with receiver pre-selection in mind, and that most receivers will have an IF of 10.7 MHz. Such selectivity is desirable and should prove useful in reducing intermodulation interference from strong signal overload.

The unit has no on/off switch, so it would be best to plug the unit into the switched receptacle on the rear apron of most stereo receivers. During operation, the unit has a power drain of about 5-watts. The power supply is transformer-operated, followed by half-wave rectification. Husky filtering removes ripple from the DC, and regulation is unnecessary. Power supply requirements are not rigid for FM preamplifiers. Operating currents are minimal, and received signals are frequency modulated rather than amplitude modulated, so signal levels do not fluctuate with modulation.

Even though the Magnum 85 FM is capable of extraordinary amplification of weak signals, it is still recommended that the user install the best antenna he can provide. It is easier to improve upon a reasonable signal level than on one buried in background noise.

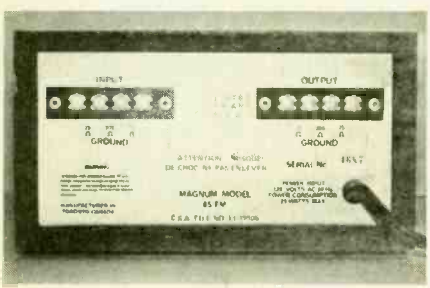
Our Tests. After becoming acquainted with the manual, we decided to test the Magnum 85 for ourselves. The receiving location was more than fifty-miles from the nearest large city, and FM signals were very weak with the inside antenna which was in use. In most cases, stereo signal levels were not high enough to activate the stereo subcarrier circuitry of the receiver, a Radio Shack STA-7 System Seven.

The test antenna was a half-wave folded dipole made from a four-foot length of TV twin lead. It was connected directly to the 300-ohm antenna terminals of the Magnum 85. The manufacturer provides an 18-inch length of twin lead with spade lugs to interconnect the receiver and amplifier.

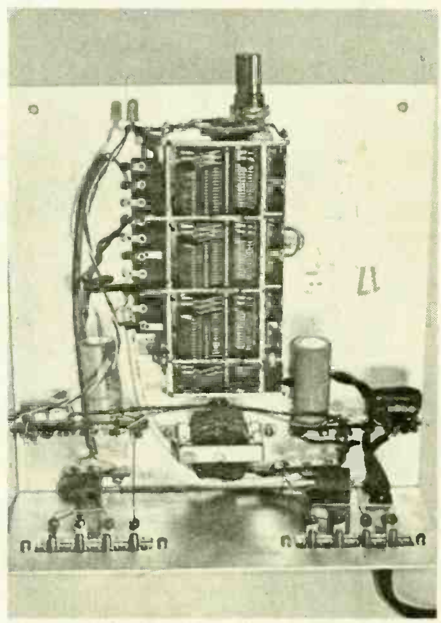
With the simple dipole lying across the amplifier, we had trouble. Apparently the high gain of the amplifier, coupled with the close proximity of the antenna, resulted in regenerative feedback, and the system went into oscillation. The 85 became a VFO, blocking any frequency to which it was tuned.

This particular problem was not discussed in the brief set of instructions, and we had to do some experimenting to eliminate it. We tried to reduce sys-

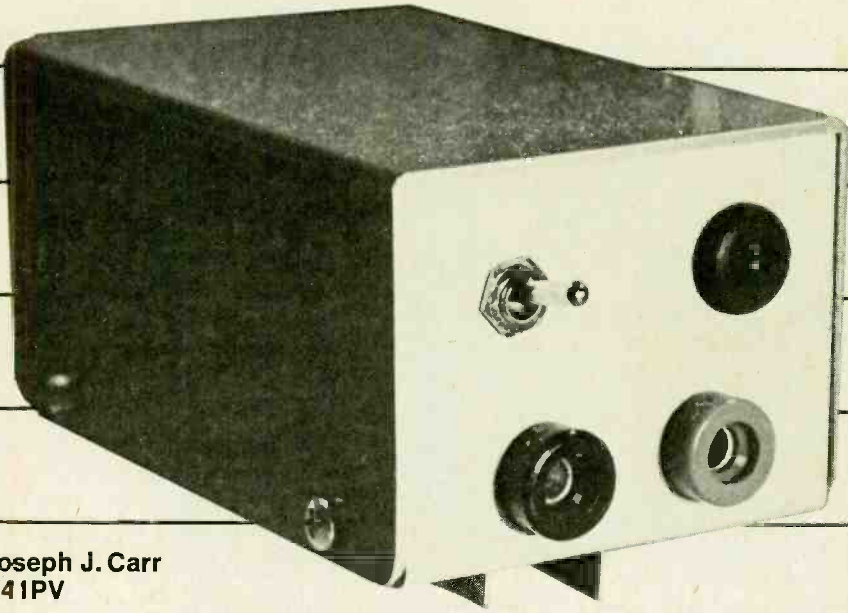
(Continued on page 86)



The Magnum 85 gives you something that many other antenna amps don't—internal antenna coupling, which eliminates need for additional antenna coupler in the line.



This interior view shows the massive triple-ganged tuning capacitor. Amplifier circuitry is at lower left, power supply at right. Circle 79 on reader service coupon.



Joseph J. Carr
K41PV

BUILD A SIMPLE VOLTMETER AND SCOPE CALIBRATOR

Make your test instruments precision measuring devices

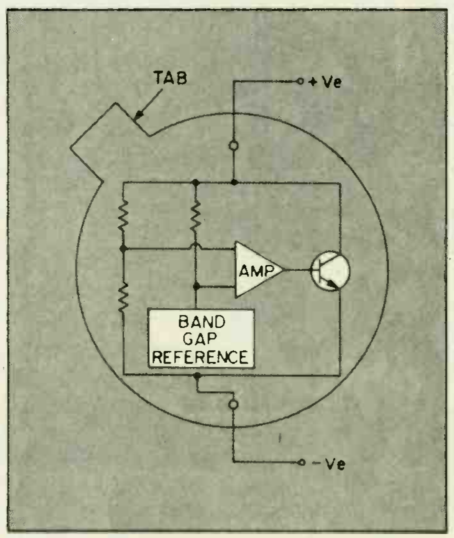
PRECISION VOLTAGE MEASUREMENTS require a calibrated source against which to compare the readings of the voltmeter or oscilloscope. In really high-class measurements, where absolute accuracy is needed, laboratories will use something like a Weston cell and a precision potentiometer. But to the hobbyist, such instruments are both too costly and, in most cases, more accurate than is necessary. In the past, the hobbyist had to be content with zener diode calibrators. Unfortunately, these diodes are not the best and tend to drift. But today, a new breed of regulator is available. Several manufacturers are now offering regulator/reference source ICs using *band gap* zener diodes, and internal amplifiers. These ICs give the hobbyist a low-cost method for building a reference voltage source.

Calculate Your Needs. The circuit in Fig 1 is sufficient to operate as a hobbyist-grade voltage calibrator. Only a power supply (in this case a battery), a resistor, the regulator IC, and a means for turning it on and off are required.

The value of the series resistor depends upon the reference current selected and the power supply voltage. The reference current may be set at any point in the range of 2 to 120 milliamperes, provided that the overall power dissipation is kept to less than 300 milliwatts. In practice, however, one is advised to select a value in the 2 to 5 mA range. In the example of Fig. 1 we have selected 8.75 mA for a very special, high level, technical reason—we had a 4.2-volt battery and a 200-ohm resistor in the junkbox at the time.

The series resistor's value is computed as:

$$Rl = \frac{Eb - Eo}{Ir}$$



Here is an internal schematic of the band gap zener diode, which serves as the heart of the calibrator. Use the tab on the case as the reference point for making circuit connections. No heatsink is required here.

Where:
Eb is the battery voltage
Eo is the output voltage (1.26 or 2.45-volts)
Ir is the reference current
Rl is the resistance in series with the IC

Example:
In the circuit of Fig. 1, we used a 4.2-volt mercury battery, and selected a reference current of 8.75 mA. Find the value of the resistor needed for *Rl*. A ZN458 (2.45 volts) is used.

$$Rl = \frac{(4.2-2.45)\ volts}{(0.00875)\ Amp}$$

$$Rl = \frac{(1.75)}{(0.00875)} = 200\text{-ohms}$$

The resistor used should be a low temperature coefficient type. We used a wirewound precision resistor for *Rl*, and selected it because it was in the junkbox. Contrary to the example above, we actually selected the reference current based on the resistors on hand. An ordinary carbon composition resistor could be used, but the results are not guaranteed.

Construction. The construction of the calibrator is shown in Fig. 3. The largest part in the project is the battery, so a small LMB aluminum box was selected to house the calibrator. The electronic circuitry was built using the banana jacks as tie points; no wire board is needed. The battery holder is ordinarily used with size "C" batteries, but the Mallory TR233 (4.2-volt mercury cell) fits nicely. The battery holder was fastened to bottom of the box using a small 4-40 machine screw. Small rubber feet can then be glued to the box to offset the "bump" created by the screw head. If you want to avoid this, however, it should be easy to superglue the battery holder flush to the aluminum.

The ZN458 has a 100 *parts per million* (PPM) drift specification, the ZN458A is a 50 ppm device, while the ZN458B is a 30 PPM device. The voltage output is nominally 2.45-volts DC. (measured at 2 mA reference current), but may have an absolute value between 2.42 to 2.49-volts. With no additional circuitry, then, these devices will produce an accuracy of ±40 millivolts, or better. This voltage cannot easily be adjusted without external circuitry, but you can use any of the standard IC operational amplifier voltage regulator circuits to set the output voltage to a standard level. Fig. 2 shows a circuit that is usable for this purpose. The ZN458 is used to set the voltage at the noninverting input of the op amp. The output voltage can then be trimmed to the desired value by potentiometer *R3*. This circuit is an ordinary op amp noninverting follower, so the desired output voltage can be derived in the following equation:

$$Eo = Eb\left(\frac{R3 + R2}{R1} + 1\right)$$

The table shows values for *R2/R3* needed for output voltages of 5 and 10-volts. Note that the resistors used in this circuit must be low temperature coefficient precision (1%) resistors, or drift will result. It is even more important in this circuit, than in the circuit of Fig. 1. The trimmer potentiometer should be a ten-turn, precision type, so that very tight control over the adjustment of the output voltage is possible.

There is, however, a hitch in this variable output circuit. It is not inherently "calibrated" as is the case of Fig. 1. Although this circuit is capable of better accuracy, initially, it must be adjusted. You will have to find a very accurate voltmeter, or precision reference potentiometer to make the initial adjustment. After this adjustment, however, it should remain in calibration for a long time. ■

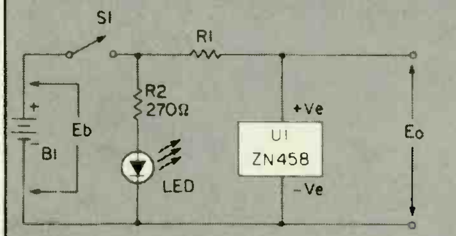


Fig. 1. This is a basic schematic used to demonstrate the calculations necessary to determine the value of the associated components used in the regulator circuit. Refer to the text for a full explanation.

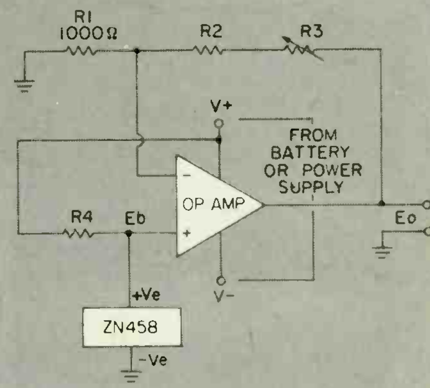


Fig. 2. This schematic depicts a variable regulated power supply, with the source being either a battery or a line-powered DC source. Refer to the table below and text, to determine your own parts needs.

TABLE 1—ZENER SELECTION

Type	Voltage	Drift
ZN423	1.26	—
ZN458	2.45	100 ppm
ZN458A	2.45	50 ppm
ZN458B	2.45	30 ppm

TABLE 2—R2/R3 SELECTION

Output Voltage	R2	R3
5	1000-ohms	100-ohms
10	2600-ohms	500-ohms

The four most popular low-voltage band gap zener diodes are listed above, with their respective drift figures. Obviously, the smaller the drift figure (in terms of parts per million) the more accurate the calibrator circuit will be. Use the highest tolerance parts available, in order to enhance the accuracy of the circuit. Refer to the text for an explanation of the significance of the values given for R2 and R3 in Table 2 above.

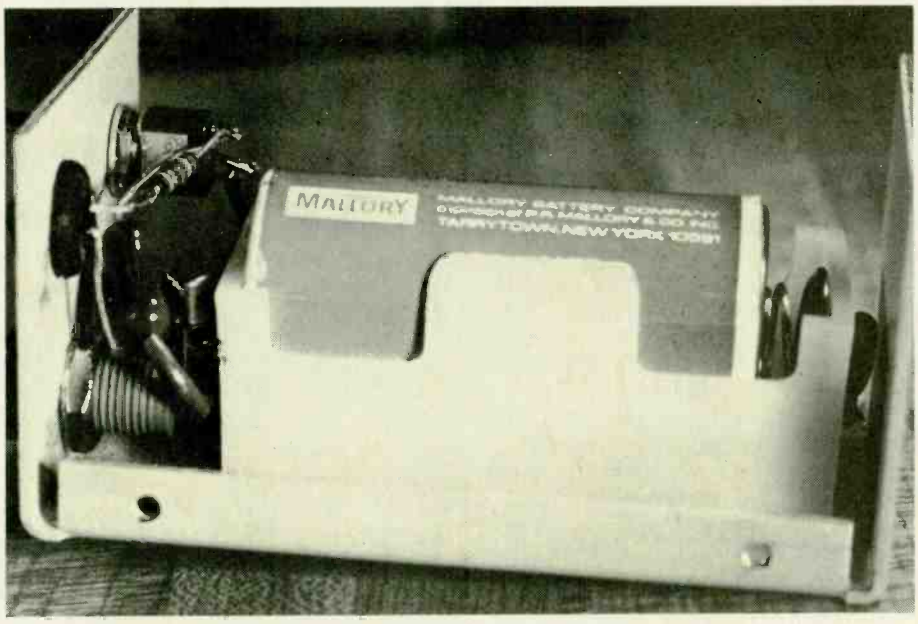
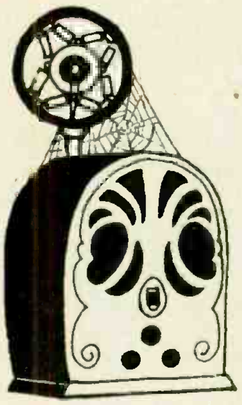
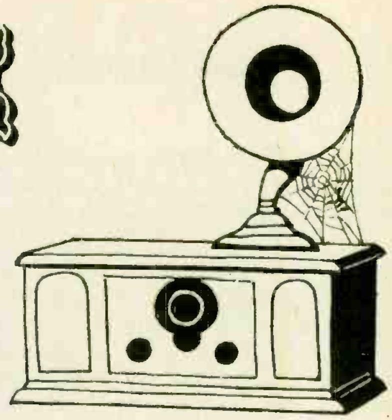


Fig. 3. The compact construction of the calibrator is seen here. We wired all components to the terminals of the banana jacks first, and then bolted in the battery holder to the bottom of the chassis to allow working room for assembly. You may choose to utilize either perfboard or even a printed circuit board for your model. This will allow you to mount it directly inside the cabinet of whatever test instrument you wish to calibrate. With this method you can always have a reliable source of instrument calibration with you, no matter where you might happen to be doing your repair or field operations.



ANTIQUE RADIO CORNER



by James A. Fred

Replacing antique knobs—the restorer's finishing touch

Several readers have written to me asking for information on restoring and replacing knobs on their old radios. The knobs, being small and not firmly fastened in place, seem to be missing on many sets. Radios built in the early 1920's had several large knobs for tuning and several small knobs for volume control or filament voltage adjustments. If you don't have the proper knobs it is immediately noticed by any old time radio collector. If the large knobs are all there, but are dingy with the white material missing from the engraved lines and numbers it is a simple matter to restore them. This is the method I use, although you may find a way you like better.

Loosen the setscrew or other fastening means and remove the knob. Carefully wash the knob with dishwashing detergent and dry it. If you like you may remove all the old white filling material with a sharp tool. Go to your building supply center and buy a white lacquer stick made to fill holes left when nailing paneling on to walls. Rub this stick briskly into the engraving until the white material completely fills the depressions. Now using a soft cloth or paper towel wrapped around a finger rub off the excess white material. As a final touch use a good paste wax on the complete knob and buff it with a soft cloth. In most cases the knobs will look as good as new.

Knob Variations. There are some knobs with silver colored skirts with black printed numbers on them. If the numbers and marks have disappeared completely clean the skirt of the knob and if necessary buff it or repaint it. Buy some press-on letters of the proper size at a drafting supply house and proceed to apply them as near the original as possible. This may look like a difficult job but if you have patience you can do it well. When it is done to your satisfaction spray a light coat of preservative over the dial and letters.

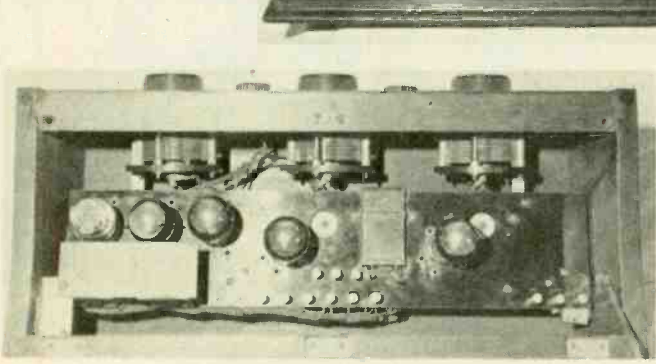
Dial Repairs. Another place to use press-on letters is on plastic dials like many of the 1930 to 1940 radios had. I remember Philco, RCA Majestic, and so on had back-lighted translucent dials, but some I've seen lately have had the letters, numbers, and markings rubbed off. If there are no markings you may have to use a signal generator to accurately locate the frequencies once again. Mark the major frequencies with long marks and intermediate points with short lines. Use as many frequencies as you have room for. You will be surprised at what an improvement a newly marked dial will make in your radio.

What happens when you find a radio that has several small knobs missing? It is virtually impossible to make wooden knobs to match those left. Most collectors are now replacing them with knobs molded from colored epoxy. If you have one good knob and want dupplicates made write to K. Parry, 17557 Horace, Granada Hills, CA 91344 for information. If you would like to mold your own knobs, I am reprinting the directions given me by Alan Douglas, Pocasset, MA on how he molded his own knobs.

Molding Your Own Knobs. Do you own a radio that needs one or two knobs replaced to complete a perfect restoration? If you have at least one of the same type on hand, you can make replicas of it that can't be told from the original. You will need silicone rubber for the mold, casting epoxy for the knob, and lots of patience.

Start by cleaning the original knob thoroughly and polishing with auto wax (I use Vista). Remember that every

This is a photo of a Federal radio sent to us from the collection of George Hausske of Wheaton, Illinois. The three large knobs on the front control variable capacitors, while the two small ones control a pair of rheostats.

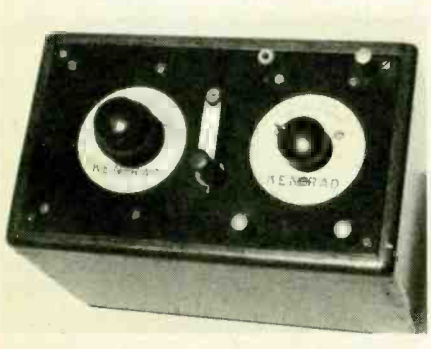


This interior view of the Federal shows the clean, rugged construction. The 3 small terminals at the lower right of the chassis are antenna and ground connection points.

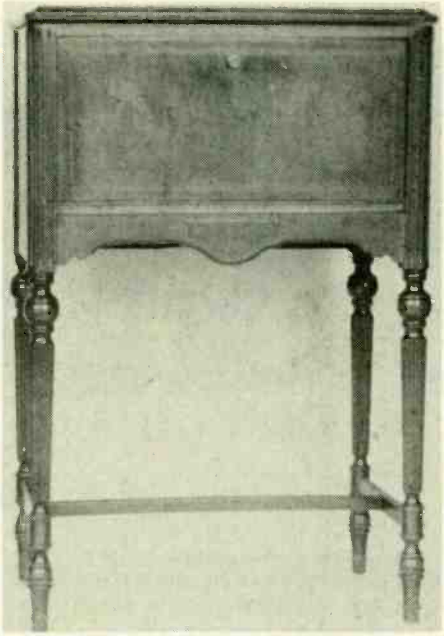
defect will be faithfully reproduced, and the surface finish of the replica can be no better than the original's surface. Plug any setscrew holes with paraffin or beeswax. Place the knob face up in a paper cup or other disposable container just a little larger than the knob. Mix a batch of rubber (about four drops of catalyst per half cupful of rubber) and pour it in slowly, to avoid trapping air bubbles under the knob. Don't heat it to speed the curing until it has begun to harden (heating creates air bubbles). When the rubber has cured (overnight) remove the knob: if it is tapered with no undercuts it will come out easily and leave the mold intact. A knob with undercuts can only be removed by partially tearing the mold in two, on each side, leaving the face intact. It is not hard to fit the mold back together by matching the torn surfaces, and a loop of wire or tape will hold it together so that the tear leaves no mark visible on the replica.

Mix the epoxy and pour into the mold. Use a tooth pick or blunt wire to stir the epoxy in the mold and knock off any air bubbles that may be attached to the mold surface. I've tried evacuating the mold under a bell jar to remove the bubbles, and I have also tried heating the epoxy; neither seems to help. Overfill the mold somewhat, since the epoxy shrinks as it cures.

When the epoxy is hard, sand the back of the knob flush with the flat bottom of the mold; it will then match the back of the original knob. Remove it from the mold and drill any shaft or set screw holes. A mold will make a dozen or more knobs before the surface looses its shine and the replica begins to stick to the mold. Silicone rubber (also called RTV) and epoxy molding compounds are available from Emerson & Cuming, 869 Washington St., Canton, MA



I recently acquired this Ken-Rad crystal set in a trade for a telephone microphone.



This is the cabinet I unearthed in Wisconsin for the A/K model 40 and "E" speaker.

02021. I would recommend that you write for their current information.

Radio Reprint. One of the most interesting books I have seen in a long time is a reprint of "Radio Enters the Home." This book was originally published in 1922 by the Radio Corporation of America. The price in 1922 was 35 cents. The reprint is about 8½ by 11 inches, has 128 pages, and is printed on enameled paper.

The introduction starts with the beginning of broadcasting on November 2, 1920 at Pittsburgh, PA. It goes on to explain in non-technical terms what everyone should know about radio broadcasting and reception in 1922. The illustrations are very good with the radios being shown in use.

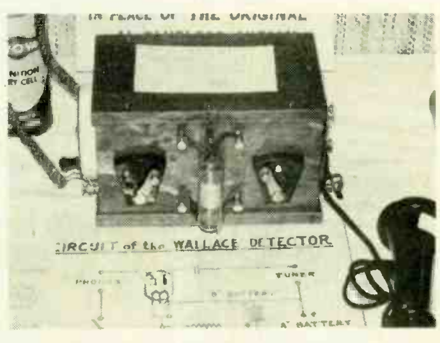
The catalog section starts with the Aeriola Jr., produced by Westinghouse, and proceeds to the ER-753 which was made by GE. I have never seen this model. Next is model AR-1375 made by the Wireless Specialty Co. These three were crystal radio receivers using mineral detectors. The Aeriola Sr. was next using a WD-11 tube as a detector. It was followed by a shortwave tuner, model RA, made by Westinghouse. This tuner could be used with the crystal detector model DB or with a vacuum tube detector and 2-stage amplifier model DA. This unit used a UV200 as a detector and two UV201's as amplifiers. There was also a combination of the RA and DA in one cabinet which was known as the RC. More sets described are the AR-1300 and AA-1400 by GE, and the Aeriola Grand, which was a 4 tube receiver with 4 ballast tubes and a built-in speaker by Westinghouse. The Aeriola Grand was a table model with a matching base that made it look just like a phonograph.

Part Two of the book features receiving circuits and accessories. Other receivers shown and described in this section are the IP-500 and IP-501, the Triode A and Triode B detector amplifier and amplifier. Part Three is concerned with radio telephone transmission. Part Four is full of general information of interest to the listener.

I highly recommend this book to every collector of old radios. The only way you could obtain all this information is if you owned the original book. Write to the Vestal Press Ltd., P.O. Box 97, 320 N. Jensen Road, Vestal, NY 13850 for purchasing information.

We all know about the energy shortage and the high price of gasoline. It has already had an impact on the antique business and the collecting hobby. This summer I attended the ARCA meeting in Elgin, Illinois and there didn't appear to be as much merchandise in the parking lot flea market as usual. There were collectors who came in airplanes, there were collectors who came from Texas by train, while many others had traded in their large cars for small fuel efficient models. Naturally the collectors in the above categories contributed practically nothing to the flea market. The collectors who did bring things for the flea market drove vans, station wagons or pick-up trucks. This also cut down on the amount of parts that were bought, sold, or traded. Small items such as tubes, books, and parts were most active. Console radios, horn speakers, etc. found few takers. I am afraid that this situation isn't going to improve. The United States Postal Service and the UPS have size and weight limits that will severely restrict the shipment of large radio items. This leaves the truck lines as the only means of moving console radios, jukeboxes, and so on. I've found in the past that pack-

(Continued on page 84)



A replica can be fun to build. This is Ross Smith's model of the Wallace Valve Detector.

e/e checks out the...

DAIWA CN-720 SWR/WATTMETER

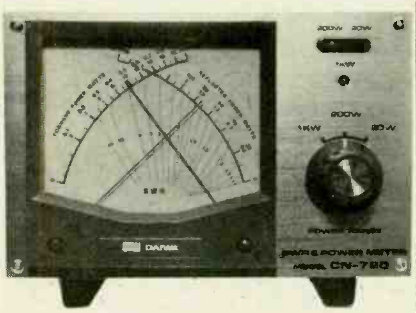
A new old way to measure SWR

CIRCLE 77 ON READER SERVICE COUPON

TODAY, VIRTUALLY ALL Amateurs measure the antenna system standing wave ratio in terms of VSWR—*V*oltage *S*tanding *W*ave *R*atio—because it's the easiest way to do the job at rock bottom cost. The problem with this is, a VSWR reading tells you very little about what's going on, because the FORWARD power indication is arbitrarily set to full-scale calibration by the user. The REVERSE reading is the VSWR (often simply called the SWR) value, and again, it's a numerical value meaning little to the operator in terms of what's going out.

Great-Grandad didn't have a power measurement problem, and neither do commercial operators, because they use (or used) a dual-movement combination SWR and POWER meter such as the DAIWA CN-720, which at one glance tells them the actual forward power fed into the transmission line, the actual reflected power caused by the line/antenna mismatch, and the SWR value.

What it Means. For example, assume an antenna system with a 2:1 SWR, which simply means that the ratio of transmission line-to-antenna impedance is 2:1. In practical terms, it means that 10% of whatever is fed into the line by the transmitter will be rejected by the antenna and returned back down the line where it is dissipated as heat in the line and in the final output circuit of the transmitter. If you pump 100-watts into the line, only 90 flows into the antenna. But there is an even more insidious effect. The VSWR changes the apparent input impedance looking into the transmission line. The transmitter does not "see" its rated impedance, and actually delivers less than the rated power into the line. It might be 50-watts, or even 25-watts depending on the VSWR, so the actual power delivered to the antenna is really lower than it appears. What it actually is, is generally unknown because the user has "calibrated" for full-scale FORWARD power meter reading in order to measure the VSWR.



The intersecting needles provide linear measurement of SWR at any power level.

What it Does. A look at the photographs illustrating the CN-720 shows how it works. The unit has a single meter device, a range switch calibrated for 20-watts, 200-watts, and 1 kW full-scale FORWARD output power. Three LED indicators, driven by a fraction of the RF fed into the line, serve as visual FORWARD power range indicators. The rear apron has three UHF-type coax connectors and a switch. One connector is the transmitter connection, one the antenna connection, and the remaining connector is for a dummy load. The switch routes the RF to the antenna or the dummy load.

What appears to be an ordinary, oversize (3 by 3½-inch) meter, is actually two separate meters, mounted at each bottom corner, sharing a common scale. One is driven from a forward power detector, the other from a reverse power detector. Both pointers indicate simultaneously.

One pointer indicates the FORWARD power on the 20, 200 and 1000-watt scale calibrations. The second pointer indicates REVERSE power on 4, 40, and 200-watt scales. Naturally, the scales are keyed; 4-watts REVERSE goes with 20-watts FORWARD, etc.

Now, in the center of the scale, between the FORWARD and REVERSE power calibrations, is a set of lines calibrated in terms of SWR from 1.1:1 to ∞. The SWR value is the line that falls directly under the point where the meter pointers cross.

The lines that represent SWR flow from the top to bottom so that regardless where the crossover takes place—which is determined by the output power—the correct SWR is indicated. Actually, the meter can *track* the SWR value as the transmitter's power output is changed. Similarly, the operator can keep track of FORWARD, REFLECTED, and SWR values all at the same time.

How it Works. A typical indication is shown at left. The CN-720 is set up for 200-watts FORWARD power. The FORWARD power meter, the left hand calibrations, indicates almost 100-watts fed into the line. The REVERSE power meter, the right hand calibrations, indicates about 14 or 15-watts reflected power. The pointers cross directly over

(Continued on page 85)

The rear panel switch allows selection of a dummy load for tuneup purposes.

IT'S SIMPLY BASIC

by Larry Friedman, WB2AHN

Utilize the full graphic capability of your computer

This month's program, GRAPH, is designed to graphically display data using the Radio Shack TRS-80 Level 2 BASIC and graphics functions. The graph can have up to 10 vertical units (used for number values, i.e. 10, 20, 30, . . . 100) and 12 horizontal units. After the graph has been printed, changes can be made in the data, and a new graph can be printed.

A statement frequently seen in this program is the PRINT@ statement. This instructs the computer to print information at a given point on the screen instead of simply printing it on the bottom of the screen. This statement is necessary for graphics use to allow for graphs of different sizes. For example, line 680 states: PRINT@128 +(H*2.5),G$. This tells the computer to print G$ 2 lines from the top, and half the width of the graph to the right. The TRS-80 screen is divided into 1023 characters, and the PRINT@ command can be used to print characters at any one of these.

Subscripted variables are also used in this program to allow for storage of data anywhere on the graph by entering new data for a subscripted variable. Subscripted variables are necessary in a graphics program when all the data is to be entered before printing.

This program can be used for loading variable electronic values for an

(Continued on page 86)

```
100 REM
110 REM     "GRAPH"
120 REM     BY LARRY FRIEDMAN
130 PEM     FOR ELEMENTARY ELECTRONICS MAGAZINE
140 PEM
150 REM     USES TRS-80 LEVEL 2 BASIC
160 REM     THIS PROGRAM USES TRS-80 GRAPHICS TO GIVE A
170 REM     VISUAL DISPLAY OF DATA. AFTER DATA HAS BEEN
180 REM     ENTERED AND THE GRAPH HAS BEEN PRINTED, THE
190 REM     DATA CAN BE ALTERED AND A NEW GRAPH WILL BE
200 REM     PRINTED.
210 REM
220 REM     THE PROGRAM'S CAPACITY IS 12 HORIZONTAL COORDINATES
230 REM     AND 10 VEPTICAL COORDINATES. INDIVIDUAL HORIZONTAL
240 REM     ENTRIES SHOULDN'T EXCEED 4 CHARACTERS. THE LARGEST
250 REM     VERTICAL COORDINATES SHOULDN'T EXCEED 10,000.
260 REM
270 DIM N$(12),V(12)
280 CLS
290 INPUT "ENTER NAME FOR VERTICAL UNITS (7 CHAR MAX) ";Q$
300 INPUT "ENTER NUMBER OF VERTICAL UNITS ";V
310 IF V>10 GOTO 300
320 INPUT "ENTER MAXIMUM VERTICAL VALUE ";M
330 IF M/V=INT(M/V) THEN 370
340 PRINT "MAX VERTICAL VALUE MUST BE DIVISIBLE"
350 PPINT "BY NUMBER OF VERTICAL UNITS"
360 GOTO 320
370 INPUT "ENTER NAME FOP HORIZONTAL UNITS ";H$
380 INPUT "ENTER NUMBEP OF HORIZONTAL UNITS ";H
390 IF H>12 THEN 380
400 PRINT "ENTEP NAMES OF HORIZONTAL UNITS (3 CHAR. MAX.) AND VALUES"
410 FOR I=1 TO H
420 INPUT N$(I),V(I)
430 IF V(I)>M THEN 400
440 IF V(I)<0 THEN 400
450 NEXT I
460 INPUT "ENTEP NAME OF GRAPH";G$
470 REM PPINT GPAPH ON SCREEN
480 CLS
490 Z=0
500 FOR I=M TO 0 STEP- M/V
510 Z=Z+1
520 PRINT@(Z+2)*64,I
530 NEXT I
540 C=(Z+3)*64+5
550 FOR I=1 TO H
560 PPINT@C,N$(I)
570 C=C+5
580 NEXT I
590 FOR I=1 TO H
600 REM DETEPMINE Y-AXIS FOP GPAPHIC DISPLAY.
610 A=V*3
620 B=(V(I)/M)*(V*3)
630 Y=A-B
640 Y=Y+10
650 X=2+(I*10)
660 SET (X,Y)
670 NEXT I
680 PPINT@128+(H*2.5),G$
690 PPINT@(Z+4)*64+(H*2.5),H$
700 PRINT@(Z+4)*64,Q$
710 PPINT@0,"CHANGE (Y/N) ?";
720 INPUT Y$
730 IF Y$="Y" GOTO 790
740 PRINT @0,"HIT 'Q' TO EPASE GPAPHIC DISPLAY";
750 INPUT Q$
760 CLS
770 STOP
780 REM CHANGE DATA FOR HOPIZ. COORDINATE AND PPINT NEW GRAPH.
790 PRINT@0,"NAME OF HOPIZ. UNIT";
800 INPUT N$
810 FOP I=1 TO H
820 IF N$=N$(I) THEN 870
830 NEXT I
840 PRINT@0,"   NAME NOT IN CHAPT.   "
850 FOP R=1 TO 300:NEXT R
860 GOTO 790
870 PRINT@0,"ENTER NEW VALUE FOP ";N$;
880 INPUT V(I)
890 CLS
900 GOTO 490
999 END
```

e/e BASIC COURSE IN ELECTRICITY & ELECTRONICS

The Digital Multimeter is the single most versatile service tool available to the electronics technician and hobbyist. In this, the second of a series on test equipment, we'll discuss the origins, theory, and uses of the Digital Multimeter

ELEMENTARY ELECTRONICS, in an effort to introduce its readers to new developments in instrumentation, will now discuss advances in the measurement of voltage, current, and resistance. In the past, measurement of these parameters has utilized analog devices; however, with the advent of large scale integration semiconductor chips, a new generation of digital sampling techniques has been developed that allows accuracy to laboratory standards with moderately priced equipment. Full appreciation of the flexibility and advantages of the newer digital devices is apparent when comparison is made with analog equipment.

The relationship between current and voltage for steady state linear direct current applications is called Ohm's Law. This "Law," the most basic concept of electronics, is written

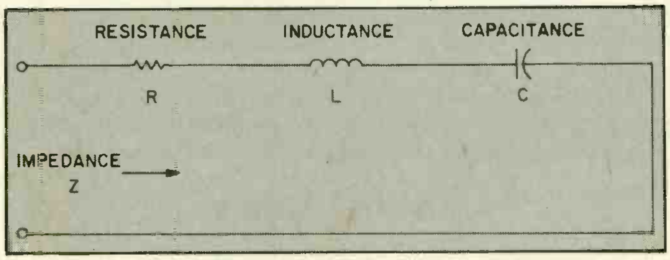
$$E = IR$$

The basic unit of voltage (E) or electromotive force is the volt. The basic unit of current (I) or time rate of change of charge is the ampere. Resistance (R) is measured in ohms.

IMPEDANCE

Things become more complex when steady state AC circuits are investigated. The units of voltage and current do not change; however, there is now a dynamic relationship between voltage and current which must take into consideration the phase angle between these two parameters. Simple DC resistance becomes a complex impedance. Impedance by definition is voltage divided by current and is the sum of the resistive

COMPONENTS AFFECTING IMPEDANCE

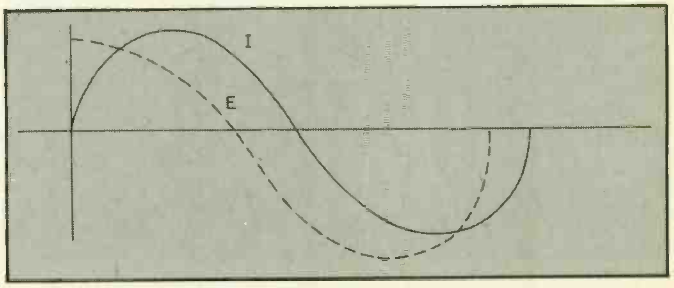


plus reactive components of the circuit. Coils and capacitors determine the magnitude of the reactance of a given circuit. It is beyond the scope of this article to deal in depth with the problem of complex impedance, but some knowledge is necessary for an understanding of voltage measurements.

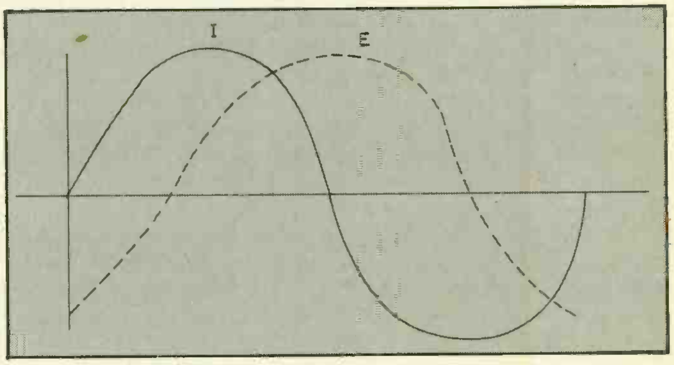
The DC resistance of an *ideal* capacitor is infinity. Actual capacitors have leakage dependent upon their composition, e.g. electrolytics will have much more leakage than ceramic or mica capacitors. An *ideal* inductor has zero resistance. Actual inductors have a series resistance which is a function of diameter, temperature, length, and composition of the wire used in their windings.

Under transient and AC conditions, the current flow in an inductor always *lags* the voltage flow, whereas the current in a capacitor always *leads* the voltage.

CAPACITOR CURRENT/VOLTAGE PHASING



INDUCTOR CURRENT/VOLTAGE PHASING



Any measurement of voltage under these conditions must take into consideration the changing nature of voltage and current flows and the impedance of the measuring device.

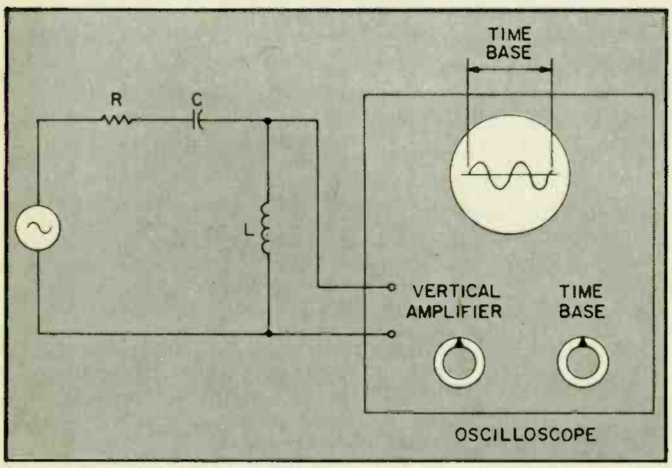
DESIGN CRITERIA

Certain criteria can be formulated concerning the equipment used to measure direct or alternating currents or voltages. First, the device should be accurate and capable of measuring both AC and DC currents or voltages. Second, linearity should be present over a wide range of readings. Third, the impedance of the device should be sufficiently high so as not to "load down" the circuit being measured. Fourth, measurements of resistance should be taken at low voltages so as not to alter the resistance of complex circuits that consist of active and passive elements. Last, the readings should be reproducible and not a function of the temperature, humidity, or the supply voltages necessary to power the measuring device.

THE STONE AGE

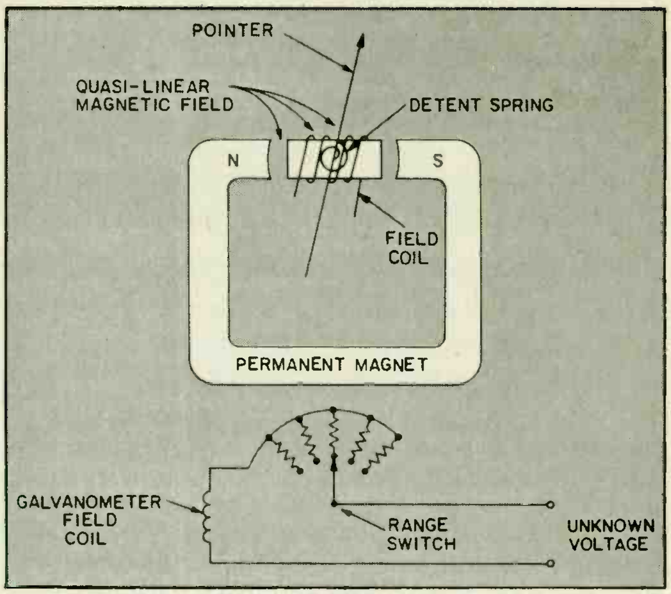
In the past, several methods were used to accomplish these goals. For AC, high frequency, and transient measurements, the oscilloscope provided the "gold standard" for a reproducible, high quality, high impedance device that had reasonable linearity. If the device was well calibrated, and had gain stability, measurements to two significant figures could be made over a wide range of voltages and frequencies. By use of suitable coupling devices, measurements of current could also be made. With appropriate attenuators, an oscilloscope could be made to have an input impedance of 10-megohms which was sufficient for most circuits. The phase relationship between voltage and current was easily demonstrated using dual sweep or chopped-beam oscilloscopes. Difficulties were commonly encountered with DC and very high frequency AC measurements, and with obtaining an accurate time base for the horizontal sweep circuit. Finally, the oscilloscope was not portable and proved to be a fragile device that was tied to a service bench.

OSCILLOSCOPE MEASUREMENTS



Most measurements of voltage, current, and resistance not done on an oscilloscope were obtained with portable devices using D'Arsonval galvanometers called "meters." These devices, like the oscilloscope, suffered from several major faults. First, because of distortion in the magnetic field, true linearity was never achieved over the entire range of readings. Second, accuracies of only two or perhaps three significant places were available. Third, as with the oscilloscope, under certain conditions parallax (difference in reading that is dependent on the position of the observer) was a major problem. Fourth, the basic resistance of the galvanometer was low, on the order of 20,000-40,000-ohms-per-volt for expensive equipment, and 5,000-10,000-ohms-per-volt for less costly gear. Impedances, when AC voltages were measured, were commensurately lower—on the order of 1,000-5,000 ohms. Lastly, the devices were basically fragile and easy to burn out. In spite of these shortcomings, the analog volt-ohmmeter was and is a popular, inexpensive device that sells for prices ranging from approximately $10 to $150, depending upon the accuracy, ranges, functions, and input resistance.

GALVANOMETER CONSTRUCTION



True laboratory standard accuracy—voltage readings to three and four significant places—could be obtained using D'Arsonval-type devices that operated over very narrow ranges and were used in bridge circuits that compared the unknown voltage to a known standard voltage. Unfortunately, this equipment was expensive, difficult to use, and not portable.

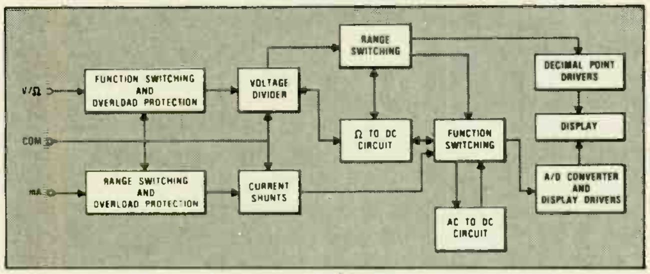
In another class of devices, the low basic input resistance of the galvanometer was improved by using vacuum tubes (VTVM) or semiconductor devices (eg, FET). Unfortunately, this was done at the expense of doubling the price of the equipment and adding the problem of gain stability and input offset voltages.

DIGITAL DESIGNS

With the advent of large scale integrated circuits, an alternate means of measuring voltage, current, and resistance became available. This class of devices converted the analog signal, e.g. the current, voltage, or resistance, and displayed it in digital form. Higher accuracies were obtained by expanding the scale of measurement and eliminating meter reading errors—parallax and nonlinearity. Therefore an order of magnitude advantage was obtained. For example, if a high quality volt-ohmmeter had an accuracy to 1 percent of a given reading, similar quality digital devices could be made to read to 0.1 percent accuracy. Such an advantage is obvious when analyzing complex circuitry using semiconductor components. Furthermore, the ohmmeter function of these new generation digital devices uses very low currents when compared to the standard volt-ohmmeter. Lastly, the input impedance of these devices is in the 10-megohm range, shunted by a small capacitor of approximately 50 pF.

Digital volt-ohmmeters are only as good as their amplifier stability and linearity, internal voltage and time references, and method of eliminating offset voltages. Various schemes have been devised to provide automatic zeroing, programmable or long term stability, and minimal offset voltages. Input signals are converted into a scaled DC voltage, which is then transformed into a digital readout by integration, logic, and display circuits. DC voltages to be measured are applied across a voltage divider. A decade fraction of this voltage is selected by the range switch. The signal

TYPICAL FUNCTION DIAGRAM



is then passed into a DC voltmeter which consists of an automatic offset correction (auto zero) circuit, a dual slope integrator, and a digital processing and multiplexing device. The reference voltage is derived from a highly stable Zener diode.

AC MEASUREMENTS

AC voltages are measured in a similar manner, except a full wave bridge is used to yield a DC voltage equivalent to the RMS of the unknown AC signal. A high impedance buffer is used to isolate the bridge circuit. Resistance measurements are made by generating a precision known constant current which develops a DC voltage across the unknown resistor. The signal is then applied to the buffer amplifier and processed in a manner similar to the voltage measurements. Current measurements are made by passing the unknown current through a precision shunt-resistor which develops an AC or DC voltage proportional to the current in the shunt resistor. This voltage is again applied through the bridge (for AC currents), buffer, and integrator circuits. Various degrees of auto ranging are available depending upon the design and price of the instrument. This auto ranging refinement allows wide ranges of voltage to be measured with one setting of the range selector without internal overload. Some manufacturers offer a high/low ohm feature that permits in-circuit resistance measurements at voltage levels below the conduction threshold of semiconductor. The high ohm feature allows semiconductor

CIRCLE 1 ON READER SERVICE COUPON

Heath's IM-2212 digital multimeter offers auto-ranging, which selects the proper voltage, current, or resistance range for more convenient measurements. It weighs 8 lbs., less optional NiCads.

junction tests by measurements of forward and reverse resistance ratios.

ACCURACY

As mentioned earlier, the specifications of digital multimeters are normally in the range of 0.5 percent of the reading, plus 0.1 percent of the range ± one count for DC voltages. A display reading of 1.00-volt DC from a low impedance source will have an uncertainty of ± 0.0035 volts; a truly amazing feat. Because of the sampling nature of the device and the auto ranging features, response time is usually less than 3 seconds to within stated accuracy. Settling time for the semi-ranging devices (100 percent overvoltage) is typically 1/2 of a second.

Optimal performance can be obtained by observing

CIRCLE 40 ON READER SERVICE COUPON

B&K Precision's model 2830 digital multimeter offers 4-place red LED readout, high/low resistance range selection, direct DC/AC current readout, a convertible carrying handle and desk prop.

a number of precautions when test measurements are made. Ground loops must be avoided since differences of ground potentials may set up loop currents and distort the measured value. Problems of this type can be almost completely eliminated by using battery operated equipment. Ground loops may be lessened by

An example of a handheld digital multimeter is B&K Precision's model 2815. The new LSI IC has built-in shielding against strong RF fields, making it a hot item with hams, CBers and radio techs.

connecting the test source ground to true earth ground if possible. In floating DC or AC measurements, it is possible to introduce a common mode voltage by reactive coupling when the line cord is connected. Again, problems of this type can be almost entirely eliminated by using a battery operated meter. If only AC operation is available, this type of measurement should be made on the highest range possible consistent with usable measurement resolution. Most devices will handle up to a 100 percent full range overvoltage with meaningful readings.

The basic design features of the digital multimeter make it the ideal replacement for the existing analog multimeters and FET/VOMs or VTVMs. In addition to providing equivalent functions and range, the inherent accuracy and features of this type of instrument provide a significant margin of improved performance over comparably priced analog meters. Digital multimeters are priced from $60 to several hundred dollars and come in kit or assembled form. Outstanding examples of this type of instrument are the Heath model IM 2212 auto ranging digital multimeter kit, the B&K Precision 2830 3½ digit multimeter, and the new inexpensive Radio Shack model 22-197 hand-held liquid quartz 3½ digit display unit.

CONCLUSION

In summation, the proven stability of dual-slope integration combined with precision, ratio-trimmed resistor networks and advanced LSI technology has generated a series of digital multimeters that provide extreme versatility and accuracy at an affordable price. They have virtually made the hand-held galvanometer-based analog volt-ohmmeter obsolete. Their major drawback is in their time to settle on a given reading and the necessity of using sampling techniques. They are an exciting, accurate, and dependable way of making basic measurements of voltage, current, and resistance in modern electronic circuitry. ■

Hey, Look Me Over

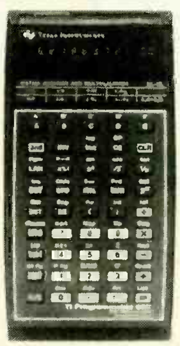
(Continued from page 12)

CIRCLE 46 ON READER SERVICE COUPON

and memory ports. Versions are available with either a full industry standard or calculator types keyboard which includes a cassette drive in the TC 2001's $795.00 price. NCE offers printers, plotters, disk drives, tape drives, memory expansions, and other peripherals for the TC 2001. It comes with a 10-day free trial and a 90-day factory warranty. For more information, write to NCE/CompuMart, P.O. Box 8610, Ann Arbor, MI 56107.

Programmable Calculator with Constant Memory

A Texas Instrument programmable calculator, the Programmable 58C, features a Constant Memory which allows the calculator to retain program steps and data when turned off. The TI Programmable 58C adds the Constant Memory feature to the already powerful capabilities of the original TI 58.



CIRCLE 51 ON READER SERVICE COUPON

The retail price of the TI Programmable 58C is $125.00. Get all the facts direct from Texas Instruments, Inc., Consumer Relations, (Attn. TI-58C), P.O. Box 53, Lubbock, TX 79408. ■

HOBBY MART

ELEMENTARY ELECTRONICS INDEX TO ADVERTISERS

DX Central

(Continued from page 17)

was handled admirably by RCI's Ian McFarland, who also serves as an official of the Canadian chapter of HAP, called CHAP. As astounding as it may seem, the spirited bidding raised a total of about $2,000 for the worthy cause.

By the way, disabled or handicapped persons are invited to contact either the U.S. or Canadian branches of HAP to inquire about HAP benefits and services available. HAP-US can be reached by writing to 27 Cleveland Avenue, Trenton, NJ 08609. CHAP's address is 6 Coolbreeze Avenue, Pt. Claire, Quebec H9S 5G4, Canada.

If you missed ANARC '79 in Minneapolis, you missed a great time.

At this writing, a decision on the location for the forthcoming convention has not been made by the ANARC delegates. Two local groups, the Southern California DXers and the Canadian SWL International club have submitted bids for the convention. Thus, DXers will gather July 18-20, 1980, for the ANARC convention, either at Irvine, California, or Thunder Bay, Ontario, Canada.

Down The Dial. Times in GMT, frequencies in kHz. **944**—HRYW, Radio Panamericana in Tegucigalpa, Honduras, is being heard with "nice signals" in Florida during the evening hours, around 0130 GMT. **3,220**—The SWL's favorite Latin American station, HCJB in Quito, Ecuador, has a new shortwave transmitter of 10 kw power operating on this frequency in the Indian language, Quechua around 0830 or 0930 GMT. **3,390**—Another Ecuadorian station noted frequently with Spanish programming during the Stateside evening hours is Radio Zaracay in the city of Santo Domingo de los Colorados. Look for it. **5020**—A bit of exotica for those who dream of a Pacific paradise is the Solomon Islands Broadcasting Service. You're apt to find this station with country and western music, Radio Australia news relays and announcements in Pidgin English. Try the middle-of-the-night time slot between about 0800 and 1130 GMT. **6,080**—More country music here from CKFX, Vancouver, British Columbia, Canada, a puny 10 watt outlet that has been putting out truly amazing signals lately. This has been heard by listeners as far away as Florida and Massachusetts, plus, across the Pacific in Australia. **11,835**—Haiti has only one shortwave station operating on a regular basis these days. The station is the missionary broadcaster 4VEH. Listen for English programming between about 1200 and 1300 GMT.

(Credits: Terry Krueger, FL; Jack Jones, MS; Brian Alexander, PA; Douglas Johnson, WA; Richard Gregory, PA; National Radio Club, P.O. Box 32125, Louisville KY 40232; North American SW Association, P.O. Box 13, Liberty, IN 47353; American SWL Club, 16182 Ballad Lane, Huntington Beach, CA 92649.) ■

Teletype Interface

(Continued from page 35)

positive bit causes Q1 to conduct. When Q1 conducts, its collector goes low, effectively "grounding" Q2's base, thereby turning Q2 off and interrupting the current through the TTY printer. The TTY current interruptions represent characters and control modes, causing the TTY to print the RS232 I/O transmission.

Construction. Just about anything goes. There are no special shielding or layout problems, and just about any general purpose replacement can be used for Q1, Q2, D1, and Z1. LED 1 is simply a "power on" indicator. Resistors can be ¼ or ½-watt rating. Do not use 1/10-watt resistors.

The unit shown is built on a section of micro-perforated wiring board, using flea clips for some tie points. Other wiring is by direct connection on the underside of the board. The cabinet is a plastic "experimenter's box" approximately 2.5 by 3 by 5.25-inches. The input and output connectors are the Molex type, sold at Radio Shack and other parts stores.

Z1 is a 50 PIV silicon rectifier bridge; you can substitute a bridge made up of four individual diodes if desired. Diode D1 can be any silicon type rated 25 PIV or higher.

The perf-board assembly can be secured inside the cabinet with a few dabs of RTV silicon rubber adhesive, or even silicon rubber bathtub calk. Allow 24 hours for the adhesive to dry. ■

King Spark

(Continued from page 68)

signal more recognizable through the interference and static.

The ultimate power supply in the days of spark was the motor driven 500 cycle alternator. This set-up gave 1000 voltage peaks per second and consequently 1000 sparks per second, which was considered ideal. When a rotary gap was used with the alternator it was usually synchronized with it by mounting the rotor on the end of the alternator shaft. More often though a quenched gap was used.

Quenched Gap. To understand the reason for the quenched gap we have to back up a little. Referring to Fig. 3 we see that power from the "closed" resonant circuit L_1 C_1 is transferred to the "open" resonant circuit, the antenna, by the coupling between L_1 and L_2. The closer the coupling, the greater the power transferred.

Unfortunately, increasing the coupling caused the generation of *two* frequencies, one above and one below the frequency of the two circuits when separated. Furthermore, these two frequencies would hetrodyne with each other and cause the generation of a broad band of frequencies. Reducing the coupling would solve this problem but transfer little power.

The ingenious solution was the quenched gap. The quenched gap consisted of a series of very narrow spark gaps, each surrounded by a great deal of metal. When the power supply produced a voltage peak the gaps would fire, but the spark would quickly extinguish itself as the ions touched the nearby cool metal surface. In a properly adjusted transmitter the power might circulate in the "closed" circuit for only a half-cycle. However this was sufficient to excite powerful oscillations in the antenna circuit which was very closely coupled.

For amateurs the end of the spark era was the transatlantic tests of 1921. Though the first amateur signals to get across were spark, the superiority of c.w. was shown so clearly that within a year or so there were few spark stations on the air.

Spark hung on in shipboard installations for a longer time and it wouldn't surprise this writer to find a still usable spark transmitter in a radio room somewhere as a back-up transmitter.

Don't try to build a spark gap transmitter for use or you will become very familiar with the FCC's power to control the air waves. A spark gap transmitter generates more harmonics than the Chicago Symphony and you'd be interfering with every radio in your area. Uncle Sam's radio people can and will prosecute anyone who tries to put such "dirty" radio waves out into the atmosphere. ■

Ithaca Audio

(Continued from page 60)

unit over so the keys are down. Remove the six screws that secure the base and gently lift the base off. Don't force anything.

Position the keyboard, if necessary, so that it conforms exactly to the pictorial supplied by Ithaca Audio. The *reset* switch should be at your upper right, as shown in the instructions. Check out the whole board. You will find eight of the ICs are in a single row and are mounted in sockets. These are the memory RAMS. You'll find two other sockets; they contain the DIP jumpers, which resemble ICs on first glance.

Double check that you're grounded. Then, holding a small screwdriver by the blade (or a non-metallic insulated screwdriver) lift each end of each IC slightly out of the socket and then remove the IC, setting it pins-down on a sheet of aluminum foil (if you want to save the 4K RAMs). Next, one at a time, remove the Ithaca Audio 16K RAMs from the conductive foam, check that all pins are straight, and install the RAMS in the sockets.

Checkout. Ithaca's instruction card gives the checkout for Level-I BASIC. Simply type PM (ENTER), and the computer will indicate 15871 if all is okay. If you have Level-II BASIC, check it out our way: Get the TRS-80 into BASIC with READY on the CRT, then type PRINT MEMORY (ENTER). A 15572 indicates all is okay. (Note: Ithaca Audio will include the Level-II checkout for 16K, 32K, and 64K of memory inside all packaging.

The Ithaca Audio TRS-80 16K upgrade kit is available from computer dealers and direct from Ithaca Audio.

For additional information, write to them direct at P.O. Box 91, Ithaca, NY, 14850, or circle number 62 on the reader service coupon. ■

Mini-Power

(Continued from page 46)

organizations and individuals listed, enclosing a SASE (self-addressed, stamped envelope) is a courtesy, and will help speed reply.

Conclusion. Operating QRP can be a very satisfying experience, but without a lot of RF power backing you up, a great deal depends on your equipment, your operating techniques, your attitude, and an extra measure of patience. Above all, remember that successful QRP operation requires careful attention to details that might not be so necessary in high-power hamming; work carefully and deliberately at improving both your flea-power installation and operating skills. As you develop your *modus operandi*, you will derive increasing satisfaction from low-power work and will indeed be surprised and excited by the results. You will find, as I did, that mini-power operation yields maxi-fun. Good luck, and think small! ■

Crydit
(Continued from page 57)

the number on the display by one.

Finally, you switch S1 to START and CRYDIT starts its counting down sequence. After you have switched S1 to START, you can, at any time, check how many minutes are left in the time period by simply pressing the DISPLAY button. The instant CRYDIT's counters reach 00, the buzzer will sound off for about 7-seconds. Note that CRYDIT is designed to keep counting down even after it reaches 00. This feature allows an absent minded CRYDIT user to figure out exactly how long it has been since the buzzer went off; all he has to do is subtract the number left on the display from 100. For example, say you had to leave CRYDIT alone for a length of time and came back after CRYDIT's buzzer went off. Upon return, you immediately check the display and find it shows 85. You then know the buzzer had gone off (100-85) 15-minutes ago.

Some Simple Modifications. If you would prefer a 1-60 minute CRYDIT, simply increase R6 to 27K and adjust the 10K printed circuit trimmer pot R7, so that the display shows 60 when both MAIN and FINE SET controls are fully clockwise.

If you would prefer a single SET control, replace R16 with a 47K fixed resistor, and use a good quality potentiometer for R17. R17 will then serve as *the* SET control. As an aid to the user, include divisions every 5 minutes on the SET dial, instead of the 10-minute divisions in the *dual* SET control model. Note that a single SET control works out especially well if you are willing to settle for the 1-60 minute CRYDIT.

Some other possible modifications: For a louder buzzer, reduce R21 to 47-ohms; for a longer/shorter buzzer, increase/decrease C9; for a longer/shorter display "ON" time, increase/decrease C8; and finally, for a brighter display, reduce R23-through-R36 from 330-ohms to 270-ohms. ■

Antique Radio
(Continued from page 74)

ing and shipping by truck is very inconvenient and expensive. If any collector has a solution to this problem I wish he would write me about it.

Want to Lend A Hand? This brings to mind a project I've had on my mind for several years. I have always been interested in the lesser known companies in the old time radio field.

I am interested in finding collectors who have time to visit their local libraries and newspaper offices. They would make copies of all the information they could find on radio set and radio accessory manufacturers who operated in that town or county. In return for this information I will pay copy costs and postage and list the researcher's name in any publication in which I can make use of his information.

We all know about Atwater Kent and his radios, but how many collectors know that up to about 1928 he did not supply console cabinets for his radios? Readers of this column have heard about the Pooley Cabinet Company that supplied many radio and speaker cabinets for Atwater Kent radios. In the spring of 1979 I was in Wisconsin and at a flea market I found a cabinet made to hold a "Breadbox Radio" i.e., Models 38 to 48 and a type "E" speaker. A small round metal label was inscribed "Red Lion Cabinet Company, Red Lion, PA." I looked in my Atlas and sure enough there is a Red Lion, PA.

So long for now. We hope to meet you all again with news about antique radios in the next issue of Elementary Electronics magazine. ■

Newscan
(Continued from page 23)

power. Western has just completed a solar collector system at its Corporate Education Center (CEC) in Hopewell, NJ after a year of planning. The system will provide about 47 percent of the center's present annual hot-water requirements. ■

Here comes the sun and these solar collectors are ready at Western Electric's Corporate Education Center in Hopewell, NJ. Engineer Donna Bold and plant engineer Bill Hall look over the 2,000 square feet of solar collectors. The solar power system will provide 47 percent of the hot water used by Western Electric professional employees at the installation.

Down Under DX
(Continued from page 62)

9660 kHz. There are no SWBC transmitters in the state of South Australia so 5CL is probably the best Medium Wave catch on our list. However if a DXer is lucky while logging 4MK he will have interference from VQO in the Solomon Islands—a station which relays newscasts from Radio Australia.

March, April, September and October are the best months for MW down under reception. Early Sunday and Monday AMs are still the best times because many U.S. stations still have an occasional silent period those mornings. 0400-0500 is the optimum time east of the Mississippi while further west 0300-0600 PST is the time to listen (interference from eastern NA will fade out during that period). ■

Dial Cords

(*Continued from page 34*)

Also, two large guide pulleys help keep the dial cord on track.

New Drums. Sometimes it's very difficult to obtain a dial drum replacement for certain models. You may be able to repair these plastic drums if they are not broken or damaged too badly. In this particular AM-FM-MPX model (Fig. 8) the plastic drum was broken around the hub area and would let the drum fall down towards the variable capacitor. You could only tune part of the radio band as the drum would jam against the printed circuit board wiring.

The plastic drum was repaired to its original position and held off the P.C. board by a couple of pencils while it dried. Now, level the plastic drum. Tighten down the screw and top washer. Mix up a dab of epoxy cement and apply over the drum shaft area. Let it set overnight.

When the dial cord will not move and the dial cord end is pulled clear out of the plastic hole, simply make another hole a little higher upon the drum (Fig. 9). Sometimes the cord will pull out a chunk of plastic from the drum area. You may repair it with epoxy cement.

Erratic Dialing. When the dial will only move in certain areas or stop at a different spot each time, suspect a loose set screw (Fig. 10). Sometimes these small screws will not bite into the tuning capacitor shaft.

Erratic dialing may be caused by slippage at the tuning shaft. First, tighten the dial spring and apply a coat of liquid rosin at the tuning shaft area.

You may encounter a dry or bent dial pointer assembly causing erratic dial operation. Notice if the pilot light wires are snagging on the PC wiring when the dial pointer assembly contains an enclosed dial bulb.

So, the next time you have a dial break or start slipping, sit down and do the work yourself. One thing for sure, you will soon find out if you have ten fingers—or ten thumbs. ■

Speakerlab 3

(*Continued from page 37*)

along this edge so that the thread line is perfectly straight and parallel to the edge of the frame. Now stretch the cloth to the center of the opposite edge of the frame, being sure to keep the thread line perpendicular to the already-stapled edge, and tack it in the center. Now stretch the cloth along this edge and tack it so that the thread line is parallel to the edge of the grill frame. Next, stretch the cloth across the center of the two long sides, being careful not to distort the vertical thread line of the grill. Finish tacking the two sides while constantly checking to see that all the thread lines are straight.

Sound Quality. Besides being nice to look at and be proud of, the Speakerlab 3 sounds great. It is a rich, musical speaker with good stereo imaging. For a speaker this size it has an extrordinarily deep bass. There is a barely noticeable lack of upper bass but this is easily adjusted for with tone controls.

The speaker is very responsive to adjustment of its crossover network. With both the tweeter and midrange switches at the zero dB (no attenuation) position the speaker is hard and bright. This is great for disco music but a little crisp for easy listening or classical sounds. However, by using full attenuation on the tweeter (4 dB down) and half attenuation on the midrange (2 dB down) the speaker assumed a more musical character. We were frankly surprised that a kit speaker could sound this good. It was noticeably superior to some factory-built and higher-priced loudspeakers.

The crossover frequencies are set at 600 Hz and 4 kHz. The speaker is rated to handle up to 200 watts RMS peak power and 100 watts continuous. The minimum recommended power is 15 watts. All these figures are for 8-ohm amplifier output impedance.

So if you're ready for a new set of speakers and you want to be proud of more than just their sound, a pair of Speakerlab 3's may be just the thing. If your speaker needs are smaller or larger the company has a full range of kits from $65 to $990 per speaker. For more information write to: Speakerlab, 735 N. Northlake Way, Seattle, WA 98103, or circle number 43 on the Reader Service Coupon. ■

Mizuho SX-59

(*Continued from page 58*)

the antenna bypass relay.

Conclusion. The ability of the SX-59 to tune continuously from 3-30 mHz makes it a desirable accessory both for novices with inexpensive ham rigs, and for SWL's with economy priced shortwave receivers. For apartment dwellers who are limited to short antennas for receiving purposes, the preselector will improve signal strength.

The large number of low-cost general coverage receivers now being released to the consumer market provides a ready application for the SX-59. It has been tested with the Yaesu FRG-7, Radio Shack DX-300 and DX-150/160 series, Panasonic RF-2800/2900, and others. In many cases, improvement was considerable. Images are reduced from strong interference to inaudibility.

We judge it to be an especially worthwhile accessory where low signal strengths or images present a problem with existing equipment.

For complete information on the Mizuho SX-59, contact: Gilfer Associates, 52 Park Avenue, Park Ridge, NJ, 07656, or circle number 47 on the reader service coupon. ■

Daiwa CN-720

(*Continued from page 75*)

the SWR calibration representing 2.5:1. (You can check the SWR using the formula:

SWR = $(\sqrt{Pf} + \sqrt{Pr}\ \sqrt{Pf} - \sqrt{Pr}.)$

Regardless of how the power input might be varied, causing the pointers to track up or down, they will always cross over at the 2:5:1 SWR calibration line.

The frequency range of the CN-720 is 1.8 to 150 MHz. Input/output impedance is 50-ohms. SWR measurements can be made from 1.1:1 to ∞.

The overall dimensions are: 7-inches wide, by 4.7-inches high, by 5.1-inches deep.

The CN-720 carries a suggested retail price of $166.95 and is available at most Amateur radio equipment suppliers. For more information, circle number 77 on the reader service coupon, or contact: J. W. Miller Division of Bell Industries, 19070 Reyes Ave., Compton, CA 90224. ■

Wilson MK IV

(*Continued from page 42*)

NiCads that you use, and both they and you will be satisfied.

Conclusion. We think the Wilson Mark IV is within the elite group of 2-meter hand-held units. The basic unit is competitively priced at $259.95, with the factory-installed touchtone pad an additional $61.95. The WC-14 charger is $15.95 ($40.90 with the NiCads).

For complete information on the Wilson Mark IV, and the rest of the Wilson VHF line, circle number 80 on the reader service coupon, or contact: Wilson Electronics Corp., P.O. Box 19000, Las Vegas, Nevada 89119. ■

Active Filter

(Continued from page 66)

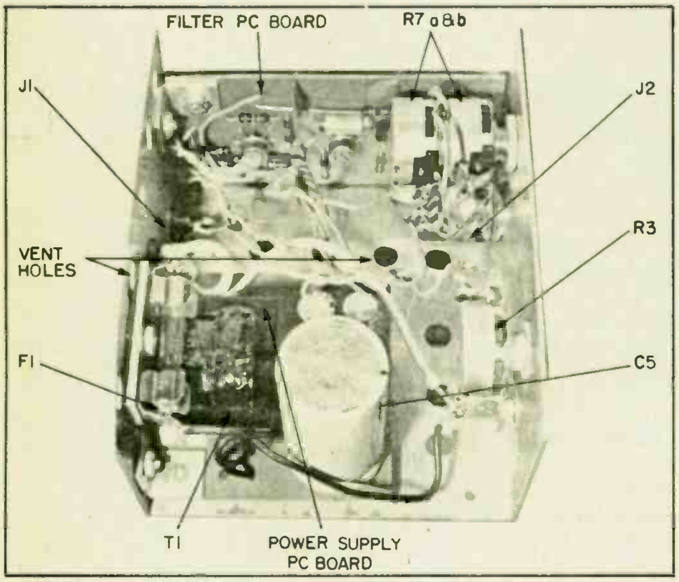
the filter is now ready for use with your receiver. To tune things up, you will need a source of unmodulated RF. The best signal is a steady one such as that from an RF generator. Couple it very loosely to the receiver's antenna jack. The marker signal from a crystal calibrator is another excellent choice. If your receiver can tune outside the ham bands, you might even use the unmodulated carrier signal from WWV (at 2.5, 5, 10 or 15 MHz).

Apply power to both the receiver and the RF signal source. Set the receiver for CW reception, and tune it to the source's frequency (any convenient value). Do not let the source overload the receiver; weak signals are preferable. Adjust the receiver's fine-tuning to maximize S-meter response

Now, turn on your filter. Feed the signal from your receiver's headphone jack to the filter's input (J1), and plug a low-impedance headset into J2. With R3 set for maximum Q, adjust R7 for peak headphone volume.

Disconnect the RF source from your receiver, and set R3 for minimum Q. Now hunt for CW signals on the ham bands. When you encounter a signal plagued by QRM (interference), tune it in as best you can with receiver's fine-tuning control. Then boost the Q with R3 to cut out the interference.

A Final Note. Although this filter was originally intended for CW operation, it was found to enhance SSB reception, too. As a general rule, less Q should be used for voice reception. Experiment with different values of both Q and center frequency to obtain the best results on SSB. Voices may assume an unnatural quality when sharply filtered, but they *will* be more intelligible. ■



The photo at left illustrates the physical layout of the filter's chassis. It is important that you be sure to drill ventilation holes where indicated, in order to avoid excess heat accumulation by the semiconductors.

Magnum 85 FM

(Continued from page 70)

tem gain by swamping the input and output terminals with low-value resistors. That didn't work. We tried using coaxial cable between the amplifier and the receiver. That didn't work either. We then separated the antenna from the amplifier by several feet of coaxial cable. Success!

With the system finally operational, we resumed our test of the Magnum 85 FM antenna amplifier. Its performance was sensational. Signals that were below the noise threshold were copied clearly when peaked by the 85. Extremely weak signals were brought up to full quieting.

Conclusion. Clearly, the Magnum 85 FM antenna amplifier is useful for increasing signal strength, reducing images, and reducing intermodulation from strong signals. It is especially suitable for FM fringe reception. It's almost frightening to think what the Magnum 85 would do if connected to a high-gain beam. (FM DX anyone?)

The Magnum 85 retails for $150.00, and is available directly from: Audio Marketing by Von, 11 Royal Crest Drive, North Andover, MA 01845. For more information on the Magnum 85, circle 79 on the reader service coupon. ■

Kathi's Carousel

(Continued from page 59)

the LED turns *on*, the rig is telling you the SWR is too high and possible damage might result.

Electrical performance is also typical of many new designs, generally better than what you got for the same price back in '75. Receiver sensitivity checked out on my instruments at 0.5 uV for 10 dB S+N/N. Selectivity was a whopping 65 dB (for AM, yet), with the clarifier providing ±1 kHz fine tuning so you can center a station in the selectivity passband. The AGC action was a tight 4 dB, which you instantly notice when you have the AF gain cranked wide open to hear a weak station, and you find a strong station coming on the channel doesn't pop your eardrums. SSB adjacent sideband rejection measured 50+ dB, about average for better-quality transceivers. Finally, the received signal audio quality was notably crisp and clean.

Overall, the Midland 7001 is a very impressive rig. For more info circle 52 on the reader service card. ■

Simply Basic

(Continued from page 76)

equation, such as plotting voltage levels for a given current rating. It can also be used for business to indicate things such as unit price for an item (see sample run). Since data can be changed after the graph has been printed, the program can be used to make long-range predictions. ■

```
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SAMPLE RUN OF "GRAPH"

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394. *KEF Electronics Ltd.* is offering two speaker systems in kit form at a significant cost-savings. The Model 104aB and the Cantata can be easily assembled and may be auditioned before purchasing.

389. You can't buy a bargain unless you know about it! *Fair Radio Sales'* latest electronics surplus catalog is packed with government and commercial buys.

388. SWLs need *Gilfer's* Shortwave Mail Order Catalog for economy one-stop armchair shopping. From top-notch rigs to reporting pads, Gilfer supplies all your hobby needs.

327. *Avanti's* new brochure compares the quality difference between an Avanti Racer 27 base loaded mobile antenna and a typical imported base loaded antenna.

362. A new catalog crunched full of military, commercial and industrial surplus electronics for every hobbyist is offered by *B&F Industries*. 44 pages of bargains you've got to see!

384. *B&K-Precision's* latest general line catalog lists instruments locally stocked at distributors throughout North America. Standard and new products are featured.

310. *NCE (Newman Computer Exchange)* has just issued their Spring/Summer 1979 "Mini-Micro" catalog, and it's full of hard-to-find equipment. Money-saving offers are listed on such items as all Data General and LSI-11 equipment.

322. *Radio Shack's* latest full color catalog, "The Expanding World of TRS-80," is out now, packed with up to the date information on this microcomputer. Specifications for the new Model II as well as the Model I are included.

386. If you're lookng for books on computers, calculators, and games, then get *BITS, Inc* catalog. It includes novel items.

335. The latest edition of the *TAB BOOKS* catalog describes over 450 books on CB, electronics, broadcasting, do-it-yourself, hobby, radio, TV, hi-fi, and CB and TV servicing.

338. "Break Break," a booklet which came into existence at the request of hundreds of CBers, contains real life stories of incidents taking place on America's highways and byways. Compiled by the *Shakespeare Company*, it is available on a first come, first serve basis.

345. For CBers from *Hy-Gain Electronics Corp.* there is a 50-page, 4-color catalog (base, mobile and marine transceivers, antennas, and accessories).

393. A brand new 60-page catalog listing *Simpson Electric Company's* complete line of stock analog and digital panel meters, meter relays, controllers and test instruments has just come out.

385. Amateur Radio buffs and beginners will want the latest *Ham Radio Communications Bookstore* catalog. It's packed with items for the Ham.

373. 48-page "Electronic Things and Ideas Book" from *ETCO* has the gadgets and goodies not found in stores and elsewhere.

382. Buys by the dozens in *Long's Electronics* super "Ham Radio Buyer's Guide." Good reading if you're in the market for a complete station or spare fuses.

383. If you're a radio communicator, either ham, SWL, scanner buff or CBer, you'll want a copy of *Harrison Radio's* "Communications Catalog 1979." Just what the shack book shelf needs.

380. If your projects call for transistors and FETS, linear and digital ICs, or special solid-state parts, then look into *Adva Electronics'* mini-catalog for rock bottom prices.

301. Get into the swing of microcomputer and microprocessor technology with *CREI's* new Program 680. New 56 page catalog describes all programs of electronics advancement.

302. Giant savings are what *Burstein Applebee* has in store in their latest mail order catalog. Everything from CB test equipment to name brand audio wares are advertised.

305. A new 4-page directional beam CB antenna brochure is available from *Shakespeare*. Gives complete specs and polarization radiation patterns for their new fiberglass directional antennas.

371. Your computer system needn't cost a fortune. *Southwest Technical Products* offers their 6800 computer complete at $395 with features that cost you extra with many other systems.

306. *Antenna Specialists* has a new 32-page CB and monitor antenna catalog, a new amateur antenna catalog, and a complete accessory catalog.

307. *Atlas* calls their 210X and 215X the perfect amateur mobile rigs. Their 6-page, full-color detailed spec sheet tells all. Yours for the asking.

330. There are nearly 400 electronics kits in *Heath's* new catalog. Virtually every do-it-yourself interest is included—TV, radios, stereo and 4-channel, hi-fi, hobby computers, etc.

392. The opening of the new Software of the Month Club has been announced by *Creative Discount Software*, which is giving out membership enrollment applications now. The Club plans to have separate branches for users of the Apple II, TRS-80, Ohio Scientific, Exity, Pet and CP/M based systems.

312. *E.D.I. (Electronic Distributors, Inc.)* carries everything from semi-conductors to transformer/relays to video cameras. In prices ranging from 19¢ to $500, products appear from over 125 electronic parts manufacturers.

390. *Whitehouse & Co.*, your "hard to find parts specialist," offers over a dozen parts and kits in their latest catalogue, featuring an entire section on gunnplexers for Amaeur Radio buffs.

318. *GC Electronics* offers an "Electronic Chemical Handbook" for engineers and technicians. It is a "problem solver" with detailed descriptions, uses and applications of 160 chemicals compiled for electronic production and packaging.

313. Get all the facts on *Progressive Edu-Kits* Home Radio Course. Build 20 radios and electronic circuits; parts, tools, and instructions included.

320. *Edmund Scientific's* catalog contains over 4500 products that embrace many sciences and fields.

321. *Cornell Electronics'* "Imperial Thrift Tag Sale" Catalog features TV and radio tubes. You can also find almost anything in electronics.

328. If you are into audio, ham radio, project building, telephones, CB or any electronics hobby you'll want *McGee's* latest catalog of parts and gadgets.

333. Get the new free catalog from *Howard W. Sams*. It describes 100's of books for hobbyists and technicians—books on projects, basic electronics and related subjects.

354. A government FCC License can help you qualify for a career in electronics. Send for information from *Cleveland Institute of Electronics*.

355. New for CBers from *Anixter-Mark* is a colorful 4-page brochure detailing their line of base station and mobile antennas, including 6 models of the famous Mark Heliwhip.

391. A new software products catalog for the Apple II Computer has just been issued by *Charles Mann & Associates*. The booklet contains business accounting, accounts receivable, inventory, BASIC teaching and other special purpose business applications.

359. *Electronics Book Club* has literature on how to get up to 3 electronics books (retailing at $58.70) for only 99 cents each . . . plus a sample Club News package.

375. *Compucolor Corp.* has a personal computer system with an 8-color integral display, a typewriter-like keyboard, and a mass storage device. Programs are ideal for checkbook and income tax figuring.

377. We can't enumerate all the products in *John Meshna, Jr.'s* catalog of surplus electronic parts: power supplies, computer keyboards, kits for alarms, clocks, speakers, and more.

311. *Midland Communications'* line of base, mobile and hand-held CB equipment, marine transceivers, scanning monitors, plus a sampling of accessories are covered in a colorful 18-page brochure.

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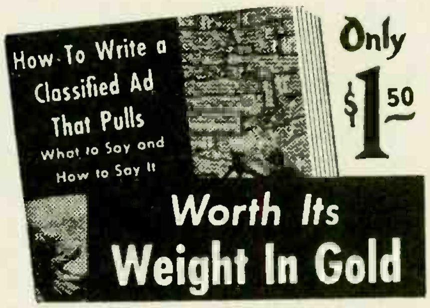

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Hank Scott, Workshop Editor
ELEMENTARY ELECTRONICS
380 Lexington Avenue
New York, NY 10017

PC Board Copy Cat

My PC boards are becoming popular in school. Friends ask me for them so that they can build my projects. Making one board at a time takes a lot of time, and going to PC board suppliers is very expensive. Any solutions, Hank?

—S.M., Long Beach, CA

Vector Electronics Co., 12460 Gladstone Ave., Sylmar, CA 91342, sells their 32XA-1 kit that makes seven boards for $28.00. Write to them and get all the facts and prices. Tell them you saw it in ELEMENTARY ELECTRONICS.

Save a Buck

Hank, the price of ICs is dropping to pennies, whereas resistors are going out of sight. You can't win as a project buildel in this inflation economy!

—D.Y., Canon, GA

Delta Electronics offers three packs of 160 fixed resistors each for eight dollars, or less than 2 cents each resistor. Digi-Key offers 5 each of the standard 72 standard 5% ¼-watt carbor film resistor for only $9.90, or 2.75 cents each! Other mail order outfits have similar offers. When you purchase ICs and other parts from these suppliers, order resistors at the same time and build up a supply. For some large projects, the peg-board blister packs source of resistors may cost more than a bulk purchase.

What an Outlet

My friend's father invested in a new electric car that he says "Detroit" is trying to suppress. It's a small car that can range up to 150 miles from home and return, and recharge in five minutes due to its very unique battery system. Isn't it a crime how new energy saving systems are being shot down?

—L.A., Westland, WI

If all that you say about the car is true, then think of this: assume the car's motor is rated at 40 horse power—remember, you said a small car. Assume it is run at 50 mph for the full range of the car (300 miles.) In six hours of driving, the car uses up 11,040 watt hours of energy. To replace their energy in five minutes would require an AC oulet at your home that can deliver about 92 ampere hours or approximately 1100 amperes for 5 minutes. Just imagine the size of your house wiring. Remember, when charging a battery, you must replace every kilowatt hour of energy that was used. Also, I did not get into the matter of efficiency and heat in the battery system. A very high current charge produces excessive heat—the battery may even glow! That's not too good for the battery. Look again into the facts, you may have your information jumbled.

Socket Sock It

Let's settle this once and for all! Is it better to solder ICs directly into a project or use IC sockets?

—A.E., Amherst, NH

The way I do it, is to rig the project on a solderless breadboard and get it working the way it should. Then hand wire the project on a perf board, homemade printed circuit board, or storebought "mother" board. I don't use sockets because the circuit works and the IC is known to be good! Sockets cause grief because an IC pin may be bent out of position or broken when inserted. If the circuit is still under design condition, even after hand wiring, then use sockets. Someone has to support the socket manufacturers.

Pinpoint Sound

Where can I get a parabolic microphone like they use in football games? I want to record speakers at large meetings, and also pickup questions from the audience.

—D.O., Garland, TX

The device used by the broadcast pros is very expensive. A cheaper unit is available from ITC Electronic Supermarket, 2772 W. Olympic Blvd., Los Angeles, CA 90006. It's a surplus Bell & Howell unit that ITC sells for $5.95 plus handling. Either write to them or call at 213/388-0621. Be sure to tell them you saw it in ELEMENTARY ELECTRONICS.

Tips on Saving Your Cool

Hank, this summer was hot! I've looked into fans to cool the attic and find them expensive. Running 3 amps continuously is not a luxury I can afford especially in my area where summer electric rates go up. Should I look to solar cells to supply the energy?

—S.W., Staten Island, NY

I installed fans to save on the air conditioning electric cost, now I find that I'm not running them and saving money. During the summer, my attic fan louvre is held open by a wood chock I fashioned. I installed a ¼-inch screen in front of the fan to keep out large flying insects, birds and squirrels. Next I installed four aluminum air vents, 2 each on either side of my peaked roof to allow rising hot air to escape. Next, I cleaned all the eaves openings which always get blocked and added several others to increase air flow. Of course, these are covered with mesh screen. I find that my attic fan does not come on at all on cloudy days, even when the outside temperature exceeds 90 degrees. You see my fan comes on automatically when the temperature hits 105 degrees. Also, it cycles on and off (mostly off) on sunny days. The fans use less electricity, the house is cooler, and when I must use air conditioning, it costs less. In the winter, I'll turn the fan power off, close the louvres, block up the extra air ports on the roof and eaves, and I plan to add another 3½ to 4 inches of insulation to save fuel bills.

Bill too Big

My wife and children are alone until I return home about 2 A.M. each workday morning. My wife is scared silly being alone, so she leaves the lights on in every room. You should see my electric bills! What can I do to save money and keep my wife feeling secure?

J.N., Walnut Creek, CA

Your wife has the right idea—lights help to keep away night intruders. So does a barking dog, but I guess you want a solution to your dollar problems. Radio Shack sells a 24-hour timer that'll turn lights on or off for intervals as short as 15 minutes. A few of these placed about normally uninhabited rooms in the evening will turn lights on and off indicating activity in the household. That'll keep a lot of trouble away. Use 3-way lamps with the lowest setting on where a light must be left on all night. Another tip! Look into the BSR X-10 Control System (ELEMENTARY ELECTRONICS Sept./Oct. 1979 issue) that can turn lights on and off in any room from any location in the house. Remote controlled modules (get as many as you need) will turn on all the lights at the same time, or independently. The system can even dim lights to save money. When you get home, you can turn all these lights off with one button. There are other systems and ideas you can use to increase your security while lowering your electric bills. Let me know if you have better ideas to pass on to our readers.

Music Kit

I'm getting into electronic music, Hank. Can you give me the names of some kit manufacturers of home disco and synthesizer products?

—R.T., Gaithersburg, MD

Sure can! Write to PAIA, Dept. 9E, 1020 W. Wilshire, Oklahoma City, OK 73116, and Heath Co., Benton Harbor, MI 49022, and ask for their catalogs. ■

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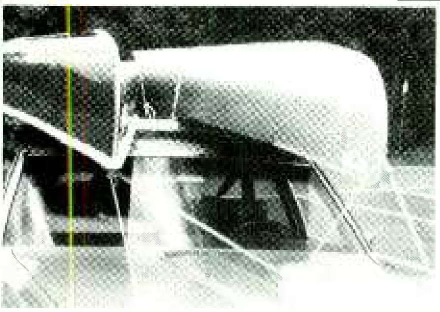

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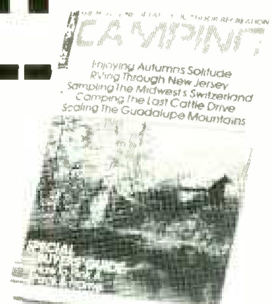

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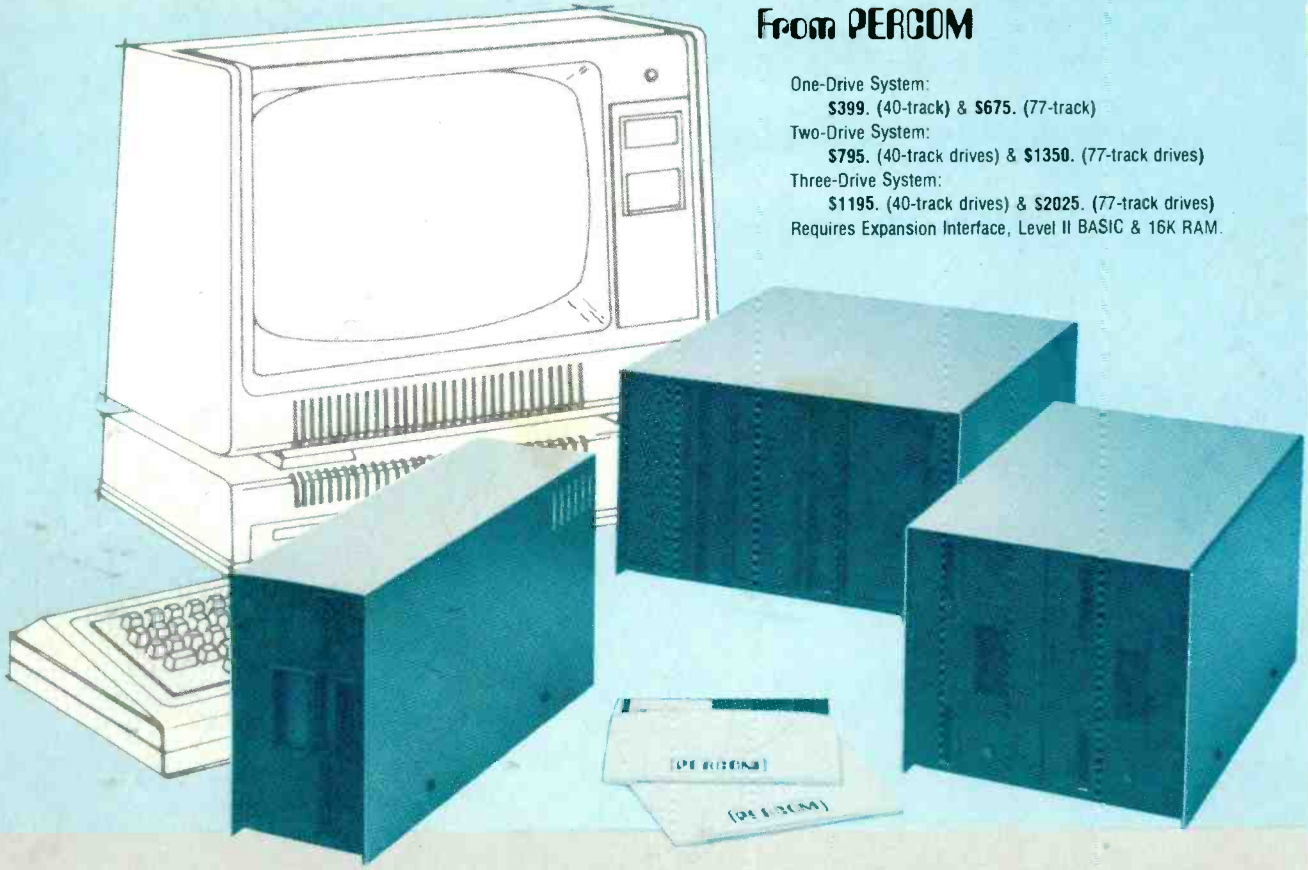

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