NOVEMBER 1982 / $2.50

ham radio magazine

hr Exclusive: Heath's SS-9000

hr

Multimode Mobile Magic

IC-290H & IC-490A

ICOM's latest state of the art 2 meter and 440MHz multimode transceivers.

IC-290H

25 Watts of Power. A full 25 watts in all modes gives extra communication range in the IC-290H.

Green LED Readout. For improved readability in bright sunlight.

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Squelch in All Modes. Standard noise squelch in FM and AGC derived squelch for CW and SSB reduce fatigue factors and allow scanning silently while looking for band openings or satellite signals.

Multimode Capability. FM, SSB, and CW modes provide solid communication modes for repeater, simplex, satellite or the CW enthusiast. Sidetone is provided on CW.

Adjustable Duplex Splits. Offset may be changed from its initial value by pressing the priority button while in VFO mode, then rotating the main tuning knob. The offset is displayed on the frequency readout.

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Memory Backup. The optional, heatsink mounted, BU1 memory backup battery option provides retention of memory when moving the transceiver from one power source to another.

Touchtone™ Microphone Supplied. Each unit comes with a touchtone® microphone as the standard unit microphone.

IC-490A

The operational characteristics of the IC-490A are the same as the IC-290H except for the features outlined in the following chart.

		IC-290H	IC-490A
Freq. Range (MHz)		143.8-148.199	430.0-439.999
Power	Hi	25	10
	Lo	1	1
Memories		5	4
Initial Offset		600KHz	5MHz
1MHz Up Button		Not Req'd	Yes
Normal	FM1	5	5
Tuning	FM2	Not used	25
Rates	SSB	0.1	0.1
(KHz)	CW	0.1	0.1

ICOM

The World System

ICOM America, Inc., 2112-116th Ave NE, Bellevue, WA 98004 **(206)454-8155**/3331 Towerwood Drive, Suite 307, Dallas, TX 75234 **(214)620-2780**

All stated specifications are approximate and subject to change without notice or obligation. All ICOM radios significantly exceed FCC regulations limiting spurious emissions.

TR-2500

BIG performance, small size, smaller price!

The TR-2500 is a compact 2 meter FM handheld transceiver with every conceivable operating feature.

TR-2500 FEATURES:

- Weighs 540 g. (1.2 lbs). 66 (2-5/8) W x 168 (6-5/8) H x 40 (1-5/8) D, mm (inches).
- LCD digital frequency readout.
- Ten memories includes "MO" for non-standard split repeaters.
- Lithium battery memory back-up, built-in, (est. 5 year life).
- Memory scan.
- Programmable automatic band scan, and upper/lower scan limits; 5-kHz steps or larger.
- Repeater reverse operation.
- 2.5 W or 300 mW RF output. (HI/LOW power switch).
- Built-in tunable (with variable resistor) sub-tone encoder.
- Built-in 16-key autopatch encoder.
- Slide-lock battery pack.
- Keyboard frequency selection.
- Covers 143.900 to 148.995 MHz.

CONVENIENT TOP CONTROLS

- Optional MS-1 mobile or ST-2 AC charger/supply for operation while charging.
- Battery status indicator.
- Complete with flexible antenna, 400 mAH Ni-Cd battery, and AC charger.

Optional accessories:

- ST-2 Base station power supply/ charger (approx. 1 hr.)
- MS-1 13.8 VDC mobile stand/ charger/power supply.
- VB-2530 2-M 25 W RF power amps., (TR-2500 only).
- TU-1 Programmable CTCSS encoder (TR-2500 only).
- TU-35B Programmable CTCSS encoder (mounts inside TR-3500 only).
- PB-25H Heavy-duty 490 mAH Ni-Cd battery pack.
- DC-25 13.8 VDC adapter.
- BT-1 Battery case for AA manganese/alkaline cells.
- SMC-25 Speaker microphone.
- LH-2 Deluxe leather case.
- BH-2A Belt hook.
- RA-3 2 m 3/8 λ telescoping antenna (for TR-2500).
- WS-1 Wrist strap.
- EP-1 Earphone.

NEW

TR-3500

70 CM FM Handheld

- Covers 440-449.995 MHz in 5-kHz steps.
- Hi-1.5 W, Low-300 mW.
- TX OFFSET switch, ±5 kHz to ±9.995 MHz programmable.
- Auto/manual squelch control.
- Tone switch for opt. TU-35B
- Other outstanding features similar to TR-2500.

TR-7950/7930

Big LCD, Big 45 W, Big 21 memories, Compact.

Outstanding features providing maximum ease of operation include a large, easy-to-read LCD display, 21 multi-function memories, a choice of 45 watts (TR-7950) or 25 watts (TR-7930), and the use of microprocessor technology throughout.

TR-7950/TR-7930 FEATURES:

- New, large, easy-to-read LCD digital display. Easy to read in direct sunlight or dark (back-lighted). Displays TX/RX frequencies, memory channel, repeater offset, sub-tone number, scan, and memory scan lock-out.
- 21 new multi-function memory channels. Stores frequency, repeater offset, and optional sub-tone channels. Memory pairs for non-standard splits. "A" and "B" set band scan limits. Lighted memory selector knob. Audible "beep" indicates channel 1 position.
- Lithium battery memory back-up. (Est. 5 yr. life.)
- 45 watts or 25 watts output. HI/LOW power switch for reduction to 5 watts.
- Automatic offset. Pre-programmed for simplex or ±600 kHz offset, in accordance with the 2 meter band plan. "OS" key for manual change in offset.
- Programmable priority alert. May be programmed in any memory.
- Programmable memory scan lock-out. Skips selected memory channels during scan.
- Programmable band scan width.
- Center stop circuit for band scan, with indicator.
- Scan resume selectable. Selectable automatic time resume-scan, or carrier operated resume-scan.
- Scan start/stop from up/down microphone.
- Programmable three sub-tone channels with optional TU-79 unit (encoder).
- Built-in 16-key autopatch encod
- with monitor (Audible tones).
- Front panel keyboard control.
- Covers 142.000-148.995 MHz in 5-kHz steps.
- Repeater reverse switch. (Locking)
- "Beeper" amplified through speaker.
- Compact lightweight design.

Optional accessories:

- TU-79 three frequency tone uni
- KPS-12 fixed-station power supply for TR-7950.
- KPS-7A fixed-station power supply for TR-7930.
- SP-40 compact mobile speaker.

NEW

KENWOOD

TRIO-KENWOOD COMMUNICATIONS
1111 West Walnut, Compton, California 90220

ham radio magazine

NOVEMBER 1982

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contents

Observation & Opinion

Meet *ham radio*'s technical editor and the latest addition to the *ham radio* staff: Rich Rosen, an active ham for a quarter century as K2TXC and K2RR. He's lived in, visited, or operated from most of the States as well as thirty foreign countries. Rich was part of the K2GL contest team in the late 50s/early 60s, and was a commercial CW op in the U.S. merchant marine and at RCA coastal station WNY. Professionally a double-E for sixteen years (MSEE) and a registered engineer (P.E.) in New York and Colorado, he has worked for the aerospace firms of AIL and Hughes Aircraft and for a Naval architecture company designing power, lighting, and communication circuits for auxiliary vessels and submarines.

Rich worked as a video/audio development engineer at CBS Television Network, and was responsible for over two hundred installations of 3.7-4.2 GHz TVRO and terrestrial point-to-point microwave circuits at Hughes. In the publishing industry, he has served as editor and associate publisher of *rf design* magazine, consulting editor for CM, Global Communications, Satcom, and TVC, and as Western editor of *MicroWaves* magazine. He recently published the book *From Beverages Thru OSCAR — A Bibliography*.

When it comes to propagation phenomena, most Radio Amateurs have heard of D, E, and F layers. But what about the lesser known C and G layers, or the E_1, E_2, and $F_{1\frac{1}{2}}$ regions of the ionosphere? Why, when 10 meters first opens to "Europe," do we sometimes have to point our beams toward North Africa to work England? It's common knowledge that solar flares inhibit hf communications and can even cause a radio blackout, but what accounts for the sudden *enhancement* of hf propagation at the beginning of the flare? These and other such questions will be answered by an authority on magneto-ionospheric effects. *Ham radio* magazine, introducing a new feature, is pleased to present in-depth interviews with experts in fields of direct and applicable interest to hams. Look for them soon.

Ham radio magazine is also making ready to provide you, the reader, with a forum — a place to direct your technical questions. Starting this January and called the Technical Forum, this new feature will consider questions on subjects ranging from Beverage antennas through PFM laser communications systems and beyond. Because space is limited, the majority of questions researched will be chosen on the basis of widest interest and need.

If, for example, you've always wanted to know where to find a TVI suppression circuit for the "signal shifter," we'd be glad to tell you to look in the March, 1955, issue of *QST* on page 32. In the unlikely event that your question stumps us, we will print the question in the next available issue and throw it open to our readership to answer. The first reader to respond — correctly — will receive our thanks and a gift. Start sending in your questions now.

Here's a preview of a few of the subjects you'll be seeing in the upcoming issues of *ham radio*: a detailed report on new-band 10 MHz propagation by one of the few U.S. Amateurs permitted to operate there; low-noise preamplifiers for 2304 MHz; Bragg-cell receivers; a 15-meter transceiver for $100; a simple, simplex autopatch; repeater antenna beam tilting; a remote receiver-site voting system; and a simple way of locating geostationary satellites.

Some of our older readers may recall the editor of *R9* and *Radio* magazines (pre-W.W.II), the author of the 1948 *Antenna Manual* and originator of several popular wire hf antennas: Woodrow W. "Woody" Smith, W6BCX. Woody will tell us about the history and development of the popular bobtail curtain antenna in an upcoming issue — and about the antenna's most recent adaptations, too.

We encourage, from among the international community of hams, the authors of articles that have appeared in foreign magazines and journals to share with us their technical achievements and views. We are eager to hear from Amateurs who have written for such publications as *Radio Communications* (England), *Break-In* (New Zealand), *Ondes Courtes Informations* and *Radio* (France), *Radio Rivista* (Italy), *Revista Telegrafica Electronica* (Argentina), *CQ DL* (Germany), and *CQ Ham Radio* (Japan). Our multilingual staff will work with you.

It was a pleasure meeting some of you at the recent Boxboro, Massachusetts, ARRL show, and I look forward to discussing any technical subject with our readers — by phone, letter, or face to face.

Rich Rosen, K2RR
technical editor

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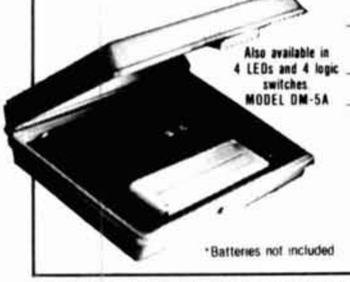

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More Details? CHECK—OFF Page 102

by Skip Tenney

If you've been looking at our masthead during the past month or so you've probably noticed a number of changes. Much of this was the result of a decision earlier this year by Alf Wilson, W6NIF, that it was time to head back to California and enjoy some of that well-earned retirement that we had so rudely interrupted a couple of years ago. Thanks, Alf, for a lot of help and for a chance for all of us to work with one of the real pros in our industry.

First is the appointment of Marty Hanft, KA1ZM, as the editor of *ham radio* magazine. Marty has served us in several important editorial positions starting as our administrative editor some years ago. Most recently he has been our managing editor. He is our resident expert in seeing that we have the best reading and best looking publication in the field and one that is properly completed on time month after month. Congratulations, Marty! You've earned your new responsibilities and earned them well.

Another important change is the addition of Deb Marshall to our staff as managing editor. She comes to us with an excellent background in technical publishing. Her experience includes having been the managing editor of *80 Microcomputing*, and she continues to find time in her busy schedule to be editor of *Bar Code News*, an interesting publication in the small computer field. Deb gave us a good hand over this past summer and we have come to depend on her as a real professional and a very important part of the *ham radio* operation.

Certainly one of the most critical positions with any publication such as *ham radio* is that of technical editor. That is the person who has the greatest control over the actual content of the magazine and the one who has a very great say as to the direction it takes. We have been extremely lucky to have acquired the very enthusiastic services of Rich Rosen, K2RR, as our new technical editor and associate publisher.

Rich brings to us a superb background including having been the editor and associate publisher of *rf Design*, a highly regarded industry magazine. He has also put in many very successful years as an engineer working in a variety of projects from VLF to microwaves. His Amateur background is also extensive. It includes every type of activity from very successful 75-meter DXing to his being both an operator and designer of one of the East's most successful major contest stations a few years back. Rich has so many exciting new ideas that all of us, both reader and *ham radio* staff alike, are really going to have to go some to keep up with the pace he will be setting for all of us.

As you can see we've been doing some real planning, and, over the next few months, I think you'll agree that more than ever before *ham radio* will be the one magazine setting the standard for everyone else to follow.

Skip Tenney, W1NLB

comments

training deaf hams

Dear HR:

I am looking for information on very simple transmitters and receivers in the 160-190 kHz band. I want to establish a training network for deaf persons so they might eventually obtain ham licenses. The equipment must be simple, easy to build, and inexpensive.

I have some military surplus BC-1208-CM receivers which need 28 volt power supplies and frequency converters from 200-400 kHz to 160-190 kHz, or plans for padding the variable capacitors down. I would like to obtain some military surplus BC-453's to try out. Do you know where I might find the latter?

Most people suggest very expensive modern equipment, which would be a severe deterrent to the success of my program.

Any help you or your readers can give will be appreciated.

Bob Real, KA6LBG
1781 North Grand Avenue
Porterville, California 93257

credit Pythagoras

Dear HR:

As both an avid reader of *ham radio* and also a college physics teacher for eighteen years, I wish to applaud the imaginative use of Fresnel diffraction, as suggested by William Brooks, WB6YVK, in the May, 1982, issue.
ter's error which misrepresented the line segments in **eq. 1** which should be rewritten to read, I believe:

$$(S_n + d_n) - (S_o + D_o) = n\lambda/2 \quad \textbf{(1)}$$

Brooks states that "trigonometry" leads us to **eq. 2**. However, while trigonometry surely relates to right triangles, I believe it is better to give Pythagoras the credit for **eq. 2**, since he proved the relation among legs and hypotenuse of a right triangle before trigonometry became tabulated in tables of sines and cosines. We might save a few readers who feel geometry is within their scope but not trigonometry by making the more modest claim.

Of course, the binomial expansion, from which derive **eqs. 4** and **5**, applies only in the approximation that R_n is much smaller than the values of S or D.

It should be possible to obtain some lightweight insulation material which includes radiation-reflective coating — such as is used in housing construction. Such would be convenient as a material for building the proposed zone plate.

David A. Cornell, K9BO
Elsah, Illinois

K9BO is indeed correct, there is an error in ***eq. 1*** *which should read:*

$$(S_n + d_n) - (S_o + D_o) = n\lambda/2 \quad \mathit{(1)}$$

The remaining equations are correct as printed.

As for geometry versus trigonometry, my McGraw-Hill Dictionary of Physics and Mathematics (1978) *defines geometry as "the qualitative study of shape and size." I would direct K9BO's attention to the bold type geometry above the paragraph containing* ***eqs. 2*** *and* ***3****. Further, my dictionary defines trigonometry as "the study of triangles and the trigonometric functions."* ***Fig. 2*** *and the supporting text are discussed in terms of triangles. I disagree with K9BO's contention that trigonometry is beyond some readers. I suspect that a large majority of* ham radio's *readers are licensed hams, and as such must have become somewhat familiar with trigonometry to have successfully confronted questions concerning phase angle, power factor, antenna dimensions, etc. in the license examination.*

William M. Brooks, WB6YVK
San Jose, California

QRP

Dear HR:

Thank you for your fine editorial on QRP in the April issue. You have thrown down a challenge — who will be the first U.S. ham to earn a WAC with 500 mW on the new WARC bands? Several active QRPers are gearing up to do so.

The points raised in your editorial are all well taken and right on target. You might get some argument, however, when you say that anything below 1 watt is QRP_p. Generally, anything less than a watt output is in the milliwatt category, while QRP_p is looked on by many low-power enthusiasts as being between mW and five watts input.

For those of your readers who would like additional information on low-power operations, QRP Amateur Radio Club International offers a free brochure. A large SASE sent to the club at Box 12072, Capitol Station, Austin, Texas 78711, will bring a copy by return mail.

Fred Bonavita, W5QJM
Austin, Texas 78711

Orlando Hamcation '83

Dear HR:

The readers of *ham radio* may be interested to learn that the 1983 Orlando Hamcation will be held on March 18, 19, and 20, 1983, at the Orlando Centroplex-Expo Centre.

Expo Centre is a large and modern exhibition hall, with roughly 100,000 square feet of available space; it's air conditioned, has a top-notch PA system, room for 400 to 500 indoor flea market spaces, and lots more.

We expect the 1983 Orlando Hamcation to be the best ever, and we thought you'd like to pass the word along to your readers.

Al Canning, Chairman
Orlando Hamcation

More Details? CHECK—OFF Page 102

presstop de W9JUV

UOSAT IS BACK IN OPERATION, following a successful command operation using Stanford Research Institute's 150-foot dish on September 20. The experiment-laden British Amateur satellite had been locked up since April, when both its 70-cm and 2-meter beacons were accidentally activated simulaneously during a checkout. The resultant desensing of both command receivers prevented control stations from re-establishing control of the bird—until SRI's giant dish, with its 42-dBd gain at 70 cm, enabled a California team to hit UOSAT with at least 12 megawatts ERP. A midnight call to G3YJO brought the good news to England, and subsequent checkouts by UOSAT's University of Surrey Command Station have determined that it's little worse for its five-month "hibernation." With an estimated half to two-thirds of the satellite's useful life still remaining, expectations are now that most of the original mission of the sophisticated satellite will be accomplished.

The Failure Of The L5 Ariane Satellite to achieve orbit on September 10 provided a contrastingly negative note to the Amateur Radio space program, however. A faulty hydrogen pump in the Ariane's third stage is believed to have been the cause of the failure, which brought the space vehicle down into the Atlantic. Though some users had expressed concern over Ariane's future as a result of this latest loss, it now appears that the failure may actually advance the launch of the Phase 3 Amateur satellite because L7, the vehicle Phase 3 is scheduled to ride, may be moved up to early next year. For various technical reasons L6, the next Ariane in line, can't be launched that soon.

An Amateur Satellite Technical Meeting, the first of its type ever held, is set for October 2 in Paris. The three-day meeting will permit Amateur satellite builders from the U.S., France, Germany, the U.K., South Africa, Japan, Hungary, and possibly elsewhere to discuss on a purely technical basis future cooperative efforts and launch opportunities.

AMATEUR EXAM ADMINISTRATION WON'T BE CHANGING very soon, despite the President's having signed the Omnibus Communications Bill into law September 13. The ARRL is studying procedures and costs for preparing and administering exams, and it should be submitting a Petition for Rule Making on the subject in October. This should result in a Notice of Proposed Rule Making from the FCC, with appropriate Comment and Reply Comment periods eventually leading to a Report and Order, spelling out procedures. The time required by the steps in this process will push the resolution into next spring at the earliest, and more likely later in the year. With current FCC staff and money reductions, however, it's possible that some FCC Field Offices could be closed before Amateurs are ready to step in.

Novice Exams May Be Changed Soon. A new procedure in which the volunteer examiner simply certifies the would-be Novice has passed both theory and CW tests would be sufficient to qualify him for a license, eliminating much FCC paperwork. This change will probably surface before the end of the year, most likely as an NPRM.

Directions For A No-Code Amateur License seem to be shifting within the Commission, with a Canadian-type "Digital" UHF license now favored over a "No-Code Technician."

PEP RF POWER MEASUREMENT has been proposed for the Amateur service in an NPRM just released by the FCC. PR Docket 82-624 proposed deleting present requirements that an Amateur have power-measuring equipment, and will specify how FCC engineers would measure it during a station inspection. Due date for Comments had not been released at press time.

Various New And Experimental Digital Codes have been authorized above 50 MHz by the FCC in a Report and Order on PR Docket 81-699. In addition to opening up a variety of new techniques, this action also marks the first time the Commission has permitted the general use of modes that its Monitoring Stations were not equipped to copy.

10-MHZ AUTHORIZATION FOR U.S. AMATEURS has still not cleared the FCC Commissioners as this goes to press, but the necessary paperwork is believed well on its way through the FCC and could be approved as soon as mid-October. Though Amateur access to the new band could then be granted immediately, it's most likely it won't come until thirty days after Commission approval. Barring unexpected developments, U.S. users of the new WARC band will be limited to CW and RTTY at a maximum input of 250 watts.

Access To The New 18 And 24 MHz Bands won't be coming along for some time, however. Unlike 10 MHz, which the WARC made available last January 1st, the other two new HF bands are to be released to the Amateur service in a much more gradual fashion, giving their present users years, if necessary, to move to other frequencies.

A SUIT AGAINST BURBANK, ILLINOIS, WAS FILED on September 10 in U.S. District Court for the Northern District of Illinois on behalf of ten Burbank Amateurs and CB operators by attorney W9WU. The suit against village officials and their recently enacted ordinance restricting antennas and interference included as a late addition N8DRN, who recently moved to Burbank to become pastor of a church there. He'd been refused an antenna permit that he'd wanted so as to continue communications with his colleagues in Nigeria, where he served his church for twenty years and had been very active as 5N6ENV.

Burbank Officials Have Until October 20 to respond to the suit.

the SS-9000 — Heath's new all-band transceiver

ham radio looks at Heath's newest and finest offering

When a top-ranking Amateur radio equipment manufacturer announces its first new all-band transceiver to be put on the market in eight years, that's news. When that new rig is completely solid-state and includes virtually every feature anyone ever dreamed of for such a radio, that's important news. When that new radio is the first Amateur transceiver specifically designed to be just as much at home interfaced to a computer as with a human operator at the front panel controls, that's more than just news — it's a major story!

Word that this important new radio was finally complete reached *ham radio* this spring, when several top Heath officials visited Greenville and discussed it on a confidential basis with members of the *ham radio* staff. Our enthusiastic reaction to their description of the new (completely manufactured — not a kit!) SS-9000 transceiver was duly noted, as was the subsequent suggestion that the SS-9000 constituted such a significant advance in Amateur equipment it could be considered for major editorial coverage. Several months and many long-distance phone conversations later, the arrangements were complete. *ham radio* was to get the first outsider's look at the SS-9000, in a no-holds-barred session from which we could write a frank appraisal of what Heath has done.

Thus it was that a hot August day found me in Benton Harbor, admiring the forest of towers and beams perched on one corner of Heath's sprawling plant just a stone's throw from the shore of Lake Michigan. Inside the plant, PR Coordinator Myron Kukla took me to the engineering department and introduced me to Dave Poplewski, KC8IV, and Jerry Tolsma, W8GPB. Dave and Jerry are the two Heath people who have been most directly responsible for the development of the SS-9000, and Dave is Heath's Product Line Manager of Communications.

Dave filled me in on the history of the SS-9000 in a very frank, candid discussion, and a very interesting story (which we'll touch on a bit later) it was. Heath had thoughtfully provided me, before my visit, with a draft copy of the preliminary operator's manual as well as a complete set of schematics for the SS-9000. I'd spent an evening studying them, so I thought I was pretty well prepared for my introduction to the real radio. I was wrong. You just can't fully appreciate an Amateur transceiver being operated by a computer until you see it happen! But before getting to that, let's talk about the SS-9000 as a radio.

By Joe Schroeder, W9JUV, associate editor, *ham radio*

band	tuning range
160 meters	1745-2055 kHz
80 meters	3425-4075 kHz
40 meters	6925-7375 kHz
30 meters	10100-10150 kHz
20 meters	*13925-15008 kHz
17 meters	17699-18200 kHz
15 meters	20925-21760 kHz
12 meters	24890-24990 kHz
10 meters	28000-29700 kHz

*transmit inhibited on high end

table 1. SS-9000 frequency coverage.

The SS-9000 is a microprocessor-controlled, all solid-state 100-watt output SSB, CW and RTTY transceiver that covers all nine Amateur bands from 160 through 10 meters. The specs are good (see **table 1**), and though an afternoon playing with a radio is no substitute for a laboratory evaluation, my gut feeling (reinforced by Heath's reputation) is that they're probably conservative. The SS-9000's styling is very attractive, with the control layout logical and easy to get used to and use.

Tuning is digital, in 100 Hz steps, using a smoothly operating knob-driven optical encoder that can be adjusted for drag to suit an individual operator's taste. One unique feature that's immediately obvious is the dual-frequency display, with pushbutton selection of either of the two displayed frequencies for transmit, receive, or both (transceive). A pair of push buttons below the tuning knob scan up or down whichever display is in the receive mode, at a rate determined by a DIP switch programmer located inside the top cover of the radio. In addition to the two displayed frequencies, there is a memory in which one additional frequency for each band may be stored.

The memories in the SS-9000, including the two frequencies in the display, are non-volatile, so even when the radio is turned off and then turned on again all the frequencies to which it was last tuned are there. Each band has its own memories, so not only the last used (and last stored) frequencies on the last band to be operated, but also those frequencies on all nine bands (twenty-seven frequencies total) are preserved. This would be a tremendous convenience for anyone who keeps regular schedules with friends or participates in nets. It would also give a DXer looking for a DXpedition that's been active on a variety of known frequencies on a number of different bands a real advantage over his less well-equipped competition.

transmitter

Dave calls the final "the world's most protected PA," and it's easy to see why after you read the specs and watch it demonstrated. Unlike so many solid-state PAs, the one in this rig will deliver power into any load it sees. It's guaranteed to deliver eighty percent of rated power into a 2:1 mismatch, and at least 15 watts into any load. I saw it delivering 25 watts into a 5:1 mismatch. It's also protected against excessive temperature and current.

There is a front panel power output control, for adjusting the output on any mode from about 1 watt to full (100 watts) power. For use with a transverter, there's a rear panel jumper to disable the final, resulting in a maximum output at the antenna terminal of about 50 mW from the driver stage. There's also front panel adjustment of speech compression, VOX (and CW) delay and mike gain. The front panel meter provides switch-selected monitoring of ALC, power output and compression on transmit as well as signal strength on receive.

receiver

The receiver has RIT (+/−250 Hz) and passband shift. The passband shift can be used only on SSB, and is adjustable in 100 Hz steps from −600 to +400 Hz. For CW, two very effective filters (400 Hz medium and 200 Hz narrow) are provided. In the CW wide mode the 2.1 kHz SSB filter is in the circuit. On RTTY the 400 Hz CW filter is used. There's also a noise blanker switch selection of slow, fast, or no AGC, and AF and rf gain controls.

The receptacle for the external power supply, an SO-239 for the antenna, and a key jack, are located on the back panel. There's also the usual array of jacks for switching external relays, muting and ALC for operating an external amplifier or other accessories. High and low level receive audio and high and low impedance transmit audio jacks are also provided for use with a RTTY terminal or phone patch. A jumpered plug determines full or low (about 50 mW) transmitter power output, providing a means for automatically switching to low power when an accessory transverter is used.

Just above the antenna connector on the rear panel is a square box. This is the motor drive for the band switch (remote band switching!). There's even better news: using Heath's SA-1480 remote coax switch with the SS-9000 provides automatic antenna selection whenever the band switch is turned manually or remotely with the motor drive. Interconnection between the transceiver and antenna switch is by means of a ten-conductor ribbon cable that plugs into the top of the motor drive box; when desired, automatic antenna switching can also be disabled from the SA-1480's front panel.

computer interface

What sets the SS-9000 apart from every other Amateur rig on the market is the 25-pin connector marked TERMINAL that's located at the top of the back panel next to the key jack. This connector is the type known to computer buffs as the DCE (DB-25S), and provides the SS-9000 with serial RS-232C interface for use with a computer, RTTY, smart terminal or modem. My introduction to the added capabilities of computer control was with an SS-9000 interfaced with a Heath H/Z-89 computer booted up with a demonstration program. After responding to the computer's request for my call and handle, the computerized SS-9000 got very friendly, alternately directing me to perform various control functions from the computer keyboard and performing others itself. Seeing an all-band rig selecting bands, frequencies and modes, then fine-tuning those selections without the hands-on help of an operator is an impressive, if somewhat disconcerting, sight!

We switched to a Heath H-19A smart terminal for further remote exercises. I first called up a listing of all twenty-seven frequencies in memory (three each on nine bands); these were displayed on the terminal's CRT. With a few more keystrokes I put the SS-9000 on 20-meter USB, listening on 14195 and ready to transmit on 14205 (just in case some DXpeditioner was on the band, handing out a new country). Some off-frequency chatter came through the speaker, but with a few more keystrokes I had a rag-chewing VE tuned in. A few more keystrokes moved the passband tuning a few hundred hertz, neatly eliminating some irritating off-frequency splatter in the background. This was fun!

Heath's versatile SS-9000 covers 160 through 10 meters, and can be operated from a computer or smart terminal keyboard just as easily as from its front panel.

Every control function of the SS-9000, with the exception of turning the rig on, can be called up and its status displayed on the computer or terminal CRT. Every control function can then be reset with a few keystrokes. Included are: band switch; mode switch; receive frequency; transmit frequency; transmit (command); receive (command); receiver passband shift; and baud rate. The terminal can also request and display all frequencies stored in memory, and call up and display all SS-9000 switch settings, whether manually set from the rig's front panel or changed through interface commands.

With this powerful control capability there would seem to be no end to what could be done with an SS-9000 and a computer. Dave suggested (only half in jest) a phone booth ham station. With suitable audio I/O to the rig, you could simply step into a phone booth with a portable terminal and modem, dial up your hamshack phone, and go on the air on whatever band and mode you chose for as many contacts you may wish. A rabid DX-chaser could program the rig to check known frequencies for a rare station or DXpedition (after programming the computer to recognize a given call sign or prefix on CW) and stop searching and give an alarm when it's heard. There seems to be no end to the possibilities!

accessories

Other than a computer or smart terminal and the SA-1480 remote coax switch, the PS-9000 power supply is the only major accessory for the SS-9000. In addition to providing 25 amps (peak) at 13.8 volts in a well regulated, fully protected circuit, the matching style PS-9000 also contains the speaker for receiver audio and CW sidetone plus two digital clocks. Though both clocks can be programmed for either twelve or twenty-four hour format, in most shacks one would be set to GMT with a twenty-four-hour presentation and the other on local time with twelve-hour format. Power on/off is normally accomplished from the SS-9000 front panel with a switch on the af pot, though an off/on switch is also provided on the bottom of the PS-9000.

history

The SS-9000 almost came on the market (less computer compatibility and some other bells and whistles) in 1979 as the SS-8000. The SS-8000, developed as a very sophisticated replacement for the

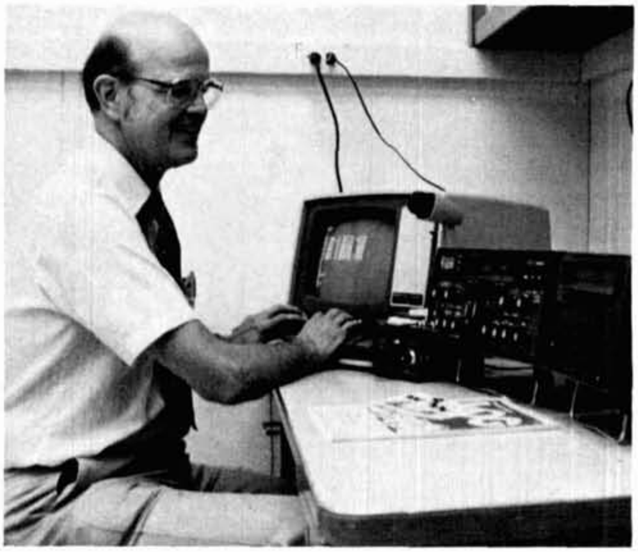
SB-104, was the result of several years of intensive research and development. It was all set to debut; a teaser announcement had appeared in one Heath catalog, the company was making no secret of the fact they were about to spring a super new rig, in fact, they had even discussed the product in detail with *ham radio* editors, when a bombshell struck! Delegates to the 1979 World Administrative Radio Conference agreed there should be three new Amateur HF bands, and these frequencies were in direct conflict with the conversion scheme so carefully worked out for the SS-8000!

Heath went back to the drawing boards, but it soon became painfully clear there was no way the SS-8000 could accommodate the new bands without making performance compromises Heath was unwilling to pass on to its customers. Despite a tremendous investment in development and tooling, the SS-8000 was scrapped.

The many good points of the SS-8000 design had not been forgotten, however. Heath still wanted a new, top-of-the-line, all-band Amateur transceiver, so when it was suggested Heath manufacture a new radio incorporating all the features developed for the SS-8000 but designed to accommodate all the hf Amateur bands, old and new, it received a warm welcome. There was one very significant addition, however: with Heath's very successful entrance into the computer market, this new rig was not only to be microprocessor based but would be fully computer compatible. Work began on the new project almost two years ago, and the SS-9000 is the result. The gang at Heath know they perform, too — SS-9000 prototypes worked both the Sweepstakes and 160-meter contest late last year!

A factory-wired Amateur rig is not a totally new concept at Heath. The SB-101 was offered completely factory built and tested, as well as in kit form, in the 1960s as the SBW-101. (If you still have an SB-101 and it has riveted boards, you've got an SBW-101.) But Heath has always been the great kit house. Why provide the SS-9000 only factory wired? Dave, Jerry and I discussed this at some length. A radio with this degree of sophistication would be a major undertaking for even the most competent home builder. Construction time could run into hundreds of hours, and debugging and checkout requires instruments not available to most Amateurs. Although some Amateurs could indeed assemble an SS-9000 and make it work, the feeling was that all too many could become frustrated in their efforts and cause a tremendous support problem for Heath.

Heath is offering the SS-9000 with a one-year warranty, so they certainly have faith in it as assembled in Benton Harbor!



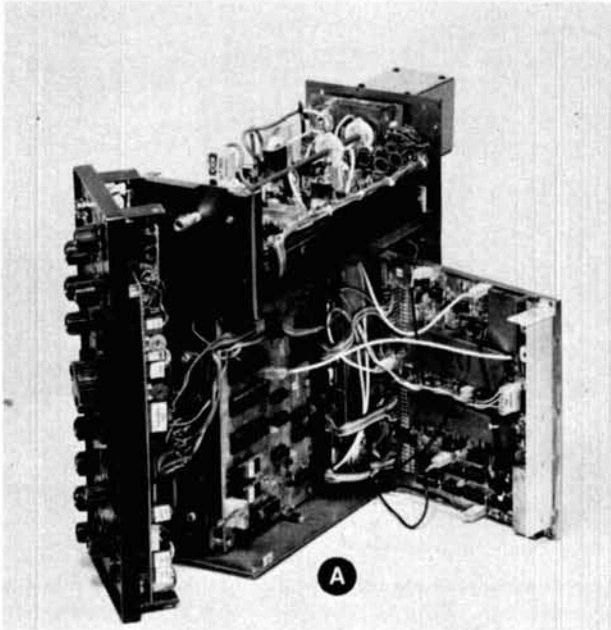
ham radio **Associate Editor W9JUV at the controls — that is, keyboard — of the SS-9000. Band (and antenna) selection, tuning and scanning and transmit/receive can all be done from the microcomputer keyboard or from the front panel knobs.**

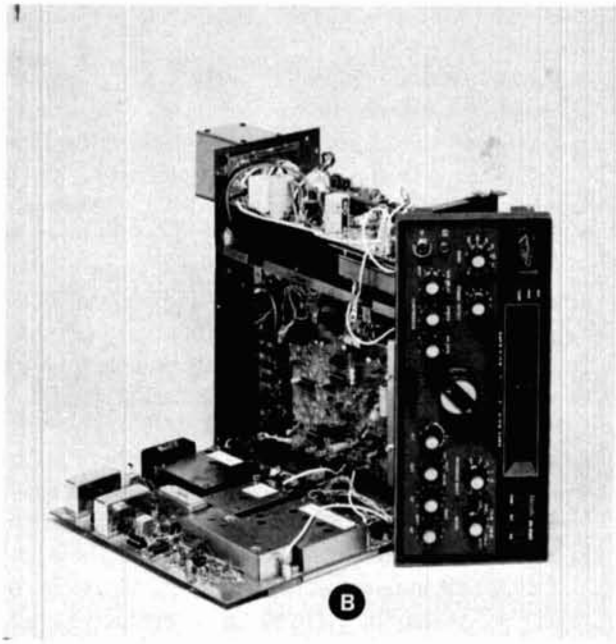
We opened up an SS-9000, and I was immediately impressed by the relative ease of internal access the rig provides. Unlike so many contemporary radios, the SS-9000 is built with hinged boards that swing out of the way, providing access to almost every part of the radio for service or checkout, even with power applied. Not even special adapter boards are required! I commented that such easy access would make it easy for a user who wanted to bring out the 9 MHz first i-f to one of the spare rear panel connectors for a panadapter, for example, to do so.

Dave replied that modifications will not be encouraged, since anything a user does inside the radio will void the warranty. It's entirely the Service Manager's decision as to whether a modification caused the problem that brought the radio back for service. If a user who had made changes in his SS-9000 (or any other Heath gear for that matter) ever does have to return it for service, it's very important that he include a note describing the changes and their purpose and whether he feels they're related to the problem.

summing up

I like the SS-9000. In fact, I like the SS-9000 very much. I like the way it handles and feels on both CW and phone. I liked the way I immediately felt at home with it, despite all its sophistication. It's a radio that I as a CW (and sometimes SSB) DX chaser, OSCAR user, and casual weak-signal VHF buff would like to have on my operating table. Most of all, I'd like to





One of the many nice features of the SS-9000 is its ease of access. The boards fold out without having to be disconnected, so almost every part of the circuitry and all test points and adjustments are available with the radio operating. Shown fully opened up from top (A) and bottom (B).

have it there because it would not only do all those things well, but because of the computer interface.

The possibilities that the SS-9000 opens up seem limitless, and with a new computer in my hamshack/office, I'd dearly love to see how well I could marry the two! Heath thoughtfully provides the necessary information for interfacing the SS-9000 with computers and terminals other than theirs, by the way. Anyone who buys an SS-9000 and doesn't already have some kind of computer with an RS-232C interface has to buy at least a smart terminal as well. The SS-9000 is a fine radio by itself, but it opens up a whole new world with CRT and keyboard attached!

Was there anything I didn't like about the SS-9000? Yes, in fact, there are several things I object to:

1. Frequency coverage: As shown in **table 1**, the frequency spread on different bands ranges from only 50 kHz on 30 meters to 1700 kHz on 10. By contrast, 20 meters goes from well below the band to 15.008 MHz, to include WWV's 15 MHz signal. These limits are burned into the synthesizer ROM, but why did some have to be so restricted on most bands? Why couldn't they all be as well-designed as 20? Another 100 kHz on 30 meters would have added the ability to receive the 10 MHz WWV signal, a significant addition in a few years when most of the sunspots go away.

2. Frequency display on transmit: The frequency displayed is always the receive frequency, even on CW or RTTY transmit. The CW transmit frequency is actually 750 Hz higher than shown on the display, while on RTTY it's offset by the AFSK frequency. I like to know where I really am, without mental arithmetic.

3. Lack of passband shift on CW: I prefer to use as wide an i-f bandpass as practical on CW, and being able to shift a strong nearby signal out of the passband is a real plus. Unfortunately, the SS-9000's logic doesn't permit this luxury. The good news is that its CW filters are so good I'd probably soon forget I ever wanted passband shift on CW.

4. Scan rate and availability: The slowest scan rate on the SS-9000 is 2.5 kHz per second, and it's internally programmable up to 270 kHz per second! My new 6-meter rig scans at a bit under 1 kHz per second, and that's just about right to stop the scan in time to catch a signal that's popped up on a previously dead band. I think the slow 2.5 kHz per second rate is much too fast, and the fifteen selectable higher rates are essentially useless. I'd also like to see the scan up/down switch contacts brought out to a rear panel connector, so with a two-switch control box I could lean back in my chair and tune the band without having to reach across the table.

None of those are terribly damning complaints, however, and after having spent just one afternoon playing with an SS-9000 at Heath, I realized that

Frequency — Two six-digit electronic displays.
Readout Accuracy — To the nearest 100 Hz.
Frequency Control — Synthesized VFO, HFO, and BFO for stability and easy tuning.
Tuning — 100 Hz per step, 5 kHz per knob rotation. Pushbuttons provided for up/down tuning (rate is internally adjustable).
Operation — Split transmit/receive or transceive from either readout.
Synthesized Lock Indicator — Visual indication when the synthesizer is unlocked. Transmitter is disabled when the synthesizer is unlocked.
Frequency Stability — Less than 3 ppm drift from turn-on for first 15 minutes. Less than 3 ppm/hour drift after 15 minutes warm-up. Less than 20 ppm drift from 0°C to +40°C. (Single crystal-controlled 10 MHz frequency standard.)
Modes of Operation — LSB; USB; CW-Wide; CW-Medium (400 Hz filter); CW-Narrow (200 Hz filter); RTTY (LSB, 400 Hz filter).
Operating Temperature Range — 0°C to +40°C.
Speech Processing — Adjustable rf speech compressor.
IF Shift — Incremental plus and minus passband shift (−600, −400, −200, −100, 0, +100, +200, and +400 Hz).
Power Requirements* — 11 to 16 Vdc with a nominal current maximum of 25 amperes at 100 watts CW output. Receiver current is 2 amperes nominal.
Front Panel Connectors — Microphone, headphones.
Rear Panel Connectors & Control — Antenna (SO-239); Linear ALC In; Linear ALC Adjust; Low Power Enable; Spares (5); DC Power Input; CW Key Jack; External Transmit Audio In (2); Speaker Out; External Receiver Audio; T/R In; T/R Out; Mute; Mute (inverted); External Relay (linear); Optional RS-232 Computer interface.
Front Panel Meter — Receive: S units, Transmit (selectable: ALC, relative rf power, or speech compression).
Phone Patch Impedance — 4-ohm output to speaker, high impedance input to transmitter.
Available Accessories — 400 Hz CW filter; 200 Hz CW filter; Computer/terminal interface; AC power supply/speaker with built-in dual time 12/24-hour clock; Customer Service Manual.
Cabinet Dimensions — 6-1/8″ high × 14″ wide × 13-3/4″ deep (15.6 × 35.6 × 34.9 cm).
Weight — 35 lbs. (15.9 kg).

Transmitter

RF Power Output — SSB: 100 watts PEP minimum. CW & RTTY: 100 watts mimimum.
Duty Cycle — 100 percent with appropriate automatic power output reduction by an internal thermal sensor. This reduction is determined by the time factor and the ambient temperature. The nominal parameters are as follows:

Ambient Temperature:	+25°C.
Supply Voltage:	+13.8 VDC.
Frequency:	14.1 MHz.
Mode:	CW key down, 100% duty cycle.

Example:

Power Output	Time
100 watts	0 min.
80 watts	3 min.
60 watts	10 min.
40 watts	Infinite

Load Impedance — 50 ohms.
VSWR — This Transceiver is stable at any VSWR and load impedance. The VSWR cutback circuitry guarantees at least 80 percent of rated power at any VSWR less than 2:1 and a minimum of 15 watts at any VSWR.
Transmitter Protection — Thermally protected. High VSWR cutback. Over-current protection.
Carrier Suppression — 50 dB down from a 100 watt, single-tone (1000 Hz) output.
Unwanted Sideband Suppression — 55 dB down from a 100 watt, single-tone (1000 Hz) output.
Harmonic Radiation — 50 dB down below 50 MHz; 65 dB down above 50 MHz.
Spurious Radiation — 50 dB down, except at 17 meters (40 dB down).
Third Order Distortion — 30 dB down from a 100-watt, PEP, two-tone output.
T/R Operation — SSB: PTT or VOX. CW: Semi break-in.
CW Sidetone — To speaker or headphones (700 Hz tone, adjustable level).
Microphone Input — High impedance (25 k ohm) with a rating of −55 dBm.

Receiver

Sensitivity — 0.3 μV for 10 dB (S + N)/N SSB on the 40 thru 10 meter bands; 0.5 μV on the 160 and 80 meter bands.
Selectivity — 2.1 kHz at 6 dB down; 5 kHz at 60 dB down.
With CW filters:
CWM: 400 Hz at 6 dB down; 1.5 kHz at 60 dB down.
CWN: 200 Hz at 6 dB down; 1 kHz at 60 dB down.
Overall Gain — Less than 1 microvolt for a .25 watt audio output.
Audio Output — 1.5 watts into 4 ohms at less than 10% THD.
AGC — Fast-attack with switch selectable Off, Fast, and Slow decay.
Intermodulation Distortion (20 kHz spacing) — −70 dB.
Image Rejection — −80 dB (except −65 dB on the 17 and 12 meter bands).
Second IF Rejection — −90dB.
First IF Rejection — −80 dB (except −60 dB on the 40 and 30 meter bands).
Internally Generated Spurious Signals — Generally below the noise level; all below 1 microvolt equivalent.
RIT — ±250 Hz.

table 2. SS-9000 Specifications.

none of them would keep me from standing in line to buy one. And if that sounds like an enthusiastic endorsement of the SS-9000, that's because it is!

At this time, final price is a bit up in the air. Heath is scheduled to begin shipping the SS-9000 in the first quarter of 1983. An introductory price of $2495 for the transceiver plus power supply is planned.

ham radio

safe power
for your low-noise
GaAs FET amplifier

Safeguard expensive GaAs FETS with this protective power supply

Without forward bias, a small-signal bipolar transistor won't do anything; without *back-bias*, a GaAs FET (Gallium Arsenide Field-Effect Transistor) may never do anything again! When power is first applied to a GaAs FET, it is important that the negative bias appears first, otherwise the transistor may go into saturation and destroy itself. Furthermore, when the supply is turned off, the negative bias voltage should not disappear until after the positive supply has run down; otherwise, the drain current may be excessively high long enough to destroy the transistor. A lack of appreciation of these subtleties may result in the demise of your expensive GaAs FET.

GaAs FETs can provide receiver front-end performance not otherwise available to most Amateurs and hobbyists, but they are usually quite expensive. Why not protect your investment with a power supply that has these important features? It's inexpensive insurance as well as good practice.

Because I frequently work with GaAs FETs, I take the necessary precautions when soldering them into a circuit. Assuming that the power supply for operating the circuit is properly designed, and in particular includes the necessary protective circuits, everything will be fine; but, if one day the negative-bias supply fails for some reason . . . no GaAs FET. A good indicator of potential trouble is a momentary kick in drain current when the device is turned on or turned off.

the supplies

Most experimenters find it convenient to use a sin-

By Norman J. Foot, WA9HUV, 293 East Madison Avenue, Elmhurst, Illinois 60126

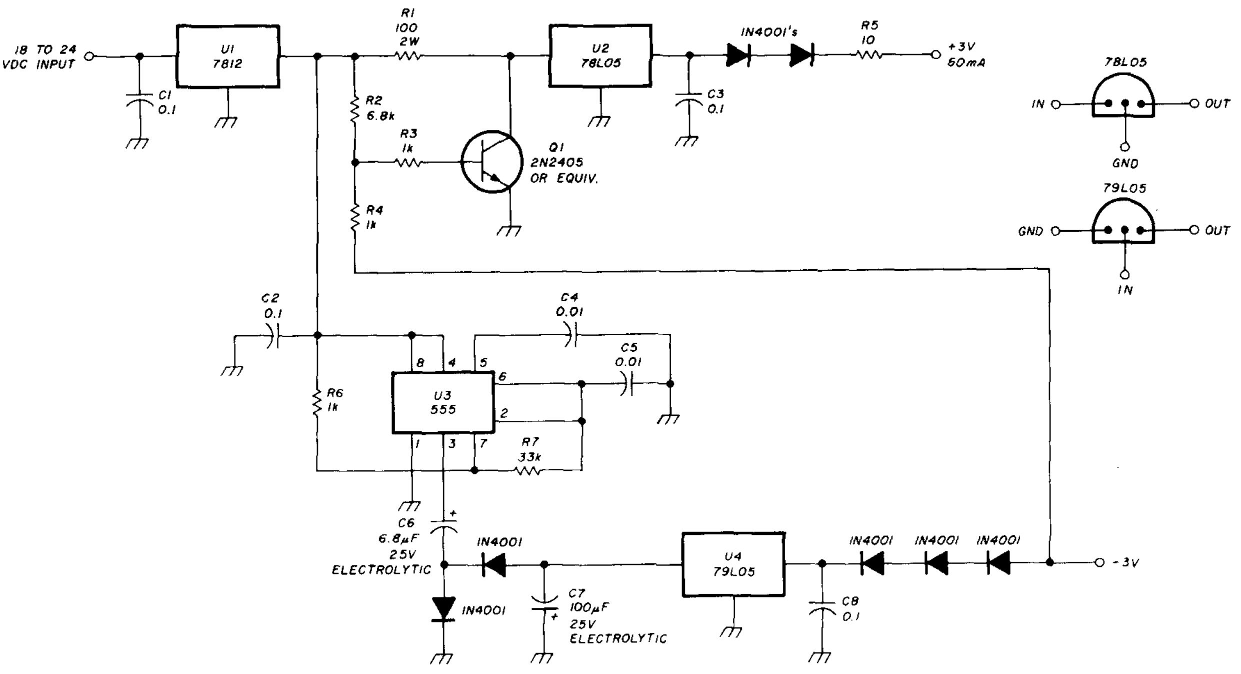


fig. 1. Safe power supply for GaAs FETs. Both positive and negative voltages are developed from a single 18 to 24 Vdc source. U3, a 555 timer, and C6 are connected to provide low-current negative-going dc pulses that are rectified and regulated. (C6 must be within 20 percent of 6.8 µF; 1N916 diodes may be substituted for the 1N4001s shown.) The R/C network of R1 and C2 delay the rise of the positive output voltage, and Q1 (a crowbar) cuts out the negative supply voltage if the positive voltage fails for any reason. This ensures that the negative voltage is always present first, and stays until the positive voltage disappears.

gle positive power supply rather than separate positive and negative supplies. An effective way to develop negative bias from a positive supply is through an inverter. A popular circuit employs a 555 timer with a rectifier and filter, such as the one described in the *Signetics Analog Data Manual*[1]. The potential hazard of this arrangement when used with GaAs FETs is that the negative supply voltage will build up slightly after the positive output voltage when the device is turned on. You need to delay the positive ramp by means of an R/C (resistor/capacitor) network.

The circuit diagram of the GaAs FET power supply is illustrated in **fig. 1**. Note that the R/C network consists of: the 2-watt 100-ohm resistor, R1; the 78L05 voltage regulator, U2; and the 0.1 µF output capacitor, C2. This allows the positive output voltage to build up at a fairly fast rate, perhaps to 63 percent of full voltage in 10 µs or less, depending on the GaAs FET drain current. How soon after dc power is applied does the negative bias appear? If a dual-trace oscilloscope is available, it can be used to display the relative timing between the negative and positive voltages when the device is turned on. More will be said about this later.

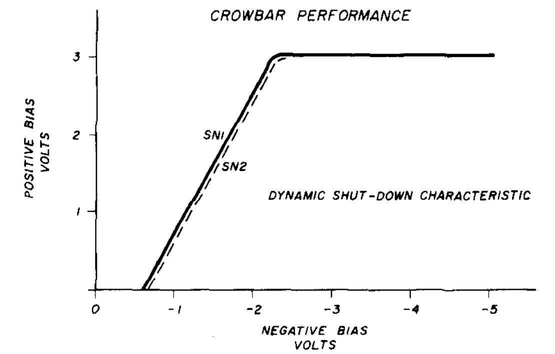


fig. 2. Dynamic characteristics of the crowbar under negative-bias short-circuit conditions.

When turned off, the charge stored in C3 (the output filter capacitor of the positive supply) will discharge harmlessly through the GaAs FET drain circuit, provided the negative bias voltage ramps down at a slower rate. (This is usually the case because the negative supply need only deliver current to one or two bias potentiometers usually between 5 and 10 kilohms each. In my application, it takes approxi-

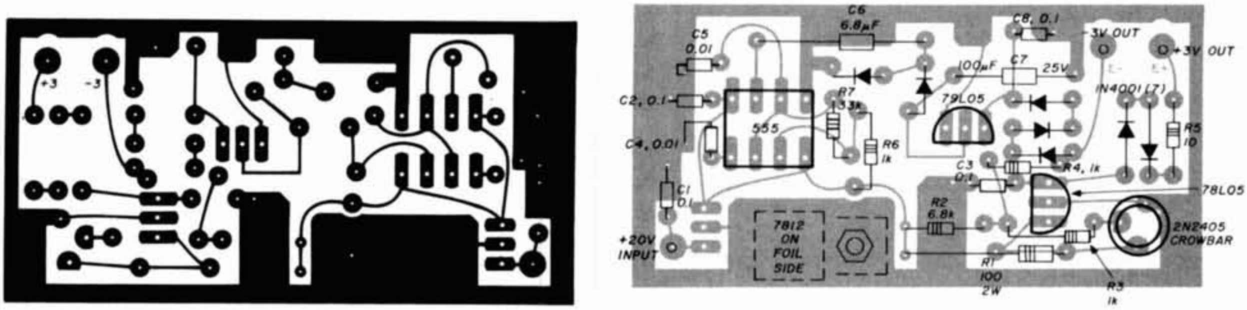


fig. 3. The power-supply board as designed by the author. *Fig. 3a* is the full-sized artwork of the foil side of the board; *fig. 3b* shows component placement from the other side.

mately 500 mS for the negative bias to decay to 37 percent of its initial level because of C7, the 100 μF capacitor at the input of U4, the 79L05 negative-voltage regulator.) At the same time, the positive output, which supplies current to a much smaller equivalent load resistance, ramps down very rapidly. This is a desirable condition.

the crowbar

What about the race between the positive and negative voltages that occurs at turn-on? And what about the catastrophic situation we talked about earlier that could result from a random failure of the negative supply? A crowbar can be used to protect against these disaster-causing events.

The crowbar consists of Q1, an NPN bipolar transistor capable of continuously dissipating the output of the positive supply. Normally this transistor is turned off, but if for any reason the negative supply should fail, the base bias of the crowbar becomes positive, turning the transistor on. A conducting transistor reduces the voltage at its collector to a fraction of a volt; as a result, the voltage available to the 78L05 is insufficient to turn it on, and the positive output voltage remains at zero.

The dynamic characteristics of the crowbar under negative-bias short circuit is such that, as the negative bias ramps down, the positive voltage also ramps down, as shown in **fig. 2**. (Even a short circuit occurs over some finite time interval.) Note that the positive voltage always lags behind the negative voltage.

connecting to the GaAs FET amp

It has been suggested that silicon diodes be placed in series with each power-supply output to any GaAs FET amplifier to protect against reverse voltage spikes. I do not recommend this; failure of such a diode in the negative lead would be catastrophic, even though the power supply would function normally. It may be desirable, however, to connect 3.9 volt Zener diodes between each power-supply output and ground, to protect against spikes or over-voltages. Failure of either of these diodes would not affect the protective ability of the crowbar and the R/C network, it would simply put the system out of operation.

Before connecting your GaAs FET amplifier to the power supply, substitute a resistive load and connect a voltmeter to the supply's positive output terminal. Then short-circuit the negative supply terminal and note that the +3 volt output goes to zero.

a testimonial

I have used the circuit in **fig. 1** for my earth station LNA (low-noise amp) for well over a year now without the loss of a single GaAs FET transistor, in spite of summer's heat, winter's cold, rain, sleet, ice, and snow; power-line fluctuations and loss, and intense lightning. I sleep better at night knowing that if the 555 timer or any of the other components in the negative supply should fail, the positive supply will shut itself off. In fact, any time the positive voltage gets ahead of the negative voltage for any reason, the crowbar holds off the positive voltage until it is safe to proceed. This includes when the device is being turned on or off. Thus, the crowbar protects against any race the positive voltage would otherwise win.

If you would prefer not to fabricate your own printed-circuit board from the artwork in **fig. 3**, boards are available from the author for $7.90 each, including postage and handling. These boards are made from 1/16-inch thick epoxy fiberglass (G-10) and they come solder plated and drilled.

reference

1. *Signetics Analog Data Manual*, 1977, fig. 6-26a, page 729.

ham radio

More Details? CHECK—OFF Page 102

Long's makes Christmas shopping easy!

COMMODORE VIC-20 personal computer with 5K memory

The VIC-20 offers more dollar-for-dollar performance than any other personal computer. It has built in BASIC language, 5K of RAM (expandable to 32K) high resolution graphics, sound, color and a wide range of add-on accessories. Full size keyboard features 64 ASCII character set, numerics and business/calculation symbols. Screen display 22 characters wide by 23 lines deep. Program line length 88 characters. Will accept plug-in program cartridges, floppy disc and cassette storage systems.

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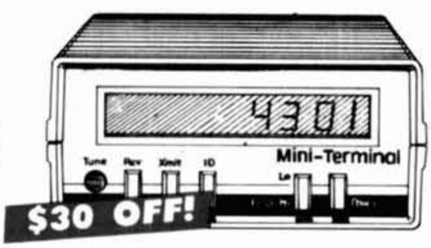

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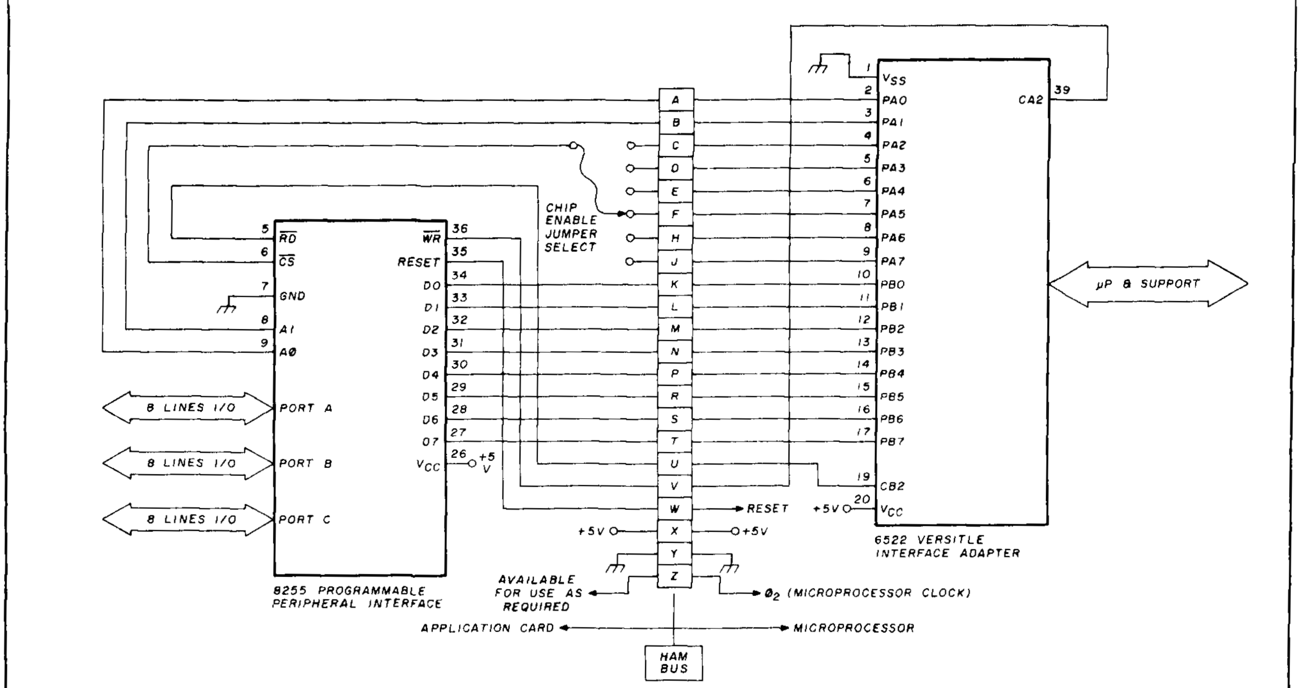

fig. 1. Basic application card schematic.

an intelligent ham gear controller part 2

Programming, communication, and display application card for the ham gear controller

Part 1 of this article detailed the controller system and basic circuit card construction. This, the second part, will cover elementary programming, communication with external devices, and describe an all-purpose, eight-digit display application card.

The controller is not intended to be a computer; the microprocessor is a 6502 chip with 1K (1024) bytes of static RAM and 2K (2048) bytes of EPROM. All communications with external devices are made

By C.A. Eubanks, N3CA, P.O. Box 127, Valencia, Pennsylvania 16059

table 1. Microprocessor instruction groups for control, output and input of application cards.

instruction	6502 data bus	program address	details
Initialize Application Card			
Set direction of VIA port A	$FF	$6003	Port A of VIA is set to OUTPUT
Set direction of VIA port B	$FF	$6002	Port B of VIA is set to OUTPUT
Select PPI and control word	(ADDR)	$600F	X-register of 6502 to contain ADDR, WRITES into VIA Port A and latches HAM BUS lines PA0-PA7 to ADDR
Set PPI port control	(CTRL)	$6000	Accumulator of 6502 to contain CTRL, WRITES into VIA Port B and latches HAM BUS lines PB0-PB7 to CTRL
Activate PPI from HAM BUS	$EC	$600C	HAM BUS CA2=0, CB2=1; PPI accepts control word on D0-D7 from PB0-PB7, sets port directions in PPI
Deactivate PPI from HAM BUS	$FF	$600C	HAM BUS CA2=1, CB2=1; PPI D0-D7 go to high-impedance
WRITE output through PPI			
Set direction of VIA port A	$FF	$6003	Port A of VIA is set to OUTPUT
Set direction of VIA port B	$FF	$6002	Port B of VIA is set to OUTPUT
Select PPI	(ADDR)	$600F	X-register of 6502 to contain ADDR, WRITES ADDR into Port A of VIA, latching HAM BUS lines PA0-PA7.
Set up DATA for OUTPUT	(DATA)	$6000	Accumulator of 6502 to contain DATA, WRITES DATA into Port B of VIA, latching HAM BUS lines PB0-PB7
Activate PPI	$EC	$600C	HAM BUS CA2=0, CB2=1; PPI accepts DATA on D0-D7, transmits it to external device.
Deactivate PPI from HAM BUS	$FF	$600C	HAM BUS CA2=1, CB2=1; PPI D0-D7 go to high impedance
READ input through PPI			
Set direction of VIA port A	$FF	$6003	Port A of VIA is set to OUTPUT
Set direction of VIA port B	$00	$6002	Port B of VIA is set to INPUT
Select PPI	(ADDR)	$600F	X-register of 6502 to contain ADDR, WRITES ADDR into Port A of VIA, latching HAM BUS lines PA0-PA7
Activate PPI	$CE	$600C	HAM BUS CA2=1, CB2=0; PPI transmits external data through D0-D7 to HAM BUS PB0-PB7, latching input in Port B
Read external DATA	(DATA)	$6000	Accumulator of 6502 loaded from VIA Port B; only read command of 6502 associated directly with I/O.
Deactivate PPI from HAM BUS	$FF	$600C	HAM BUS CA2=1, CB2=1; PPI D0-D7 go to high impedance. Accumulator retains DATA if $FF sent from X-register.

table 2. Detailed bit assignments of PPI for ADDR data in table 1.

		HAM BUS bit states			
PPI function	selected bit PA7 to PA2	PA1	PA0	CB2	CA2
READ Port A data into HAM BUS	0	0	0	0	1
READ Port B data into HAM BUS	0	0	1	0	1
READ Port C data into HAM BUS	0	1	0	0	1
WRITE HAM BUS data to Port A	0	0	0	1	0
WRITE HAM BUS data to Port B	0	0	1	1	0
WRITE HAM BUS data to Port C	0	1	0	1	0
WRITE HAM BUS data into PPI to select port direction (Control Word)	0	1	1	1	0
Disable PPI data bus D0-D7 by setting high-impedance state	0	x	x	1	1
-OR-	1	x	x	x	x
Illegal state, don't use in program	0	1	1	0	1

Note: Selected bit is jumpered from PPI $\overline{CS}$ pin 6 to HAM BUS connector; *all other bits* in address must be logic *one*.
"x" is 'don't-care' condition, either 1 or 0.

by a 6522 Versatile Interface Adapter (VIA) located on the processor card through eighteen input/output (I/O) lines of the system's HAM BUS. An 8255 Programmable Peripheral Interface (PPI) on each application card links the HAM BUS with external circuitry.

The emphasis in this article will be placed on VIA and PPI interaction with the microprocessor, plus specific program operation with the eight-digit application card. The builder needs some knowledge of microprocessor or computer action. Hexadecimal (hex) notation is indicated by the dollar-sign prefix convention.

the VIA connection

Fig. 1 shows the basic application card connection to the HAM BUS and VIA on the microprocessor card. Port A of the VIA is always used to address a PPI. Port B of the VIA is bidirectional, used primarily for handling external circuit data. Only two of the four control lines are connected to the HAM BUS; CA2 and CB2 are output ports used to control the read and write functions of the PPI.

VIA function is set by both address and data busses within the microprocessor card. The four least-significant bits of the processor address bus are connected to VIA register-select pins RS0 to RS3; these are major VIA function lines. The processor data bus handles sub-functions.

To facilitate your understanding of the operation of the VIA, **table 1** lists the three major instruction groups for basic I/O handling of application cards. For more detail on VIA capabilities, the reader should study data sheets or tutorials on support devices.

communication

An 8255 has three modes of operation; Mode 0, or basic I/O is assumed.[1] Each PPI must be initialized for mode and port usage through the first instruction group shown in **table 1**.

The first two instructions set the VIA ports to transfer output from the 6502 to the HAM BUS; the 6502 data bus ADDR (address) state is detailed in **table 2**. Port arrangement in a PPI is controlled by writing a control word into pins D0 to D7. Both PA1 and PA0 of the HAM BUS must be set at logic 1 to select a control word. Only one line of PA7 to PA2 may be logic 0 to address a particular PPI (all others logic 1), because of the simplified addressing jumper on each application card.

Writing anything to VIA addresses $6000 or $600F will latch the 6502 data bus into the appropriate VIA output port. The fourth initialization instruction writes CTRL into VIA port B, to prepare for the PPI port selected for use. **Table 3** lists the 6502 data bus states for the different PPI port directions.

A PPI is activated when VIA control lines CB2 and CA2 are set to opposite states (**table 2**). Once a WRITE mode is established, the PPI is selected and the control word is loaded into it. PPI port direction

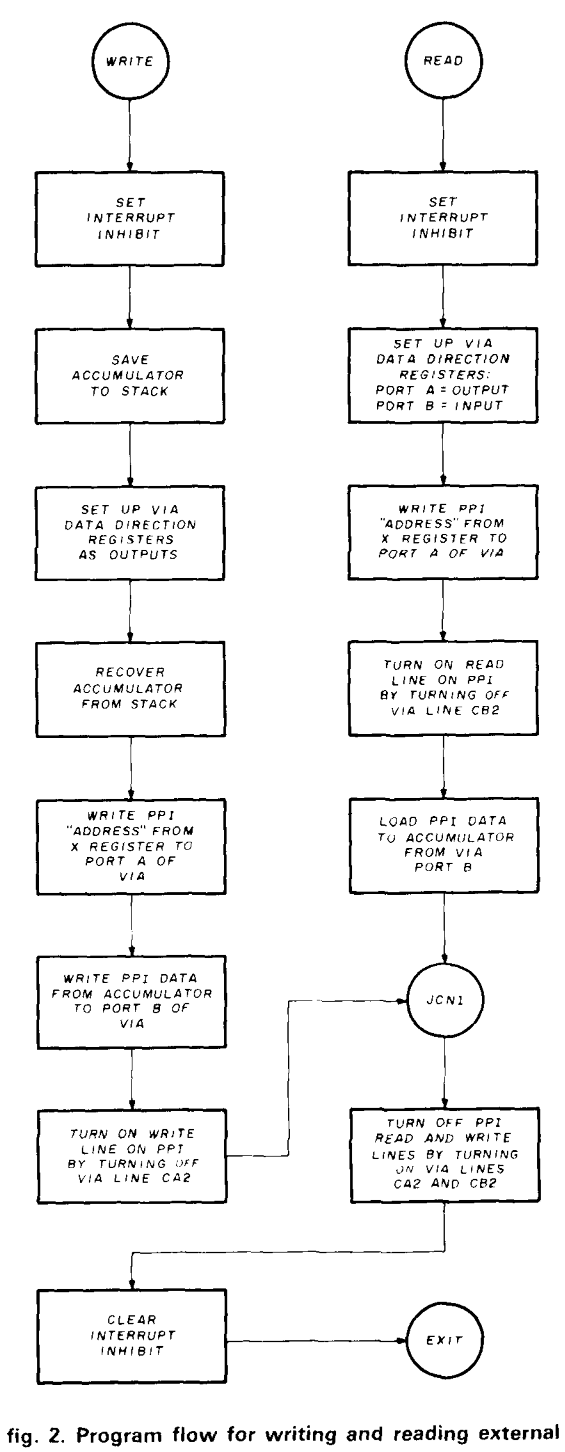

fig. 2. Program flow for writing and reading external circuitry through a PPI.

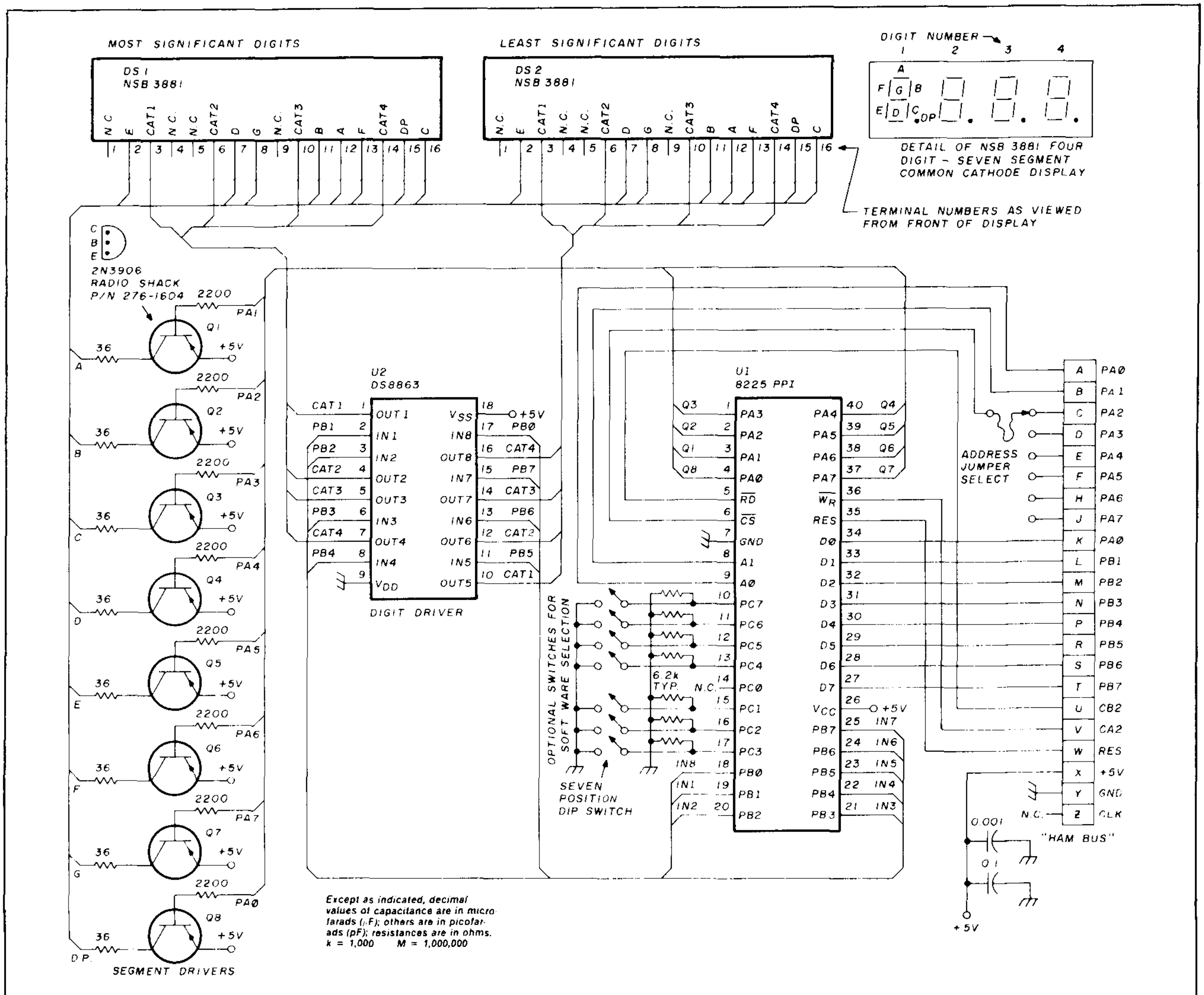

fig. 3. Eight-digit display application card.

and mode are then configured for communication.

The final instruction deactivates all 8255 data lines (D0-D7) by placing them in a high-impedance state. Any PPI port set for an output will hold that data, latched internally. Deactivating the 8255 data lines will minimize VIA loading.

external communications

Writing to and reading from external devices is done through the last two groups of instructions listed in **table 1**. To write data you must choose one of the three bit patterns shown in **table 3**; CB2 and CA2 remain in the state they were in upon initialization. DATA is the eight-bit word sent through the PPI to the external circuitry.

A READ instruction (**table 1**) is organized differently. The address must be one of the three READ conditions found in **table 2**. The PPI is activated immediately after a PPI READ. This sequence allows the PPI to send its port data into the HAM BUS, automatically latching that data into VIA port B. The 6502 is then able to address the VIA to read the data in port B into memory.

WRITE and READ instruction sequences are shown in **fig. 2**. A WRITE sequence starts with the PPI address in the 6502 X-register and the output data (or control word) in the accumulator. A READ sequence also starts with the PPI address in the X-register, but ends with external data input loaded in the accumulator.

This explanation, illustrating the HAM BUS operation, occupies more space than the routines occupy in memory. The READ and WRITE sequences are housekeeping subroutines requiring only fifty-three bytes of program memory.

table 3. Selection matrix of PPI port direction. CTRL data in table 1.

port A	port B	port C	hex word on HAM BUS PB0-PB7
output	*output*	*output*	$80
output	output	input	$89
output	input	output	$82
output	input	input	$8B
input	output	output	$90
input	output	input	$99
input	input	output	$92
input	input	input	$9B

an eight-digit display application card

A full explanation of application cards and supporting software is too lengthy to give here; the digit display in **figs. 3** and **4** is an example, however. Eight *digits will show one Hertz on a 30-MHz frequency* display. More or fewer digits may be used as desired.

The display is multiplexed one digit at a time by software. Scanning is at 500 Hz, fast enough to appear continuous. I chose four-digit, seven-segment units for ease of construction; individual, non-multiplexed digits can also be used.

The display is bright enough to be seen in high-level indoor lighting; the segment currents peak at about 55 mA. Higher peak currents could be used if they don't exceed the 8863 digit-cathode driver's ratings. Another risk occurs at high current: an inadvertent scanning stop may burn out individual segments.

When I finished the display, the eight lines of PPI port C were left unused. Rather than waste those lines, an eight-pole DIP switch could be added to

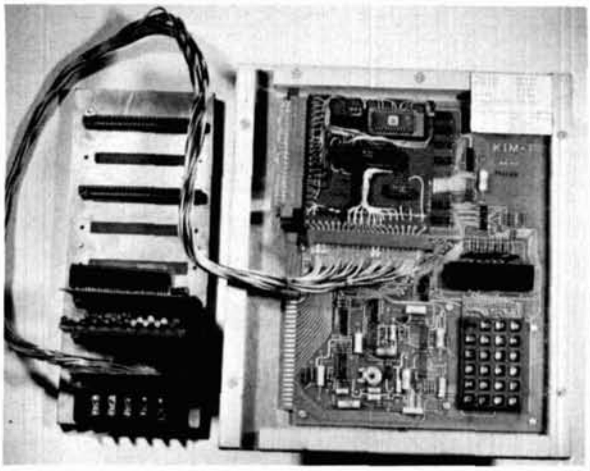

fig. 4. Eight-digit display card, component side.

table 4. Display card character coding and multiplexed scanning control assignments.

character displayed	HAM BUS hex byte at PPI port A	segment	PPI port line
0	$81	A	PA1
1	$F3	B	PA2
2	$49	C	PA3
3	$61	D	PA4
4	$33	E	PA5
5	$25	F	PA6
6	$05	G	PA7
7	$F1	d.p.	PA0
8	$01		

character displayed	HAM BUS hex byte at PPI port A	digit	PPI port line
9	$21		
A	$11	1	PB1
B	$07	2	PB2
C	$8D	3	PB3
D	$43	4	PB4
E	$0D	5	PB5
F	$1D	6	PB6
		7	PB7
		8*	PB0

*Least-significant digit.

Note: Subtract 1 for right-hand decimal point.

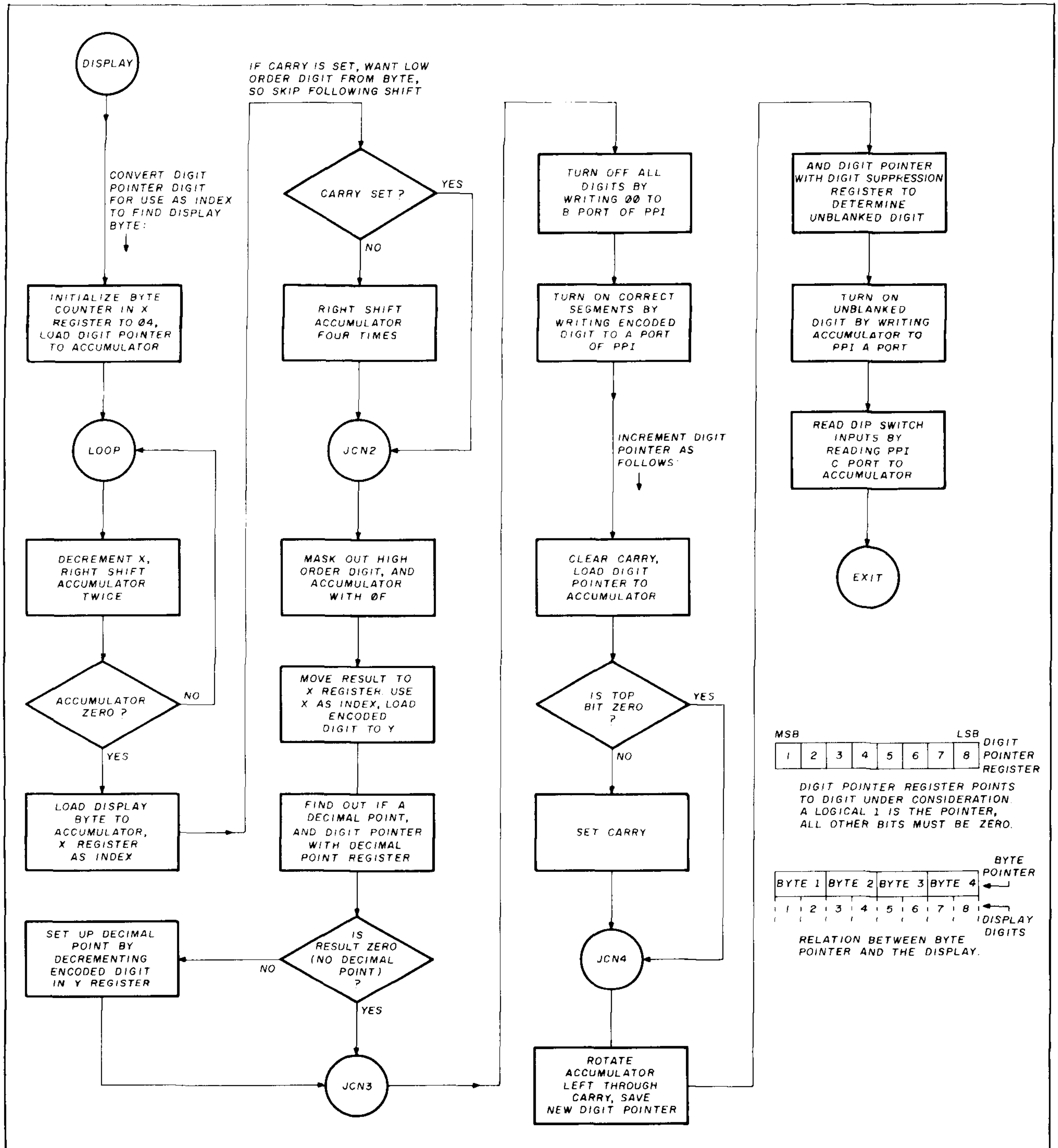

fig. 5. Display card program flow with decimal-point register bit locations.

select software options. The eight lines of port C could then be used for many purposes with appropriate software changes.

Fig. 5 shows the program flow of the display card software. Digit encoding and multiplex scanning is handled by the microprocessor. Software control makes it possible to display decimal or hex numbers, control blanking, and locate decimal points without hardware changes. Display card character coding and multiplexed scanning control assignments are seen in **Table 4**.

My display routine requires seven bytes of RAM: four bytes for display information, one byte as a digit pointer, one as a decimal-point register, and one byte for digit suppression (blanking). The EPROM contains sixteen bytes devoted to an encoded digit look-up

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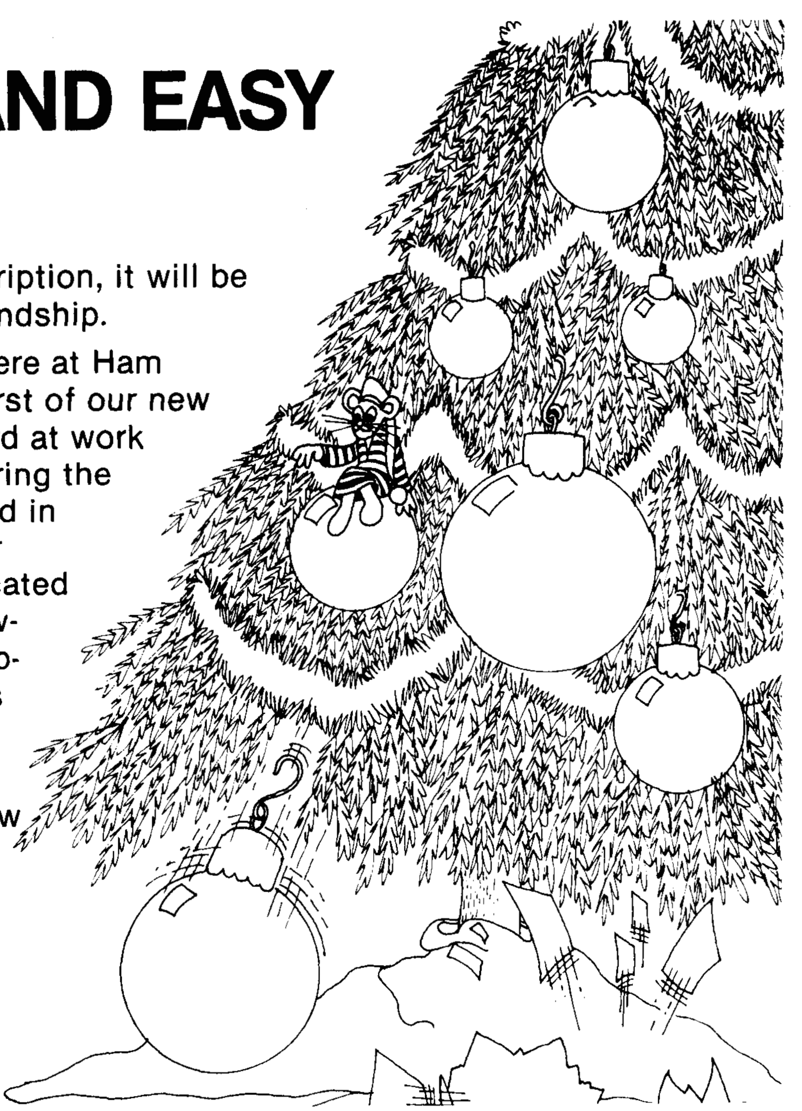

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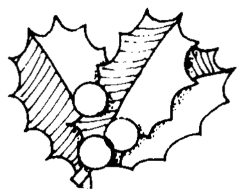

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table. Total EPROM space is only 115 bytes, including the look-up table and initialization of the digit pointer register. The latter operation requires setting only one bit of the pointer register to logic 1.

start-up and test

Trace and ring-out all wiring before installing the ICs, then begin with the simulator card alone. Connect the simulator and use +5 Vdc from the microprocessor development system for the initial testing only. Install ICs only when the wiring checks out correctly. *Caution:* many ICs are static sensitive — be careful how you handle them!

Power up the development system and simulator. Verify that the EPROM can be read. The 6522 counters will run freely at clock frequency after reset. Check them out by observing the operation at addresses $6004 and $6007.

Next, shut off the power, remove the development system +5 Vdc temporary connection, and connect the mother board with only the bus status indicator card installed. Turn on the development system and the controller power supply. Manually check the HAM BUS lines by development system control. Check all 6522 functions.

Write a demonstration program for the microprocessor card. I chose to use a simple routine with the display card that counted in hex and displayed the result. Then burn the completed, debugged program into the EPROM[2].

Finally, install the microprocessor card and disconnect the controller from the development system. Testing the microprocessor is made easier by including the display card switches in the demonstration program.

I encountered two glitches during checkout. Turning on and off the fluorescent lights over my work area caused panic in the simulator and development system but no problem with the controller itself. This may be caused by line noise getting into the development system.

The second problem I encountered was intermittent edge connector contacts. I cured that by cleaning contact surfaces with a typewriter eraser (or try fine sandpaper).

Information on program documentation and burned EPROMs may be obtained by sending the author a self-addressed, stamped envelope.

references

1. *Peripheral Design Handbook*, August, 1981, Intel Corporation, 3065 Bowers Avenue, Santa Clara, California 95051.
2. C.A. Eubanks, N3CA, "2716 EPROM Programmer," *ham radio*, April, 1982, pages 32-36.

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At microwave frequencies, an isolator or terminated circulator (a non-reciprocal device — passing a signal in one direction only) is an easy fix. The insertion loss (which adds directly to the noise figure) and cost are drawbacks. A low noise figure and good match may be achieved with feedback circuitry up to a few hundred MHz. Some amplifiers use the Miller effect to reduce the input impedance without changing the noise figure. Added emitter (drain) inductance does the same thing, at some risk of parasitic oscillation. Other circuits use ferrite transformers to introduce feedback. The resulting reduction in gain and the effect upon the amplifier's reverse isolation may not be important enough to matter at frequencies up to 70 MHz or so.

the hybrid-coupled amplifier

Above 100 MHz, there is another practical solution: two identical amplifiers between two quadrature hybrid couplers, one at input and the other at output. Because of the characteristics of a 90-degree hybrid, identical mismatches at the two amplifier inputs add up to a low (1.2:1 or less) input VSWR. The noise figure is increased only by the loss through the hybrid; the gain is the same, and the permissible input signal is doubled. Networks may be inserted between the hybrid outputs and the amplifier base leads to improve the noise figure.

Equalizing networks can be put on the amplifier outputs to obtain flat gain over a two-to-one useful frequency range, and it is even practical to add up to four shunt PIN diodes for gain control, as shown in **fig. 1**, without adversely affecting the impedance match.

By Henry H. Cross, W1OOP, 111 Birds Hill Ave., Needham, Massachusetts 02192

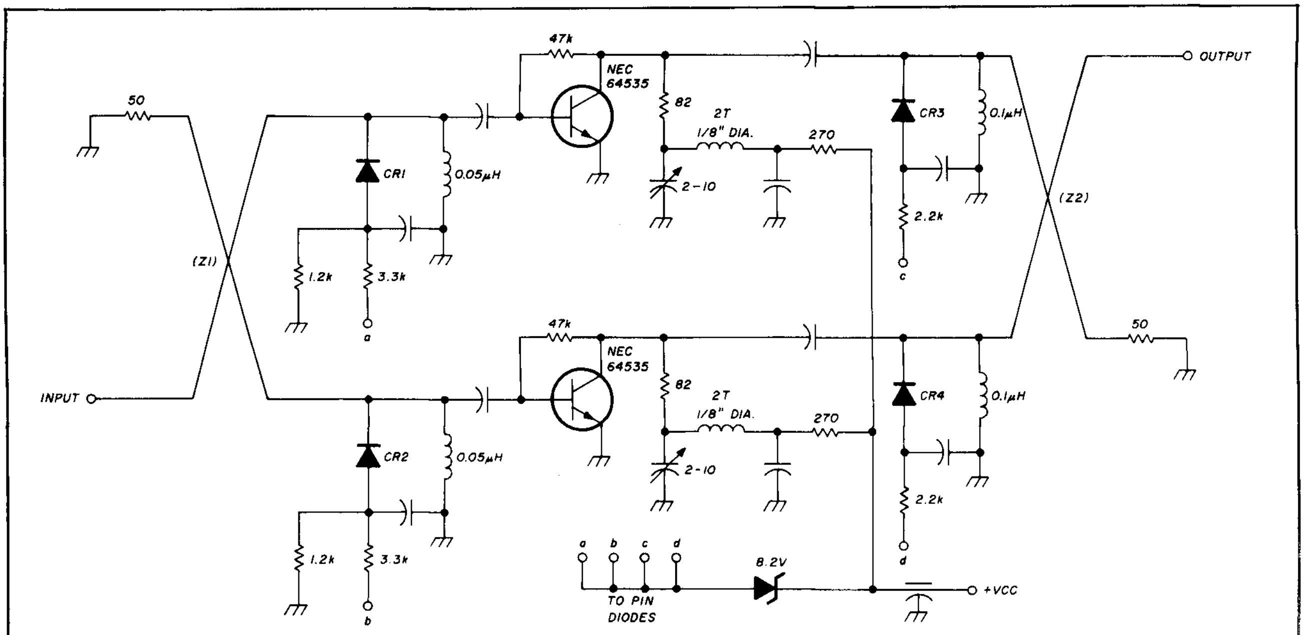


fig. 1. A gain-controlled amplifier for 200-400 MHz. Gain at V_{cc} = 7 volts is 20 dB; at V_{cc} = 15 volts is 6 dB. All unmarked bypass capacitors are 0.001 μF chips. CR1 through CR4 are PIN diodes. Z1 and Z2 are hybrids constructed of Wireline® as described in the text.

The hybrid-coupled amplifier was described in print many years ago.[1] The units I constructed (for 200-400, 300-600, 600-1300, and 900-1500 MHz) all have good noise figure, good match, and are stable and well-behaved. I used the NEC 64535 (about $12 — relatively as cheap as my first 6AC7 in 1941) because it suits 50-ohm circuits very well, and has excellent gain at low-noise operating conditions. I was able to get 12 dB gain at 1296 MHz, 18 dB at 432 MHz, and 20 dB at 220 MHz, from a single stage. The amplifiers can be made flat in response (plus or minus 0.5 dB) over a two-to-one frequency range without much trouble, and it was easy to get them working properly. The results are worth the extra parts required for twin amplifiers.

VHF quadrature hybrids are commercially available from many sources. Microwave Associates, Merrimac, and Anaren sell a flat, rectangular package with solder tabs. Sage Laboratories, Inc., for whom I developed the amplifiers, makes Wireline®, a cable designed so that any length constitutes a directional coupler, and a quarter-wavelength (× 0.65) is a 3-dB hybrid. It has two wires embedded in a Teflon-dielectric coaxial cable. I used the copper-jacketed type HC, and wound the lengths on a mandrel to get coils which would easily fit in the amplifier enclosure. The hybrid assemblies are stripped and soldered in place on the glass-Teflon pc board. This required only dots of solder on the copper jacket at each end. **Fig. 2** shows an assembly for 200 to 400 MHz (16 cm).

impedances

Like many other microwave transistors operating in the UHF region, the NEC 64535 requires a particular value of base-source impedance for each value of collector current and frequency to obtain the best

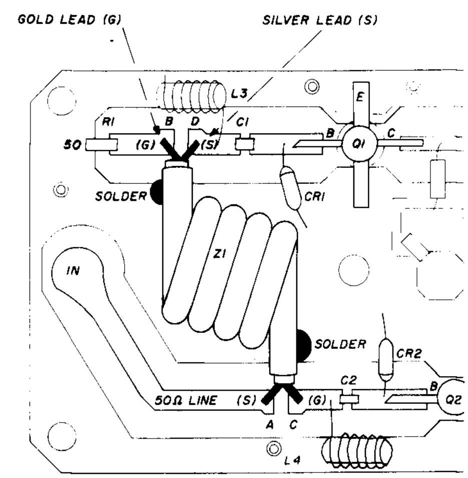


fig. 2. Construction and mounting details for Z1 and other components. Note the connection points for the gold-colored (G) and silver-colored (S) leads. The copper shield of the Wireline® is tack-soldered to the circuit-board foil at each end. The diode (CR1,CR2) position is that used in *fig. 4*. L4, like L3, goes from terminal C to ground.

possible noise figure. The proper value, if known, could be obtained by some kind of a pi- or L-type matching network. For a wide band of frequencies, things could get complicated. In general, matching networks have a bit of loss associated with them. I chose to put either a series or a shunt coil at the output of the hybrid, since one or the other can be adjusted to come close to what's needed.

The Smith chart in **fig. 3** shows several sets of manufacturers' data and the locus of the two possible curves: 50 plus $j\omega L$ and 50 in shunt with $j\omega L$ (where $\omega = 2\pi F$). Neither of these is quite on target, but I found that by juggling current and adjusting the coil, I could find a best spot for either circuit, and they measured close to the same noise figure. The shunt inductor has a few minor advantages, especially for a wide-band amplifier. The inductor value probably should be tweaked at or near the high end of the band.

theory of operation

The incoming signal is split in half and goes to each of the two transistors. The signal-to-noise ratio in each transistor is three decibels below what it would be in a single amplifier. However, it is increased 6 dB when the correlated signals add at the output, while the thermal noise from the input termination is combined and fed into the output termination. This works very well over the octave range. If there were a short or open at the connectors, the amplifier would see a maximum 3:1 VSWR because of the terminated hybrids. The input match is good so

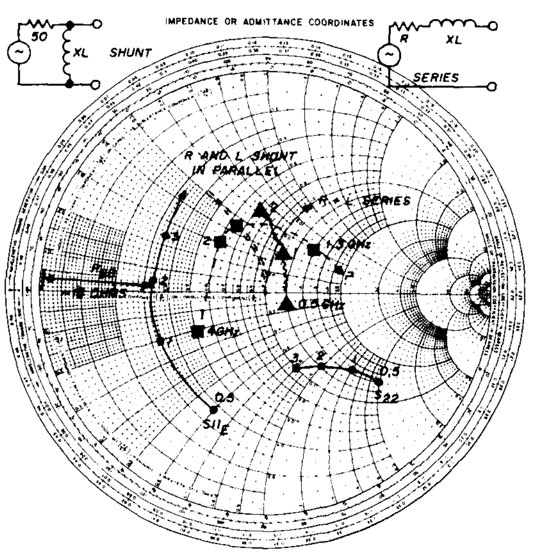


fig. 3. Manufacturers' optimum-source-impedance data plots shown are for one current value. Lower frequency or lower I_c produce higher Zs.

long as the two amplifiers are the same and are the same distance from the hybrid output terminals. Even out-of-band (less than half center-frequency or near twice center-frequency), where the hybrids aren't coupling, things are stable because one end of each amplifier is hooked to a 50-ohm resistor.

At 432 MHz, the amplifier has approximately 18 dB forward gain and 26 dB back isolation when load and source are matched. Inside, at 860 MHz, the forward gain is about 14 dB and the back isolation 24 dB, so things are still stable.

Fig. 4 shows the schematic of the 432 MHz preamplifier. The simple biasing method is made idiot-proof by the Zener diode, but the diode should be picked so it doesn't draw any current under normal operation. Its function is to protect against excess or reversed supply voltage. My design value for an NEC 64535 is 7 volts at 7 mA, so a 9.1 volt, 5-percent diode will do the job. Because the transistor is fed from a voltage twice its operating voltage, any change in current drawn will reduce the collector dissipation. The base-bias resistor can be hooked directly from base to collector, or to the bottom end of the collector choke, as is convenient. Its value may be different for different transistors: if the collector voltage is low, increase the value of the base-bias resistor. The Schottky diode from base to emitter is for protection from transmitter leakage. I wasn't able to measure a difference in noise figure after I added these diodes.

The inductances for impedance matching (L1, 2, 3, and 4), were constructed of No. 28 bus wire, either wound on a 2-56 nylon screw or self-supporting. In one case I tried a commercially made molded choke, and it was worse than nothing — its losses made the noise figure 0.6 dB worse than the air-wound (shunt) inductor.

The 33-ohm resistor with a two-turn pigtail coil is the (adjustable) gain-flattening device. Slightly more gain can be obtained if the coil is replaced by an LC circuit resonated at the high end of the band (550 MHz in this case), and the resistor can be at the hot end if desired (as shown in **fig. 1**).

A set-up for feeding in the supply voltage by way of the output coax is shown. If it isn't needed, omit L7 and L8 and put a bit of foil in place of the 15-pF capacitor. A 1N4001 is preferred as a voltage-feed diode because it is a poor rf rectifier.

construction

The circuit board is fairly simple. The two transistors are set in microstrip lines about 0.787 inch (2 cm) apart. Line widths for the 0.031 inch (0.079 cm) Teflon-fiberglass board (two sides copper) are equal to about three board thicknesses for 50 ohms. The chip capacitors are 0.05 × 0.1 inch (0.127 × 0.254 cm),

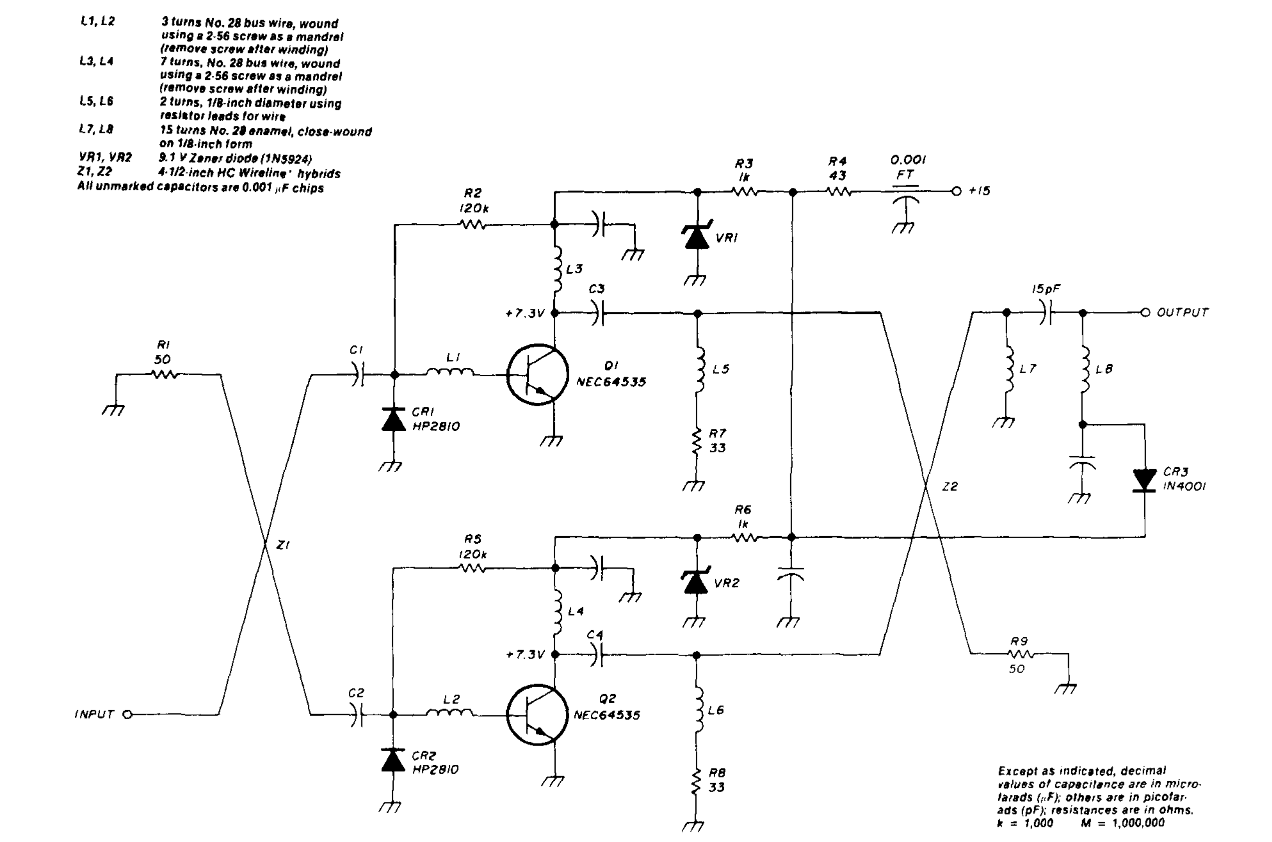


fig. 4. Schematic diagram of the 432-MHz amplifier. Best noise figure was obtained at 4 mA with a 9-volt supply. Gain is approximately 16 dB.

as are the 50-ohm chip resistors at the hybrids. I use 1000 pF chips partly because they are physically stronger than low values, and partly because they help discourage low-frequency parasitics (1 to 50 MHz). Eyelets are used as bonds from the top to bottom ground plane, and foil soldered around the edges near the input and output helps keep the top ground plane cold for rf.

The resistors and diodes are soldered to the flat copper surface. The chips are laid across gaps and soldered in place by putting the iron against the copper and letting the heat flow to the chip as the solder is applied at the junction.

mounting the transistor

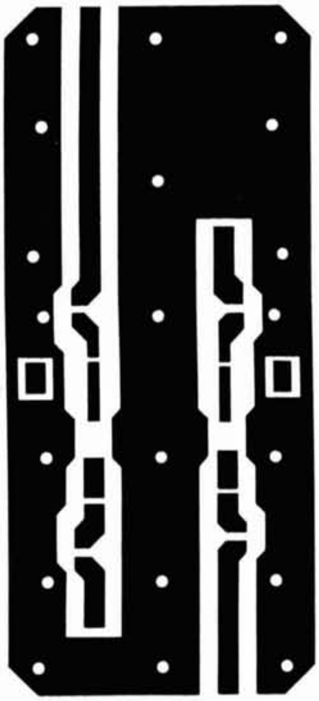
Since these transistors work best (at least at 1296 and below) with a bit of inductance in both base and collector leads, I put a small bend or loop in the leads (don't cut them short) before soldering them to the microstrip lines. The emitter leads lay flat on the copper, but there's no need to solder them close to the transistor body. They can be easy to change and still work their best. The leads help cool the package, but 50 milliwatts isn't much heat. The real problem is in the silicon: the chip is 0.3 mm square.

forming the Wireline® hybrids

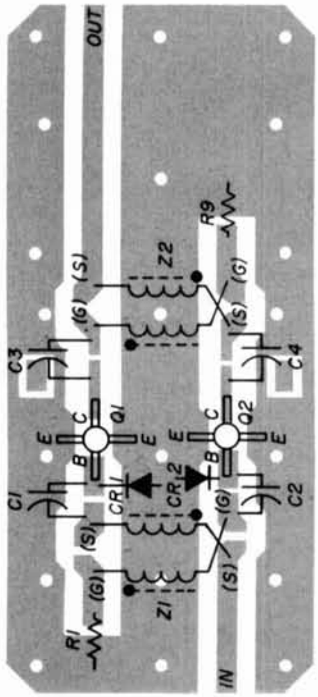
Type HC Wireline® can be coiled on a 5-mm rod if need be. The formula for length in inches is 1900 divided by F in MHz; 4.5 inches for 432. I used about 9 mm diameter (3/8 inch). Start with a piece 6 or 7 inches long, mark the length with paint or ink, then bend it by hand around the rod until the marked ends come out at the right places. Score with razor blade and crack the shield, then use diagonal cutters to cut the cable about a quarter inch farther out. Pull off the sheath and very carefully strip the insulation with a sharp blade — don't nick the little inner wires.

One conductor has gold insulation on it which will have to be removed to solder it to the wire. The sheath can be soldered to the ground plane at the ends, as the Teflon insulation doesn't melt easily. Keep the end leads very short — the end of the sheath should come right out to the striplines (see **fig. 2**).

The circuit board can be mounted inside a metal



Full-sized artwork for the quadrature-coupled amplifier. Double-sided glass-Teflon pc board is used. The dark areas are unetched copper. Top and bottom ground planes are bonded together by eyelets through the board and copper foil around the edges.



Component placement of the amplifier. Be sure to observe the polarity of the windings in the hybrids Z1 and Z2. Chip capacitors and resistors are used to obtain low-inductance paths.

box with six or seven screws to hold it flat against the bottom. The box should be no wider than the board (4 cm) for best stability. Input and output connectors should connect directly to the 50-ohm microstrip, mounted either at right angles to the board with the pins laid on the strip conductors, or mounted through the bottom of the box so the contact pins come up through holes in the board to the conductors.

The 50-ohm terminating resistors are either chip type (film with solderable ends on a piece of ceramic, 0.050 × 0.100 inches, or 0.1270 × 0.254 cm), or a pair of 100-ohm 1/8-watt resistors with short leads and ends spread apart, placed flat on the board.

checking operation

The biasing circuits permit you to short one or the other base to ground while listening to a signal. The signal-to-noise ratio should get slightly worse, but the gain shouldn't change much more than 6 dB as one transistor at a time is turned off. The first tests are to check voltages and currents (to make sure the bias is on target and that the various diodes are installed the right way). The characteristics are measurable with a sweep generator and a noise-figure setup, but amplifier *input* impedance usually can't be checked because the test set (with the possible exception of the HP8505) usually fires too strong a signal into the amplifier.

You can use a bridge, provided it doesn't have a detector built in, in conjunction with a signal generator and a sensitive receiver. You can use a directional coupler, but it helps if the generator output goes into the coupled output and the detector is on the main line, as the signal fed to the amplifier will be less that way, especially if it's a 10- or 20-dB coupler. A slotted line is another possibility, but again use it reversed, with the signal fed in by way of the probe, and the detector on the far end of the line (the detector level will be less than a microwatt). If the amplifier gets more than about ten microwatts (minus 20 dBm) there will be a change in its input impedance, making the measurement pointless. If the amplifier has higher gain, it makes sense to operate at even lower signal levels.

referencce

1. R.S. Engelbrecht, and K. Kurokawa, "A Wide-Band, Low-Noise, L-Band Balanced Transistor Amplifier," *Proceedings of the IEEE*, March, 1965, page 237.

ham radio

More Details? CHECK—OFF Page 102

the **weekender**

synthesized time identifier for your repeater

The membership of Woodbridge Wireless, Inc., decided that the club repeater, WB4FQR, should have an automatic method for recording the time after termination of an autopatch. Members without LED watches often found it difficult, if not dangerous, while driving after dusk, to hold a microphone and refer to their watch for the time. The project was referred to our technical committee, with the suggestion that the time should be in voice with a cost less than $150.

Synchronized tapes were ruled out for two reasons. First, our repeater is located in an unheated metal building under a water tower, which could cause tape problems during cold months. Second, obtaining the tape system was too costly. A synthesized voice for the time function was decided upon, and the membership was in concurrence.

By Douglas Phelps, Jr., WA4GUA, 2912 Wren Court, Woodbridge, Virginia 22191

available hardware

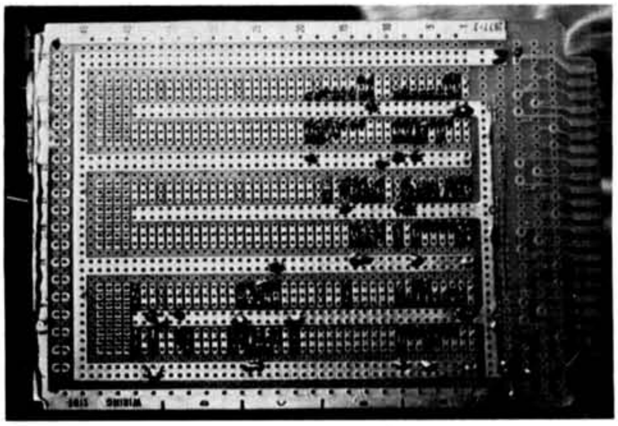
Sharp™ makes a synthesized voice clock known as "Talking Time." It is the size of a pack of cigarettes and sells for $80.00. Pressing a button on top of the clock controls the synthesized, voiced time signal.

Using Sharp's voice clock, a Vector™ prototype board and a few integrated circuits, the time function was incorporated into our repeater for $105. The time function was designed to be activated by the pound (#) button on a Touchtone™ pad. This provided easy access to the time function logging of the correct time at the end of an autopatch transmission.

The clock monitors the COR line in the repeater so that the time will not be transmitted over the air until the sending unit unkeys the microphone. A disable circuit was built for use with repeaters with remote-control capability — a feature that turns the clock off at any given moment.

circuit description

U5 (**fig. 1**) is a type-D flip-flop used as a memory for the decoded pound (#) signal. The D input of U5 is high when the clock is enabled. The flip-flop is normally reset, providing a low signal on Q output. The Q output will go high when the clock input goes high and will remain high until reset. Inverter C of U3 ensures that the logic level at pin 11 of U5 is normally low and goes high when a pound (#) signal is detected. Inverter B of U3 ensures that the logic level at pin 12 of NAND gate A goes low when a receive carrier is detected (COR active). Inverter A ensures that the logic level at the D input of U5 is high for enable and low for disable. (These inverters may be omitted to match other repeaters.)



Circuit is assembled on a standard Vector™ 44-pin prototype board. Clock is mounted in front with a piece of phenolic perfboard for a front panel.

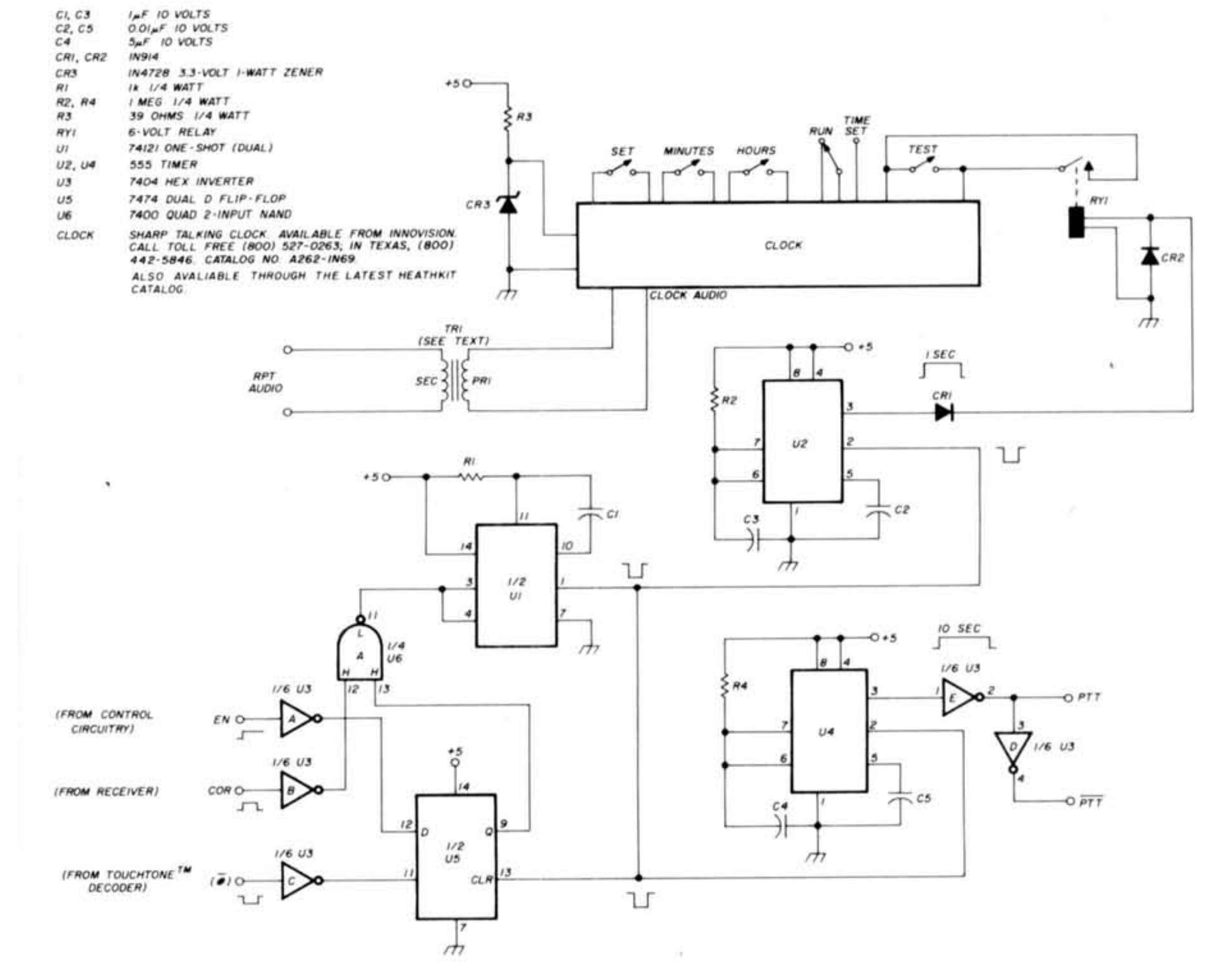
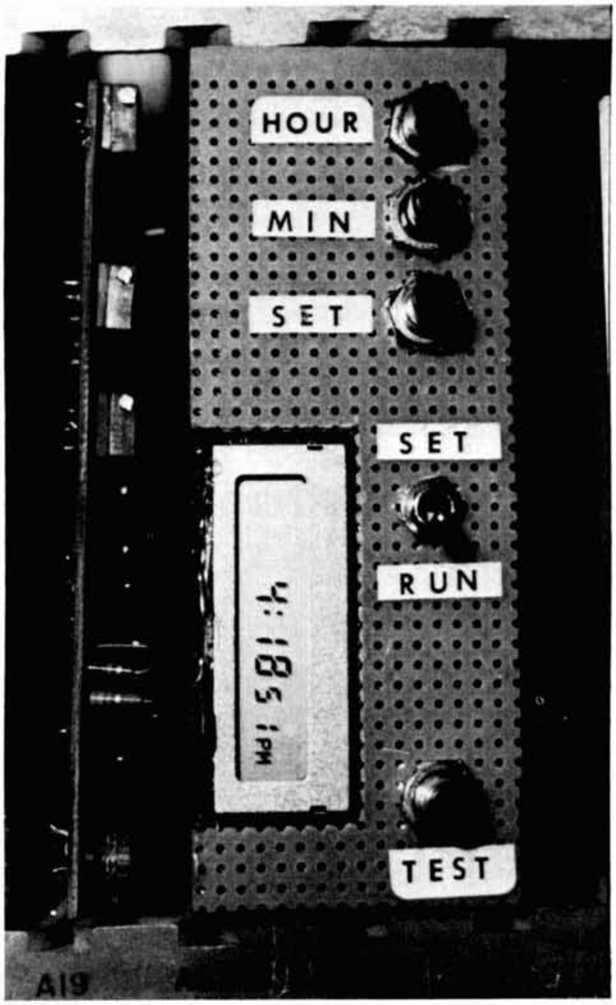


fig. 1. Schematic diagram of the synthesized time identifier.



Closeup of the clock mounted in the control-circuit card cage.

When a pound (#) signal is detected, pin 12 of U6 will be held low by the COR, and pin 11 of U5 will go high, latching pin 9 of U5 high. The high at pin 9 is applied to pin 13 of U6. When a unit starts transmitting, pin 12 of U6 will be held low by the COR, and pin 11 of U5 will go high, latching pin 9 of U5 high. The high at pin 9 is applied to pin 13 of U6. When a unit stops transmitting, pin 12 of U6 will return high and pin 11 of U6 will go low. When pin 11 of U6 goes low, U1 will produce a negative-going pulse on pin 1.

The negative pulse from pin 1 of U1 performs three functions. First, it resets the pound (#) storage flip-flop U5 through pin 13. Second, it triggers timer U2 through pin 2. Third, it triggers timer U4 through pin 2.

IC U4 is a 555 timer with a positive-going output pulse of approximately 5 seconds duration. This output pulse is selected by R4 and C4. The output pulse appears on pin 3 of U4 and is used to hold the transmitter on during the voice time announcement. Inverters D and E of U3 generate PTT and $\overline{\text{PTT}}$ for versatility.

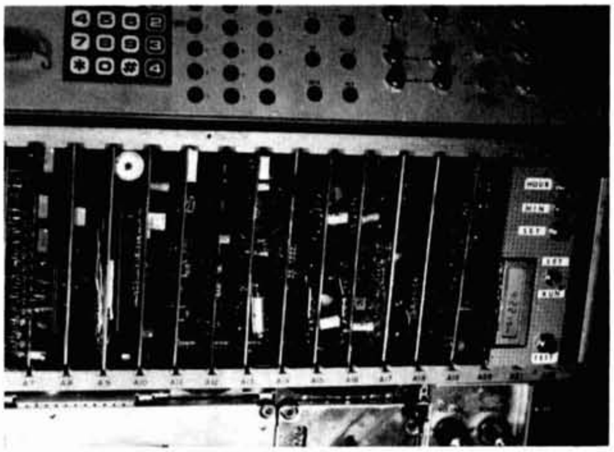
IC U2 is also a 555 timer with a positive-going output pulse of 1 second duration. The output pulse is determined by R2 and C3. The output pulse on pin 3 of U2 drives relay RY1 directly. The normally open contacts of relay RY1 are connected in parallel with the clock activation button, which starts the time announcement routine inside the clock.

Components R3 and CR3 form a 3.3-volt zener-diode regulator to eliminate the need to use the clock's internal batteries. The run-set, hour, minute, and set functions are internal to the clock and may be left alone. However, it may be convenient to run these out to a set of front-panel switches so that the time may be set while the card is still plugged into the card cage. If the clock is not mounted in a manner that prevents access to the set switches, then external mounting of the switches is unnecessary.

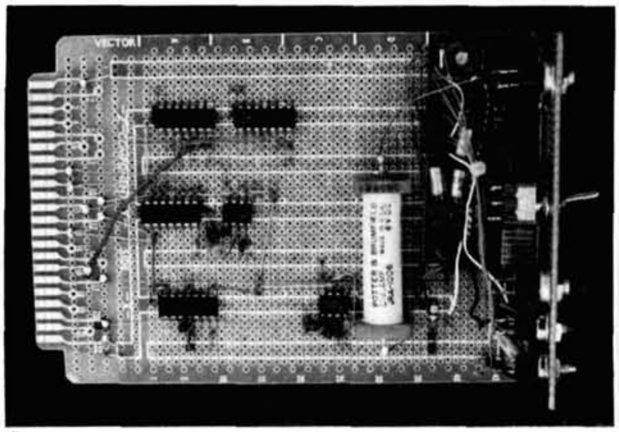
The clock audio is accessed by removing the internal speaker and substituting a matching transformer with a primary impedance of 8 ohms and a secondary impedance that matches the audio circuit that the clock is to drive. In addition to providing impedance matching, the transformer's inductance smoothes out the square-wave output produced by the clock. We found that the transformer filtering was sufficient to provide easily understood speech on the repeater. Since the clock's audio output circuit contains no dc isolation, any attempt to interface the audio without a transformer will kill all audio output.

construction

The control circuitry of our repeater is composed of 44-pin, double edge connect cards. For this reason the entire clock circuit was built on a 4-1/2 × 6-1/2 inch (11 × 17 cm) Vector™ prototype board. A simpler method would be to build the control circuit on a



Repeater control circuits of WB4FQR with the clock to the right.



Details of circuit wiring on the Vector™ board.

smaller board and leave the clock in its original case, bringing out only the speaker audio lines and the activate switch.

The photos show how the clock fits into the card cage and the construction method we used. The clock circuit board was removed from its case and secured to the front of the Vector™ board with a small amount of five-minute epoxy cement. A piece of perf board with a window cutout for the clock display was then cemented to the front of the Vector™ board. The hour, minute, set, time, run-set, and test switches were mounted on this board. The test button is merely another switch in parallel with the clock activate switch.

Number 30 (0.25 mm) wire-wrap wire can be used to connect the front panel switches to the clock and also for some of the longer jumpers on the circuit board. Wiring is in no way critical, nor is parts placement.

adjustments

Once the clock is constructed and interfaced with the repeater, the only adjustment required is the audio level. The volume control is provided on the original clock and can be seen in the photo in the upper right-hand corner of the clock board behind the test switch. If you do not have a method of measuring deviation, simply increase the audio until it is the same loudness as an average mobile signal. Be careful that you do not start distorting the audio.

The clock circuit is very easy to build and can be completed in one day. If desired, any signal may be used to activate the clock. This clock has been in service on WB4FQR/R for nine months with no problems. We have received many favorable comments on it, and it is surprising how well the club has adjusted to having it. The talking clock is an easy, inexpensive, but very useful addition to any repeater.

ham radio

ham radio TECHNIQUES

Bill Orr W6SAI

In a recent column I discussed the problems of cleaning up radar-oven RFI so it didn't wipe out the nearby TV receiver, the kitchen radio and my station receiver. Once that was behind me, I thought I was in the clear, with happy days ahead. This was not to be.

A few days ago my neighbor came by and asked if I knew why his radio-controlled garage door opened and closed at odd times of the day and night. He had called the installer, who came out, charged a service call, and left without doing anything.

I had a hunch I knew what the problem was, so I went to look at the installation. It was a brand-new digital control job with a sub-audible security system so no one but the owner (ha!) could open the garage door. It operated in the 390 MHz range.

Before I did anything, I called a ham friend in the business of installing radio-controlled garage doors. I asked him about the mysterious operation of the garage door. Did he know anything about that kind of problem, and could my ham transmitter be the culprit?

It turns out he knows a lot about the problem. He explained that about a year ago, the majority of companies manufacturing garage-door remote control devices changed from a metal box containing the receiving and coding equipment to a plastic box to save a few pennies.

Since then, he's developed a lucrative business desensitizing garage-door receivers to spurious rf signals. "Even a military plane flying overhead using radio gear in the 400 MHz range can open a dozen garage doors," he confided happily. "Police cars, delivery trucks, CBers and hams, too, can open the new generation of garage doors, because the protective rf shield around the sensitive devices is missing."

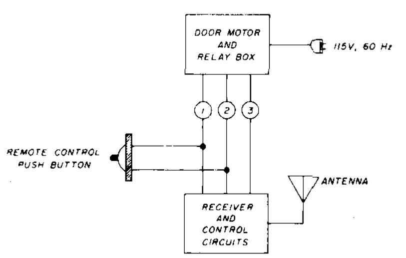


fig. 1. Representative radio-controlled garage door opener. The motor drive and control relay are activated by the control circuit of the receiver when a properly coded signal is received from the approaching vehicle. In many installations wire 1 is ground, wire 2 is control, and wire 3 is the relay coil voltage (about 32 volts dc).

Well, I didn't want to spoil a good thing for him, but I wanted to know if he had any suggestions that would ease my problem.

"Simple," he replied. "There are two cures. The first, and easiest, is to prevent rf from entering the receiver the wrong way. Most installations have a remote push-button located near the door of the garage that leads into the house. The leads from the push-button to the receiver are usually quite long and act as a very good pick-up antenna for hf and VHF signals. (The leads in my neighbor's case were about 25-feet (7.62 m) long.) Place a filter in the leads and in most cases, the receiver will desensitize to locally generated rf (**fig. 1**)."

"And what if that doesn't work?" I asked.

"If that isn't enough, you have to place the whole receiver in a metal box, bypass the leads coming out of the box and — as a last resort — place a high-pass filter in series with the pick-up antenna."

"I hope I don't have to go through that," I gulped.

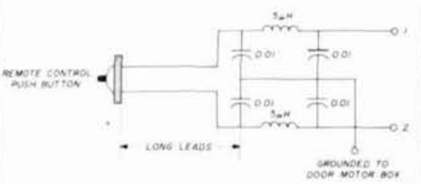


fig. 2. A simple filter made on a piece of printed circuit board cleaned up the interference problem. Filter was mounted directly at the metal motor control box. Since, at the time, I didn't know if either wire 1 or 2 was ground, I filtered each and brought the filter ground to a sheet metal screw on the motor box. The inductors were small, 1/4-inch diameter surplus inductors wound on a 1-inch long form.

The next day I made a simple rf filter on a piece of printed circuit board (**fig. 2**) and I made a long control lead of zip-cord so I could place my transmitter on the air when I was standing outside my neighbor's garage.

My neighbor, a friendly chap, was mystified by all the activity, and he was astonished when I keyed my transmitter by means of the long control cable and his garage door mysteriously opened while we were both standing there!

The next step was to scramble up a short ladder, disconnect the wires from the receiver box to the remote control push-button and insert the filter in the leads. I did this and then once more keyed my transmitter. Nothing. The door stayed shut! Problem solved.

The evening I reported my success to my helpful friend and thanked him for his wisdom. He told me I should have been in San Francisco the time a certain new television station went on the air. As soon as they threw the switch at the transmitter, hundreds of garage doors opened in the city, as well as the doors on fire houses and some police stations! It nearly caused a panic.

"In fact," he confided, "That's what set me up in business!"

After all the brouhaha died down, I called the manufacturer of the garage door controller device and spoke to a bright young lady who was a "trouble shooter." Without tipping my hand, I explained the problem. Oh, yes, she had heard of it. The cure was to bypass the leads running from the receiver to the remote push-button. "Just place a 0.01 μF capacitor from terminal 2 (the control wire) to terminal 1 (ground). That will clean up the trouble."

I then had the temerity to ask her why, if they knew that all this mess could be cleaned up by adding a cheap bypass capacitor, why, why wasn't it installed at the factory?"

She allowed as that might be a good idea, and closed the conversation by telling me that she would "suggest it to the Engineering Department."

so there you are

For want of a cheap capacitor, a whole new generation of garage door radio-control devices seems to be wide open to control by a nearby, strong radio signal. What short-sightedness!

In a nutshell, then, if you have garage door RFI you might consider these three steps:

1. Bypass the remote push-button leads at the receiver with a 0.01 ceramic disk capacitor.

2. If that doesn't do the job, place a filter in the push-button leads.

3. As a last resort, completely shield the receiving unit, bypass all leads and place a high-pass filter in the antenna lead.

Now, save me from any more wide-open, RFI-prone electronic consumer items built by those who should know better for those whose only concern is price!

An afterthought: the garage door receiver and associated circuitry is also capable of creating TVI in the presence of a strong local signal. I think all those unshielded and unfiltered ICs in it are the culprits. In any event, there's a short item in the January, 1982, issue of *QST* magazine (pages 49-50) by John Hartung, W7THY, who chased channel 2 and 6 TVI caused by his transmitter for years. He finally traced it to a Sears garage door opener that was distorting the transmitting signal and reradiating it in the television channels. He ran shielded wire to the remote pushbutton and incorporated a simple filter in the line. This cured the TVI.

the W1PLH compact 10-meter antenna

The ten-meter band should be coming back to life now that the summer season is over. Interest always runs high on simple, compact antennas for that band. Here's an interesting antenna submittd by Charlie, W1PLH (**fig. 3**). The antenna measures less than four feet (1.2 meters) on a side and can be built around a simple wood or bamboo framework. It looks something like a horizontal Quad loop, but it is merely a loaded dipole made up of 300-ohm TV ribbon line. The wires of the line are connected in parallel, so no impedance transformation takes place.

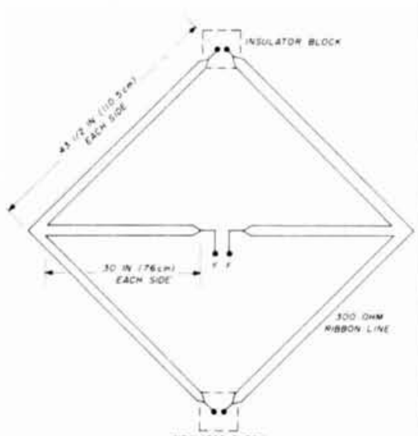


fig. 3. Top view of the W1PLH horizontal antenna for 10 meters. Device is made up of ribbon line, with wires connected in parallel to make a fat element. Antenna is fed at points F-F with a 1-to-1 balun and coaxial line. A lightweight wood frame supports the antenna. Directivity is bidirectional, through the insulator blocks.

Top and bottom physical terminations of the lines are two small insulators; the whole assembly is mounted parallel to the ground. W1PLH placed his antenna atop a 17-foot (5.2 m) high wooden mast. With the dimensions shown, the antenna is resonant near 28.8 MHz, but exhibits a very low SWR (less than 2-to-1) over the range of 28.55 to 28.95 MHz.

Because of its small size, the antenna is very unobtrusive and is recommended to those Amateurs wishing to retain a low profile with their neighbors, yet enjoy contacts on the air with their friends.

the N6CX 40-meter mobile home antenna

The editor of the PARG Bulletin (Pacific Amateur Radio Guild) — Hal Glen, N6CX — has an interesting solution to the invisible antenna for mobile home use. His idea is shown in **fig. 4**. This data was forwarded to me by Bob, W6CYL, who vouches for the efficiency of the antenna. He calls it "the sneaky antenna for mobile home hams, or, it is better to be sneaky than off the air!"

Basically, the antenna looks like a sixteen-foot (4.9 m) flag pole, complete with flag. The main assembly is 1¼-inch plastic pipe, and the flag pole is made in two sections. The top section has a metal toilet tank ball (**A**) connected electrically to the top end of a helical winding (**B**) inside the flag pole (**C**). The ball is mounted by a ¼-inch bolt to an end cap secured to the pole.

The antenna itself is a ¾-inch pipe about 10 feet (3.0 m) long, telescoped within the larger pipe. The smaller pipe is wound with 68 feet of No. 16 enameled wire, spaced as evenly as possible over the complete length.

The bottom end of the winding passes through a tee fitting and a ¾-inch diameter nipple, which is bolted to the wall of the mobile home with a matching flange. The nipple should

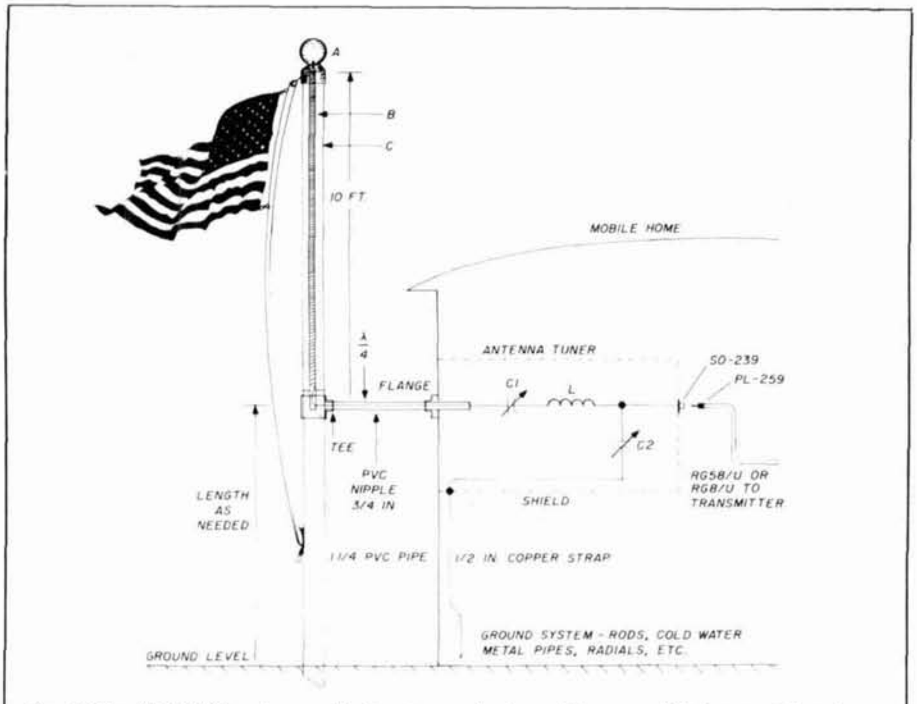


fig. 4. The N6CX 40-meter vertical antenna designed for a mobile home. There's no reason why the design couldn't be modified for other bands.

be long enough so the antenna clears the eaves of the mobile home. In addition to serving as a lead-in, the nipple also braces the antenna against the wind.

The lower section of the antenna, which acts merely as a support, is a section of 1¼-inch PVC, the length adjusted to fit the particular installation. The bottom of the PVC pipe is fitted into a hole dug a foot or two into the ground.

A pulley is installed at the top of the antenna for a halyard and flag. The halyard should be nylon rope, or equivalent.

The helical-wound vertical antenna has a feed-point impedance of about 5 ohms at resonance (determined by the number of turns on the winding). A ten-to-1 toroid transformer will do a good job of matching the antenna to a 50-ohm line. Or, the tuning unit shown will do the job. Capacitor C1 is 1500 pF and C2 is about 1350 pF. The units used were flea market jobs from old trf broadcast receivers. The coil, L, is about 0.7 μH (eight turns, spaced to one inch long, ¾-inch diameter of #12 wire).

A good ground system is absolutely essential with this antenna. The ground connection is a short length of ½-inch wide copper strap. The tuning unit should be placed near the operating table and the ground lead run from this point to the actual ground. N6CX uses a combination of ground rods, cold water pipe, and radials for his ground, and it seems to do a good job.

reprint available again!

I didn't know I had a best-seller on my hands! The reprint *Design Considerations for Linear Amplifiers* is once again available. If you'd like a free copy of this three-part article that appeared in *ham radio* some months ago, please send four first-class stamps, or four IRCs to: Bill Orr, Varian EIMAC, 301 Industrial Way, San Carlos, California 94070, and I'll be happy to send you this brochure.

ham radio

More Details? CHECK—OFF Page 102

More Transceiver

Contest or rare DX – the world is waiting to hear from the new breed of HF operators who'll have the power of a microcomputer at their instant command. Introduction of the Heath SS-9000 signals a new era in Amateur Radio communications. An era full of exciting promise. Challenge. And opportunity…

Anticipating the future, the Hams at Heath have created a remarkably advanced HF transceiver based on microprocessor logic. And with it, they open an entire universe of innovation and potential to the serious, active ham.

MORE WORLD HORIZONS

In the SS-9000, Heath met a major design goal: *provide the highest-tech, most versatile transceiver possible.* Our objective? Nothing less than setting the pace for transceiver performance in the next decade. And transforming the whole state-of-the-art in amateur telecommunications.

As a microprocessor-controlled, nine band (including WARC) Transceiver, the SS-9000 pioneers the revolution in computer-enhanced hamshacks – with advanced design applications yet to be imagined. At your command under direct, modem, RS-232 terminal or computer control, it could break all known records for station performance.

MORE TOTAL TALK POWER

Even without a command terminal, Heath's SS-9000 will be the best transceiver your club or QTH ever aired. The superbly sensitive front end is mated to a transmitter providing 1W QRP or 100W PEP output on SSB/CW/RTTY. At any level, dedicated operators who appreciate the finest and expect great results will discover it to be a hot CQ and DX magnet.

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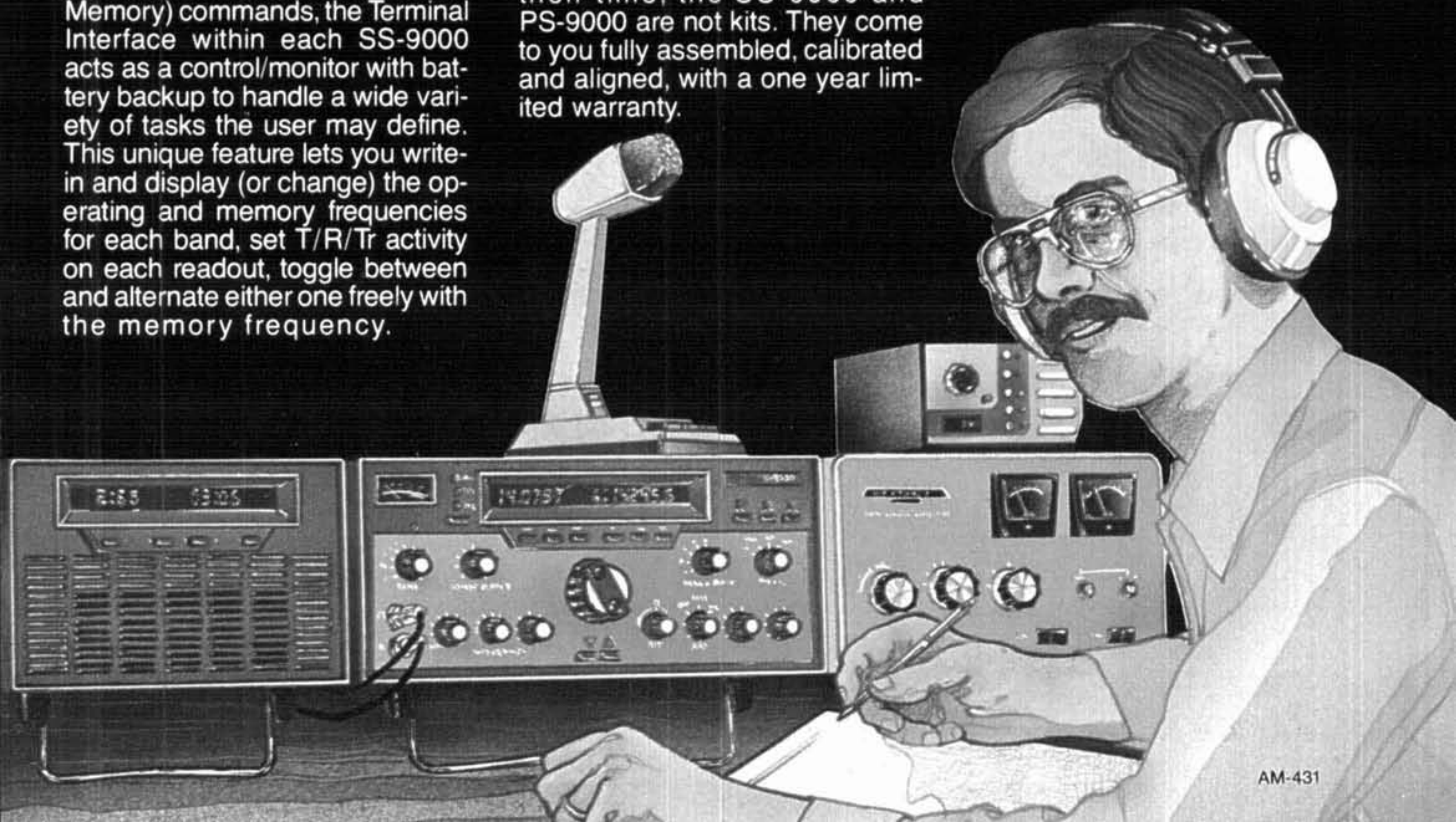

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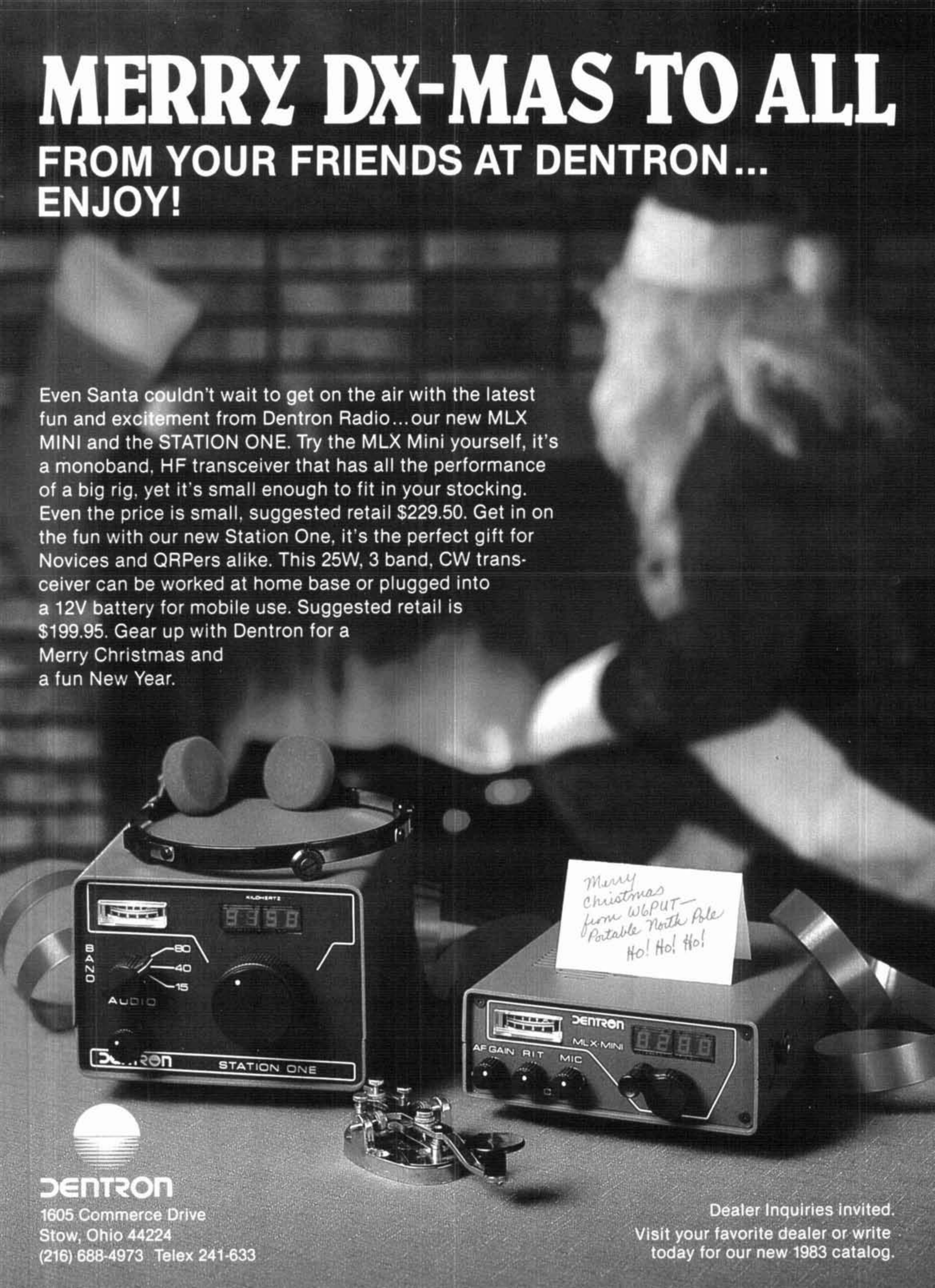
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operation upgrade:
part 11

The eleventh part in a continuing series designed to help you upgrade your ticket

Previous articles in this series have explained the fundamentals of electricity, passive and active devices, power supplies, CW transmitters and receivers, and a little about radio wave propagation and different antennas. In this article we will explain how amplitude modulation is produced and detected.

Amplitude modulation (a-m or A3) was *the* method of communicating by voice over radio prior to the early 1950s, before single-sideband (SSB or A3J) made its entrance on the Amateur bands. Since SSB is based on double-sideband a-m you should understand the basics of this older form of voice communication before we investigate how SSB systems work. Even today a-m stations are heard on 160, 80, 10, and some VHF bands. Standard broadcast band and high-frequency international broadcast stations use A3, and television stations use amplitude modulated video (A5). A-m is a relatively easy and inexpensive way for the experimenting Amateur to get on the air with voice communications. It is legal to use on any Amateur band in the phone sections.

an amplitude transmitter

The simplest a-m transmitter is an oscillator with a carbon microphone connected in series with the antenna. Such a system is called absorption modulation, because a carbon microphone absorbs more and less power when its diaphragm is vibrated in and out by sound waves, leaving less and more power to

By **Robert L. Shrader, W6BNB,** 11911 Barnett Valley Road, Sebastopol, California 95472

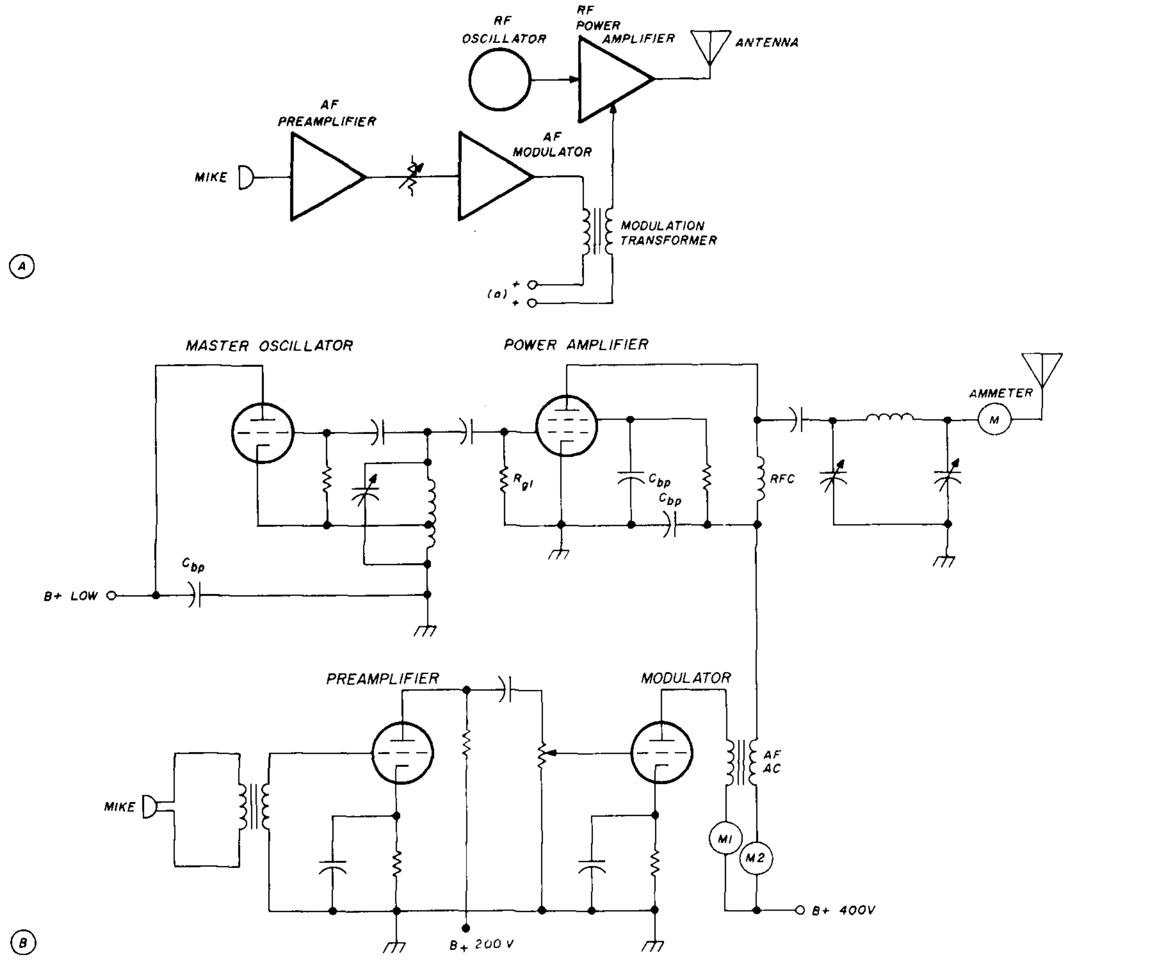


fig. 1. Basic plate modulation system, (A) block diagram, (B) schematic.

be radiated by the antenna respectively. The resulting output rf wave varies in amplitude (strength) in step with the voice waves' modulation of the microphone's resistance. This produces very little rf amplitude change, modulates only very low rf power levels, and produces a simultaneous change in, or modulation of, the oscillator's frequency — which is undesirable.

A reasonably successful amplitude-modulated system can use a master oscillator power amplifier (MOPA) CW type transmitter (part 7, June, 1982) with a microphone feeding audio-frequency amplifier stages that vary the plate supply voltage to the PA stage. **Fig. 1** presents this system in block and schematic diagram forms. The stages are shown using vacuum tubes since most a-m rigs used them. Today, JFETs, VMOSs, or BJTs might be used instead. The block diagram shows an rf oscillator driving a class C (must be grid-leak biased) rf power amplifier coupled to an antenna. The low af voltages produced by the microphone are amplified, first by the preamplifier (*pre* because it is ahead of the gain control), and finally by the modulator stage. The job of the modulation system is to produce voice af ac voltages across the secondary of the modulation transformer with peaks equal to the plate voltage of the PA stage, which would be 400 volts in our case. The result is the production of maximum amplitude changes of the rf carrier power without causing distortion. The af ac peak voltages should equal +400 and −400 on the two half-cycles of the af ac. This produces voltages between the plate and cathode of the PA tube that vary from 400 volts with no modulating af ac added, to +800 volts at the positive peak, and down to zero volts at the negative peak of the modulating voltage.

Two conditions must be considered when discussing a-m systems. One is when undistorted sine-wave af ac is fed into the preamplifier, and the other is when voice ac produces the modulation. When the modulating voltage is sinusoidal, the required af modulating power is exactly half of whatever the plate power input to the PA stage happens to be for 100 percent modulation. For example, if the PA I_p meter M_2 reads 100 mA (0.1 A), the power input to the PA is $P = EI$, *or 400 (0.1)*, or *40 watts*. If the PA is 60 percent efficient, the output power radiated by the antenna will be *40 (0.6)*, or *24 watts*.

Since a single device audio amplifier must be biased to class A to produce undistorted sinusoidal audio output, and since class A stages are usually only about 33 percent efficient, at least 60 watts must be fed to the modulator tube plate circuit to produce the required 20 watts (33 percent of 60 watts) of af ac for 100 percent modulation. Therefore, M_1 would read (from $P = EI$, and rearranging the formula to solve for current) $I = P/E$, *or 60/400, or 0.15 A, or 150 mA*. Thus, the power supply must produce 400 volts at *100 + 150 mA*, or a total of *250 mA*.

However, with most voices, only about half of the sine-wave af power requirement will produce voice peaks high enough to produce full or 100 percent modulation. Therefore, the modulator dc current would only be about 75 mA at full operation, and the power supply would only have to supply *75 + 100, or 175 mA*. How about overall efficiency? To transmit a fully voice-modulated 24 watt rf carrier it requires from the power supply at least $P = EI$, *or 400 × 0.175*, or *70 watts* of dc power. The efficiency is therefore *(24/70)100*, or 24 percent. This is not very good when we compare it with the 60-70 percent efficiency of modern SSB transmitters which balance out all the carrier power, and then filter out one of the two developed sidebands. Sidebands? What are they?

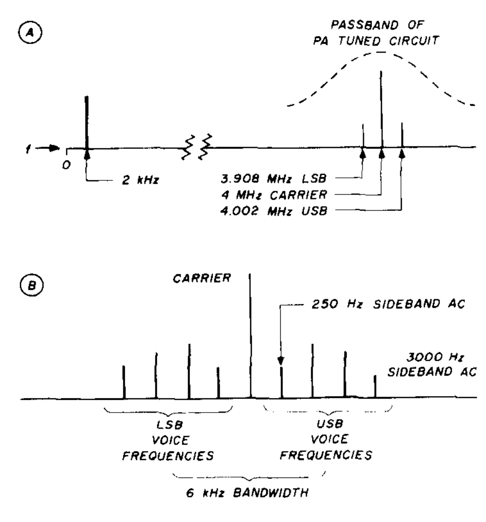


fig. 2. (A) Spectrum of carrier, sidebands, and rf passband of PA tuned circuit. (B) carrier plus voice sidebands and bandwidth.

sidebands

Amplitude modulation is actually a form of heterodyning or mixing two frequencies (rf carrier and voice af) in some nonlinear circuit (the plate circuit of a PA stage). If an rf carrier is modulated by an af tone there will be four frequencies as the output: the rf; the af; the sum of the two; and the difference between the two.

Let's consider the carrier to be 4 MHz, or 4,000,000 Hz, and the modulating ac to be 2 kHz, or 2,000 Hz. The sum frequency will be 4,002,000, and the difference frequency will be 3,998,000 Hz (**fig. 2A**). The tuned PA circuit is rather broad tuning (dashed curve) and will accept the carrier plus the sum and difference frequencies and transmit all three. But the af is too low a frequency to produce any voltage-drop across the 4-MHz tuned circuit and does not appear anywhere in the output.

The sum frequency is higher than the carrier frequency, so it is called the upper sideband (USB). The difference frequency is the lower sideband (LSB). In the case of voice modulation, only the frequencies between about 250 Hz and 3000 Hz are required to convey intelligence. Therefore, the width of either the upper or the lower sidebands will be about 2750 Hz, as indicated in **fig. 2B**. Note that each voice tone produces equal-amplitude upper and lower sideband signals. This is a double-sideband with carrier signal, called a-m. If the carrier is reduced to zero or nearly zero, the signal produced is known as A3H. If the carrier is cancelled and one set of sidebands is filtered out and not transmitted, the emission is known as single-sideband, SSB or A3J. Note that our 4-MHz a-m signal would be illegal because the USB is out of the band!

The bandwidth of an amplitude modulated transmission is the spread of frequencies between the highest USB ac signal to the lowest LSB ac signal. Amateur a-m voice transmissions must not exceed 6 kHz in bandwidth (3 kHz as the top audio tone transmitted). Little energy is usually transmitted at frequencies lower than 250 Hz for voice transmissions. What should be the bandwidth of an SSB voice emission? How about 2750 Hz, or 2.75 kHz?

Standard a-m broadcast transmitters (535-1605 kHz) and high-frequency international a-m broadcast stations modulate with audio frequencies up to at least 5 kHz, and many up to 10 kHz or higher, with the lowest frequencies down to 50 Hz. The wider the bandwidth of the sidebands, the more faithful the reproduction of voice and musical sounds (any music transmission is illegal for hams).

the modulated envelope

There is another way to consider amplitude modulation signals and their carriers. If a sample of the rf ac carrier is coupled to the vertical input of an oscilloscope, with the horizontal sweep a 20 to 30 Hz sawtooth ac, an illuminated band will stand still across the screen, as illustrated in **fig. 3A**. We can say the scope is showing an envelope carrier pattern. With no modulation the carrier alone is known as an A0 emission. If the carrier is increased in power the envelope band will extend higher and lower. If the carrier is reduced to nearly zero there will be only a thin line across the center of the screen. In **fig. 3B** we see two cycles of sinusoidal modulation have been applied to the carrier. The first cycle increases by only 50 percent at its peak, whereas the second cycle produces 100 percent modulation (100 percent peaks are twice the carrier level, and the minimums go to zero output for an instant).

If the modulator stage feeds more than the necessary amount of voltage in series with the PA plate circuit, a condition such as that illustrated in **fig. 3C** will occur. Here the positive peak of modulated wave is greater than twice the carrier level, which is not likely to cause any troubles. But on the negative peak of modulation, the negative modulating voltage drives the plate voltage below zero to some negative value. As a result, for a period of time nothing is transmitted. This results in a very rapid drop-off of the modulated waveform and also a very rapid increase from zero toward the carrier level. The abrupt change from something to zero and then zero to something represents the wave shape of a very high frequency ac. Very high frequency ac will produce sidebands far removed from the carrier. They produce interfering sidebands far from the carrier on both sides. Such widely displaced noise-type sidebands are called splatter, buckshot, and other derogatory terms by Amateurs trying to listen on frequencies near a carrier with this kind of over-modulation.

Over 100 percent modulation is not the only thing that can cause splatter. If the af amplifiers produce distortion of the modulating signal, harmonics (multiples) of these modulating frequencies will appear in the modulated output. These harmonics develop high frequency USBs and LSBs far removed from the *carrier frequency*.

Note that the oscilloscope pattern is not showing the sidebands of a modulated signal. It *is* showing the results of sidebands, though. If the sidebands were not generated by modulation the amplitude waves of the carrier would not increase and decrease.

A scope provides an excellent method of tuning transmitters. All rf stages are tuned for a maximum height of the illuminated band shown on the screen.

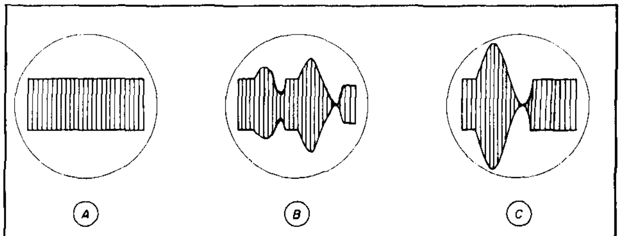


fig. 3. Oscilloscope presentations. (A) Carrier alone, (B) carrier with a 50 percent and a 100 percent modulated wave, (C) carrier with an over-modulated wave.

For modulation checks the microphone can be spoken into and the af gain control increased until the negative peaks of modulation drop to zero, or the waveform begins to show changes of wave shape, or flattening of the peaks. Such distortions are reduced by reducing the gain control.

other methods of modulating

We have explained plate modulation (it would be collector or drain modulation if BJTs or FETs were used) in which the modulating voltages are added to the plate voltage. The more total E_p the greater the rf power output. The less the E_p the less the rf power output. If you watch the antenna ammeter shown in **fig. 1B**, the carrier alone might develop 1 ampere. When 100 percent sinusoidal modulation is applied, the ammeter should increase by 6 percent, to 1.06 amperes. With voice modulation peaking at 100 percent the ammeter will hardly move at all. This is because the average power of speech ac is very low, even if the peaks are high. The average of a sinusoidal wave is always 0.636 of the peak. The average of voice wave voltages is rarely over 0.2 or so of the peaks (unless voice-peak clipping is used in the af amplifiers). For this reason an antenna ammeter is almost worthless as an indicator of modulation percentage. It can be handy to indicate whether the transmitter and the final amplifier are tuned to resonance properly, however. At resonance the antenna ammeter will peak and the PA I_p will dip to a minimum reading. Today there are few antenna ammeters in use. Instead, Amateurs use remote field-strength meters, or a form of rf ac antenna voltmeter to tell when maximum radiated power is being developed.

The modulator shown in **fig. 1B** is a single tube class A audio amplifier. When a class A stage is working properly there will be no change in its plate current, meter M_1 in our circuit, whether there is a very low signal or a very high signal value being amplified. If the meter does move, it indicates distortion of some kind, usually af input overdriving the stage. In most cases, modulator stages use push-pull class AB or class B amplifiers, which have efficiencies of

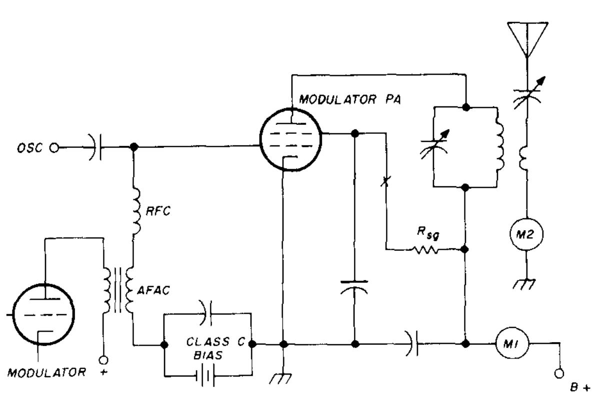


fig. 4. Grid modulated tetrode, screen-grid modulated if the af ac is added at point X.

perhaps 50 percent, rather than the approximately 33 percent of class A stages.

If the modulating voltage is applied in series with the grid circuit (base or gate for BJTs and FETs) and the bias voltage, the output of the stage can also be modulated. Consider **fig. 4**, in which the af ac is added in series with the bias voltage. The stage is biased to class C, which means that with no rf ac drive from the oscillator the bias is high enough to cut off the I_p completely. With a little oscillator rf ac drive there will be a little I_p flowing and the plate tank circuit can be tuned to a minimum I_p value, as indicated by M_1. An antenna ammeter would peak at the same tuning point. As the drive from the oscillator increases the I_p and antenna current values increase up to a point. Increasing the drive further will produce no greater antenna current. The drive should be decreased to a value a little below maximum antenna current. Now, when af ac is added to the bias voltage, the plate current will increase with positive peaks of af ac and decrease with negative peaks. The envelope waveform seen on an oscilloscope with grid modulation should look the same as with plate modulation, except that it is a little more difficult to determine the correct values of drive and antenna coupling to produce undistorted modulated output. Grid modulation is also known as grid bias modulation or efficiency modulation, because under modulation the efficiency of the modulated stage rises from a low value up to about 60 percent to produce the high positive peaks of modulation without adding more plate voltage to the stage. If the PA were a triode it would have to be neutralized, but its operation would be essentially the same as with the tetrode shown.

If the modulation transformer is removed from the grid circuit and connected instead in series with the screen grid circuit at the place marked X, screen grid modulation would result. Whereas grid modulation requires almost no af ac modulating power, screen grid modulation requires about 10 percent as much as plate modulation.

The circuit in **fig. 5** shows a pi-network output bipolar junction transistor rf PA being modulated by a pair of BJTs in push-pull. If 100 percent modulation cannot be produced with the circuit as shown, some of the modulating ac voltage can be fed to the driver stage (dashed circuit with resistor, and disconnect $+V_{CC}$). Neutralization may be necessary (dashed circuit with capacitor C_n). This modulation is somewhat similar to using plate and grid modulation at the same time, which in vacuum tube circuits is known as cathode modulation because the cathode has both plate and grid-modulated currents flowing through it. (The modulating voltage can also be connected directly in series with the cathode lead.)

undesirable results

In all modulation systems it is important that distortion be held to a minimum. This means the microphone must produce clean signals, the audio amplifiers and modulator must not be overdriven enough to produce distortion and unwanted harmonics. The impedances of the modulation transformer must match both the modulator stage and the impedance of the stage being modulated. The antenna must be coupled just tight enough to reflect back on the modulated rf PA the proper impedance to produce undistorted modulation. While there may be considerable latitude in plate-type modulations, grid-type modula-

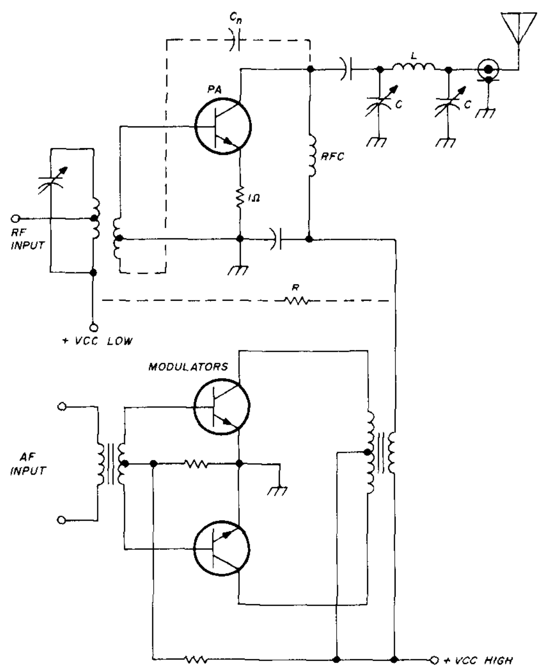


fig. 5. Collector-modulated BJT by push-pull BJTs.

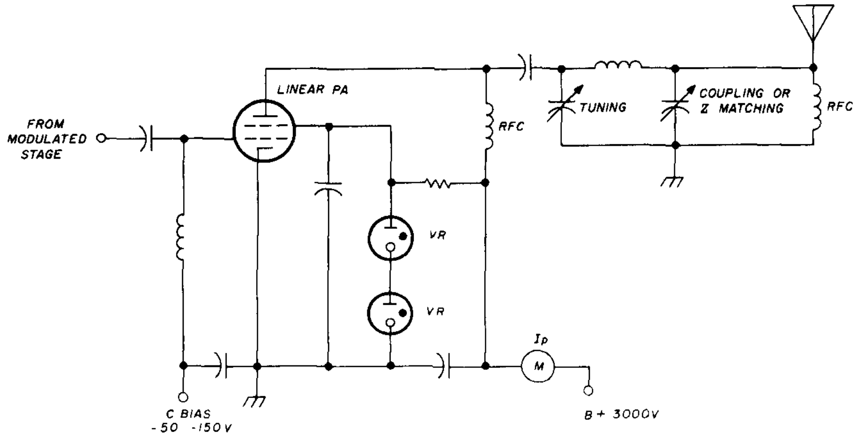


fig. 6. Linear amplifier following a low-level modulated stage.

tion systems are much more difficult to adjust for optimum or near optimum modulated output.

If the dc of the power supplies is not adequately filtered, or if the filter capacitors dry out, the power supply voltage ripple will produce an rf amplitude variation that appears in receivers as a low frequency (60 or 120 Hz) hum modulation riding along with the voice modulation. New filter capacitors are required or more filtering should be added.

About the only way to be sure a transmitter is not over-modulated and producing splatter is to monitor the output signal with an oscilloscope. The negative peaks of modulation should not be allowed to hit zero; one way to prevent this is to use clipper circuits in the preamplifier. Such a circuit clips off all voice peaks exceeding a set limit. Since clipping produces distortion and harmonics, clippers must be followed by a 3-kHz lowpass filter to prevent the harmonics from modulating the PA and producing sidebands far removed from the carrier frequency.

linear amplifiers for a-m

To produce the maximum 1 kW of input power allowed to Amateurs, an a-m PA stage would require about 250 to 500 watts of undistorted audio power to do the modulating. This requires large, heavy af equipment. It may be easier to modulate a lower level rf stage and amplify the modulated rf signal with a linear amplifier. For example, if the linear amplifier is a beam-power tetrode it may require only 20 watts or less of modulated rf signal to drive it to its full output capability with 1 kW of input dc plate power. Under this condition the modulated rf amplifier could be a 40 watt dc-input stage, requiring only 10 to 20 watts of audio to modulate it. This level of audio is relatively simple to develop.

Linear power amplifiers are often beam-power tetrodes rather than triodes because they require much less driving signal (have more gain) and do not need to be neutralized. (Grounded-grid triode stages do not need to be neutralized but require high drive.) The circuit shown in **fig. 6** represents a linear amplifier that might be used with a low-level amlitude-modulated transmitter. Since the amplifier must amplify what is fed into it without distorting it in any way, a linear amplifier will have to be biased to class A, AB, or B. It requires a well-regulated bias supply, a well-regulated screen grid supply (by using voltage regulator tubes in this case), and a well-regulated high voltage plate supply. Remember, only class A could be used with a single tube in audio amplifiers. When class AB or B is used, the bias voltage is higher so that on the negative half-cycle of the input the active device would go into cut-off and part of the input signal would be missing in the output.

In rf linear amplifiers, however, the output signal is the result of the flywheel oscillation of the output LC circuit. The LC circuit oscillations make up for the part of the negative input cycle that might be missing. As a result, an rf linear amplifier may use a single-ended circuit (one active device). In most cases the linear uses class AB for slightly higher efficiency than is possible with class A. Even so, when amplifying a carrier plus modulation the efficiency of the amplifier will run only around 35 percent efficient. (When used to amplify SSB with no carrier being transmitted it can operate at an efficiency of over 60 percent.)

The rf choke* between antenna and ground is to leak off any static charges the antenna may pick up

*It can also act as a crowbar shorting the plate supply to ground in case of failure of the plate-blocking capacitor — protecting the antenna circuit (and operator) from high voltage. **Editor.**

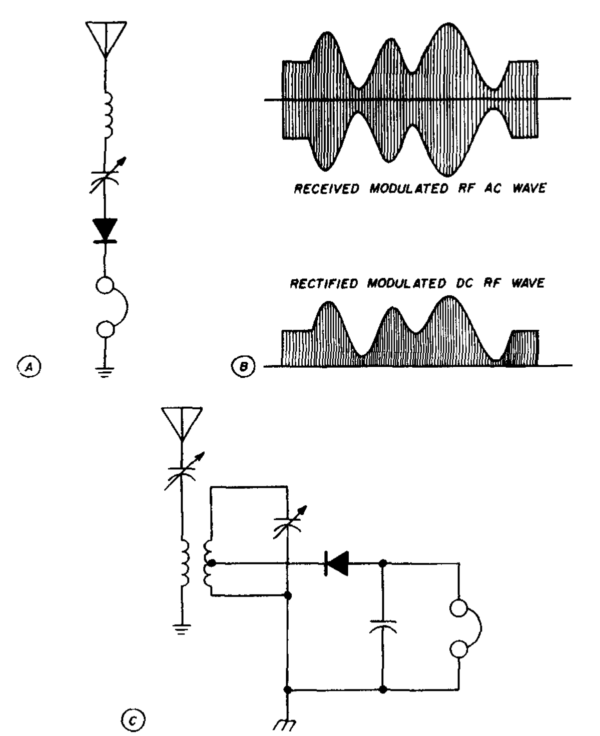


fig. 7. (A) Simplest diode detector, (B) modulated rf and same signal rectified, (C) basic diode (crystal) detector receiver.

when charged clouds pass overhead, which can sometimes amount to thousands of volts.

a-m detectors

Detectors for CW (A1) signals (discussed in July, 1982) require a means of heterodyning the incoming code signals with some kind of a local oscillator to produce a beat tone audible to the operator.

Amplitude modulated signals contain their intelligence not in coded dots and dashes but in the amplitude modulation of the carrier wave with its sidebands. The simplest type of a-m detector is a tunable antenna, a diode, and a pair of earphones, **fig. 7A**. When the antenna wire, inductor, and capacitor are resonated at the frequency of some nearby a-m transmitter, the diode will rectify the rf ac to the varying amplitude pulses of dc, **fig. 7B**. The varying amplitude pulses will attract and release the earphone diaphragms at the modulation frequency rate, producing sound waves that can be heard. Unfortunately, if there are several nearby stations on frequencies relatively close together, the detector will detect them all, because one tuned circuit does not discriminate against other frequencies very well. It is said to have poor selectivity.

A far better detector-receiver is shown in **fig. 7C**. In this circuit there is first a tuned antenna with which to try resonating at only one carrier frequency. Coupled to the tuned antenna circuit coil is a secondary coil which is also tunable. When it is tuned to the same frequency as the antenna circuit, adjacent frequencies will be considerably attenuated. Now only one station should be heard in the earphones. This is the basic idea of the original crystal detector receivers used from about 1910 to the mid-Twenties. Surprisingly enough, it is essentially the same detector circuit used today in modern a-m superheterodyne receivers. The further the diode and earphones (the load) is tapped down the coil the higher the Q of the LC circuit and the better the selectivity of the secondary circuit.

There is another way of looking at a-m detection. Amplitude modulation is the result of beating a carrier ac with audio ac to produce a carrier-plus-sidebands output. When this carrier plus its sidebands are received and fed into a nonlinear circuit (diode detector) the sidebands mix with the carrier and produce sum and difference frequencies. These sum and difference frequencies are the same as the original audio frequencies at the transmitter. The earphones make them audible to the listener.

a-m receivers

Basic CW receivers discussed in the July, 1982, article are the tuned radio frequency (TRF) amplifier receiver and the superheterodyne. An a-m superheterodyne is actually the front-end of one heterodyne TRF receiver coupled to the input of a second complete TRF receiver, but using a diode detector, as indicated in the block diagram (**fig. 8**).

The tunable rf amplifier (with arrow), the tunable first detector or mixer, and the tunable local oscillator are all ganged to tune together (indicated by the dashed lines) across the radio spectrum. They would be the first two stages of a CW TRF, and form the front end of the a-m superheterodyne. The fixed-tuned i-f amplifier (450 kHz usually), the fixed-tuned diode detector (450 kHz), the volume control, the af amplifiers and the loudspeaker form the second TRF system and complete the superheterodyne system. Note that something new has been added. It is the automatic gain control (AGC) circuit which uses some of the dc voltage developed when the diode type second detector rectifies the i-f signal being fed to it. This negative (or reverse bias) AGC voltage is fed back to the i-f and the rf amplifier input circuits. A strong signal into the second detector develops a high AGC reverse bias voltage which reduces the gain of the rf and i-f amplifiers, thereby reducing the voltage to the second detector. Weak signals at the second detector produce almost no reverse bias and the rf and i-f stages amplify at their maximum capability.

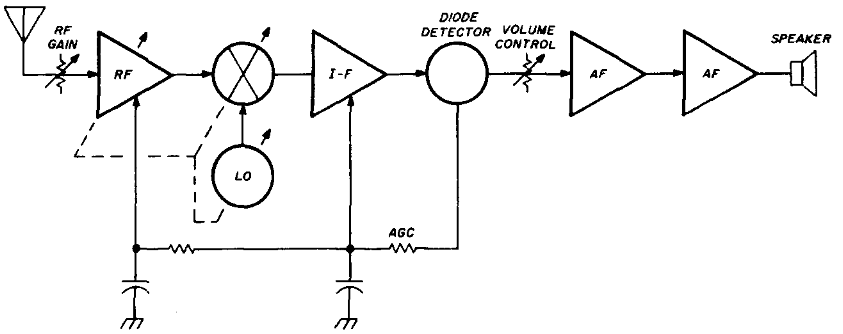


fig. 8. Block diagram of an a-m superheterodyne including an AGC circuit.

The result of this is that all signals, weak, medium, and strong, produce nearly the same signal strength at the output of the detector. As you tune across a band having several a-m signals on it they should all sound about the same strength to you if AGC is being used. This type of circuit is also referred to as automatic volume control.

More advanced a-m receivers may use a separate i-f amplifier to produce a greater and more effective AGC voltage in a circuit, somewhat as shown in **fig. 9**. The negative (or reverse bias) AGC voltage is not only fed to the i-f and rf amplifiers to control their gain, but also to an S-meter to indicate the relative strength of the signal being received. The stronger the signal the more AGC voltage and the higher the S-meter will read.

We have shown the rf, mixer, local oscillator, i-f, detector, and af stages as being separate identities. Today it is possible to use a special front-end integrated circuit (IC) and add only the tuning circuits to it, plus a few resistors and capacitors. A second IC can be used for the i-f and detector circuits, requiring only the addition of tuned i-f transformers, and another IC for the af amplifiers. It is also possible for one IC to provide the i-f detector and af amplifiers, reducing equipment size greatly.

FCC test topics

The following Novice class FCC test topics are discussed in this article:

- vacuum tubes, applications, symbols
- transmitter tune-up procedure
- undesirable harmonic output, cause and cure
- superimposed hum, cause and cure

The following Technician/General class FCC test topics are discussed in this article:

- amplitude modulation, overmodulation, splatter
- block diagram of complete a-m transmitter and receiver

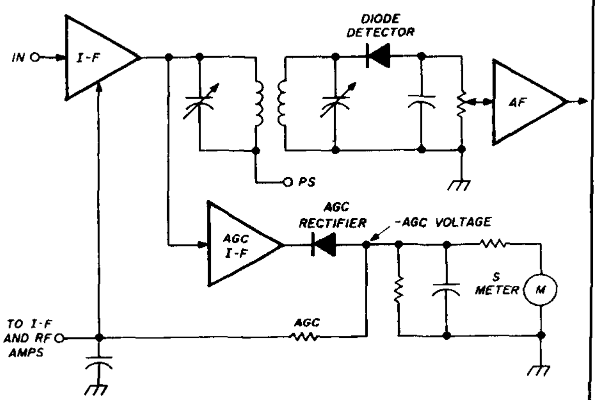


fig. 9. Diode second detector, with separate AGC and S-meter circuit.

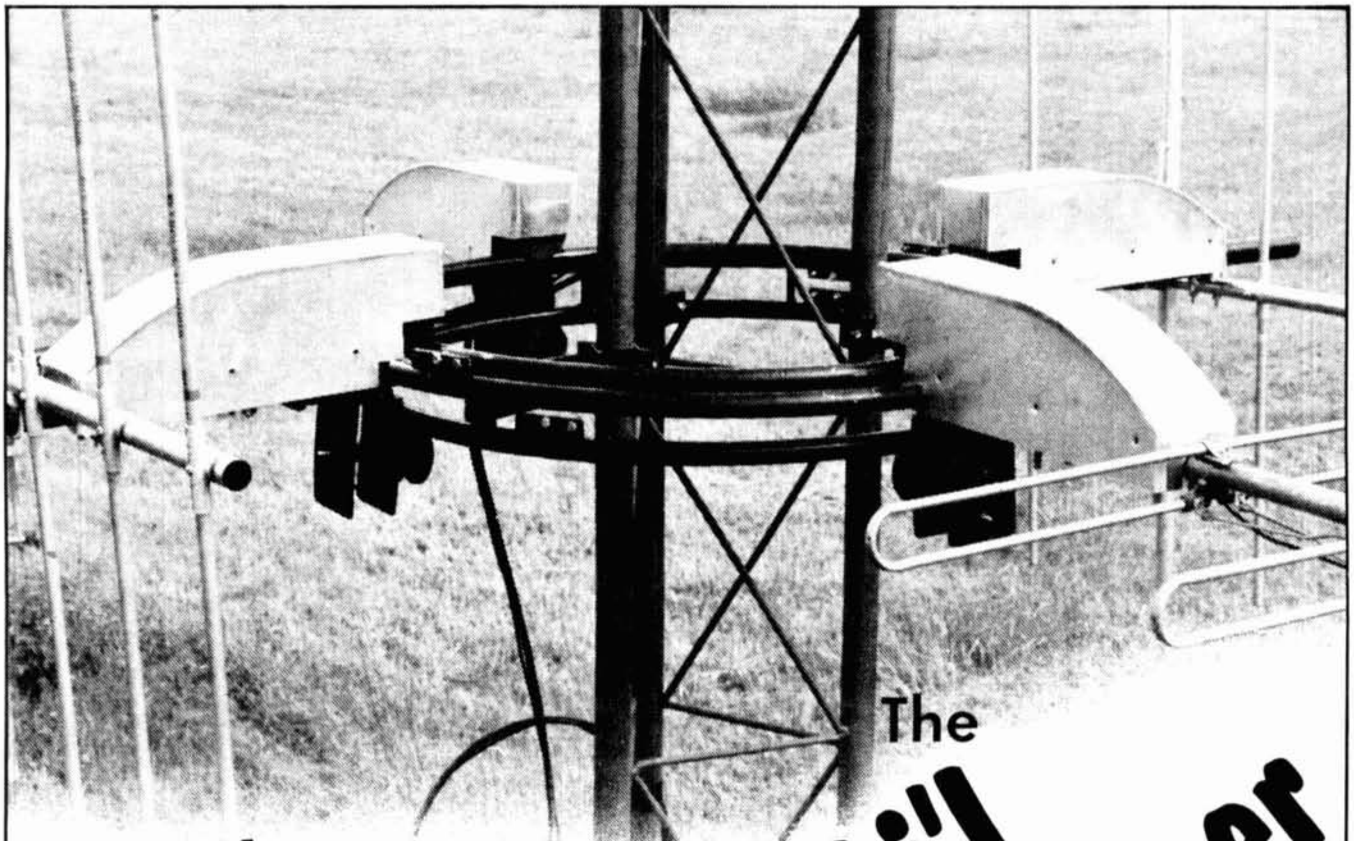
- sidebands, double sideband, single sideband
- frequency mixing
- bandwidth
- transformer applications
- emission types A0, A3, A3J
- use of field strength meter and S-meter

The following Advanced class FCC test topics are discussed in this article:

- modulators, a-m methods
- emission types, A3, A5
- oscillator applications
- transmitter final amplifiers
- detectors, mixer stages
- rf and i-f amplifier stages

For additional information on these subjects refer to *Electronic Communication*, or to *Amateur Radio Theory and Practice*, by Robert L. Shrader, W6BNB, McGraw-Hill Book Company, available through *Ham Radio*'s Bookstore.

ham radio



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30002	1980 Nat. Interface Book (640 pg.)	6.95
30003	1982 Nat. Linear Book (1952 pg.)	11.95
30005	1981 Nat. TTL Book (624 pg.)	9.95
30008	1980 Nat. Memory Data Book (464 pg.)	6.95
30011	1980 Nat. Linear Applications (736 pg.)	15.95
30013	1983 Zilog Data Book (641 pg.)	7.95
205610	1981 Intel Peripheral Design (828 pg.)	9.95

DYNAMIC RAMS

Part No.	**Pins			Price
1103	18	1024x1	(300ns)	.99
4027	16	4096x1	(250ns)	2.49
4116N-2	16	16,384x1	(150ns)	1.89-8/14.95
4116N-3	16	16,384x1	(200ns)	1.69-8/12.95
4116N-4	16	16,384x1	(250ns)	1.49-8/10.95
4164N-150	16	65,536x1	(150ns)	7.95-8/59.95
4164N-200	16	65,536x1	(200ns)	7.49-8/54.95
MM5261	18	1024x1	(300ns)	.49-8/1.95
MM5262	22	2048x1	(365ns)	.49-8/1.95
MM5270	18	4096x1	(250ns) MK4096	4.95
MM5280	22	4096x1	(200ns) 2107	3.95
MM5290-2	16	16,384x1	(150ns)	1.89-8/14.95
MM5290-3	16	16,384x1	(200ns)	1.69-8/12.95
MM5290-4	16	16,384x1	(250ns)	1.49-8/10.95
MM5298-3	16	8192x1	(200ns)	1.69

STATIC RAMS

1101	16	256x1	(650ns)	1.49
2101	22	256x4	(450ns) 8101	2.49
2102	16	1024x1	(350ns)	.89
21L02	16	1024x1	(450ns) L.P.	1.49
2111	18	256x4	(450ns) 8111	2.95
2112	16	256x4	(450ns) MOS	2.95
2114	18	1024x4	(450ns)	1.95-8/15.95
2114L	18	1024x4	(450ns) L.P.	2.25-8/15.95
2114-2	18	1024x4	(200ns)	2.25-8/15.95
2114L-2	18	1024x4	(200ns) L.P.	2.49-8/17.95
2141-3	18	4096x1	(150ns)	3.95
2147	18	4096x1	(70ns)	4.95
2148	18	1024x4	(70ns)	8.95
TMS4044	18	4096x1	(450ns)	3.95
TMS4045	18	1024x4	(450ns)	3.95
5101	22	256x4	(450ns) CMOS	4.95
MM5257	18	4096x1	(450ns) 4044	4.95
HM6116P-3	24	2048x8	(150ns) CMOS	7.95
HM6116-4	24	2048x8	(200ns) CMOS	6.95
HM6116LP-4	24	2048x8	(200ns) L.P. CMOS	7.95
7489	16	16x4	(50ns) 3101	2.25
74C920	22	256x4	(250ns) CMOS (6551)	3.95
74C921	18	256x4	(250ns) CMOS	3.95
74C929	16	1024x1	(250ns) CMOS (6501)	3.95
74C930	18	1024x1	(250ns) CMOS (6518)	3.95
74S189	16	16x4	(35ns) 93405	1.95
74S200	16	256x1	(80ns) 93410	3.95
74S206	16	256x1	(60ns) 93411	3.95
74S289	16	16x4	(35ns) 3101	2.25
82S10	16	1024x1	(50ns) O.C. (93415)	3.95
82S25	16	16x4	(50ns) O.C. (74S289)	2.25

EPROMS

1702A	24	256x8	(1us)	4.95
2708	24	1024x8	(450ns)	3.95
2708-5	24	1024x8	(550ns) SM00246	2.95
TMS2516	24	2048x8	(450ns) 2716	6.95
TMS2532	24	4096x8	(450ns) NMC2532	9.95
TMS2564	28	8192x8	(450ns)	19.95
TMS2716	24	2048x8	(450ns) 3 voltage	7.95
2716	24	2048x8	(450ns)	4.95
2716-1	24	2048x8	(350ns)	6.95
2732	24	4096x8	(450ns)	9.95
27580	24	1024x8	(450ns) single +5V	2.95
MM2764	28	8192x8	(450ns)	16.95
MM2764-3	28	8192x8	(300ns)	19.95

PROMS

74S188	16	32x8	PROM O.C. (6330-1)	1.49
74S287	16	256x4	PROM T.S. (6301-1)	1.95
74S288	16	32x8	PROM T.S. (6331-1)	1.95
74S387	16	256x4	PROM O.C. (6300-1)	1.95
74S471	20	256x8	PROM T.S. (6309-1)	5.95
74S472	20	512x8	PROM T.S. (6349-1)	4.95
74S473	20	512x8	PROM O.C. (6348)	4.95
74S474	24	512x8	PROM T.S. (DM87S296N)	4.95
74S475	24	512x8	PROM O.C. (6340)	4.95
74S478	24	1024x8	PROM T.S. (TBP28S86)	8.95
74S570	16	512x4	PROM O.C. (6305)	2.95
74S571	16	512x4	PROM T.S. (6306)	2.95
74S572	18	1024x4	PROM O.C. (6352)	4.95
74S573	18	1024x4	PROM T.S. (82S137)	4.95
82S23	16	32x8	PROM O.C. (27S18)	2.95
82S115	24	512x8	PROM T.S. (27S15)	9.95
82S123	16	32x8	PROM T.S. (27S19)	2.95
82S126	16	256x4	PROM O.C. (27S20)	3.95
82S129	16	256x4	PROM T.S. (27S21)	3.95
82S130	16	512x4	PROM O.C. (27S12)	5.95
82S185	18	2048x4	PROM T.S. (TBP24S81)	9.95
DM87S180N	24	1024x8	PROM O.C. (82S180)	9.95
DM87S181N	24	1024x8	PROM T.S. (82S181)	9.95
DM87S184N	18	2048x4	PROM O.C. (82S184)	9.95
DM87S185N	18	2048x4	PROM T.S. (82S185)	9.95
DM87S190N	24	2048x4	PROM O.C. (82S190)	19.95
DM87S191N	24	2048x8	PROM T.S. (82S191)	19.95

DATA ACQUISITION

DC10		Mostek DC/DC Convert. +5V to -9V	2.95
MC3470P	18	Floppy Disk Read AMP System	4.95
MC1408L7	16	7-bit D/A Converter (DAC0807LCN)	2.49
MC1408L8	16	8-bit D/A Converter (DAC0808LCN)	2.95
ADC0804	20	8-bit A/D Converter (1 LSB)	3.49
DAC0806	16	8-bit D/A Converter (0.78% Lin.)	1.95
ADC0809	28	8-bit A/D Converter (8-Ch. Multi.)	4.49
AY-5-1013A	40	30K BAUD UART (TR1602)	4.95

CONNECTORS

DB25 — D Subminiature (meets RS232)

Part No	Description	Price
DE9P	9 Pin Plug	$1.79
DE9S	9 Pin Socket	1.95
DA15P	15 Pin Plug	1.95
DA15S	15 Pin Socket	2.95
DB25P	**25 Pin Plug (Meets RS232)**	**2.49**
DB25S	**25 Pin Socket (Meets RS232)**	**3.25**
DB25P-831	25 Pin Right Angle Plug	4.95
DB25S-831	25 Pin Right Angle Socket	5.25
DC37P	37 Pin Plug	4.95
DC37S	37 Pin Socket	5.95
DD50P	50 Pin Plug	5.95
DD50S	50 Pin Socket	6.95

Accessories

DE-9H	Hood for DE-9 Series Connectors	$1.19
DA-15H	Hood for DA-15 Series Connectors	1.29
DB25H	Hood for DB25 Series Connectors	1.25
DC37H	Hood for DC37 Series Connectors	1.39
DD50H	Hood for DD50 Series Connectors	1.49
DZ0418-2	2 screws for mtg. connectors to a panel	.79

Solder Eyelet/Wire Wrap Edge Card

Part No	Cnts	Sp	Description	Price
15/30SE	15/30	156	Solder Eyelet	$1.79
18/36SE	18/36	156	Solder Eyelet	1.95
22/44SE	22/44	156	Solder Eyelet	2.49
22/44PC	22/44	156	PC type (no mtg. ears)	.99
50/100SE	50/100	125	Solder Eyelet	9.95
22/44WW	22/44	156	Wire Wrap - Level 3	4.95
67031-5	22/44	156	WW (Pins .0625x.01x.75)	3.95
R 681-1	50/100	125	Wire Wrap - Level 3	7.95
R 681-2	50/100	125	Wire Wrap - Level 1	6.95

RF Coaxial Connectors

Part No	Description	Price
PL259	UHF Plug	$.89
SO239	UHF Panel Receptacle	.69
PL258	UHF Straight Adapter	.89
UG175/U	UHF Reducing Adapter	.49
UG88/U	BNC Plug	1.49
UG89/U	BNC Jack	1.69
UG306/U	BNC Angle Adapter	2.49
UG260/U	BNC Plug	1.49
UG1094/U	BNC Bulkhead Receptacle	.89

IC SOCKETS

For Socket Required, See Column After The IC Part No.

LOW PROFILE (TIN) SOCKETS

	1-9	10-99	100-999
8 pin LP	.16	.14	.13
14 pin LP	.17	.15	.14
16 pin LP	.19	.17	.16
18 pin LP	.26	.24	.23
20 pin LP	.30	.27	.25
22 pin LP	.31	.28	.26
24 pin LP	.33	.30	.28
28 pin LP	.40	.37	.35
36 pin LP	.46	.42	.39
40 pin LP	.49	.46	.43

— Soldertail Standard Tin & Gold Also Available —

WIRE WRAP (GOLD) SOCKETS LEVEL #3

	1-9	10-99	100-999
8 pin WW	.49	.45	.42
10 pin WW	.65	.62	.59
14 pin WW	.65	.62	.59
16 pin WW	.69	.65	.61
18 pin WW	.89	.85	.79
20 pin WW	1.09	1.05	.99
22 pin WW	1.25	1.19	1.15
24 pin WW	1.29	1.23	1.18
28 pin WW	1.59	1.50	1.45
36 pin WW	1.85	1.75	1.69
40 pin WW	1.99	1.89	1.79

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INTERSIL

*Evaluation Kits

Part No.	**Pins	Function	Price
7045IPI	28	CMOS Precision Timer	14.95
7045EV/Kit*	28	Stopwatch Chip, XTL	19.95
7106CPL	40	3½ Digit A/D (LCD Drive)	9.95
7106EV/Kit*	40	IC, Circuit Board, Display	34.95
7107CPL	40	3½ Digit A/D (LED Drive)	11.95
7107EV/Kit*	40	IC, Circuit Board, Display	29.95
7116CPL	40	3½ Digit A/D LCD Dis. HLD	16.95
7117CPL	40	3½ Digit A/D LED Dis. HLD	15.95
7201IUS		Low Battery Volt Indicator	2.25
7205IPG	24	CMOS LED Stopwatch/Timer	12.95
7205EV/Kit*	24	Stopwatch Chip, XTL	14.95
7206CJPE	16	Tone Generator	4.95
7206CEV/Kit*	16	Tone Generator Chip, XTL	7.95
7207AIPD	14	Oscillator Controller	5.95
7207AEV/Kit*	14	Freq. Counter Chip, XTL	7.95
7208IPI	28	Seven Decade Counter	15.95
7209IPA	8	Clock Generator	3.95
7215IPG	24	4 Func. CMOS Stopwatch CKT	13.95
7215EV/Kit*	24	4 Func. Stopwatch Chip, XTL	14.95
7216AIJI	28	8 Digit Univ. Counter C.A.	29.95
7216CIJI	28	8 Digit Freq. Counter C.A.	24.95
7216DIPI	28	8 Digit Freq. Counter C.C.	19.95
7217IJI	28	4 Digit LED Up/Down Counter C.A.	10.95
7217AIPI	28	4 Digit LED Up/Down Counter C.C.	11.95
7224IPL	40	LCD 4½ Digit Up Counter DRI	10.95
7226AIJL	40	8 Digit Univ. Counter	29.95
7226AEV/Kit*	40	5 Function Counter Chip, XTL	74.95
7240IJE	16	CMOS Bin Prog. Timer/Counter	4.95
7242IJA	8	CMOS Divide-by-256 RC Timer	2.25
7250IJE	16	CMOS BCD Prog. Timer/Counter	6.00
7260IJE	16	CMOS BCD Prog. Timer/Counter	5.25
7555IPA	8	CMOS 555 Timer	1.45
7556IPD	14	CMOS 556 Timer	2.20
7611BCPA	8	CMOS Op Amp Comparator 5MV	2.25
7612BCPA	8	CMOS Op Amp Ext. Cmvr. 5MV	2.95
7621BCPA	8	CMOS Dual Op Amp Comp. 5MV	3.95
7631CCPE	16	CMOS Tri Op Amp Comp. 10MV	5.35
7641CCPD	14	CMOS Quad Op Amp Comp. 10MV	7.50
7642CCPD	14	CMOS Quad Op Amp Comp. 10MV	7.50
7660CPA	8	Voltage Converter	2.95
8038CCPD	14	Waveform Generator	3.95
8048CCPE	16	Monolithic Logarithmic Amp	16.95
8069CCQ		50ppm Band—GAP Volt Ref. Diode	2.50
8211CPA	8	Volt Ref/Indicator	2.95
8212CPA	24	Volt Ref/Indicator	2.95
30009		**1983 Intersil Data Book (1356 pages)**	**$9.95**

74C—C/MOS

74C00	14	.35				74C221	16	1.95
74C02	14	.35				74C240	20	1.95
74C04	14	.29	74C95	14	1.39	74C244	20	1.95
74C08	14	.35	74C107	14	.89	74C373	20	2.49
74C10	14	.35	74C151	16	2.49	74C374	20	2.49
74C14	14	.59	74C154	24	3.49	74C901	14	.59
74C20	14	.35	74C157	16	2.25	74C903	14	.59
74C30	14	.35	74C160	16	1.19	74C906	14	.59
74C32	14	.39	74C161	16	1.19	74C911	28	8.95
74C42	16	1.39	74C162	16	1.19	74C912	28	8.95
74C48	16	1.95	74C163	16	1.19	74C915	18	1.19
74C73	14	.79	74C164	14	1.49	74C917	28	8.95
74C74	14	.69	74C173	16	.79	74C922	18	4.49
74C85	16	1.95	74C174	16	1.19	74C923	20	4.95
74C86	14	.39	74C175	16	1.19	74C925	16	5.95
74C89	16	5.95	74C192	16	1.49	74C926	18	5.95
74C90	14	1.19	74C193	16	1.69	80C95	16	.39
74C93	14	1.19	74C195	16	1.39	80C97	16	.39

NEW PRODUCT! 74HC High Speed CMOS

74HC00	14	.75	74HC138	16	1.49	74HC243	14	2.79
74HC02	14	.75	74HC139	16	1.49	74HC251	16	1.19
*74HCU04	14	.75	74HC147	16	1.19	74HC266	14	.99
74HC08	14	.75	74HC151	16	1.19	74HC280	14	4.95
74HC10	14	.75	74HC157	16	1.19	74HC373	20	3.95
74HC20	14	.75	74HC160	16	1.79	74HC374	20	3.95
74HC27	14	.75	74HC161	16	1.79	74HC533	20	3.95
74HC74	14	.99	74HC164	14	1.79	74HC534	20	3.95
74HC75	16	.99	74HC174	16	1.39	74HC4075	14	.75
74HC86	14	.99	74HC175	16	1.39	74HC4538	16	2.95
74HC109	16	1.39	74HC242	14	2.79	74HC4543	16	4.95

*74HCU04 is unbuffered. All others are buffered. **Send $.30 for Data Sheet.**

NEW Programmable Array Logic (PALS)

Part No.	**Pins	Function	Price
PAL10H8	20	Octal 10-Input AND-OR Gate Array (High Output)	$5.95
PAL12H6	20	Hex 12-Input AND-OR Gate Array (High Output)	5.95
PAL14H4	20	Quad 14-Input AND-OR Gate Array (High Output)	5.95
PAL10L8	20	Octal 10-Input AND-OR-Invert Gate Array (Low Output)	5.95
PAL12L6	20	Hex 12-Input AND-OR-Invert Gate Array (Low Output)	5.95
PAL14L4	20	Quad 14-Input AND-OR-Invert Gate Array (Low Output)	5.95
PAL16L8	20	Octal 16-Input AND-OR-Invert Gate Array (Low Output)	9.95
PAL16R8	20	Octal 16-Input Register AND-OR Gate Array	9.95
PAL16R6	20	Hex 16-Input Register AND-OR Gate Array	9.95
PAL16R4	20	Quad 16-Input Register AND-OR Gate Array	9.95
30012		**1982 National PAL Data Book (176 pages)**	**$5.95**

LINEAR

TL071CP	8	.79				NE570N	16	3.95
TL072CP	8	1.39				LM703CN	8	1.19
TL074CN	14	1.95	LM340K-15		1.35	LM709N	14	.49
TL081CP	8	.59	LM340T-5		.79	LM710N	14	.69
TL082CP	8	1.19	LM340T-12		.79	LM711N	14	.79
TL084CN	14	1.95	LM340T-15		.79	LM723N	14	.55
LM301CN	8	.35	LM348N	14	.99	LM733N	14	1.00
LM302H		1.95	LM350K		4.95	LM739N	14	1.95
LM304H		1.95	LF355N	8	1.10	LM741CN	8	.35
LM305H		.99	LF356N	8	1.10	LM747N	14	.69
LM307CN	8	.45	LM370N	14	4.49	LM748N	8	.59
LM308CN	8	.69	LM373N	14	3.95	LM1310N	14	1.49
LM309K		1.25	LM377N	14	1.95	LM1458CN	8	.59
LM310CN	8	1.75	LM380N	14	.89	LM1488N	14	.69
LM311CN	8	.69	LM381N	14	1.79	LM1489N	14	.69
LM312H		2.49	LM382N	14	1.39	LM1496N	14	1.95
LM317T		1.19	LM384N	14	1.79	LM1800N	16	1.49
LM317K		3.95	LM386N-3	8	.89	LM1889N	18	1.95
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LM319N	14	1.95	TL496CP	8	1.19	LM2002T		1.49
LM320K-5		1.35	NE510A	14	4.95	LM3189N	16	1.59
LM320K-12		1.35	NE529A	14	2.95	LM3900N	14	.59
LM320K-15		1.35	NE531V	8	2.95	LM3905CN	8	1.19
LM320T-5		.89	NE536H		8.95	LM3909N	8	.99
LM320T-12		.89	NE540H		4.95	LM3914N	18	3.49
LM320T-15		.89	NE544N	14	2.95	LM3915N	18	3.49
LM323K		5.95	NE550A	14	1.95	LM3916N	18	3.49
LM324N	14	.59	NE555V	8	.35	RC4136N	14	1.25
LM337T		1.95	LM556N	14	.69	RC4151NB	8	1.95
LM338K		6.95	NE564N	16	2.95	ICL8038B	14	3.95
LM339N	14	.69	LM565N	14	1.19	LM13080N	8	1.19
LM340K-5		1.35	LM566CN	8	1.49	LM13600N	16	1.19
LM340K-12		1.35	LM567V	8	.89	MORE AVAILABLE		

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22 pf	.08	.06	.05	.0047µF	.08	.06	.05
47 pf	.08	.06	.05	.01µF	.08	.06	.05
100 pf	.08	.06	.05	.022µF	.09	.07	.06
220 pf	.08	.06	.05	.047µF	.09	.07	.06
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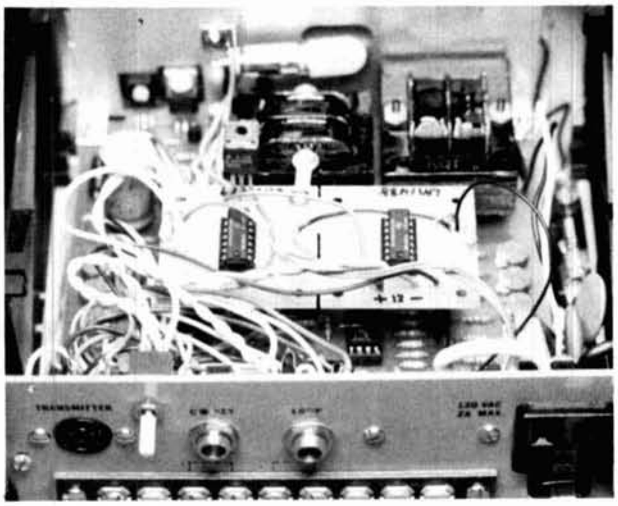
3.3/50V	.17	.15	.11	1.0/16V	.15	.13	.12
4.7/25V	.18	.15	.11	1.0/25V	.16	.14	.13
10/25V	.18	.15	.11	1.0/50V	.17	.15	.14
10/50V	.19	.16	.12	4.7/16V	.15	.13	.12
22/25V	.19	.16	.12	4.7/25V	.16	.14	.13
22/50V	.24	.20	.18	4.7/50V	.17	.15	.14
47/25V	.25	.21	.19	10/16V	.15	.13	.12
47/50V	.29	.25	.23	10/25V	.16	.14	.13
100/25V	.28	.24	.22	10/50V	.17	.15	.14
100/50V	.41	.37	.34	47/50V	.25	.21	.19
220/25V	.39	.34	.33	100/16V	.21	.17	.14
220/50V	.49	.45	.41	100/25V	.25	.23	.21
470/25V	.54	.49	.45	100/50V	.37	.34	.31
1000/16V	.79	.69	.61	220/16V	.25	.21	.19
2200/16V	.89	.79	.69	470/25V	.35	.31	.27

an RS-232 to TTL interface

Let your computer be your teleprinter



Interface circuit installed in Flesher TU-170 on prototype board in middle. Normal/ASCII switch selector is on the left side of rear panel.

With FCC approval of ASCII transmissions, more and more Amateurs are letting the dust collect on their teleprinters and are using their computers for RTTY or CW communication. If your computer or computer terminal has a standard RS-232 serial interface port, this circuit will allow ASCII through your RTTY Terminal Unit (TU).

This circuit was designed to work with a Flesher TU-170 and will work with any TU having TTL input/output. A National Semiconductor LM1488 line driver inverts the TU demodulator to Mark low at −12 Vdc, Space high at +12 Vdc for RS-232 input to the computer. The National LM1489 line receiver converts the computer output Mark to TTL high and Space to TTL low for keying the audio frequency shift input of the TU.

The Flesher provides regulated ±12 Vdc but a 7805 +5 Vdc three-terminal regulator was added for the LM1489. The 2200-ohm series resistors are for serial port protection and may be considered optional. All components mount easily inside the TU-170, as shown in the photograph. The DB-25 connector

By **Bob Harvey, WD4KQI,** 231 Winding Way Road, Lynchburg, Virginia 24502

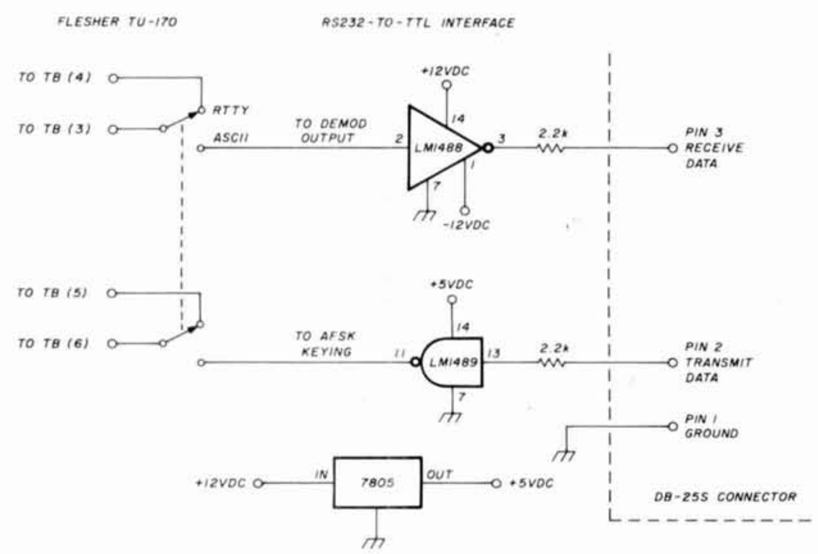
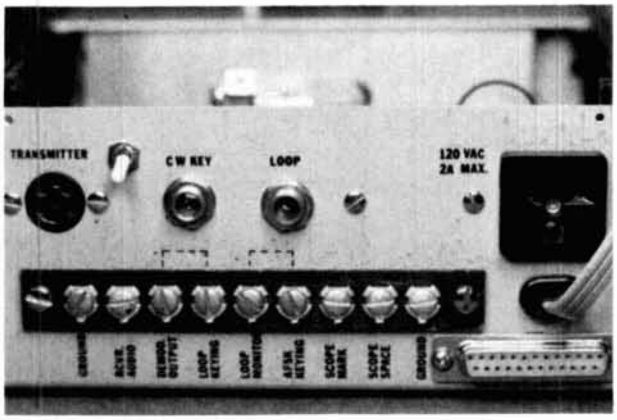


fig. 1. RS-232 to TTL interface.

quantity	description
1	LM1488N, Jameco
1	LM1489N, Jameco
1	7805 +5 Vdc regulator IC, Radio Shack 276-1770
2	2.2K, ¼ watt resistors
1	dual IC board, Radio Shack 276-159
2	14 pin IC sockets, Radio Shack 276-1999
1	dpdt switch, Radio Shack 275-614
1	DB-25S connector, Jameco



Rear panel of Flesher TU-170. Selector switch is between the transmitter and CW key connectors. DB-25 connector for serial input/output is on the bottom right. Note jumper markings on terminal board: internal jumpers must be removed for selector switch operation.

for the RS-232 interface mounts on the TU-170 rear panel.

The toggle switch allows the Flesher unit to operate normally or with the RS-232 interface. The Flesher TU-170 must be modified to pass the higher 110 baud ASCII rate: change C19, C20, and C23 from 0.01 μF to 0.005 μF and remove the two jumpers from TB(3) to TB(4) and TB(5) to TB(6).

The computer must be initialized to 110 baud, with no parity, eight-bit word, two stop bits, and zero nulls. Some software may be required for serial communication and several companies provide hardware and software packages. Two companies providing ready-to-run packages for the TRS-80 Model III are Crown Micro Products and Macrotronics, Inc.

The Flesher TU-170 is a proven, reliable unit, but I have found it is susceptible to stray rf in the shack. The autostart may be tripped; a cure is to bypass the audio input at TB(2) to ground with a 150 pF capacitor. Ferrite beads on each terminal strip lead will help to keep out rf. The audio line from transceiver to TU should be shielded for proper operation of the terminal unit.

Only three pins of the RS-232 connector are required for TRS-80 to TU-170 interconnection. Other computers or terminal units may require more lines; the remaining three line drivers and receivers are unused and available.

This interface has been installed in other terminal units and it is a welcome relief to operate in relative silence, compared with the noise made by a teleprinter.

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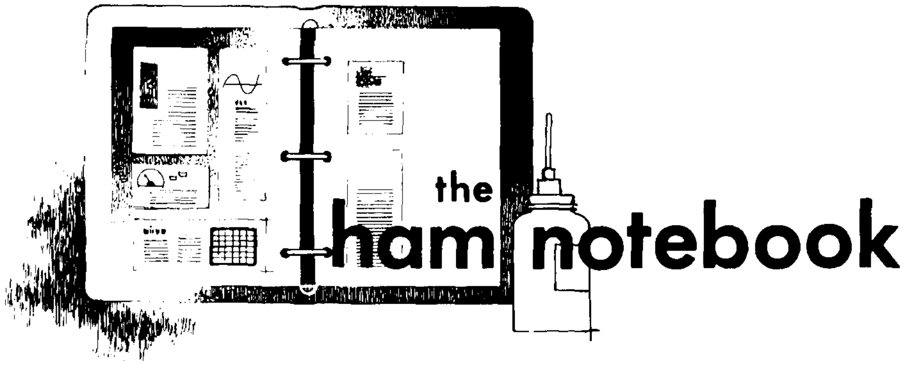

trans-global power supply

The power supply in this design can supply solid state low-voltage requirements from a variety of input mains voltages, making it ideal for any equipment used internationally. It satisfies a 12 volt at 1 amp specification for a particular piece of equipment; by changing the voltage and/or current limitations of the components, it can be altered to suit your needs over a very wide range of input and output combinations.

The novelty in this design (see **fig. 1**) is the use of switch S1 to handle wide variations in input voltages while providing the desired output. S1 can be a physically actuated switch accessible to the user, or a leaf-type switch thrown automatically when the proper U.S. or non-U.S. (usually 220 Vac) cord is inserted into the back apron receptacle.

When the switch is in the 120 Vac position, the transformer operates with the full secondary voltage applied to a bridge rectifier system whose filtered dc output is fed to the regulator. In the 240 Vac position, the transformer is center-tapped, supplying the rectifier system with one-half the available transformer secondary ac voltage. The bridge becomes a full wave rectifier system, ignoring two of the diodes, and a dc filtered output in approximately the same voltage range as the 120 Vac position of S1 is fed to the regulator to obtain the same regulated dc output.

The supply may be re-designed by applying textbook design formulas to it. Use the higher voltage and current requirement each component part requires; this will satisfy all the requirements for dual input voltage use, but what of the variations found in international use?

The transformer may have to be a 50 Hz instead of 60 Hz model, to meet the more common 50 Hz mains frequency found in most countries. Many places may have only 105 Vac as the nominal voltage, or perhaps 200 Vac as a high tap input. The transformer, diodes, and filtering should be calculated to prevent the filtered dc feeding the regulator to drop below the regulation minimum dc input to the regulator device. On the other side of the coin, diode PIV rating, the ratings of filter capacitors, and the regulator maximum dc input limits will have to be watched carefully to allow headroom for countries with poor mains regulation or high-side mains input like 140 Vac or 260 Vac.

Switches used in the primary of a transformer must be rated for at least the mains voltage, which in international use can climb to as high as 260 Vac. By using a switch in the secon-

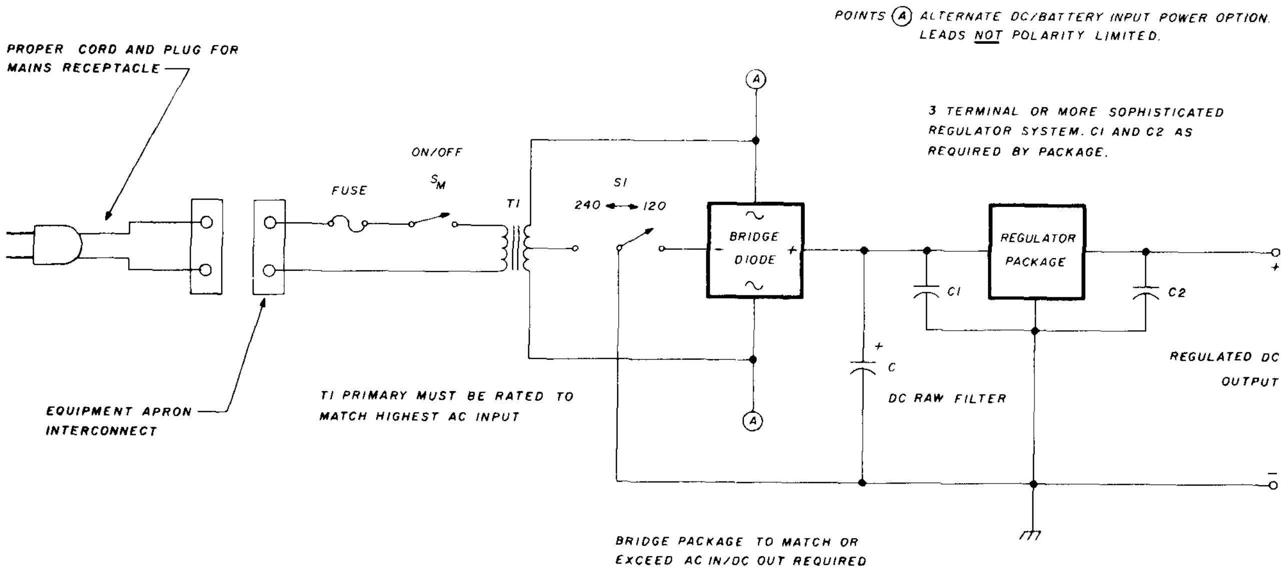

fig. 1. International power supply.

dary, and for most solid state dc requirements, that voltage can be much lower even when the switch is used at the ac secondary of the transformer, like S1. You have to remember the current requirement at that point is quite a bit higher than in primary uses, but the switches should still be easier to find, less expensive, and not need the UL and other higher-voltage requirements necessary in primary applications of switches.

David J. Brown, W9CGI

homebrew linears: treat or trap?

An account of a fatal disaster that killed a broadcast engineer some years ago made me wonder if a similar accident could happen to any Amateur. As I saw that indeed, it could, I decided to write this note to warn fellow Amateurs.

The original accident arose from a discontinuity between the main TX chassis and the high voltage B return from the power supply. This resulted in the TX chassis, cabinet, and antenna becoming *hot* at B+ potential.

A similar situation could easily occur with a homebrew linear equipped with a separate power supply. Consider the arrangement outlined in **fig. 2.** This shows the basic configuration of a tube linear, and power supply implemented on a separate chassis, a fairly common arrangement adopted by homebrewers (and by some commercial ones, too). Assume the builder adopts the usual practice and grounds the PS via the ac earth return, but omits, as many of us do, to connect a separate earth return to the linear chassis. Next, assume that the antenna and driving TRX are connected to the amplifier, and the big switch is turned on. The linear tubes light, drive is applied, and the appropriate plate voltage and current appears on the respective meters. All appears to be in order.

Suppose now that due to error or cussedness the B return has a discontinuity. Should our builder now disconnect the drive input coax, or perform some other operation that isolates the linear from a default earth return, he will find himself shaking hands with the full B+ as his body now provides the B− return to ground.

I leave it to the reader to work out the various combinations and circumstances that can lead to a similar result. The moral of the story is that because we tend to visualize current going to and coming from a device, we see any interruption of the to- or from-circuit as rendering the device inoperative and neutral. We fail to appreciate that decidedly unhealthy current can return via internal circuitry to make contact at a considerable potential with grounded objects like ourselves. In the case in question, the amplifier tubes provide the continuity for the B+ to the chassis and case, particularly as the separate filament transformer keeps the tubes lit and conductive.

Make certain you are not relying on just one wire and its associated contacts for the B return between the linear and the HT power supply. A better, but not absolutely fail-safe, method is to ground one side of the filaments at both ends of the connecting cable if these are supplied from the PS chassis. Another is to isolate the B minus on the PS side from the PS chassis. Alternatively, use a braided ground strap and bolt this to both boxes. Please check your homebrew devices and correct them accordingly, lest you become an untimely addition to the silent key list.

postscript

After writing this article, I took a look at the details of a number of linear amplifiers in the 1981 *ARRL Handbook*. All indicated only one return connection between the amplifier and the HT power supply. Filaments are invariably fed through a separate transformer with a non-earthed ac input. A check in the power supply section showed a 3400 volt supply offering a two-terminal output. The B− was grounded to the chassis and the ac input was shown as having a three-way plug input with the ground to chassis. Users of such a PS/linear-amplifier combination are only one pin connector away from a sudden end.

L.R. Newsome, VK4LR

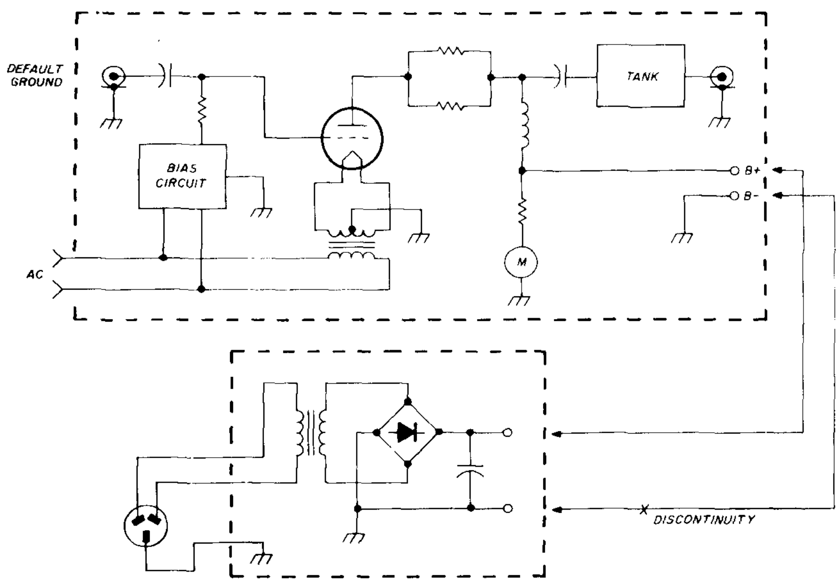

fig. 2. Tube linear with power supply.

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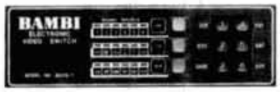

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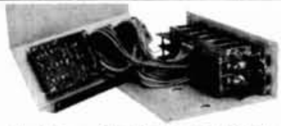

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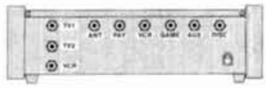

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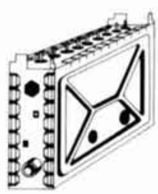

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KNOW FIRST! Ham fanatics, you need The Pink Sheets — twice-monthly award-winning Hot Insider Newsletter! Ten pages, acclaimed best! Confidential facts, ideas, insights, news, technology, predictions, alerts! Quoted coast-to-coast! We print what you don't get elsewhere! $18.00 annually w/money back guarantee! Free sample — SASE (two stamps) W5YI, Box #10101-H, Dallas, TX 75207.

PC BOARDS from your artwork or schematic. Info and sample. Jaxxon Electronics, K0UV, 1530 W. Villa Theresa, Phoenix, AZ 85023. (602) 866-9071.

SAVE MONEY on Rubber Stamps. Catalog plus discount coupon. Send 25¢. Hastings, Box 1951-HR, Pine Bluff, AR 71613.

HAMMARLUND HQ 180 General coverage receiver, very clean w/manual, best offer. Hans J. Kunz, WB4OEY, 9 Mallard Road, Acton, Mass. 01720. (617) 263-9321.

More Details? CHECK—OFF Page 102

APARTMENT HAMS — Solve your headaches with antennas, grounds, RFI, landlords. Every aspect of apartment/condo operation explained in *Handbook of Apartment Operation* by Dan Fox, W2IQD. Based on 24 years' experience. "Invaluable assistance!" says QST. Get on the air and stay on! Money back Guarantee! Rush $12.50 plus $1.50 p&h. Check, MO, Visa or MasterCard (number, expiration date). Foundation Publishing, Dept. H9, Box 805, Merrimack, NH 03054.

COLLINS 204C-1 linear amplifier, as new. W6XY, 3348 Arbor Drive, Pleasanton, CA 94566. (415) 846-1459.

WANTED: Buy or swap Model 28 paper winders (LPW 300). Top prices paid for complete units or parts. Call or write Van, W2DLT. In NJ 800-272-1331, outside NJ 800-526-3662. Box 217, Berkeley Hts., NJ 07922.

MANUALS for most ham gear made 1937/1970. Send $1.00 for 18 page "Manual List", postpaid. HI-MANUALS, Box R802, Council Bluffs, Iowa 51502.

WANTED: Bird 43. Joe Adinolf, 1028 Fairview, Ojai, CA 93023.

SATELLITE TELEVISION — Howard/Coleman boards to build your own receiver. For more information write: Robert Coleman, Rt. 3, Box 58-AHR, Travelers Rest, SC 29690.

WANTED: Schematics-Rider, Sams or other early publications. Scaramella, P.O. Box 1, Woonsocket, RI 02895-0001.

WANTED: Early Hallicrafter "Skyriders" and "Super Skyriders" with silver panels, also "Skyrider Commercial", early transmitters such as HT-1, HT-2, HT-8, and other Hallicrafter gear, parts, accessories, manuals. Chuck Dachis, WD5EOG, The Hallicrafter Collector, 4500 Russell Drive, Austin, Texas 78745.

TELETYPE PARTS WANTED: Any quantity, any models, highest prices paid. In NJ 800-272-1331, outside NJ 800-526-3662. Van, W2DLT, Box 217, Berkeley Hts., NJ 07922.

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(ROHN TOWERS) — Wholesale direct to users — All products available — write or call for price list. Also we are wholesale distributors for Antenna Specialists and Regency FM Radios. Hill Radio, P.O. Box 1405, 2503 GE Road, Bloomington, IL 61701. (309) 663-2141.

HAM RADIO REPAIR, experienced, reasonable, commercial licensed. Robert Hall Electronics, P.O. Box 8363, San Francisco, CA 94128. W6BSH, (408) 292-6000.

DX PREDICTOR: Computes MUF, FOT, LUF between any two QTHs. Documented: Easy to Use: Graphical/tabular output. Adapted from algorithms currently used by US Govt. agencies. Available for Apple II + (48K: disk or cassette) and PET (16K, cassette only). Documentation $5 (refundable). Program + Documentation $40.00. Checks to K.J. Flynn, P.O. Box 903, Mountain View, CA 94042.

RUBBER STAMPS: 3 lines $3.25 PPD. Send check or MO to G.L. Pierce, 5521 Birkdale Way, San Diego, CA 92117. SASE brings information.

D & V RADIO PARTS — Variable capacitors, miniductors, toroids, etc. Write for flyer, stamp please. 12805 W. Sarle, Freeland, Michigan 48623.

MOBILE IGNITION SHIELDING provides more range with no noise. Available most engines. Many other suppression accessories. Literature, Estes Engineering, 930 Marine Dr., Port Angeles, WA 98362.

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CB TO 10 METER PROFESSIONALS: Your rig or buy ours — AM/FM/SSB/CW. Certified Communications, 4138 So. Ferris, Fremont, Michigan 49412; (616) 924-4561.

AFC SEMI-KITS! Stop VFO drift. See June 1979 HR. $55.00 plus $3.00 UPS. Mical Devices, P.O. Box 343, Vista, CA 92083.

HAMS FOR CHRIST — Reach other Hams with a Gospel Tract sure to please. Clyde Stanfield, WA6HEG, 1570 N. Albright, Upland, CA 91786.

FOR SALE: Yaesu FL-101 all band SSB transmitter S/N5M306181; Yaesu Loadliner; Yaesu Monitor scope Y0100 S/N 6M214156; Dentron Radio Clipperton-L Linear Amplifier. John Bauer, 422 S. Park, LaGrange, IL 60525 (312) 352-0328 (Home); (312) 352-9441 (Business). $500/ offer for lot.

KLM: Echo II, $129; KLM Echo 70CM, $249; Pkg. deal

$370 — I ship. WB6AWM/7, P.O. Box 251, Electric City, WA 99123.

KT5B Multi-Band dipole 160-80M (WARC) $59.95, 2KW plus center connector w/SO239 $8.50. Kilo-Tec, P.O. Box 1001, Oak View, CA 93022. (805) 646-9645.

MOTOROLA ALL SOLID-STATE MOTRAN RADIOS, Model X43LSN-2170, four frequency, transmit 150 MC (30W), receive 450 MC. Will operate in Ham Bands. No modification required. Large stock available. $150.00 each. Omni Communications. Call (312) 852-0738.

MOTOROLA VHF (2 meters) U43 Motran, 4 channel all solid state. Omni Communications. Call (312) 852-0738.

Coming Events

ACTIVITIES

"Places to go..."

ARKANSAS: The Arkansas DX Association's annual DX meeting and banquet, Saturday, December 4, Fort Smith Ramada Inn. Friday night mixer and hospitality suite for early arrivals. Saturday morning ADXA business meeting followed by a DX forum. Saturday afternoon Arkansas/Texas football party. Saturday evening banquet with a DX speaker of note. For information: Harold Wilson, KB5RF, 3507 Lochland, North Little Rock, Ark. 72116. (501) 753-8625.

MASSACHUSETTS: The Hampden County Radio Association's annual auction, Friday, November 5, Granger School, intersection of Routes 57 and 187, Feeding Hills. Doors open 7 PM; auction begins 8 PM. For more information: Dick Manner, N8BQU at (413) 783-9380.

MASSACHUSETTS: The Honeywell 1200 Radio Club, sponsor of 147.72/12 repeater and the Waltham Amateur Radio Association, sponsor of 146.04/64 repeater, will hold their annual Amateur Radio and electronics auction, Saturday, November 20, Honeywell Plant, 300 Concord Road, Billerica. Doors open 10 AM. Free admission and parking. Talk in on both repeaters. For more information: Doug Purdy, N1BUB, 3 Visco Road, Burlington, MA 01803.

MICHIGAN: ENCON Corporation together with SOLAREX Corporation will provide a FREE photovoltaic seminar (electricity from the sun), November 4, 7:30 PM, Dearborn Hyatt Regency, Dearborn. A talk on history, production of solar cells, and applications will inform and educate all those who attend. Call for reservations: Encon Corporation, 27584 Schoolcraft Rd., Livonia, MI 48150. (313) 261-4130.

MICHIGAN: The 17th annual Hazel Park Amateur Radio Club's Swap and Shop, Sunday, December 5, Hazel Park High School, Hughes St. at 9½ Mile Road, Hazel Park. Doors open 8 AM. Tickets $1.50 advance or $2.00 door. Plenty of food, parking, prizes. Tables $1.00 per ft. Talk in on 146.52. For tickets, table reservations, information SASE to Hazel Park Amateur Radio Club, P.O. Box 368, Hazel Park, MI 48030. (313) 398-3189.

NEW YORK: The Radio Central Amateur Radio Club's 1982 edition "Ham-Central", Sunday, November 28, main social hall, Temple Isaiah, 1404 Stony Brook Road, Stony Brook, Long Island, 50 miles east of NYC. General admission $2.00, XYL's and kids under 12 free. Doors open 8:30 AM. Prizes, refreshments, slide shows. Talk in on WA2UEC, 144.550/145.150 and 146.52 simplex. For advanced sellers' reservations: Scotty Policastro, KA2EQW, 80 - 7th Street, Bohemia, NY 11716 (516) 589-2557 and Bob Yarmus, K2RGZ, 3 Haven Court, Lake Grove, NY 11755 (516) 981-2709.

PENNSYLVANIA: The Foothills ARC annual Swap and Shop, November 6, St. Bruno Church, South Greensburg. Indoor flea market, prizes. Talk in on 146.07/67 and .52/.52. For information: Mario, W3TTN or write FARC, P.O. Box 236, Greensburg, PA 15601.

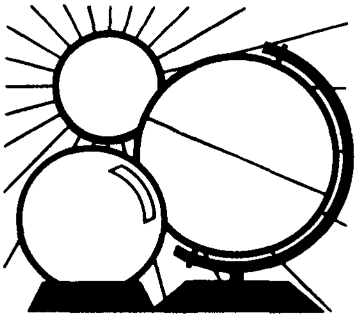
OPERATING EVENTS

"Things to do..."

DECEMBER 11: The K1BCI C/Q Radio Club will operate a special event station honoring the 35th anniversary of the Christmas Village in Torrington, CT. The club will operate from Christmas Village on 10, 15, 20, 40 and 80 meters, December 11 through 19. Certificates will be issued for contacts made. For information: Jim, WA1YZA or Nellie, WB1DVC.

JANUARY 15: The Potomac Valley Radio Club is sponsoring the United Nations World Communications Year contest from 0001 UTC to 2400 UTC, Saturday, January 15, 1983. The object of the competition is to stimulate interest in communications development. For more information SASE to Potomac Valley Radio Club, P.O. Box 337, Crownsville, MD 21032.

More Details? CHECK—OFF Page 102



DX FORECASTER

Garth Stonehocker, KØRYW

wintertime DX

November comes long enough after the fall equinox to begin wintertime DX. Usually most of us stay closer to home, pursuing indoor activities. Except for a little time spent outside putting finishing touches on new antennas or making winterizing repairs on old ones, the warmth of your shack feels just right. The wintertime DX season's advantages help make it a time of enjoyment, too. The sun, shining more in the southern hemisphere, lets signals escape from some daytime attenuation so lower-powered DX can reach us. The QRN noise from spring, summer, and fall thunderstorms decreases as fewer local thunderstorms pass through and the large thunderstorm areas near the equator move further south. The decrease in noise is particularly noticeable on the 160, 80, and 40-meter bands.

Another plus is that November is often specially significant because of the quiet conditions of the geomagnetic field. November and December are the quietest months of the year. By quietest I mean the increased steadiness of the magnitude and direction of the magnetic field, as measured at any selected point by a magnetometer (a very sensitive compass). See this column in *ham radio*, November, 1981, for more on geomagnetic variations.

The long hours of winter darkness allow the ionosphere to decay for an extended period after the midday peak. The long decay time leaves little ionization, and good DX on the lower-frequency bands becomes possible. Hence, 160 meters (our lowest frequency band) is a good bet for late night and early morning DX fun. This deep daily pre-dawn minimum contrasts with the maximum useable frequency's steep rise to a high value (almost as high as in the equinox periods) each day with the sunrise. The MUF and depth of the pre-dawn dip are related to the solar flux each day.

Plenty of meteor showers will be occurring from October 26 to November 22, with a maximum count of ten per hour from the third through the tenth. This shower is known as the Taurids. Lunar perigee is on the fourth, and full moon falls on the first.

last-minute forecast

The high-frequency bands, 10 through 20, will be the best DX bands the first and last weeks of the month. That will make the Thanksgiving holiday a good weekend for DX. The lower frequencies will be best for the middle of the month, although not too bad all month long. Geomagnetic disturbances may be expected around the fourth and twenty-first from solar flares and near the twelfth from coronal hole activity. Have a good holiday.

band-by-band summary

Fifteen meters will be open for F2 long skip by the trans-equatorial one-long-hop propagation. Openings should be frequent. Worldwide DX is prevalent from after sunrise until well after sunset, especially during the periods of high solar flux. (Listen to WWV at 18 minutes after the hour for reports on solar and geomagnetic conditions.)

Twenty meters will be open most days and nearly through the night to some areas, with long skip of 1000-2500 miles and some short-skip of 1200 miles near midday. Both propagation modes follow the sun across the sky: east, south, then west.

Forty meters is the transition band, with all-night propagation as well as some short skip during the day. Most areas of the world can be worked from darkness until just before sunrise. Hops shorten to about 2000 miles on this band, but the number of hops can increase since signal absorption is low during the night.

Eighty meters is traditionally a ragchewer's band, but DX is also possible. The band operates much like 40 meters, except the hop distances shorten to around 1500 miles at night and shorter during the daytime. Noise is so low this band is a joy to work during this time of year. The path direction follows the darkness across the earth (east, south, then west). You'll have to wiggle in between the QRM, however.

One-sixty meters will be like 80 meters, with skip range reduced to 1000 miles. It will provide good DX for late night and early morning DXers. The new band power and unrestricted areas should increase activity.

ham radio

WESTERN USA

NOVEMBER	2300	2200	2100	2000	1900	1800	1700	1600	1500	1400	1300	1200	1100	1000	0900	0800	0700	0600	0500	0400	0300	0200	0100	0000	GMT
	3:00	2:00	1:00	12:00	11:00	10:00	9:00	8:00	7:00	6:00	5:00	4:00	3:00	2:00	1:00	12:00	11:00	10:00	9:00	8:00	7:00	6:00	5:00	4:00	PST
ASIA FAR EAST	15	15	15	15	15	20	20	20	20	—	—	—	—	—	—	—	—	—	—	20	15	15	10	10	N
EUROPE	20	20	20	20	15	15	15	20	20	20	—	—	—	—	—	—	—	—	40	40	20	20	20	20	NE
S. AFRICA	15	15*	15*	10	10	15	15	15	20	—	—	—	—	20	20	20	20	20	20	20	20	15	15	15	E
S. AMERICA	10	10	10	10	10	15	15	15	15	20	40	40	40	40	20	20	20	20	20	15	15	15	15	10	SE
ANTARCTICA	15	15	15	15	15	15	—	—	—	—	40	40	20	20	20	20	20	20	15	15	15	15	15	15	S
NEW ZEALAND	10	10	10	10	10	15	15	40	40	40	40	40	40	40	20	20	20	15	15	15	10	10	10	10	SW
OCEANIA AUSTRALIA	10	10	10	15	15	15	15	15	20	40	40	40	20	—	—	20	15	15	15	15	10	10	10	10	W
JAPAN	10	10	10	15	20	—	—	—	—	—	—	40	40	40	40	40	20	20	20	15	15	15	15	15	NW

MID USA

	2300	2200	2100	2000	1900	1800	1700	1600	1500	1400	1300	1200	1100	1000	0900	0800	0700	0600	0500	0400	0300	0200	0100	0000	GMT
	4:00	3:00	2:00	1:00	12:00	11:00	10:00	9:00	8:00	7:00	6:00	5:00	4:00	3:00	2:00	1:00	12:00	11:00	10:00	9:00	8:00	7:00	6:00	5:00	MST
ASIA FAR EAST	—	—	—	—	20	20	20	20	20	20	20	20	—	—	—	—	—	—	—	—	20	15	15	15	N
EUROPE	20	20	20	20	15	15	15	15	20	20	—	—	—	40	40	40	40	40	40	40	20	20	20	20	NE
S. AFRICA	15	15	15	15	10	10	10	10	10	—	—	—	—	—	—	—	20	20	20	20	20	20	15	15	E
S. AMERICA	15	15	15	10	10	10	10	10	10	15	20	20	40	40	20	40	40	40	20	20	20	20	15	15	SE
ANTARCTICA	15	15	—	—	—	—	—	—	—	—	—	—	—	20	20	20	20	15	15	15	15	15	15	15	S
NEW ZEALAND	15	10	10	10	15	20	20	20	—	—	—	—	—	—	20	20	20	20	20	20	15	15	10	10	SW
OCEANIA AUSTRALIA	10	10	10	15	15	15	15	15	20	—	—	—	—	—	20	20	20	20	20	15	15	15	15	10	W
JAPAN	10	10	15	20	—	—	—	—	—	—	—	—	20	20	20	20	—	—	20	20	20	15	15	15	NW
	5:00	4:00	3:00	2:00	1:00	12:00	11:00	10:00	9:00	8:00	7:00	6:00	5:00	4:00	3:00	2:00	1:00	12:00	11:00	10:00	9:00	8:00	7:00	6:00	CST

EASTERN USA

	2300	2200	2100	2000	1900	1800	1700	1600	1500	1400	1300	1200	1100	1000	0900	0800	0700	0600	0500	0400	0300	0200	0100	0000	GMT
	6:00	5:00	4:00	3:00	2:00	1:00	12:00	11:00	10:00	9:00	8:00	7:00	6:00	5:00	4:00	3:00	2:00	1:00	12:00	11:00	10:00	9:00	8:00	7:00	EST
ASIA FAR EAST	—	—	—	—	—	10	15	15	20	20	—	—	—	—	20	20	20	—	—	—	—	—	15	15	N
EUROPE	20	20	20	15	15	15	15	10	15	15	—	—	—	—	40	40	40	40	40	20	20	20	20	20	NE
S. AFRICA	15	15	10	10	10	10	10	10	10	10	10	—	—	40	40	40	20	20	20	20	20	20	20*	15	E
CARIBBEAN S. AMERICA	15	15	15	10	10	10	10	10	10	10	20	20	40	40	40	40	20	20	20	20	20	20	20	15	SE
ANTARCTICA	15	15	15	—	—	—	—	—	—	—	—	—	—	—	20	20	20	20	20	15	15	15	15	15	S
NEW ZEALAND	10	10	10	10	15	15	20	20	—	—	—	—	80*	40	20	20	20	20	20	20	15	15	15	10	SW
OCEANIA AUSTRALIA	10	10	15	15	15	15	15	15	15	—	—	—	—	—	20	20	20	20	20	20	20	15	15	10	W
JAPAN	15	15	15	20	—	—	20	20	—	—	—	—	—	—	—	20	20	20	20	20	20	20	15	15	NW

*Look at next **higher** band for possible openings.

calculator or computer — which to buy?

An outline of the capabilities of today's machines

This article is for the ham who has computational work to perform. It's intended to help answer the question, Should I buy a personal computer? If not, should I stick with my calculator, or maybe get a better one? To answer this, we'll need to look at the problems to be solved, the capabilities of calculators and computers, and factors of cost and time.

Let's assume that three types of calculators and three sizes of computers are being considered. For the calculators, these are:

- a small "four-function" calculator with four-function memory;
- a "scientific" or "slide rule" calculator, with twenty to twenty-five functions and addressable memory;
- a programmable calculator, with some dozens of memory locations and one hundred to two hundred program step capacity, with loop and decision capability.

For the computer, let's assume the following types, each with average memory:

- a "pocket" or "book" computer, with Basic and at least some scientific functions;
- a "single package" expandable computer, with TV screen and a keyboard;
- an expanded computer with a disk memory and two internal languages.

The calculator costs will be about \$10, \$35, and \$200, and the computer costs will run about \$175, \$350, and \$2500. More can easily be spent on the top calculator and on any of the computers. Cost will obviously be an important element in the decision.

Let's look at these possibilities with respect to problems to be solved. Let's say that the first problem is a receiver design, where the tuning inductor is to be worked out. And, to give an idea of impedance levels, we decide that the reactance should be calculated. The pertinent equations are:

$$X_C = 1/2\pi fC = X_L = 2\pi fL$$

where, given C, you determine X and L.

The little four-function calculator handles this nicely, with a few keystrokes and ample accuracy. So do the other calculators. If the computers have a proper Basic, they can be used as calculators in the direct execution mode, but with a few more key strokes (the relation is entered without the line number, causing immediate execution on carriage return — the answer may need to be recalled with a separate operation). At this level of problem, the larger calculators and the computers are somewhat more likely to cause a keystroke error, but otherwise, all calculators and computers can be considered usable.

However, suppose we are working on a new nine-band superhet with rf stage. Now the problem must be repeated twenty-seven times. The two smaller calculators take twenty-seven times as long, with the slide-rule type no better than the smallest. But a small program can be written for the programmable calculator and the computers, so that only the data need be entered. And some programming "tricks" can be introduced, such as the fact that the local oscillator differs from the rf by the i-f frequency, simplifying data input.

It is apparent that the number of calculations and the time available for doing them will both have an important bearing on your choice. If such problems don't come up too often, and there is plenty of time for them, the low-cost way is all right.

There is another consideration here. For these basic calculators and computers, it is necessary to

By R.P. Haviland, W4MB, 2100 S. Nova Road, Box 45, Daytona Beach, Florida 32019

pause after each value of inductance is read, copy it on paper, check the recorded value, then proceed. It would be much easier to have the results printed. This is possible, at a price.

Printing versions of the smallest calculator are available at an incremental cost of $30 or so. But there isn't a single slide-rule calculator with print capability on the market until you reach the top calculator line. And here the incremental cost is likely to be nearer $200. This is about the minimum cost of any computer printer, although small printers are becoming available at about half this cost. But full printers run $500 to $5,000 — often as much as a computer.

This is an important point. How important is printout to you? And how much do you need page production versus single-column prints? And how much will these cost?

Let's look at another problem. Suppose you are considering a new 80-meter antenna, and decide to look at an array of phased verticals. The space you have available doesn't allow a standard square, so you want to calculate patterns of some possibilities.

The basic equation to be solved is simple,

$$e_{\theta,\phi} = f_n(\theta)\,(1 + k_n e^{ja_n})$$

(see *ham radio*, May, 1977, page 79)

but the k_n involves a ratio of currents and the a_n the spacing between antennas, their phase, and the direction being calculated. For a vertical, there are four quantities to be handled for each antenna. And for each 10 degrees or so there is a calculation, typically out to 180 degrees of angle.

Because this equation involves sine and cosine functions plus polar to rectangular coordinate conversion, forget the smallest calculator — you can do better graphically. And for some of the slide rule calculators, be prepared for tedious coordinate conversion. For others, it's built in. Solution is easy for a programmable calculator, but tricks may be necessary for one with small storage.

The solution should be no problem with any of the computers. But the results will have to be hand copied with the smaller, unless a printer is added. The two larger computers do have an advantage, in that the pattern can be displayed. This is good for preliminary study, and can be photographed, or duplicated on a page printer.

If there aren't too many of these problems, the better slide-rule calculators would be all right. But there is a strong urge to go first class — at least a programmable calculator, with plenty of registers and a printer, or one of the computers with a printer.

For a final problem, let's look at the series of Yagi antenna articles by W2PV, published in *ham radio* in 1979 and 1980. The first article gives the relations used. They aren't really difficult, and all but the simplest calculator can handle the calculations. But look at the amount of calculation involved. A single point on the curve involves matrix inversion, with complex numbers, and from two to nine unknowns. A single curve might require ten or so such runs, and there are hundreds of curves. Unless there is a lot of memory, and a curve plotter available, the work load is atrocious. And this gives a bias to the largest computer, with plenty of expansion capability.

Let's insert a caution here. Problems of this type can be solved by simple means, even by pencil, paper, and a set of trig and log tables. For example, see *Tables of Functions* by Jahnke and Emde for plots which are even better than can be generated by computer. The major ingredients needed are time and dedication.

Let's put these points in summary form. If you are on a tight budget, stay with calculators. Probably you will want a slide-rule type, preferably with addressable memory. And be prepared to spend time on the larger problems. And hope that some manufacturer brings out a matching, low-cost printer.

If the budget is less tight, you'll need to choose between a programmable calculator and a small computer. To make a decision, it seems that you'll have to examine the size and type of problem you expect in some detail, and also the way you approach problems. At this time the expandable programmable calculator seems best if you have problems of any complexity, but the small computers are developing rapidly, so look them over carefully.

With essentially no budget limitations, the choice falls between the top of the line programmable calculator and an expanded computer. As far as calculation capability goes, there isn't much difference between them. The computer can have more memory, making larger and repetitive problems easier to handle. Also, a page printer is better for organizing data for presentation, making plots and even writing reports. But don't expect to get all of this capability for free. You'll have to buy a lot of accessories and programs to run them, or spend a lot of time on hardware and software development. And don't forget that the top computer considered here costs around ten times as much as the top calculator.

To complete the evaluation, we should note that there can be a bias factor in the decision. If you are interested in computers as such, and like either hardware or program development, this puts a strong bias on going to a computer. But if you just want to solve problems, the calculator has to be considered. It is almost certainly the less expensive way to go, and for you, it may be the best way.

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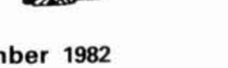

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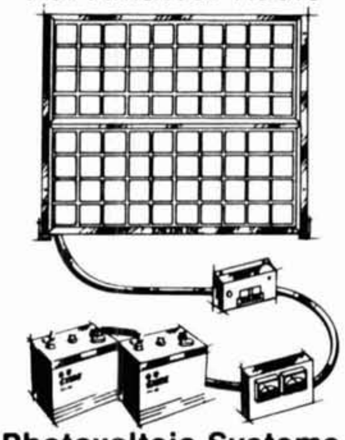

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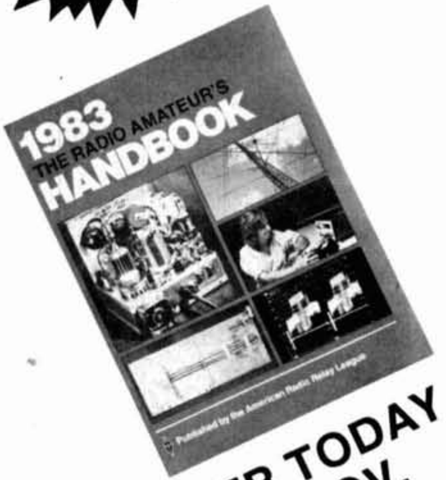

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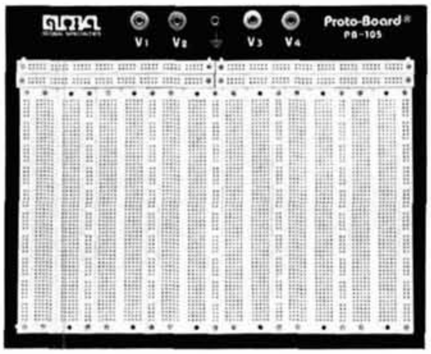
The new PB-105 solderless breadboard from Global Specialties Corporation contains five binding posts, eighteen distribution buses and six solderless breadboarding sockets. The 9.2 × 11.4 × 0.05 inch (234 × 290 × 1.3 mm) superboard, designed for microprocessor applications, of-



fers fifty percent more breadboarding area (up to 48 14-pin ICs) than the next smaller size.

The solderless breadboard assemblies combine quick test socket and bus strip elements on sturdy aluminum backplates. Breadboard elements are screw-mounted from beneath the backplate. Red binding posts are electrically insulated from the backplate while the black binding post is electrically connected to the metal backplate (ground plane).

Other specifications for the PB-105 include: sockets, six QT-59S; bus strips, four QT-47B, seven QT-59B; IC capacity, 48 14-pin DIP 912 terminals; 4560 tie points; binding posts, five five-way binding posts; #22 AWG wire size preferred, 0.01-0.033 inch (0.25-0.84 mm) diameter component leads acceptable, 0.015-0.032 inch (0.38-0.81 mm) recommended; resistance — initial contact resistance is less than 0.5 milliohms, reduces to less than 0.04 milliohms after multiple insertions.

Proto-Board assemblies are engineered for use in design, text fixturing, quality control, prototyping, evaluation inspection and custom circuit applications. The suggested price is $115.50.

For more information, contact Globe Specialties Corporation, P.O. Box 1942, New Haven, Connecticut 06509-1942; telephone 203-624-3103.

one-handed mobile mic dialing

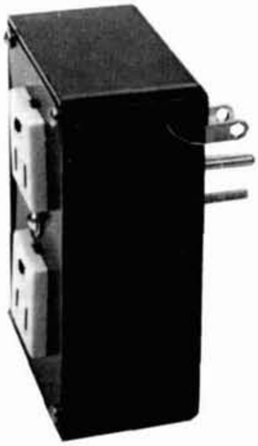
Communications Electronics Specialties introduces its CES 635 Microdialer. The CES 635 incorporates the mike element and the Touchtone buttons on the same side of the microphone, and features a programmable pause that allows the operator to bring up the patch, pause, and dial the telephone number by pushing two buttons. It also keys the PTT line prior to sending the first tone so that nothing is lost in the transmission.

The CES 635 Microdialer also features ten programmable memories. The first five memories hold up to eleven digits, while memories 6-0 hold up to seven digits. Dialing speeds from one to eight digits per second can be programmed.

For more information, contact Communications Electronics Specialties, Inc., P.O. Box 507, Winter Park, Florida 32790; telephone 305-645-0474.

wall socket pollution control

Power-line electrical noise, hash, and spikes often cause erratic transmission or poor reception. In addition, severe spikes from lightning or heavy machinery may damage expensive hardware.



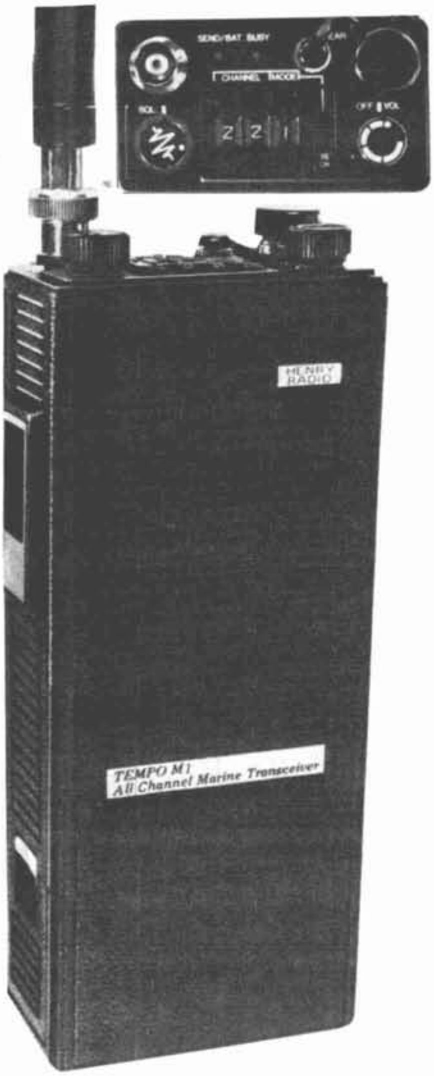
Electronic Specialists' new Direct Plug Super Filter and Suppressor features a dual-pi filter to control electrical pollution. A 6500-ampere spike/surge suppressor protects equipment from damage caused by lightning or heavy machinery spikes.

Direct Plug Super Filter pollution control and equipment protection is available for $55.95 (Model DP-SF/T-32).

For more information, contact Electronic Specialists, Inc., 171 S. Main St., Box 389, Natick, Massachusetts 01760; telephone 617-655-1532.

Tempo marine portable

Henry Radio introduces a new marine VHF band portable, the Tempo M1. Other transceivers oper-



ate on only six to twelve channels, but the new M1 operates on every marine channel, both U.S. and international, with all the necessary offsets built-in. It also includes all weather channels and a channel-16 override function. Channel selection is made by a thumbwheel switch on the top panel. Simply dial up the channel number; no crystals to change, no internal adjustments.

Other special features designed into the M1 include a one-hour quick-charge-type battery with built-in overcharge protection. The battery pack is a professional, twist-off type. Each unit is supplied with rechargeable Ni-Cd battery pack, a rubber flex antenna, and full marine band, all channel programming.

Circuit design features include permanent memory programmed into a microprocessor controller for easy service and operation. The receive audio is extraordinary in volume and quality for a portable. Standby current is below 25 mA, insuring long battery life. It also includes a high-power 2-1/2-watt position and a low power 1-watt position.

For more information, contact Henry Radio Marine Div., 2050 S. Bundy Drive, Los Angeles, California 90025; telephone 213-820-1234.

Z-80 microcomputer kit

The Z-80 microprocessor has had a successful existence for many years. The microcomputers designed around the Z-80 have provided an excellent choice for the business-oriented user. However, till now there has been no economical system that would meet the needs of students, teachers, and experimenters who wished to evaluate the performance of the Z-80.

Carefully designed for maximum versatility, the PRO/80 includes an S-100 bus allowing the user to expand his system at will by choosing from various modules already available on the market. Extra wire wrapping space has been left for experimentation and the building of process control circuits on the prime circuit board. The PRO/80 also has two parallel input/output ports permitting access to external peripheral equipment. These two ports possess eight bits each, and each bit can be controlled by software. These ensure the user control of sixteen individual lines for particular applications. An interface for an audio cassette provides the user with an economical means of

NEW products

recording programs and data directly on tape.

The PRO/80 memory is one kilobyte of RAM, expandable on the board to two kilobytes. A third kilobyte of EPROM contains the monitor which performs several powerful functions such as memory examine and change, register examine and change, next memory location, next alternate register and a single step operation mode that provides the user with the capability to execute and debug programs one instruction at a time. Other functions such as reset, program execute, and cassette read-write are also featured on the PRO/80 monitor.

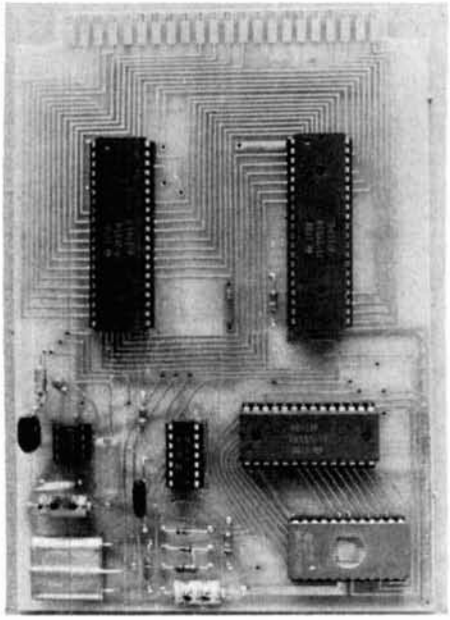
A hex keyboard with an additional eight keys is used to load data and programs and to initiate the different functions of the monitor. Six "seven segment" digits are used to display the memory addresses, the Z-80 registers, the alternate registers and their contents.

The PRO/80 requires only an 8-volt, 1-amp transformer to supply the required voltage. Complete instructions are supplied so that the kit can be built in a minimum amount of time, even by the novice constructor. A four-chapter manual is supplied to give the user additional information regarding use, construction, and operation of the PRO/80. This unique kit is available from ETCO Electronics, Plattsburgh, New York 12901, and is priced at $169.95.

For further information, contact Ted Duskes, ETCO Electronics Corp., Plattsburgh, New York 12901; telephone 514-342-1555.

Morse decoder

This Morse decoder automatically adapts to speeds from 2 to 80 WPM without any manual adjustments. "TAIMD" provides ASCII serial (110



Baud) and parallel outputs, plus dash/dot ratio (from 2 to 6.3) as well as calculated speed. Other outputs are strobe, two format controls for video terminals, and error signal.

NMOS microelectronic circuitry is compatible with low power TTL, and requires only 5 Vdc at 3/10 amp. Onboard PLL can be connected to receiver speaker terminals or earphone jack. Alternative input accepts contact-closure (key). Symbol set includes English alphabet plus foreign characters, digits, punctuations, and procedural symbols. Delivery is stock to 2 months.

For more information, contact Telecraft Laboratories & Company, P.O. Box 1185, East Dennis, Massachusetts 02641.

receiver kits

Three new VHF and UHF receiver kits have been designated with model numbers R144 for 143-150 MHz, R220 for 213-233 MHz, and R451 for 420-470 MHz. They cost $119.95, no more than previous top-of-the-line receivers.

Built on a single, compact pc board, the new receivers include volume and squelch controls mounted on the board for easy wiring. Sharp front-end filters reduce intermod and dense problems in demanding applications; the VHF receivers have a three-section helical resonator in the front end, the UHF version has a six-section tuned-line filter. I-f filtering utilizes both an eight-pole crystal filter and a ten-pole ceramic filter for a very sharp ± 12 kHz bandwidth at 100 dB down. Automatic frequency control compensates for off-frequency transmissions.

Both receivers provide for an optional crystal oven with proportional heater to provide 2 PPM stability over a −30°C to +60°C temperature range (−22°F to +140°F). Hysteresis is provided in the squelch circuit to lock onto fading mobile signals. Sensitivity for 12 dB SINAD is only 0.15 μV for the R144 and R220 and .025 μV for the R451.

For further information, write Hamtronics, Inc., 65 Moul Road, Hilton, New York 14468-9535; telephone 716-392-9430.

Code Class

Macrotronics has announced the introduction of Code Class, a Morse code tutorial for the TRS-80 Model I or Model III microcomputer. Code Class is a machine language program written by licensed hams who understand the problems of learning Morse code. It is simple to use and exceptionally effective. Unlike the traditional Morse tapes and records, Code Class is interactive and presents code in a variety of formats in nonrepetitive sequences at adjustable speeds.

For the newcomer, there is a code tutorial that assumes no previous knowledge of Morse code. It is divided into eleven lessons. Each of the lessons teaches only four characters and may be repeated as often as necessary. Lessons combine both easy and hard characters so that the whole alphabet is learned quickly.

The code practice portion of Code Class is designed to increase your speed and accuracy in copying Morse code. The program randomly generates a page of text, either random words, random characters or random ham callsigns; then it transmits the characters. After a page of text has been sent, the program stops to let you check the accuracy.

When coupled with a Macrotronics ham interface, Code Class will copy hand-sent code. The Morse receive algorithm in Code Class is excellent at receiving hand-sent code. The exact characters received will be displayed on the video monitor. Code Class requires a TRS-80 Model I (16K, level II BASIC) or Model III (16K, Model III BASIC). To receive Morse code, add a Morse code key and a Macrotronics ham interface (M80, M83, CM80, CM83, TM80, TM83, or TERMINALL). Specify cassette ($29) or disk ($39) Model I or Model III version.

For more information, contact Macrotronics, Inc., 1125 N. Golden State Blvd., Suite G, Turlock, California 95380; telephone 209-667-2888.

1/4-wave whip for handhelds

Centurion has introduced a new 1/4-wave straight whip antenna for use with handheld radios. The whip is 17-7 PH stainless steel with high-gloss black PVC coating. The base is fitted with a BNC connector.

The antenna is available in standard frequency ranges and factory-tuned to discrete frequencies from 118 MHz to 512 MHz. Approximate length for 2 meter band is 19.5 inches. The advantages of the new antenna, designated Model W, are higher efficiency and greater durability.

For more information, contact Centurion International, P.O. Box 82846, Lincoln, Nebraska 68501; telephone 402-467-4491.

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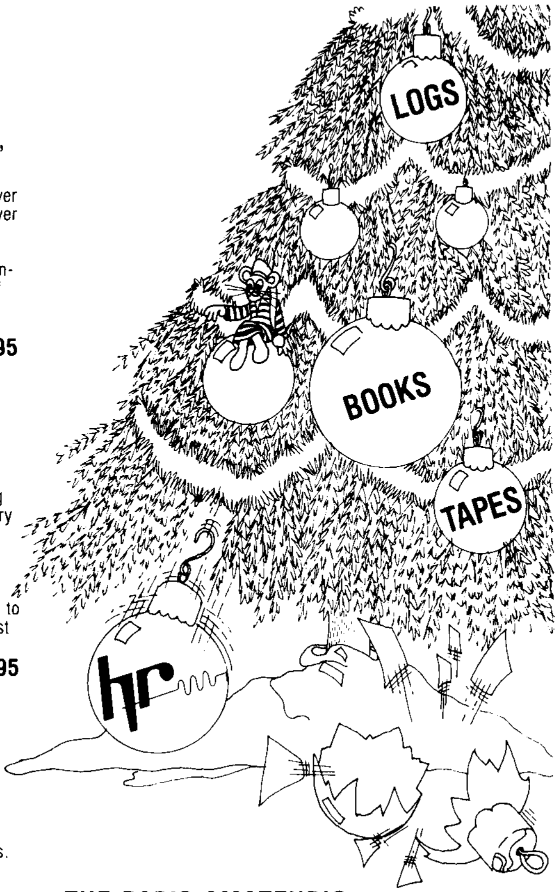

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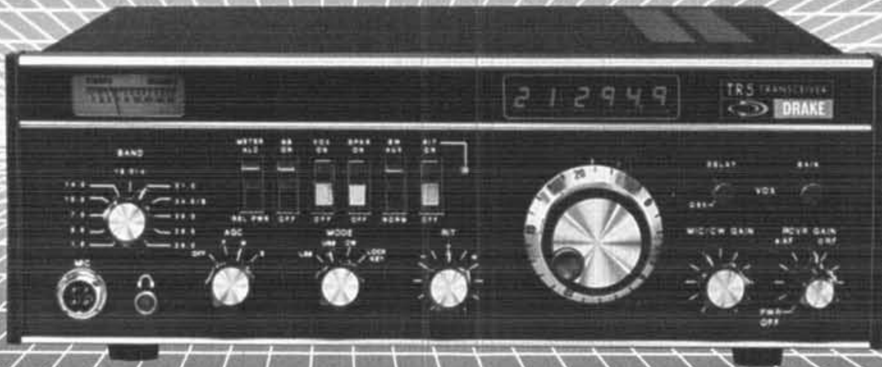

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