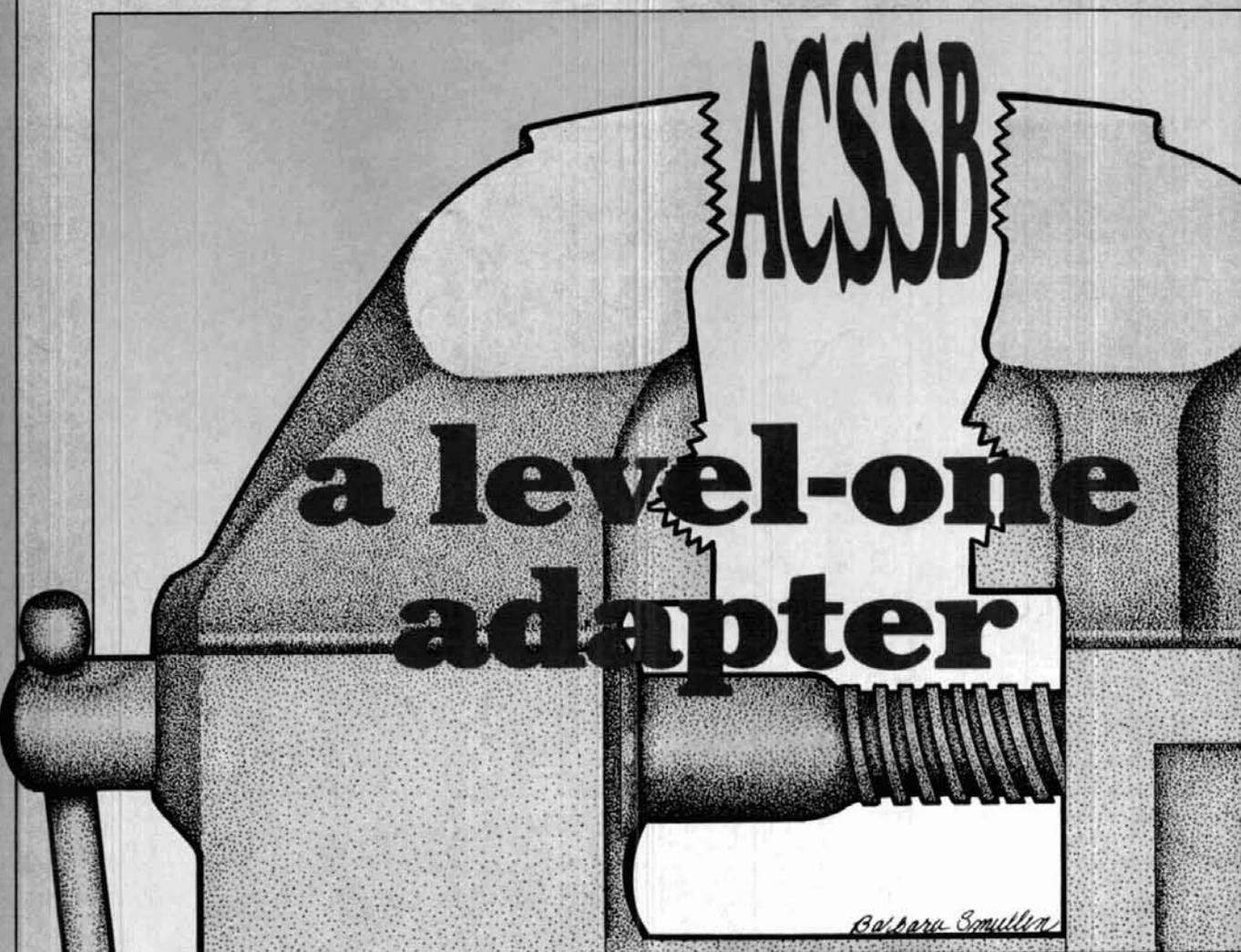


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ICOM HAND HELDS

SURROUND YOURSELF WITH THE BEST!

Reliable. ICOM's extensive line of reliable, field-proven handhelds and interchangeable accessories give you the most options for handheld communications. 2-meter, 220MHz, 440MHz or 1.2GHz...ICOM has your frequency covered.

2-Meters. For 2-meter coverage, ICOM offers the IC-02AT and IC-2AT handhelds. The versatile IC-02AT covers 140.000-151.995MHz, the IC-2AT 141.500-149.995MHz...both include frequencies for MARS and CAP operation. The IC-02AT features an LCD readout, 32 PL tones standard, DTMF, direct keyboard entry, three watts output, (optional 5 watts output with IC-BP7 battery pack), 10 memories and three scanning functions. The IC-2AT, the most rugged handheld on the market, has a DTMF pad, 1.5 watts output and thumbwheel frequency selection. The IC-2A is also available and has the same features as the IC-2AT except DTMF.

220MHz. To get away from the crowd, ICOM has the IC-3AT 220.000-224.990MHz handheld with 1.5 watts output, thumbwheel selection and a DTMF pad.

440MHz. For 440MHz operation, ICOM has two handhelds available, the versatile IC-04AT and the IC-4AT. The IC-04AT and IC-4AT offer full coverage from 440.000-449.995MHz. The IC-04AT includes an LCD readout, 32 PL tones standard, DTMF direct keyboard entry, three watts output, (optional 5 watts output with IC-BP7 battery pack), 10 memories and three scanning systems. The IC-4AT has a DTMF pad, thumbwheel selection and 1.5 watts output.

1.2GHz. ICOM announces the IC-12AT 1260.000-1299.990MHz handheld, the first 1.2GHz handheld available. The IC-12AT features 10 memories, an LCD readout, DTMF direct keyboard entry, two scanning systems and one watt output.

Accessories. A variety of interchangeable accessories are available, including the IC-BP8 800mAH long-life battery pack, HS-10 boom headset, CPI cigarette lighter plug and cord, HM9 speaker mic (for IC-02AT, IC-04AT and IC-12AT), leather cases, and an assortment of battery pack chargers.



First in Communications

ICOM America, Inc., 2380-116th Ave NE, Bellevue, WA 98004 / 3150 Premier Drive, Suite 126, Irving, TX 75063
1777 Phoenix Parkway, Suite 201, Atlanta, GA 30349

ICOM CANADA, A Division of ICOM America, Inc., 3071 - #5 Road, Unit 9, Richmond, B.C. V6X 2T4 Canada

All stated specifications are approximate and subject to change without notice or obligation. All ICOM radios significantly exceed FCC regulations limiting spurious emissions. HH786

Pick a Mode, Any Mode.



Kantronics lets you pick the modes, and the features you want for your multi-mode communications station.

If packet is your game, Kantronics features two TNC's, the KPC-2™ for 300 and 1200 BPS operation, and the new KPC-2400™ for 300, 1200, and 2400 BPS packet.

For CW, RTTY, ASCII, and AMTOR, Kantronics features the Universal Terminal Unit™ (UTU), and the UTU-XT™, both including true 170 HZ shift RTTY.

If an ALL-MODE station is what you're after, combine a Kantronics TNC and TU for true, all-mode capability.

Whether you're building your first computer-based station, or you've decided to expand into new modes, let Kantronics TNC's and TU's deliver top quality performance and uncompromised features to your multi-mode communications station.

KPC-2

This Kantronics AX.25 version 2 TNC features a built-in HF modem, full duplex operation, multiple connects, and over 100 software commands. The enhanced generic command structure fits any computer, even PC compatibles. KPC-2 includes 128K EPROM, 16K RAM—expandable to 32K, and 4K EEPROM. **Suggested Retail \$219.00.**

Pacterm™ programs for VIC-20, C-64, 128, TRS III, IV, IVP are currently available. **\$19.95-\$24.95.** Pacterm operates KPC-2, KPC-2400, and UTU-XT.

KPC-2400

KPC-2400 includes all the features of the KPC-2, plus 2400 BPS packet. The KPC-2400 is fully compatible with all other TNCs because it operates at 300, 1200, and 2400 BPS, software selectable. **Suggested Retail \$329.00.**

In addition Kantronics has introduced the 2400 TNC (add-on) Modem™ for TNC-1's and TNC-2's, giving them the 2400 BPS option. **Suggested Retail \$149.00.**

UTU

UTU features switched capacitance filters and a ten-segment LED bargraph for extra easy tuning. Front panel LOCK and VALID LED indicators for AMTOR operation are also included. UTU transmits/receives CW 6-99 WPM; RTTY 60, 67, 75, 100, and 132 WPM; ASCII 110, 150, 200, and 300 baud; and AMTOR modes A, B, and L. UTU receives all RTTY shifts, and transmits on 170 HZ. **Suggested Retail \$199.95.**

UTU-XT

UTU-XT features user programmable parameters, such as MARK/SPACE tones, multiple RTTY shifts, and limiter/limiterless operation. Operating with a TNC-like command structure, UTU-XT includes 54 commands, and utilizes a 6303 microcomputer, 2K RAM, NOVDRAM, and 128K EPROM. UTU-XT operates CW 6-99 WPM, RTTY from 45-300 baud, ASCII from 110-300 baud, and AMTOR modes A, B, and L. **Suggested Retail \$359.00.**

**NOW AVAILABLE 2400 BPS PACKET VIDEO \$25.00 (includes shipping)
BASIC PACKET VIDEO \$25.00 (includes shipping)**

Kantronics

RF Data Communications Specialists

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KENWOOD

...pacesetter in Amateur radio

NEW

Listen Up!



R-5000

High performance receiver

THE high performance receiver is here from the leader in communications technology—the Kenwood R-5000. This all-band, all mode receiver has superior interference reduction circuits, and has been designed with the highest performance standards in mind. Listen to foreign music, news, and commentary. Tune in local police, fire, aircraft, weather, and other public service channels with the VC-20 VHF converter. All this excitement and more is yours with a Kenwood receiver!

- Covers 100 kHz-30 MHz in 30 bands, with additional coverage from 108-174 MHz (with VC-20 converter installed).
- Superior dynamic range. Exclusive Kenwood DynaMix™ system ensures an honest 102 dB dynamic range. (14 MHz, 500 Hz bandwidth, 50 kHz spacing.)



- 100 memory channels. Store mode, frequency, antenna selection.
- Choice of either high or low impedance antenna connections.
- Extremely stable, dual digital VFOs. Accurate to ± 10 ppm over a wide temperature range.
- Kenwood's superb interference reduction. Optional filters further enhance selectivity. Dual noise blankers built-in.
- Direct keyboard frequency entry.

- Versatile programmable scanning, with center-stop tuning.
- Voice synthesizer option.
- Computer control option.
- Kenwood non-volatile operating system. Lithium battery backs up memories; all functions remain intact even after lithium cell expires.
- Power supply built-in. Optional DCK-2 allows DC operation.
- Selectable AGC, RF attenuator, record and headphone jacks, dual 24-hour clocks with timer, muting terminals, 120/220/240 VAC operation.

Optional Accessories:

- VC-20 VHF converter for 108-174 MHz operation
- YK-88A 1.6 kHz AM filter
- YK-88S 2.4 kHz SSB filter
- YK-88SN 1.8 kHz narrow SSB filter
- YK-88C 500 Hz CW filter
- YK-88CN 270 Hz narrow filter
- DCK-2 DC power cable
- HS-5, HS-6, HS-7 headphones
- MB-430 mobile bracket
- SP-430 external speaker
- VS-1/VS-2 voice synthesizer
- IF-232C/IC-10 computer interface.

More information on the R-5000 and R-2000 is available from Authorized Kenwood Dealers.

R-2000

- 150 kHz-30 MHz in 30 bands
- All modes
- Digital VFOs tune in 50 Hz, 500 Hz, or 5 kHz steps
- 10 memory channels
- Programmable scanning
- Dual 24-hour digital clocks, with timer
- 3 built-in IF filters (CW filter optional)
- All mode squelch, noise blanker, RF attenuator, AGC switch, S meter
- 100/120/220/240 VAC operation
- Record, phone jacks
- Muting terminals
- VC-10 optional VHF converter (108-174 MHz)



Specifications and prices are subject to change without notice or obligation.

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

ham radio

magazine

OCTOBER 1986

volume 19, number 10

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ham radio magazine is published monthly by
Communications Technology, Inc.
Greenville, New Hampshire 03048-0498
Telephone: 603-878-1441

subscription rates

United States:

one year, \$22.95; two years, \$38.95; three years, \$49.95

Canada and other countries (via surface mail):

one year, \$31.00; two years, \$55.00; three years, \$74.00

Europe, Japan, Africa (via Air Forwarding Service): one year, \$37.00

All subscription orders payable in U.S. funds, via international
postal money order or check drawn on U.S. bank

international subscription agents: page 102

Microfilm copies are available from
University Microfilms, International
Ann Arbor, Michigan 48106
Order publication number 3076

Cassette tapes of selected articles from ham radio
are available to the blind and physically handicapped
from Recorded Periodicals,
919 Walnut Street, Philadelphia, Pennsylvania 19107

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Title registered at U.S. Patent Office

Second-class postage paid
at Greenville, New Hampshire 03048-0498
and at additional mailing offices
ISSN 0148-5989

Send change of address to ham radio
Greenville, New Hampshire 03048-0498



contents

10 ACSSB: a level-one adapter

James Eagleson, WB6JNN

30 the ZIA connection: a multi-state 2-meter repeater link

Alex F. Burr, K5XY

38 ham radio techniques

Bill Orr, W6SAI

43 get on SSTV— with the C64

Giuseppe Cameroni, I2CAB, and Giancarla Morellato,
I2AED; translation and additional text
by Jim Grubbs, K9EI

52 convert an inexpensive CB mag-mount antenna into a superb 2-meter whip

Donald K. Reynolds, K7DBA

59 VHF/UHF world

Joe Reisert, W1JR

66 practically speaking

Joe Carr, K4IPV

73 SPECIAL: expanded ham notebook

Ed Marriner, W6XM; H.H. Hunter, W8TYX; Don
Kadish, W1OER; Earl H. Hornbostel, DU1AE; Emile
F. Alline, Jr., NE5S; Thomas A. Keely; and Jerome
M. Havrel, W2RRX.

109 the Guerri report

Ernie Guerri, W6MGI

- | | |
|-----------------------|------------------|
| 110 advertisers index | 104 ham mart |
| and reader service | 100 new products |
| 9 comments | 6 presstop |
| 92 DX forecaster | 4 reflections |
| 106 flea market | |

REFLECTIONS

a monument to the past?

At the latest ARRL board meeting, the Board of Directors voted to approve in principle the construction of an Amateur Radio museum and visitors' center in Newington. As proposed, the new facility would include 6500 square feet of exhibit space, with several Ham stations representing the progress of Amateur radio through the years on display. There would be a member's library, a lounge, a film viewing room, a small gift shop, and several other sundry rooms — plus extensive renovations for W1AW. The facility's opening would coincide with festivities marking the League's 75th Diamond Anniversary in 1989. Total cost: an estimated \$2.7 million.

What comes immediately to mind upon hearing this proposal is that the Board has established a set of priorities that appear to be contrary to the needs of the hobby. By this I mean that we have a far greater need to ensure our future than we do to preserve the past.

This is not to say that the League is not thinking about the future of Amateur Radio. At the October, 1984 Board meeting, two optimistic goals were set: one, to recruit 50,000 new hams per year for the next five years and two, to increase ARRL membership by 25,000 by the end of 1985 and by 20 percent per year thereafter (see *QST*, 12/84, p. 52). At the most recent board meeting, however, the League's executive vice president reported that League membership has grown from 129,698 to 139,910 — an increase of approximately 8 percent. *The same report disclosed only a 2.3 percent increase in the number of hams during 1985. (*QST*, 9/86, p. 63). So while the League has done a fair job increasing its membership, it hasn't come close to meeting its number-one goal: increasing the Amateur ranks.

On the positive side, several good things are happening. Most notably, the Archie comic book — a \$20,000 project, half-funded by the ARRL, promoting Amateur Radio to youngsters — is nearing completion and should be ready for distribution as you read this. A League-sponsored proposal for the expansion of Novice privileges awaits consideration by the FCC. The VEC program seems to be working successfully.

Bringing the museum and visitors' center to completion will consume a tremendous amount of time in planning, fund-raising, construction, and installation and maintenance of the exhibits. Once established, operating costs will increase the League's budget as new employees are added to meet the increased needs of the larger physical plant. Over the next few years, the executive vice president and ARRL staff will spend an inordinate amount of time on this project — time that would be better spent working to meet the goals set by the Board in 1984.

Can you imagine what could be done with a \$2.7 million "war chest?" That's more than 270 times the ARRL contribution to the Archie project alone! The scope of projects that could be instituted with this kind of funding is mind-boggling.

There'd be money to support a speakers bureau to send dynamic, persuasive representatives of Amateur Radio into schools, scout meetings, and other places where potential hams congregate. Attractive educational materials based on an upbeat theme (how about *Amateur Radio — 75 years young and looking for YOU!?*) could be professionally produced and distributed. Movies, public service announcements, posters, and other promotional materials could be made available. How about producing a set of low-cost, instructional videotapes (or disks for popular home computers) for self-teaching or small-group study of the fundamentals of Amateur Radio — a la *Tune In The World?* I've just scratched the surface; there are innumerable ways this money could be used to advance the cause of Amateur Radio.

A far better achievement to mark the 75th Diamond Anniversary of the ARRL would be to meet or exceed the goals established by the Board in 1984. Preserving the past is an admirable goal indeed — but not at the cost of the future!

Craig Clark, N1ACH
Assistant Publisher
ARRL Life Member

*Of this number, only 126,281 are full members; the larger figure includes associate members and others who subscribe to *QST* but do not belong to the ARRL (*ARRL Letter*, 7/786, p. 2).

KENWOOD

...pacesetter in Amateur radio

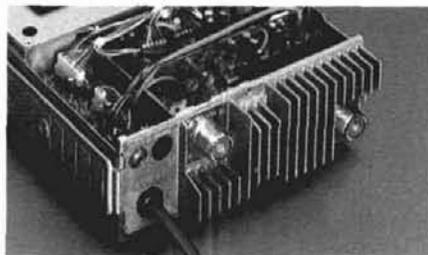
“Dual-Band” Leader!

TW-4000A 2-m/70-cm FM transceiver.

The first is still the best! The original FM “Dual Bander” TW-4000A delivers 25 watts output on both VHF and UHF in a single compact package.

- 2 m and 70 cm FM in a compact package.
Covers the 2 m band (142.000-148.995 MHz), including certain MARS and CAP frequencies, plus the 70 cm FM band (440.000-449.995 MHz), all in a single compact package. Only 6-3/8 (161)W x 2-3/8 (60)H x 8-9/16 (217)D inches (mm), and 4.4 lbs. (2.0 kg.).
- Single-function keys allow easy operation.
- Large, easy-to-read LCD display. A green, multi-function back-lighted LCD display for better visibility. Indicates frequency, memory channel, repeater offset, “S” or “RF” level, VFO A/B, scan, busy, and “ON AIR.” Dimmer switch.
- Front panel illumination.
- 10 memories with offset recall and lithium battery backup.
Stores frequency, band, and repeater offset. Memory 0 stores receive and

transmit frequencies independently for odd repeater offsets, or cross-band (2 m/70 cm) operation.

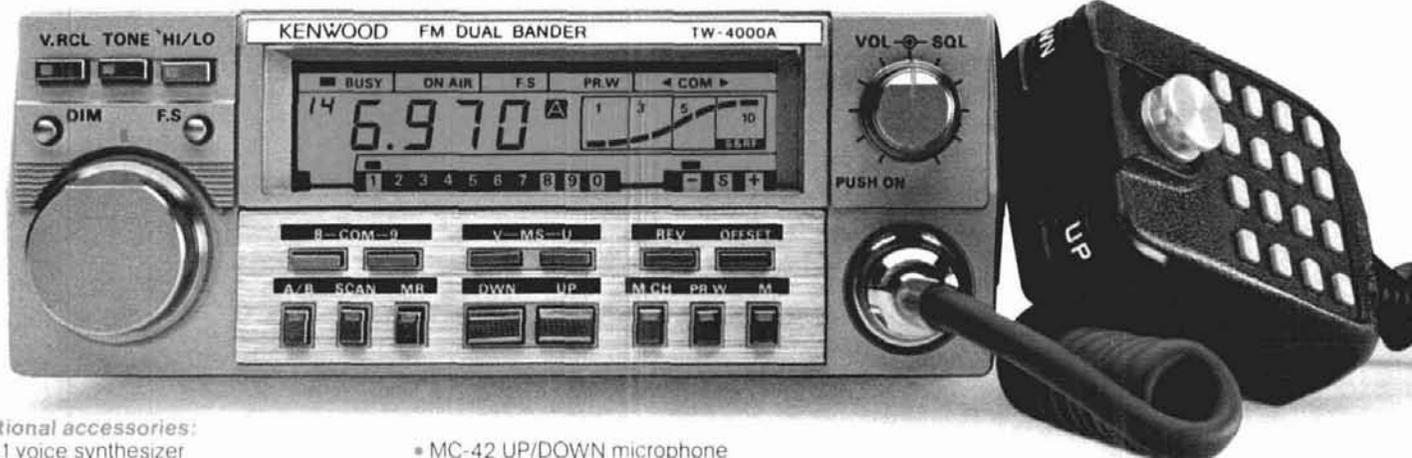


- Rugged die-cast chassis.
- Two separate antenna ports.
Use of separate antennas is recommended. This simplifies antenna matching and minimizes loss. However, mobile installations may require a single antenna. The optional MA-4000 dual band mobile antenna comes with an external duplexer.
- Programmable memory scan with channel lock-out.
Programmable to scan all memories, or only 2 m or 70 cm memories. Also may be programmed to skip channels.
- Band scan in selected 1-MHz segments.
Scans within the chosen 1-MHz segment (i.e., 144.000-144.995 or 440.000-440.995, etc.): The scanning direction

may be reversed by pressing either the “UP” or “DOWN” buttons on the microphone.

- Priority watch function.
Unit switches to memory 1 for 1 second every 10 seconds, to monitor the activity on the priority channel.
- Common channel scan.
Memories 8 and 9 are alternately scanned every 5 seconds. Either channel may be recalled instantly.
- High performance receiver/transmitter.
GaAs FET RF amplifiers on both 2 m and 70 cm, high performance monolithic crystal filters in the 1st IF section, provide high receive sensitivity and excellent dynamic range. The high reliability RF power modules assure clean and dependable transmissions on either band.
- Optional “voice synthesizer unit.”
Installs inside the TW-4000A. Voice announces frequency, band, VFO A or B, repeater offset, and memory channel number.
- Repeater reverse switch.

More TW-4000A information is available from authorized Kenwood dealers.



Optional accessories:

- VS-1 voice synthesizer
- TU-4C two-frequency CTCSS tone encoder
- PS-430 DC power supply
- KPS-7A fixed station power supply
- MA-4000 dual band mobile antenna with duplexer
- SP-40 compact mobile speaker
- SP-50 mobile speaker
- MC-42 UP/DOWN microphone
- MC-55 8-pin mobile mic. with time-out timer
- SW-100B SWR/power meter
- SW-200B SWR/power meter
- SWT-1/SWT-2 2 m/70 cm antenna tuners
- PG-3A noise filter
- MB-4000 extra mounting bracket

Complete service manuals are available for all Trio-Kenwood transceivers and most accessories. Specifications and prices are subject to change without notice or obligation. Antenna mag mount is not Kenwood supplied.

KENWOOD

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AUTOMATIC TRANSMITTER IDENTIFICATION HAS BEEN PROPOSED BY THE FCC in a Notice of Proposed Rule Making released August 8. Though General Docket 86-337 is directed at video satellite uplink stations in response to "Captain Midnight" having broken into an HBO movie last spring, of more importance to Amateurs and other services is a Notice of Inquiry also included, asking whether an Automatic Transmitter Identification System (ATIS) shouldn't be required for all transmitters used by the various FCC licensed services!

Many ATIS Are Already In Use In Police and other U.S. communications systems. In the mid 70s, at the height of the CB craze, ATIS was also proposed for that service as a means of curbing the rule-breaking so rampant at that time. It was not adopted.

No Specific Suggestions For General ATIS Use were made by the FCC in its NOI. Instead, they ask only general questions (about the need for ATIS, its applicability, implementation, timing, format, and similar subjects) and seek user response to the proposal. They also solicit comments on adding ATIS to existing radios, though the resulting logistical and financial burden would make that possibility rather unlikely. In conclusion, the NOI also suggests that various user groups and other interested parties may wish to form an "Advisory Committee" -- possible with FCC support -- to review the many issues involved and devise a mutually acceptable ATIS format.

Comments On The ATIS Proposal, General Docket 86-337, are due at the Commission on October 20; Reply Comments must be submitted by November 19.

JAS-1, RENAMED "FUJI" BY THE JAPANESE, IS UP. Launched August 12 from Japan's Tanagashima Space Center, the new OSCAR's Mode JA transponder (145.9-146.0 MHz up, 435.9-435.8 MHz down -- inverted) has been working well, though users report deep spin-induced fading because the satellite hasn't yet stabilized. Considerable user dexterity is also required to compensate for large doppler shift (up to 15 kHz) as a result of the satellite's rapid orbital travel. Users are reminded to correct for doppler shift with the transmitter's VFO rather than the receiver.

OSCAR 10 Continues To Come On And Shut Down as programmers try to determine what parts of the bird's damaged memory still function, then write software that will provide reasonably reliable operation. At presstime OSCAR 10's future is unknown.

FEDERAL RULES LIMITING RF EXPOSURE SEEM ALMOST CERTAIN, with three government agencies now involved in their development. The Environmental Protection Agency is leading the effort, with the Food and Drug Administration participating and the FCC also involved to some degree.

Exposure Limits Suggested By ANSI (American National Standards Institute) have long been voluntary in the U.S. The RF exposure limits in many other nations are much stricter, however, and it appears that the EPA may adopt a standard that is five times stricter than the ANSI limits. U.S. commercial radio interests, though concerned about the proposed EPA rules, appear likely to go along with the federal effort in order to forestall further development of inconsistent individual state RF exposure regulations.

Though Amateur Radio Had Been Exempted from much previously proposed RF exposure rule-making, it appears likely this time all services will be covered. What effect all this will have in the real world of transmitters and antennas remains to be seen.

RESPONSIBILITY FOR ALL AMATEUR EXAM QUESTIONS WAS DELEGATED to the Amateur Radio community through the Volunteer Examiner Coordinators in an FCC Report and Order released at the Commission's Washington VEC Conference August 9. The Commission's decision on PR Docket 85-196 had been opposed by the ARRL out of concern for exam uniformity; the FCC said "VECs are capable of satisfactorily performing the task and are in the best position to do it in their role as coordinators." However, the Commission did agree with the League that exam standardization was important, and an important result of the VEC conference was the establishment of a "Committee for Question Pool Maintenance" made up of N4BAQ (Western Carolina VEC), WB9IHH (ARRL VEC), and W6NLG (Sunnyvale VEC). Questions for Amateur exams can come from many sources, but their acceptance for the exam pool will be by this committee.

A New Class Of Volunteer Examiner. The "Preparing Volunteer Examiner." was another development of the Report and Order. Present VEs will now be known as "Administering VEs" (AVEs), while the PVEs will be individuals who submit questions for or prepare exams for use by the VECs or AVEs. PVEs will also be permitted to market packaged exams to AVEs.

"CARE KIT," A Complete Novice CW and Written Exam Package, is now available free to VEs and clubs on a first-come, first-served basis from CARE, Box 688H, Glenview, IL 60025.

STILL ANOTHER VERSION OF THE COMMUNICATIONS PRIVACY ACT was introduced in the Senate just before summer recess, but didn't make it to the Senate floor before adjournment. This new version permits monitoring Land Mobile transmissions and reduces some penalties for violations of the Act. Added, however, is a new 1 to 10-year prison term and up to \$250,000 fine for willful interference to satellite communications ("Captain Midnight" vs. HBO).

Whether The Summer Recess Will Result In Still Further Changes in the Act is uncertain, though the pressure to further temper its repressive aspects continues.

A NEW "INTERFERENCE HANDBOOK" HAS BEEN ANNOUNCED by the FCC. The extremely well done 64-page manual covers essentially all kinds of TVI and RFI and also includes information on obtaining assistance from most home entertainment electronics manufacturers. It's available free for the asking from any FCC Field Office.

KENWOOD

...pacesetter in Amateur radio

Just arrived!

All-Mode Mobility!

TR-751A Compact 2-m all mode transceiver

It's the "New Sound" on the 2 meter band—Kenwood's TR-751A! Automatic mode selection, versatile scanning functions, illuminated multi-function LCD and status lights all contribute to the rig's ease-of-operation. All this and more in a compact package for VHF stations on-the-go!

- Automatic mode selection, plus LSB
- 144.0 144.1 144.5 145.8 146.0 148.0 MHz

CW	USB	FM	USB	FM
----	-----	----	-----	----

- Optional front panel-selectable 38-tone CTCSS encoder
- Frequency range 142-149 MHz (modifiable to cover 141-151 MHz)
- High performance receiver with GaAs FET front end
- VS-1 voice synthesizer option

- 25 watts high/5 watts adjustable low
- Programmable scanning—memory, band, or mode scan with "COM" channel and priority alert
- 10 memory channels for frequency, mode, CTCSS tone, offset. Two channels for odd splits.
- All mode squelch, noise blanker, and RIT
- Easy-to-read analog S & RF meter

- Dual digital VFOs
- Semi break-in CW with side tone
- MC-48 16-key DTMF hand microphone included
- Frequency lock, offset, reverse switches
- Digital Channel Link (DCL) option

Optional accessories:

- CD-10 call sign display
- PS-430, PS-30 DC power supplies
- SW-100A/B SWR/power meter
- SW-200A/B SWR/power meter
- SWT-1 2-m antenna tuner
- TU-7 38-tone CTCSS encoder
- MU-1 modem unit for DCL system
- VS-1 voice synthesizer
- MB-10 extra mobile mount
- SP-40, SP-50 mobile speakers
- PG-2K extra DC cable
- PG-3A DC line noise filter
- MC-60A, MC-80, MC-85 deluxe base station mics.
- MC-42S UP/DOWN mic.
- MC-55 (8-pin) mobile mic.



Actual size front panel

TR-9500 70 CM SSB/CW/FM transceiver

- Covers 430-440 MHz, in steps of 100-Hz, 1-kHz, 5-kHz, 25-kHz or 1-MHz.
- CW-FM Hi—10 W, Low—1 W. SSB 10 W.
- Automatic band/memory scan.
- Search of selected 10-kHz segments on SSB/CW.
- 6 memory channels.



25th Anniversary

KENWOOD

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Compton, California 90220

Complete service manuals are available for all Trio-Kenwood transceivers and most accessories. Specifications and prices are subject to change without notice or obligation. Specifications guaranteed for the 144-148 MHz Amateur band only.

MFJ ACCESSORIES

300 WATT ANTENNA TUNER HAS SWR/WATTMETER, ANTENNA SWITCH, BALUN. MATCHES VIRTUALLY EVERYTHING FROM 1.8 TO 30 MHz.



\$99.95 MFJ-941D

NEW FEATURES

MFJ's fastest selling tuner packs in plenty of new features!

- **New Styling!** Brushed aluminum front. All metal cabinet.
- **New SWR/Wattmeter!** More accurate. Switch selectable 300/30 watt ranges. Read forward/reflected power.
- **New Antenna Switch!** Front panel mounted. Select 2 coax lines, direct or through tuner, random wire/balanced line or tuner bypass for dummy load.
- **New airwound inductor!** Larger more efficient 12 position airwound inductor gives lower losses and more watts out. Run up to 300 watts RF power output. Matches everything from 1.8 to 30 MHz: dipoles, inverted vee, random wires, verticals, mobile whips, beams, balanced and coax lines. Built-in 4:1 balun for balanced lines. 1000V capacitor spacing. Black. 11x3x7 inches. Works with all solid state or tube rigs. Easy to use, anywhere.

RTTY/ASCII/CW COMPUTER INTERFACE

MFJ-1224
\$99.95



Free MFJ RTTY/ASCII/CW software on tape and cable for VIC-20 or C-64. Send and receive computerized RTTY/ASCII/CW with nearly any personal computer (VIC-20, Apple, TRS-80C, Atari, TI-99, Commodore 64, etc.). Use Kantronics or most other RTTY/CW software. Copies both mark and space, any shift (including 170, 425, 850 Hz) and any speed (5-100 WPM RTTY/CW, 300 baud ASCII). Sharp 8 pole active filter for CW and 170 Hz shift. Sends 170, 850 Hz shift. Normal/reverse switch eliminates retuning. Automatic noise limiter. Kantronics compatible socket plus exclusive general purpose socket. 8x1¼x6 in. 12-15 VDC or 110 VAC with adapter, MFJ-1312, \$9.95.

RX NOISE BRIDGE

Maximize your antenna performance!

Tells whether to shorten or lengthen antenna for minimum SWR. Measure resonant frequency, radiation resistance and reactance.

New Features: individually calibrated resistance scale, expanded capacitance range (±150 pf). Built-in range extender for measurements beyond scale readings. 1-100 MHz. Comprehensive manual. Use 9 V battery. 2x4x4 in.



\$59.95 MFJ-202B

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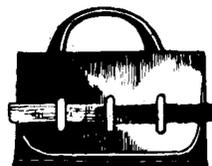
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comments

YLs in Amateur Radio

Dear HR

Though once considered a man's hobby, Amateur Radio is now seeing a growing influx of YLs. Although the theory and code requirements are the same for both genders, some are voicing their concerns about the growing number of licensed YLs and the long-term effect on "their" repeaters. Many have expressed fears that the bands will soon be overrun by inexperienced YLs who will turn 2 meters into a glorified CB band filled with meaningless gossip.

To be adequately prepared for entering the world of repeater operations, I — a newly licensed technician — first turned to the FCC manual on Rules and Regulations. Although a basic description of repeater operation was given, it was suggested that the local repeater be monitored to observe the accepted operating procedures. So, to avoid any further accusations of engaging in meaningless gossip, I monitored the local repeater for approximately four hours and compiled a list of accepted topics currently being discussed by the OMs and noted some basic acceptable operating procedures:

- You may talk about baseball, football, cheerleaders and the girls in the stadium.
- You may talk about your favorite restaurant, the foods you are most hungry for, and how long it has been since your last meal. You can even exchange recipes.
- You may talk about car repairs, home repairs, or even vacations. But if you're a YL, don't mention house-

hold chores such as laundry or you'll be accused of trashing the air waves with CB type communications.

- You may talk about your wife's moods, her dermatological problems, and even her dental problems.
- You may discuss gardens, grandchildren, and pets or even "the old lady" back at the home QTH. (I thought Q signals were for non-verbal communications?)
- Hobby talk is acceptable if the hobby happens to be golf, cycles, fishing, guns, or photography.
- If it's Sunday, you may discuss church services, choirs, attendance, and even have "roast minister."
- You may comment on road construction or complain about the car in front of you or the car behind you. (But if you're a YL, don't mention that you're mobile chaffeur children or you'll be accused of misusing the repeater.)
- OMs can ask: "What's up?" or "What's happening?" or "How are things with you?" But if you're a YL, you'd best refrain — because you'll be accused of attempting meaningless gossip and it will be implied that you should stick with the telephone.
- You can certainly talk about the weather
- If something is funny, don't laugh or you'll be accused of being tacky. A verbal "HI HI" is acceptable, however. Don't giggle — you'll be accused of flirting.
- I've also observed that it's apparently acceptable etiquette for an OM to sneeze, cough, clear his throat, or even burp into a keyed mike.

I don't mean to cause undue strife in the Amateur Radio community or cause a battle between the sexes, but honestly, give us YLs a chance! We worked just as hard as you did to get our licenses and we hold the same pride in our accomplishments (and the same license) that you do. We too are unimpressed with the CB mentality and want the Amateur Radio bands to maintain the high standard of operation that first attracted us to this service.

So, OMs, please listen first before you cast stones.

(Name Withheld by Request)

increasing Amateur ranks

Dear HR

Recently three local Amateur clubs — the Enfield Radio Amateur Group (ERAG), the Mt. Tom Amateur Repeater Association, and the Pioneer Valley Repeater Association — joined in a venture to increase public awareness and to encourage growth of the Amateur fraternity.

A large local shopping mall allowed us to put on an Amateur Radio display in the central concourse; the mall agreed to provide professionally lettered display signs, assist in the erection of the tower, antennas, and power drops, and also agreed to supply tables and dropcloths. The radio clubs were required to have insurance coverage.

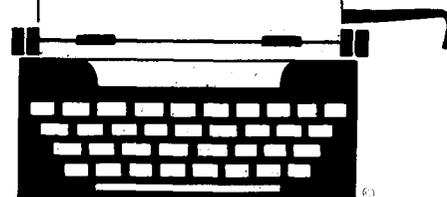
Several displays were set up to demonstrate packet radio, HF communications, traffic handling, and VHF repeater operations. A VCR presentation covered Amateur emergency communications. While several club members manned these exhibits, others talked to the public, answering questions and obtaining the names and addresses of those interested in becoming Radio Amateurs.

During the first day, several hundred people viewed the exhibit and 45 enrolled in Amateur licensing courses offered by ERAG.

Peter J. Bertini, K1ZJH
Somers, Connecticut

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ACSSB: a level-one adapter

Expansion and compression techniques can yield significant S/N improvement

Everyone who uses communications frequencies is aware of the problems of channel sharing and interference. In many parts of the United States, repeater coordinating councils have declared the 2-meter subbands "full." The CB bands are hopelessly cluttered, and commercial users of VHF/UHF frequencies are searching for a solution to channel overcrowding in the land mobile bands. Obviously, better spectrum management — re-use of existing channels, for example — or new spectrum-saving techniques will be necessary if these problems are to be solved.

One spectrum-saving technique just beginning to be used in commercial communications is ACSSB (Amplitude Companded, or "compandored," SSB). This system consists of a compressor at one point in a communication path (to reduce signal amplitude) followed by an expander at another point (to improve the ratio of the signal to the interference entering the path between compressor and expander). Unfortunately, current implementations of the technology are quite expensive by Amateur standards (over \$1200).

ACSSB systems provide the following:

- 4:1 compression of speech during transmission;
- 1:4 expansion during reception;
- Transmitter spectrum equalization (pre-emphasis);
- Receiver spectrum equalization (de-emphasis); and
- Pilot tone reference for AGC control (up to 20-50 Hz fading, typical), automatic frequency control (phase locking), and squelch operation.

The process of compression on transmit and expansion on receive is called "companding" or "compan-

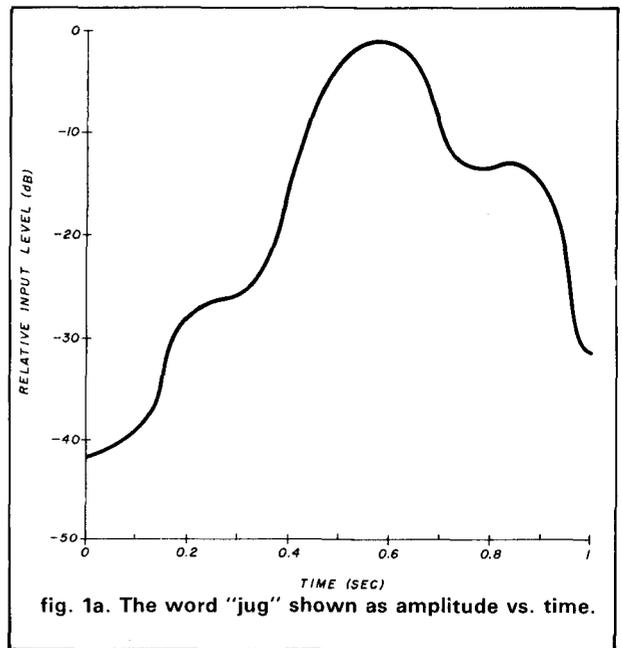


fig. 1a. The word "jug" shown as amplitude vs. time.

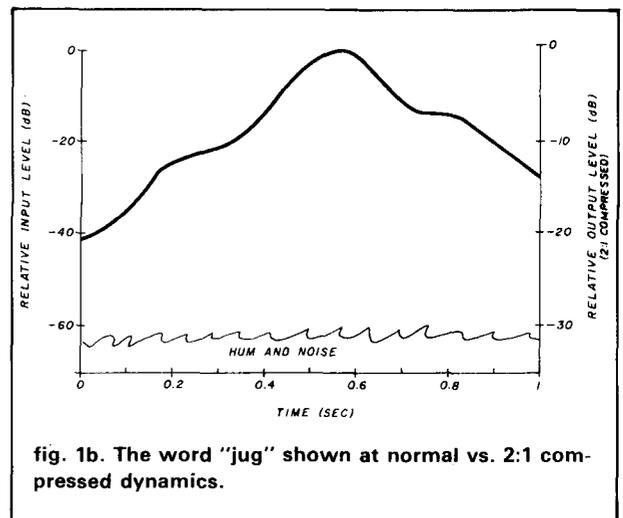


fig. 1b. The word "jug" shown at normal vs. 2:1 compressed dynamics.

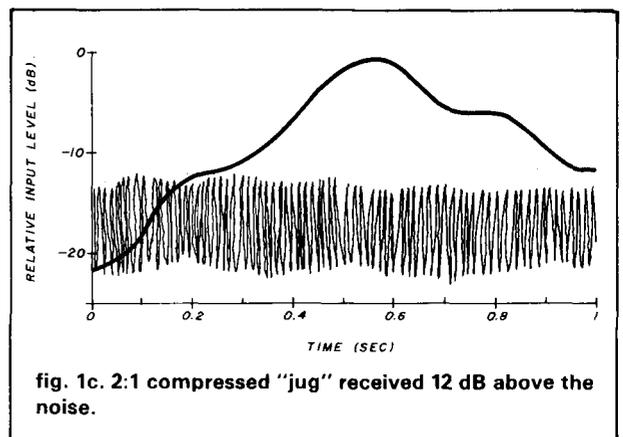


fig. 1c. 2:1 compressed "jug" received 12 dB above the noise.

By James Eagleson, WB6JNN, 15 Valdez Lane, Watsonville, California 95076

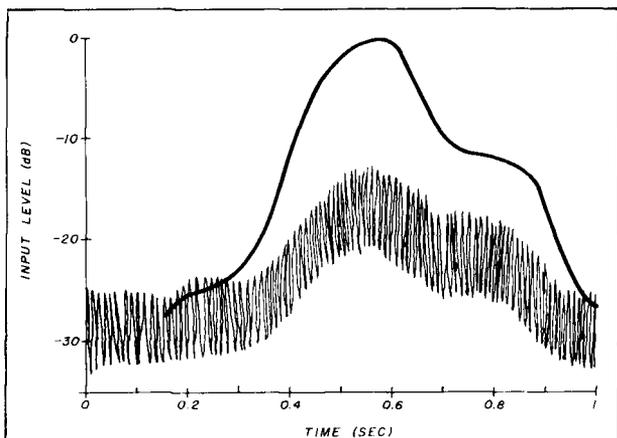


fig. 1d. The signal received in fig. 1c after it is de-emphasized and passed through a 1:2 Expander (2 dB of output change for each 1 dB of input change).

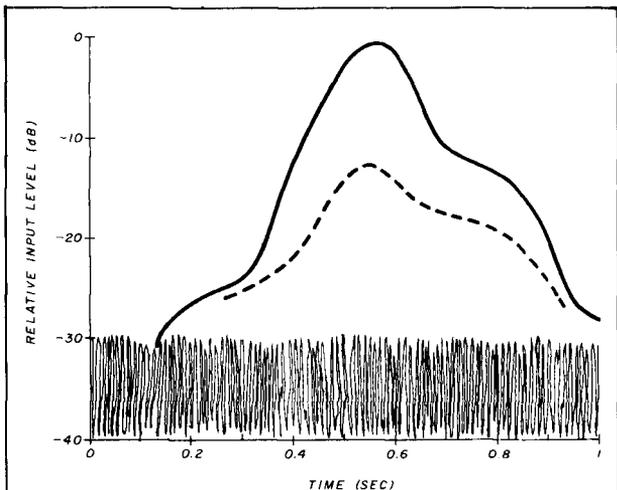


fig. 1e. Direct comparison of FM quieting performance relative to 2:1 ACSSB when both signals arrive at 12 dB SNR occurs much earlier with 2.4 kHz ACSSB than with 20 kHz FM, of course.

doring." For signals above a certain threshold level (5 dB for 4:1 and 10 dB for 2:1 systems), the apparent signal-to-noise ratio will be improved by the compander ratio (either two or four times).

Thus, these systems provide all of the normal conveniences of hands-off operation found in FM systems, but require a channel spacing of only 5 kHz instead of the usual commercial 20 to 25 kHz spacings. (Amateurs use 15 kHz in some instances, but for similar channel-to-channel protection ACSSB channels could be spaced 4 kHz apart). Furthermore, the quieting and capture performance is very similar to that

* Transparency — The ability to pass natural, uncolored sound. Related to SNR, harmonic & intermodulation distortion, tonal balance, transient and phase responses of a system.

of FM, with ACSSB having slightly improved threshold over FM, although FM has somewhat better transparency.* But \$1200 is still \$1200!

level-one circuit

A system offering several of the same performance advantages as commercial ACSSB, but at a fraction of the cost, has been developed by Project OSCAR for use with OSCAR 10. Unlike the commercial versions, which require complete integration of RF and processing circuits, this basic — or Level One — circuit will also work with most SSB transceivers and provide meaningful performance improvements when used on HF through UHF bands.

The Level One ACSSB adapter allows:

- 2:1 compression on transmit (fig. 1);
- 1:2 expansion on receive (fig. 1);
- Transmitter spectrum equalization (pre-emphasis) (fig. 2);
- Receiver spectrum equalization (de-emphasis) (fig. 2).

At this time there is no provision for a pilot tone AGC circuit (which could be termed Level Two); however, work is scheduled to provide a Level Two unit that will enhance the Level One adapter by providing a pilot-tone AGC system, squelch, and possibly a second level of companding (yielding a total of 4:1 companding). For simplicity the Level Two circuit will not use phase locking of the pilot, but will be manually tuned instead.

transmit adapter

The transmit adapter (fig. 3 and table 1) has a microphone preamplifier that increases the audio to the proper level for processing. This preamp also provides a moderate level of pre-emphasis — about 4-5 dB at 3000 Hz.

The microphone selected should be low impedance (under 500 ohms). Otherwise the remaining op amp in the 3403 (quad op amp) should be made into a buffer stage in front of the preamplifier stage (fig. 4).

As shown in fig. 2A, normal distribution of voice energy drops off rapidly above 700 to 800 Hz. The second stage in the transmit adapter equalizes this dropoff by boosting frequencies above 800 Hz to compensate for the rolloff. Thus the audio energy is spread evenly across the entire 300-3000 Hz spectrum (fig. 2B). Figure 2C shows system response with net or combined equalization.

This provides several advantages. First, it provides more high tones to allow the ALC to function more efficiently (more cycles per second allows faster attack time). Secondly, it reduces the intermodulation prod-

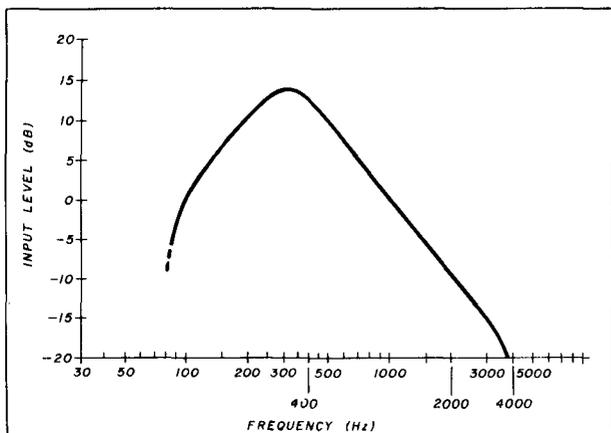


fig. 2a. Typical spectral density of human voice relative to frequency.

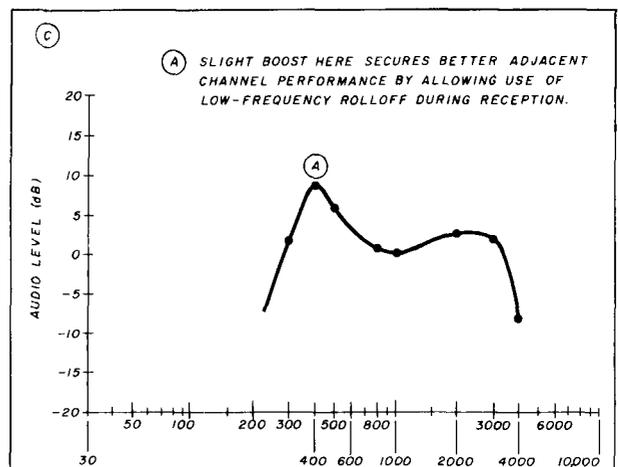


fig. 2c. Equalized audio levels as transmitted (Curve 2a + 2b = 2c).

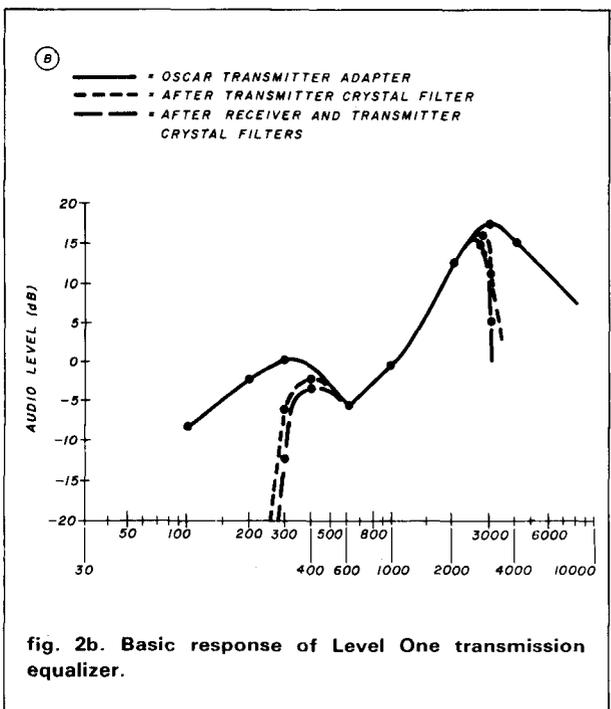


fig. 2b. Basic response of Level One transmission equalizer.

ucts somewhat by lowering the relative level of low voice tones. Thirdly, it raises the important sibilant ("ch," "s," "f") sounds so that they will be above the receiver's noise level entering the radio instead of being 8 to 12 dB below the noise, as would be the normal case at 10 dB signal-to-noise ratio (SNR) without equalization.

The third stage provides 2:1 compression at a syllabic rate. Each syllable is compressed individually so that the typical 40-dB dynamic range of human speech is compressed into only about 20 dB of output level change. This technique, borrowed from telephone long-line services, uses the NE570 or NE571 integrated circuit. Similar techniques are used for Dolby and DBX recording systems.

The advantage of the 2:1 compression used here over normal compression techniques is that the relative dynamic changes in speech levels, though modified, are *maintained after compression*. Most compressors merely suppress loud sounds falling above a certain level. A 2:1 compression ratio generally presents a more pleasing and natural sound to the audio since relative dynamics are maintained.

Furthermore, due to control of each syllable the average power will be raised somewhat. While not as effective as RF clipping, the 2:1 compressor has better harmonic and intermodulation distortion capability.

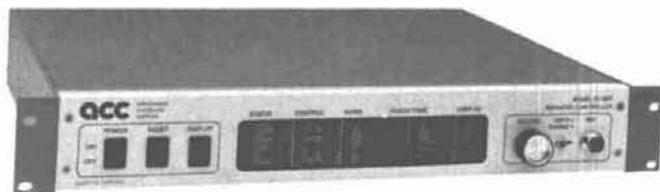
Finally, the audio is attenuated to microphone audio levels once again then fed to the transmitter. To provide maximum flexibility with the adapter individual switching is provided for each stage. This can be used or not used, as required. A second level of equalization is provided for use with stations that do not have the receive adapter. Normally about 15 dB of boost is used. A switch setting giving only about 10 dB is available also. Of course, 2:1 compression only can also be used, though the slight pre-emphasis, 5 dB, is present all the time.

receive adapter

The receive adapter deprocesses the transmitted signal by restoring the original frequency response and dynamics. A schematic diagram and parts list are provided in **fig. 5** and **table 2**.

A gain stage allows optimizing the levels into the adapter while using normal volume settings on the receiver's volume control. It will also allow adapter use inside the receiver between the detector output and the top of the volume control pot. This latter is the best way to use the adapter since it will eliminate the

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table 1. ACSSB Level One transmit adapter parts list.

item	description		
capacitors			
C1	1 μ F tantalum (TM 1/35)*	† R11	470 kilohm
C2	1 μ F, tantalum (TM 1/35)*	† R12	18 kilohm
† C3	1000 pF Epoxy Dipped Ceramic (EDC) (272-154)**	† R13	180 kilohm
† C4	1000 pF EDC (272-154)**	R14-R16	not used
C5	1 μ F, tantalum (TM 1/35)*	R17,R18	470 kilohm
† C6	1 μ F, tantalum (TM 1/35)*	R103	10 kilohm
C7	10 μ F, tantalum (TM 1/35)*	R102	47 kilohm
C8	1 μ F, tantalum (TM 1/35)*	R101	680 kilohm
† C9	1000 pF EDC (272-154)**	R104	470 kilohm
† C10	1000 pF EDC (272-154)**	R105	1 kilohm (see note)
C11	1 μ F, tantalum (TM 1/35)*	R106	1 kilohm (see note)
C101	1 μ F, tantalum (TM 1/35)*	R107	1.5 kilohm
C102	22 μ F, tantalum (TM 22/6)*	R108	3.3 kilohm
C103	0.22 μ F (TM 0.22/35)*	R109	4.7 kilohm
C104	1 μ F, tantalum (TM 1/35)*	R110	1 kilohm potentiometer
C105	0.1 μ F(TM 0.1/35)* (272-158)**	R111	150 kilohm
C106	10 μ F, tantalum (TM 10/25)*	R112	470 kilohm
CBY	1 μ F, tantalum (TM 1/35)*		
integrated circuits			
U1	MC3403 or equivalent	S1,2	DPDT (275-1546)**
U2	NE570 or 571	S3,4	SPDT (275-625 or 647)**
resistors			
R1	47 kilohm	voltage regulators	
R2	10 kilohm potentiometer	U3	7806 or 78L05
R3	1 kilohm	U4	7812 or 78L12
R4	not used	miscellaneous	
† R5,R6	470 kilohm	box, lid	Pomona 2902
† R7	1 Megohm	knob	to fit R2 potentiometer
R8,R9	10 kilohm	connectors as required	
R10	36 kilohm	standoffs 4-40 threaded \times 1 inch (25.4 mm) long	

Note: Select for about 3-6 dB loss through adapter in the out position with $\Delta G = 0$ and drive potentiometer = max.
 * JAMECO
 ** Radio Shack
 † 5 percent tolerance, if possible

need for an external amplifier and speaker. It will also provide less distortion by eliminating any receiver audio distortion or hum at the input to the adapter.

The de-emphasis circuit is provided by two stages. The first is a simple 800-Hz low-pass filter, which provides a good compromise between tonal balance and sound quality when the unit is used in the expand mode on noncompressed, nonequalized input signals. The second filter is a 600-Hz band-pass filter, which can also be used for reception of noncompressed signals. Its tonal quality provides more punch to the received audio. When receiving fully compressed and equalized signals, both filters restore the original audio frequency response. Rolloff of low-pitched and high-pitched adjacent channel interference will also result to a certain extent.

Finally, the 1:2 expansion circuit decompresses the incoming audio in the opposite way from that in the 2:1 compressor. That is for each 1 dB of input audio change, the expander provides 2 dB of output change. Since this occurs on each syllable (at about a 100 ms

time constant), noise between words will fall to a level that is much lower than the actual SNR of the incoming signal (for example, for 10-dB SNR incoming, the 1:2 expander drops the noise to -20 dB relative to peak audio output).

The expand limiter, fig. 5, biases the expander's control port so that signals below a certain input level will not be expanded. This action reduces the peaky sound caused when the expander is used with non-compressed transmit signals. The value can be selected to suit the user, or a 10-Megohm pot may be used in series with a 1-Megohm resistor to provide continuous control of expansion in place of a switched position.

Since the audio is de-emphasized before applying 1:2 expansion, the SNR enhancement is somewhat better than 2:1. The audio bandwidth after de-emphasis is about 1 kHz out of 2.7 kHz of transmitted audio so that the SNR enhancement due to bandwidth limiting is about 4.3 dB ($10 \log_{10} 2.7/1.0$). Thus an incoming 10-dB SNR signal would be improved to 14.3

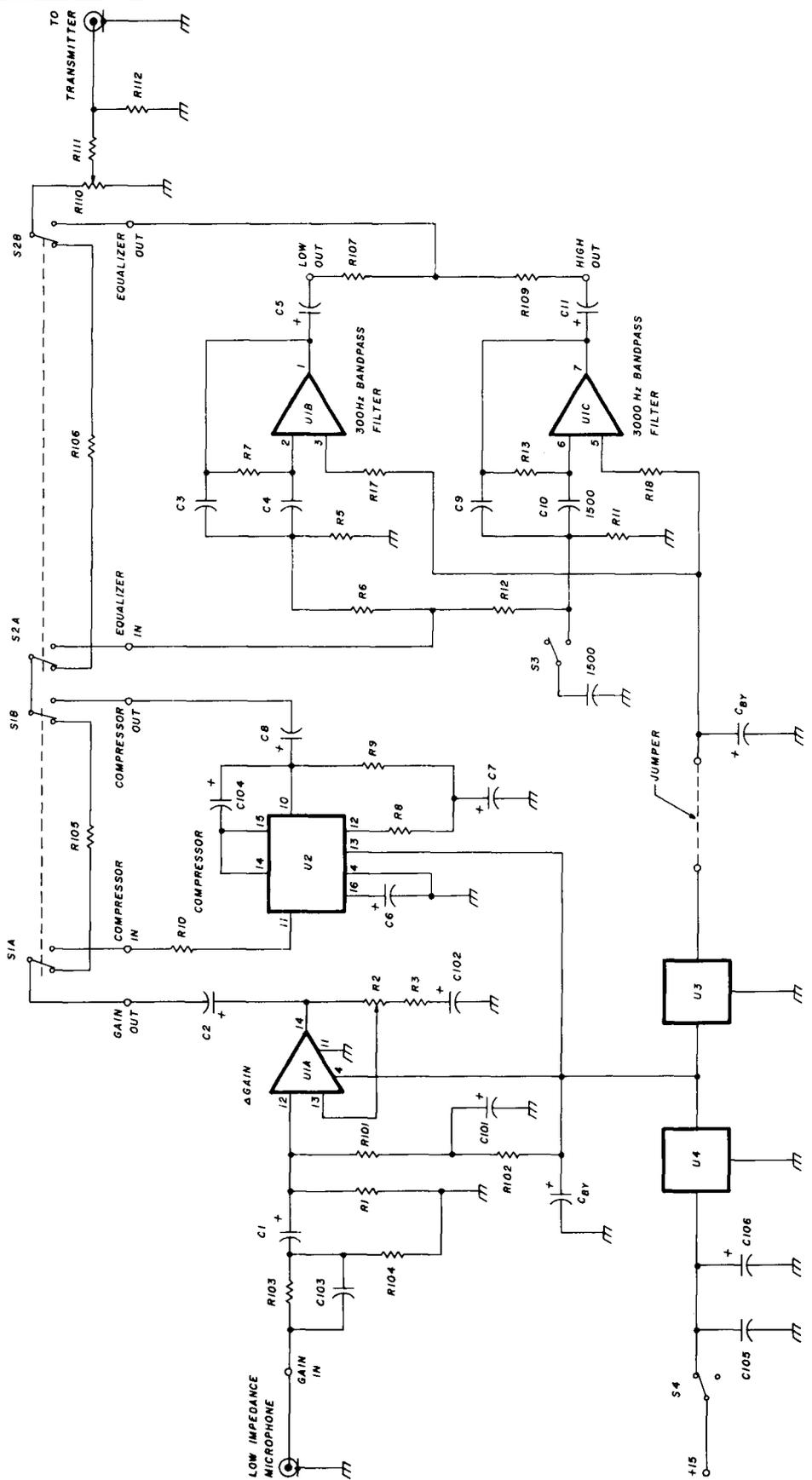


fig. 3. ACSSB Level One transmit adapter schematic diagram.

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table 2. ACSSB Level One receive adapter parts list.

item	description
capacitors	
C1	1 μ F (TM 1/35)*
C2	22 μ F (TM 22/6)*
C3	1 μ F (TM 1/35)*
† C4	4700 pF 10 percent (MY 0.0047/100)* (272-155)**
† C5	0.1 μ F 10 percent (MY 0.1/100)* (272-158)**
C6	1 μ F (TM 1/35)*
† C7,C8	0.01 μ F 10 percent (MY 0.01/100)*(272-156)**
C9,C10,C11	1 μ F (TM 1/35)*
C12	4.7 μ F (TM 4.7/35)*
† C13	C13 1 μ F 5 percent (TM 1/35 OK)*
CBY	1 μ F (TM 1/35)*
C101	10 μ F (TM 1/35)*
C102	0.1 μ F (MY 0.1/100)
resistors	
R1	10 kilohm
R2,R3	47 kilohm
R4	10 kilohm trim potentiometer
† R5	36 kilohm
R6	(not used)
† R7	36 kilohm
† R8	18 kilohm
R9	47 kilohm
† R10	36 kilohm
R11-R13	(not used)
R14,R15	47 kilohm
R16,R17	(not used)
R18	3.3 Megohm
R19	36 kilohm
RL	(load resistor to match source. 8 ohms or 100 kilohms, typical)
R100	1 kilohm (jumper if more gain is needed)
R101	4.7 kilohm
R102	10 kilohm
Rv	potentiometer, 500 ohms (low impedance in) 100 kilohm (high impedance in) (audio taper)
switches	
SW1-4	DPDT (275-1546)**
SW5	SPDT (275-625 or 647)**
integrated circuits	
U1	MC3403 or equivalent*
U2	NE570 or NE571*
voltage regulators	
U3	7806 (78L05 OK)* **
U4	7812 (78L12 OK)* **

* JAMECO

** Radio Shack

† 5 percent tolerance, if possible

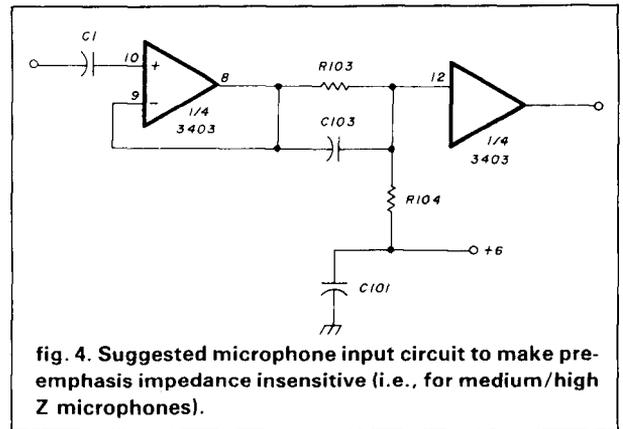


fig. 4. Suggested microphone input circuit to make pre-emphasis impedance insensitive (i.e., for medium/high Z microphones).

dB after de-emphasis, then would be expanded 2:1 to 28.6 dB effective SNR.

In reality, however, some of this SNR improvement, though measurable with instrumentation (such as a VU meter) is lost due to the human ear's frequency sensitivity. The Fletcher-Munson curve* shows a higher sensitivity to mid-range tones than to those above and below roughly 700-1000 Hz. Actual subjective SNR enhancement falls somewhere between 10-14.3 dB improvement over our incoming 10-dB SNR — a good guess being 22-24 dB equivalent SNR after expansion.

CW filter

Though not directly intended for CW operation, it so happens that our lowpass filter, bandpass filter, and expander circuits provide a moderately good CW filter system. The combination lowpass filter/bandpass filter peaks in the 600-1000 Hz region, and the time constants of the expander are about right for normal CW speeds. The expansion provides selectivity about one-half the bandwidth of the bandpass filter/lowpass filter alone but does not cause the ringing often associated with audio filters. On the other hand, any fading present on the signal will be intensified when the expander is in operation.

AGC and fading

Unfortunately, radio circuits are not telephone circuits and noise, fading, and interference are frequently present. While AGC circuits reduce fading significantly, many receivers have AGC overshoot, undershoot, and a control range that is only marginally acceptable. Any such anomalies in receiver AGC performance will be worsened by a 2:1 ratio when used with an expander circuit. Use of the RF gain control

* Also called equal-loudness contours. A group of sensitivity curves showing the characteristics of the human ear for different intensity levels between the threshold of hearing and the threshold of feeling. The reference frequency is 1000 Hz.



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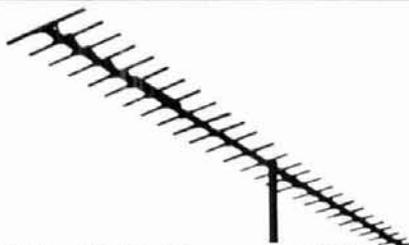
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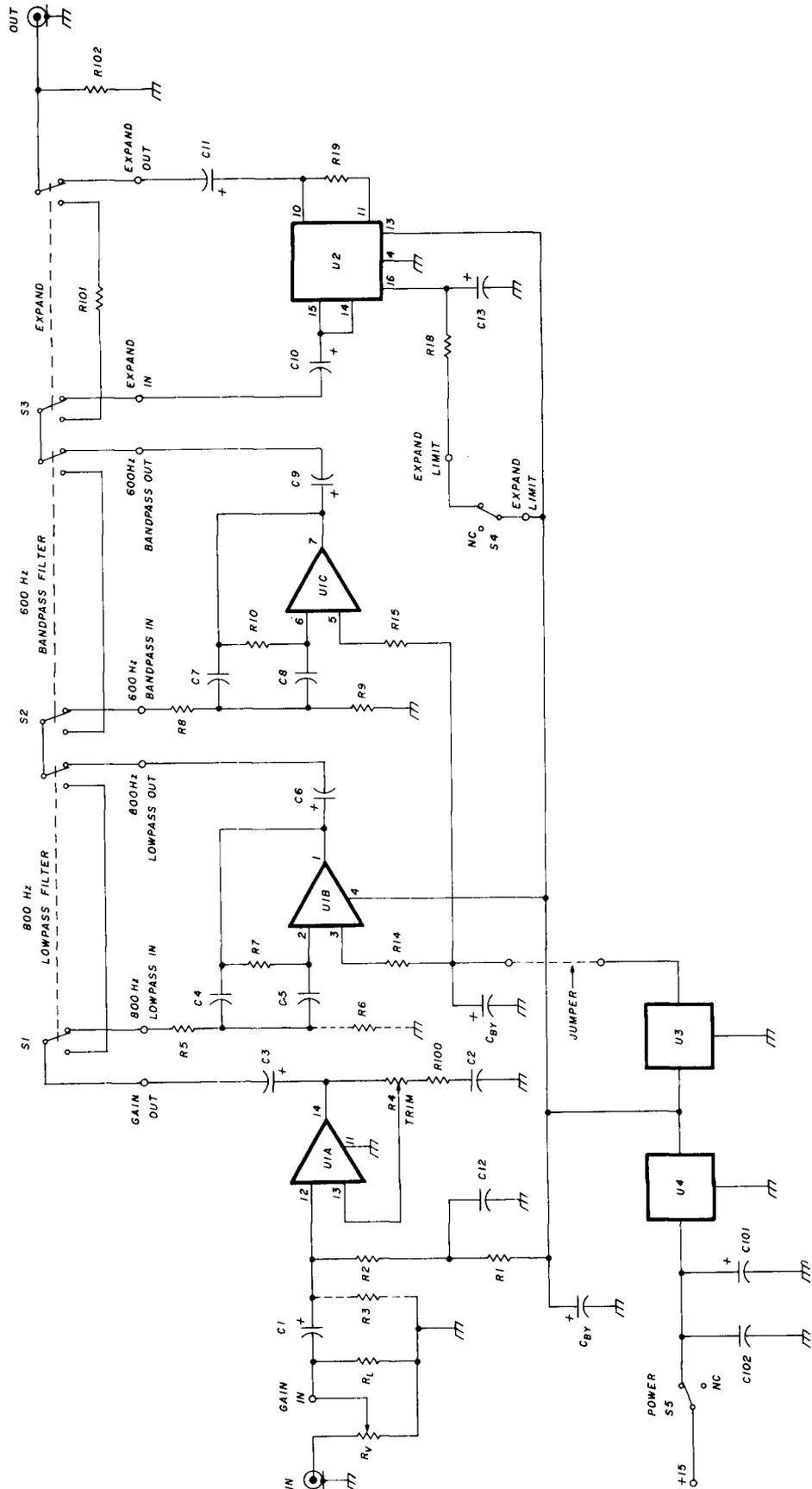


fig. 5. ACSSB Level One receive adapter schematic diagram.

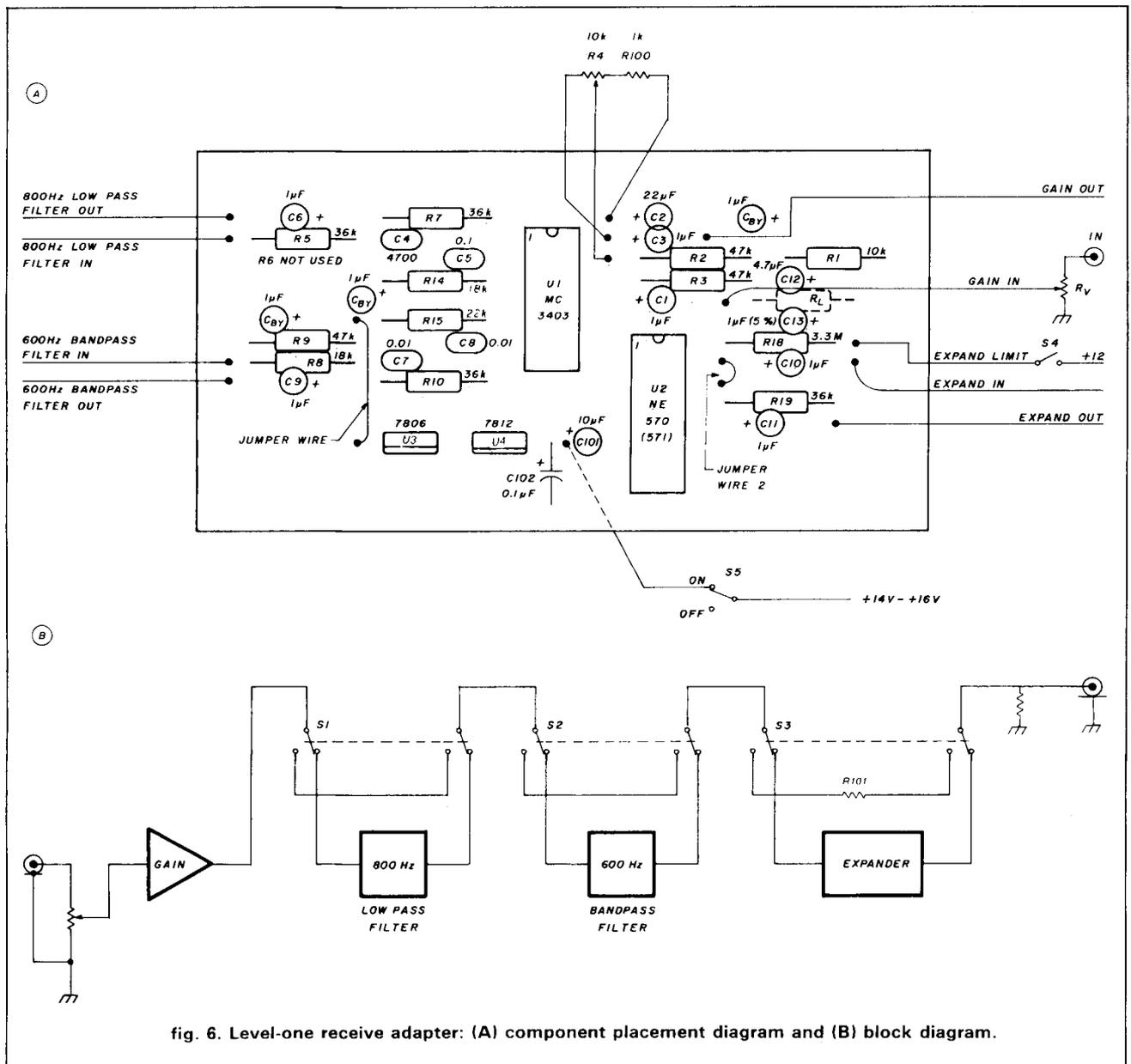


fig. 6. Level-one receive adapter: (A) component placement diagram and (B) block diagram.

and/or fast AGC may be necessary to keep this kind of problem under control.

The Level Two adapter being developed by Project OSCAR should lessen these problems to some extent. It will also provide a tighter control of AGC performance under rapid fading conditions and allow use of carrier-operated relay (COR) and squelch circuits as well as an extra level of 2:1 companding (making a total of 4:1 for the combined system).

Level Two will also allow use of Gateway† stations with automatic frequency locking by adding phase-

locked-loop (PLL) circuits to the receiver (Level Three). This would use the pilot tone of Level Two as a known frequency reference. Level Three phase locking can also be implemented by experienced Amateurs with their home equipment, but thorough knowledge of the receiver's internal workings and phase-locked-loop techniques is probably a prerequisite to implementing such circuits.

construction

The OSCAR Level One adapter has no audio output stage. This is partially because there was no room in the Pomona 2901 box for the audio stage and partly because the adapter is really designed to use between

†Gateway stations — sophisticated ground stations that accept several inputs and act as an uplink to the satellite.

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using level-one adapters

The effects of compression and expansion are best when used when all parts of the system are completely stable — that is, same gain and frequency response are maintained.

The compressor circuit is the easiest to understand in terms of set-up. It merely needs to be placed on an oscilloscope; microphone gain R2 should be adjusted so that the output at the top of R110 has the same peak value as unprocessed audio. Some adjustment of the values of R105 and R106 may be required if total balance is to be achieved between the various modes of the unit.

This can also be done using the transmitter output by adjusting the drive control, R110, for about half the normal transmitter output on the RF output meter of the transmitter, then adjusting microphone sensitivity, R2, and drive control, R110, until all modes give about the same level on the meter. Again, some adjustment of R105 and R106 might be required.

After this is done, boost the drive control for normal transmitter output. If ALC is used in the transmitter you may be able to boost the output slightly more into the ALC. This may provide slightly more output when using the 2:1 compressor since the peak value of the audio will be maintained more evenly than without the compression (that is, the peak-to-average is better).

You will probably find that the compressor is useful under most conditions to provide more even audio to your transmitter. On the other hand, 2:1 compression alone won't be noticed by most people unless you have high background noise or room echo.

The 10-dB equalization will definitely yield more "brightness" to your signal, thus increasing clarity under weak signal conditions. The 15 dB may be too "bright" without some amount of de-emphasis during reception, however. Then again, under weak signal conditions, either position will help improve clarity.

Note that a slight amount of pre-emphasis is present at all times. This is not extreme, but high-pitched microphones should probably be avoided. Also note that the input circuit assumes a 500-ohm or lower impedance microphone. Values of the input pre-emphasis must be changed (R103, C103, R104) if other impedance microphones are used.

To summarize: adjust R2, R110, R105, and R106 so that each mode gives your transmitter about equal output power. Run slightly into ALC by adjusting R110 after the earlier adjustments. You will probably want to run the 2:1 compressor under normal circumstances where background noise is no problem.

Setting up the receive adapter is sometimes more critical. First, the gain of the audio power amplifier

following the unit is undefined (I don't know what you plan to use or its drive and gain requirements — but I recommend a TA 7205 IC.)

This amplifier should be capable of several watts of output for best results and be able to give about 2 watts output with less than 0.25 volt p-p into 10 kilohms at its input. Most output stages will do this (that is, inserting audio into the adapter from the top of the potentiometer then reinserting after the potentiometer). Many hi-fi amplifiers require 1 volt or more rms or several volts p-p, however. The NE570 will not provide several volts. A buffer stage must be provided in these cases (perhaps made from the remaining stage of the 3403).

With the unit in the expand position, the volume from your receiver and to your audio amplifier/speaker should be adjusted to a level somewhere below the point at which the expander starts to cause distortion. This should be adjusted with a clean signal using fast AGC (or on a pre-compressed station) and with the receiver audio in its normal position. Rv can be used to set the gain through the expander to your audio stage so that it does not overload. Your amplifier's gain can then be adjusted for a desired listening volume. Resistor R101 can then be adjusted so that the audio is at the same level as the expanded audio when the expander is switched out.

Resistor R4, by the way, should be adjusted so that Rv can provide up to 10 dB gain at full volume or can reduce signals to levels well below the input level. Resistor R4 could even be replaced with a 4.7 kilohm resistor.

When all is adjusted properly, signals coming through the adapter will be roughly the same peak level with or without de-emphasis and/or expansion. However, expansion using the 600-Hz bandpass filter only may be slightly higher in volume than with the 800-Hz lowpass filter. Furthermore, when both filters are used on an unprocessed incoming signal, the volume may seem lower due to suppression of high and low frequencies. Some back-and-forth adjustments between Rv and your amplifier's volume may be required before you find the right combination for your system. Adjustment of the value of R101 may be needed also.

To summarize, the level to the NE570 must be set so it does not distort. The value of R101 may then be set to balance the in-out levels. The 600-Hz bandpass filter may show slight volume increase when used with the expander. The 800-Hz lowpass filter provides the best "punch" and should be used in circumstances when this is useful. Expand only should be used with fast AGC if the station received has no clipping and/or compression. The full system should yield significant SNR enhancement at 10-dB SNR or higher levels. Adjacent channel and high- or low-pitched carriers and interference should also be reduced due to both filtering and expansion.

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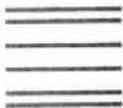
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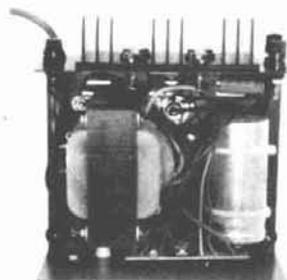
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RS-12A	9	12	4 1/2 x 8 x 9	13
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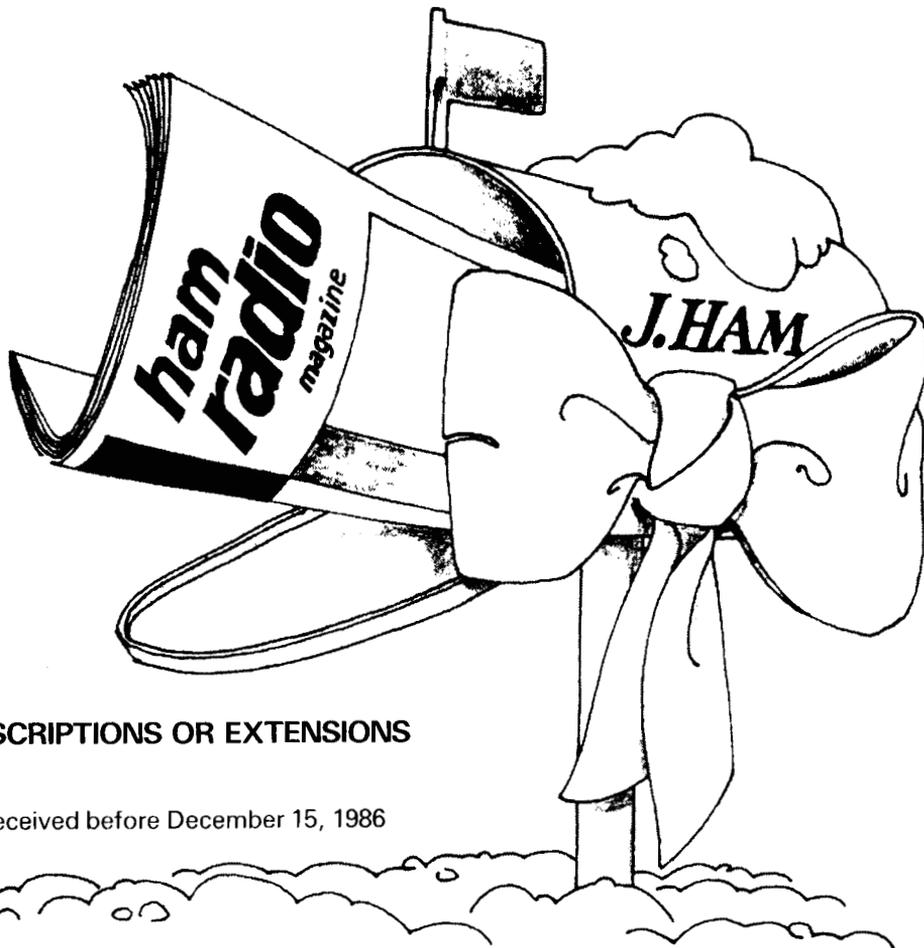
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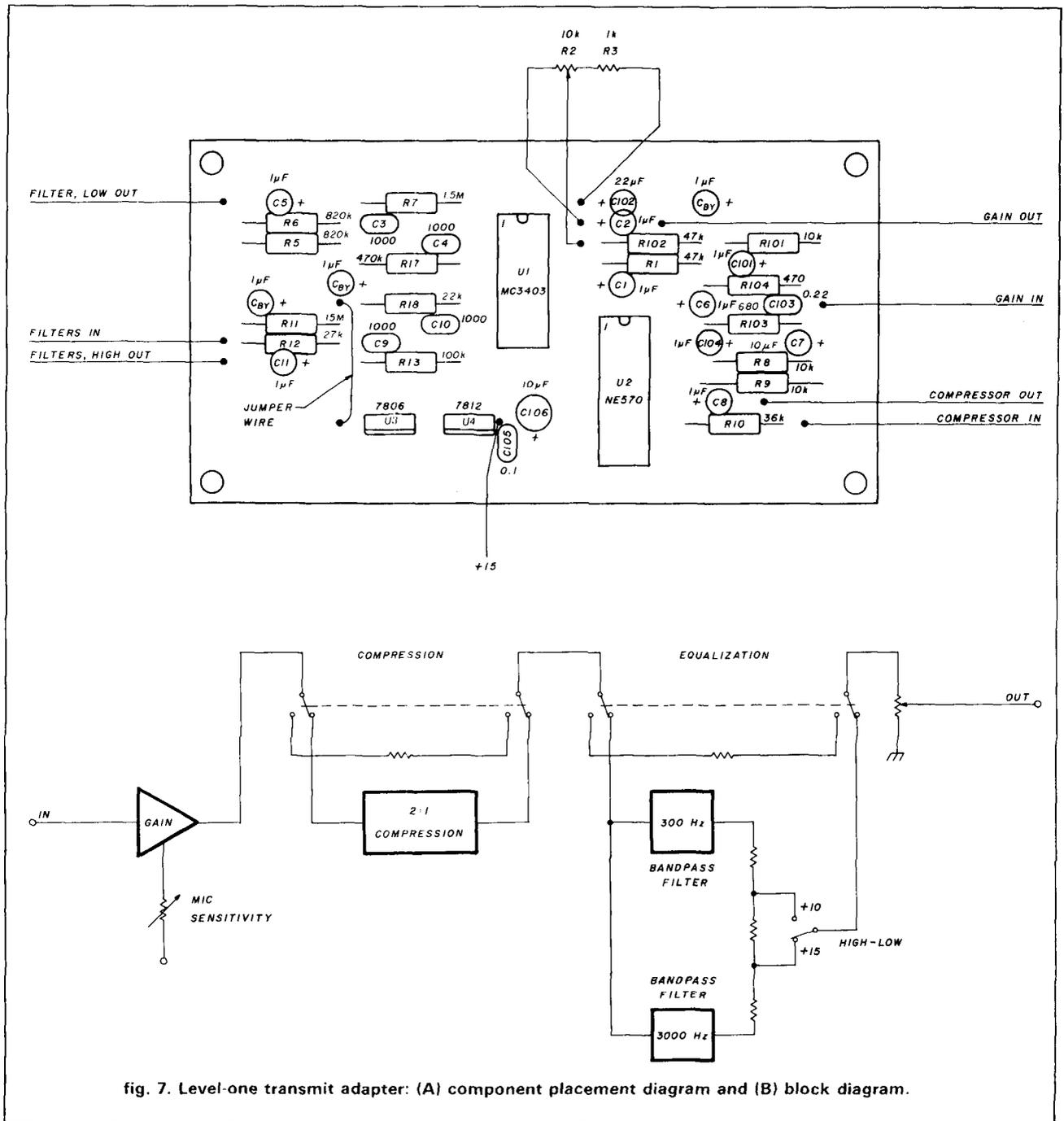


fig. 7. Level-one transmit adapter: (A) component placement diagram and (B) block diagram.

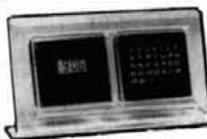
the receiver's volume control and the receiver's audio stage. This provides the best overall performance and is recommended.

The Radio Shack TA-7205 audio output IC is a good choice for a 3 to 5 watt output stage. It is readily available and comes with a schematic diagram. It can be built into a third Pomona Box or on a heat sink mounted in the external speaker box. I do not recommend such old standby ICs as the LM380, which does not have enough "headroom." Certain 2 watts per

channel hi-fi parts with built-in heatsinks can be paralleled with good results, however.

Parts placement diagrams for the receive and transmit adapters are provided in **figs. 6 and 7**, respectively. ** No special construction procedures are required beyond good RF shielding and grounding. When used with OSCAR stations, for example, it isn't acceptable

** An information sheet including prices on adapter PC boards is available from *ham radio*, Greenville, New Hampshire 03048. Please enclose SASE with your request.



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Radio Shack also sells several nice boxes for those who desire to put both transmitter and receiver adapters into one box. Be sure to use a few more screws than you normally would and scrape off a little paint here and there to ensure good RF shielding. Also remember that looping to both transmitter and receiver circuits from a common external box can create ground-loop problems.

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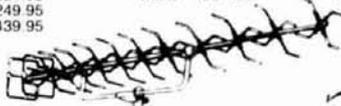
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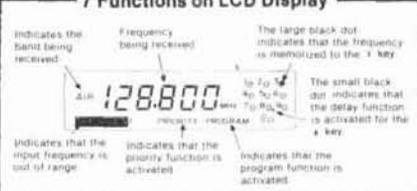
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6 Frequency Bands

Band	Frequency range	Tuning interval
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	MW 530 - 1600 kHz (531 - 1602 kHz)*	10 kHz (9 kHz)
	LW 150 - 529 kHz (150 - 530 kHz)*	1 kHz

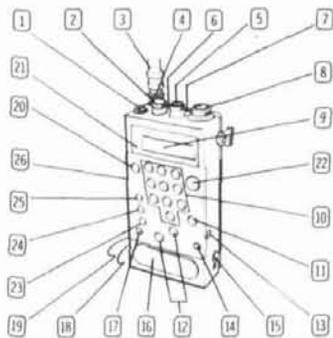
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the Zia connection: a multi-state 2-meter repeater link

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"K7DLN, this is WB5AOX in Artesia. Has that storm reached Phoenix yet?" ...not an unusual ham transmission — except that WB5AOX is sitting in his kitchen, talking to a mobile station 500 miles away on a 2-meter HT. This kind of conversation has come to be perfectly routine in the area of the southwestern United States covered by the Zia Connection, a VHF/UHF communications super-system that takes its name from the ancient sun symbol of the Zuni Indians.

Zia links eleven 2-meter repeaters in what amounts to one 2-meter repeater with tremendous coverage. The dotted line in **fig. 1**, illustrating the area covered, represents the approximate limit of the system for an average mobile station running 10 to 25 watts with a 5/8 wavelength antenna. If the range available to fixed stations with large antennas or remote bases were included, the area covered would be even larger; as is, about 100,000 square miles are accessible to mobile stations within the system. About 1300 miles of six separate interstate highways are covered. Six hundred-mile QSOs between handheld stations are routine.

The major repeater sites include Tucson (population: 350,000); Phoenix (800,000); Albuquerque (350,000); El Paso (450,000); and Ciudad Juarez, Mexico (600,000). Given these numbers — and the nature of the geographical area covered — opportunities for public service (conducting weather watch and swap nets, reporting highway accidents, providing travel directions and locating travelers) abound. Hams are never out of touch in this vast area, even if they're miles from the nearest telephone . . . and much of the area *is* miles from the nearest telephone! In October, 1983, when flash floods wiped out telephone service to communities throughout the center of the region for several days, Zia provided

trouble-free communication for the Red Cross and National Guard until services were restored.

Obviously Zia didn't spring into existence without precedent or without a lot of work by many hams. The western United States has long been noted for long-range repeaters situated on high mountain tops. Partly because the population density is low, there's been a drive toward even greater coverage. During the 1960s, shortly after 2-meter FM repeaters were first introduced to the region, there was a time when the major New Mexico repeaters were linked together. The first regular link between New Mexico and Arizona was established in 1977 between the 16-76 repeater of the Mesilla Valley Amateur Radio Club and the 31-91 repeater of the Eastern Arizona Amateur Radio Society. This was a part-time, tone-controlled link between well-established repeaters. Because the sponsors often differed as to how the link should be operated, however, it was eventually discontinued.

The Zia Connection acts just like a single wide-range repeater. The links are completely transparent to users and the whole system is open 24 hours a day to all who wish to use it, without any controlling necessary. The only time portions of the system aren't available is when technical difficulties or emergencies occur. There are no multiple squelch tails and no lost words at the beginning of a transmission. If one of the linked repeaters is timed out by a long-winded user, only that repeater — not the whole system — is shut down.

Each 2-meter repeater is similar to each of the others. All have CW identifiers and the same time-out timers, courtesy beeps, and controlled audio levels. The equipment must be highly reliable, available 24 hours a day, and able to withstand a high duty cycle. All stations are well designed, with such refinements as notch filters in the audio lines of the link receivers to remove the CW identification of the links, which are on 420 MHz.

Figure 2 shows the block diagram of a typical repeater node. The main component is the 2-meter repeater shown at the top. There is provision for up to three

By Alex F. Burr, K5XY, 2025 O'Donnell, Las Cruces, New Mexico 88001

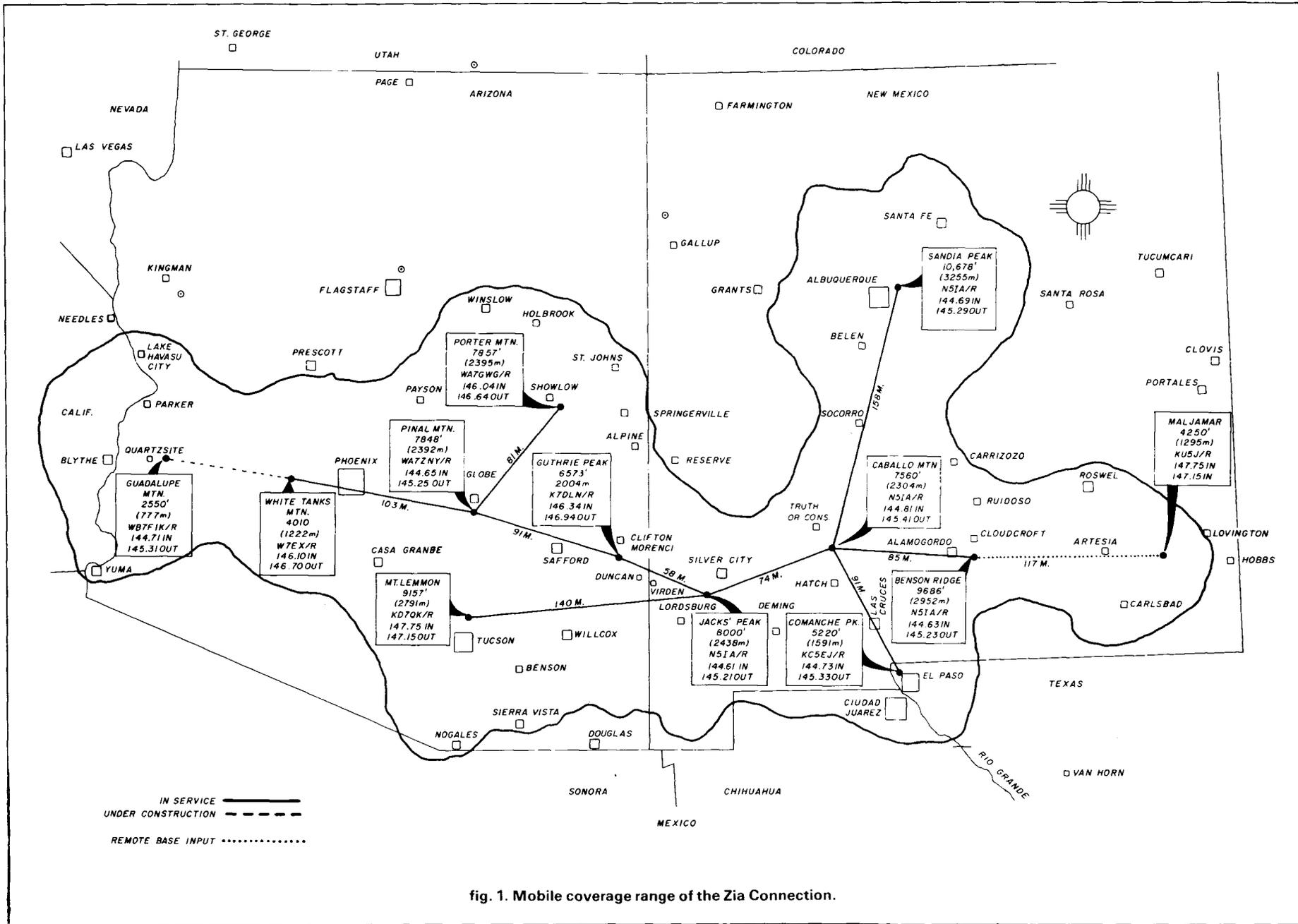


fig. 1. Mobile coverage range of the Zia Connection.

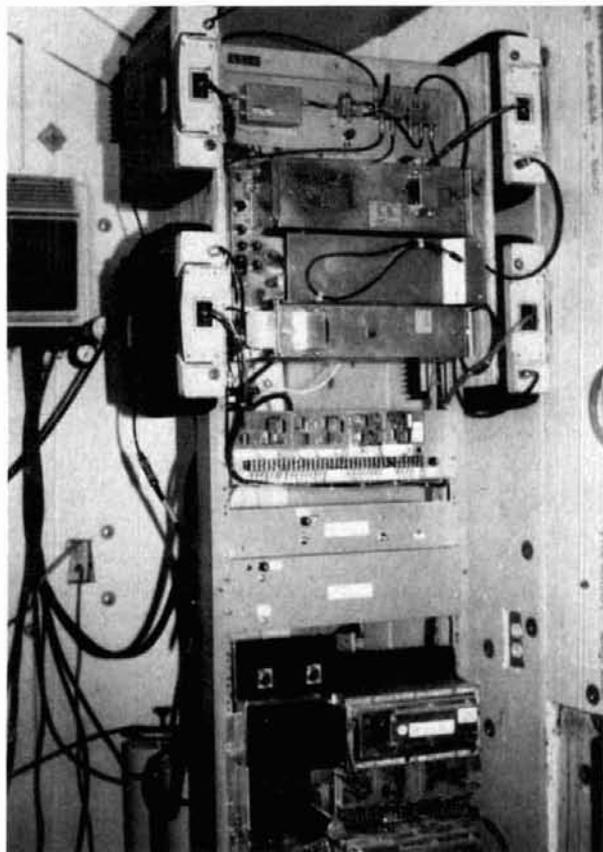


Photo A. The equipment rack at the Caballo Mountain, New Mexico location of the Zia Connection. Four converted commercial transceivers for the UHF links can be easily spotted on the two edges of the rack. The four printed circuit boards which make the essential transceiver and repeater interconnections are located in the middle.

UHF channels to act as control links. Two additional link ports are available with the addition of one more link board.

All three subsystems use typical Amateur equipment. The main antenna is a commercial grade 2-meter antenna; the UHF link antennas are home-brewed. The duplexers are standard, as are the various receivers and transmitters, which are mostly retuned commercial rigs. The links are full duplex, so there's only minimal delay in switching them.

The equipment used by the Caballo Mountain 144.81-145.41 repeater in central New Mexico, typical of what's available at each node, is a combination of commercial, modified commercial, and ham-built equipment. Four surplus Motorola MoTran 406-420 MHz transceivers used for the UHF links (**Photo A**) underwent minor modifications to insert audio level controls, bypass internal audio amplifiers, speed up the squelch action, and provide full duplex capability. The original 12-VDC power supplies have been replaced with external 24-volt



Photo B. Waterproof boxes near the base of the Zia Connection tower at Benson Ridge, New Mexico house all equipment.

power supplies. A General Electric MasterPro, modified in a manner similar to the UHF transceivers, is used for the 2-meter repeater. The 2-meter duplexer is a WACOM; the UHF duplexers are Phelps Dodge mobile duplexers.

The 2-meter feedline is Heliax and the UHF feedline uses RG213 coax. The antennas are mounted on a TV translator tower; the 2-meter antenna is a Phelps Dodge 340 and the UHF directional antennas — either 6- or 14-element verticals, depending on path requirements — are home-brewed models patterned after KLM designs. **Photos B** and **C** show another typical Zia installation at Benson Ridge, New Mexico.

Of course the key to the whole operation is the rather uncomplicated control system (**fig. 3**). With the emphasis on audio quality and fast keying response, it's designed to have a dropout time (time of response to loss of carrier on the 2-meter receiver) from one end of the system to the other of about 200 ms. The pickup time (time of response to the presence of a signal on one of the receivers) is about 300 ms for the complete system.

The control system consists of four main parts, three of which are quite conventional. Based on an EPROM,

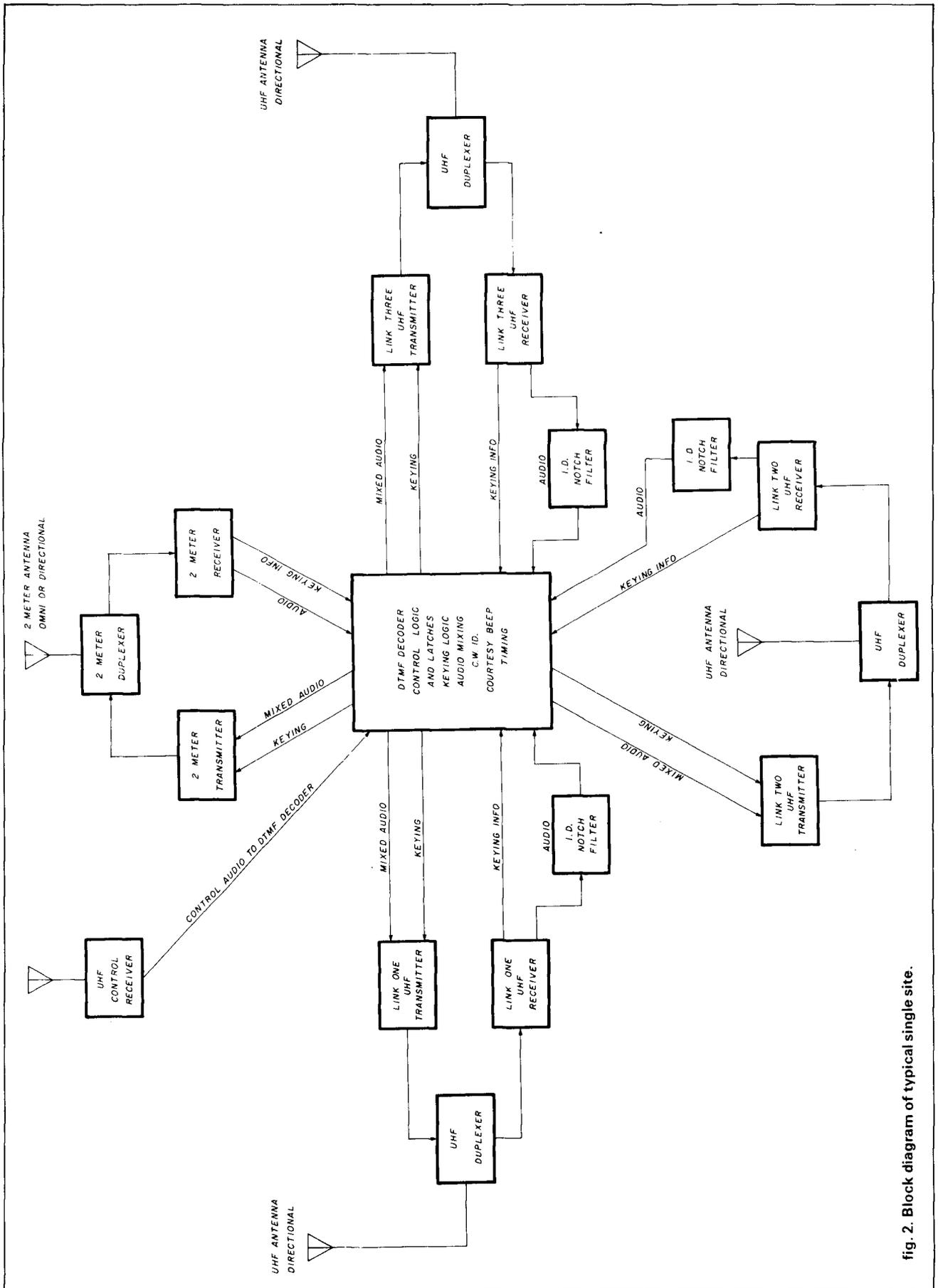


fig. 2. Block diagram of typical single site.

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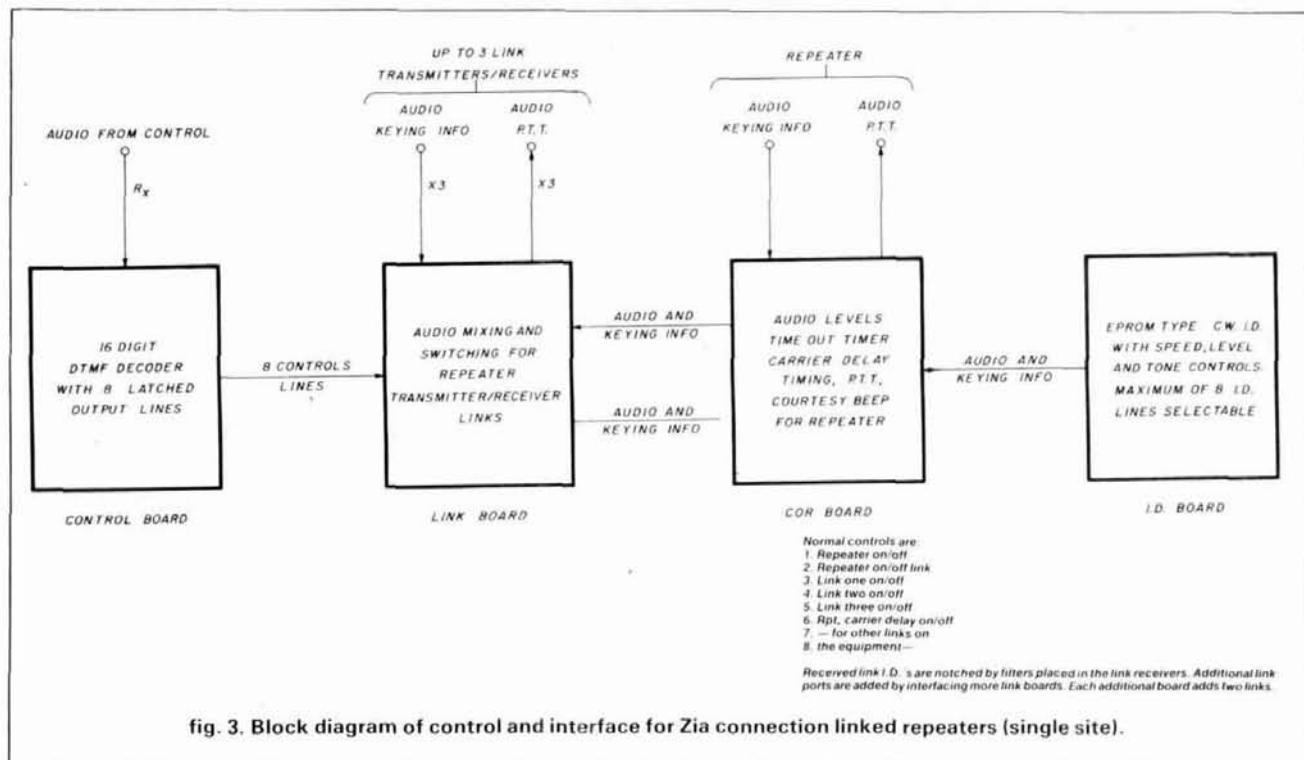


fig. 3. Block diagram of control and interface for Zia connection linked repeaters (single site).

the identification board (I.D.) on the right-hand side of the block diagram shown in **fig. 3** provides the required CW identification signal with speed, level, and tone controls. Its only unusual feature is the maximum of eight identification lines from which to select.

The control board on the left accepts audio from the UHF control receiver to a 16-digit DTMF decoder with eight latched output lines. Six of these lines are reserved for specific functions: the first turns the repeater on or off, the second connects the repeater to the link or lets it operate as an isolated repeater, the next three turn the three link systems on or off, and the sixth turns the repeater carrier delay on or off. The remaining two lines are for any other link equipment that might be added. All controls are independent of the others. The input to a particular board is accessed via UHF by the control stations for this particular part of the system.

The carrier operated relay (COR) board, also quite conventional, allows for setting audio levels, time-out protection, carrier delay timing, push-to-talk, and the courtesy beep for the repeater. The only unusual features are the audio and keying information input from the links, a similar output, and a mixing circuit to include the audio from the 2-meter receiver with the audio from the links.

The link board, the least conventional part of the system, has to process and mix the audio to and from as many as three links and the 2-meter repeater. It also has to provide and respond to the appropriate keying infor-



Photo C. View from the top the Zia Connection tower at Benson Ridge, New Mexico. The photograph was taken during construction.

mation and accept the eight output lines from the control board.

It should be obvious that no single piece of the system's hardware is particularly sophisticated; instead, the Zia Connection is more of a triumph of organization and cooperation, of hard work and commitment, than of technology. Of the several factors in its successful operation, the most important is the dedicated leadership of Milt Jensen, N5IA, who started the network with three linked repeaters in August, 1982. Milt is the first to ad-

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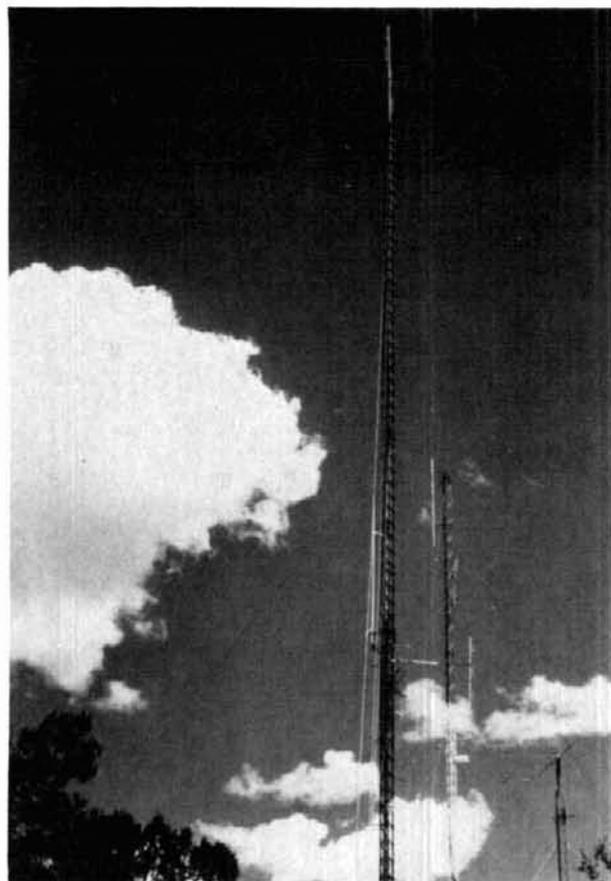


Photo D. The 135-foot tower used by the Zia Connection at Jack's Peak, New Mexico. The tower supports 11 antennas used by the 2-meter and UHF equipment. It took 12 people two and a half days to prepare the base, erect the tower, and mount the antennas.

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mit that he hasn't done it alone, but has relied on the help of many others who've designed and built components, set up repeaters, made repairs, and performed regular maintenance. Site acquisition and frequency coordination have been no small jobs, either. But it was N5IA who decided to establish the Zia Connection, set the first parts in place and got them working, and continues to plan, guide, and help with expansion.

Because previous experience with repeater linking showed that it's difficult for established groups to agree on a single plan, N5IA decided to start afresh, without benefit of existing repeaters or radio clubs. Only individuals who would wholeheartedly support the basic concept were recruited. **Table 1** lists repeater sites and equipment owners; fortunately, at about the time this operation was begun, the number of repeater channels was increased so that new repeaters could be installed with little or no inconvenience to users of existing repeaters.

Milt received significant assistance from Joe Montierth, WA7ZNY, who designed the control and inter-

Table 1. Zia connection nodes.

Site	Altitude (feet)	Equipment Owner
Mt. Lemmon	9157	John Vanza, AK7Z
Porter Mountain	7857	Kachina Radio Club
White Tanks	4010	Ken Simpson, WB7DRD
Jack's Peak	8000	Milt Jensen, N5IA
Caballo Mtn.	7560	Milt Jensen, N5IA
Benson Ridge	9686	Milt Jensen, N5IA
Sandia Peak	10,678	Milt Jensen, N5IA
Comanche Peak	5220	Rick Fultz, KC5EJ
Guthrie Peak	6573	Eastern Arizona Amateur Radio Society
Maljamar	4250	Bob Perkins, KU5J
Pinel Peak	7848	George Lewis, WA7SBZ, & Joe Montierth, WA7ZNY

face circuits and performed many of the equipment modifications. Rick Fultz, KC5EJ, provided the control and interface circuit board layouts, and Norm Smith, K7DLN, built the link antennas.

An example of the kind of cooperation common to Zia activities was the Jack's Peak antenna-raising party, coordinated by N5IA, which was necessitated by a severe ice storm that coated guy wires with 5 inches (i.e., 4 tons) of ice and brought the tower down (see **Photo D**). The operation involved building a concrete base (with 3 cubic yards of concrete mixed in a 1/3-sack mixer), raising a 135-foot tower, and setting eleven antennas and feedlines in two and a half days. All this was done on top of an 8000-foot mountain 150 miles from the nearest large city. Twelve people — including two from El Paso (200 miles away), two from Tucson (200 miles away), and two from Los Angeles (800 miles away) — were recruited for this project. The group even included a video tape camera operator who shot many minutes of tape showing the tower being slowly inched into position.

Several factors over which nobody has any control contribute to the success the Zia Connection. One is the low population density of the area. There are enough hams to ensure that *somebody* is likely to be listening,

and therefore able to respond to a request for emergency aid, but not so many that the channel is always busy. The present duty cycle is a comfortable 65 percent. Another factor is the apparent dearth of "squirrels" (or "nuts," if you prefer) among the ham population of the region. The network hasn't been significantly bothered by unstable operators and everybody gets along without the need for formal rules or control operator intervention. No area of the system has preference over any other area; in all aspects, the system operates as if it were just one large, friendly repeater.

Of course the availability of mountain-top repeater sites helps, although remote mountain sites do have their disadvantages. But N5IA is quick to point out that the system can be duplicated, and even improved upon, anywhere that people have the desire to do so. A greater number of links, for example, could compensate for an insufficient supply of barely-accessible mountain-top sites.

The separate units in the network belong to individual owners and two small clubs, who are responsible for all aspects of their repeaters and the associated links. Owners or owner-recruited volunteers such as Martin Raue, WB5LJO, Jim Devenport, WB5AOX, and John Braden, K7LKL, are responsible for maintenance. N5IA owns four of the eleven repeaters; others own the rest. Financing has been mostly by individuals, with some donations for maintenance and operation. There are no dues, and no soliciting; donations are made for the purpose of contributing to a good cause, rather than, for example, expecting x hours of operating time.

Even after the network was established and running, lots of effort had to be — and still must be — expended to keep it going. Time is the biggest problem; N5IA often feels that he has to be in several places at once. When you have to drive 150 miles (one way) to repair a repeater, it's bound to cut into your free time. Storms, with their antenna icing or lightning-induced failures, present the greatest challenge.

As it is, the region is fortunate to have a group of Amateurs who find pleasure in providing a remarkable service to a large number of hams.

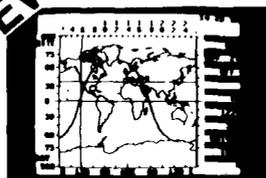
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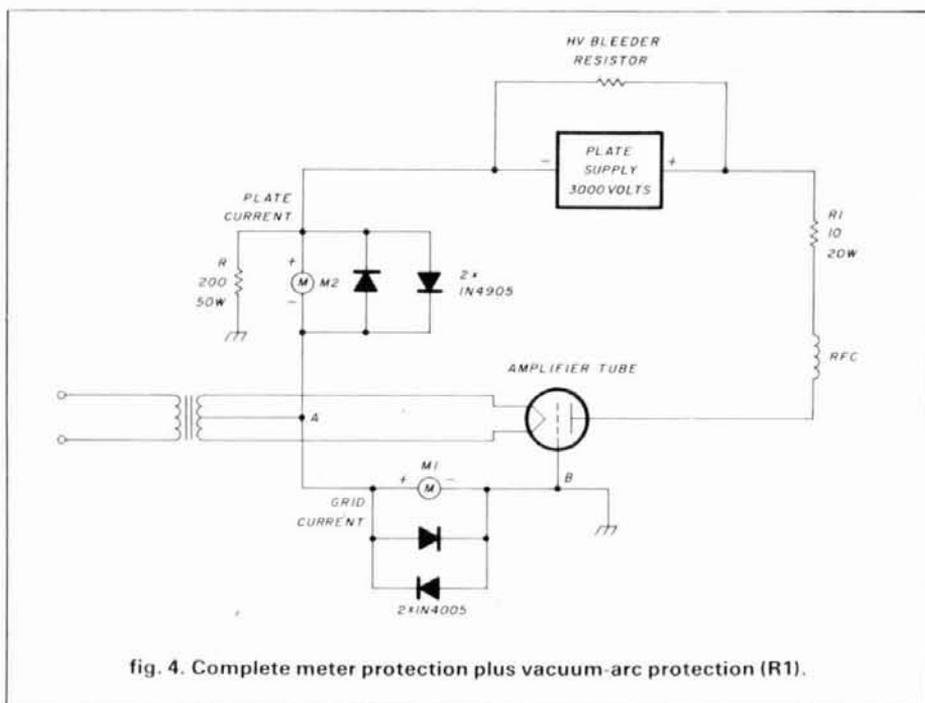


fig. 4. Complete meter protection plus vacuum-arc protection (R1).

Many prudent Amateurs run the filaments of their power tubes from a separate filament transformer set to the correct voltage by means of a variable voltage transformer ("Variac" or "Powerstat" are two trade names for such a device.) The filament voltage is set "on the nose" by means of a filament voltmeter. Or is it?

Primary voltage in most of the United States is affected by industrial loads that can alter the waveform from the classic sine wave. The primary line is full of harmonics, spikes, and other unpleasant surges and dips. This makes an easy job difficult because inexpensive voltmeters and other instruments that employ a rectifier and DC meter to measure AC voltage simply lose their accuracy when confronted with a distorted waveform.

An accurate method of measuring filament voltage is to use an "RMS responding" AC meter. The old Weston Model 301 AC instruments often found at flea markets are of this type. Beware of a meter bearing a label that says "rectifier-type instrument." It won't do the job as well.

When you find an RMS-responding AC meter, take it to an instrument laboratory, if there's one nearby, or perhaps a local college. Ask their standards lab to calibrate your meter for you.

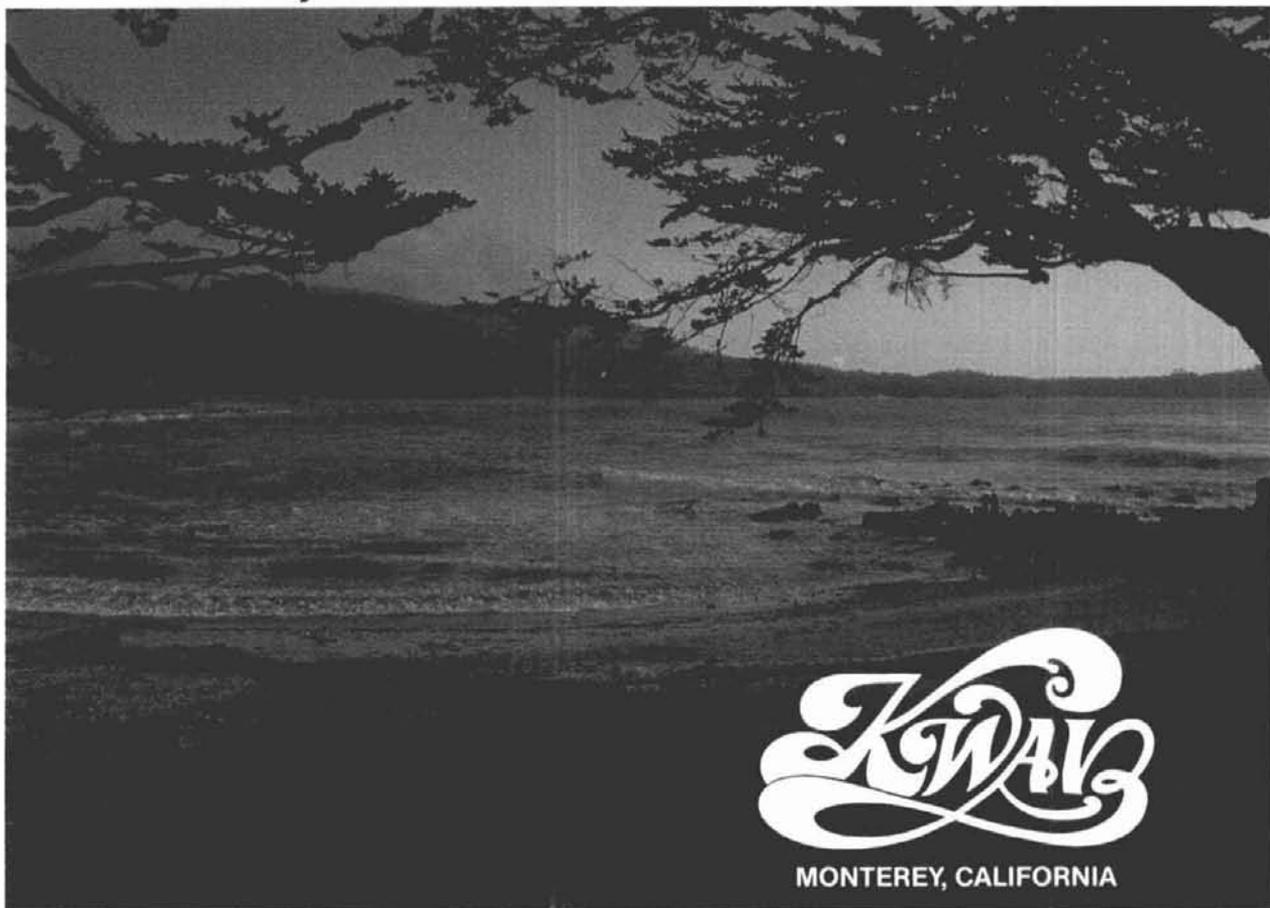
This is a cheap and easy way to obtain a 1 percent meter for a few dollars and just a little effort. You can then use the meter to monitor your filament voltage or your line voltage.

I picked up a nifty 0-150-volt Weston laboratory-type meter with a mirror-scale for a few dollars at a local swap meet. A local standards lab checked the meter out, and now I have a "standard" meter, good to 1-percent accuracy. I leave it permanently connected across the primary line to observe the daily fluctuations of line voltage. In my case, the voltage varies with the time of day, ranging from 118 to 124 volts! Since it's always above 117 volts, I have a multi-tap filament transformer connected as an autotransformer. I usually set the voltage to my transmitter at 115 volts, slightly under normal, in the hope that everything will run cooler and with less stress than if I operated it directly off the line. The voltmeter is atop the operating table and the tapped transformer is suspended under the tabletop, to the right of my equipment.

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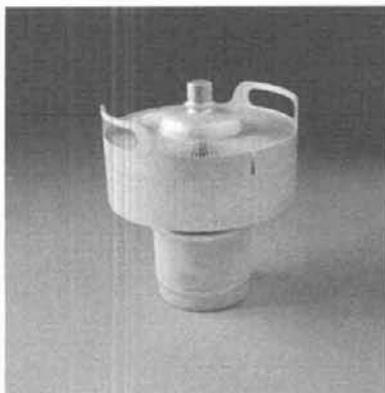
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get on SSTV — with the C-64

Software approach/ uses BASIC and/ machine language routines

Although the Commodore 64 computer has proved to be a popular addition to many hamshacks, its full potential hasn't always been realized. The Commodore has excellent graphics capabilities that are easily accessible to a knowledgeable programmer — and these capabilities are directly applicable to slow-scan television.

Several years ago, Edwin Cox designed and published an SSTV send and receive program for the VIC-20, later upgrading it for the C-64.^{1,2,3} Others have written programs to allow weather facsimile to be displayed using the Commodore machines.⁴ Numerous articles and books have explored what can be done with the versatile Commodore machines⁵; the possibilities described in the Amateur literature go far beyond applications available commercially.

While the earlier programs required additional hardware in order to use the Commodore for visual reception, the programs described in this article make full use of the hardware already contained in the C-64. The only interface necessary is protection of the sensitive ICs from the fluctuations of the outside world.

What follows is the brainchild of two Italian computer and radio enthusiasts. Once you've typed in the programs, you'll be ready to send and receive black and white SSTV pictures with very little additional work. — Jim Grubbs, K9EI.

slow-scan basics

Before we program the computer for transmission and reception, let's briefly review the basics of SSTV. SSTV is transmitted as a continuous series of tones using normal voice bandwidth channels. While most SSTV activity occurs on HF using standard SSB techniques, it's equally well-suited to FM modulation on UHF/VHF or even transmission over standard grade telephone lines.

First the image to be transmitted is scanned. For a

standard black and white picture, it takes about 8 seconds to scan and send a single frame of video. In order to know when a new scanning line begins and when a new picture frame begins, certain tones are reserved to indicate synchronization signals. A 1200-Hz tone represents a sync pulse. A horizontal sync pulse consists of a 1200-Hz tone for a period of 5 milliseconds. A longer 1200-Hz tone for 30 milliseconds represents a vertical sync signal.

In order to distinguish between black and white portions of the picture, the tones between 1500 and 2300 Hz are used to specify everything from pure black to pure white — including all the shades of gray in between.

making the computer speak SSTV

In order for the computer to interpret an SSTV signal accurately, it has to know exactly what frequency is present during each sampling period. By connecting the audio to the user port, (see **fig. 1**) of the Commodore 64, we can count the number of zero crossings present and determine the frequency of the incoming signals. We use pin "B" on the user port, which is available as a general-purpose interrupt input on the 6526 complex interface adapter chip.

The sampling of the input frequency must be done continuously using a very short time interval in order to reproduce a slow-scan picture accurately. This is achieved by rewriting the Non-Maskable Interrupt (NMI) routine that's resident in the C-64. By modifying the pointers to the NMI routine, we can substitute a program designed to suit our needs for SSTV. The pointers are located at hex locations \$0318 and \$0319.

taking a break

The central processing unit in the C-64 is kept very busy; all the pretty graphics and sounds available take their toll on processor time. For the purpose of SSTV reception, this can present a problem if we don't focus the attention of the CPU on our assigned task. Normal-

By Giuseppe Cameroni, I2CAB, and Giancarla Morellato, I2AED, Via Damiano Chiesa 26, Vigevano 27029, Italy. Translation and additional text by Jim Grubbs, K9EI.

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Table 1. SSTV reception program listing.

```

1000 rem *****
1010 rem direct reception of sstv
1020 rem pictures via commodore 64
1030 rem written by:
1040 rem giancarla morellato i2aed
1050 rem address: via d. chiesa 26
1060 rem 27029 vigevano
1070 rem italy
1080 rem *****
1230 print chr$(147)
1270 rem data loading
1280 :
1290 for i=32768 to 33285:read a:poke i,a:next
1300 poke 53280,0:poke 53281,0
1310 print chr$(147)
1320 print"sstv reception active"
1330 for i=1 to 5000:next
1340 sys 32768
1350 :
1360 data 120,160,000,132,158,169,096,133,159,169
1370 data 000,145,158,200,208,251,230,159,166,159
1380 data 224,128,144,243,160,000,132,158,169,004
1390 data 133,159,169,102,145,158,200,208,251,230
1400 data 159,166,159,224,008,144,243,160,000,132
1410 data 158,169,216,133,159,169,001,145,158,200
1420 data 208,251,230,159,166,159,224,220,144,243
1430 data 088,160,000,132,158,169,096,133,159,141
1440 data 033,208,169,080,133,159,169,188,145,158
1450 data 200,208,251,230,159,166,159,224,095,144
1460 data 243,169,241,141,134,002,173,000,221,073
1470 data 001,141,000,221,173,017,208,073,032,141
1480 data 017,208,173,022,208,073,016,141,022,208
1490 data 169,072,141,024,208,169,036,141,024,003
1500 data 169,129,141,025,003,169,127,141,013,221
1510 data 169,101,133,159,169,080,133,158,169,152
1520 data 141,015,221,141,006,221,169,003,141,007
1530 data 221,169,000,133,003,168,145,158,169,255
1540 data 141,004,221,141,005,221,173,013,221,169
1550 data 153,141,014,221,169,147,141,013,221,088
1560 data 032,228,255,240,251,201,136,208,011,173
1570 data 017,208,073,016,141,017,208,076,199,128
1580 data 072,173,000,221,073,001,141,000,221,173
1590 data 017,208,073,032,141,017,208,173,022,208
1600 data 073,016,141,022,208,169,021,141,024,208
1610 data 169,001,141,134,002,169,071,141,024,003
1620 data 169,254,141,025,003,169,142,032,210,255
1630 data 173,017,208,009,016,141,017,208,169,065
1640 data 032,210,255,088,104,104,104,104,234,234
1650 data 120,096,072,138,072,152,072,172,013,221
1660 data 169,127,141,013,221,186,224,064,176,006
1670 data 162,250,154,076,178,128,152,041,129,201
1680 data 129,240,243,152,041,145,201,144,208,039
1690 data 162,008,142,015,221,173,007,221,133,077
1700 data 173,006,221,070,077,106,070,077,106,174
1710 data 005,221,134,077,162,025,142,015,221,162
1720 data 003,221,246,129,176,013,202,016,246,230
1730 data 003,169,025,141,014,221,076,235,129,165
1740 data 077,073,255,074,133,077,074,024,101,077
1750 data 134,077,072,041,248,168,104,106,041,003
1760 data 073,003,170,165,077,024,202,048,004,010
1770 data 010,144,249,072,166,003,224,018,176,035
1780 data 224,004,144,048,230,158,208,004,230,159
1790 data 048,023,165,158,041,007,208,025,165,158
1800 data 024,105,056,133,158,165,159,105,001,133
1810 data 159,201,126,144,008,162,101,134,159,162
1820 data 080,134,158,169,000,132,077,168,145,158
1830 data 164,077,104,182,184,176,004,017,158,145
1840 data 158,152,105,008,166,169,000,133,003,145
1850 data 158,169,147,141,013,221,104,168,104,170
1860 data 104,064,052,085,106,123,000,075,160,105
1870 data 105,095,078,085,073,074,081,032
ready.

```

Table 2. SSTV transmission program listing (BASIC).

```

1000 rem *****
1010 rem sstv transmission via c-64
1020 rem conceived by:
1030 rem giuseppe cameroni i2cab
1035 rem and
1040 rem giancarla morellato i2aed
1050 rem
1060 rem *****
1100 for i=19968 to 20079:read a:poke i,a:next
1110 for i=20224 to 20274:read a:poke i,a:next
1120 for i=20480 to 20696:read a:poke i,a:next
1130 for i=20736 to 20856:read a:poke i,a:next

```

(continued on page 47)

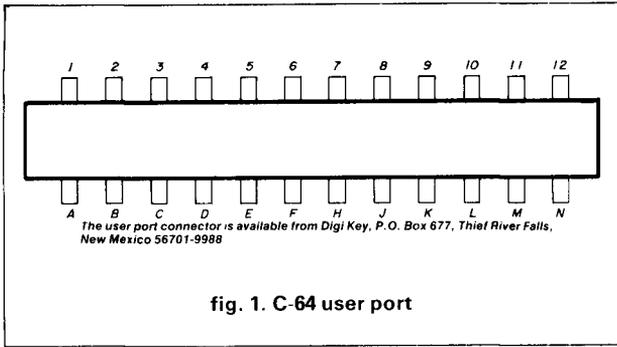


fig. 1. C-64 user port

ly the C-64 stops everything it's doing and takes time out to update the graphics screen. If these video interrupts are left intact, our program will work, but there will be "holes" in the picture where the CPU goes and does other things.

By making a small compromise in operating convenience, this problem is easy to overcome. The SSTV receive program has been written so that by pressing the F7 function key, the video interrupts normally processed by the CPU are suspended until the F7 key is pressed again. This results in the screen being blanked during reception of a picture, but ensures that no data is lost (during the reception. (The Cox SSTV program suffered from the same problem and used a similar solution).

Because no external processing is being done, it's necessary to keep the audio gain of the receiver fairly high in order to saturate or clip the signal. The computer doesn't understand much other than square waves.

Two interfaces are presented here (see figs. 2 and 3). The first is definitely intended for those in a hurry, but it works! Just about any NPN transistor will do; its primary purpose is to protect the 6526 chip in the computer from damage. The second, a slightly more complex single-chip interface, allows a much more acceptable audio level to be used from the receiver. It uses a single LM311 voltage comparator IC and a few resistors.

getting the picture

Once you've typed in the program and built either of the two interfaces, you're ready to receive black and white SSTV pictures.

For convenience, the program for SSTV reception is presented in BASIC (table 1). Because the timing for SSTV is in the millisecond range, only a machine language routine is fast enough to provide the needed accuracy. This program "pokes" in the machine language program from BASIC.

To begin, connect the interface, making sure that the power to the computer is turned off; trying to connect the interface with power on could damage the C-64's sensitive circuitry.

Next, load and run the program. There will be a short

delay while the machine language routines are poked into memory. After that the screen should turn black.

The best place to look for SSTV activity is around 14.230 MHz, particularly on Saturday and Sunday mornings. Be aware that several formats are in use; much of the activity you'll hear will be color transmissions not well-suited to this simple program. Many SSTV nets, however, ask their participants who work in color to also send their pictures in standard 8-second black and white format for those with less sophisticated equipment.

The best way to tune an SSTV signal is to adjust the receiver for normal-sounding speech and then leave the tuning alone during picture transmission. If everything is working smoothly, you'll see a picture begin to be traced in the center of the computer screen. The image will occupy only a portion of the screen.

The best images for this simple program will consist of graphics that don't contain subtle color changes. Signals generated using a SSTV keyboard or employing block-type graphics will come through best.

Using this program we've been able to display live images of distant SSTV operators. The display is somewhat grainy, but the image is still quite interpretable as a person.

Once you can receive pictures, you may want to transmit some yourself. While the simple program shown in table 2 won't allow you to create and send fancy pic-

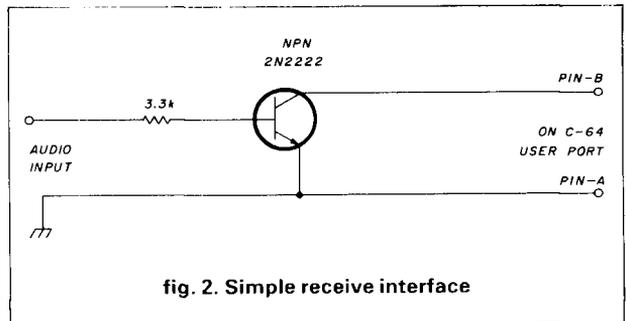


fig. 2. Simple receive interface

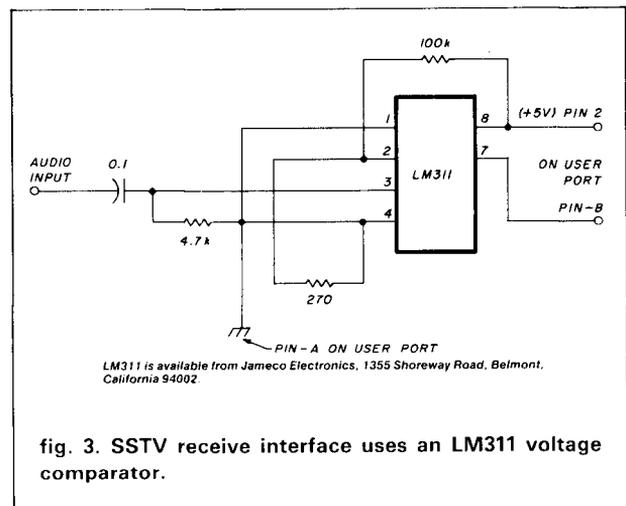


fig. 3. SSTV receive interface uses an LM311 voltage comparator.

LM311 is available from Jameco Electronics, 1355 Shoreway Road, Belmont, California 94002.

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tures, it will enable you to call CQ and acknowledge other SSTV signals with one of your own.

SID sends a picture

Normally we think of the SID sound chip in the Commodore machine as being the hardware necessary to make music. For SSTV, however, it becomes an important part of getting a "picture" on the air.

The simple SSTV transmit program takes a portion of the regular text screen available on the C-64 and provides a conversion for everything typed in this special "window." The window consists of seven lines of up to eight characters each. Any of the standard Commodore characters, including the graphics characters, can be used. I did find that the program acted strangely when I tried to send reverse-image characters. — K9EIJ

The characters you type on the screen are presented, one at a time, to a special interpreter program. Every character consists of individual points of light; by processing these points and applying them to the sound chip, we can create an SSTV signal in standard format.

Since we're using only standard characters, all of the information will represent either pure black or pure white, depending on whether the point being "scanned" by the program is on or off. The computer itself will allow us to specify up to 255 different shades of gray. A more advanced program could use the main subroutines from this one to send a true bit-mapped image, perhaps prepared with one of the graphics programs like Koalapainter.

Every line of the video from our SSTV transmit program consists of 64 memory locations. A \$00 specifies white, which is represented by a 2300-Hz tone sent for 0.93 milliseconds. A value of \$FD indicates black, sent at 1500 Hz, while \$FE indicates a horizontal sync pulse and \$FF is used to indicate vertical sync.

Each frame of transmitted video consists of seven text lines containing eight characters each. Each character is represented by an 8 x 8 matrix. The image definition will be 63 points horizontal (8 x 8 less one horizontal sync pulse) by 128 points (7 characters by 8 x 2 — each line is transmitted twice — plus 16 lines of buffer). The extra lines of buffer were inserted to allow for easy reception of the picture even if the monitor isn't set up perfectly.

Finally the SID chip is turned on and the frequency is changed according to the values stored in the matrix. The resulting standard SSTV audio signal can be heard coming out of the monitor speaker.

Once you've created your picture, you can send it by pressing the "backarrow" key located in the upper left hand corner of the keyboard. You can move the text window around using the cursor keys. You can return to the upper left hand corner of the window by pressing the RETURN key. To terminate transmission, you must press and hold the RETURN key. The key is scanned during the vertical sync period.

```

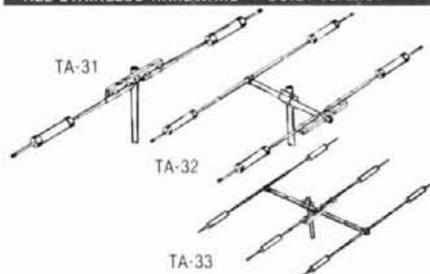
1150 print chr$(147):printtab(10)"setv transmission"
1155 for z=1 to 8
1160 print chr$(17)
1170 next z
1180 printtab(3)"activate transmission by the ";
1195 print chr$(18)+chr$(95)+" key"+chr$(146)
1200 printtab(2)"stop transmission by pressing ";
1210 print chr$(18)+"return"+chr$(146)
1250 print chr$(19);:for i=1to8:print chr$(175);:next
1260 print chr$(19);:for i=1to 7:printtab(8)chr$(212);:next
1270 for i=1to8:print chr$(197);:next
1280 print chr$(19)
1290 for c=1 to 7
1300 for i=1to8:print " ";:next i:print
1310 next c
1330 print chr$(19):n=0
1340 p1=1064
1350 poke p1+54272,14:pokep1,peek(p1)+128
1360 geta$:ifa$=""thenpokep1,peek(p1)-128:goto1350
1370 if asc(a$)=157thenprinta$;poke p1,peek(p1)-128:n=n-1:p1=p1-1:goto 1350
1380 if asc(a$)=29 then print a$;poke p1,peek(p1)-128:n=n+1:p1=p1+1:goto1350
1390 if asc(a$)=145then print a$;poke p1,peek(p1)-128:n=n-8:p1=p1-40:goto1350
1400 if asc(a$)=17then print a$;poke p1,peek(p1)-128:n=n+8:p1=p1+40:goto 1350
1410 if asc(a$)=95then pokep1,peek(p1)-128:goto1540
1420 if asc(a$)=13 then n=0:pokep1,peek(p1)-128:goto1330
1430 poke p1,peek(p1)-128:printa$;:p1=p1+1
1440 n=n+1
1450 if n=8thenp1=p1+32:print
1460 if n=16 then p1=p1+32:print
1470 if n=24 then p1=p1+32:print
1480 if n=32 then p1=p1+32:print
1490 if n=40 then p1=p1+32:print
1500 if n=48 then p1=p1+32:print
1510 if n=56 then n=0:goto1330
1520 goto 1350
1540 ct=0
1550 sys 20224
1560 for i=1064 to 1351 step 40
1570 forc=1to1+7
1580 poke 20479,ct
1590 lc=peek(c)
1600 aq=0
1610 poke 56334,peek(56334)and254
1620 poke1,peek(1)and251
1630 go=lc*8+53248
1640 for p=potopa+7
1650 poke16384+aq,peek(p)
1660 aq=aq+1
1670 nextp
1680 poke1,peek(1)or4
1690 poke56334,peek(56334)or1
1700 sys20736
1710 ct=ct+1
1720 if ct=56 then 1750
1730 nextc
1740 nexti
1750 for i=24576 to 32896 step 64
1760 poke1,254
1770 next
1780 poke1-64,255
1790 sys20480
1800 poke 54296,0
1810 goto 1330
1820 data 000,098,008,098,016,098,024,098,032,098
1830 data 040,098,048,098,056,098,000,102,008,102
1840 data 016,102,024,102,032,102,040,102,048,102
1850 data 056,102,000,106,008,106,016,106,024,106
1860 data 032,106,040,106,048,106,056,106,000,110
1870 data 008,110,016,110,024,110,032,110,040,110
1880 data 048,110,056,110,000,114,008,114,016,114
1890 data 024,114,032,114,040,114,048,114,056,114
1900 data 000,118,008,118,016,118,024,118,032,118
1910 data 040,118,048,118,056,118,000,122,008,122
1920 data 016,122,024,122,032,122,040,122,048,122,056,122
1930 data 169,096,141,016,079,169,126,141,036,079
1940 data 162,000,169,253,157,000,096,232,208,250
1950 data 238,016,079,169,098,205,016,079,208,238
1960 data 162,000,169,253,157,000,129,232,208,250
1970 data 238,036,079,169,129,205,036,079,208,238,096
1980 data 169,016,141,024,212,169,240,141,006,212
1990 data 169,017,141,004,212,169,127,141,013,220
2000 data 169,239,045,017,208,141,017,208,173,126
2010 data 128,201,000,240,029,201,253,240,057,201
2020 data 254,240,085,201,255,240,113,169,069,032
2030 data 210,255,096,234,234,234,234,234,234,234
2040 data 234,234,234,234,169,240,141,000,212,169
2050 data 152,141,001,212,162,001,160,153,136,208
2060 data 253,202,208,248,238,029,080,208,195,238
2070 data 030,080,076,028,080,255,169,200,141,000
2080 data 212,169,099,141,001,212,162,001,160,153
2090 data 136,208,253,202,208,248,238,029,080,208
2100 data 163,238,030,080,076,028,080,255,169,200
2110 data 141,000,212,169,079,141,001,212,162,008
2120 data 160,240,136,208,253,202,208,248,238,029
2130 data 080,208,131,238,030,080,076,028,080,000
2140 data 169,200,141,000,212,169,079,141,001,212
2150 data 162,097,160,130,136,208,253,202,208,248

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(continued on page 51)

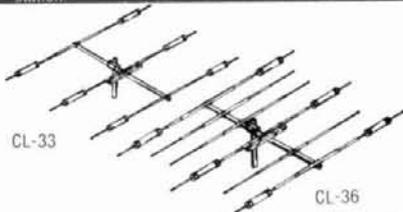
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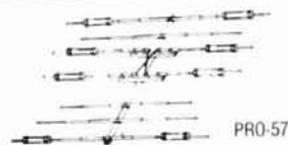


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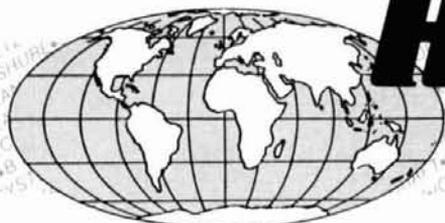
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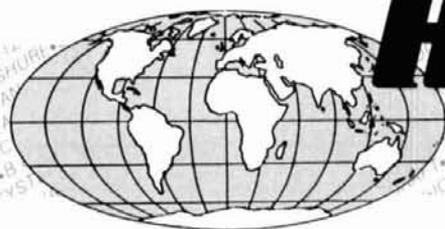
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The real measure of any data controller is what kind of on-air performance it gives. While the PK-64 and PK-232 use different types of modems, both give excellent performance on VHF. The optional HF modem of the PK-64 uses independent four-pole Chebyshev filters for both Mark and Space tones, and A.M. detection. The HF option can be factory or field installed.

The PK-232 uses an eight-pole bandpass filter followed by a limiter discriminator with automatic threshold correction. The internal modem automatically selects the filter parameters, CW Fc = 800 Hz, BW = 200 Hz; HF Fc = 2210 Hz, BW = 450 Hz; VHF Fc = 1700 Hz, BW = 2600 Hz.

The PK-64 uses on screen indicators to show status, mode, and DCD (Data Carrier Detect) while the PK-232 uses front panel indicators. Both units use discriminator style tuning for HF operation. And that's just the tip of the iceberg. Features like multiple connects on packet, hardware HDLC, CW speed tracking, and other standard AEA software features are included in both the PK-64 and PK-232.

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2160 data 169,129,141,013,220,169,016,013,017,208
2170 data 141,017,208,032,228,255,201,000,240,004
2180 data 096,234,234,234,169,000,141,029,080,169
2190 data 096,141,030,080,076,015,080
2200 data 173,255,079,010,234,234,170,189,000,078
2210 data 141,049,081,141,081,081,232,189,000,078
2220 data 141,050,081,141,082,081,162,000,160,000
2230 data 189,000,064,141,255,063,062,000,064,144
2240 data 005,169,000,076,046,081,169,253,153,184
2250 data 125,200,234,234,234,234,192,008,144,232
2260 data 160,064,173,255,063,157,000,064,062,000
2270 data 064,144,005,169,000,076,080,081,169,253
2280 data 153,184,125,200,234,234,234,192,072
2290 data 144,232,232,224,008,208,001,096,169,128
2300 data 024,109,049,081,141,049,081,141,081,081
2310 data 144,172,238,050,081,238,082,081,076,028,081
ready.

```

Incidentally, it does take a few seconds for the program to assemble the text into the matrix, so anticipate a few seconds delay when you press the transmit key. Like the receive program, the transmit program is presented in BASIC language form, although it does use machine language subroutines that are accessed from the BASIC program using the SYS command.

The SSTV audio tones will be present on the regular audio output connection of your monitor cord. If you're using a TV set as a monitor, the tones will appear in the TV speaker.

It's best to establish a direct connection between the audio output of the computer and your transmitter. You may wish to insert a small potentiometer in the line to allow adjustment for the proper level.

apples and oranges

How does this software-only method of SSTV reception and transmission compare with other methods that involve some external hardware? The original program published by Ed Cox in *vicComm* allowed SSTV reception on an unexpanded VIC-20 but required a two-chip interface. Because of the memory limitations of the VIC-20, the picture was a somewhat elongated, compressed image. The reception program presented here maintains the proper aspect ratios but doesn't produce a larger image. Later versions of the Cox program for both the VIC-20 with additional memory and the C-64 did give a full-screen presentation and at least got the aspect ratio pretty close.

On reception I found the Cox program and this one to be nearly identical

in their level of clarity. They certainly aren't commercial quality, but are still a great way to get your feet wet on SSTV.

For transmit, the Cox program is somewhat more nicely configured, but does require the external interface. The picture quality coming from the software-only program is virtually identical, with the advantage of no external interface.

When compared to the program and hardware combination available from Kinney Software,* both programs show their limitations. While the Kinney approach is still not up to the state-of-the-art, it does produce a fairly high resolution image both in receive and transmit that neither of the other programs can produce. Still, it's a larger investment, so better results are to be anticipated.

While the SSTV software here has inherent limitations, it certainly shows what can be done by talented programmers with a machine as "simple" as the Commodore 64. With very little more than an expenditure of time, you can put your C-64 to work sending and receiving SSTV signals. Imagine what else it can do!

postscript

Questions or comments should be addressed directly to the authors at the address given at the beginning of this article, which was originally published in a somewhat different form in the national magazine of The Associazione Radioamatori Italiani (ARI).

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Note: *vicComm* available from: *vicComm*, Box 5491, Duke Station, Durham, North Carolina 27706.

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5. Jim Grubbs, K9EI, *The Commodore Ham's Companion*, QSKY Publishing, 1985. **

*Kinney Software, 121 North Hampton Road, Donnelsville, Ohio 45319.

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From the tip to the bottom of the conical aluminum base, it measures 37-1/2 inches — close to the 1/2-wave resonant length at 146 MHz. It's tuned at CB frequencies by placing an inductor between the base of the whip and ground that resonates with the short monopole capacitive reactance. Tapped a short distance up the coil from the grounded end, it produces a 50-ohm resistive impedance.

modifying the base

Dismantling the base is easy. The conical aluminum base unscrews by hand from the black plastic housing, separating the aluminum base from the disc-shaped magnetic mount below. The plastic housing is then pulled gently from the magnetic mount, revealing the matching assembly: a tapped-inductor tuner! The only damage to the assembly caused by taking it apart is to a ring of caulking compound (probably silicone rubber) that breaks loose from the base of the black plastic housing. Weatherproofing can be restored — even improved — by replacing this and adding more caulking compound to the periphery of the hole where the RG-58/U cable emerges from the plastic housing.

matching network design

The existing matching system for the Archer antenna is ideally suited for modification into an L-network. The coil form, measuring 5/8 inch in diameter, is made

of solid plastic. The No. 18 wire of the existing coil is entirely satisfactory. Even the mounting terminals on the coil form can all be conveniently used. A small variable capacitor is the only component that must be added. I used a compression mica capacitor from my junk box (the screw-adjustable kind, mounted on a little white rectangular ceramic base). Since the capacitance required will be in the order of 5 pF, I recommend one that's ad-



fig. 1. Mag-mount whip antenna after modification and installation.

By Donald K. Reynolds, K7DBA, 749 San Jude Avenue, Palo Alto, California 94306

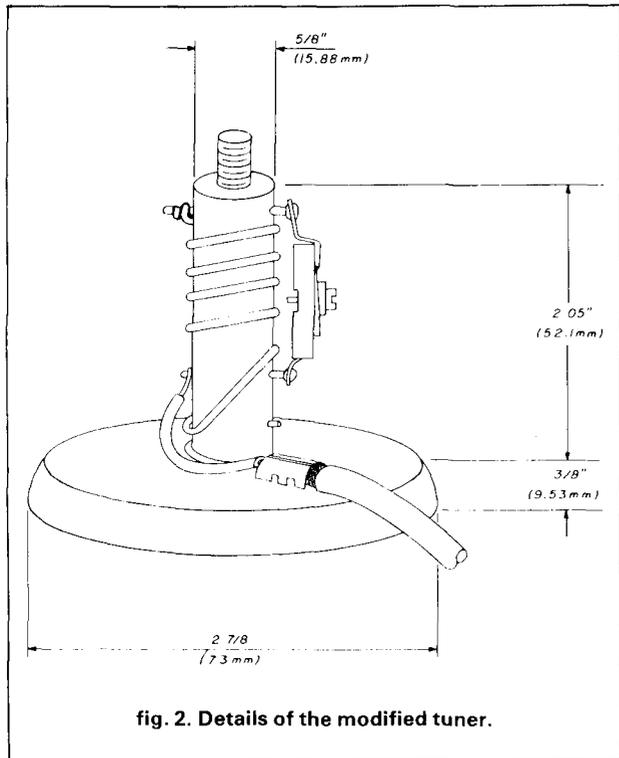


fig. 2. Details of the modified tuner.

justable in the 3- to 10-pF range. The ceramic-based compression mica type should handle powers of up to 100 watts.

I achieved a practically perfect match at 146 MHz by using the usual cut-and-try methods. My final coil had exactly five turns, from a bottom pin on the coil form (which is internally grounded to the magnetic base) to the pin directly above it at the top of the coil form, which is internally connected to the 1/4-20 screw onto which the aluminum base of the antenna is threaded. Since the spacing between the bottom and top pins to which the coil is attached is slightly over 1-1/2 inches, the turns are considerably spread out. In my final version, the top four turns are spaced about 1/4 inch apart; the bottom turn descends more steeply to reach the bottom pin. Three pins are on the coil form, each one extending horizontally through the plastic form so as to be accessible from either side.

The finished L-network is shown in fig. 2. The terminals on the capacitor have been bent out flat so that they can be soldered directly to the pins on the coil form. One terminal of the capacitor is soldered to the other end of the pin to which the center conductor of the coaxial cable is already soldered, and the other terminal of the capacitor is soldered to the opposite end of the pin to which the top of the inductor is soldered (that is, the base of the antenna). Nothing has to be done to the outer braid of the RG-58/U cable because it's already securely grounded to a lug under the coil form.

Figure 3 shows the schematic diagram of the final L-

network. For those unfamiliar with the operation of these simple matching sections, they are ideally suited for transforming primarily resistive impedances from one value to another. Resistance R , the input resistance presented to the base of the whip and ground at the whip resonant frequency, will have a value in the neighborhood of 1000 ohms. The load resistance is shunted by the inductor so that the parallel combination is equivalent to a resistance of 50 ohms, in series with an inductive reactance. This reactance is then tuned out by the capacitive reactance of the adjustable capacitor. Assuming that the antenna represents a pure resistance of 1000 ohms at 146 MHz, calculated values for the L network are: $L = 0.25 \mu\text{H}$ and $C = 5.0 \text{ pF}$.

measured results

The final tuning of the antenna should be done with the antenna mounted at the selected location on the vehicle. It can be done with the black plastic covering of the matching network removed and the whip screwed to the top of the coil form. With a reflected power meter in series with the coaxial line, the capacitor is adjusted with an insulated tuning tool at a frequency near the center of the band. A deep minimum in the reflected power should be obtainable. I used a Bird Wattmeter; on the 25-watt scale, using 25 watts of transmitted power, my reflected power between 144 and 148 MHz did not exceed 0.3 watt. This corresponds to a maximum VSWR of 1.25. When the plastic cover is put back in place, the tuning is hardly affected. From past experience, I know that with a more sensitive directional coupler and a little more tweaking, I could reduce the reflected power at the center of the band to practically zero. However, at present, it's close enough.

positioning mobile whip antennas

A monopole antenna is really an abstraction implying a single conductor extending out from an infinite conducting plane. Its most familiar practical implementation is a broadcast antenna tower, in which an RF voltage is applied between the base of the tower and the earth. Even here, one could regard the antenna as a very unbalanced dipole, one side being the tower and the other the earth. In mobile whips, the dipole consists of the whip

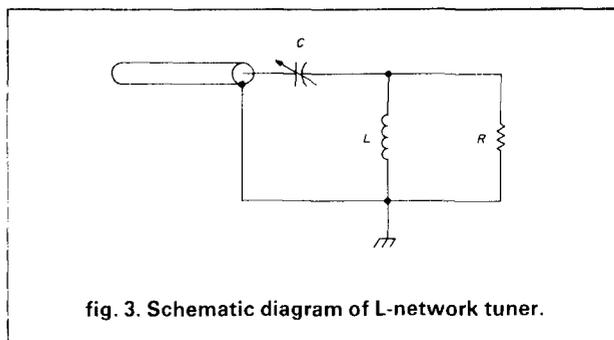


fig. 3. Schematic diagram of L-network tuner.

and the car, between which RF drive is applied.

It's a common mistake to think that the radiation pattern of a given antenna, such as a 1/4-wave, 1/2-wave, or 5/8-wave whip, is the same when mounted on a vehicle as when it's mounted above an infinite conducting plane. At 146 MHz the car's roof is a small ground plane elevated about 3/4 wavelength above the earth ground. This elevation affects the whip antenna radiation pattern.

When VHF antennas are mounted on cars, the main differences between antennas show up in the lack of symmetry of their respective radiation patterns in the horizontal plane. The most circular pattern is always obtained with the whip mounted at the center of a metal-topped roof. Contrary to popular belief, little gain differences are noted between 1/4-, 1/2-, and 5/8-wave whips when they're mounted on finite ground planes (car roofs), certainly not the 3-dB improvement realized when comparing a 1/4-wave to a 5/8-wave vertical working against an infinite-conductivity, infinite-extent ground system. (*This is related to the fact that at low take-off angles, as in mobile-to-mobile contacts, none of these antennas produces a maximum field component. It would be necessary to tilt the car and antenna system as a unit, adjusting the incline for each antenna/ground optimum take-off angle, in order to properly compare maximum developed field strengths.* — Ed)

feedpoint currents

At very asymmetrical locations, such as at one side of a trunk lid, or on one side of the hood, rather large differences between different antennas may appear. This is because of the different levels of current that emerge from the feedpoint at the bases of different antennas and spread out over the surface of the car. Of the three lengths of whips popularly used, the 1/4-wave whip spreads the most current; the current from the 5/8-wave whip is about 70 percent of the value of the 1/4-wave whip, and the current from the 1/2 wave is the lowest, being in the order of 20 percent of the value of the 1/4 wave (depending on the diameter of the whip). These differences in current spreading out over the car have little effect when the antenna is placed at a point of symmetry. However, when the whip is in a highly asymmetrical location, the patterns can be drastically affected.

radiation intensity measurements

Some years ago a group of professors at the University of Washington (including myself), who were also licensed Amateurs, made a series of measurements of the radiation intensity in the horizontal plane from 2-meter whips mounted on vehicles. The cars were mounted on a rotator, flush with the ground, and the radiation intensity was measured using a distant pickup antenna in conjunction with a Scientific Atlanta pat-

tern recorder. The best antenna location, as expected, was the center of the roof, where the maximum variation in intensity throughout 360 degrees of rotation was about 3 dB. The worst case was for a 1/4-wave whip mounted at the side of the trunk of a sedan, just forward of the hinge. In this case, the pattern was very irregular, showing a 17-dB hole in one direction. The most surprising result was in the case of a 1/2-wave whip mounted on the centerline of the top at the rear end, just above the tailgate window of a station wagon. The pattern for this case had a maximum-to-minimum variation of only 3 dB in 360 degrees.

There seems to be little doubt, then, that the 1/2-wave base-driven whip is the most tolerant of mounting location. It is therefore an excellent choice for a magnetically mounted antenna, especially when placed beside the trunk lid or to one side of the hood, just ahead of the windshield. Since maximum current occurs halfway up the whip, the 1/2-wave antenna can "see" over the car top better than a 1/4-wave whip at the same location.

acknowledgment

I want to thank my friend and colleague, Eric Lindahl, WN7WNL, who first noticed this antenna, bought one, and converted it for 2-meter use.

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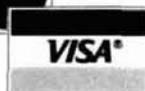
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1.3 GHZ
#1300H

The Excitement of Satellite Communications

An ever increasing number of radio amateurs are joining the excitement of Phase III-type satellite communications, and there are some good reasons. This new medium combines the communications range of the 20 and 80 meter bands with the line of sight reliability of 2 meters in a completely perfected manner. It's equivalent to a totally new band, it's unaffected by sunspot variations, and a vast technical background isn't necessary for enjoying the action.

ICOM America stands ready to help you enjoy the fascinating new capabilities of OSCAR 10 and future amateur satellites, and it has a full line of equipment to back that statement. Its all mode 2 meter and 70 cm base transceivers bring the operating conveniences of low band units to the VHF and UHF amateur bands. They can be used for local FM operations via repeaters or for SSB/CW communications via any Phase III OSCAR satellite. The new IC-1271 all mode 23 cm transceiver is in a class of its own, providing mode L satellite uplink capability (mode L is 23 cm uplink, 70 cm downlink) and optional fast scan amateur TV operations using home video equipment.

The overwhelming preference of mode B equipment (435MHz band transmit, 145MHz band receive), among OSCAR groups and users, is ICOM's IC-271H and IC-471H transceivers. Why? Satellite relayed signals are somewhat weak in nature, and the IC-271H's low

noise/high sensitivity receiver gives the highest possible performance for hearing everyone regardless of their uplink performance. The IC-271H's noise blanker also prevents pulse-type electrical interference from masking some highly desired DX signals, and its selectable AGC can follow fast fades associated with spin modulation. There are also 32 all mode memories which can be used for intermixed FM repeater and SSB/CW operations. When the IC-271H is equipped with the optional mast-mounted AG-25 GaAsFET preamp, it becomes a satellite operator's dream come true.

ICOM's IC-471A (25 watts output) or IC-471H (75 watt output) 70 cm transceivers boast an output signal that's recognized on the satellite by its crystal clear audio. Power output of either unit IC-471A/IC-471H is continuously front panel adjustable to adjust to daily signal variations. This sidesteps the taboo practice of overloading a satellite's on-board receiver. The IC-471A/IC-471H also includes 32 all-mode memories for the ultimate in operating flexibility.

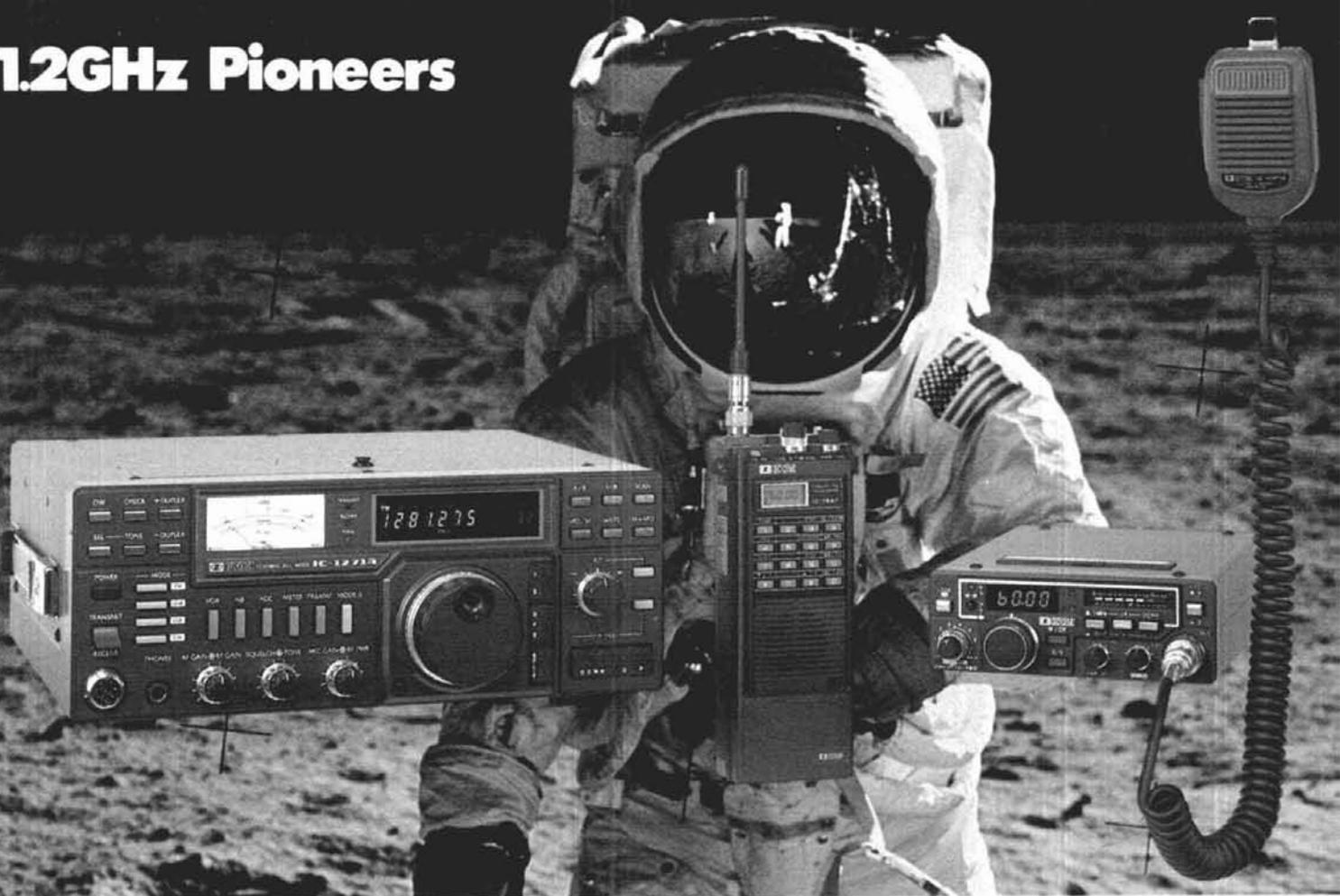
ICOM's IC-PS30 system DC power supply is an ideal single cabinet unit for simultaneously powering both satellite transceivers, or the IC-271A and IC-471A can be equipped with an optional PS-25 internal DC power supply for "stand alone" operation. A pair of small 16 element antennas, one for 435MHz operation and one for 145MHz opera-

tion, connect to their respective transceivers to complete the space-age setup. No complex interwirings are necessary in the previously described setup.

Operating OSCAR 10's popular mode B is almost as easy as operating an HF band. The satellite's band centers are 435.100MHz uplink (receive from ground operators) and 145.900MHz downlink (transmit back to ground operators), with its band edges roughly 50KHz above and below those frequencies. Assuming both transceivers are tuned to band centers, ones own satellite-relayed signals can be received while transmitting and used for "tweaking" antenna positions and offset-tuning doppler shift. OSCAR 10's inverting passband is then tracked as follows: for each KHz the IC-271H's receiver is tuned above 145.900MHz, the IC-471A/471H's transmitter should be tuned an equal number of KHz below 435.100MHz to "zero beat" others. The accurate readout of ICOM's digital displays even eliminate the need to "talk oneself onto frequency."

If you're interested in joining today's most exciting era of amateur communications, OSCAR 10 and future Phase III satellites are the medium to use. If you appreciate top performance equipment for those activities, ICOM is the logical choice. It's simply the best, and it's backed by an uncompromised policy of top service. Isn't it time you enjoyed these exciting pleasures?

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The IC-1271A 1240-1300MHz base station transceiver features 10 watts of RF output power, 32 memories, scanning and multi-mode operation including ATV (amateur TV).

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coder/decoder, IC-PS25 internal AC power supply, AG1200 preamplifier and the TV1200 TV interface unit.

TV-1200

The new IC-12AT covers from 1260-1299.990MHz, has ten memory channels, memory scan, program scan and programmable offset. It also features an LCD readout, RIT and VXO, 32 built-in tones and a DTMF pad.

The IC-120 1.2GHz mobile transceiver has six memory channels, scanning, an HM-14 up/down scanning mic, RIT, LED readout and three tuning rates. Accessories include the ML12 10 watt amplifier and the PS45 slim-line external power supply.

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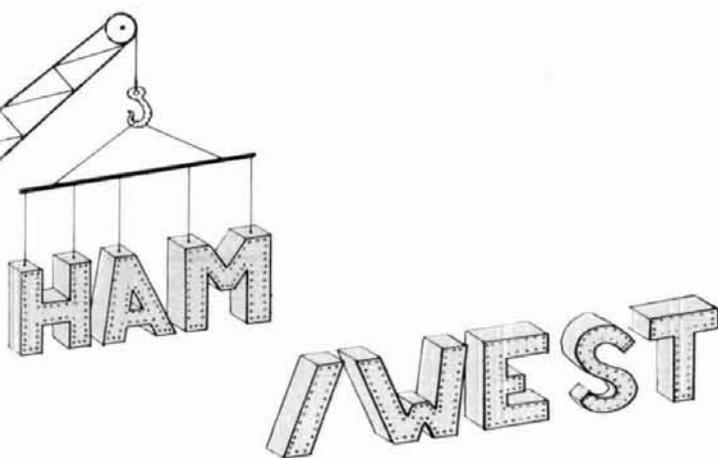
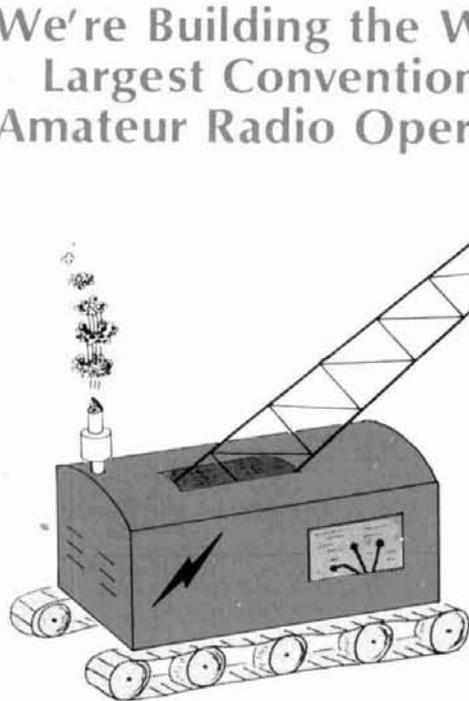
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RF connectors: part II

Last month's column introduced the subject of RF connectors, described some of the major series, and provided relevant mechanical and electrical data. This month's column will complete the subject and present additional data on the mechanical and electrical aspects of the RF connectors most often used by Amateurs.

mechanical considerations

RF connectors come in many types, shapes, and sizes, depending on whether the cable to be connected has a braided, solid, or helical/annular outer shield. The most common RF connectors are designed for flexible coaxial cable. Hardline and Heliax™ cables require special connectors which are usually bigger and more difficult to attach, frequently requiring the use of a hacksaw or tubing cutter. Crimp-type connectors, which are becoming very popular, will be discussed later.

RF connectors are manufactured from many different materials. The most common materials in the outer conductor are brass, stainless steel, aluminum, die-cast zinc, or beryllium copper. Stainless steel, one of the most durable materials, is expensive. Aluminum, usually cheapest, is the least durable.

Connector plating is very important, especially on active metals. Even stainless steel connectors are usually plated. Until the price of precious metals soared, the most common platings were silver or gold; nowadays, less expensive platings such as nickel, tin, or chrome are used.

Another important but frequently overlooked indicator of quality in an RF connector is the material of which the delicate center pin is made. The most common materials — brass, beryllium copper, and phosphor bronze — are preferred because they can be readily soldered. Center pins are usually plated with a precious metal.

Depending on the connector series and type, the center pin can be captive, connected to the center conductor of the cable, or actually fabricated from the center of the cable itself. If the center pin is captive, proper positioning inside the connector body will usually be assured. However, if the center pin is connected directly to the cable, its position on the center conductor is very crit-

ical during the time when the connection is assembled. If it's too long, it may protrude too far and damage the mating connector. If it's too short, contact may be either lacking or intermittent.

Because the center pin may move in or out with changes in the environment (such as temperature, for example), the latter can be a problem at temperature extremes or when a cable is coiled up. This is why connector manufacturers usually provide detailed assembly instructions indicating exact cutting lengths on all the sections of the cable being prepared to mate with a connector. Furthermore, coaxial cables should *always* be secured to a tower or mast so that no pressure is placed on the connector itself.

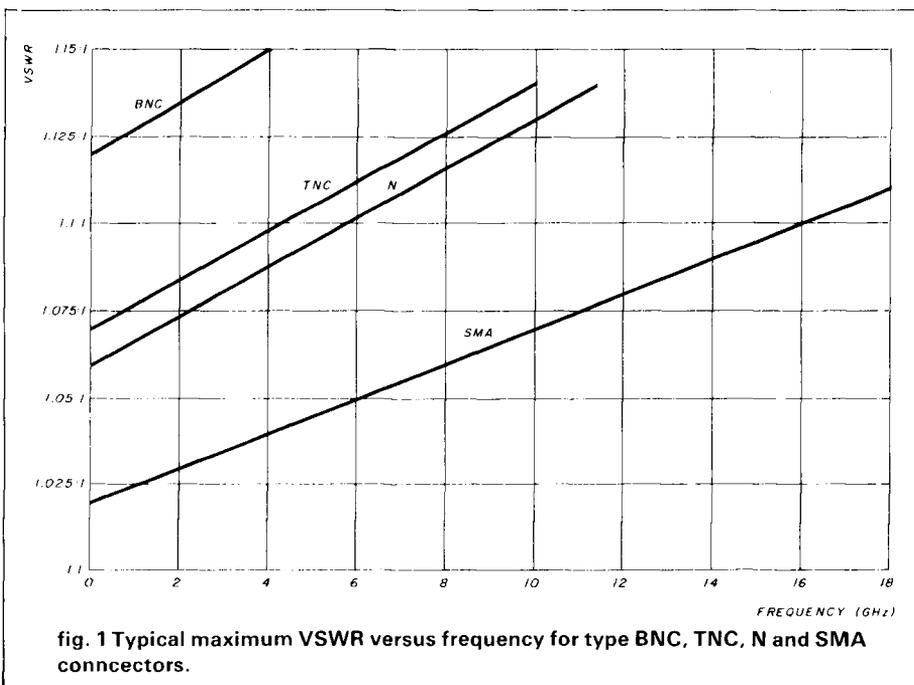


fig. 1 Typical maximum VSWR versus frequency for type BNC, TNC, N and SMA connectors.

The quality of the RF connector's threads is also important. Although the threads are usually quite durable, those on less expensive connectors — such as the UHF type — generally don't work well after many matings. If the connector body is aluminum, the threads may seize; sometimes a lubricant is necessary.

Before mating connectors, always make sure that the connectors are properly aligned to avoid cross-threading. Sometimes it helps to first rotate a connector either one half or one full turn in the *reverse* direction before turning it in the desired direction. Finger-tightening is usually sufficient; if further tightening is required, use a wrench only as a last resort, applying only as much pressure as is absolutely necessary. Too much pressure may damage the connector permanently.

Connectors use many types of dielectrics, including air or polystyrene, teflon, Rexolite™, glass-terflon, and mica-filled bakelite. Because these materials often require a precise fit, they must be properly handled when connectors are assembled. Any heat (such as that applied by a soldering iron during assembly) or external side-pressure can permanently distort the dielectric.

It should go without saying that all connectors must be properly assembled, especially if they're to be used near their frequency limits. Designers have spent countless hours ensuring that connectors will meet their specifications; if improperly assembled, the specified impedance or insertion loss may be exceeded.

One frequently overlooked mechanical parameter of RF connectors is the quality of the environmental seal. Is the connector weatherproofed? Does it have a gasket or washer made of synthetic rubber, silicon rubber, or neoprene? If it doesn't, it should never be used outdoors or in indoor applications where moisture is present.

electrical performance

The most important electrical properties of an RF connector are frequency of operation, impedance, power handling capability, and insertion loss. Reference 1 details the typical maximum frequencies for the major series of connectors. Above the maximum recommended frequencies, the impedance of an RF connector may wander and "suckouts" attributable to resonances may occur. This can severely limit performance, perhaps without your knowledge.

Connectors may be damaged if subjected to high RF levels, especially if there's a VSWR mismatch. VSWR performance is usually tightly controlled on RF connectors; for UG-type connectors, it's generally spelled out in the various military standards. Remember that this maximum VSWR applies *only* if the connector is properly assembled to a low-VSWR cable. If the cable has a poor VSWR, or if the connector is improperly assembled, all bets are off.

VSWR usually increases with frequency at a fairly predictable rate below the cutoff frequency of the connector. It can be defined mathematically by the following equation:

$$VSWR = K_1 + K_2f \quad (1)$$

where K_1 and K_2 are VSWR constants (that depend on the connector series) and f is the operating frequency in GHz. The lower the constant, the lower the VSWR.

The typical VSWR constants for the RF connector series most popular with Amateurs are shown in **table 1**. For instance, using **eqn. 1**, a properly assembled N connector should have a VSWR below 1.088 at 4 GHz and 1.13 at 10 GHz. **Figure 1** shows some typical connector VSWR variations with frequency.

Insertion loss is another important RF connector parameter. The maximum insertion loss of a connector can be estimated using **eqn. 2**:

$$I.L. = K\sqrt{f} \quad (2)$$

where $I.L.$ is insertion loss in dB, K is the insertion loss constant from **table 1** and f is frequency in GHz. For instance, using the constants in **table 1**, the maximum insertion loss of a properly assembled N connector at 4 and 10 GHz will be 0.1 and 0.158 dB, respectively. **Figure 2** has been prepared to show some typical losses of RF connectors at different frequencies.

In last month's column I alluded to the fact that some Amateurs throw connector specifications around quite loosely. For example, I'll bet most of you have heard somebody say that connectors should be avoided at all cost since a typical RF connector has up to 0.5-dB insertion loss. A 0.5-dB insertion loss is equal to a power dissipation of 11 percent. Said another way, if 1000 watts of RF power were

Table 1. Parameters needed to properly choose an RF connector in the main series used by Amateurs. Typical constants for determining VSWR and insertion loss versus frequency are also shown where known. Consult text for explanation on use of the constant.

Connector series	Peak RF Voltage at 100 MHz	Peak power in watts	Impedance in ohms	Max freq in GHz	VSWR constants	Max insertion loss constant	RF leakage in dB**
BNC	1000	500	50*	4	1.12 + 0.007f	0.1	-60 + f
N	1000	1000	50*	11	1.06 + 0.007f	0.05	-85 + f
SMA	1000	500	50	18	1.02 + 0.005f	0.03	-100 + f
TNC	1000	1000	50	11	1.07 + 0.007f	0.05	-90 + f
UHF	500	500	50-70	0.3	NA	NA	NA

*75-ohm versions are in use, especially in the CATV and computer industries.

**f in GHz (see text for further explanation).

to pass through a connector with a 0.5-dB insertion loss, 110 watts would be dissipated. *Goodbye connector!* Even a 0.1-dB loss is about 2.25 percent, or, under the same conditions, a 22.5-watt dissipation. This is still enough loss to destroy most RF connectors when sufficient power is applied.

Another important RF connector parameter is power handling capability. It's painfully obvious from the material just presented that insertion loss, to a great extent, is the determining parameter when specifying power. Indirectly linked to power is the breakdown voltage of the connector.

Power handling is inversely related to frequency. Hence the power rating of an RF connector decreases with increasing frequency. **Figure 3** has been prepared to show typical manufacturers' ratings of RF power versus frequency for some of the most popular

Most Amateurs running high power on 70 cm and above have probably exceeded the ratings on N connectors at one time or another even with the old FCC power limits. Furthermore, the power limits assume a 1:1 VSWR. What do you do if your VSWR isn't 1:1? You must derate the power handling capabilities of the connector accordingly.

Table 2 shows the recommended percentage of RF power derating for an RF connector with a VSWR greater than 1:1. For instance, if your VSWR is

2:1, the connector power rating shown in **fig. 3** should be decreased to 88 percent. Therefore, the maximum rating of an N connector at 1:1 VSWR operating at 432 MHz is approximately 450 watts. With a 2:1 VSWR at the same frequency, the maximum power rating should be dropped to approximately 400 watts!

The voltage breakdown on RF connectors isn't always clear. Manufacturers usually do a high potential breakdown, but this is at DC. The actual RF

determining parameter of the RF breakdown voltage.

The VSWR indirectly enters the picture because the voltage across the connector may rise if the VSWR isn't 1:1. As noted in reference 1, some series of RF connectors are highly recommended if breakdown voltage is a criterion.

RF leakage is sometimes a criterion, especially if the connector is operated in a strong field (such as the output of a down-converter feeding a 28 MHz I-F.). Typical values of RF leakage are shown in **table 1**, where *f* is frequency in GHz. Hence a BNC connector at 4 GHz will have a leakage of only 56 dB below the internal or external signal level, while an SMA connector at the same frequency will have a leakage of typically 96 dB!

Table 2. This table lists the recommended deratings of a connector's RF power handling if the VSWR is higher than 1:1:1.

VSWR	Derating factor (in percent)
1.5:1	94
2.0:1	88
2.5:1	83
3.0:1	78
3.5:1	73
4.0:1	70
4.5:1	67
5.0:1	65

adapters

So far we've been discussing only RF connectors. RF adapters are also very common. Generally speaking, they're about two to three times poorer than a single connector. Therefore, to estimate the VSWR or insertion loss of a coaxial adapter, double or triple the value shown for a single connector.

crimp connectors

Although most Amateurs use standard RF connectors that can be assembled with simple hand tools, crimp-type connectors have been available for many years. These connectors, however, weren't always reliable, were often more costly than comparable non-crimp types, and usually required expensive crimping tools.

In recent years this situation has changed. Crimp-type connectors have become less expensive and more reliable; any necessary crimping tools have also decreased in price. In fact, Gilbert Engineering* has developed type-N crimp connectors for RG 8/U, RG 213/U, RG 214/U, and Belden 9913 that are less than two-thirds the price of comparable non-crimp-type connectors. They all use the same crimping tool, which costs about \$45.00.

Once you've assembled about 30 crimp-type connectors, the crimp tool

breakdown, typically done at 5 MHz, is much lower. Some typical limits are shown in **table 1**. Note that in this regard there's normally *no difference* between BNC, N, TNC or SMA-type connectors; therefore, size isn't the only

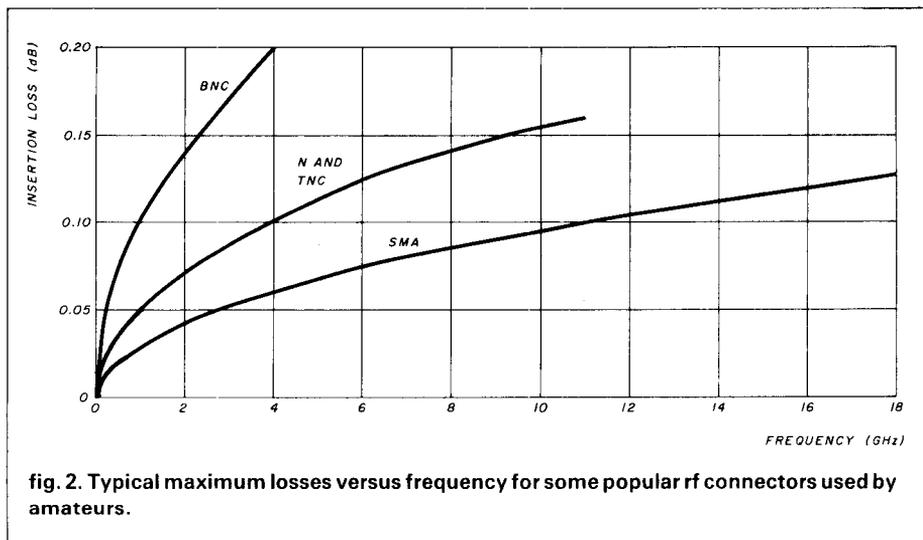


fig. 2. Typical maximum losses versus frequency for some popular rf connectors used by amateurs.

*Gilbert Engineering Co., P.O. Box 23189, Phoenix, Arizona 85063-3189

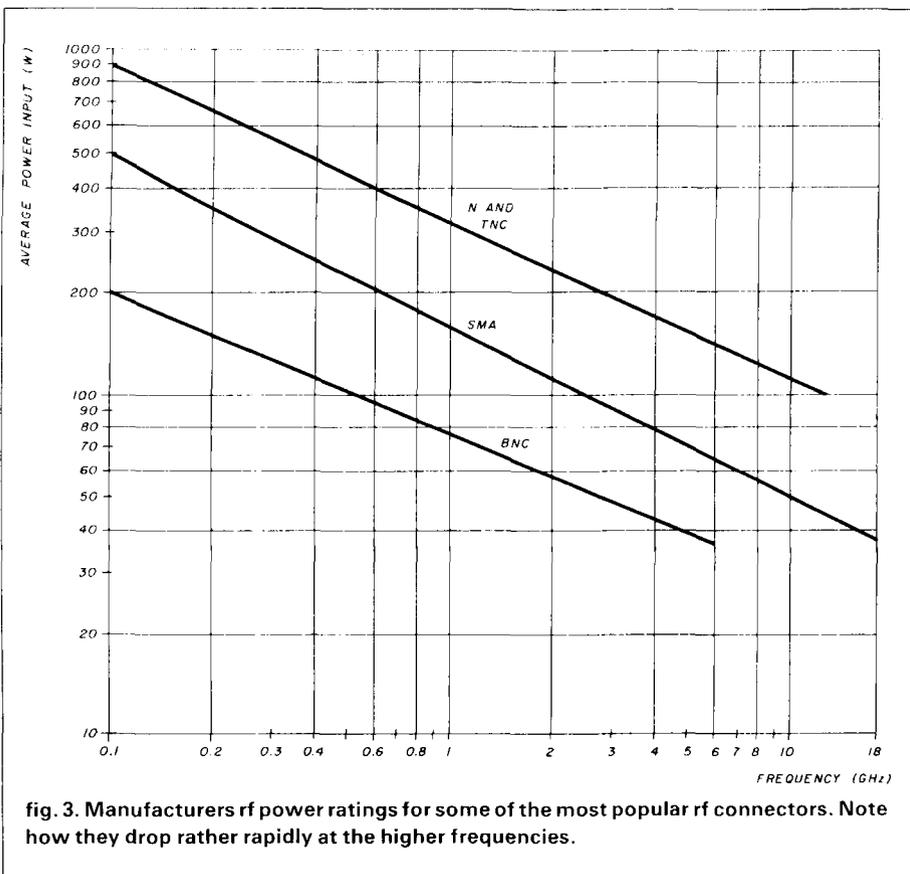


fig. 3. Manufacturers rf power ratings for some of the most popular rf connectors. Note how they drop rather rapidly at the higher frequencies.

has paid for itself and you'll save money on each connector thereafter — not to mention the considerable savings in assembly time. I've used all Gilbert Engineering types mentioned and can attest to their performance and ease of assembly. No more tight trimming or filing down the center of the coax!

The only problem with most crimp-type RF connectors is that they're not waterproofed. However, if you slip a small (2- to 3-inch) piece of heat-shrinkable tubing over the rear portion of each connector, you'll have a very weatherproof connector that probably has a better seal than the typical non-crimped connector with its built-in environmental seal. These connectors should be especially useful in alleviating the drudgery of assembling a large antenna array!

availability and cost

Good new RF connectors aren't cheap. The price of most common connectors runs from \$2 to \$5 each in small quantities. The smaller the connector

and the higher the frequency of the operation, the more costly they're likely to be. Likewise, connectors with silver or gold plating or teflon dielectric are more expensive. If you're going to use a connector outdoors, make sure it has a weatherproof seal.

Connectors for hardline and Heliax™ are much more expensive. This is easy to understand because they're bigger, more complex, and more difficult to manufacture. However, once they're installed on a line, they'll give many years of service and will pay for themselves in improved performance.

Don't skimp on connectors, especially if you use an expensive transmission line. Low-cost connectors could break down or allow moisture to form inside the connector and thereby ruin an expensive transmission line. Do shop for bargains, especially at flea markets, but don't be penny wise and pound foolish.

tips

Always be sure that a neoprene washer or equivalent seal is used on all

connectors mounted outdoors. Sealing connectors from the weather is tricky business. Some Amateurs recommend special sealing techniques on the connectors, while others say not to worry about any of the above. I suggest taking a position somewhere in between; if you try to seal off a connector completely (using tape, acrylic strays, or rubber/silicon-type compounds) and any moisture enters (and believe me, it will), you're in real trouble. I've tried placing silicon grease inside RF connectors only to have it degrade with time and then take on moisture; this can result in an explosion, however, if the VSWR gets too high!

If you do decide to seal a connector, Coax-Seal™ is highly recommended. It's reasonably priced and does a good job of filling most of the places where moisture can enter. It's also reworkable if the connector has to be opened. But unsealed RF connectors aren't always as much of a problem as you might think. If water enters a UG 21/U type-N connector, it will frequently evaporate in a day or so.

It's best to position connectors so that rain is less likely to enter and then take reasonable precautions. For example, moisture will often creep along the threads of a connector via capillary action. You can prevent this by applying a light coating of silicon grease to the exposed threads of one of the connectors just before final connection to the antenna. Once the connector is screwed together, the protective coating will prevent moisture from entering.

As mentioned earlier, RF connectors should never be subjected to pushing or pulling. Mount cables securely with tape, Tiewraps™, or Kellum clamps ("torture fingers") so that no external pressure is exerted on the connector. This is particularly true with RG 17/U coax, which has a different expansion coefficient between the center conductor and the shield. Tie RG 17/U down carefully, *without bends*, to prevent pin pullout in cold weather.²

It's important to pay close attention to the assembly of an RF connector so that the center pin is properly located. (This is especially important with the

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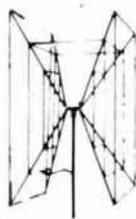
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"captivated" type of connectors.) One
test I perform involves placing a finger-
tip on the center pin of the assembled
connector. If the finger lightly touches
the pin, then the pin is probably assem-
bled properly. If the pin tries to puncture
your fingertip, it's probably protruding
too far. Conversely, if you can't feel the
pin, then it's too far inside the connec-
tor body and probably won't have suffi-
cient overlap for a reliable connection.

For maximum reliability, test all connec-
tors for VSWR after assembly. If
possible, also check insertion loss. It's
a lot easier to test and repair an RF connec-
tor in the shack than on an antenna
mounted 100 feet in the air!

summary

RF connectors are constantly being
improved, and Amateurs who follow
these developments will reap the
benefits. Those who take the time to
properly assemble connectors — fol-
lowing the manufacturer's instructions
— will have the least amount of down-
time and the most pleasure in operation.

With the data provided in last
month's and this month's columns, you
should have all the information neces-
sary to choose the right RF connector
for your application. Remember to use
a connector type that will have low loss
and be able to handle the RF power re-
quired at the frequency of operation.

acknowledgments

I'd particularly like to thank Charlie
Button of Gilbert Engineering for his
helpful suggestions with the use of
crimp-type connectors.

references

1. Joe Reiser, W1JR, "VHF/UHF World: RF Con-
nectors, Part 1," *ham radio*, September, 1986, page 77.
2. Joe Reiser, W1JR, "VHF/UHF World: Transmission
Lines," *ham radio*, October, 1985, page 83.

Important VHF/UHF events:

- October 4-5 : *Mid-Atlantic States VHF
Conference, Warminster,
Pennsylvania (contact
WA2OMY)*
- October 4-5: *International Region 1
UHF/SHF Contest*
- October 7: *EME perigee*
- October 9: *Predicted peak of the
Draconids Meteor Shower at
0900 UTC*
- October 10-11: *First ARRL 10 GHz Cumula-
tive Contest, second
weekend*
- October 20: *Predicted peak of the Ori-
onids Meteor Shower at 0900
UTC*
- October 25-26: *ARRL EME contest, first
weekend*
- November 2: *Predicted peak of the Taurids
Meteor Shower at 1520 UTC*
- November 3: *Predicted peak of the Cas-
seopids Meteor Shower at
1515 UTC*
- November 4: *EME perigee*
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22-23: *ARRL EME contest, second
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transistor substitution: part II

Last month we discussed the use of crossover guides, derating specs for mobile and other over-temperature applications, and certain other matters. In this second and final installment we'll look at frequency response and mechanical problems with replacement transistors.

frequency response

Suppose you've installed a "universal" small-signal replacement transistor and it doesn't amplify. According

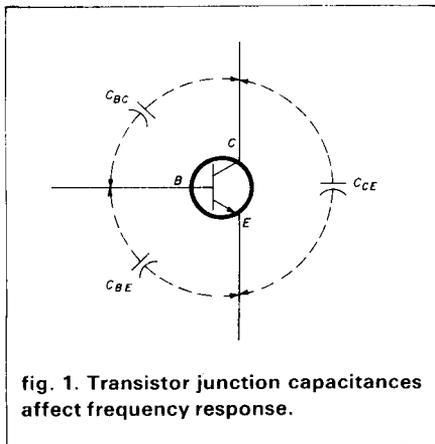


fig. 1. Transistor junction capacitances affect frequency response.

to the DC voltages, however, it draws normal current and doesn't heat excessively — yet still fails to operate. Chances are good that the transistor selected has a bandwidth that's too narrow, and so the amplification is insufficient.

As you know, there's no one way of measuring the frequency response of transistors. Worse yet, the manufacturers can't seem to agree on the correct method of rating the frequency response. In fact, I've seen examples of three different methods all used in the same crossover guide!

Probably that's the reason you can

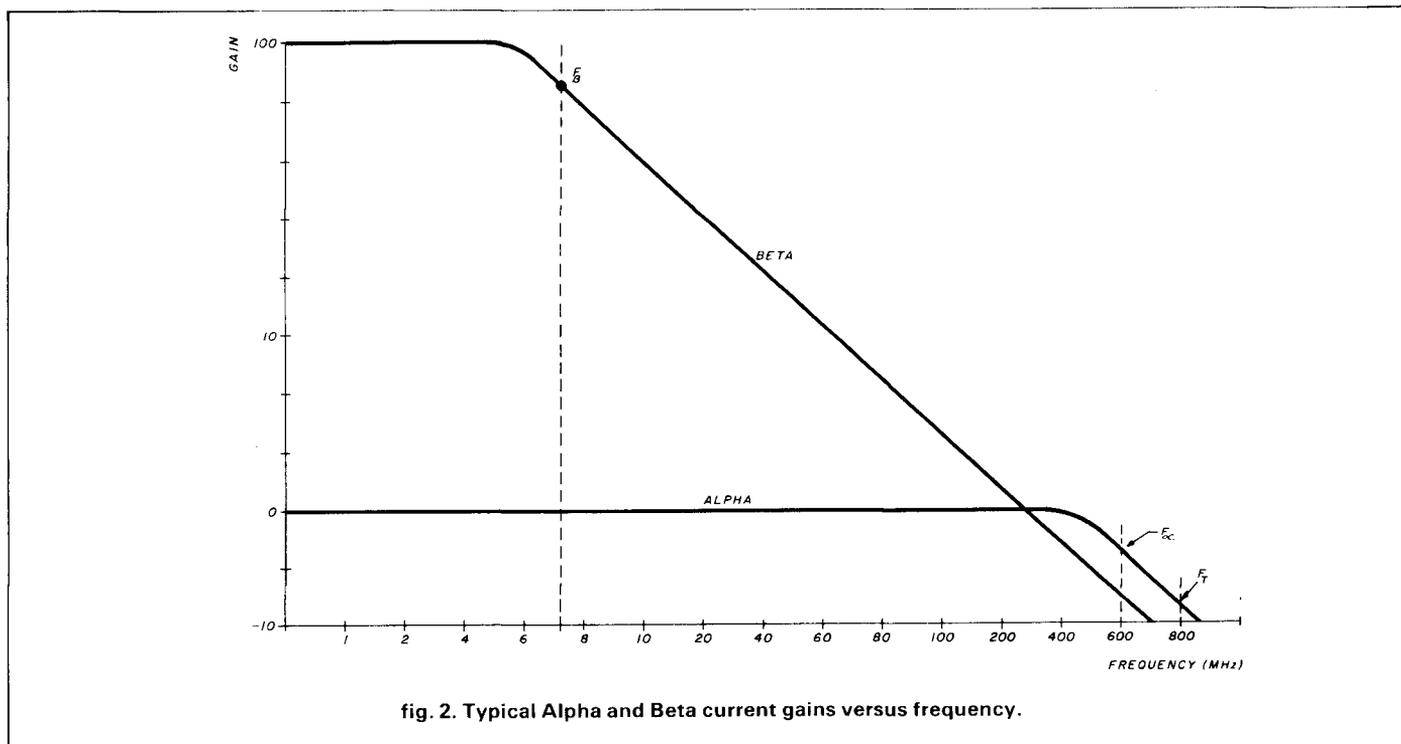


fig. 2. Typical Alpha and Beta current gains versus frequency.

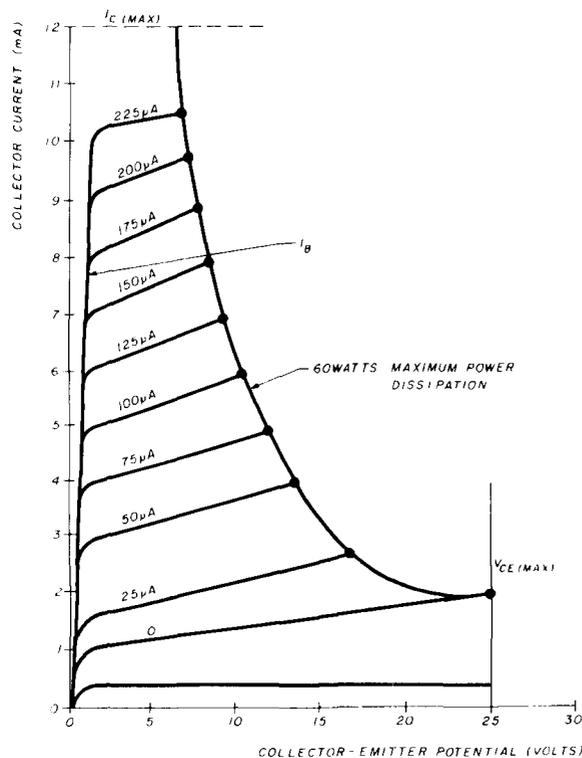


fig. 3. Maximum voltage, current and power dissipation ratings are related and must not be exceeded.

install a transistor rated "50 MHz" and yet find it won't properly amplify a signal in a 10.7-MHz IF amplifier in a 2-meter FM radio receiver. In rating the transistor at 50 MHz, the manufacturer wasn't lying — but he may have inadvertently used a rating system that doesn't fit your circuit.

As shown in fig. 1, one factor in rating transistors is the capacitances between the junctions. Another factor is the thickness and geometry of the base region and the time necessary for the majority of the electrical carriers to cross it. If the capacitances of the replacement are too far out of tolerance, then the gain will be reduced at high frequencies and any LC tank circuits in the transistor amplifier will be mistuned.

There's also the Miller effect, which is the effective capacitance produced by internal feedback from the output signal back to the input "amplifying" the actual capacitance. Because of the Miller effect, a small difference in in-

ternal capacitance can create a larger change in effective capacitance.

alpha and beta gain

Transistor alpha gain, the ratio of the collector current to the emitter current, can never exceed 1. Alpha gain is often measured in a common-base circuit. Beta gain, the ratio of collector current to base current, is usually measured in the common-emitter configuration. As illustrated in fig. 2, the frequency cutoff point is greatly different for these two kinds of ratings. A manufacturer who rates transistors by the common-base method might correctly list them as having a far wider response than would be possible if the common-emitter method were used. Of course, the common-base rating can provide a no-gain 10.7-MHz IF stage!

gain-bandwidth product

Another way of rating frequency response is the gain-bandwidth

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P/N	Rating	2-30 MHz 12V (* 28V)	Each	Match Pr.
MRF412,IA	80W	18.00	45.00	
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MRF422*	150W	38.00	82.00	
MRF426,IA*	25W	18.00	42.00	
MRF433	12.5W	12.00	30.00	
MRF449,IA	Q 30W	12.50	30.00	
MRF450,IA	Q 50W	14.00	31.00	
MRF453,IA	Q 60W	15.00	35.00	
MRF454,IA	Q 80W	15.00	34.00	
MRF455,IA	Q 60W	12.00	28.00	
MRF458	80W	20.00	46.00	
MRF475	12W	3.00	9.00	
MRF476	3W	2.75	8.00	
MRF477	40W	11.00	25.00	
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MRF485*	15W	6.00	15.00	
MRF492	Q 90W	16.75	37.50	
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SRF3775	Q 75W	14.00	32.00	
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MRF224	40W 136-174	13.50	32.00
MRF237	4W 136-174	3.00	—
MRF238	30W 136-174	13.00	30.00
MRF239	30W 136-174	15.00	35.00
MRF240	40W 136-174	18.00	41.00
MRF245	80W 136-174	28.00	65.00
MRF247	75W 136-174	27.00	63.00
MRF260	5W 136-174	7.00	—
MRF261	10W 136-174	9.00	—
MRF262	15W 136-174	9.00	—
MRF264	30W 136-174	13.00	—
MRF607	1.75W 136-174	3.00	—
MRF641	15W 407-512	22.00	49.00
MRF644	25W 407-512	24.00	54.00
MRF646	40W 407-512	26.50	59.00
MRF648	60W 407-512	33.00	69.00
SD1441	150W 136-174	74.50	170.00
SD1477	100W 136-174	32.50	78.00
2N3866*	1W 30-200	1.25	—
2N4427	1W 136-174	1.25	—
2N5591	25W 136-174	13.50	34.00
2N6080	4W 136-174	7.75	—
2N6081	15W 136-174	9.00	—
2N6082	25W 136-174	10.50	—
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2N6084	40W 136-174	13.00	31.00

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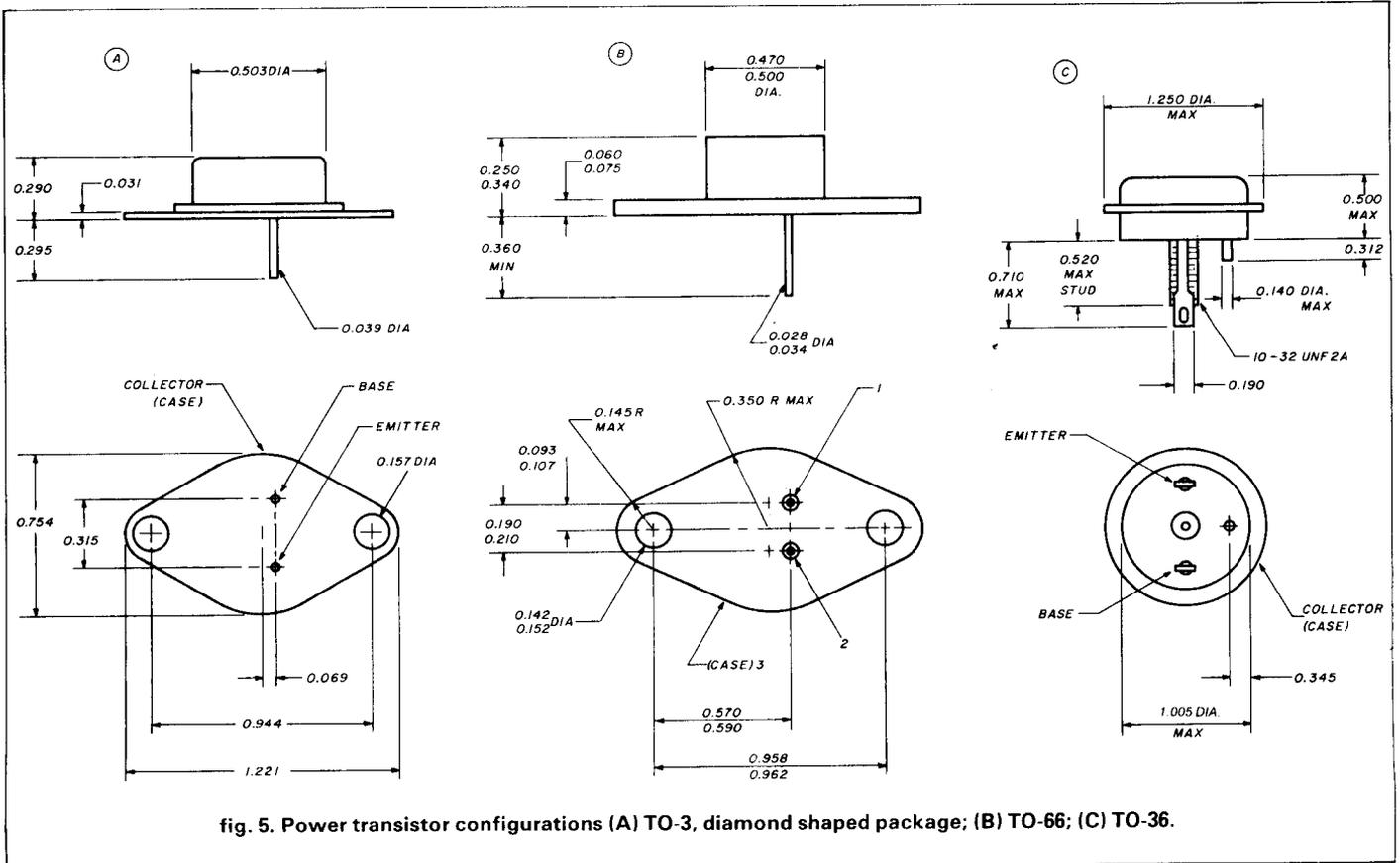
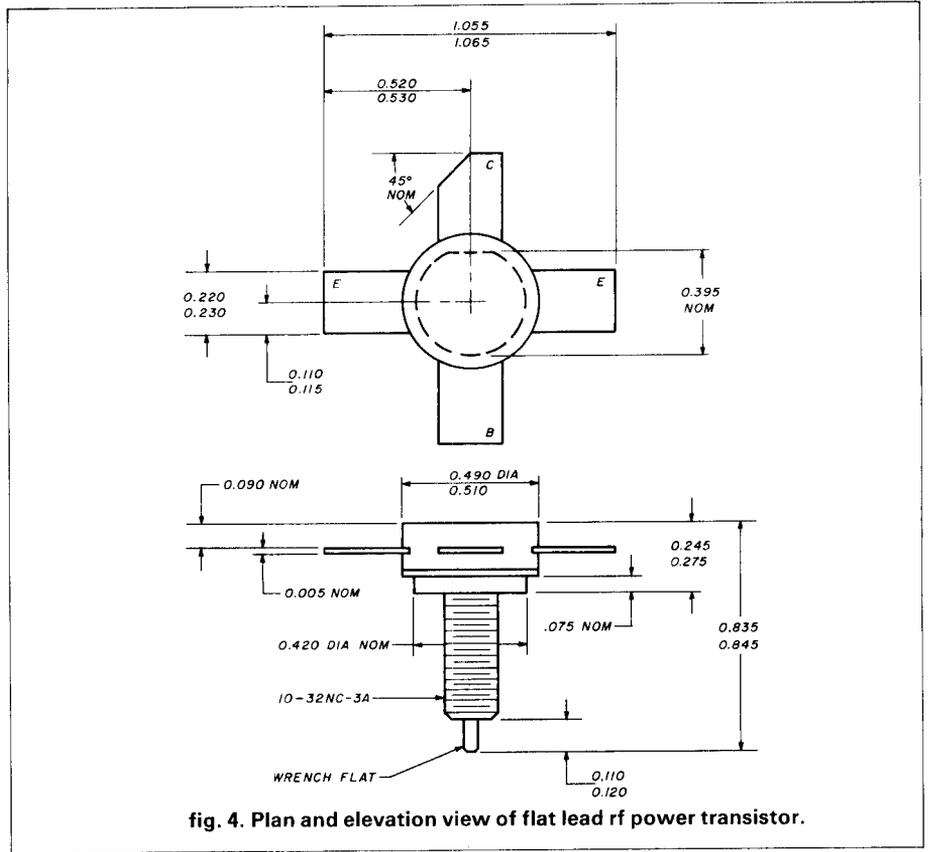
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product method, defined as the frequency at which the common-emitter gain drops to unity. For example, let's look at a transistor with a low-frequency (1000 Hz) beta rating of 50 and a gain-bandwidth product of 50 MHz. The gain-bandwidth product equals beta times the common-emitter cutoff frequency, so the common-emitter cutoff frequency is found to be only 1 MHz. That's why you can act on some of the short-form specifications and still obtain a dud that won't amplify.

analyzing maximum ratings

Care must be used in analyzing the manufacturer's maximum voltage and current ratings. Just because a transistor is listed for certain maximum collector voltage and current doesn't mean it can always operate safely at those levels. **Figure 3** shows that the transistor can safely stand either high current or high voltage, but not both at the same time. Maximum collector dissipation (watts), the *product* of both



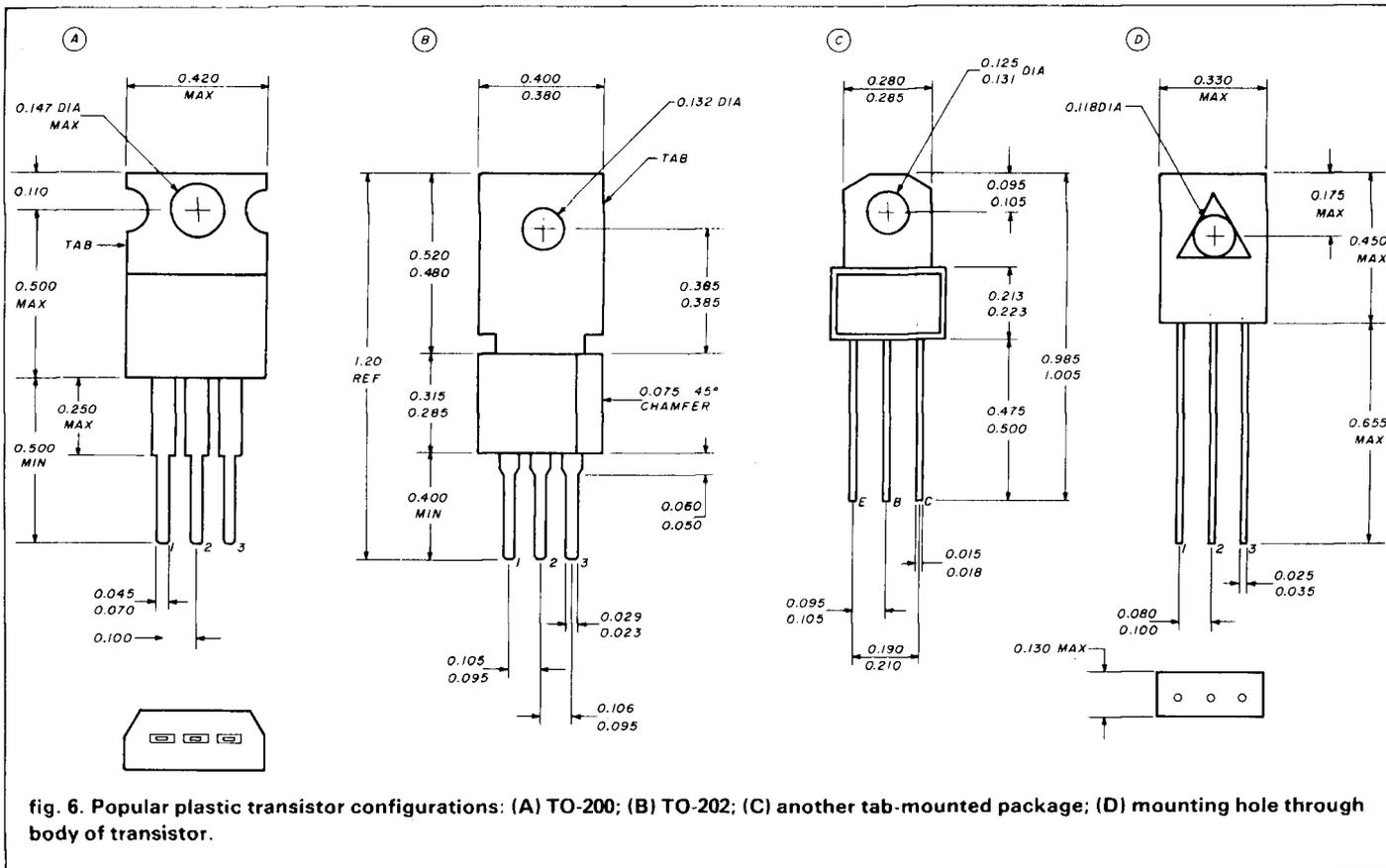


fig. 6. Popular plastic transistor configurations: (A) TO-200; (B) TO-202; (C) another tab-mounted package; (D) mounting hole through body of transistor.

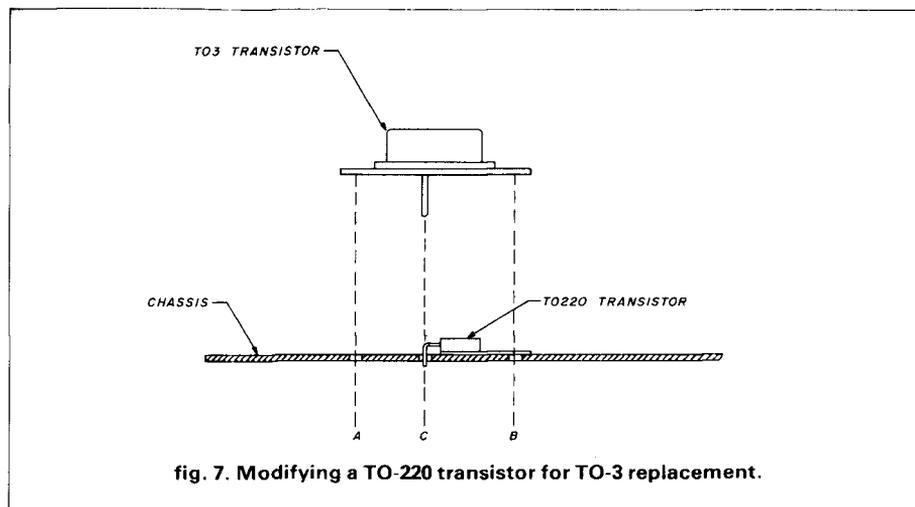


fig. 7. Modifying a TO-220 transistor for TO-3 replacement.

voltage and current, must not be exceeded.

mechanical problems

Problems of physical size, connecting leads, and methods of mounting some substitute transistors are equally as vexing as those of finding a suitable electrical characteristic.

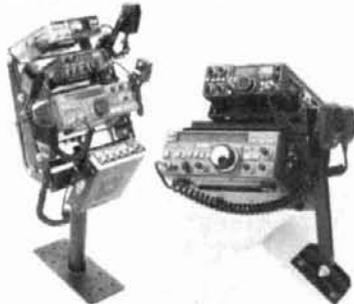
Our first transistor package is the RF power transistor shown in fig. 4. This device uses thin, flat "low inductance" leads. Several sizes are available, and size doesn't necessarily indicate relative power dissipation rating (although it usually does). There was one kit-form 2-meter FM mobile power amplifier that came with either of two differ-

ent types of power transistor. The hole in the printed wiring board was cut for the larger type and rubber "O-rings" were placed around the smaller to make them fit.

Figure 5 shows several types of power transistor package. The TO-3 transistor in fig. 5A is the so-called "standard" power transistor in a diamond-shaped package. A smaller diamond-shaped package is the TO-66 shown in fig. 5B. There's also a Japanese "similar-to-TO66" package that looks, at first glance, like the TO-66 but has slightly different pin spacings. Finally, the big horse shown in fig. 5C is the TO-36. This high-power transistor is used extensively in automotive audio applications, mobile solid-state HV multivibrator DC power supplies, and in industrial electronics applications.

Figure 6 shows several popular plastic power transistor packages. Some of these are listed as replacements for TO-3 or TO-66 diamond-

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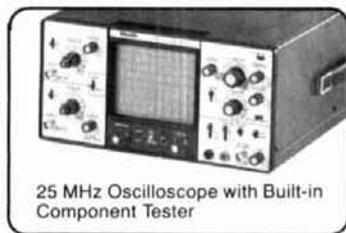
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matching linears to transceivers on 10-15 meters

Grounded grid linear amplifiers don't always present a perfect 50-ohm resistive input for the transceiver. And long leads from the transceiver sometimes present a reactive load on the 10- and 15-meter bands. What happens? The transceiver goes into self-oscillation when the amplifier is driven.

To solve this problem I first tried a transmatch, but it didn't work because of the difficulty of obtaining short leads. An "L" network didn't work, either.

But the "T" match (fig. 1), with its short leads, worked the first time. The transceiver loaded up to full power, driving the linear with no ensuing oscillations. I was delighted with the results.

The matcher was built in a small LMB Flange Lock Box (No. EL532), measuring 5 1/4 x 3 x 2 1/2 inches (fig. 2). With the capacitor bolted to the front panel and the two input and output BNC coax fittings on the back, leads were kept short. The capacitor should tune 10 meters with a 50 pF setting and adjustment coil. For 15 meters I just increased the setting to about 70 pF. The SWR dipped 1:1 without any switching or shorting out turns for 10 meters. I could cover both bands.

Calculations would show about 50 pF for 15 meters and 45 pF for 10 meters, adjusting the coil for that value. However, I don't find this necessary.

Ed Marriner, W6XM

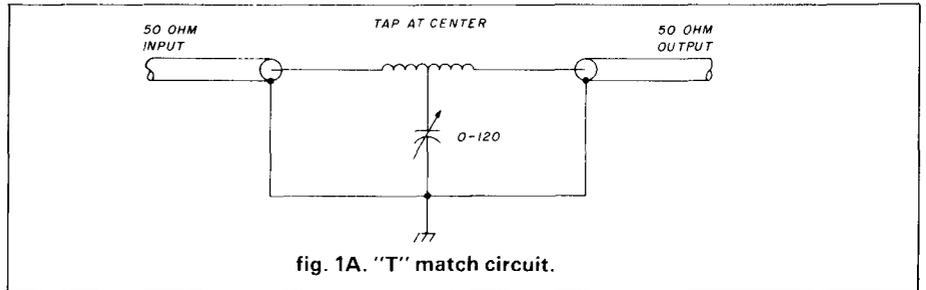


fig. 1A. "T" match circuit.

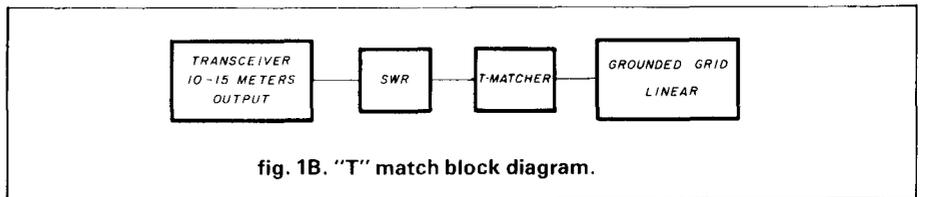


fig. 1B. "T" match block diagram.

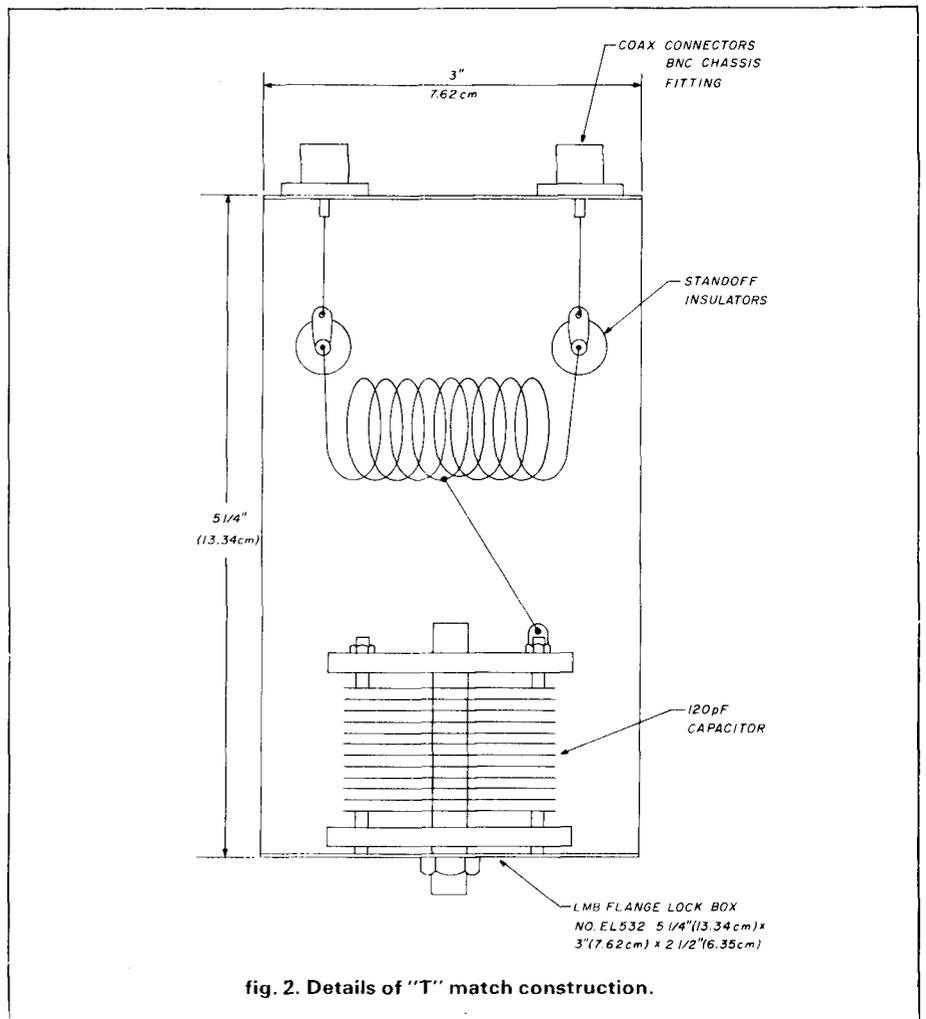


fig. 2. Details of "T" match construction.

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100 watts	100H	100A	100B	100C	100D	100E
250 watts	250H	250A	250B	250C	250D	250E
500 watts	500H	500A	500B	500C	500D	500E
1000 watts	1000H	1000A	1000B	1000C	1000D	1000E
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MADISON

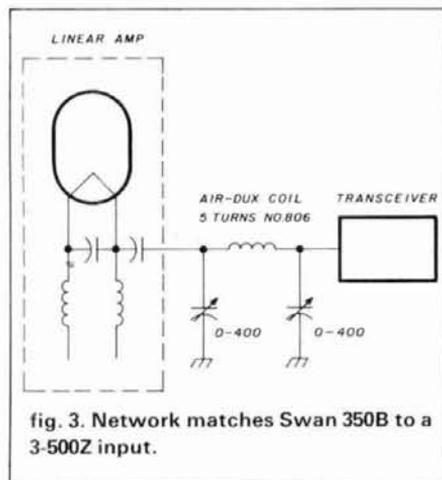
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coupling to a GG linear

Some of the grounded linear amplifiers, especially home brew jobs, capacitively couple directly into the filament RFC



through a coupling capacitor. Generally the coax link is rather long; the driver transceiver has to work a lot harder than necessary to make up for the loss in mismatch. A 3-500Z, for example, has an input of about 150 ohms.

A simple matching device to match the output of the transceiver to 150 ohms is a pi-network. Many handbooks show a pi-network using fixed capacitors. I found being able to vary the capacitors made it easier to match. Fig. 3 shows a network I used for matching a Swan 350B 50-ohm output to a 3-500Z 150 input.

The unit was constructed in a small box and inserted in the coax line to the amplifier. The capacitors were small 0-400 pF BDC type, and did not arc over. The coil can be either five turns of Air-dux #806 or five turns of No. 14 AWG

wire wound six turns per inch on a 3/4-inch coil form. It takes very little inductance for 15 meters.

First I loaded the Swan 350B into a 50-ohm load. I then fed a signal into the amplifier and adjusted both capacitors for maximum output. Next, the loading capacitor on the Swan 350B was adjusted slightly for maximum output again on the linear. I found it took a lot less drive from the 350B to drive the linear over the old method, without a matching device. It's worth the effort to build one for each band if necessary. The received signal has to come through this network, but it does not seem to cause any deterioration in signal sensitivity.

Ed Marriner, W6XM

line regulator

It's often desirable to adjust the 120-volt AC line voltage if you're using a computer or other equipment that won't tolerate high or low line voltage.

Although line voltage could be varied with a large variac, there is a way to do this inexpensively — through a system called "line bucking" — using a small variac and a filament transformer (fig. 4).

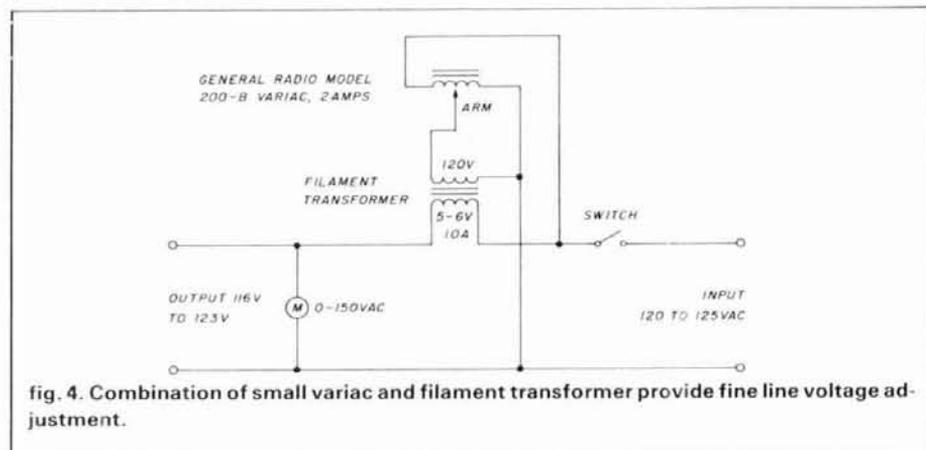
In line bucking, a 120-volt line runs through the low voltage secondary of a filament transformer. This winding must carry the current of whatever you're drawing with your equipment.

I used a 10-ampere, 5-volt filament transformer.

By varying the voltage on the primary side, you can add or subtract on the secondary. I used a surplus General Radio 200-B 2-ampere variac to perform this operation. By varying the arm on the variac I can adjust the line voltage by several volts plus or minus. I bring my 127-volt line down to 120 volts very nicely and don't have to worry about burning out my equipment.

The project is well worth the effort required to locate parts. I found mine — for less than \$10 — at a radio swap meet and surplus store.

Ed Marriner, W6XM



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V5-53	10/15/20/40/80	3	42'	69.95
V5-64	10/15/20/40/80/160	4	73'	89.95

*Can be used without radials
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D-80	80/75	130'	25.95
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241



an easy way to measure capacitance

Like many hams, I have a can of capacitors whose values are either unmarked or marked in a code I don't understand. I use a simple method to measure their values.

The equipment required is modest: all you need is a signal generator, a frequency counter (if you don't have one, use the frequencies indicated on the signal generator) and an indicating meter together with a few resistors, capacitors, and diodes. The signal generator should cover the audio and low radio frequencies. The indicating meter can be a VOM.

Figure 5 shows the basic circuit. A signal from the generator is applied to a known resistance, R , connected in series with the unknown capacitor, C . The frequency of the signal is adjusted so that the RMS voltage across the resistance and the capacitance are equal as measured by two voltmeters, V_{ac} . Then,

$$X_c = \frac{I}{2\pi f C} = R \quad (1)$$

where:

X_c = reactance of the capacitor, ohms
 f = frequency of the applied signal, Hz
 C = capacitance, Farads
 R = resistance, ohms

After some calculations I chose R to be 1000 ohms. Rearranging eqn. 1, substituting 1000 for the value of R , and changing a constant so that C is now in μF , we have:

$$C = \frac{159.15}{f} \quad (2)$$

Figure 6 illustrates the actual circuit I used. Instead of measuring the AC voltage across the resistance and the capacitance, the AC is rectified by each of the two diodes and used to charge the two $4\text{-}\mu\text{F}$ capacitors. The resulting DC then is measured by a voltmeter that's connected as indicated.

Accuracy of the results will depend on the actual value of the known resistance, R , and your ability to determine the frequency of the applied signal. Use a high-tolerance resistor or measure it and substitute the actual value into eqn. 1. The values of the other resistors and

capacitors aren't critical. The diodes can be any signal diodes.

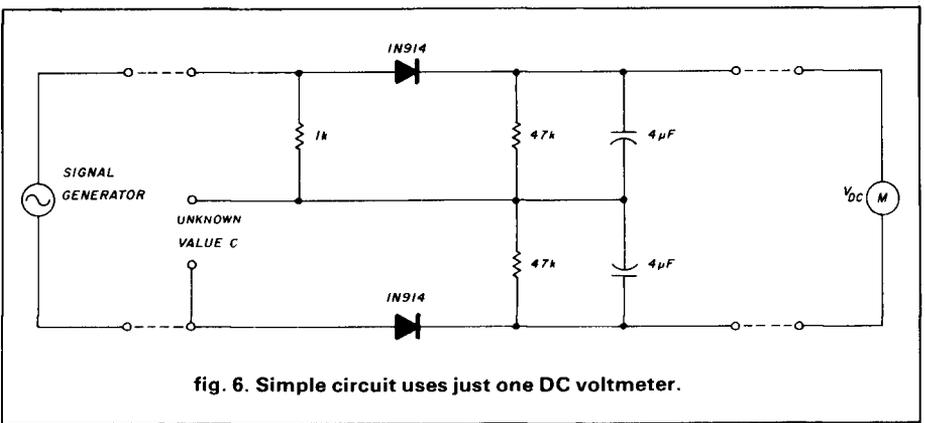


fig. 6. Simple circuit uses just one DC voltmeter.

operation

The unknown capacitor is connected

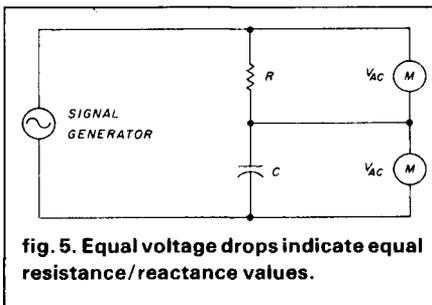


fig. 5. Equal voltage drops indicate equal resistance/reactance values.

and a signal from the generator is applied to the circuit. The frequency of the signal is adjusted so that the output as indicated by the DC voltmeter is zero. The frequency of the applied signal is noted (or measured if you have a frequency counter) and the capacitance is calculated from eqn. 2.

For the DC voltmeter, I used a zero-

center meter I happened to have. If you don't have such a meter, use an ordinary DC voltmeter and connect the polarity of the meter as required. Remember that when you measure a capacitor, the DC output voltage will be of one polarity when the frequency of the signal generator is too low and of the opposite polarity when the frequency is too high. You could add a polarity-reversing switch for the meter or use the bridge arrangement shown in fig. 7, although this scheme would broaden the frequency range for the zero-voltage indication somewhat because of the voltage drop across the bridge diodes.

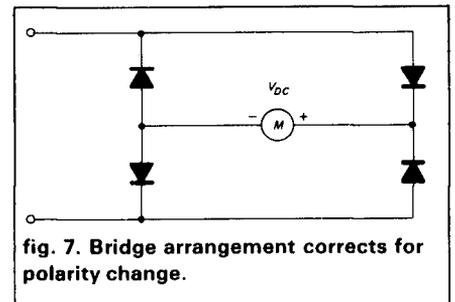


fig. 7. Bridge arrangement corrects for polarity change.

Table 1. Measurements of known capacitors.

Nominal capacitance, μF	Zero-voltage output frequency, Hz	Calculated capacitance, μF
0.05	3305	0.048154
0.02	8509	0.018704
0.01	15,761	0.010098
0.005	32,404	0.004911
0.002	82,875	0.001920
0.001	168,915	0.000942
0.000510	317,853	0.000501
0.000470	358,631	0.000444
0.000330	498,930	0.000319

performance

I built the circuit shown in **fig. 6** and checked it using some 5-percent tolerance capacitors. **Table 1** shows the nominal value of those capacitors, the frequencies at which I obtained zero-output voltage, and the calculated values of the capacitors using **eqn. 2**. The calculated values of capacitance are in good agreement with the nominal values. I didn't have any 5-percent capacitors larger than $0.05 \mu\text{F}$, but the system should work well with larger capacitors. From **eqn. 2**, if your signal generator goes down to 100 Hz, you can measure capacitors as large as $1.59 \mu\text{F}$. If a smaller value of R is used, even larger capacitors can be measured.

For my tests I used a Hewlett-Packard model 200-CD signal generator and a Heathkit model 2410 frequency counter.

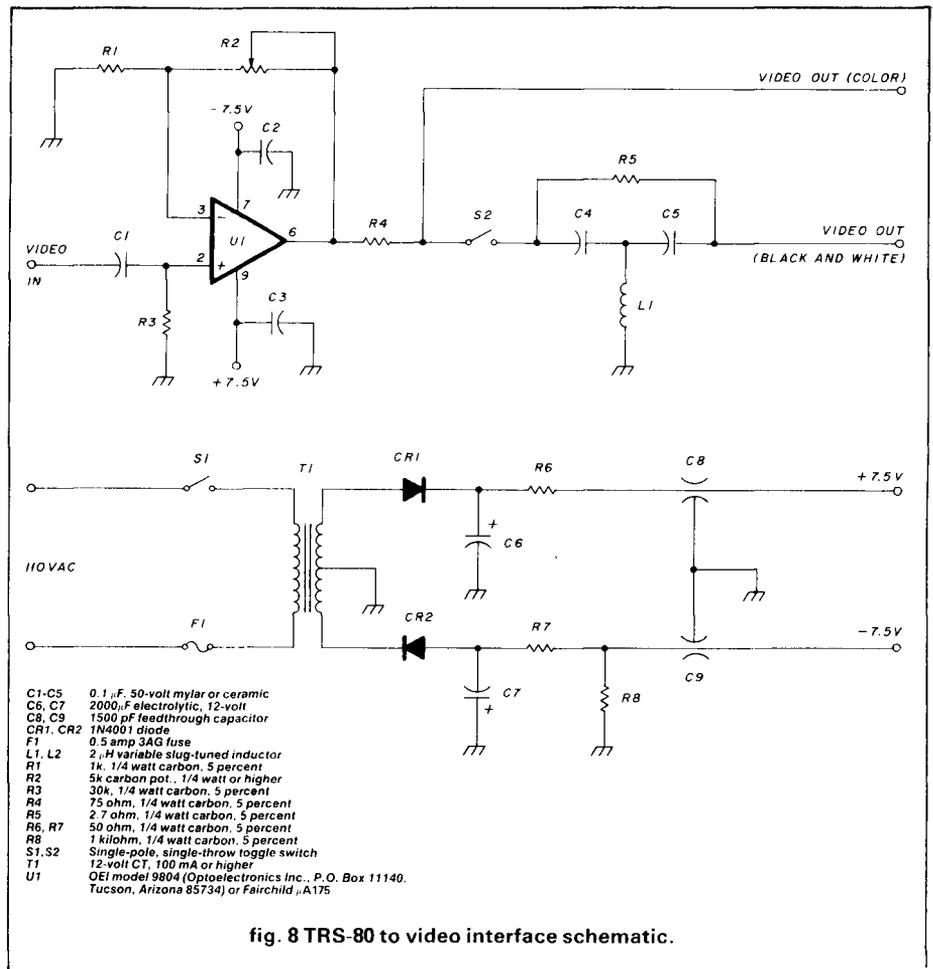
A word of caution: this method measures the impedance of an unknown. For a capacitance, with the exception of electrolytics, the impedance is nearly the same as the reactance. However, this is not true for an inductance. You can measure the impedance of an inductance with this method — but unless you know the AC resistance of the inductance, you can't determine the L value of the inductor. The AC resistance is different from the DC resistance, so a measurement made with an ohmmeter won't solve that problem.

H.H. Hunter, W8TYX

TRS-80C to video monitor interface

This article describes a video amplifier-filter used in conjunction with a Radio Shack Color Computer and a video monitor.

Severe RFI from my radio transmitter into a television set used as a monitor convinced me to try a number of possible solutions. A low-pass filter at the transmitter output along with a high-pass filter at the input to the television



set minimized the RFI somewhat, but not enough to call it a cure. I then decided to buy a black and white video monitor and use the direct video approach. Much better character resolution is also achieved by this method.

My first thought was to use a wide bandwidth operational amplifier with a gain setting high enough to produce a standard composite video amplitude of 1 volt peak-to-peak. The output signal from the op-amp is then applied to a black and white or color monitor. **Figure 8** shows an OEI model 9804 op-amp; however, any op-amp with a bandwidth of 30 MHz or higher should work well. Input to U1 is connected to U12, pin 12 in the TRS-80C. This point can be found at resistor R16 (3.9k), located at the rear and center of the computer printed circuit board (component side up).

Connect the left-hand lead of the resistor to the input of U1 with miniature

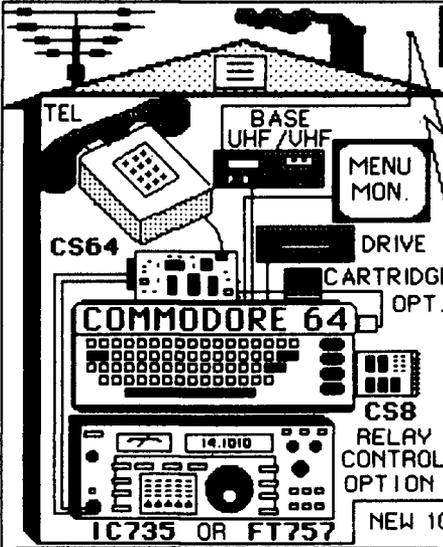
coax and ground the shield of the coax to the ground plane of the circuit board housing U1. Amplifier gain is set by adjusting R2. A simple alignment approach is to adjust the monitor contrast control for maximum contrast and the sync pulses are not overloading the monitor. If a scope is available the op-amp output can be monitored until 1 volt peak-to-peak is observed.

A problem develops with the color signal from the computer driving a black and white monitor. The color burst signal riding on the composite video signal distorts the displayed characters observed on the screen. I solved the problem by installing a notch filter at the output of the op-amp tuned to the 3.58-MHz color burst frequency. While observing the monitor screen, adjust L1 until the characters look the best (you

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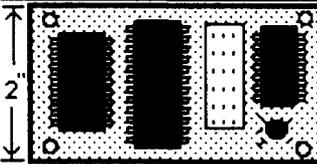
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should see sharp corners with no overshoot or smearing). Again, if a scope is available, L1 can be adjusted until the color burst disappears. The color burst will be seen as a burst of RF sinewaves after the horizontal sync pulse. If a color monitor is used the notch filter can be eliminated or switched out of the circuit as shown in **fig. 8**.

Approximately 40 mA is drawn from the op-amp so the power supply can be very simple in design. Any junkbox 12-volt center-tapped transformer can be used.

construction

I built the op-amp circuit on a perforated ground plane circuit board and enclosed it in a well-shielded aluminum box (very important for RFI elimination). The box should be thin enough to fit inside the computer enclosure underneath the top cover. I also installed the power supply inside the computer enclosure. The power supply parts were installed on the metal cover inside the computer (top side). Connect feed-through caps (1500 pF) onto the video circuit box in series with each power supply voltage lead. This will bypass the small amount of remaining RF from the transmitter into the video amplifier enclosure. Use miniature coax (RG174) between the output of the amplifier and the video monitor.

The results from this effort were very rewarding in that I can now run a kilowatt input from the transmitter with a clean screen. Character resolution was improved markedly because the maximum bandwidth of the monitor is realized. This is especially true with a black and white monitor such as mine, which has an 8 MHz bandwidth.

Don Kadish, W1OER

some thoughts on quad construction

Over the years, the quad antenna — frequently in the form of a three-band unit for 10, 15, and 20 meters — has been used extensively by Amateurs. It's a compact antenna that offers good performance.

spreaders

The quad's ability to survive strong winds depends largely upon the spreaders and how they're attached to the boom. The cast aluminum type of spider mounting on the boom is lightweight and relatively inexpensive, but may crack under wind stress. In an attempt to overcome this problem, I began, about 20 years ago, to use nylon monofilament as a means of reinforcing the spreaders (**fig. 9**). This method of reinforcement has been quite successful.

When the last major typhoon hit Manila in 1970, damage was extensive. Many houses, power and telephone utility poles, and main distribution lines were blown down. Most of the city was without power for two weeks. One of my antennas was a multi-band quad and delta system, with a total boom length of 50 feet, mounted atop a self-supporting 75-foot tower. The boom had a two-element 40-meter quad, a three-element 20-meter quad, a four-element 15-meter delta loop above the boom, and a five-element 10-meter delta loop below the boom. The largest antenna — which consisted of the 40-meter quad, the reflector of the 20-meter quad, and the director of the 20-meter quad — measured about 28 feet across. The rest of the boom was the bow sprit, where the antenna stays were attached. While one might not expect such a structure to survive a typhoon, the only significant damage was that the 2-inch solid steel shaft on which the boom was mounted was badly bent at the point at which it entered the retaining bearing at the top of the tower. The prop-pitch rotator, set about 5 feet lower, suffered no harm. There was a crack, however, in one of the 40-meter spreaders, which were made of the best material obtainable — phenolic resin molded with fiberglass.

Although I'd used 200-pound monofilament fishing line to reinforce the spreaders of this antenna, a less elaborate antenna, such as two- or three-element 20-meter quad, need not use anything heavier than line rated at 150

pounds. In such cases, the boom extension doesn't need to be quite as strong as the boom itself; the most practical thing to do is use the next smaller size of tubing — preferably about the same length as the quad spreaders themselves — so as to make a snug fit in the main boom. All assembly work should be done on the ground to make sure that all stays are of equal length, type, and shape. This means that the boom will have to be placed on an improvised sawhorse about 12 feet off the ground (for a 10-, 15-, and 20-meter antenna), so that the antenna and boom assembly can be rotated axially to provide access to all spreaders.

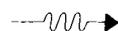
home-brewed spreaders

Hams in third-world countries may have difficulty finding spreaders; if they can be located, the cost of shipping may be prohibitive. Ordinary PVC pipe is now available almost anywhere, however, and can be used successfully.

There's a problem with PVC pipe, however. Even in the thicker wall sizes, it's too flexible and must be reinforced for rigidity. One way to do this is to obtain a piece of straight-grained lumber as long as the spreader and split it lengthwise into several square pieces whose dimension across the flats is slightly greater than the inner diameter of the tubing, using knives and coarse sandpaper to bring each to the correct dimension. One could also use a lathe.

After preparing the wood, it should be treated with preservative, allowed to dry thoroughly, and then inserted into the PVC pipe. Seal the ends with epoxy to keep moisture out. (It's a good idea to keep the wood slightly shorter than the pipe (perhaps one-fourth inch over-all) to allow for this layer of epoxy.)

This type of spreader has been successfully used here in the Philippines. We find it will greatly outlast bamboo; it's also stronger. And while it may not compare with the best pressure-molded phenolic fiberglass, it costs much less. It does weigh more, but not as much as one might assume.



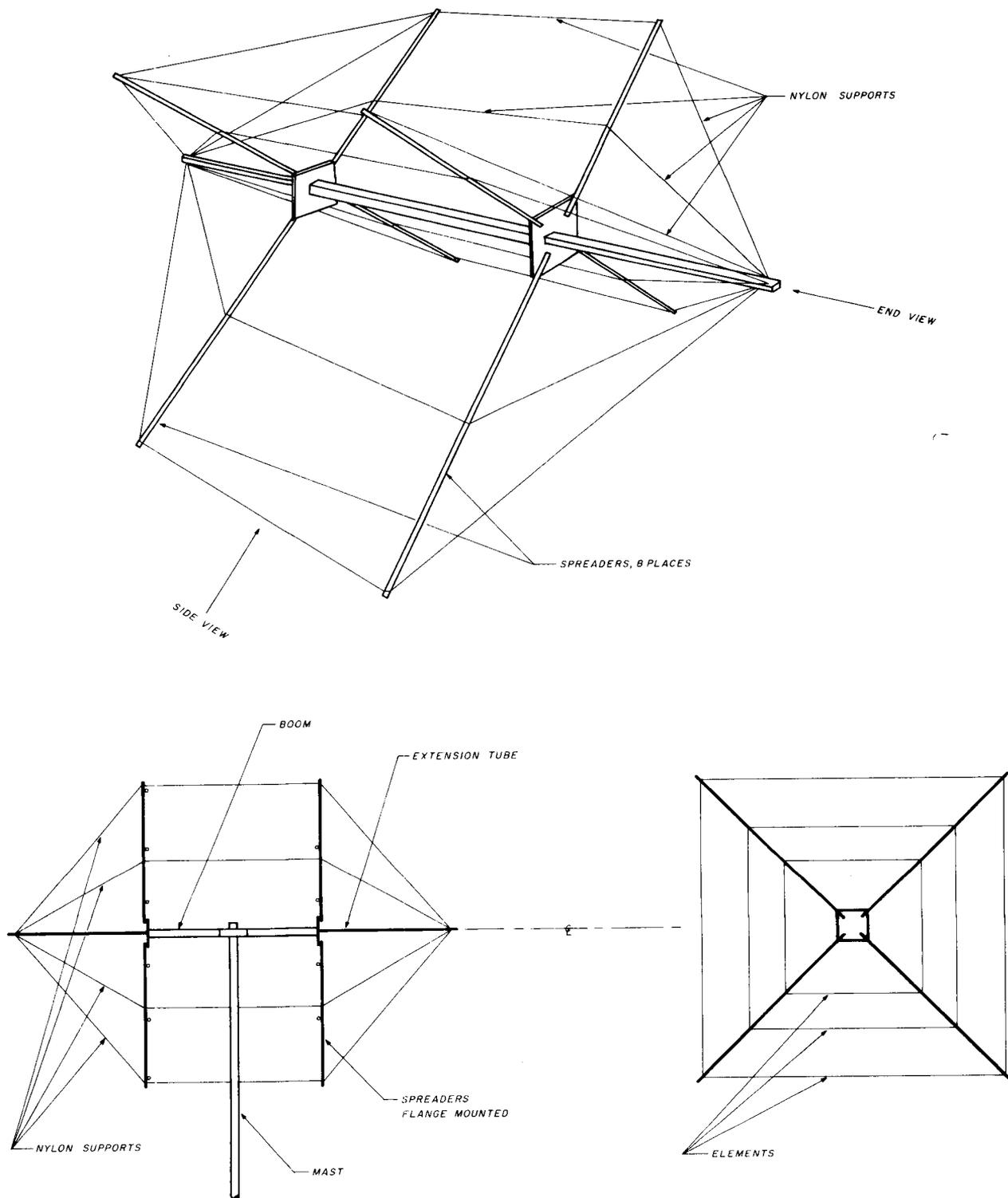


fig. 9. 10 through 20 meter quad antenna (A) three dimensional view shows spreader and nylon support structure; (B) end view (in the line of fire); (C) side view shows the relationship between the boom extension and elements.

selecting wire

Using insulated wire in a quad would result in unexpected difficulty in resonating the antenna. This is because the velocity of propagation is slower in insulated wire than in uninsulated wire in air.

It's possible to use magnet wire, which doesn't have this problem because its very thin coating has little effect. Older types of magnet wire may crack in the sun, but newer types, coated with tougher enamels, offer greater protection against corrosion and are more durable.

The ideal wire would be small-diameter copperweld such as 18 AWG, which has greater breaking strength than ordinary copper wire of larger diameter. I don't know of a source of enamel copperweld, but considering the advantages of copperweld — even without enamel — I would prefer to use it rather than any other material. Though it's more difficult to handle, less wind resistance and greater strength mean that there's less chance of damage from vibration in heavy winds.

Plated electric fence wire is even cheaper than copperweld and is strong and durable. It can be used on quads, although not in high-power applications.

weatherproofing

When putting up your coax, take particular care to protect the ends of the coax from moisture by using protective materials (for example, Coax Seal™). To make your antenna look more balanced to the transmission line, convert a section of the coax near the joint with the antenna, into a choke, winding the coax around a ferrite rod. The handbooks and various magazine articles have covered this subject; it costs little and will reduce susceptibility to noise with vertical polarization. If you use a two-element, three-band quad, you would probably find that a 75-ohm cable will give a better overall SWR than a 50-ohm cable, and for the same loss or power handling capacity, cost a bit less.

installation and adjustment

One of the serious problems of put-

ting up a beam antenna is the difficulty in adjusting the antenna near the ground, whether it's a quad or Yagi. If one has a four-legged, self-supporting tower such as mine, the solution is easy — simply build a temporary scaffold (with a railing) extending out from the tower at the level necessary for working on the boom out to the farthest element. For other types of masts, you'll have to find your own solution, for the true tuning-up must be done on the spot.

Earl H. Hornbostel, DU1AE
Manila, Philippines

audio switcher for mobile operation

I don't know about you, but I have a very annoying problem. Even though blessed with two ears, I can't seem to really listen to more than one thing at a time. And, sad to say, the problem seems to be growing worse with age! Lately it seems that all the cocktail-party conversations and the rare DX seem to get mangled and mauled by QRM.

The problem was especially acute on the road while scanning the repeaters and trying to listen to the stereo at the same time. No amount of fiddling with the volume controls would produce the right result, and I was always lurching to turn down the stereo volume before pressing the PTT, which I usually squeezed instinctively. I'd be driving along the highway, shouting into the mic and groping for the stereo's volume control.

solving the problem

The circuit shown switches the car's speakers from the stereo to the rig whenever the PTT is pressed or whenever the rig's squelch is opened. Neither the rig nor the stereo has to be modified. Compact enough to fit into any small space, the circuit can be built and installed in a day. Parts selection is neither critical nor costly. Everything you need is probably right there in your junk box; even if you were to purchase all new parts, their cost should not exceed \$15 to \$20.

Before beginning construction, check to make sure that your stereo has

four "hot" speaker leads and a common ground. Some stereo systems — Sanyo, for example — use a "matrixed" speaker output consisting of four speaker leads with no common ground. I know of no way around this except to use the phone or amplifier outputs and an external amplifier with the normal four "hot" channel outputs and one common ground.

The circuit shown in **fig. 10** consists of a quad op amp, two transistors, a relay, and a few resistors and capacitors. Construction techniques aren't particularly demanding. I pushed the parts through perf board and just soldered the component leads together (**fig. 11**). The

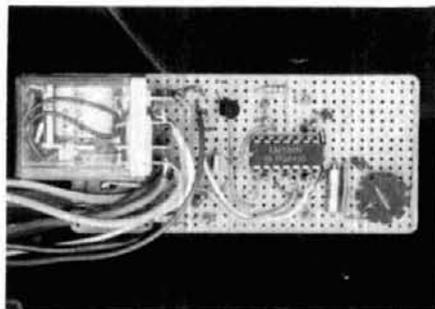


fig. 11 Simple perf board construction provides quick results.

relay was hot-glued to the perfboard and the completed unit was installed in a hinged plastic box that had once held standard-size staples. (A DIP socket was used for the op amp for development purposes, but it isn't necessary.)

operation

Audio output from the rig is fed into two successive stages of the LM324 op amp, where it's amplified and effectively clipped at a 12-VDC signal level. Capacitor C1 and variable resistor R1 determine the time constant for signal decay. This acts like a VOX delay to prevent relay dropout between words or pauses in the conversation. An additional op amp stage sharpens the signal and acts as a buffer. The signal is then fed into a 2N2222 PNP or equivalent transistor which drives the 4PDT relay. This relay switches all four speaker leads from the normal stereo position to the rig's audio output. The 1N4004 diode

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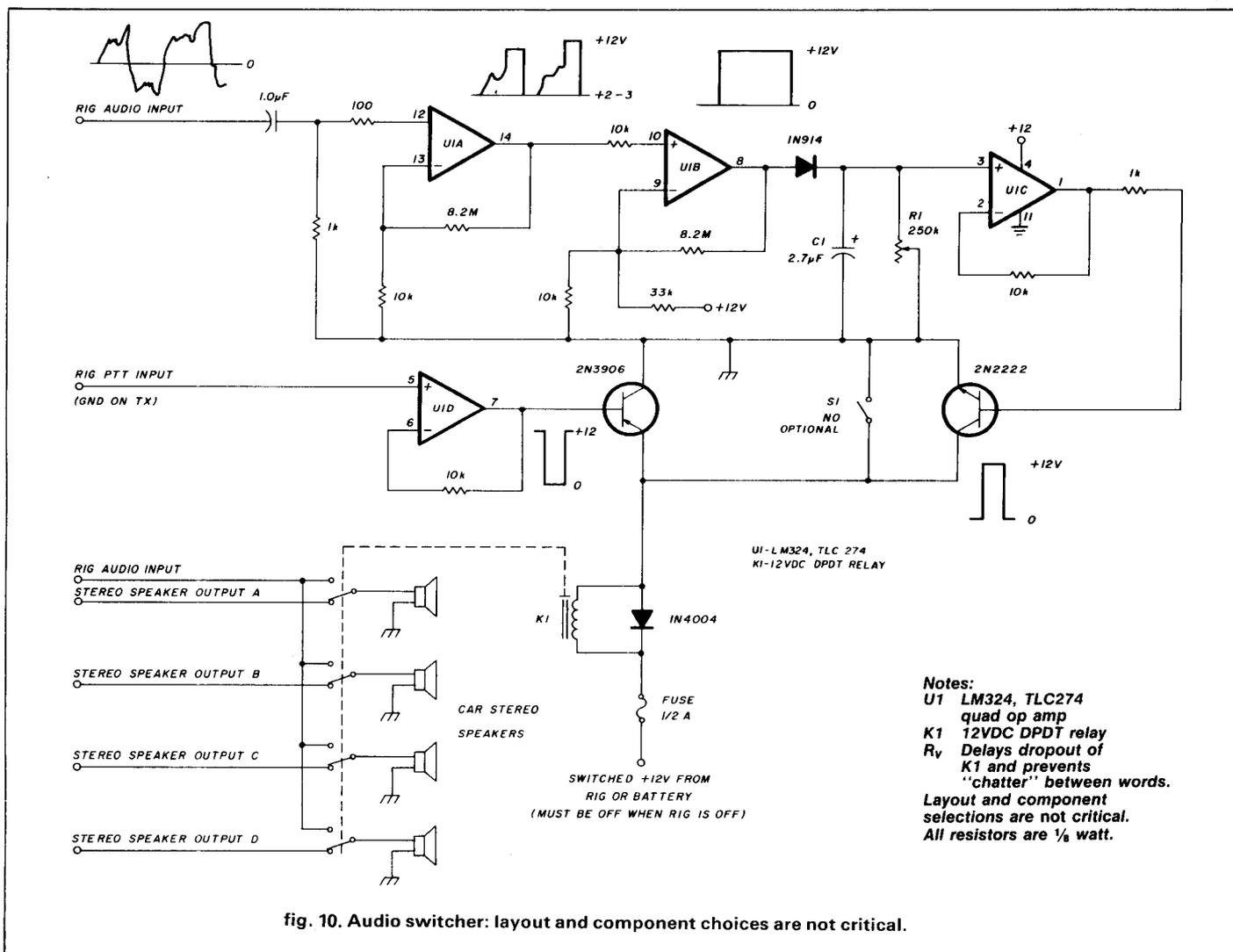
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shunts any harmful spikes when the relay opens. Sensitivity is high enough so that almost any audible output from the rig will operate the relay and switch the speakers from stereo to rig audio. The fourth op amp in the package is used to drive a 2N3906 NPN (or equivalent) transistor to pull in the relay when the PTT switch is pressed. This mutes the stereo system while you're talking into the microphone. Use of switch S1 is optional. It's normally used in the open position; when it's closed, it locks in the relay and the speakers are connected to the rig's audio output only. This may be useful under marginal receive conditions, but I usually just turn the rig off.

No tweaking or alignment is necessary after construction. However, you

should double-check all wiring, solder joints, etc. If you've installed a socket for the op amp, leave it empty while you check relay operation and voltages. Check pin 4 for a nominal +12 VDC. Ground the transistor side of the relay coil and see if it actuates. If it's working up to this point, plug in the op amp and proceed. If not, double-check everything *again*.

Once everything is operating to your satisfaction, enclose it all in a small plastic case. At approximately 1 x 1.5 x 4 inches, my board fit into the staple box neatly, without movement. I placed a piece of non-conducting foam underneath the board and concealed the unit behind the ashtray above the radios. If space is a problem, you could, with a lit-

tle effort, reduce the size of the board by at least 50 percent.

Operation is very simple. The only "set once and forget" adjustment is R1, which should be adjusted just as you would any VOX delay circuit. Listen to a few typical QSOs on the rig and adjust the resistance until the relay stops dropping out between words. That's all there is to it.

Some additional ideas came to mind after I built this nifty little circuit. One is to use some form of solid-state switching if relay noise becomes bothersome. Those running a "full house" of VHF, HF, scanners, and such may want to add a digital voting scheme. This would require a much costlier and complex circuit, however.

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simple IC function generator

The Exar XR-2206 is a widely available IC function generator (see fig. 12). The VCO frequency is controlled by the current drawn from either pin 7 or 8. Three volts is applied as bias on pins 7 and 8. Frequency of oscillation is given by:

$$f(\text{Hz}) = \frac{320 \cdot I(\text{mA})}{C(\mu\text{F})}$$

where I is the current drawn at pin 7 or 8 and C is the value of a capacitor placed across pins 5 and 6.

A typical method of varying the frequency is to place a potentiometer between pin 7 and ground. The frequency of oscillation now becomes

$$f = \frac{320 \cdot 3}{CR}$$

where R is the value of the pot. The frequency of oscillation is proportional to the inverse of the pot's resistance. If the pot has a linear taper, most of the frequency change takes place at the end of rotation. A better frequency control scheme is needed.

A solution is the voltage-to-current converter. A basic V to I converter is shown in fig. 13. The improved frequency control is shown in fig. 14.

The 2k turn pot has a maximum voltage range of about 2 volts and the V to I converter has a "gain" of 1V to 1mA

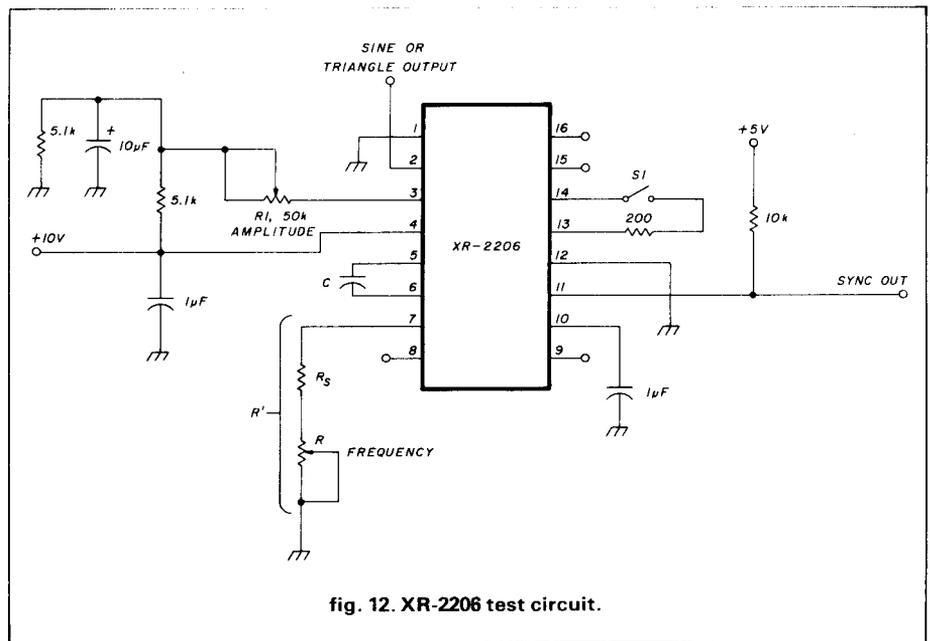


fig. 12. XR-2206 test circuit.

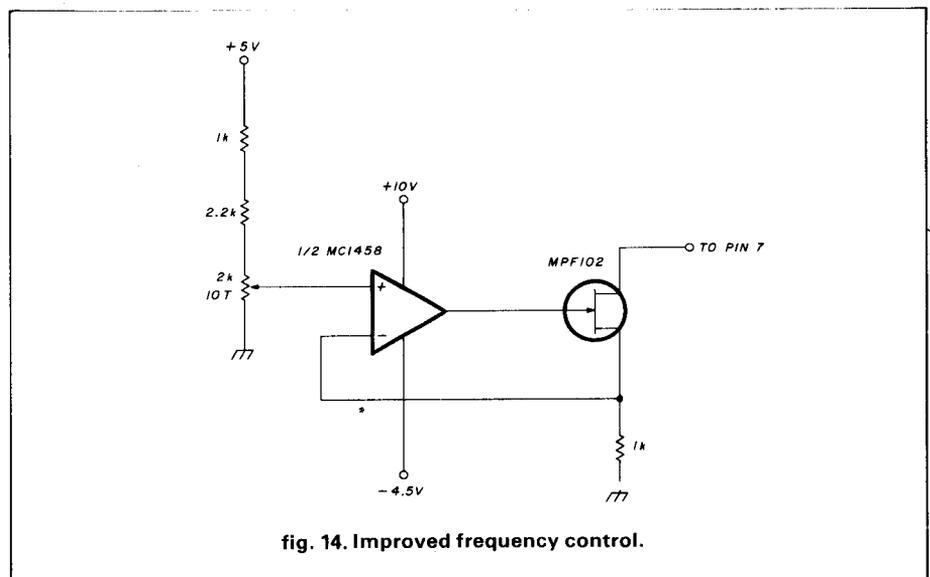


fig. 14. Improved frequency control.

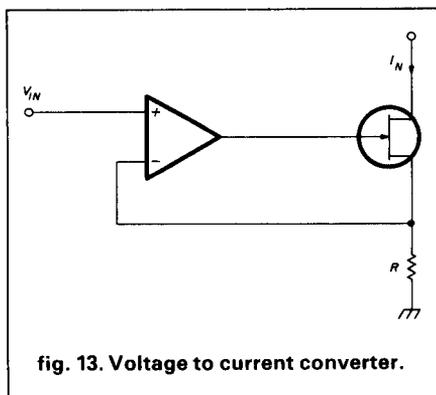


fig. 13. Voltage to current converter.

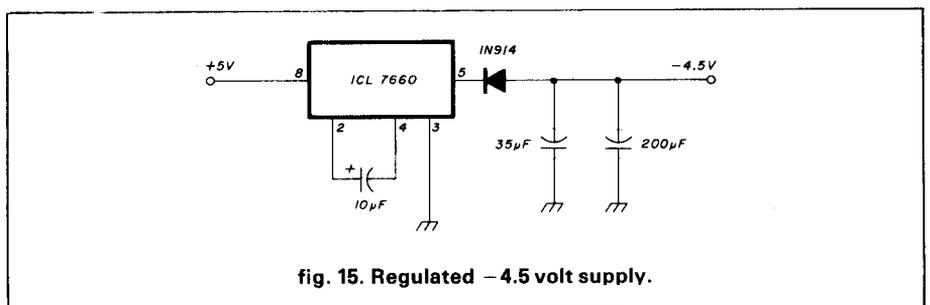


fig. 15. Regulated -4.5 volt supply.

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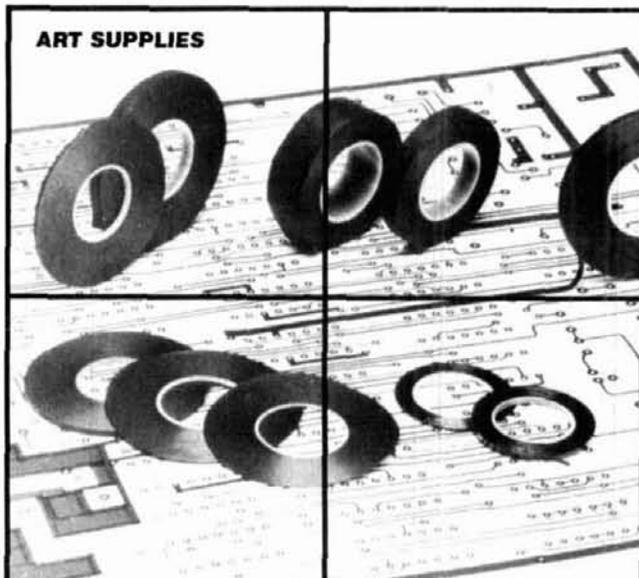
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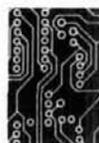


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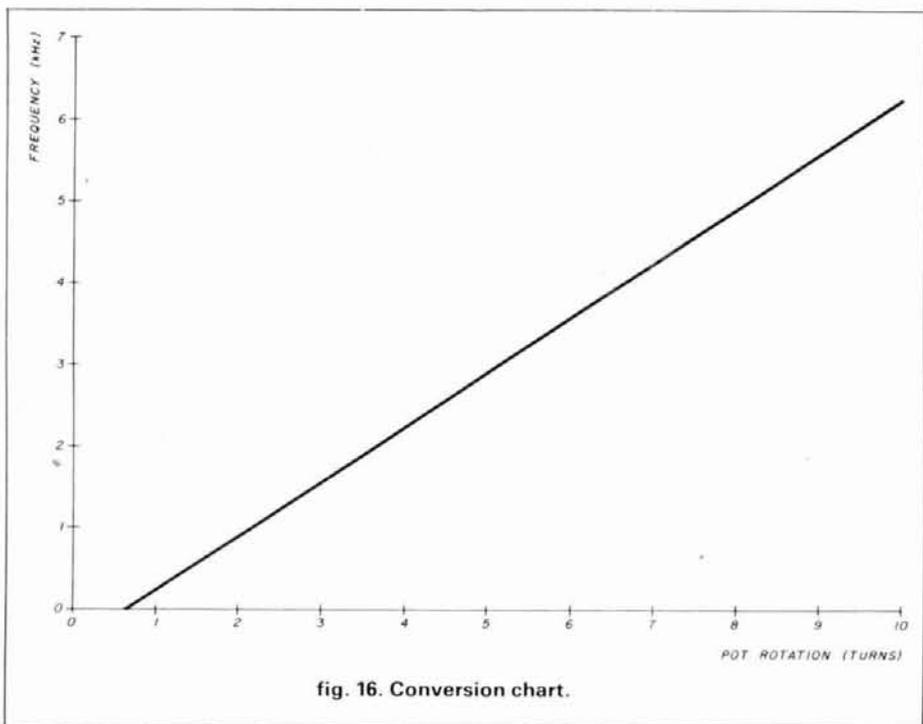
*See review in October 73, 1984 **See review in March 73, 1986

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so that the maximum current drawn from pin 7 is about 2 mA. Exar says that current drawn from pin 7 or 8 should be less than 3 mA.

The Op amp is supplied with -4.5 volts to allow full-range operation down to 0V input. The -4.5 volts is supplied by an ICL 7660 voltage converter chip. The schematic is shown in fig. 15.

The $35 \mu\text{F}$ capacitor on the output provides extra filtering to reduce voltage variations to the V to I converter.

The results have been pleasing. Figure 16 is a graph showing frequency versus pot rotation.

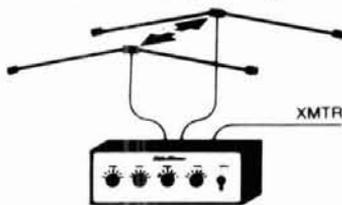
Thomas A. Keely

Yaesu FT707 DC power cable

Just a word of caution if you plan to make your own DC power cable for the Yaesu FT707 using off-the-shelf, four-contact Jones plugs. The pin numbering system of the Yaesu plug is different from that of the off-the-shelf plugs. On the Yaesu, pins 1 and 2 (horizontal blades) have a jumper, pin 3 is positive, and pin 4 is negative. On the off-the-shelf Jones plug, pins 1 and 3 should have the jumper, pin 2 is positive, and pin 4 is negative.

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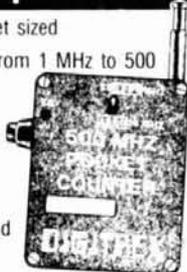
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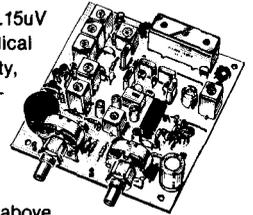
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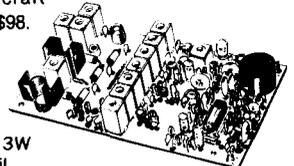


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146-148	28-30
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28-30	50-52
27-27.4	144-144.4
28-30	220-222*
50-54	220-224
144-146	50-52
144-146	28-30

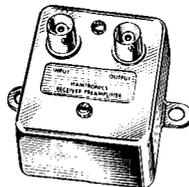
For UHF, Model XV4
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Wired \$139

28-30	432-434
28-30	435-437
61.25	439.25
144-148	432-436*

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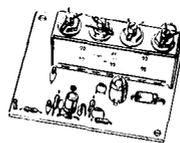
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LNG-144	137-150 MHz	\$49
LNG-160	150-172 MHz	\$49
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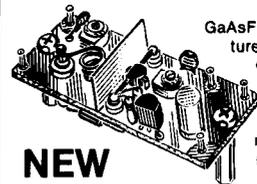
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MODEL	TUNING RANGE	PRICE
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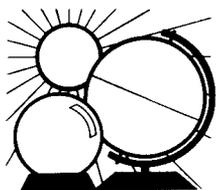
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DX FORECASTER

Garth Stonehocker, KØRYW

antenna-to-ionospheric path match

Up North, October is probably your last chance to work on your antennas before winter and the contest season begin in earnest. Winds and temperature changes can take their toll. If your antennas and towers haven't been checked recently, hardware needs to be tightened and wires checked for cracks or worn places.

How have your antennas been performing? Perhaps a different antenna or configuration might be in order. At this point of the sunspot cycle, emphasis is now on the lower bands. What improvements could you incorporate to enhance your signal to your favorite DXing area?

Re-read K2RR's article, "Secrets of Successful Low-Band Operation (*ham radio*, May and June, 1986). Might there be something in it that would help improve your signal — analyzing your ground reflection areas, for example?

In January, 1985 I presented HORANT, a short computer program, written in BASIC, designed to provide the elevation angle, take-off angle, and the lobes of maximum radiation from a horizontal antenna mounted a selected height above ground for specific frequencies. I've since found that adding two lines to each of four places will also provide the ground reflection distance (associated with each lobe) away from the antenna feedpoint. A revised version of HORANT is listed in **fig. 1**.*

In part two of his article, K2RR pointed out (in **table 10**) that the quality of this reflection was the crux of the comparison of the efficiency of low horizontal antennas and verticals under poor ground conditions. Some horizontal antennas were able to provide more signal

at the identical angle under poor soil conditions. HORANT can determine where your ground reflection point is and the take-off angle for comparison to the required radiation angle for your ionospheric path to your DX. (The latter angle can be found by using the modification of the MINIMUF 3.5 program or **table 1** of February, 1985's "DX Forecaster.")

After analyzing your ground reflection condition, there are a couple of things you can do to improve the situation. You can alter the reflection condition by soil management (add more radials or ground screen) or move the antenna to a point at which the ground reflection location is better. Relating the take-off angle and ground reflection

terms is called *coupling the signal to the ionosphere*. Doing this allows for the efficient use of HF propagation, regardless of whether you're interested in conveying information over long distances or merely having some fun with DX.

last-minute forecast

Beginning with the first week of October and continuing through the second and third weeks of the month, MUFs are expected to be lower. This will result in poorer conditions on the 10- through 30-meter bands, making the lower bands — and nighttime conditions — more appropriate for DXing. During the fourth week, expect to see a return to better higher-band conditions until the

```
10 REM PROGRAM HORANT, ANGLE & DISTANCE
20 R1=180/3.141659
30 PRINT "ANTENNA HEIGHT ABOVE GROUND IN FEET"
40 INPUT H1
50 PRINT "FREQUENCY IN MHZ"
60 INPUT F1
70 REM CALCULATE A FULL WAVELENGTH L1 AT THIS FREQ
80 L1=984/F1
90 REM CALCULATE FIRST LOBE ANGLE,A1
100 A1=ASN(L1/(4*H1))
110 D1=H1/TAN(A1)
120 A1=A1*R1
130 PRINT "ANGLES OF MAXIMUM RADIATION FROM THIS ANTENNA"
140 PRINT
150 PRINT "FIRST LOBE ANGLE,DEG=",A1
160 PRINT "DISTANCE TO GROUND REFLECTION IN FEET=",D1
170 PRINT
180 REM CALCULATE 2ND LOBE ANGLE ,A2
190 IF (4*H1)<(3*L1) THEN 420
200 A2=ASN((3*L1)/(4*H1))
210 D2=H1/TAN(A2)
220 A2=A2*R1
230 PRINT "SECOND LOBE ANGLE IN DEG =",A2
240 PRINT "DISTANCE TO GROUND REFLECTION=",D2
250 PRINT
260 REM CALCULATE THIRD LOBE ANGLE,A3
270 IF (4*H1)<(5*L1) THEN 420
280 A3=ASN((5*L1)/(4*H1))
290 D3=H1/TAN(A3)
300 A3=A3*R1
310 PRINT "THIRD LOBE ANGLE IN DEG=",A3
320 PRINT "DISTANCE TO GROUND REFLECTION=",D3
330 PRINT
340 REM CALCULATE FOURTH LOBE ANGLE,A4
350 IF (4*H1)<(7*L1) THEN 420
360 A4=ASN((7*L1)/(4*H1))
370 D4=H1/TAN(A4)
380 A4=A4*R1
390 PRINT "FOURTH LOBE ANGLE IN DEG=",A4
400 PRINT "DISTANCE TO GROUND REFLECTION=",D4
410 PRINT
420 PRINT "NO (OTHER) SIGNIFICANT LOBES"
430 END
```

fig. 1. HORANT Program helps determine takeoff angles and distances to associated ground reflection points (written for IBM 4341 in IBM BASIC/VS).

GMT	PDT	WESTERN USA										MDT	MID USA										CDT	EASTERN USA																										
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1800	11:00	40	20	10	10	12	20	20	40	40	20	10	10	12	20	40	40	20	10	10	12	15	20	40	1:00	40	40	30	20	20	20	30	2:00	40	40	30	20	20	20	30	2:00	40	40	30	20	20	20	30		
1900	12:00	40	20	12	10	12	15	20	20	40	20	12	10	12	15	20	30	40	20	12	10	12	15	20	30	2:00	40	40	30	20	20	20	30	3:00	40	40	30	20	20	20	30	3:00	40	40	30	20	20	20	30	
2000	1:00	40	30	12	10	12	12	15	20	40	30	15	10	12	15	20	40	30	15	10	12	12	15	20	3:00	40	40	30	20	20	20	30	4:00	40	40	30	20	20	20	30	4:00	40	40	30	20	20	20	30		
2100	2:00	40	40	15	10	12	12	12	20	40	40	15	10	12	12	20	40	40	15	10	12	12	12	20	4:00	40	40	30	20	20	20	30	5:00	40	40	30	20	20	20	30	5:00	40	40	30	20	20	20	30		
2200	3:00	40	40	20	10	12	12	12	20	40	40	20	12	12	12	20	40	40	20	10	12	12	12	20	5:00	40	40	30	20	20	20	30	6:00	40	40	30	20	20	20	30	6:00	40	40	30	20	20	20	30		
2300	4:00	30	40	20	10	12	10	12	20	30	40	20	15	12	12	20	40	40	20	12	12	12	12	20	6:00	40	40	30	20	20	20	30	7:00	40	40	30	20	20	20	30	7:00	40	40	30	20	20	20	30		

The italicized numbers signify the bands to try during the transition and early morning hours, while the standard type provides MUF during "normal" hours.
 *Look at next higher band for possible openings.

33 cm. • 23 cm. • 13 cm.



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end of the month; transequatorial openings associated with a disturbed geomagnetic field from the 20th to 23rd may even be possible. Another period of disturbance may occur from the 5th to 7th. Because both of these disturbances are within the equinox season, they may have more effect than we've seen recently. Look for openings on east-west paths, with DX signals arriving from some unusual directions.

The Orionids meteor shower will be visible from the 15th to 24th of October, with a maximum rate of between 10 to 20 per hour on the 20th and 21st of the month. A full moon will occur on the 25th; perigee will take place on the 7th. An annular eclipse of the sun extending from Alaska to northern South America begins on October 3 at 1657 UTC. It moves to the east, reaching Eastern Canada and Greenland by 2030 UTC, then ending at 2114 as it approaches Great Britain and Africa.

band-by-band summary

Ten, twelve, fifteen, and twenty meters provide many openings during the daytime. The higher bands will experience shorter openings; these will occur around local noon mainly in a southerly direction. Fifteen meters is now only a transition band between 12

and 20. Twenty is the daytime band for the northern directions and transequatorial openings may occur in the evening. Distances may reach 2000 miles per hop if antenna take-off angles are as low as 10 degrees.

Thirty, forty, eighty, and one-sixty meters are all useful for nighttime DX. Thirty and 40 meters are the night frequencies for the east-west and northern directions and for distances of up to 1600 miles tivity. In these days of low solar activity, the MUFs can drop as low as the 80-meter band frequencies, resulting in higher propagated signal levels. These bands should be much quieter now that the thunderstorms have moved back down to the tropics.

* To run this program on the Apple IIe or IIc, or on other machines that don't have an intrinsic ARC-SIN (ASN) function, substitute the following lines. — Ed.

```

95 IF 4*H1 < L1 THEN 420
98 Y = (L1/(4*H1))
100 A1 = ATN (Y/(1-Y 2) 0.5)
198 Y = (3*L1)/(4*H1)
200 A2 = ATN (Y/(1-Y 2) 0.5)
278 Y = (5*L1)/(4*H1)
280 A3 = ATN (Y/(1-Y 2) 0.5)
358 Y = (7*L1)/(4*H1)
360 A4 = ATN (Y/(1-Y 2) 0.5)
    
```

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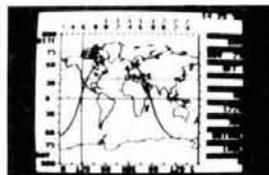
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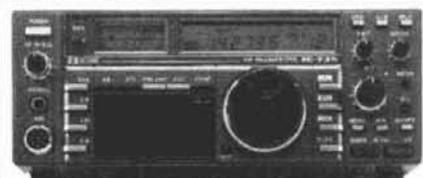
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Other Accessories:	
IC-2KL 160-15m solid state amp w/ps	1999.00 1699
PS-15 20A external power supply	169.00 154⁹⁵
PS-30 Systems p/s w/cord, 6-pin plug	299.00 269⁹⁵
OPC Opt. cord, specify 2, 4 or 6-pin	10.00
MB Mobile mount, 735/745/751A	24.50
SP-3 External speaker	61.00
SP-7 Small external speaker	49.00
CR-64 High stab. ref. xtal (745/751)	63.00
PP-1 Speaker/patch	159.25 149⁹⁵
SM-6 Desk microphone	44.95
SM-8 Desk mic - two cables, Scan	78.50
SM-10 Compressor/graph EQ, 8 pin mic	136.25 124⁹⁵
AT-100 100W 8-band auto. antenna tuner	445.00 389⁹⁵
AT-500 500W 9-band auto. antenna tuner	559.00 489⁹⁵
OPC-118 Adapts AT-100/500 to IC-735	16.00
AH-2 8-band tuner w/mount & whip	625.00 549⁹⁵
AH-2A Antenna tuner system, only	495.00 429⁹⁵
OPC-137 Adapts AH-2/2A to IC-751/745	16.00



Check the Prices at AES!

Other Accessories - continued:	
GC-4 World Clock (Closeout)	99.95 59⁹⁵
GC-5 World clock	91.95

6-meter VHF Portable	
IC-505 3/10W 6m SSB/CW portable	549.00 489⁹⁵
BP-10 Internal Nicad battery pack	89.00
BP-15 AC charger	14.00
EX-248 FM unit	55.50
LC-10 Leather case	39.50

VHF/UHF base multi-modes	
IC-551D 80W 6-meter SSB/CW	799.00 699⁹⁵
EX-106 FM option	140.00 126⁹⁵
BC-10A Memory back-up	9.50
IC-271A 25W 2m FM/SSB/CW	859.00 759⁹⁵
AG-20 Internal preamplifier	64.00
IC-271H 100W 2m FM/SSB/CW	1099.00 969⁹⁵
AG-25 Mast mounted preamplifier	95.00
IC-471A 25W 430-450 SSB/CW/FM xcvr	979.00 869⁹⁵
AG-1 Mast mounted preamplifier	99.50
IC-471H 75W 430-450 SSB/CW/FM	1399.00 1169
AG-35 Mast mounted preamplifier	95.00

Accessories common to 271A/H and 471A/H	
PS-25 Internal power supply for (A)	115.00 104⁹⁵
PS-35 Internal power supply for (H)	199.00 179⁹⁵
SM-6 Desk microphone	44.95
EX-310 Voice synthesizer	46.00
TS-32 CommSpec encode/decoder	59.95
UT-15 Encoder/decoder interface	14.00
UT-15S UT-15S w/TS-32 installed	92.00

VHF/UHF mobile multi-modes	
IC-290H 25W 2m SSB/FM, TTP mic	639.00 569⁹⁵
IC-490A 10W 430-440 SSB/FM/CW	699.00 599⁹⁵

VHF/UHF/1.2 GHz FM	
IC-27A Compact 25W 2m FM w/TTP mic	429.00 379⁹⁵
IC-27H Compact 45W 2m FM w/TTP mic	459.00 399⁹⁵
IC-37A Compact 25W 220 FM, TTP mic	499.00 439⁹⁵
IC-47A Compact 25W 440 FM, TTP mic	549.00 489⁹⁵
PS-45 Compact 8A power supply	139.00 129⁹⁵
UT-16/EX-388 Voice synthesizer	34.99
SP-10 Slim-line external speaker	35.99

IC-28A 25W 2m FM, UP/DN mic	429.00 379⁹⁵
IC-28H 45W 2m FM, UP/DN mic	459.00 399⁹⁵
IC-48A 25W 440-450 FM	459.00 399⁹⁵
HM-14 TTP microphone	55.50
UT-28 Digital code squelch	37.50
UT-29 Tone squelch decoder	43.00
HM-16 Speaker/microphone	34.00
IC-3200A 25W 2m/440 FM w/TTP	599.00 499⁹⁵
UT-23 Voice synthesizer	34.99

AH-32 2m/440 Dual Band antenna	37.00
AHB-32 Trunk-lip mount	34.00
Larsen PO-K Roof mount	20.00
Larsen PO-TLM Trunk-lip mount	20.18
Larsen PO-MM Magnetic mount	19.63
RP-3010 440 MHz, 10W FM, xtal conf.	1229.00 1099
IC-120 1W 1.2 GHz FM Mobile	579.00 499⁹⁵
ML-12 1.2 GHz 10W amplifier	379.00 339⁹⁵
IC-1271A 10W 1.2 GHz SSB/CW Base	1229.00 1079

AG-1200 Mast mounted preamplifier	105.00
PS-25 Internal power supply	115.00 104⁹⁵
EX-310 Voice synthesizer	46.00
TV-1200 ATV interface unit	129.00 119⁹⁵
UT-15S CTCSS encoder/decoder	92.00
RP-1210 1.2 GHz, 10W FM, 99 ch. synth	1479.00 1299



Hand-held Transceivers	
Deluxe models	Regular SALE
IC-D2AT for 2m	399.00 339⁹⁵
IC-04AT for 440 MHz	449.00 389⁹⁵

Standard models	
IC-2A for 2m	279.00 249⁹⁵
IC-2AT with TTP	299.00 259⁹⁵
IC-3AT 220 MHz, TTP	339.00 299⁹⁵
IC-4AT 440 MHz, TTP	339.00 299⁹⁵

IC-12AT 1W 1.2GHz FM HT/batt/cgr/TTP	459.00 399⁹⁵
A-2 5W PEP synth. aircraft HT	569.00

Accessories for Deluxe models	
BP-7 425mah/13.2V Nicad Pak - use BC-35	74.25
BP-8 800mah/8.4V Nicad Pak - use BC-35	74.25
BC-35 Drop in desk charger for all batteries	74.95
BC-16U Wall charger for BP7/BP8	20.25
LC-11 Vinyl case for Dlx using BP-3	20.50
LC-14 Vinyl case for Dlx using BP-7/8	20.50
LC-02AT Leather case for Dlx models w/BP-7/8	54.50

Accessories for both models	
BP-2 425mah/7.2V Nicad Pak - use BC35	47.00
BP-3 Extra Std. 250 mah/8.4V Nicad Pak	37.50
BP-4 Alkaline battery case	15.25
BP-5 425mah/10.8V Nicad Pak - use BC35	58.50
CA-5 5/8-wave telescoping 2m antenna	18.00
FA-2 Extra 2m flexible antenna	11.50
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CP-10 Battery separation cable w/clip	22.50
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EX-390 Bottom slide cap	5.50
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SS-32M CommSpec 32-tone encoder	29.95

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FL-63 250 Hz CW filter (1st IF)	54.50
FL-44A SSB filter (2nd IF)	178.00 159⁹⁵
EX-257 FM unit	42.50
EX-310 Voice synthesizer	46.00
CR-64 High stability oscillator xtal	63.00
SP-3 External speaker	61.00
CK-70 (EX-299) 12V DC option	12.25
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R-7000 25 MHz-2 GHz scanning rcvr	1099.00 969⁹⁵
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software for ICOM repeaters

Processor Concepts has announced its new RPS-1 repeater program for the ICOM repeater series. The RPS-1 software is a program written for the ICOM repeater series that will add new features and custom programming to ICOM RP-1210s, RP-2010s, RP-3010s, or commercial repeaters.

A direct EPROM replacement for the ICOM repeater controller memory chip, the RPS-1 supports many new features such as two separate CW-ID messages and enough memory to include a club name or city and state. The CW-ID is sent at the speed you request; the ID timer is programmable from 30 seconds to 10 minutes. The timeout timer can be reset without waiting for the repeater transmitter to drop out. A courtesy beep tone signals the next user; the repeater stays on the air for a smooth transition. Pre- and post-timeout CW warning messages keep users informed and reduce confusion during timeouts.

The software is custom-programmed for individual CW and timing requirements. A reprogramming service is also available.

The RPS-1 software is priced at \$74.00 plus \$3.00 shipping. For information, contact Processor Concepts, P.O. Box 26023, St. Paul, Minnesota 55126.

Circle #301 on Reader Service Card.

half-wave VHF Kulduckie™

Larsen Electronics has announced a new half-wave Kulduckie™ portable antenna, Model KD14-2M HW. The VHF antenna operates at frequencies from 144-148 MHz with a resonant half-wave design that allows it to function independently of a ground plane. Its performance is said to equal that of a full quarter-wave on a perfect ground plane. The rigid impedance transformer at the base contributes to performance and adds extra strength.

Finished in black chrome, the KD14-2M-HW also telescopes, using internally shorted collapsing joints. The unit extends to 41 inches for operation and collapses to 7-3/4 inches. The antenna uses a special double spring BNC connector to reduce wear in the female contact on the radio.

For details, contact Larsen Electronics, P.O. Box 1799, Vancouver, Washington 98668.

Circle #302 on Reader Service Card.

tone panel offers digital CTCSS

Digital CTCSS is now available as an option on Communications Specialists' TP-38 Shared Repeater Tone Panel. The new option, called the

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TP-DCS, is compatible with Motorola's Digital Private Line,TM General Electric's Digital Channel Guard,TM and E.F. Johnson's Digital Call Guard.TM A TP-38 equipped with TP-DCS allows up to 14 DCTCSS subscribers as well as 37 CTCSS subscribers in a single repeater panel. Tone translation may be made from one DCTCSS code to any other DCTCSS code. Time and hit accumulation, remote access, and remote data retrieval function are applicable to all DCTCSS subscribers. All DCTCSS codes between 000 and 777 Octal are available in normal or inverted polarity; squelch tail elimination is provided.

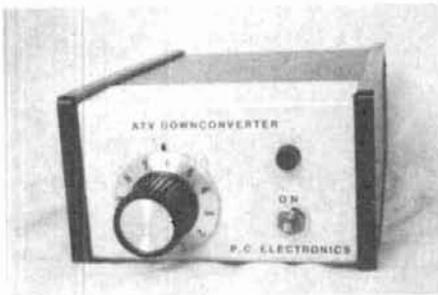
The TP-DCS is available as an option in new TP-38 Shared Repeater Panels or may be retrofitted into existing TP-38s. Priced at \$149.95, the TP-DCS is in stock for immediate shipment and is covered by a one-year warranty.

For information and a free catalog, contact Communications Specialists, Inc., 426 West Taft Avenue, Orange, California 92665-4296.

Circle #303 on Reader Service Card.

GaAsFET ATV down-converter

A new GaAsFET ATV downconverter for the new 33-cm (902-928 MHz) band from P. C. Electronics features a dual-gate GaAsFET in both the RF preamp and the mixer stage for low noise and wide dynamic range. A varicap VCO tunes the whole band down to TV channel 3 (2 or 4 can also be used). Total conversion gain is ± 25 dB, more than enough to reach the noise floor with most TV sets (even if one wants to remote the downconverter at the antenna to get the most sensitivity.)



The new band will provide relief for ATVs in high population density areas plagued with interference from radar, geophysical survey locators, and other mode users in the 70-cm (420-450 MHz) band. Parts and equipment should be more available and less expensive in this band than in the 12-cm band because of the proximity of cellular and business-band radios. Path loss is a little less too.

Model TVC-9G includes a wall-mounted 120-VAC to 12-VDC power supply. Just add an antenna, coax, and your TV set. Antenna input is a BNC connector, and the TV output is type F. The shielded cabinet measures 4 X 2.5 X 7 inches.

For those who want to make their own cabinet, the TVC-9 is available as a wired and tested board measuring 2 X 4 inches. With the on-board regu-

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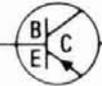
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lator, the power requirement can be anywhere from 11 to 18VDC at 30 mA. A removable 10-k trim pot is used for frequency tuning.

P. C. Electronics also offers a DC decoupler (Model DCD) and remote control box (Model DCB) for tuning and powering up through the channel-3 downconverter output.

For more information, contact P.C. Electronics, 2522 Paxson Lane, Arcadia, California 91006.

Circle #304 on Reader Service Card.

compact mobile radio mounts

IIX Equipment, Ltd. has announced the addition of two new compact mobile radio mounts to its Mount 100 system. The additions bring the model count to four, which can handle all types of communications gear needed in mobile operations. Models MM1007 (7 inches) and MM10010 (10 inches) represent a new design that provides the user with a strong, adjustable two-radio mount that will fit in most vehicles. The mounts are constructed of welded steel finished in satin black, with necessary hardware supplied. UPS shipping is included in the price of \$79.50 for the smaller MM1007 and \$84.50 for the larger MM10010. A free catalog and information sheet are available from IIX Equipment, Ltd., P.O. Box 9, Oaklawn, Illinois 60454.

Circle #305 on Reader Service Card.

coax lightning arresters

New coax lightning arresters from Cushcraft feature fast-action gas discharge elements. Four models offer choices of 200-watt or 2-kw power handling and type N or UHF connectors. They're precisely manufactured to give very low insertion loss from 2 to 1000 MHz. Replacement cartridges are available. Dimensions are 3.5 x 1.375 x 1.875 inch.

For more information, contact Cushcraft Corporation, P.O. Box 4680, Manchester, New Hampshire 03108.

Circle #306 on Reader Service Card.

digital capacitance tester

Mercer Electronics, a division of Simpson Electric Company, has introduced a new digital capacitance tester. The Model 9670 features nine ranges that will measure from 0.1 pF to 20,000 μ F with 0.5 percent accuracy.

Priced at \$99, the Model 9670 has a 0.5-inch LCD display with over-range and an "LO BAT" indication. The tester measures 6.85 x 3.54 x 1.42 inches, weighs 3/4 pound and uses a standard 9-volt battery. Convenient features include input discharge protection, easy-insert "cap-lead" jacks, color-coded test leads with alligator clips, a flame-retardant plastic case with an acrylic window, and a tilt bail.

For information write Mercer Electronics, 859 Dundee Avenue, Elgin, Illinois 60120.

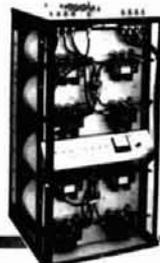
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(continued on page 106)

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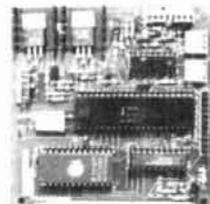
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DYNAMIC COLOR NEWS: Monthly newsletter provides programming instruction for Radio Shack Color Computers. Includes HAM RADIO section. FREE sample. Dynamic Electronics, Box 896, Hartselle, AL 35640. (205) 773 2758.

CABLE TV CONVERTERS & EQUIPMENT: Plans and parts. Build or buy. SASE for information: C & D Electronics, PO Box 1402, Dept. HR, Hope, AR 71801

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R-390A Receiver: \$195 checked, \$115 repairable. Parts, tubes, sections. Info SASE. CPRC 26 six meter transceiver (see HR, March 1995) \$17.50 apiece, \$32.50 pair (add \$4.50/unit ship ping). Baytronics, Box 591, Sandusky, OH 44870. 419-627-0460 evenings.

SOME QSLs 100 for \$6.25. Sample: SASE, WB2EUF, Box 708, East Hampton, NY 11937.

MARCO: Medical Amateur Radio Council, Ltd. operates daily and Sunday nets. Medically oriented Amateurs (physicians, dentists, veterinarians, nurses, physiotherapists, lab technicians, etc.) invited to join. Presently over 550 members. For information write MARCO, Box 73's, Acme, PA 15610.

IBM-PC RTTY/CW. New CompRtty II is the complete RTTY/CW program for IBM-PC's and compatibles. Now with larger buffers, better support for packet units, pictures, much more. Virtually any speed ASCII, BAUDOT, CW. Text entry via built-in screen editor! Adjustable split screen display. Instant mode/speed change. Hardcopy, discopy, break in buffer, select calling, text file transfer, customizable full screen logging, 24 programmable 1000 character messages. Ideal for MARS and traffic handling. Requires 256k PC or AT compatible, serial port, RS 232C TU \$65. Send call letters (including MARS) with order. David A. Rice, KC2HO, 25 Village View Bluff, Ballston Lake, NY 12019.

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NATIONAL RADIO EQUIPMENT manual list or NCL-2000 parts kits. SASE. Maximilian Fuchs, 11 Plymouth Lane, Swampscott, MA 01907.

ATTENTION AMATEURS Send for Free discount catalog. Amateur Communications, 2317 Vance Jackson, San Antonio, TX 78213. (513) 734-7793.

8877 VHF AMP KITS: HV power supplies, CX600N relays, Mu Tek LTD front end boards for IC251/IC271, EME newsletter and QRO parts. SASE for new catalog. KB7Q, "Q" Products, 417 Staudafer Street, Bozeman, MT 59715.

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THE GOOD SAM HAMS invite RV operators to check in the Good Sam Ham net 14.240 Sundays 1900Z also 3.880 Tuesdays at 2359Z. Net control N5BDN, Clarksville, IN

IMRA, International Mission Radio Association helps missionaries. Equipment loaned. Weekday net, 14.280 MHz, 2-3 PM Eastern. Eight hundred Amateurs in 40 countries. Brother Frey, 1 Pryer Manor Road, Larchmont, New York 10538.

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DISCOUNT CATV CONVERTERS/DECODERS and Video accessories. Send for free information and prices. It could save you BIG MONEY on your next purchase of these and other CATV items. Easy View, (HR) PO Box 221K, Arlington Heights, Illinois 60006. (312) 952 8504. Ask for Rudy Valentine.

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CHASSIS and cabinet kits. SASE K3IWK, 5120 Harmony Grove Road, Dover, PA 17315.

COMING EVENTS

Activities — "Places to go . . ."

OKLAHOMA: October 5. The Salt Plains Amateur Radio Club will hold their annual Ham Social, Salt Plains Lake, Northern Alfalfa County. Covered dish dinner. Talk in on 147.30/90. Inquiries to: Gary Gerber, KB0HH, 511 Lincoln, Anthony, KS 67003. (405) 842-5076.

MARYLAND: October 5. The Columbia Amateur Radio Association's 10th annual Hamfest, Howard County Fairgrounds, just west of Baltimore, off I-70, 8 AM to 3:30 PM. Admission \$3.00. Spouse and children free. Reserved tables \$7.00 prior to September 30. \$8.00 after. Outdoor tailgating \$3.00 additional. Indoor tailgating \$6.00 additional. Food available. Talk in on 147.735/135, 146.52/52. For table reservation and information: Mike Vore, W3CCV, 9098 Lambskin Lane, Columbia, MD 21045. 992-4953.

PENNSYLVANIA: October 4. Pack Rats (Mt. Airy VHF ARC) invites all Amateurs to the 10th annual Mid-Atlantic VHF Conference, Warrington Motor Lodge, Rt 611, Warrington and the 15th annual Pack Rat Hamarama, Sunday, October 5, Bucks County Drive-In theater, Rt. 611, Warrington. Flea market admission \$5.00 per car. Selling spaces \$6.00 each. Gates open 6 AM rain or shine.

GEORGIA: November 1-2. The Alford Memorial Radio Club of Stone Mountain is sponsoring Ham Radio and Computer Expo '86. Gwinnett County Fairgrounds, 20 minutes NE of Atlanta. 9 AM to 5 PM Saturday; 9 AM to 4 PM Sunday. Admission \$4

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Girard Electronics has developed a non-chemical system for generating flexible prototype circuits which the user can laminate into double-sided PCBs, multilayer circuits and boards for standard or surface-mount components.

Protoflex-III uses optical-mechanical technology to produce prototype circuits. An optical system scans circuit artwork mounted on the right side of a drum within the machine. Protoflex-III machines circuits from 1 oz. copper sheeting on a polyimide base affixed to the left side of the drum.

Protoflex-III works from a variety of artwork media — transparent, translucent or opaque.

The user can produce artwork simply with graph paper and taping puppets or use camera shots or CAD plots, positives or negatives.

Additionally, the machine comes with CAD interface that allows the circuit designer to proceed directly from schematic capture to printed board.

Protoflex-III handles materials as large as 7 x 16 inches and machines flexible circuits in 140 minutes or less, depending upon the size of the board, with resolving power down to 0.010 inches in lines and spaces.

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For information, contact Girard Electronics, 13914 West Oakgreen Circle South, Afton, Min-

new mic

Astatic has confirmed the rumor that they're working on a new microphone. The new model, titled the D-204, is a scaled-down version of the D-104 with new features. Said to have the same high-luster chrome finish as the Silver Eagle D-104, it will carry the trade name "Silver Classic." VOX compatibility and an adjustable pre-processor are some of the features expected to be included. For information, contact P.O. Box 120, Conneaut, Ohio 44030-0210.

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NEW products

advance, \$5 at door. Forums, awards, VEC exams both days, free cookout Saturday night. Activities for the entire family. Super-dealer facilities, giant undercover flea market. Discount hotel rooms. Free parking, RV sites with full hookups. Talk in on 146.16/76, 449.25/4.25. Information: Alford Memorial ARC, PO Box 1282, Stone Mountain, GA 30086 or call N8LM at 404 925-7615.

NEW HAMPSHIRE: October 4. The Hosstraders Fall Tailgate Swapfest, Deerfield Fairgrounds. Donation \$2 per person. Friday night camping at nominal fee. Entry 4 PM. Profits benefit Shriner's Hospital. Last Spring's gift was \$7767.00. Sponsored by WIGWU, K1ROG and WA1VB. For map SASE to WA1VB, RFD Box 57, West Baldwin, ME 04091.

NEW HAMPSHIRE: October 4. In conjunction with the Hosstraders Swapfest, the volunteer examiners of NH will conduct exams at the Northwood Elementary School Gymnasium, Deerfield, NH. For further information SASE to Don Clark, N1AKS, 2 Cortland Street, Londonderry, NH 03053.

OHIO: October 26. The Marion Amateur Radio Club will hold its 12th annual "Heart of Ohio" Ham Fiesta, 0800 to 1600 hours, Marion County Fairgrounds, Coliseum. Tickets \$3.00 advance, \$4.00 at door. Tables \$5.00. Check in on 146.52 or 147.90/30. For information, tickets or tables contact Ed Margraff, K8BOC, 1989 Weiss Avenue, Marion, OH 43302. (614) 382-2608.

CONNECTICUT: November 9. SCARA annual indoor Flea Market, North Haven Park and Recreation Center, North Haven. Sellers 7 AM. Buyers 9 AM to 3 PM. Tables \$10.00 advance, \$15.00 at the door. Buyers \$2.00. For information or table reservations SASE with phone number to SCARA Flea Market, PO Box 81, North Haven, CT 06473. Reservations must be received by November 3, 1986. No reservations taken by phone. For information ONLY contact Brad (203) 265-6478. 7 PM to 10 PM.

KANSAS: October 11-12. ARRL Convention, Holiday Inn Plaza, 250 W. Douglas, Wichita, KS 67202. Starts 9 AM both days. Indoor flea market, QCWA Meeting, ARRL Forum, FCC Booth, Ladies' lounge, VE exams, EME/OSCAR basics. Banquet with entertainment. Sunday buffet breakfast. Hospitality suite. Kansas Amateur of the Year award. Talk in on W0KA repeater, 146.82. For further information: Kansas ARRL Convention, 1520 W. 16th, Wichita, KS 67203.

MASSACHUSETTS: October 26. The Framingham Amateur Radio Association will hold its annual Fall Flea Market and Exams, Framingham Civic League Bldg, 214 Concord Street, Downtown Framingham. Doors open 10 AM. Sellers setup 8:30 AM. Admission \$2.00. Tables \$10.00, includes one free admission. Pre-registration for tables and exams required. Talk in on 75/15 repeater. To reserve tables: Jon Weiner, K1VVC, 52 Overlook Drive, Framingham, MA 01701. (617) 877-7166. To register for exams send Form 610, copy of ham license and check for \$4.25 payable to ARL/VEC to FARA, PO Box 3005, Framingham, MA 01701.

ALABAMA: October 25 and 26. The Montgomery Amateur Radio Club's 9th annual Hamfest and South Net Convention, Civic Center, downtown Montgomery, 9 AM to 4 PM. Free admission, free parking, all indoors, including Flea Market. Flea Market reservations not required. Setup begins 6 AM. FCC exams both days. Bring copy of current and \$2.00. For more information: Hamfest Committee, 2141 Edinburgh Drive, Montgomery, AL 36116 or phone Phil (205) 272-7980 after 5 PM CST.

MASSACHUSETTS: November 8. New England annual DXCC Banquet, Masonic Lodge Building, Monument Square, in historic Concord Center. Afternoon session 2 PM to 5:30 PM. Banquet 6:30 PM. For further information: Charles Lukas, Jr., W1DOH, RFD 1, 24 Durkee Road, Acton, MA 01720. (617) 263-3743.

CALIFORNIA: October 4. Scatcon '86, 9 AM to 3 PM, Cortez Park, 2441 Cortez Avenue, West Covina. Tech sessions. Hands-on packet, satellite and more. Swaps, vendors. Donation \$2.

Talk in on 147.765-600. For more information: Bob, N6NGN. (818) 917-6470

FLORIDA: October 18, 19. ARRL South Florida Section Suncoast Convention. Sponsored by the Florida Gulf Coast ARC National Guard Armory, St. Petersburg. Admission \$4.00 advance; \$5.00 at the door. 9 AM to 4 PM both days. QCWA luncheon Saturday, Western Barbeque Saturday night. Swap tables \$12.00 for both days. Plenty of free parking. Some RV spaces. For information: FGCARC* PO Box 157, Clearwater, FL 33517.

MINNESOTA: November 1. The 2nd annual Hamfest Minnesota and Computer Expo, sponsored by the Twin City FM Club, Richfield High School, 7001 Harriet Avenue South, Richfield. 7:30 AM to 3 PM. Admission \$3.00 advance, \$4.00 at the door. Wayne Green, W2NSD, guest speaker. DX seminar, FCC exams, indoor flea market, ARRL, AMSAT and computer seminars and much more. Talk in on 16/76. For more information, registration SASE to Hamfest Minnesota and Computer Expo, Box 555, Minneapolis, MN 55440 or Lyly Vogt, KA0UDL, 5130 Willow Lane, Minnetonka, MN 55345.

PENNSYLVANIA: November 2. The RF Hill ARC's 11th annual Hamfest, Pennsylvania National Guard Armory, Rt. 152, Sellersville. Dealer setup 6 AM. Buyers 8 AM. Admission: Hams \$4.00. Accompanying non-ham spouse and children free. Dealers 8x6' inside space \$8.00. \$6.00 outside. Own tables. Talk in on 144.71/145.31 Allmont, PA. 146.28/146.88 Hilltown. 146.52 simplex. To reserve space: Frank Benner, W3BRU (215) 257-2450 or write Hamfest Chairman, RF Hill ARC, 523 Vine Street, Perkasie, PA 18944.

MICHIGAN: November 2. The Oak Park ARC will hold its largest ever 1986 SWAP N SHOP. New location: City of Southfield Civic Pavilion, Evergreen Road between 10 and 11 Mile Roads, northwest Detroit suburb of Southfield. Ham Radio and Computer activities from 9 AM to 5 PM in the new fully carpeted 30,000 sq. ft. pavilion. The Detroit Area Repeater Team (DART) will provide food and refreshments. Admission \$4, under 12 free. VE's at par. Tables \$10.00. Advanced reservations required. Talk in on DART 146.04/64 and 146.52 simplex. For further information SASE to OPARC Swap-N Shop, 303 South Vermont Avenue, Royal Oak, MI 48067. Swap-N Shop Hotline (313) 399-3991.

TENNESSEE: October 11, 12. The Mid-South Amateur Radio Association and allied clubs will hold their annual Hamfest, Shelby County Agricenter (New Location), Memphis. Saturday 8 AM to 5 PM. Sunday 9 AM to 4 PM. Dealers and flea market inside large air-conditioned building. Flea market spaces \$6.00 each per day. Tables furnished. Non-hams and children admitted free. Setup time Friday, 5 PM to 9 PM. Doors open Saturday morning for vendors/dealers 6 AM. FCC exams for all license classes. Bring license and copy, and Form 610. Hospitality party Friday evening at Hamfest Motel, Admiral Benbow Inn, free to all hams. Talk in on 28/88. Alternate 22/82. For further information: Clayton Elam, K4FZJ, 28 No. Cooper, Memphis, TN (902) 274-4418 days. (901) 743 6714 nights.

1986 "BLOSSOMLAND BLAST" Sunday, October 5, 1986. Write "BLAST", PO Box 175, St. Joseph, MI 49085.

CALIFORNIA: FCC exams, Novice-Extra. Sunnyvale VEC ARC. (408) 255-9000 24 hour. 73, Gordon, W6NLG, VEC

MASSACHUSETTS: The MIT UHF Repeater Association and the MIT Radio Society offer monthly Ham Exams. All classes Novice to Extra. Wednesday, October 22, 7 PM, MIT Room 1-134, 77 Mass Avenue, Cambridge MA. Reservations requested 2 days in advance. Contact Ron Hoffmann (617) 253-0160/646-1641 or Craig Rodgers (617) 494-1986. Exam fee \$4.25. Bring copy of current license (if any), two forms of picture ID and completed form 610 available from FCC in Boston (223- 6609)

NEW YORK: October 5. Electronics Fair and Giant Flea Market, Yonkers Municipal Parking Garage, Nepperhan Avenue and

New Main Street, 9 AM to 4 PM. Satellite TV, SSTV, Amateur Radio, Computers and more. Giant Auction 2 PM. Unlimited free coffee all day. Admission \$3.00. Children under 12 free. Sellers \$7.00 per parking space, one admission. Bring tables. For information call (914) 969-1053.

MICHIGAN: October 12. Ham Fair '86, Michigan National Guard Armory, 2500 S. Washington Avenue, Lansing. 8 AM to 3 PM. Dealer sales, swap shop, handcrafted items, FCC exams starting 1 PM. Register for exams by September 12. Donation \$3.00 adults. Handicap facilities on premises. For information and reservations: Rowena Elrod, KA8OBS, 111 Lancelot Place, Lansing, MI 48906. (517) 482-9650.

NEW JERSEY: October 4. The Orange County ARC will hold its Hamfest and Auction, John S. Burke Catholic High School, 9 AM to 3 PM. Tailgating \$3.00. Setup 8 AM. License exams starting 9 AM. Admission \$3.00. Tables \$7.00. Talk in on 146.76 Rpt. and 146.52 simplex. For more information call Bob, WB2ENA (201) 767-6698.

OPERATING EVENTS

"Things to do . . ."

COLUMBUS DAY SPECIAL EVENT. October 11, 12. 1400Z to 2400Z. Open to all Amateur Radio operators worldwide. To promote explorer Christopher Columbus, the city of Columbus, Ohio and Amateur Radio. Exchange name, QTH and RS#. All requests for awards and correspondence should be sent to: ARS W8TO, Special Event Coordinator, 280 East Broad Street, Columbus, OH 43215.

HELP CELEBRATE The Virginia Beach Amateur Radio Club's 25th anniversary by contacting Club Station WA4TGF, Saturday, Sunday, October 5 and 6. For a special 8 x 10 QSL certificate, send 9x12 envelope and two 1st class stamps to R.C. Brown, VBARC, 4821 Rosecroft Street, Virginia Beach, VA 23464.

LONDON BRIDGE Amateur Radio Association, WB7DWS, will operate from Lake Havasu City, the home of the London Bridge, October 11 from 1600Z to 2000Z to celebrate the dedication of the London Bridge. For certificate send QSL to Don Harrington, WB7ALO, 1208 McCulloch Blvd South, Lake Havasu City, AZ 86403.

October 11 and 12: Members of the Dalton ARC, Dalton, GA will operate a special event station from historic Praters Mill Country Fair. The station will be set up in a turn of the century Cotton Gin. 10 to 3 EDT each day. QSL's will include information and a picture of the mill. Dalton ARC, PO Box 143, Dalton, GA 30722.

W.E.C.A. (Westchester Emergency Communications Association) initiates Equipment/"Elmer" Banks to help new hams get on the air. More information write the club at PO Box 131, North Tarrytown, NY 10591.

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Model 610 scope memory

Sibex, Inc. has introduced the Model 610 scope memory, an addition to the line of instruments that convert an analog oscilloscope into a digital storage scope. The Model 610, with its 10-MHz maximum sampling rate, is capable of storing sine wave signals up to 1 MHz in its 2K x 8 static RAM. The input sensitivity is 10 mv/div.

The unit features pre- and post-triggering capabilities or the selection of a 1/2-pre and 1/2-post data combination. A sweep function allows the operator to sweep through the entire memory, then expand any portion of the waveform for detailed analysis.

Priced at \$985, Model 610 is available from Si-

bex, Inc., 3320 U.S. 19 N., Suite 410, Clearwater, Florida 33519

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rechargeable memory back-up batteries

Plainview Electronics has introduced its PMB series of rechargeable nickel cadmium batteries for printed circuit board-mounted memory back-up. They're available in 2.4, 3.6, and 4.8-volts, with capacitance of either 35 mAh or 110 mAh. The batteries measure only 16.5 and 23.5 mm, respectively, in diameter.

These batteries are a direct second source to Motorola's MMB series of batteries. Availability is stock to 6 weeks. For information, contact Plainview Electronics, 28 Cain Drive, Plainview, New York 11803.

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microloop™ monoband antennas

Advanced Design Networks (ADN) has announced a new generation of compact monoband antennas called *Microloop*. Across-the-loop dimensions vary from 27 inches for 10 meters to 104 inches for 40 meters. Performance is said to be approximately equivalent to a full-size dipole in a much smaller space.

A comprehensive overview of the *Microloop* is available to readers on request. For information, contact Advanced Design Networks, 8601 66th Street N., Pinellas Park, Florida 33565.

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THE GUERRI REPORT

by Ernie Guerri, W6MGI

electronic sleuths detect fatal flaws

A high-performance F-15 fighter streaks toward a target, its pilot depending on radar for accurate environmental data. But suddenly the radar picture changes — and then returns to "normal."

Was the pilot in error, or did the radar give erroneous information?

Unfortunately, this was not a simulation, but a real-life situation confronted by radar designers at Hughes. Apparently an intermittent problem in the radar was causing incorrect responses in testing. Worse yet, the problem would also appear in the field, then disappear without explanation.

To solve the problem, Hughes turned to a group of "electronic pathologists" at a division of Gould in Los Angeles. An exhaustive "autopsy" on hundreds of hybrid modules revealed that tin from the plating on the hermetic covers of the modules was contaminating the circuit. The underlying cause was subtle: chemical reactions within the hybrid caused tin "whiskers" — only 0.0001 inch in diameter and about 0.1-inch long — to "grow" inside the module. At random intervals, these whiskers would detach themselves from the case and fall into the active circuitry, causing intermittent operation of just one portion of a complex hybrid. Moreover, random vibration, or current through the whisker, would cause the problem to disappear — frequently without damage to the hybrid.

This was a difficult problem because the whiskers don't begin growing until three to seven years after manufacture, and therefore cannot be detected by any type of screening during the manufacturing process. The only solution may be to design Hi-Res modules with hermetically-sealed packages that don't use plated materials. Unfortunately, this will mean greatly increased complexity and expense.

As the first electronic "MDs" appear on the scene, will it be only a matter of time before the local TV repair shop becomes a "clinic?"

high-power satellites may affect terrestrial systems

There is growing concern that increased transmitter power on some satellites may begin to affect certain terrestrial activities that depend on low power to accomplish their tasks. A particularly important case in point are the various test ranges operated by NASA and the Department of Defense. These ranges typically use signals in the 2.2 GHz region for telemetry links. Missiles and targets are usually very limited in the amount of power they can spare for telemetry transmitters, and the typical transmitter is not more than 3 to 5 watts, with a very simple antenna. The antenna, which usually conforms to the shape of the vehicle's skin, may have little gain (or even a slight loss) with respect to a dipole.

The major concern is that signals from high-power satellites may mask or interfere with these low-power measurement signals, causing erroneous results. Since some tests may require months of planning and cost several million dollars, the consequences of not gathering the intended data are potentially quite serious. It may be possible to coordinate results with the known passing of a given satellite if it belongs to an entity willing to cooperate. However, not all satellite owners and operators have our best interests at heart.

One possible remedy involves using range antennas with more carefully-shaped patterns. Unfortunately, this runs counter to the desire of most range operators, who would like to "look at" the maximum amount of space, to make sure they don't miss anything if a vehicle departs abruptly from its planned course. Another possibility in-

volves establishing polarization standards for satellites and ground stations using the same frequency assignments. While this would add considerable complication to the telemetry ranges, it would be an effective cure — if everyone were to cooperate.

Cooperate? Sounds like the big guys have the same problems in their bands that we see every day on the Amateur bands!

new super-speed semiconductors

Continuing advances in semiconductor technology have been made possible by parallel progress in fabrication techniques. More than 20 years ago it was shown that very high switching speeds could be achieved at room temperatures by an atomic energy-state process known as electron tunneling.

Developed by Esaki in Japan, the theory was brought to practical maturity at IBM and GE in the United States. The early results were the germanium tunnel diodes of the 1960s. In those days, these were the only semiconductor devices capable of oscillating and providing gain in the microwave region.

Modern fabrication methods have made it possible to assemble very complex, multi-layer transistors which embody the Esaki concept. The results are still being investigated, but these "resonant tunneling" devices, as they are called, offer the prospect of switching speeds of as fast as 0.1 picosecond (a tenth of a trillionth of a second). Experimenters have reported observing the phenomena at frequencies of about 2.5 THz (1 THz = 1000 GHz).

Don't expect to see commercial devices using these technologies for a long time. Although the ultra-low-noise HEMT has been in the labs for nearly ten years, the first commercial devices were offered on the market just this year.

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- Pi-network input for maximum drive
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- Pi-L output for greater harmonic attenuation

Ruggedly constructed of proven design, this amplifier reflects the manufacturer's critical attention to details—such as the silver-plated tank coil for maximum efficiency. Cathode zener fuse and internal/external cooling are among the protective and safety devices employed. Input and output impedances are 50 ohms.

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Call or write factory for complete specifications.



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READER SERVICE #	PAGE #	READER SERVICE #	PAGE #
272 - Advanced Computer Controls, Inc.	13	249 - Mirage/KLM	63
248 - Advanced Receiver Research	70	240 - Mirage/KLM	82
253 - AEA	50	255 - Mosley Electronics	47
208 - All Electronics Corp	102	263 - Naval Electronics, Inc.	34
* - Amateur Electronic Supply	99	202 - NCG	111
239 - Amateur Wholesale Electronics	65	262 - Nel-Tech Labs, Inc.	36
258 - AMSAT	46	234 - Nema Electronics	86
269 - Astron Corp	26	203 - Nuts & Volts	111
* - Barker & Williamson	110	252 - Optoelectronics, Inc.	55
* - Barry Electronics	95	271 - P.C. Electronics	18
233 - Bilal Company	86	265 - Pac-Comm Packet Radio Systems, Inc.	34
209 - Buckmaster Publishing	102	237 - Pacific Rim Communications	64
* - Butternut Electronics	101	214 - Pilgrim Video Products	98
* - Caddell Coil Corp	100	206 - Processor Concepts	105
216 - Coaxial Dynamics, Inc.	98	204 - The PX Shack	108
247 - Communication Concepts, Inc.	70	223 - QEP'S	95
200 - Communications Specialists	112	256 - Radio Amateur Callbook	44
229 - CTM	88	201 - Radiosporting	111
* - Dick Smith Electronics	64	222 - Ramsey Electronics, Inc.	97
231 - Digirex	87	* - RF Parts/Westcom Engineering	67
228 - Down East Microwave	94	212 - RF Products	101
217 - The DX Edge	96	220 - S-Com	96
205 - EGE, Inc.	108	* - Spec-Com	98
* - Engineering Consulting	78	268 - Spectronics	29
259 - Fluke Mfg. Co.	40	266 - Spectrum International	28
* - Fox River Radio League	103	241 - Spi-Ro Manufacturing, Inc.	75
* - Fox Tango Corp.	51	267 - STV/OnSat	28
* - Gem Quad Products Ltd.	64	232 - Sultronic	87
261 - GLB Electronics	36	219 - Synthetic Textiles, Inc.	96
221 - Grove Enterprises	96	211 - Telewave, Inc.	103
218 - H.L. Heaster, Inc.	96	210 - Texas Magnetics Corp.	108
270 - HAL Communications Corp.	21	225 - Transverters Unlimited	94
226 - Hall Electronics	94	* - University Microfilm Int.	102
254 - Ham Radio Outlet	48, 49	276 - Vanguard Labs	108
* - Ham Radio's Bookstore	25, 37, 54, 72, 84, 95	260 - Varian	41
* - The Ham Station	72	246 - W9INN Antennas	70
* - Ham West	58	230 - Wacom Products, Inc.	87
* - Hamtronics, NY	91	207 - Western Electronics	102
213 - Hamtronics, PA	100	264 - World Tech Products	34
* - Hamtronics, PA	102	199 - Yaesu Electronics Corp.	CIII
245 - Heath Company	71	PRODUCT REVIEW/NEW PRODUCTS	
275 - ICOM America, Inc.	CII	308 - ADN	107
250 - ICOM America, Inc.	56, 57	310 - Astatic	106
244 - IIX Equipment Ltd.	71	303 - Communications Specialists	100
236 - Jun's Electronics	84	306 - Cushcraft Corp.	103
274 - Kantronics	1	311 - Girard Electronics	106
257 - Kendecom/MCS	42	305 - IIX Equipment Ltd.	103
* - Trio-Kenwood Communications	2, 5, 7, 16, CIV	302 - Larsen Electronics	100
235 - Kepro Circuit Systems	86	307 - Mercer Electronics	103
242 - Madison Electronics Supply	74	304 - P.C. Electronics	101
227 - Glen Martin Engineering	94	309 - Plainview Electronics	107
273 - MFJ Enterprises	8	301 - Processor Concepts	100
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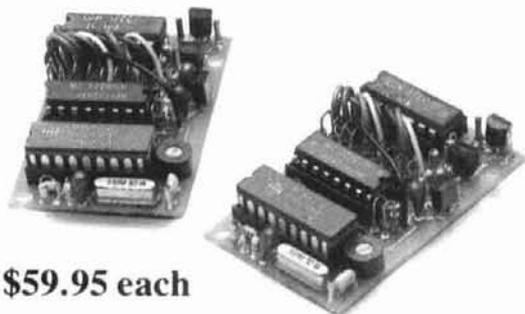


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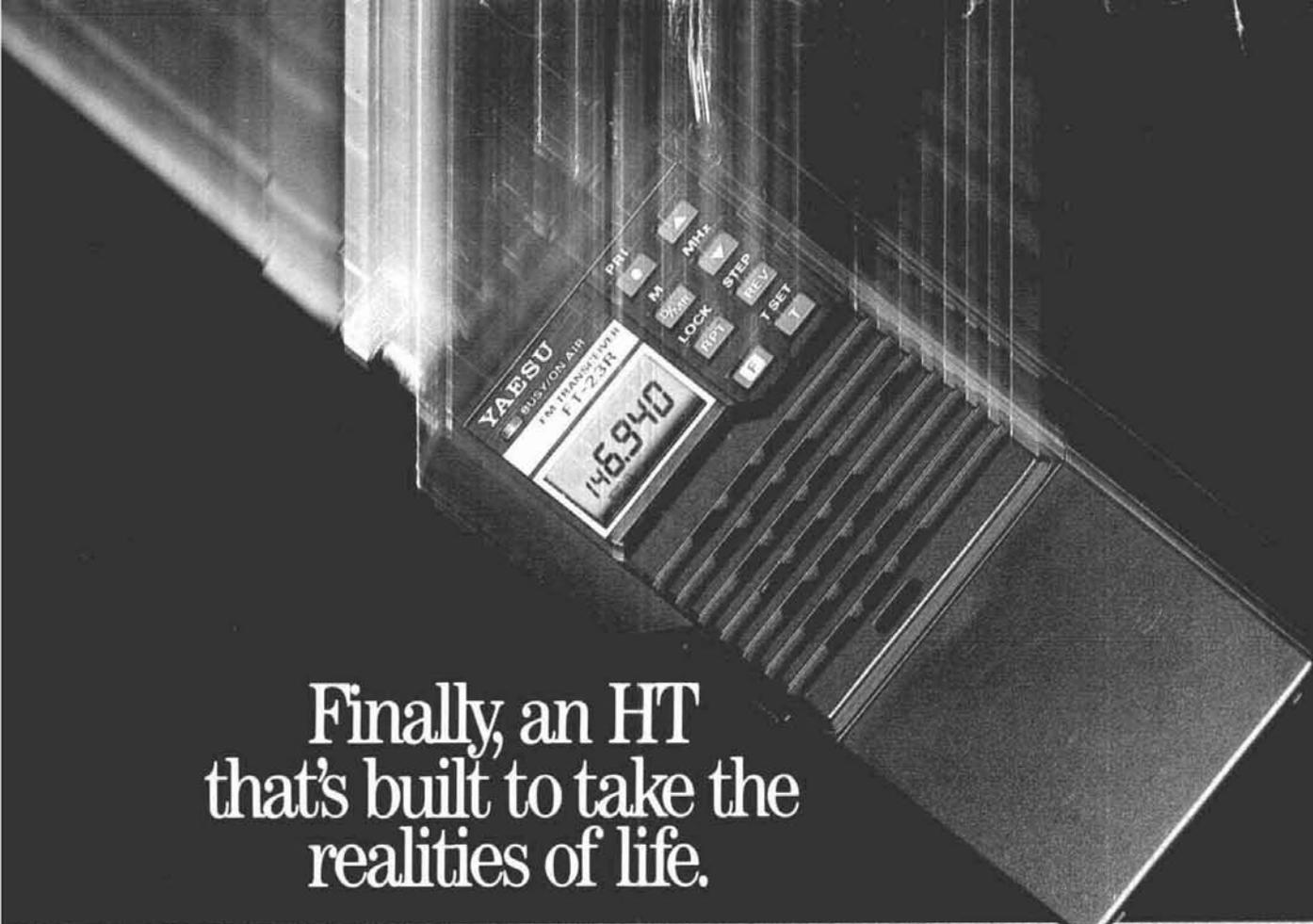


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