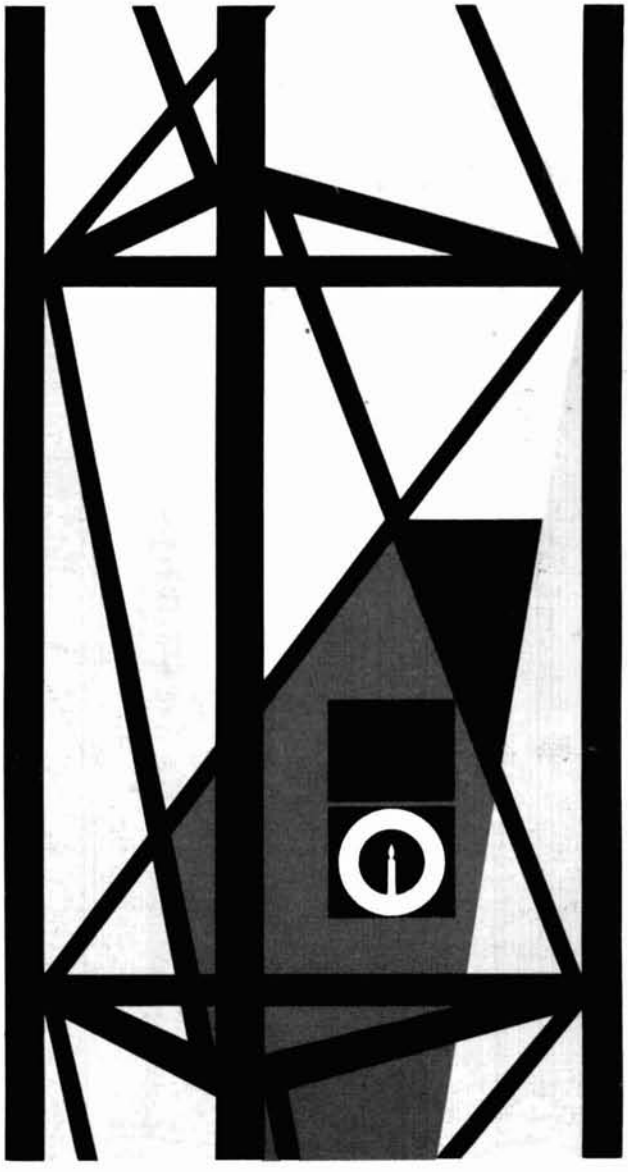
one dollar

ham radio

magazine

DECEMBER 1976



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the TEMPO line means solid value

Tempo VHF/ONE

the "ONE" you've been waiting for

No need to wait any longer – this is it! Whether you are already on 2-meter and want someting better or you're just thinking of getting into it, the VHF/ONE is the way to go.

• Full 2-meter band coverage (144 to 148 MHz for transmit and receive. • Full phase lock synthesized (PLL) so no channel crystals are required. • Compact and lightweight – 9.5" long x 7" wide x 2.25" high. Weight – About 4.5 lbs. • Provisions for an accessory SSB adaptor. • 5-digit LED receive frequency display. • 5 KHz frequency selection for FM operation. • Automatic repeater split – selectable up or down for normal or reverse operation. • Microphone, power cord and mounting bracket included. • Two built-in programmable channels. • All solid state. • 10 watts output. • Super selectivity with a crystal filter at the first IF and E type ceramic filter at the second IF. • 800 Selectable receive frequencies. • Accessory 9-pin socket. • $495.00

TEMPO SSB/ONE

SSB adapter for the Tempo VHF/One

• Selectable upper or lower sideband. • Plugs directly into the VHF/One with no modification. • Noise blanker built-in. • RIT and VXO for full frequency coverage. • $225.00

TEMPO fmh

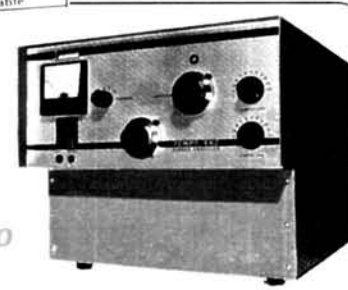
So much for so little! 2 watt VHF/FM hand held 6 Channel capability, solid state, 12 VDC. 144-148 MHz (any two MHz), includes 2 pair of crystals, built-in charging terminals for ni-cad cells, S-meter, battery level meter, telescoping whip antenna, internal speaker & microphone. $199.00

FMH MC for Marine & Commercial service also available

TEMPO CL 146A

. . . a VHF/FM mobile transceiver for the 2 meter amateur band. It is compact, ruggedly built and completely solid state. One channel supplied plus two channels of your choice FREE

144 to 148 MHz coverage • Multifrequency spread of 2 MHz • 12 channel possible • Metering of output and receive • Internal speaker, dynamic microphone, mounting bracket and power cord supplied. A Tempo "best buy" at $239.00.



TEMPO 6N2

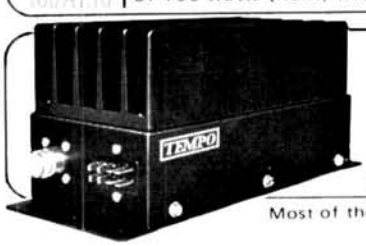
The Tempo 6N2 meets the demand for a high power six meter and two meter power amplifier. Using a pair of Eimac 8874 tubes it provides 2000 watts PEP input on SSB and 1000 watts input on CW and FM. Completely self-contained in one small desk mount cabinet with internal solid state power supply, built-in blower and RF relative power indicator. $895.00

The Tempo 2002.. 2 meters only $745.00
The Tempo 2006.. 6 meters only $795.00

TEMPO POCKET RECEIVERS

MS-2, 4 channel scanning receiver for VHF high band, smallest unit on the market. **MR-2**, same size as MS-2 but has manual selection of 23 channels, VHF high band. **MR-3**, miniature 2-channel VHF high band monitor or paging receiver. **MR-3U**, single channel on the 400 to 512 UHF band. All are low priced, extremely compact and dependable.

TEMPO 100AL10 | **SOLID STATE VHF LINEAR AMPLIFIER.** 144-148 MHz. Power output of 100 watts (nom) with only 10 watts (nom) in. Reliable and compact.



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Solid state power amplifiers for use in most base/mobile applications. Increase the range, clarity, reliability and speed of two-way communications.

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Most of the above products are available at dealers throughout the U.S.

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LSP-520BX. 30 db dynamic range IC log amp and 3 active filters give clean audio. RF protected. 9 V battery. 3 conductor, ¼" phone jacks for input and output. 2-3/16 x 3-1/4 x 4 inches.

$59.95

LSP-520BX II. Same as LSP-520BX but in a beautiful 2-1/8 x 3-5/8 x 5-9/16 inch Ten-Tec enclosure with uncommitted 4 pin Mic jack, output cable, rotary function switch.

SUPER LOGARITHMIC SPEECH PROCESSOR

Up To 400% More RF Power is yours with this plug-in unit. Simply plug the MFJ Super Logarithmic Speech Processor between your microphone and transmitter and your voice is suddenly transformed from a whisper to a **Dynamic Output.**

Your signal is full of punch with power to slice through QRM and you go from barely readable to "solid copy OM".

$27.95

CWF-2BX Super CW Filter

By far the leader. Over 5000 in use. Razor sharp selectivity. 80 Hz bandwidth, extremely steep skirts. No ringing. Plugs between receiver and phones or connect between audio stage for speaker operation.

• Selectable BW: 80, 110, 180 Hz • 60 dB down one octave from center freq. of 750 Hz for 80 Hz BW • Reduces noise 15 dB • 9 V battery • 2-3/16 x 3-1/4 x 4 in. • CWF-2PC, wired PC board, $18.95 • CWF-2PCK, kit PC board $15.95

$49.95

CMOS-8043 Electronic Keyer

State of the art design uses CURTIS-8043 Keyer-on-a-chip.

• Built-in Key • Dot memory • Iambic operation with external squeeze key • 8 to 50 WPM • Sidetone and speaker • Speed, volume, tone, weight controls • Ultra reliable solid state keying +300 volts max. • 4 position switch for TUNE, OFF, ON, SIDETONE OFF • Uses 4 penlight cells • 2-3/16 x 3-1/4 x 4 inches

$39.95
NEW

MFJ-16010 Antenna Tuner

Now you can operate all band — 160 thru 10 Meters — with a single random wire and run your full transceiver power output — up to 200 watts RF power OUTPUT.

• Small enough to carry in your hip pocket, 2-3/16 x 3-1/4 x 4 inches • Matches low and high impedances by interchanging input and output • SO-239 coaxial connectors • Unique wide range, high performance, 12 position tapped inductor. Uses two stacked toroid cores

$29.95

SBF-2BX SSB Filter

Dramatically improves readability.

• Optimizes your audio to reduce sideband splatter, remove low and high pitched QRM, hiss, static crashes, background noise, 60 and 120 Hz hum • Reduces fatique during contest, DX, and ragchewing • Plugs between phones and receiver or connect between audio stage for speaker operation • Selectable bandwidth IC active audio filter • Uses 9 volt battery • 2-3/16 x 3-1/4 x 4 inches

$27.95

MFJ-200BX Frequency Standard

Provides strong, precise markers every 100, 50, or 25 KHz well into VHF region.

• Exclusive circuitry suppresses all unwanted markers • Markers are **gated** for positive identification. CMOS IC's with transistor output. • No direct connection necessary • Uses 9 volt battery • Adjustable trimmer for zero beating to WWV • Switch selects 100, 50, 25 KHz or OFF • 2-3/16 x 3-1/4 x 4 inches

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MFJ-1030BX Receiver Preselector

Clearly copy weak unreadable signals (increases signal 3 to 5 "S" units).

• More than 20 dB low noise gain • Separate input and output tuning controls give maximum gain and RF selectivity to significantly reject out-of-band signals and reduce image responses • Dual gate MOS FET for low noise, strong signal handling abilities • Completely stable • Optimized for 10 thru 30 MHz • 9 V battery • 2-1/8 x 3-5/8 x 5-9/16 inches

$27.95

MFJ-40T QRP Transmitter

Work the world with 5 watts on 40 Meter CW.

• No tuning • Matches 50 ohm load • Clean output with low harmonic content • Power amplifier transistor protected against burnout • Switch selects 3 crystals or VFO input • 12 VDC • 2-3/16 x 3-1/4 x 4 inches

MFJ-40V, Companion VFO $27.95
MFJ-12DC, IC Regulated Power Supply, 1 amp, 12 VDC $27.95

$15.95
NEW

CPO-555 Code Oscillator

For the Newcomer to learn the Morse code.
For the Old Timer to polish his fist.
For the Code Instructor to teach his classes.

• Send crisp clear code with plenty of volume for classroom use • Self contained speaker, volume, tone controls, aluminum cabinet • 9 V battery • Top quality U.S. construction • Uses 555 IC timer • 2-3/16 x 3-1/4 x 4 inches

TK-555, Optional Telegraph Key $1.95

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Try any MFJ products and if you are not completely satisfied, return it within 30 days for a full prompt refund (less shipping). Call us today **toll free 800-647-8660** and charge your Bank-Americard or Master Charge, or mail your order in today with your check or money or[illegible] (or use your BAC or MC). Please add $2.00 for shipping and handling. Order now and avoid the Christmas rush.

73, Martin F. Jue, K5FLU

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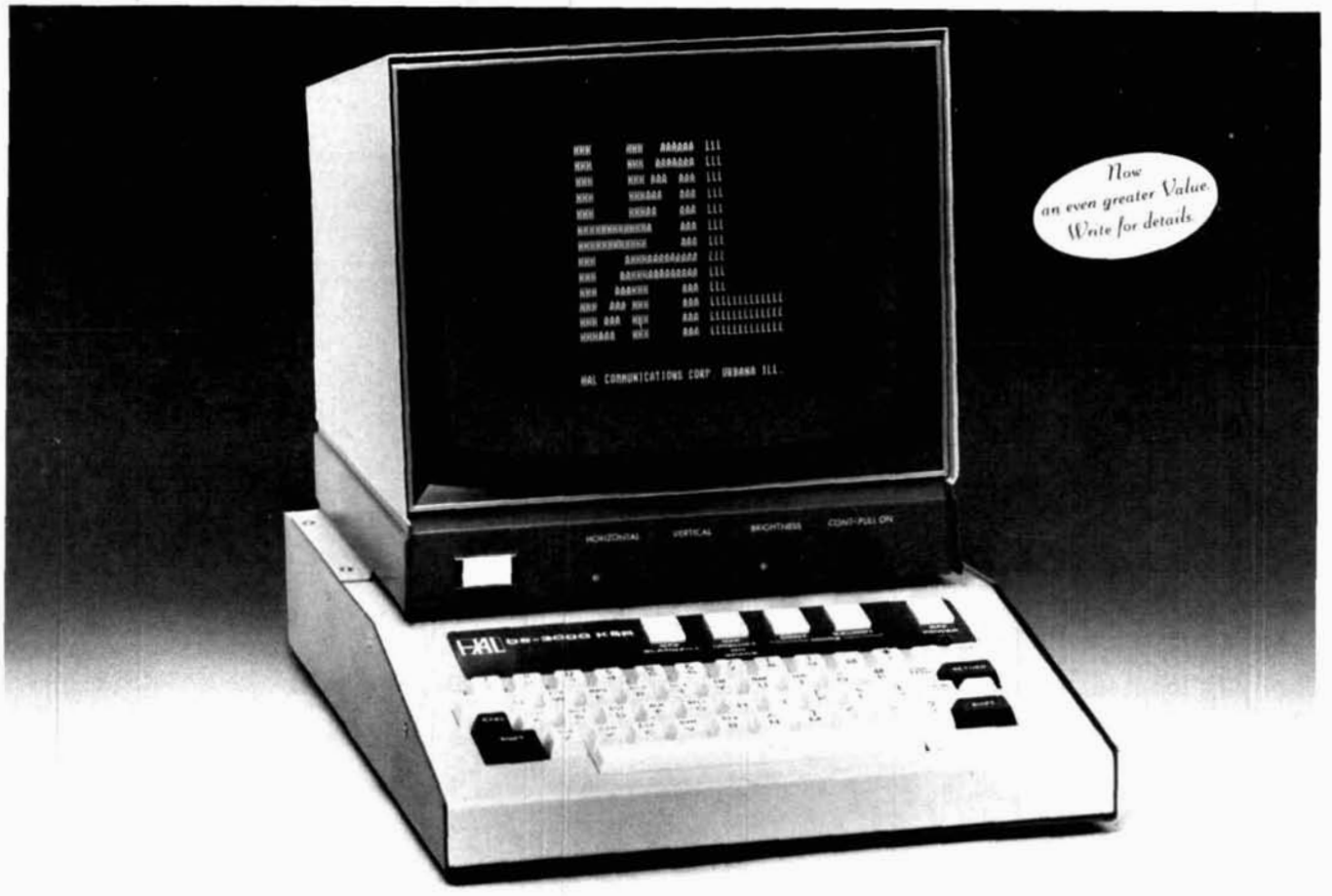

Now an even greater Value. Write for details.

The HAL ST-6000 demodulator /keyer and the DS-3000 and DS-4000 KSR/RO series of communications terminals are designed to give you superlative TTY performance today —and in the future. DS series terminals, for example, are re-programmable, assuring you freedom from obsolescence. Sophisticated systems all, these HAL products are attractively priced—for industry, government and serious amateur radio operators.

The HAL ST-6000 operates at standard shifts of 850, 425, and 170 Hz. The tone keyer is crystal-controlled. Loop supply is internal. Active filters allow flexibility in establishing different tone pairs. You can select AM or hard-limiting FM modes of operation to accommodate different operating conditions. An internal monitor scope (shown on model above) allows fast, accurate tuning. The ST-6000 has an outstandingly high dynamic range of operation. Data I/O can be RS-232C, MIL-188C or current loop.

The DS-3000 and DS-4000 series of KSR and RO terminals provide silent, reliable, all-electronic TTY transmission and reception, or read-only (RO) operation of different combinations of codes, including Baudot, ASCII and Morse. The powerful, programmable 8080A microprocessor is included in the circuitry to assure maximum flexibility for your present needs —and for the future. The KSR models offer you full editing capability. The video display is a convenient 16-line format, of 72 characters per line.

These are some of the highlights. The full range of features and specifications for the ST-6000 and the DS series of KSR and RO terminals is covered in comprehensive data sheets available on request. Write for them now—and tune in to the most sophisticated TTY operation you can have today... or in the future.

HAL

HAL Communications Corp., Box 365, 807 E. Green Street
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More Details? CHECK—OFF Page 142

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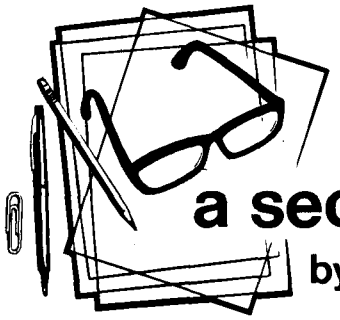

a second look

by Jim Fisk

In looking back over the advances in IC technology that have occurred during the past several years, it's hard to realize that integrated circuits actually celebrated their 18th birthday this past summer. It was during the summer and fall of 1958 that Jack S. Kilby of Texas Instruments built the first integrated circuit. Other semiconductor companies had been working on ways to miniaturize solid-state electronic circuits, but most of these techniques used miniature components of one kind or another; Kilby was the first to use semiconductor material for both the active (transistors) and passive elements (resistors and capacitors) to build a complete circuit on a single piece of germanium.

His first circuits, a phase-shift oscillator and multivibrator, demonstrated the feasibility of this approach. Since, at that time, germanium was well established as a semiconductor material, and silicon was not, Kilby used germanium. On top of the germanium wafer were the contacts of the diffused transistors, junction capacitors, and resistors. A gold-plated metal frame protruded from the lower surface of the substrate, and thermally-bonded gold wires were used for connections between those elements not linked by the wafer itself.

Kilby's first circuits were large and irregular — at least by today's standards — and were considerably different from the precision ICs that are presently on the market. The photo masks and resists necessary to IC manufacturing were yet to be developed, so the patterns were hand painted on the semiconductor chip with black wax. Needless to say, the end product was rather crude looking (and huge by today's standards), but it worked.

About the same time Kilby was working on his first integrated circuits, Fairchild Semiconductor developed the *Planar* process — an innovation that is generally conceded to be the foremost semiconductor discovery of the 1960s. This process made semiconductors more reliable and cheaper to produce, as well as accelerating IC progress and acceptance.

Since these early developments, the number of circuits per unit area has increased and prices have plummeted. In 1962, a typical IC flip-flop chip was about 0.1 inch (2.5mm) square; by 1970 a similar circuit was one-tenth that size, and today the same circuit is even smaller. At the same time circuit size (and unit cost) were decreasing, circuit speed increased from audio to 1 MHz or so, then to 5 MHz, 15 MHz, and on up the scale. It was only a few short years ago that a 30-MHz frequency counter was only a dream — today 600-MHz counters are commonplace, and even higher count frequencies are available if you're willing to pay a small premium for the capability.

It wasn't all that long ago that I reported on this page that, ". . . you can now buy a dual flip-flop for a couple of dollars or a complete decade counter for about seven." And these were RTL devices, with maximum counting speeds in the low MHz range. The same issue carried ads for 709 op amps at $3.98 and 711 dual comparators for $4.98. A low-current voltage-regulator IC, if you could find one, cost ten dollars or more. Scanning through the ads in the back of this issue, you can now buy a 30-MHz decade counter for about 45 cents, a 709 op amp for 29 cents, and a 711 dual comparator for 39 cents — about one-sixteenth of their 1968 prices. Considering that the consumer price index has increased nearly 70 per cent during the same period of time, ICs have to be among the best buys of all time.

Although I've said it before, it's worth saying again that, with the sophisticated, low cost ICs that are on the market, it's possible for amateurs to build exotic electronic equipment that only large laboratories with big budgets could afford a few years ago — and some they couldn't afford at any price because the technology just wasn't available!

Jim Fisk, W1DTY
editor-in-chief

ICOM INTRODUCES THE REVOLUTION IN VFO TECHNOLOGY

Introducing the IC-245, 144-148 MHz FM Transceiver

The VFO Revolution goes mobile with the unique, ICOM developed LSI synthesizer with 4 digit LED readout. The **IC-245** offers the most for mobile on the market. The easy to use tuning knob moves accurately over 50 detent steps and assures excellent control as easily as steering the vehicle. With its optional adapter, the **IC-245** puts you into all mode operation on 12V DC power with a compact dash-mounted transceiver. In FM, the synthesizer command frequency is displayed in 5 KHz steps from 146 to 148 MHz, and with the side band adapter the step rate drops to 100Hz from 144 to 146 MHz. For maximum repeater flexibility, the transmit and receive frequencies are independently programable on any separation. The **IC-245** even comes equipped with a multiple pin Molex connector for remote control.

The **IC-245** is a product of the revolution in VFO design, from its new style front panel, to its excellent mechanical rigidity and Large Scale Integrated Circuitry. Your **IC-245** will give you the most for mobile.

SPECIFICATIONS

GENERAL	
Frequency Coverage	**144.00 to 148.00 MHz*
Modes	*FM (F3)*
	**SSB (A3J), CW (A1)*
Supply Voltage	*DC 13.8V ±15%*
Size (mm)	*90H x 155W x 235D*
Weight (kg)	*2.7*
TRANSMITTER	
TX Output	*F3 10W*
	**A3J 10W (PEP), A1 10W*
Carrier Suppression	*40 dB or better*
Spurious Radiation	*−60 dB or less below carrier*
Maximum Frequency Deviation	*±5 KHz*
Microphone Impedance	*600 ohms*
RECEIVER:	
Sensitivity	**A3J, A1 0.5 microvolt input gives 10 dB S+N/N or better F3 0.6 microvolt or less for 20 dB quieting S+N+D/N at 1 microvolt input, 30 dB*
Squelch Threshold	*−8 dB or less (F3)*
Spurious Response	*−60 dB or better*
SYNTHESIZER:	
Frequency Range	*144 MHz to 148 MHz*
Step Size	*5 KHz for FM*
	**100 Hz or 5 KHz for SSB*
Stability	*per C in the range of −10 to +60 C, ±0.0000145% per C*

* Valid with SSB Adapter only

THE BEGINNING OF THE ICOM VFO REVOLUTION!

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presstop

"N" PREFIXED TWO-LETTER CALLS are now available to any Amateur eligible for a 1x2 callsign. The release of N prefixes applies only to 1x2 callsigns at this time, though presumedly the N prefix will also continue to be available when requested for special events stations.

"X" Suffix Callsigns, released in late October, increases total pool of 1x2 calls in each district by 676. Although the X suffix has traditionally indicated an experimental station in the United States, 1x2 X calls have not been issued since well before World War II so are not expected to cause any great confusion. Who's first for W1XX, Whiskey one Double Cross?

AMSAT'S ANNUAL MEETING drew about 75 people to Goddard Space Flight Center in October. JA1ANG brought the prototype 2-meter to 70-cm transponder from JAMSAT, and reported about 500 Japanese Amateurs are users of OSCARs 6 and 7. The AMSAT 2-10 meter transponder for OSCAR A-OD is now ready for test.

OSCAR 6's Birthday was October 15 and AMSAT's longest lived bird is over four years old and still going strong. As the launch anniversary ended OSCAR 6 began its 18,300 orbit, a lot of miles and many thousands of contacts to its credit.

OSCAR 7 Also celebrated a birthday; it was a healthy two-years old November 15.

N6V's Operation by the Jet Propulsion Laboratory's Amateur Radio Club was seen by millions of viewers on NBC's Today show. Featured during the outstanding segment was N6V's relaying of Mars photographs throughout the world via Amateur slow-scan TV.

The European Space Agency has announced approval of an Amateur Radio satellite launch on its experimental Ariane launch vehicle. A German-built OSCAR is scheduled to go aloft with Ariane's test flight B during December, 1979.

EXCELLENT RFI/EMI SURVEY article appeared in the September 20, 1976 issue of Electronic Design, should be "must" reading for any one seriously interested in the subject. Interference to as well as by communications equipment is included, and there's strong emphasis on FCC's increasing role in the problem area.

CB Is A Major cause of TVI/RFI complaints, of course, and in a recent discussion with FCC Chief Engineer Ray Spence he made the interesting observation that by far the majority of complaints of CB-caused interference was found to involve illegal power!

ITU SECRETARY-GENERAL MILI was the top brass at the dedication of United Nations' club station K2UN on October 21st. W1AW and 4U1ITU in Geneva joined in the inaugural ceremony, though K2UN's current antennas toward Europe leave much to be desired.

ARRL'S BICENTENNIAL CONTEST could become an annual affair, though under a different name. So many participants said they liked its format that League Communications Manager W1NJM has asked for comments.

AMATEUR NOVICE TRAINING PROGRAM currently has more than five times the enrollment it had last year — nearly 35,000 vs 6,000 in 1975. Unlike previous years, established classes continue growing with nearly zero dropout while newcomers appear after hearing about them from friends or on 27 MHz.

CARF WILL HAVE a headquarters office complete with Amateur station thanks to a grant of $10,000 to the Kingston (Ontario) Old Timers' Amateur Radio Association. The office and Amateur station (VE3VCA) will be located at 370 King Street, West, in Kingston, but the mailing address will remain Box 356.

CANADIAN CB WILL EXPAND to 40 channels following the U.S.'s lead, but the General Radio Service operators won't be able to use their new channels until April 1. 40 channel radios for the Canadian market must be tested to tighter specs, but they can't be submitted for testing until after January 1. Commercial users presently operating on the new frequencies have the option of staying put or applying for a new assignment.

Whether A U.S. CBer entering Canada with a shiny new 40 channel radio before April 1 would have problems remains to be seen.

SEVERAL THOUSAND CB LICENSES issued around the beginning of 1976 apparently never reached the applicants. Areas affected include Zip Codes beginning with 0 through 8, and the problems ran from December through April. New licenses for the affected blocks are being printed and mailed; however, any licensee receiving one as a duplicate should discard it.

AMATEUR RADIO RELATED articles have been showing up in non-Amateur Radio publications with increasing frequency, but those not written by Amateurs often suffer from distracting inaccuracies. Ham Radio's editorial staff volunteers its services in reviewing future Amateur Radio articles for any non-Amateur publication that wishes to take advantage of the offer.

Does Your Transmitter Love Your Antenna?

If you're fighting the constant battle of limited band width, high SWR ratios, inefficient low-pass TVI filter operation due to high SWR you're not alone.

DenTron makes the Problem Solvers.

The DenTron tuners give you maximum power transfer from your transmitter to your antenna, and isn't that where it really counts?

Our Super Tuners (A. B. & E.) are the only tuners on the market that match everything between 160 and 10 meters. Whether you have balanced line, coax cable, random or long wire the DenTron Super Tuners will match the antenna impedance to your transmitter.

NEW: The Monitor Tuner (E.) was designed because of overwhelming demand. Hams told us they wanted a 3 killowatt tuner with a built-in wattmeter, a front panel antenna selector for coax, balanced line and random wire. So we engineered the 160-10m Monitor Tuner. It's a life time investment at $299.50

The DenTron 80-10 AT (D.) is a random wire, 80-10 meter tuner which is ideal for portable operation or apartment dwellers.

Every serious ham knows he must read both forward and reverse wattage simultaneously for that perfect match. So upgrade with the DenTron W-2 Dual in line Wattmeter. (C.)

The flexibility we build into our Tuners make any previous tuner you might have owned obsolete.

A. Super Tuner 1KW PEP	$129.50
B. Super Super Tuner 3 KW PEP	$229.50
C. W-2 Wattmeter	$ 99.50
D. 80-10 AT 500 W PEP	$ 59.50
E. Monitor Tuner 3 KW PEP	$299.50

All DenTron products are made in U.S.A.

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- Advance Registration $12.50 per person; with Hotel Sahara Late Show and two drinks $23.00 per person or with Hotel Sahara Congo Dinner Show (entree Cornish Hen), no drinks $30.00 per person. Tax and Gratuity included.
- Totie Fields and Bert Convy are scheduled entertainers in Hotel Sahara's Congo Room.
- Advance Registration must be received by SAROC on or before January 1, 1977.

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January 6-9, 1977

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- Hotel Sahara room rate for SAROC registered delegates $17.00 per night plus room tax, single or double occupancy.
- Hotel Sahara room reservation request card will be sent to SAROC registered delegate.

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More Details? CHECK–OFF Page 142

KENWOOD'S TS-520

... worth waiting for!

Why wait any longer for a rig that offers top performance, dependability and versatility . . . the TS-520 has proven itself in the shacks of thousands of discriminating amateurs, in field day sites, in DX and contest stations, and in countless mobile installations.

Superb craftsmanship is evident throughout . . . in its engineering concepts as well as its construction and styling . . . craftsmanship that is a Kenwood hallmark.

Maybe the Kenwood TS-520 is the one you have been waiting for.

Specifications TS-520

MODES: USB, LSB, CW
POWER: 200 watts PEP input on SSB, 160 watts DC input on CW
ANTENNA IMPEDANCE: 50-75 Ohms, unbalanced
CARRIER SUPPRESSION: Better than -45 dB
UNWANTED SIDEBAND SUPPRESSION: Better than -40 dB
HARMONIC RADIATION: Better than -40 dB
AF RESPONSE: 400 to 2600 Hz (-6 dB)
AUDIO INPUT SENSITIVITY: 0.25μV for 10 dB (S+N)/N
SELECTIVITY: SSB 2.4 kHz (-6 dB), 4.4 kHz (-60 dB). CW 0.5 kHz (-6 dB), 1.5 kHz (-60 dB) (with accessory filter)
FREQUENCY STABILITY: 100 Hz per 30 minutes after warmup
IMAGE RATIO: Better than 50 dB
IF REJECTION: Better than 50 dB
TUBE & SEMICONDUCTOR COMPLEMENT: 3 tubes (2 x 6146B, 12BY7A), 1 IC, 18 FET, 44 transistors, 84 diodes
DIMENSIONS: 13.1" W x 5.9" H x 13.2" D
WEIGHT: 35.2 lbs.
SUGGESTED PRICE: $629.00

VFO-520

Provides high stability with precision gearing. Function switch provides any combination with the TS-520. Both are equipped with VFO indicators showing at a glance which VFO is being used. Connects with a single cable and obtains its power from the TS-520. Suggested price: $115.00.

SP-520

Although the TS-520 has a built-in speaker, the addition of the SP-520 provides improved tonal quality. A perfect match in both design and performance. Suggested price: $22.95.

TV-502

TRANSMITTING/RECEIVING FREQUENCY: 144-145.7 MHz, 145.0-146.0 MHz (option).
INPUT/OUTPUT IF FREQUENCY: 28.0-29.7 MHz
TYPE OF EMISSION: SSB (A3J), CW (A1)
RATED OUTPUT: 8W (AC operation)
ANTENNA INPUT/OUTPUT IMPEDANCE: 50Ω
UNWANTED RADIATION: Less than -60 dB
RECEIVING SENSITIVITY: More than 1μV at S/N 10 dB
IMAGE RATIO: More than 60 dB
IF REJECTION: More than 60 dB
FREQUENCY STABILITY: Less than ±2.5 kHz during 1-60 min after power switch is ON and within 150 Hz (per 30 min) thereafter.
POWER CONSUMPTION: AC 220/120V, Transmission 50W max., Reception 12W max. DC 13.8V, Transmission 2A max., Reception 0.4A max.
POWER REQUIREMENT: AC 220/120V, DC 12-16V (standard voltage 13.8V)
SEMI-CONDUCTOR: FET 5, Transistor 15, Diode 10.
DIMENSIONS: 6⅝" W x 6" H x 13¼" D
WEIGHT: 11.5 lbs.
SUGGESTED PRICE: $249.00

CW-520
500 Hz CW Crystal Filter: $45.00.

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Today's erratic propagation conditions together with the tremendous increase in the number of amateur stations make DX operating much more difficult than, say, ten or fifteen years ago. In my case, using an SB220 linear amplifier and a four-element quad antenna, I had fair response to directional CQ DX calls only to become frustrated by adjacent-channel overload or interference in my receiver by strong local or short-skip stations.

The answer to this problem is a receiver with characteristics such as those in the design described in this article. Tests made on the 20- and 40-meter front ends of this design produced the data shown in **table 1**. Note that the dynamic range is 100 dB for both test conditions on 40 and 20 meters.

receiver front-end design

Conflicting requirements and tradeoffs were necessary to obtain a receiver with a wide dynamic range. Recent articles, studies, and experiments indicated that balanced mixers, together with selective rf tunable filters ahead of the first active device, represented effective means for diminishing third- through fifth-order intermodulation (IMD) and cross-modulation products.

I tried hot-carrier diode mixers using discrete diodes (monolithic packages weren't available) in both ring and cross configurations. It was an unsuccessful attempt, since low input-output impedances created matching problems and these mixers seemed to have an insatiable hunger for oscillator power.

The overall receiver noise factor is interrelated with the receiver passband; and in the mathematical formula, one term shows that it is also inversely proportional to the mixer gain. With the diode mixer, the receiver lacked sensitivity because of a conversion loss of almost 9 dB.

Without discrediting the hot-carrier diode mixer, better results were obtained by using the Motorola C6050G double-balanced integrated circuit and also selected pairs of the RCA 40673 dual-gate mosfet.

Occasionally, at certain antenna bearings, the combination of galactic, ionospheric, atmospheric, and man-made noise is below predicted levels; therefore an "in-out" rf amplifier would be justified. For higher-frequency bands, extremely good sensitivity is possible by using a balanced amplifier as in some vhf receivers.

Theoretically, this kind of arrangement should have a better noise factor, as somewhat more than 50% of internally generated random noise would be rejected in the common-mode operation, being cancelled in the balanced output circuit. The rf amplifier becomes a nuisance when the bands become crowded with strong signals exceeding S9+40 dB levels. Receiver gain compression occurs, along with numerous intermodulation products, indicating that it's time to turn off the rf amplifier! This is accomplished in this design by means of miniature reed relays.

Another unwanted phenomenon in mixers is so-called "reciprocal mixing." This mixing is a direct consequence of oscillator noise modulation. When a large interfering signal appears at the mixer input, the signal will mix with oscillator noise and, although the interfering signal may be out of the i-f passband, the noise so produced will be within the i-f passband.

Reciprocal mixing is measured by the amount of noise introduced by a closely spaced interfering signal;

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i.e., when the level of the interfering signal, expressed in dB above 1 μV and spaced 20 kHz away from the desired signal produces a reduction of signal-to-noise ratio by 10 dB.[1] Oscillator noise reduction is possible by a) careful elimination of unwanted spurious generation

Ultimately, reciprocal mixing reduces mixer dynamic range by raising its equivalent noise floor. As stated above, inherent oscillator noise modulation is also dependent on oscillator power; therefore, mixers working at high injection levels will be more affected.

table 1. Measured characteristics of the DX receiver 20- and 40-meter front ends.

receiver characteristic	40-meter band		20-meter band	
	rf ampl off	rf ampl on	rf ampl off	rf ampl on
Sensitivity for 10-dB s/n	0.5 μV (−119 dBm)	0.1 μV (−133 dBm)	0.2 μV (−127 dBm)	0.07 μV (−136 dBm)
third-order intercept point (dBm)	+23	+6	+15	+3
gain compression (dBm)	+10	−10	0	−15
dynamic range (dB)	100	100	100	100

on other frequencies, b) good dc filtering, c) good stability, and d) reducing oscillator power and narrowing oscillator bandwidth. Recommended low-noise oscillators are those consisting of differential amplifier integrated circuits with balanced output circuitry.

Front end. Four separate front ends are selected by rotary switch S1 (**fig. 1**). In this design resistors in the signal path were kept to a minimum as they are noise devices. Despite the cumbersome appearance, this setup allows individual band optimization and eliminates

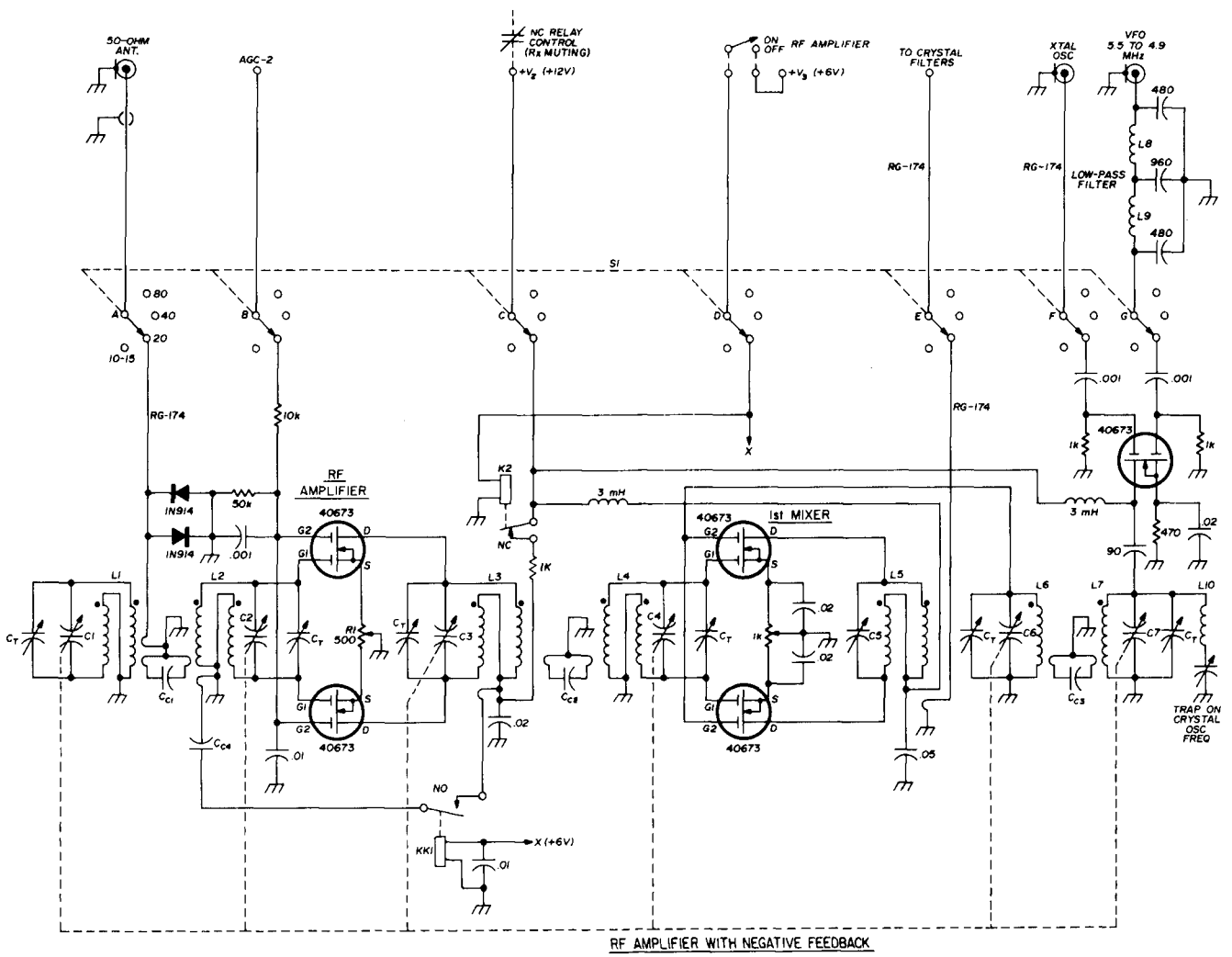
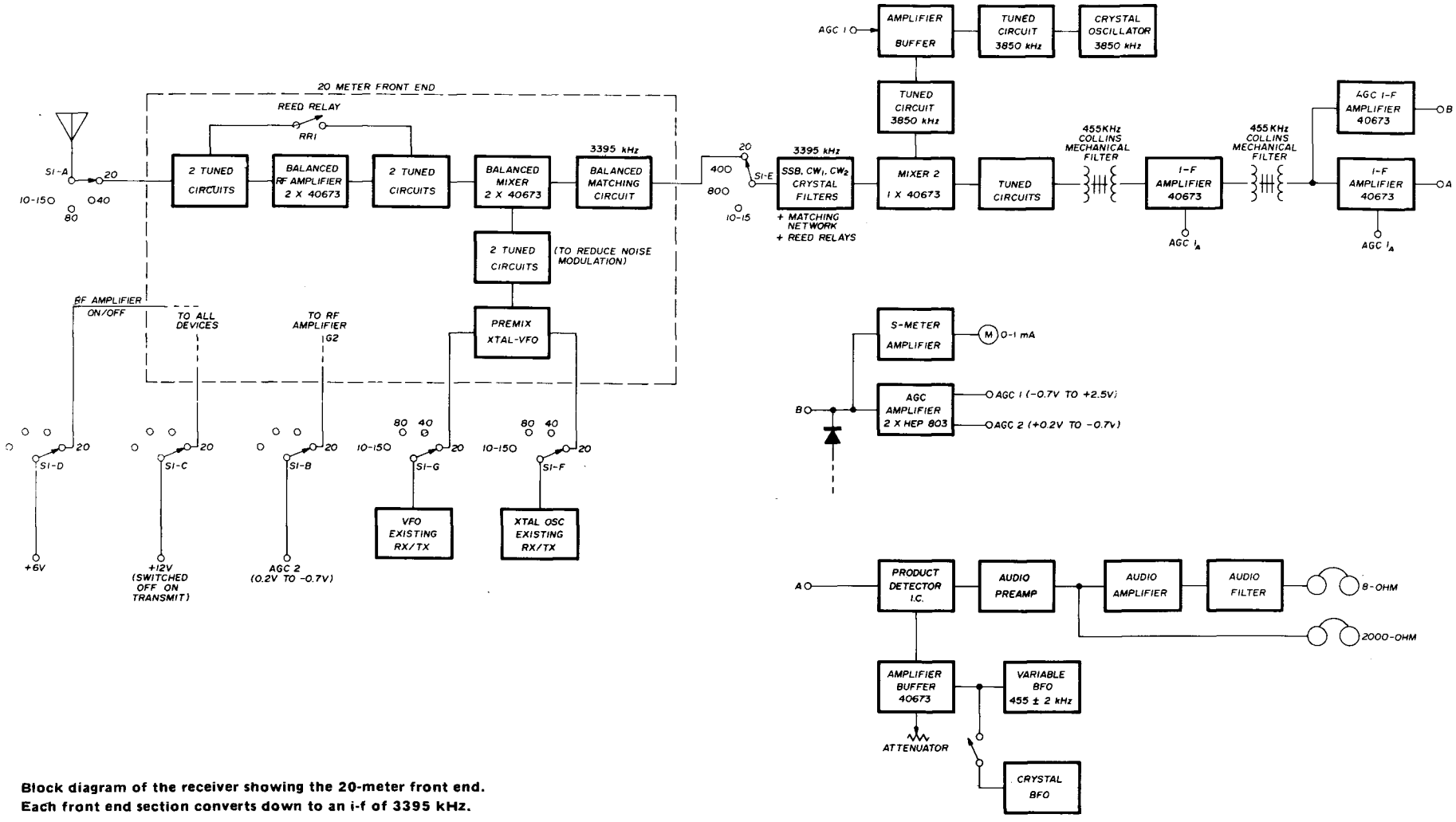


fig. 1 Schematic of the DX receiver front end, first mixer, and vfo. All links are one turn for an impedance of approximately 50 ohms. All trimmer capacitors are mica, 20 to 130 pF. L8, L9, 17 turns no. 24 AWG (0.5mm) on Amidon T-50-6 core. L5, 44 turns no. 28 AWG (0.3mm) wound 2 x 22 on Amidon T-50-6 core. The i-f is 3395 kHz.



Block diagram of the receiver showing the 20-meter front end. Each front end section converts down to an i-f of 3395 kHz.

problems related to balanced circuitry switching. I was fortunate enough to obtain some surplus vhf six-gang split-stator variable capacitors. To prospective builders of this front end, I suggest the use of smaller units of the kind having a shaft extension on both sides, which could be mechanically ganged. A good substitution would be a matched set of varactors for an unbalanced arrangement.

Good tracking between rf input and pre-mixer output circuits is imperative since the 4-pole rf filter is very selective, particularly on the lower bands. On the low values of CC3), while the upper quad could be saturated or unsaturated (our signal port). Recommended external biasing is:

$$(V6, V9) - (V7, V8) \geq 2\ V$$
$$(V7, V8) - (V1, V4) \geq 2.7\ V$$
$$(V1, V4) - (V5) \geq 2.7\ V$$

Filters. In accordance with modern receiver design practice, an ssb filter and two CW crystal filters are

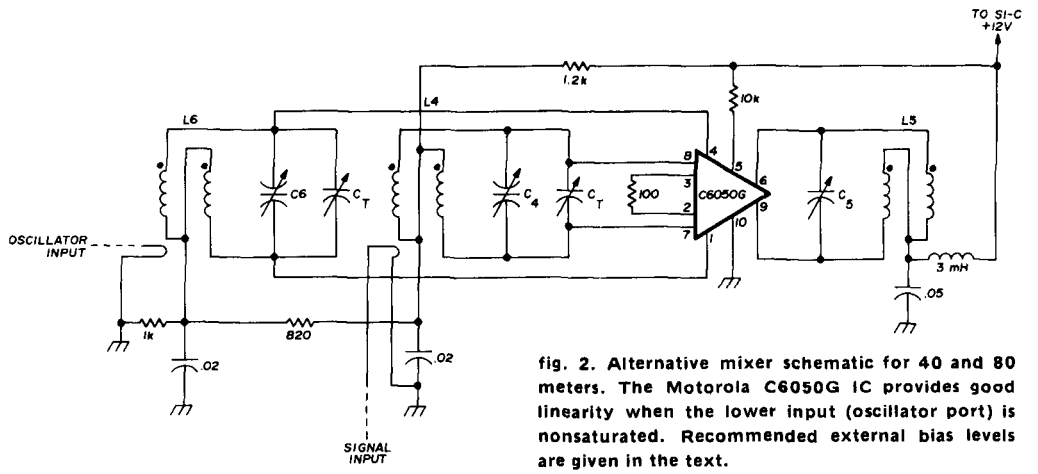


fig. 2. Alternative mixer schematic for 40 and 80 meters. The Motorola C6050G IC provides good linearity when the lower input (oscillator port) is nonsaturated. Recommended external bias levels are given in the text.

20-meter band with the rf amplifier off, measured filter response was 50 kHz wide at 20-dB down, which means that an unwanted signal 25 kHz away from the receive frequency is attenuated 20 dB. The frequencies shown in **table 2** would be applicable to Kenwood or Heathkit lines, but the principle could be extended to other makes.

Mixer. The dual-gate 40673 mosfet mixer has lower third- and fifth-order products in its output when gate G2 remains nonbiased; however, gain is definitely lower. For best performance oscillator injection level was set at 300 mV.

Fig. 2 shows the 40- and 80-meter alternative mixer configurations. The Motorola C6050G double-balanced differential amplifier with emitter degeneration has good linearity when the lower input (i.e., our oscillator port) is nonsaturated (maximum 27-mV oscillator level — see

placed at the first mixer output through a matching network. Filter selection is accomplished by using remotely controlled miniature reed relays. Interelectrode capacitance of these reed relays is so minute that, when dc switching voltage is removed, signal feedthrough was measured at 120 dB down.

Fig. 3 shows the crystal filter arrangement. To obtain the above attenuation figure, filters were placed against a ground plane (double-clad printed circuit board, the face next to the filter grounded on one spot only). The second mixer is of classic design, and the local oscillator operates in a very stable mode. The second i-f strip is on 455 kHz and uses two Collins ssb mechanical filters.

Agc. An elaborate amplified agc system is derived from a separate uncontrolled i-f amplifier. One branch of this fast-rise, slow-decay agc system controls the i-f stages along with the local oscillator amplifier-buffer by

table 2. Coil and capacitor values for coverage between 3.5-28 MHz.

band (MHz)	frequency coverage (MHz) circuit 1 to circuit 4	circuits 6 and 7	vfo	xtal osc	coils and capacitors* L1 = L2 = L3 = L4 (turns)	L6 = L7 (turns)	C1 = C2 = C3 = C4 (pF)	C6 = C7 (pF)	$C_C1 = C_C2$ (pF)	C_C3 (pF)
3.5	3.5-4.0	6.895-7.395	5.5-4.9	12.395	2 x 20 T-50-6	2 x 16 T-50-6	10-30	8-20	800	90
7	6.9-7.9	10.295-11.295	5.5-4.9	15.895	2 x 14 T-50-6	2 x 12 L7 = 24T	10-30	8-20	470	51
14	13.9-14.9	17.295-18.295	5.5-4.9	22.895	2 x 7 T-50-6	12T T-50-10	10-30	8-20	350	330
21-28	20.5-30.0	23.895-33.395	5.5-4.9	29.895 36.895 37.395	2 x 5 T-50-10	8T T-50-10	10-100	8-90	250	220

*No rf amplifier on 3.5 MHz. Rf amplifier on 7 MHz is unbalanced

Notes:
455 kHz i-f transformer:

A&B —	primary impedance	Z_p = 35k	Radio Shack
	secondary impedance	Z_s = 6k	"black core"
C —	primary impedance	Z_p = 60k	"yellow core"
	secondary impedance	Z_s = 500k	
D —	primary impedance	Z_p = 40k	"white core"
	secondary impedance	Z_s = 1k	

SSB crystal filter Trio 4 pole 2.2 kHz at −6 dB
CW-1 crystal filter Trio 4 pole .5 kHz at −6 dB
CW-2 crystal filter Heathkit .4 kHz at −6 dB
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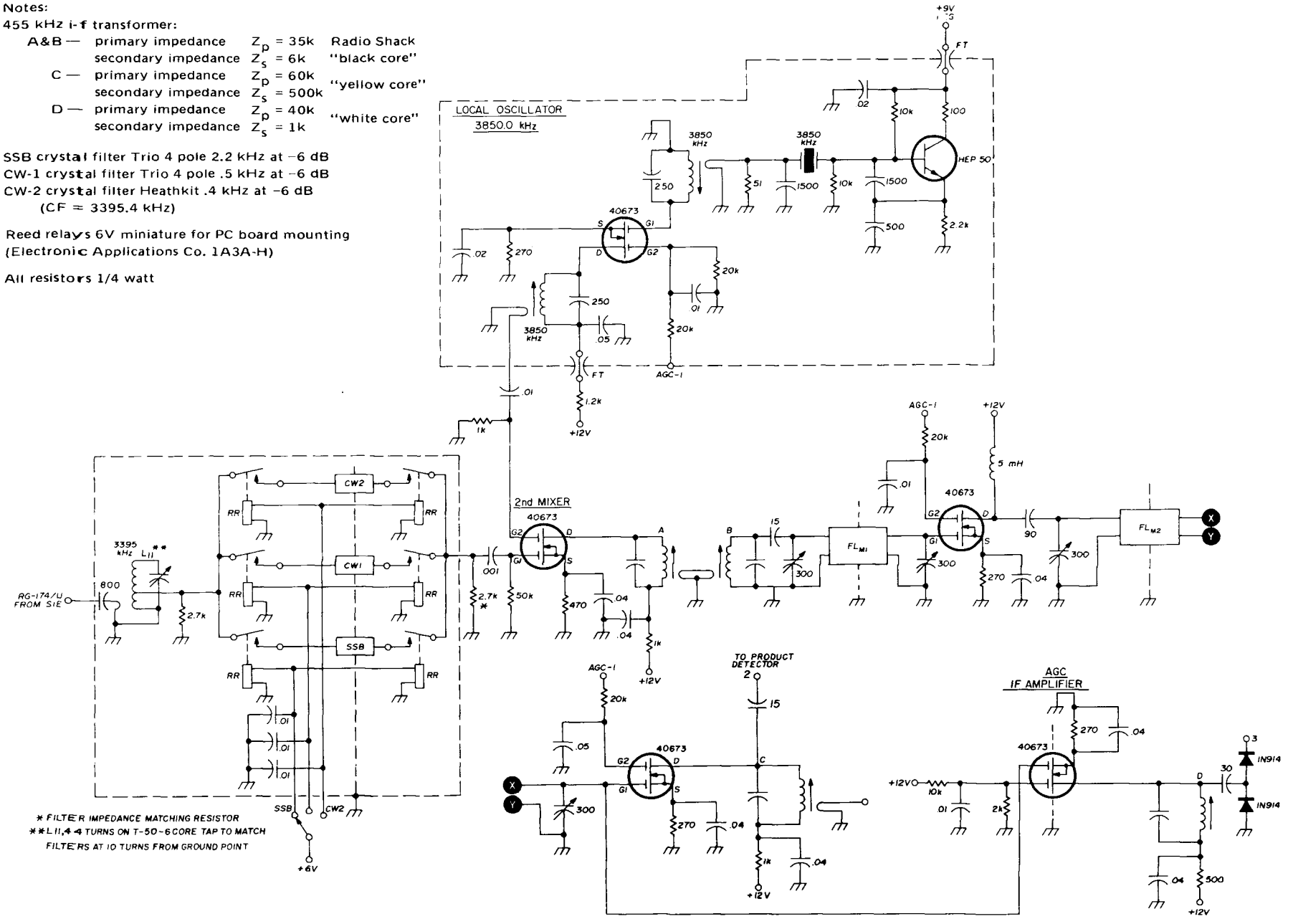


fig. 3. Crystal filter, local oscillator, second mixer, and agc amplifier schematic. Filter sections are selected by remotely controlled reed relays.

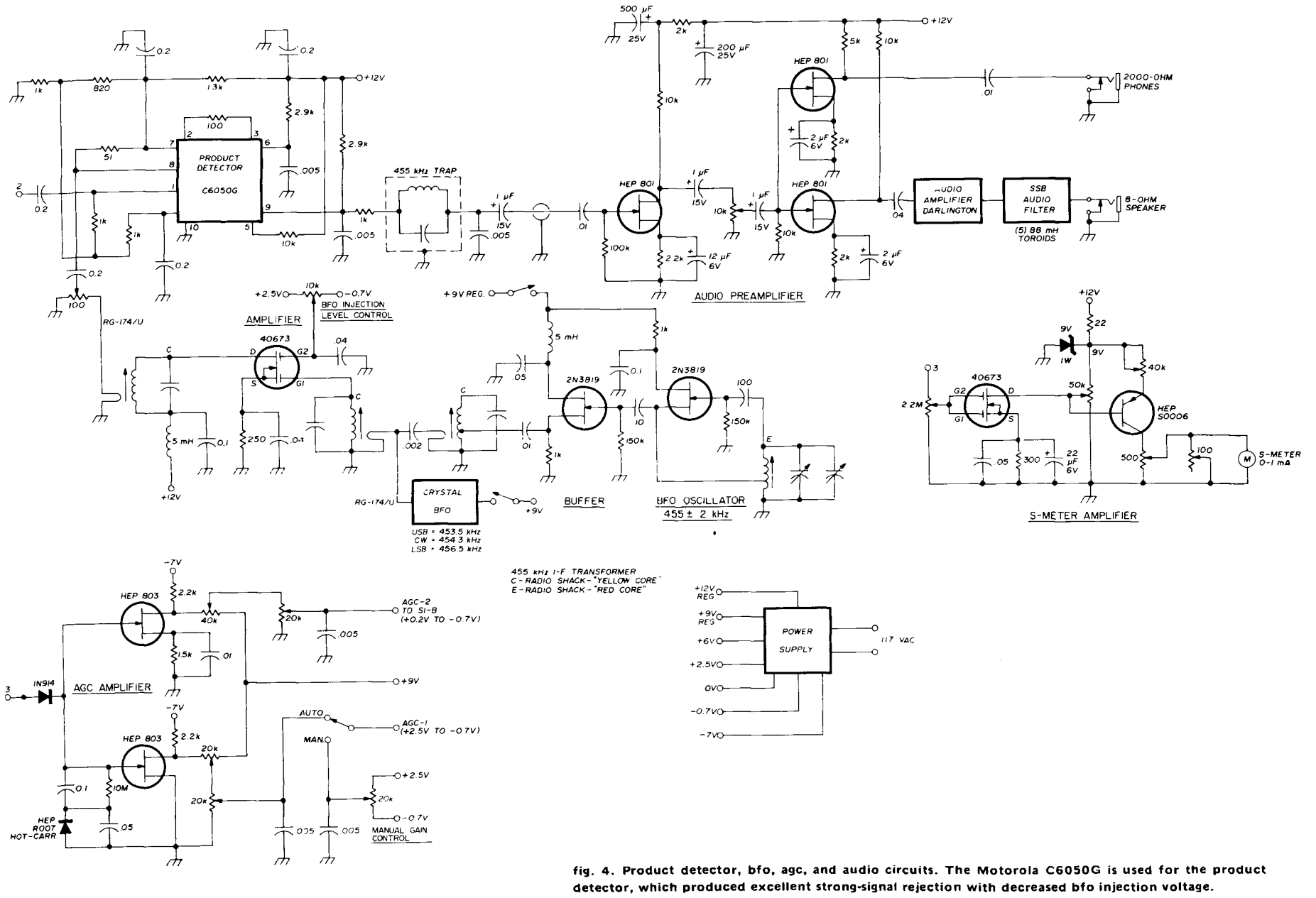


fig. 4. Product detector, bfo, agc, and audio circuits. The Motorola C6050G is used for the product detector, which produced excellent strong-signal rejection with decreased bfo injection voltage.

swinging voltages from +2.5 V (weak signals) to −0.5 V (strong signals). The second agc branch is threshhold-biased and applied only to the rf amplifier over a restricted range, so that front-end linearity is not impaired. The receiver has a separate S-meter amplifier as shown in **fig. 4**. Minipotentiometers are used to calibrate the meter. Accuracy is within 3 dB, or one-half S-point.

Detector and bfo. The product detector and bfo are of particular interest. A very sensitive Motorola C6050G double-balanced IC makes a good product detector and requires a maximum of 300 mV bfo injection for the strongest signals.

The beat-frequency oscillator is variable within 455 ±2 kHz. Its output is amplified and filtered to supply the required maximum of 300 mV into a 50-ohm load at the product detector.

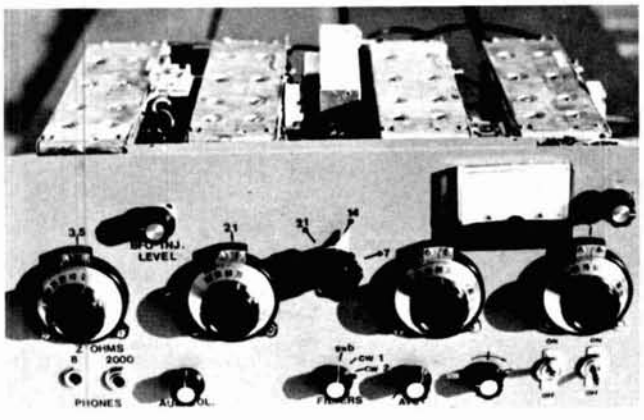
Theory says that, for minimum distortion a product detector requires carrier injection at least 10 times the level of the incoming signal at the input port. What would happen upon lowering that injection level? Decreasing the bfo level caused strong perturbing signals to become unreadable, while weak DX signals were still crystal clear. One helpful finding was that the audio output versus bfo level dropped about 10 dB faster for the stronger signal compared to the weak one.

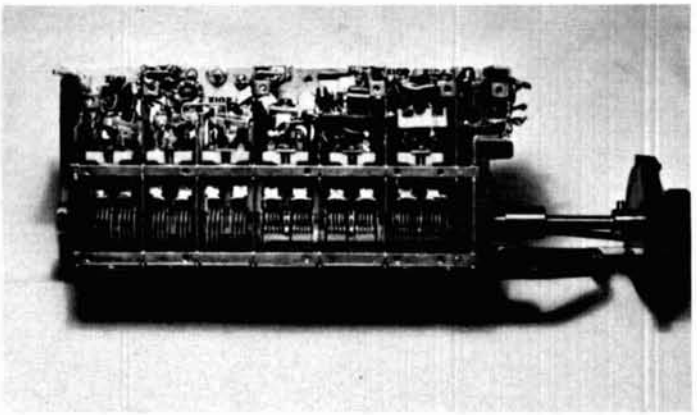
A crystal bfo was incorporated for good transceive operation. This crystal bfo is used to calibrate the variable bfo. At times, the output from the product detector is extremely low; henceforth, a noiseless audio preamplifier is required. The receiver also employs a 5-toroid audio filter to alleviate inherent noise pickup when using an audio amplifier.

construction hints

This is an experimental receiver; appearance was secondary to conveniences such as avoiding stray noise pickup, rf feedback, and audio hum. It was constructed by degrees starting with the front end for the 20-meter band. Mosfet devices were first tested with respect to dynamic transconductance and dc for matching purposes. Each device was set up in an amplifier with a plug-in socket and identical rf signal levels were applied

Front view of the DX receiver with cabinet removed.





Typical receiver front-end arrangement. Capacitor stator plates are easily removable so that proper maximum-minimum capacitance is obtained for band coverage and precise tracking.

to both gates from a signal generator, while a vtvm was used to measure output level on a tuned circuit. A table was compiled, and devices showing close characteristics were paired. From 40 available devices I could select only three closely matched pairs, which leads to the conclusion that integrated mosfet circuits would be a far better choice.

tests and results

The 20- and 40-meter front ends were tested for sensitivity, IMD, gain compression, and dynamic range (**table 1**). Two powerful signal generators (most signal generators are not capable of delivering more than 100 mV into a 50-ohm load) were used, tuned 10 kHz apart, each at a level of +12 dBm, which becomes +6 dBm after the hybrid combiner. The spectrum analyzer indicated at this level an IMD of 35 dB on the 40 meter band.

acknowledgement

I wish to express gratitude to Serge Costin, WB2ZWJ, for his continuous technical advice in the design and construction of this receiver.

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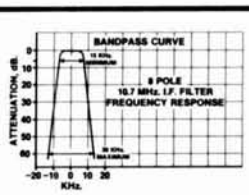
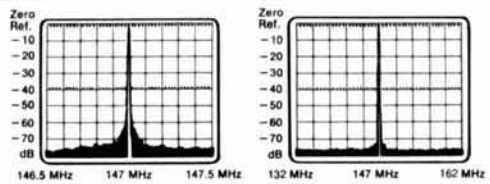


An 8-pole IF crystal filter greatly reduces adjacent channel interference.



Actual spectrum analyzer photos of the HW-2036 transmitter output operating at 147 MHz.

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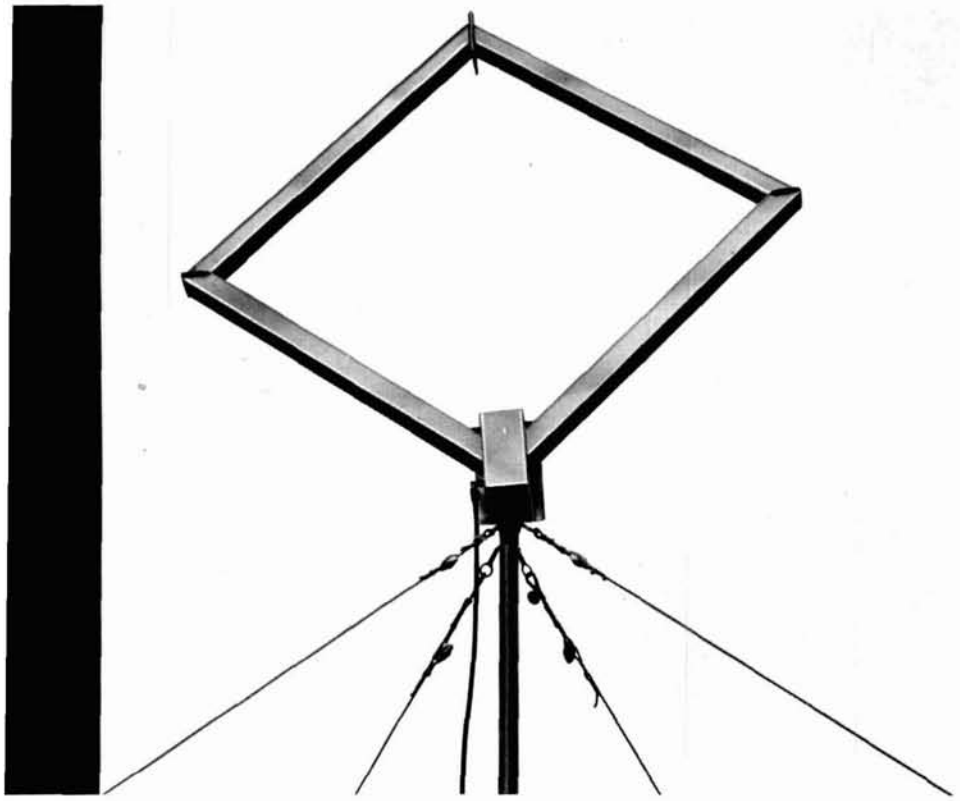

loop antennas

A discussion of small loop receiving antennas and details on their construction for the low-frequency bands

Most amateurs use the same antenna for both receiving and transmitting. This makes a lot of sense on vhf, and on 10, 15 and 20 meters, but at the lower frequencies which are more susceptible to noise interference entering via the antenna (160, 80 and 40 meters), the small loop receiving antenna has some advantages in reducing the susceptibility to certain types of noise. This article will attempt to expain the loop's operation in the simplest possible terms and will describe several practical loop antennas which are suitable for amateur use.

The electric- and magnetic-field components of an incoming electromagnetic wave are at right angles to each other. The plane formed by these components is at right angles to the direction of wave arrival. With the wave polarization and the direction of wave travel shown in **fig. 1**, both the electric and magnetic field components excite current flow in the vertical portions of the simple unshielded loop. The current induced by the electric field is due to the difference in charge impinging along the length of the vertical elements, while the current due to the magnetic field is because of the motor-generator action of the vertical conductors cutting the lines of force in the magnetic field as it moves past the conductors.

The currents due to both field components are mutually in phase, and although neither the electric nor the magnetic field components can exist without the other in the radiated electromagnetic field, the loop antenna behaves identically with excitation from either or both field components.[1]

While the voltage available at the terminals of a dipole is simply proportional to the current induced in the dipole, the voltage available at the terminals of a small loop is proportional to the *difference* between the

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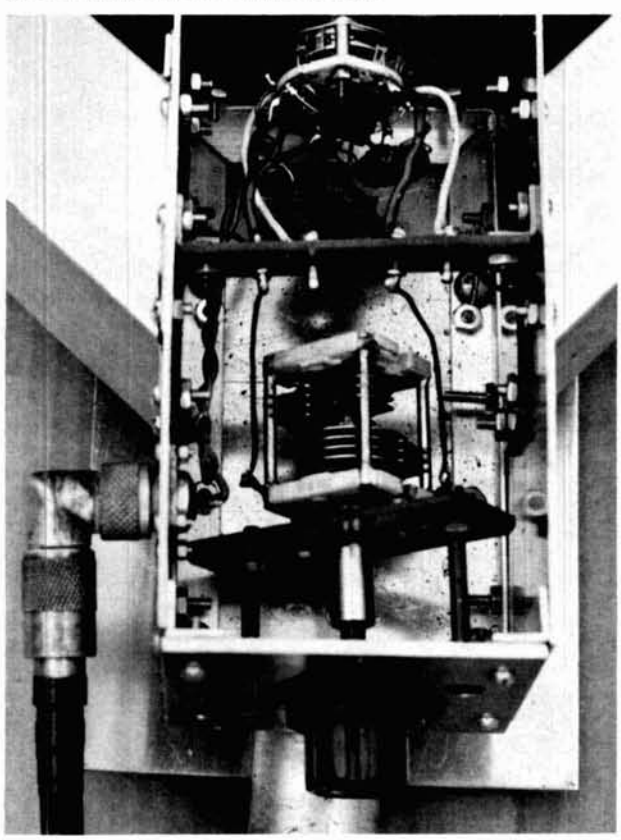
currents induced in the two opposite vertical loop elements. No currents are *induced* in the top or bottom horizontal conductors connecting the vertical elements.

When the *axis* of the loop is pointing toward the signal source as in **fig. 1A**, the two vertical elements of the loop are excited at the same phase point of the wave front. Thus the current induced in both elements is of the same amplitude and phase, and flow in the same absolute direction (see **fig. 2**). However, the two currents are actually flowing in opposite directions with respect to a continuous, one-way travel around the loop, and therefore cancel each other, producing zero net voltage.

On the other hand, when the *plane* of the loop is pointing toward the signal source, as in **fig. 1B**, maximum voltage is produced because the two vertical elements are now in positions of maximum *difference* in phase relationship with the wave front, with the resulting difference between the currents induced in the vertical elements producing a maximum voltage. In fact **fig. 1B** shows that during the portion of the wave cycle when the field is changing most rapidly, the currents in the two elements are flowing in *opposite* absolute directions (one flowing upward and the other downward), with the result that both currents are actually flowing in the *same* direction around the loop, and are therefore mutually aiding instead of opposing as in **fig. 1A**. For orientations of the loop at angles in between the two just described, and in general, the voltage produced is proportional to the cosine of the angle formed between

Junction box for the square loop antenna containing 80/40 bandswitch, balun and tuning capacitor.



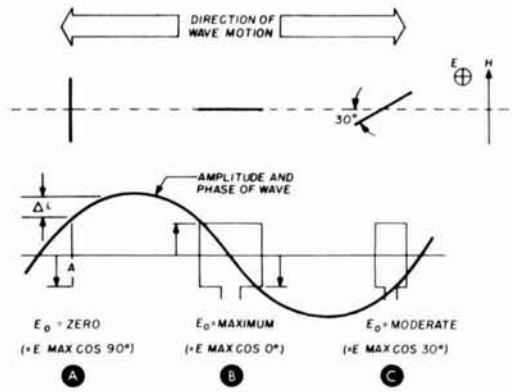


fig. 1. Directivity of the loop arises from the interception of the wavefront by each half of the antenna. In (A) the currents are of equal amplitude and phase, producing no net voltage difference at the output. In (B) the currents are at maximum amplitude and phase difference, producing maximum output voltage. In (C) the current difference between loop halves is moderate, producing a corresponding voltage difference at the output terminals. Voltage output is small for angles larger than 60 degrees.

the loop plane and direction of the wave propagation, as in **fig. 1C**. The resulting figure-eight radiation pattern is thus a perfect pair of circles tangent to one another as shown in **fig. 3**.

For several basic reasons, nearly all practical loop antennas are electrostatically shielded by means of an open-turn shield. One reason is that electrostatic shielding is a convenient way of achieving a capacitance balance between the two opposite halves of the loop and ground. Without this balance the figure-eight pattern would be distorted and the nulls misplaced and obscured. Second, the open-turn shield shown in **fig. 3** forms a balun, permitting the loop to feed an unbalanced load without upsetting the loop-to-ground balance. And third, electrostatic shielding renders the loop insensitive to the electric component of a passing wave. This has an insignificant effect on the reception of a wave propagated in the far field (radiation field). However, in the case of several types of man-made noise interference, the effect is to reduce the reception of the noise.

If the electrical disturbance producing the interfering noise is confined primarily to the *induction* field (as many such noise disturbances are), the electric compo-

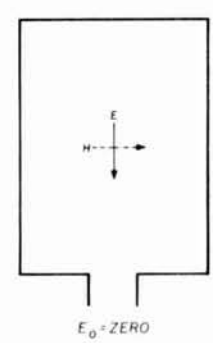


fig. 2. Electric (E) and magnetic (H) components of a wavefront impinging upon a loop antenna, showing current flow in the loop. When the plane of the loop is parallel to the wavefront, as shown here, output voltage is minimum (see fig. 1A).

nent generally predominates over the magnetic field. Since the shielded loop is sensitive only to the magnetic field, there's a noticable reduction in noise pickup as compared to that of a vertical dipole. Providing the desired signal is not arriving from the same direction as the noise, some additional reduction in noise interference level is also available due to the directivity of the loop radiation pattern. Simply pointing the axis of the loop in the direction of the noise will minimize the noise pickup, while the desired signal still arrives from a favorable angle on the directivity pattern.

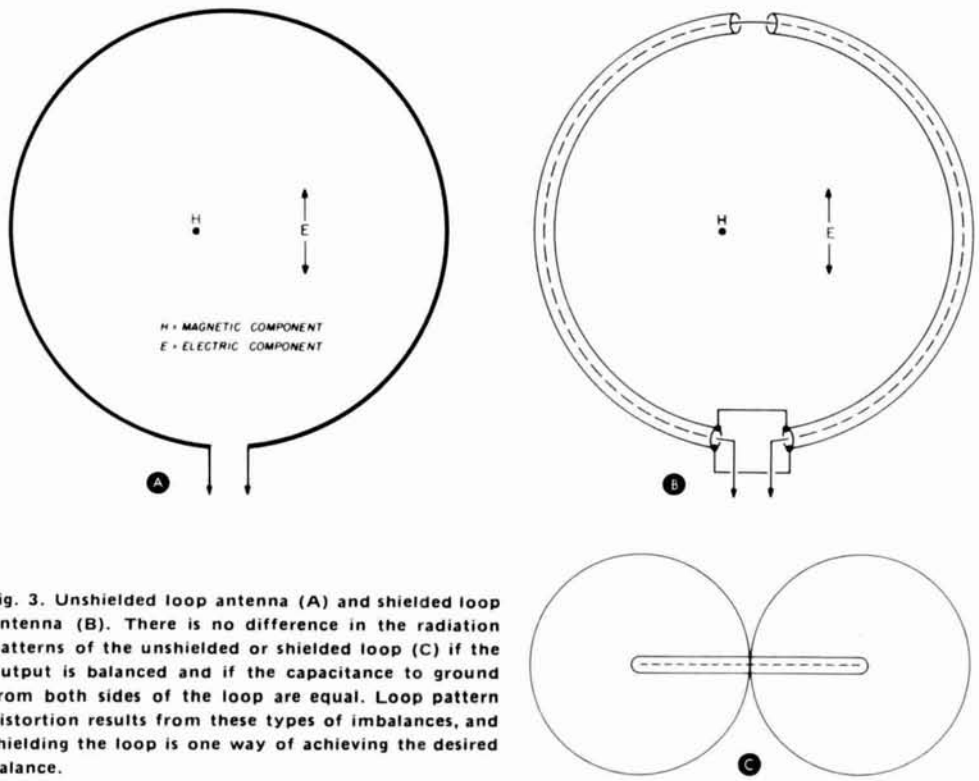


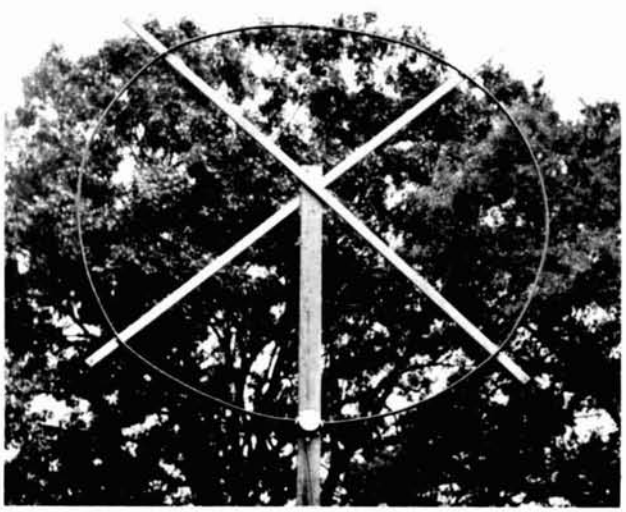
fig. 3. Unshielded loop antenna (A) and shielded loop antenna (B). There is no difference in the radiation patterns of the unshielded or shielded loop (C) if the output is balanced and if the capacitance to ground from both sides of the loop are equal. Loop pattern distortion results from these types of imbalances, and shielding the loop is one way of achieving the desired balance.

In general, atmospheric noise is propagated as a *radiation* field, generated by the electrical discharges that attend thunderstorms, both locally and throughout the world. Noise from an electrical storm concentrated in a single direction may be reduced by the directive properties of a shielded loop, but not by its insensitivity to the electric field. On the other hand, interference from precipitation static will be effectively reduced by the shielding properties of the loop because precipitation static is caused by an *induction* field localized directly around the receiving antenna.

The illustration of **fig. 1** is greatly exaggerated. When a loop 6½ feet (2m) between legs is used on 80 meters, the maximum wavefront intercepted represents only a small fraction of the energy intercepted by a half-wavelength dipole. However, such a small antenna is still adequate for good signal reception.

References 2 and 3 state that a maximum wire length of about 0.08 wavelength will produce currents throughout the loop of relatively equal amplitude and phase. This condition will produce the figure-eight pattern illustrated, but lengths in excess of this criteria will cause some pattern distortion. Reference 4 states that loops as large as 0.1 wavelength in diameter (0.314 wavelength circumference) can be used without serious pattern distortion. However, this reference is confined to aperiodic loops, while reference 2 deals with loops that are tuned, providing higher Q. The higher Q changes the current and phase difference in the loop wire, resulting

The coaxial loop of fig. 4 as built by the author.



in the shorter specified loop lengths (0.08 wavelength maximum).

The advantage of dual-band reception from a single loop further compromises the design criteria. For those who wish to retain the criteria of references 2 and 3, table 1 has been included. Corrections to table 2 must be made to compensate for this altered construction. Single-band designs would do well to follow the referenced design for maximum performance.

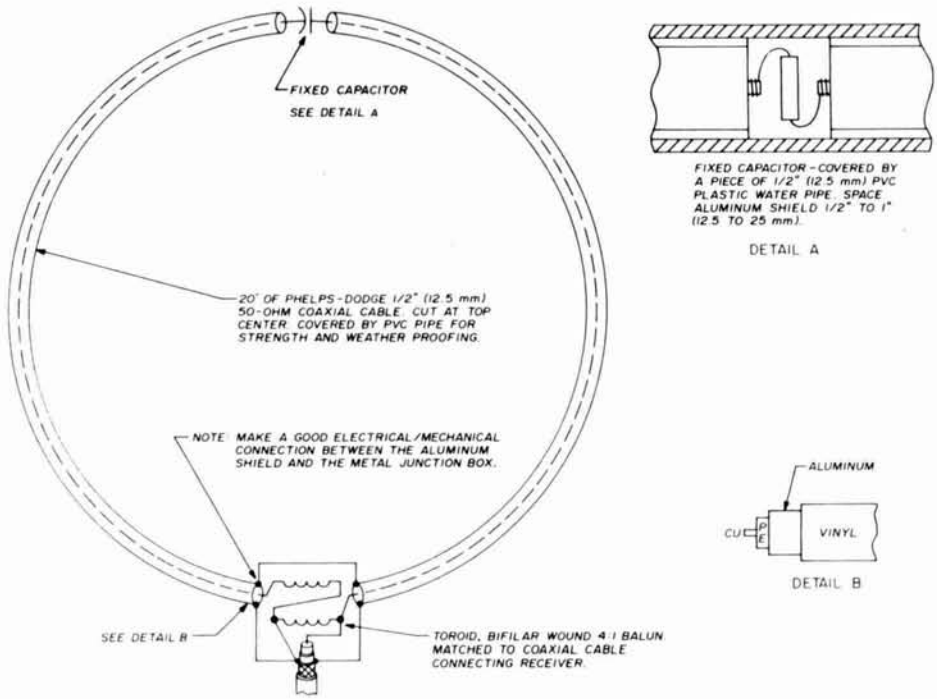


fig. 4. Single-turn coaxial loop antenna suitable for use on 80 and 160 meters. The toroid transformer balances the loop output to ground, whether shield is present or not. Typical dimensions are listed in table 2.

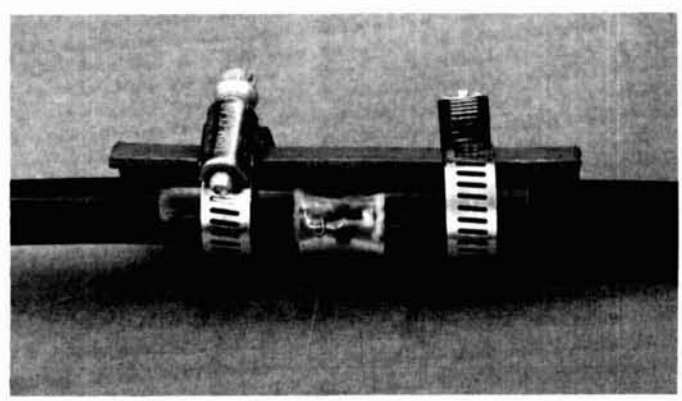
effects of nearby re-radiation

If there are metallic structures near the loop antenna of ample conductivity and size, such as power lines, homes with electrical wiring, water and furnace air-conditioning ducts and piping, as well as antennas, towers and guy wires, etc., signals will be injected into a loop antenna from both the direct signal and re-radiation from these nearby structures. If such structures have high Q and are at or near resonance at the frequency of the exciting signal, their energy may approach that of the direct signal and cause appreciable deviation to the true bearing of the signal source. The resultant voltage induced into the loop will be the vector sum of the amplitude and phase of the multiple sources. Since the amateur is not generally interested in obtaining accurate bearings of signal sources, such deviation is relatively unimportant. What is of prime importance is the amplitude of the desired signal and, secondarily, the depth of

table 1. Maximum wire length for direction-finding loops as specified in references 2 and 3 (0.08 wavelength).

frequency (MHz)	wavelength (meters)	maximum wire length
1.8	166.7	43' 7" (13.28m)
1.9	157.9	41' 4" (12.60m)
3.5	85.7	22' 6" (6.86m)
3.6	83.3	21' 10" (6.67m)
3.7	81.1	21' 4" (6.49m)
3.8	78.9	20' 9" (6.32m)
4.0	75.0	19' 8" (6.00m)
7.0	42.9	11' 3" (3.43m)
7.1	42.3	11' 1" (3.38m)
7.2	41.7	10' 11" (3.33m)
7.3	41.1	10' 9" (3.28m)

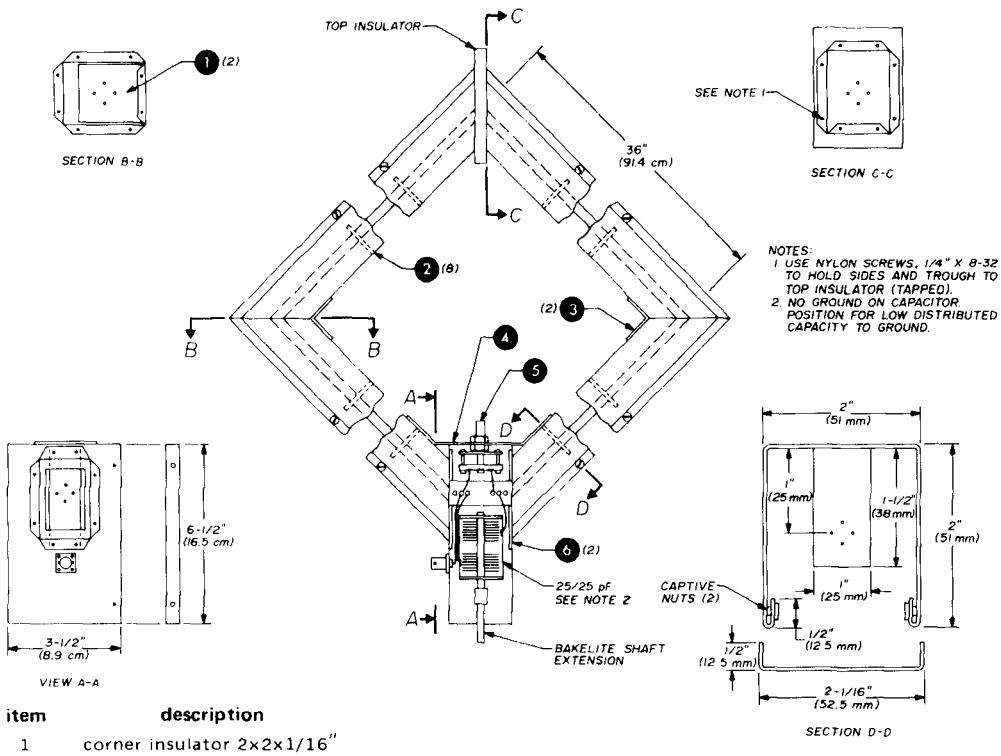
Detail of the break in the coax at top of loop. See detail B in fig. 4.



the null available to reduce the strength of an interfering signal.

If installed with the axis of the loop horizontal, only signals from the horizon i.e., low angle or ground wave, will produce the deep nulls shown. Signals from higher vertical angles will not have their wave front parallel to

lated covering that will provide strength to this point of the loop will be satisfactory, but it should also provide a weatherproof seal to keep moisture out of the break. Before placing the cover on the break, check for peak performance on your desired portion of the band. I used a grid dipper in the shack and tuned its signal in on the



item	description
1	corner insulator 2x2x1/16" (51x51x1.5mm)
2	insulator spacer, 1½x1x1/16" (38x25x1.5mm)
3	stiffeners, semi-hard aluminum, 2" (51mm) wide, 1/16" (1.5mm) thick
4	stiffener, semi-hard aluminum, 2" (51mm) wide, 1/16" (1.5mm) thick
5	five-pole, double-throw rotary switch
6	insulator, junction box, 1½x4x1/16" (38x102x1.5mm)

fig. 5. Double-turn, square-loop antenna for 40, 80 and 160. Typical loop dimensions and tuned-circuit components are listed in table 2.

the plane of the loop and even though the azimuth is correctly set, the signal received will still be appreciable.* Therefore, do not expect many signals to show an extremely sharp null unless provision is made to tilt the loop axis in elevation as well as azimuth.

As shown in **fig. 4**, a practical loop antenna may be built from a single turn of coaxial cable. The shield must be broken as previously explained to remove the "shorted turn" effect. A loop so configured will almost completely shield the electric component of the wave. To insure retention of the figure-eight pattern the two halves of the loop must maintain symmetry as closely as possible.

Detail B of **fig. 4** shows the method used to insert a capacitor between the ends of the inner conductor as well as providing spacing of the outer shield. Any insu-

*This feature of the loop enhances its ability to null out interfering signals, particularly local ground waves or electrical noise, while still maintaining reception of skywave signals. **Editor**

receiver. I noted each frequency for S-meter reading, then substituted various fixed capacitors (and combinations) to center the required bandpass.

An alternate construction method is shown in **fig. 5**. This illustration should provide most of the required construction details. The stiffeners at the junction box, J, and the two side corners were added to reduce the floppyness that existed without them. An even number of turns is required for symmetry since both the inductor and the capacitor are located in the junction box. Two turns (33 inches or 83.8cm on a side) are adequate for 80 and 160 meter operation. For 40 and 80 meters, two turns (16 inches or 40.6cm on a side) would comply with the design criteria of reference 1. For single-band operation, the lengths given in **table 2** provide an optimum signal-to-noise ratio and should result in maximum performance.

The tuneup procedure for the square loop is similar to that for the circular loop. Using a length of coaxial cable with a loop at the end attached to the output

connector, the grid dipper is used to get the resonant frequency of the system near that required. (Caution: The grid dipper will also show a dip at the resonant length of the coaxial cable used.) Vary the number of turns on the primary of the toroid and the fixed paralleling capacitor until the loop shows peak pickup

I have substituted an alternate coupling network shown in **fig. 6** that provides slightly better pickup and higher loaded Q. It has been incorporated in all loops shown in **figs. 4, 5** and **6. Table 3** lists the required components.

The Hula-Hoop was separated, and the twinlead inserted. The loop is then spirally covered with folded

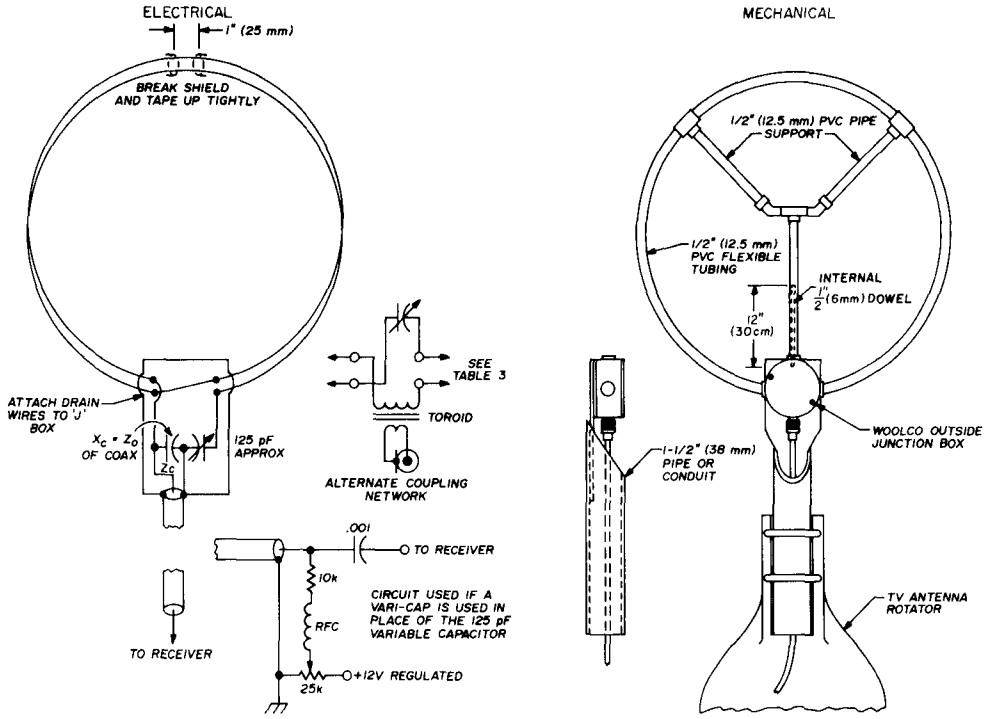


fig. 6. The Hula-Hoop designed by W5DS. The alternate coupling network is suggested. Component values for the coupling network are given in table 3.

near your favorite spot in the band. Then position the loop where it is to be permanently mounted, with the required length of coaxial cable to connect it to the receiver, and inject a grid dipper signal into it. Plot the S-meter reading for each frequency. Adjust the inductor and capacitor until the bandpass is centered on the desired frequency.

(two layers, 3-inches or 76mm wide) heavy-duty aluminum foil with a number-15 (1.5mm) aluminum drain wire to provide connection for the foil shield. This was then continuously taped with vinyl electrical tape for weatherproofing. The aluminum wire is connected to the junction box to provide a path to ground for currents induced by the electric component of the wave.

table 2. Wire lengths and tuning capacitors used in the loops of figs. 3 and 4.

	frequency (MHz)	loop size	wire length	number of turns	toroid turns primary	toroid turns secondary	capacitor (pF) variable	capacitor (pF) fixed
coaxial cable loop	1.8 MHz	8'3" (2.5m)	26' (7.9m)	1	20/20 balun		0	500
	3.8 MHz	6'3" (1.9m)	20' (6.1m)	1	10/10 balun		0	125
square loop	1.8 MHz	36x36" (91x91cm)	48' (14.6m)	4	40	8	15-15	0
	3.5 MHz	36x36" (91x91cm)	24' (7.3m)	2	24	6	15-15	40
	7.0 MHz*	36x36" (91x91cm)	24' (7.3m)	2	12	7	15-15	75

*This loop built before reading references 2 and 3 so wire is considerably longer than 0.08 wavelength. Although it works fine, the design criteria of those references is recommended.

A third arrangement is shown in **fig. 6.** It was suggested by Bob Edlund, W5DS, who has named it the "Hula Hoop Loop" due to the basic material used to support the loop wires. A single-turn of TV twinlead is used to provide a two-turn loop when series connnected.

I used a 10-foot (3-meter) length of ½ inch (12.5mm) PVC tubing in place of the Hula-Hoop. This in turn is supported by ½ inch (12.5mm) PVC water pipe and fittings to form a Y-shaped support for the loop. A ½-inch (12.5mm) wooden dowel, boiled in beeswax, was

inserted into the vertical member of the Y support, terminating in the junction box to increase strength against wind torque at this point. The coupling networks shown will provide a good match between the loop and the coaxial line to the receiver.

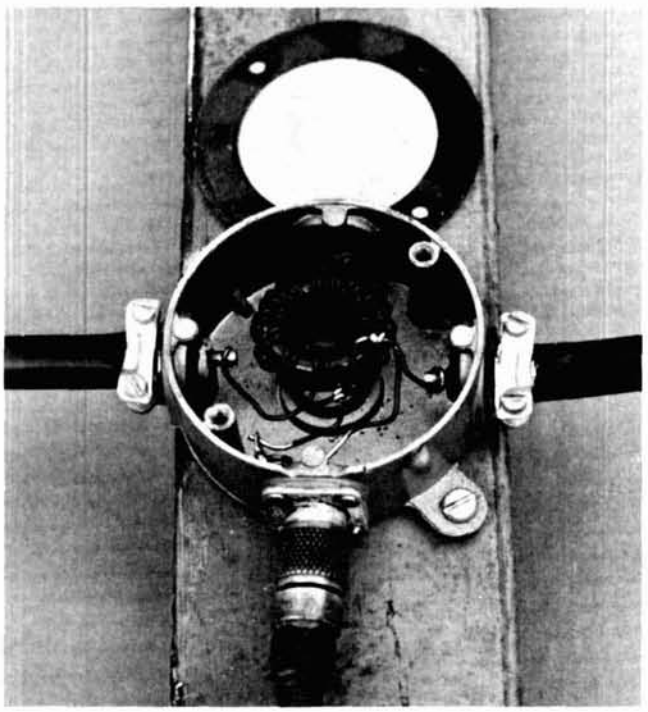
In an attempt to remotely tune the loop a voltage-variable capacitor (varicap) was substituted for the capacitor in the loop-coax coupling network. John Venters, K4UR, suggested, and provided, a silicon planar epitaxial diode (ITT type BA163) which, when reverse biased with 1 to 12 volts dc, provides a capacitance range of 10 to 260 pF. However, when feeding the varicap via the rf coaxial line with the required rf chokes to isolate the dc from the rf, the loaded Q dropped to about 10 (indicating the introduction of some form of undesired loss resistance). The convenience such a device would provide is worth further investigation; however, still to be found is a way to use the varicap and retain high Q. With the coupling networks shown, the loaded Q is in the vicinity of 75. This provides a 50-kHz bandwidth (at the 6 dB points) which is adequate on 80 meters if you operate near one spot most of the time.

table 3. Components for the alternate coupling network shown in fig. 5.

frequency	twinlead length	loop diameter	approximate capacitance (pF)	type	toroid primary turns	secondary turns
1.8 MHz	20' (6.1m)*	3'3" (99.1cm)	150	T106-2	14	8
3.5 MHz	10' (3.0m)	3'3" (99.1cm)	110	T68-2	12	7
7.0 MHz	5' (1.5m)	1'7" (48.2cm)	75	T56-2	10	6

*Two turns (be sure capacitor is centered in loop).

The 4:1 balun for the coaxial loop, mounted in the Woolco junction box.



In all loop configurations and couplers I tested there is a loss of about two S-units of signal pickup with respect to the vertical radiator I use for transmitting on 40 and 80 meters. Some of the weaker signals are then below the noise level of the receiver. A low-noise front-end preamplifier/preselector, similar to that described recently in *QST*[5] provides about 20 dB gain and puts the signal back up where the receiver can detect even the weakest signals.

conclusions

Comparing the loops against my "Five Band, Tower Antenna System"[6] for receiving, I get about five S-units reduction of man-made noise and precipitation static,* with only a loss of a couple of S-units of signal pickup.

Since the radiation resistance of such a small loop on the wavelengths involved is less than one ohm, it would make a very poor transmitting radiator.

*Atmospheric noise is propagated entirely by the radiation field so it *cannot* be reduced by using a shielded loop antenna. Precipitation static which is due to wind-blown rain, on the other hand, is an induction field and *can* be reduced by using a shielded loop. **Editor**

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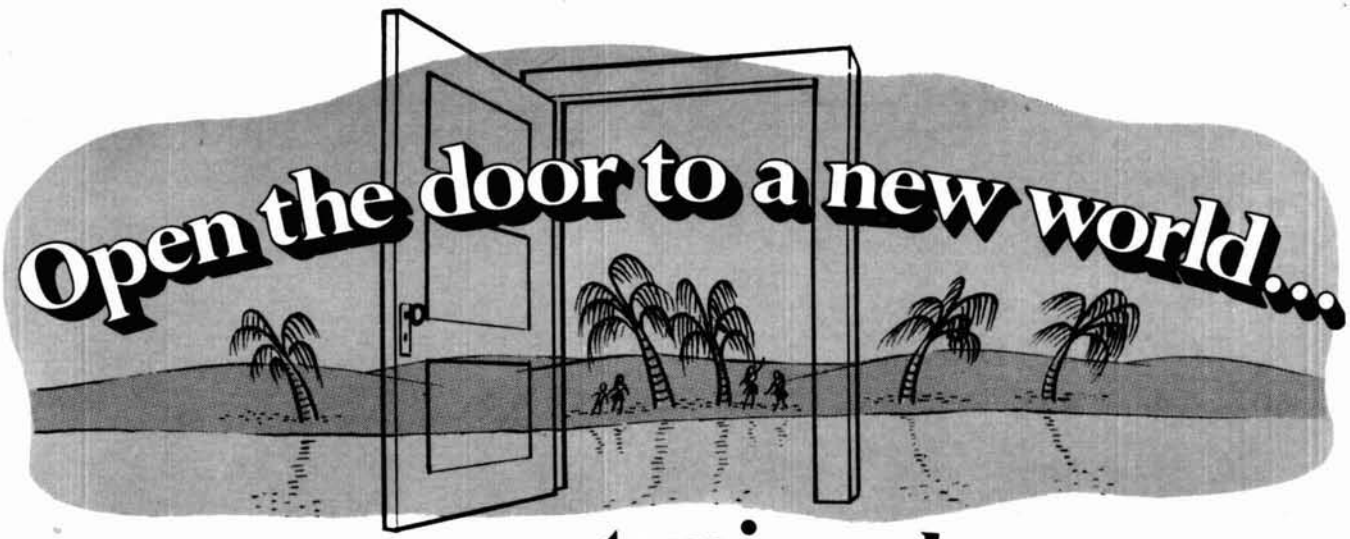

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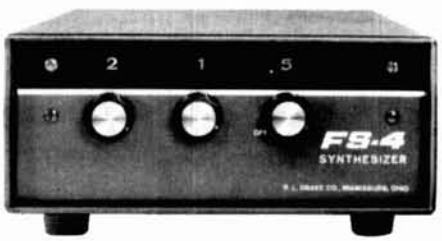

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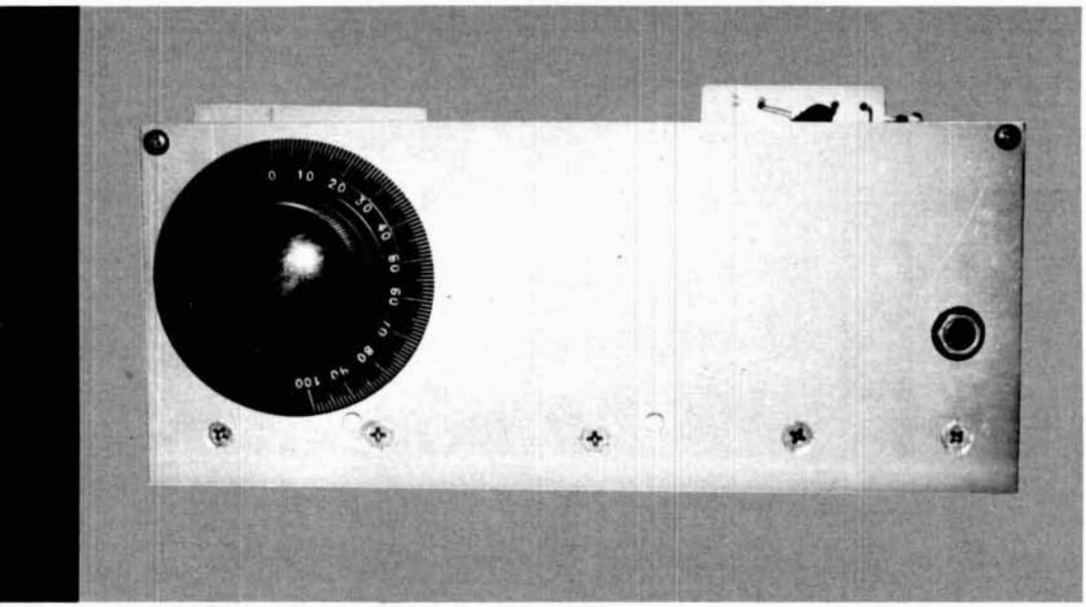

QRP transmitter

for 7-MHz CW

This little rig is still in the low-power class, but it will make a big difference on the crowded 40-meter band

The amateur radio literature over the past several years has described numerous solid-state QRP transmitters. Most of these transmitters have been in the power range of milliwatts, some a little higher and a few as high as 5 or 10 watts. These articles have made significant contributions to the development of better solid-state transmitters and have also kept interest high in building and testing such transmitters. The authors wish to thank all who have published their circuits and designs, thus enabling others to experiment and build designs of their own.

The CW transmitter described here is not just another low-power rig. It has some features that make it interesting, very inexpensive to build and, using a twenty-cent transistor in the final stage, it provides 20 to 30 watts input. The CW note is a pure delight to hear. All the transistors, which cost from twenty to fifty cents, are easily obtainable from Poly Paks, Radio Shack, and many surplus radio parts dealers.

The transmitter can be duplicated easily as it contains no critical circuits. It is built on five pieces of perf board, although etched PC boards would be the best construction approach. One such transmitter, built into a transceiver, has worked into most of the U.S., parts of Europe, and Australia.

power supplies

Before discussing the transmitter circuits, we'll talk about power requirements. A power supply must deliver

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the quality and quantity of current and voltage required by the transmitter or problems will occur such as instability, poor performance, burned-out transistor, chirps, and key clicks.

This transmitter uses two separate power supplies. The first is a 12-volt, well-filtered and regulated supply capable of delivering up to 1 ampere. The transmitter will require about 250 mA from this supply. Reference 1 describes the power supply we used. The second supply powers the final amplifier transistor. It's a very useful power supply for transistor experimentation and test work, providing a well-regulated output to about 3 amperes at variable voltages between 5-30 volts. Its three transistors can be purchased for less than a dollar each. This power supply could be updated with an IC voltage regulator, but the circuit of reference 2 was used and is recommended.

circuit description

The transmitter has five stages, **fig. 1**. The vfo and doubler run continuously when the transmitter is keyed. The keyed stage, buffer amplifier Q5, Q6, operates in class C. Although collector voltage is present on this stage during operation, it has no rf output until the key is closed. Power to the vfo, doubler, buffer, amplifier, and driver is supplied by the 12-volt supply. The final

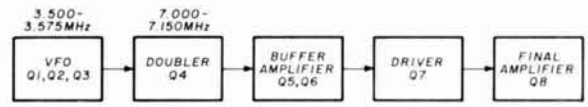
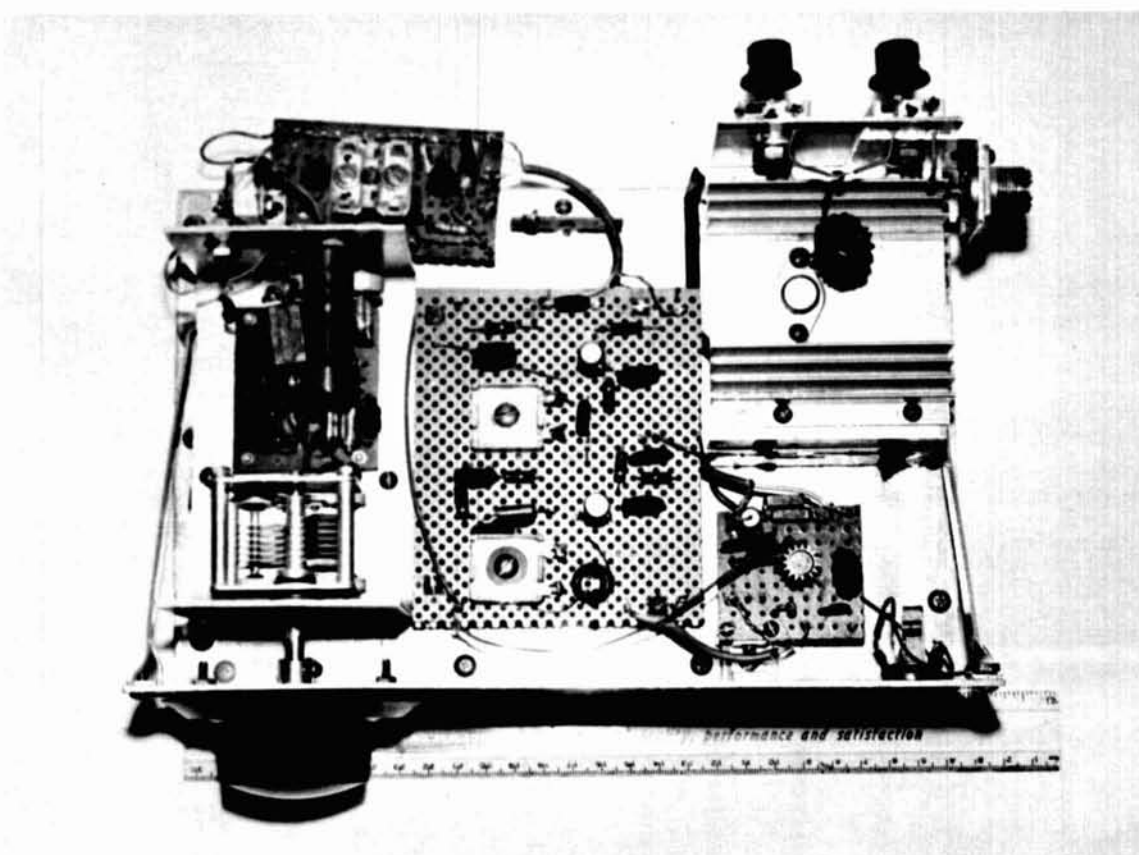


fig. 1. QRP transmitter block diagram. Eight low-cost transistors provide 2-30 watts input power for beefing up your CW signal on 40 meters.

amplifier, which also operates in class C, is powered by the variable 5 to 30 volt supply. Voltage to the other stages must be turned off during receive so you can hear the other fellow in your receiver.

Variable-frequency oscillator. The vfo (**fig. 2**) is straightforward, using an fet in a Colpitts configuration followed by an amplifier stage and an emitter follower for isolation. The vfo tunes 3.5-3.575 MHz. If you wish, you can make it tune the entire 75-meter band and have as much bandspread as desired. This circuit has little bandspread, however, as we're concerned with only 125 kHz of the 40-meter band, including the Novice portion.

The significant feature of this vfo is that frequency doubling from 3.5 to 7 MHz is used. This technique avoids pulling effects on the vfo frequency when keying the transmitter. The note you hear is the note that goes out over the air — crisp, clean, and chirpless. A 6.8-volt



The completed QRP 7 MHz CW transmitter. Vfo section is at left with the frequency doubler mounted at its rear. Buffer amplifier and doubler are shown at right, with the final amplifier removed from the chassis.

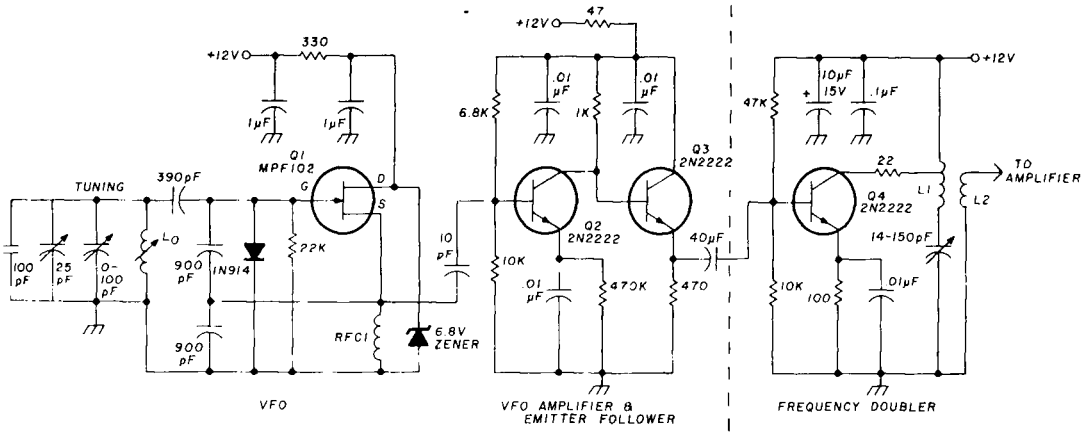


fig. 2. Vfo and frequency-doubler schematic. Circuit provides a stable, harmonic-free output to drive succeeding stages.

zener in the drain of Q1 and a high-speed switching diode in its gate ensure low harmonic content in the vfo output. The 1N914 acts as a clamp on the positive-going half cycle of the oscillator signal, thus preventing Q1 from reaching an operating point where high harmonic content may occur. Although many other transistors could have been used for the vfo amplifier, emitter-follower and doubler, the 2N2222 was chosen on the basis of performance and low cost.

Buffer amplifier. In this stage we begin to get a lift in rf output. **Fig. 3** shows the circuit, which uses two 2N3053s in class B. The 2N3053 will easily dissipate the power, provided it has a proper heatsink. The 12-volt supply to the collector must be well bypassed, and ferrite-bead chokes must be used on the collector leads. This is the keyed stage: the 2N3053 emitters aren't grounded until the key is closed. The component values shown in **fig. 3** will permit this stage to function as a stable amplifier. Neutralization wasn't found to be necessary.

Driver. The driver is the simplest of all the stages. It operates as a class-C amplifier. The reliable 2N3053 is also used here, and it *must* be installed in a heatsink, otherwise it will be zapped. If this occurs, the 12-volt power supply will draw excessive current.

Final amplifier. So far we've been concerned with stages resonant at 3.5 or 7 MHz. In the final amplifier stage, however, we must think not only of having a 7-MHz resonant output circuit but must obtain an output impedance close to 50 ohms to match the antenna feedpoint impedance.

The final amplifier (**fig. 3**) also operates in class C. The input circuit to Q8's base uses a tuned-T network, and the collector output circuit uses a pi network so that the amplifier output impedance will be near 50 ohms. Rf

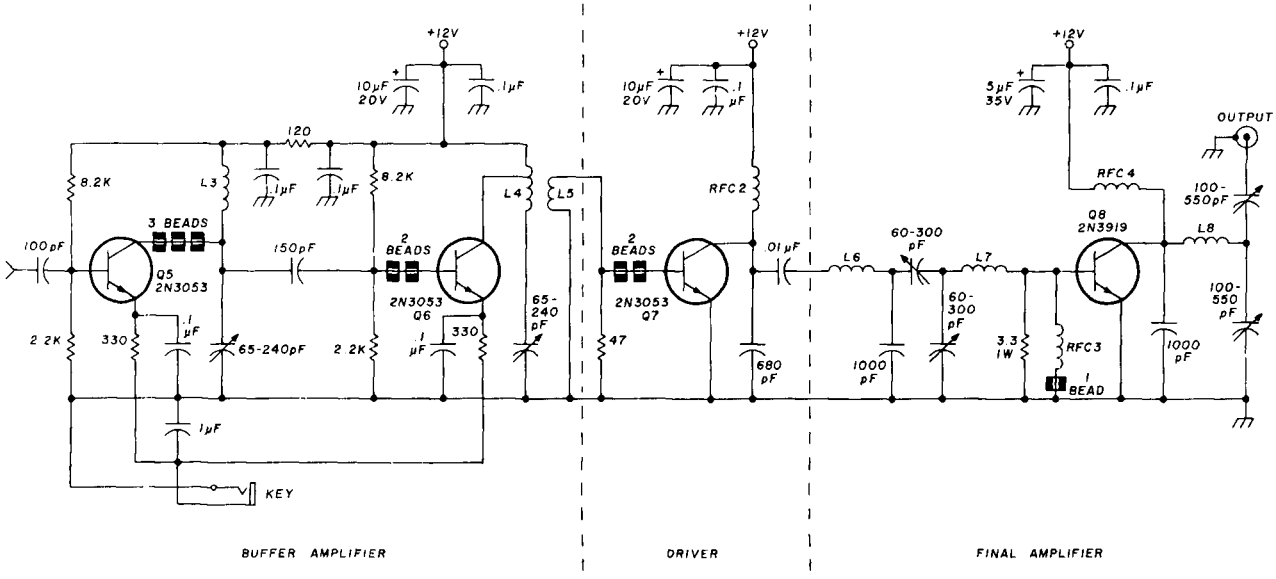


fig. 3. Buffer amplifier, driver, and final amplifier schematic. Note the use of toroid coils for resonant circuits and liberal use of ferrite beads for decoupling.

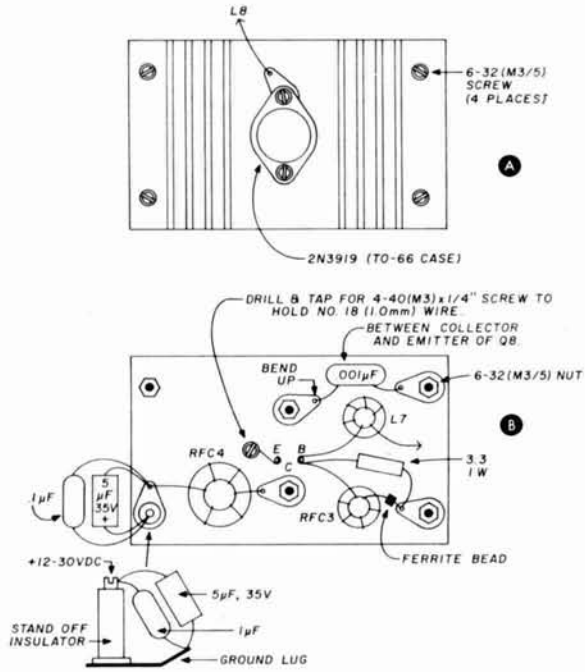


fig. 4. Construction details for the final amplifier. Sketch A shows mounting of the 2N3919 in its heatsink; B shows underchassis wiring and parts location.

bypassing and rf chokes are important. This stage is built on a heavy aluminum heatsink, so the transistor barely gets warm while dissipating nearly 30 watts. It's hard to find a low-cost transistor on today's market to beat this one (Fairchild 2N3919 or Poly Paks 92CU1234). One word of caution: when testing you *must* use a 50-ohm dummy load. Adequate drive must be provided to this stage before it will function. References 3 and 4 are suggested for further reading.

construction

As mentioned earlier, the transmitter is built on five perf boards. Prepunched boards may be obtained from such as Vector T-28 or flea clips (Lafayette Radio 198302) work well on this board. Arrange the parts on the board for a symmetrical layout, bearing in mind the necessity for short rf leads and adequate bypassing. Avoid crowding and try to keep dc voltage wiring isolated physically from circuits carrying rf voltages. Install a wire around the board periphery to serve as a ground plane for connecting all circuits to be grounded; this will avoid ground loops and feedback problems. The nice thing about perf-board construction is that you can rearrange parts until you're satisfied with the layout without touching a soldering iron.

Close-up view of the final amplifier. L8 is shown wound on the toroid.

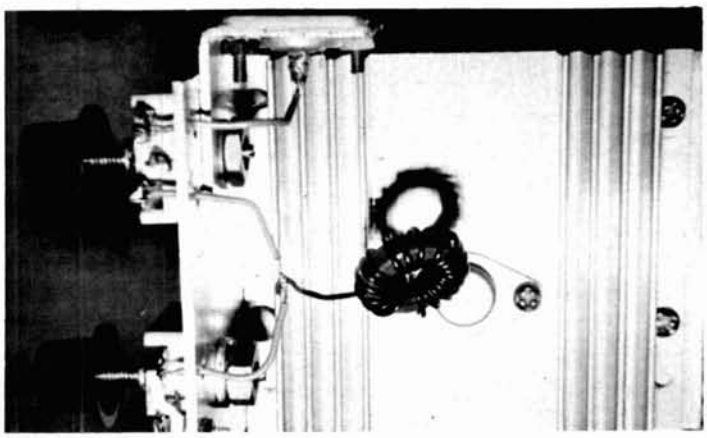


table 1. Construction data for the inductors used in the QRP transmitter.

RFC 1	1 mH (not critical)
RFC 2	60 or 70 turns no. 28 (0.3mm) enamelled wire on T50-2 toroid core (Amidon). Fill core with wire.
RFC 3	25 turns no. 28 (0.3mm) enamelled wire on T50-2 toroid core (Amidon)
RFC 4	75 turns no. 28 (0.3mm) enamelled wire on T68-2 toroid core (Amidon)
L0	40 turns no. 26 (0.4mm) enamelled wire close wound on ½ in. (12.5mm) O.D. slug-tuned coil form
L1	27 turns no. 28 (0.3mm) enamelled wire on T50-2 toroid core (Amidon), tapped 7 turns from plus end of coil
L2	3 turns no. 22 (0.6mm) enamelled wire over L1
L3	21 turns no. 28 (0.3mm) enamelled wire on T50-2 toroid core (Amidon)
L4	27 turns no. 28 (0.3mm) enamelled wire on T50-2 toroid form (Amidon), tapped 7 turns from plus end of coil
L5	3 turns no. 22 (0.6mm) enamelled wire over L4
L6	14 turns no. 22 (0.6mm) enamelled wire on T50-2 toroid core (Amidon)
L7	14 turns no. 22 (0.6mm) enamelled wire on T50-2 toroid core (Amidon)
L8	17 turns no. 22 (0.6mm) or no. 18 (1.0mm) enamelled wire on T68-2 toroid core (Amidon)

Plastic transistor sockets are used for all devices except the final-amplifier transistor, which is packaged in a TO-66 case and mounted directly on a heavy heatsink. Coil data is provided in **table 1**. **Fig. 4** shows parts layout for the final-amplifier stage. Note that this stage is built on a separate chassis, which includes the heatsink for the 2N3919 (**fig. 5**). The sketches in **fig. 5** also provide overall dimensions for the frame that contains the five chassis.

test equipment

A few essential instruments will be needed for testing and making measurements. A vtvm with an rf probe capable of measuring up to 25-30 volts will be needed. The Heath Company stocks one that is a good buy, or if you want to build one a description appears in reference 5. Another useful item is the absorption frequency meter, also described in reference 5. A grid-dip meter is needed to determine resonant frequencies of toroid coils

and LC circuits. To save headaches later on, all toroid LC circuits should be tested before wiring them into the stages to ensure they are resonant and cover the proper frequencies.

A dummy load capable of handling about 8 watts is needed. It can be made by paralleling four 200-ohm, 2-watt resistors or some other combination of resistors to give 50 ohms and a power capacity of 8 watts or more.

When you complete construction of a stage, it should be tested with respect to the preceding stage. When you reach the last stage, be sure it has adequate rf drive. Connect the 8-watt dummy load to the SO239 output connector. You are now ready to test the completed transmitter.

Starting with 12 volts on the final-amplifier transistor, key the transmitter and tune all stages for maximum rf output using the vtvm probe. Two precautions: be sure your rf probe will handle 30 volts and *don't* test without dummy load. It's best to peak the final amplifier stage first, work back to the vfo, then repeak the final stage. Now you can release the key and advance the final-amplifier voltage to 20 volts. Key the transmitter and peak the four capacitors in the final. By working incrementally and peaking the final stage each time, you can in one or two more steps obtain an input of 25-30 volts at 700-850 or more mA. Thus at 30 volts at 850 mA you are putting 25.5 watts into the final transistor and will obtain 8 or more watts output. You can calculate your output power from E^2/R by measuring the rf voltage across the 50-ohm dummy load — pretty good performance for a few inexpensive transistors.

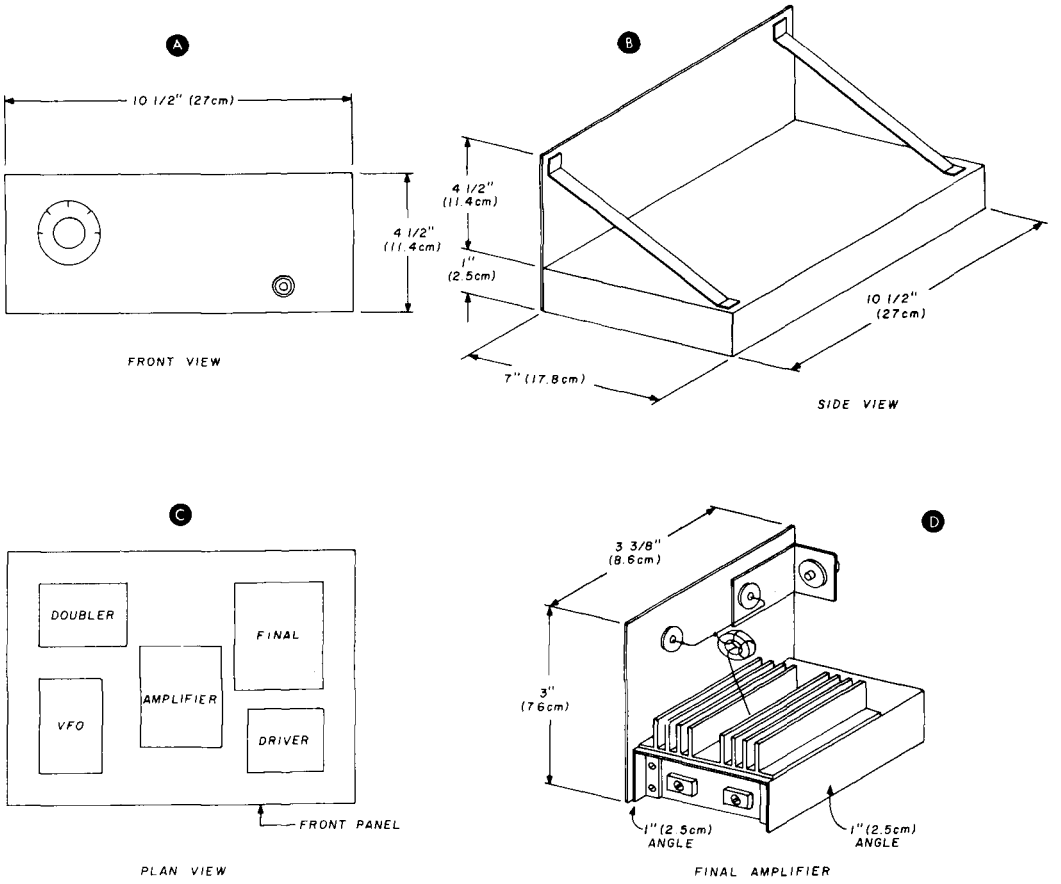


fig. 5. Dimensions and layout of the QRP transmitter. Sketches A through C show details of the main chassis; D shows the final amplifier arrangement.

When you connect the transmitter to the antenna, all you'll have to do is peak the capacitors in the final pi network for a maximum output. A tuning indicator is required here, such as an swr indicator. If there is a high swr, better antenna efficiency will be obtained with an antenna tuner.

references

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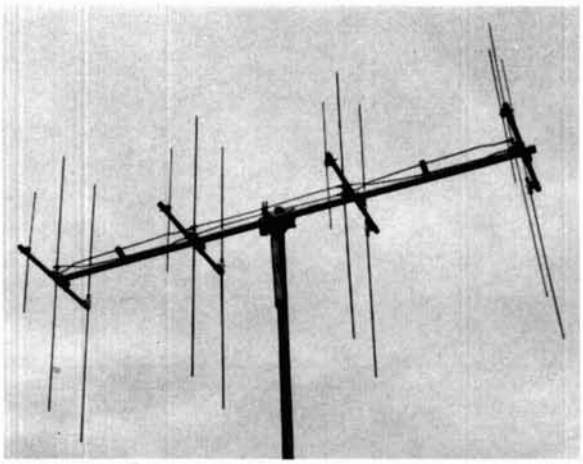
3. "Matching Network Design and Computer Solutions," *Motorola Application Note AN267.*
4. Wes Hayward, W7ZOI, "Increased Power for Solid-State Transmitters," *QST,* May, 1972, page 19.
5. "Rf Probe for Electronic Voltmeters," *The Radio Amateur's Handbook,* ARRL, 1975, pages 535-536.

ham radio

VHF DX



FM —

Enjoy the thrill of dependable long distance contacts on simplex or thru remote repeaters. The 20 element co-linear DX-Array offers a precise pattern with large capture area. This vertically polarized, horizontally stacked array provides a narrow beamwidth for the discriminating FM user. Wide impedance and gain bandwidths make the DX-Array a natural choice for the serious FM'er. A vertical polarization bracket, model DX-VPB, is required (support boom and mast not supplied). Seek out new horizons with DX-Array!

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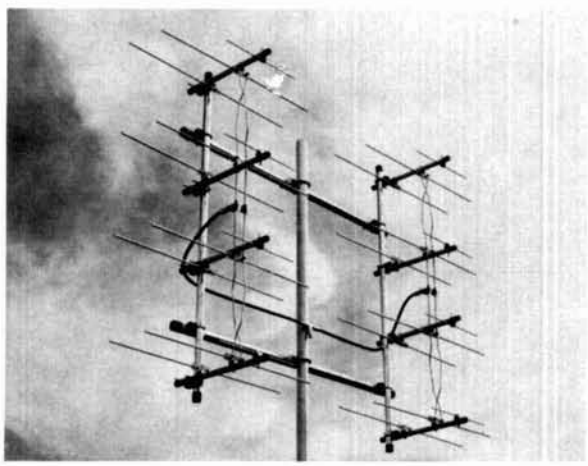
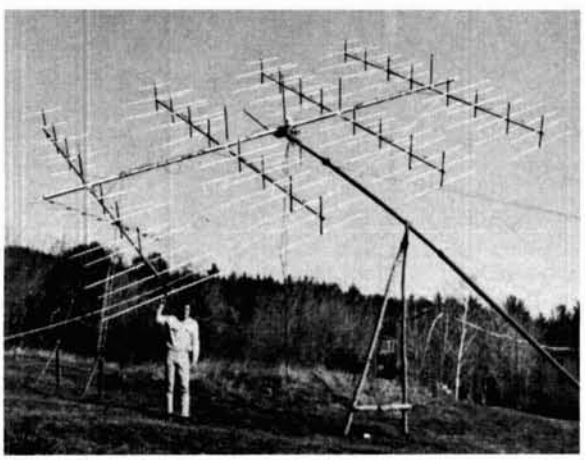
Discover reliability in long-haul communications with VHF SSB and CW. The Cush Craft DX-Array also gives low angle, high gain performance for many exotic propagation modes — tropo, aurora, sporadic-E, and meteor scatter. Horizontally polarized DX-Arrays may be used singly or combined in pairs (twice Effective Radiated Power) or quads (4 x ERP). Each DXK stacking kit is complete with stacking frame and phasing harness (vertical mast not supplied). This year has seen some spectacular VHF band openings — Don't miss the next one!





Dave Olean, K1WHS, with his 160 Element DX-Array and Polar Mount EME System

EME —

Many VHF experimenters have found excitement in conquering the formidable Earth-Moon-Earth (EME) path. 2-meter moonbouncers have achieved outstanding success using eight stacked DX-Arrays. Impedance and gain characteristics of this antenna permit stacking without the critical detuning problems inherent in large arrays of Yagis. Enlarging system size will yield a more uniform gain increase with DX-Arrays than with many other large antennas. The physical configuration alleviates mounting and phasing/tuning problems. EME enthusiasts are setting new records — So can you!

DX-ARRAY LEADS THE WAY!

Description:	*144 MHz.* Model:	Price:	*220 MHz.* Model:	Price:	*432 MHz.* Model:	Price:
20 Element DX-Array	DX-120	$39.50	DX-220	$32.50	DX-420	$29.50
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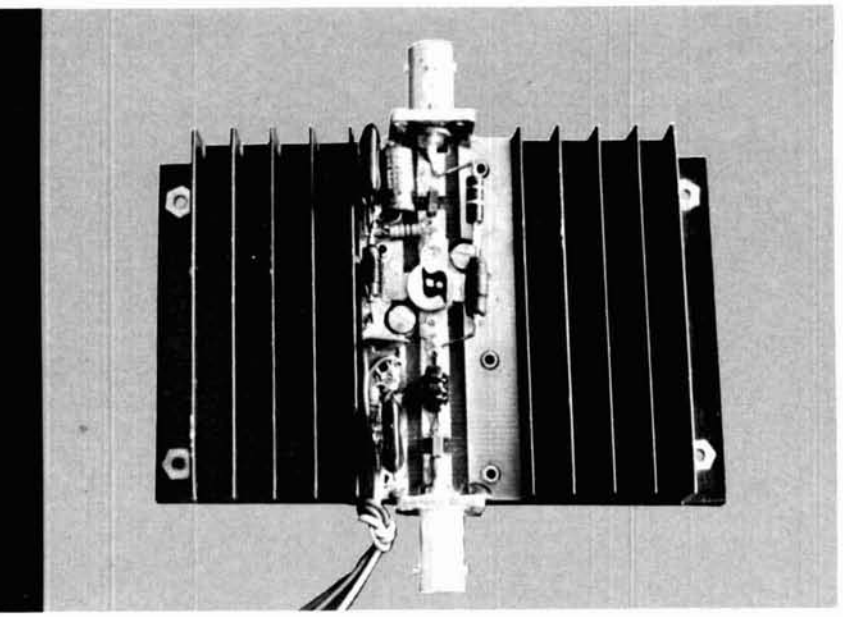
Frame & Harness (80 El.)	DXK-180	$100.00	DXK-280	$85.00	DXK-480	$70.00
1-1 52-ohm Balun	DX-1BN	$10.95	DX-2BN	$10.95	DX-4BN	$10.95
Vert. Pol. Bracket (20 El.)	DX-VPB	$8.95	DX-VPB	$8.95	DX-VPB	$8.95

More Details? CHECK—OFF Page 142



mospower fet as a broadband amplifier

A new type of power transistor provides linear performance over three vhf bands without switching

The *Mospower* fet introduced by Siliconix* in late spring, 1976, is undoubtedly the most revolutionary semiconductor in decades and one that will open up exciting new applications heretofore impossible with bipolar transistors. Switching of 1-ampere in less than 4 nanoseconds is commonly accomplished with this new power mosfet. Among the many new features is one in particular that will interest those who seek wide dynamic range: a linear transfer characteristic! Imagine too a transistor that can double for either a linear power amplifier or a wide dynamic range, low noise, small-signal, front-end transistor!

Other features of the *Mospower* device are typical for field-effect transistors and would be especially desirable for bipolar transistors. As with all fets, there is no thermal runaway nor secondary breakdown, and no minority-carrier storage time. The latter opens up interesting applications for class-D (switching) amplifiers. Additionally, the *Mospower* fet can accept any vswr — open or short — at any phase angle without debilitating effects. This enhancement mode, N-channel, mosfet can be operated in any class (A, AB, B, or C) without requiring a bias supply.

Unlike the usual mosfet, which is *planar* in construction, the *Mospower* fet is a four-layered vertical structure shown in **fig. 1**. This drawing compares, somewhat oversimplified, the fundamental differences between MOS, DMOS and VMOS — which is the generic name for the *Mospower* structure. Common to both MOS and DMOS (but not VMOS) is the singular disadvantage which affects their power handling capabilities: the geometry requires massive area to handle the necessary current. A further disadvantage of MOS and DMOS lies in their inability to accept high voltages. In the *Mospower* fet the current travels vertically, the source being on top while the drain is the bottom of the chip. In this vertical structure there are four layers whose dimensions are controlled by diffusion processes rather than by the less precise photolithographic methods common to planar (MOS) technology.

VMOS construction offers high current densities, high source-to-drain breakdown capability, and low gate-to-drain feedback capacitance, which makes the *Mospower* fet a great device for hf and vhf applications. Probably the most attractive aspect of this revolutionary semiconductor is its inherent linear transfer characteristic. In conventional mosfet (and jfet) devices this transfer characteristic is closely identifiable to a square-law

By Ed Oxner, Siliconix, Inc., 2201 Laurelwood Road, Santa Clara, California 95054

*Mospower is a trademark of Siliconix, Incorporated.

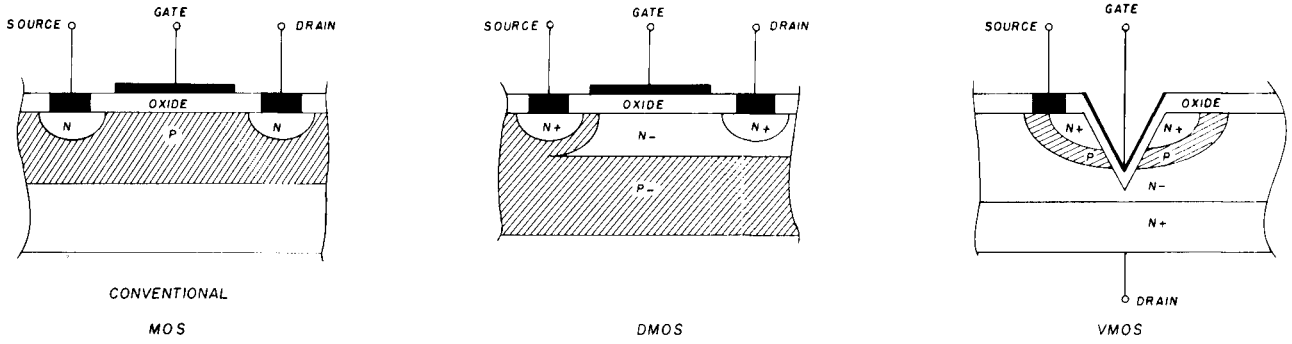


fig. 1. Fundamental differences in enhancement-mode MOS structures.

response; that is, the drain current is proportional to the square of the gate-to-source voltage. However, in the VMOS structure the short channel causes the drain current to be linearly proportional to the gate-to-source voltage. **Fig. 2** is a transfer characteristic which shows this effect.

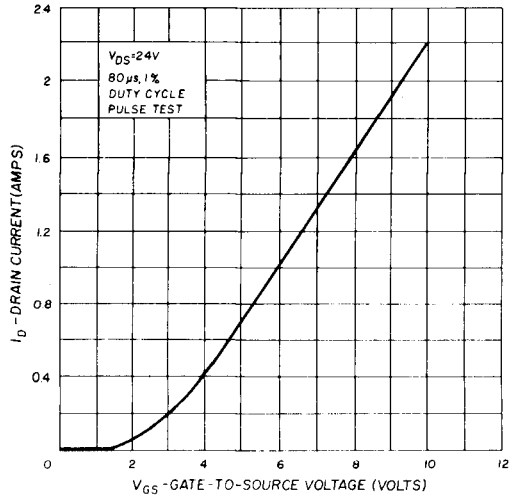
mospower vhf fet

The Siliconix VMP4 is packaged in the popular flange-mount, "opposing-emitter" (in this case, opposing-source) stripline configuration. This transistor is capable of saturated output power approaching 20 watts at 160 MHz. The performance shown in **fig. 3** represents the available *saturated* output power versus frequency when both the input and output impedances of the VMP4 are conjugately matched (but *not* in the circuit described in this article). The input and output impedances (in the common-source configuration) are particularly well-suited for wideband amplifier service with *complete stability*. Unlike bipolar power semiconductors these impedances are affected very little by drive levels.

the circuit

Simplicity is an understatement for the wideband power amplifier shown schematically in **fig. 4** and in the photo of the finished amplifier. Unlike many claims for broadband performance, this amplifier, by virtue of a negative feedback circuit, performs with flat gain response (±0.5 dB) over its entire operational bandwidth.

fig. 2. Transfer characteristic of the VMOS structure.



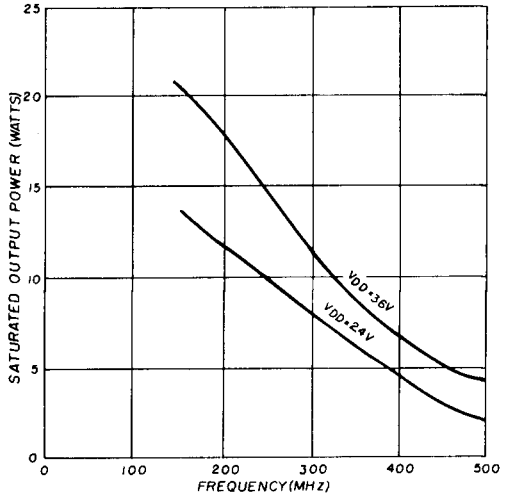


fig. 3. Showing the output power (saturated) versus frequency of the Siliconix VMP4. This assumes that the input and output impedances are matched. Drive power is 1 watt, drain current is 0.8 amp.

Two interesting features are immediately apparent in the circuit diagrams: first, the simple 4:1 transformer for broadband input matching and, second, effectively no matching circuit at the output. My philosophy is, "Why use parts if they're really not necessary?" The drain circuit needs no further complication. Some readers may question the wisdom of such an over-simplistic design, especially in light of the familiar equation

$$R_O = \frac{(Vcc - Vsat)^2}{2P} \qquad (1)$$

where R_O = output impedance, V_{cc} = drain supply voltage, V_{sat} = saturated drain-to-source voltage, and P = output power.

However, using this formula and making a few first-order assumptions, we can arrive at some near 50-ohm values

for the drain load impedance; for example

$$R_o = \frac{(25 - 3)^2}{2 \times 4} = 60.5 \text{ ohms}$$

To reach the lowest operational frequency requires a ferrite core with reasonably high permeability, but in this design 6 meters was my low-end goal and the 220-MHz band uppermost, so an operational bandwidth extending from 40 to 265 MHz was chosen. Only one circuit trick was required to reach the upper frequency objective and in reality it wasn't so much a circuit trick as a careful selection of component. I do not recommend the use of a commercially available molded 0.15 μH feedback inductor – manufactured inductors appear to exhibit too much distributed capacitance for this application. I used 6 to 8 turns of no. 30 AWG (0.25mm) enameled wire on a ½-watt, 1-megohm resistor. If you have an inductance bridge you can wind the choke to 0.15 μH, otherwise you may need to experiment. Using a commercially molded choke will severely reduce the upper-frequency limit.

About the only difficult aspect in building this circuit is preparing the double copper-clad board to accept the flange-mounted stripline transistor. Careful layout and cutting is required. As with any rf layout be sure to connect both copper foils (top and bottom) together, either with small eyelets or what-have-you. Additionally, remember that the *Mospower* fet is MOS and has an unprotected gate, so don't handle it without first being absolutely sure that you are not carrying a static charge. Stay off rugs and out of crepe-sole shoes until you've got the transistor soldered into your circuit. Once in the circuit you're free to do anything you want to with your amplifier.

Since this transistor operates with healthy currents it is absolutely necessary to mount the flange to a suitable heatsink. The large one shown in the photo is an overdesign but it does emphasize that a heatsink is necessary. As is typical with any heatsink, you should use a suitable silicon grease or thermal compound between the flange and the sink.

A second precaution common to any high-current load is to avoid current-carrying molded chokes that may vaporize when the power is applied. I have found, quite by accident, that generally speaking, values of inductance *less than* 0.22 μH will hold up with currents of 1.5 amp or less. Further proof of reliability in regard to this construction is that I have built four identical amplifiers and all performed equally well.

An interesting aspect of this wideband amplifier is that performance does not seem dependent upon whether you use it for a small-signal amplifier, say in the microwatt area of a front-end receiver design, or for medium power (1 to 2 watts) amplification, possibly to excite a linear final amplifier.

Of special interest to those advocates of wideband amplifiers will be the observation that in a *Mospower* fet amplifier the wideband noise is literally unmeasurably low! For an example, this VMP4 (and any other VMP device) offers excellent small-signal noise figures. A typical value of 2.4 dB at 146 MHz is easy to achieve

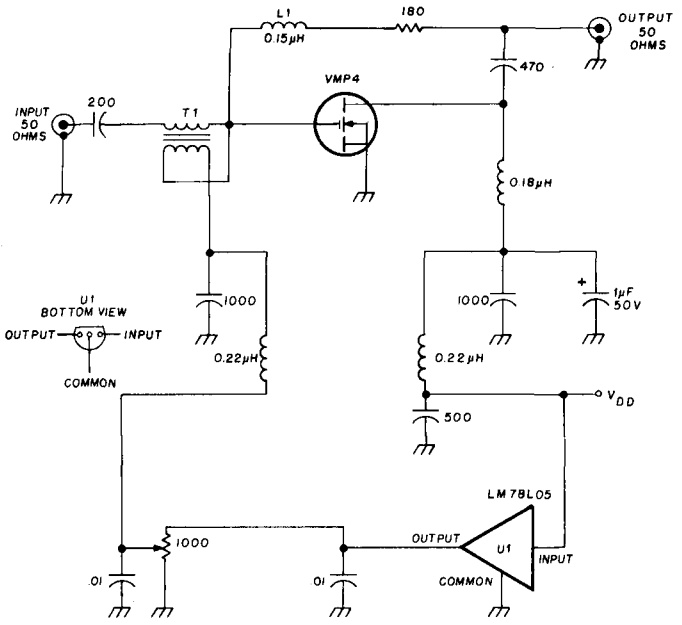


fig. 4. Simplicity is the keynote in this broadband amplifier. L1 should not be a molded choke; see text for winding information. T1 is 4 turns no. 22 AWG (0.6mm) twisted pair on an Indiana General F625-9Q2 toroid core.

with a properly matched input circuit. However, it should be pointed out that this particular circuit using the 4:1 matching transformer is *not* properly matched for optimum small-signal noise figure; that was not the objective in the first place. Bandwidth for two power levels is shown in **fig. 5**. With 1-dB compression occurring at an input level of +23 dBm, the +27 dBm input level is understandable under compression, hence the lower gain figure.

Two-tone, third-order intermodulation performance at both the 100-mW and the 1-watt output levels is displayed in **fig. 6** as intercept point (IP). This point was calculated with reference to a single-tone output, using the formula

$$IP\,(dB) = P_{out}\,(dB) + \frac{P_{imd}\,(dB)}{2} \qquad (2)$$

When calculating the intercept point, or when comparing specifications between devices, care must be

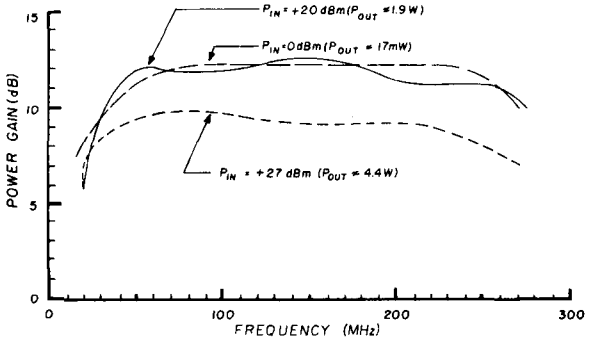


fig. 5. Power gain versus frequency curves at different levels of drive. The +27 dBm curve is above the compression point, therefore the gain is lower.

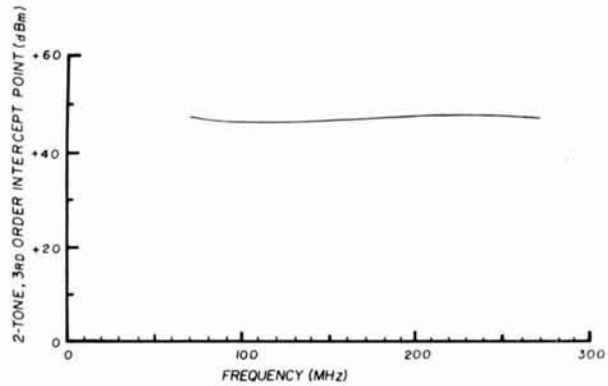


fig. 6. Two-tone, third-order intercept point for the Siliconix VMP4 power fet. V_{dd} is 26V, I_d is 0.4A. Intercept point was referenced to a single tone. Power levels were 100 mW and 1 watt.

taken to know how the numbers were obtained. Some manufacturers may use the PEP output as a reference; others may use average power. A more conservative rating may be obtained by using the single-tone output as a reference, as in **fig. 7**.

Another interesting feature of the VMP4 *Mospower* fet is that it is not sensitive to load mismatch; there is no need to panic if you disconnect the output cable during testing or tuning. Should a slip occur during a tweaking session, sparks may fly from the metal tool, but when things have calmed down again, the fet will still be ready for action. *Mospower* fets appear to have three funda-

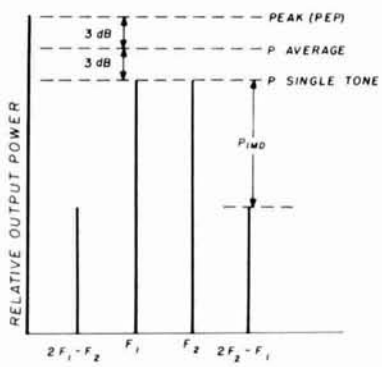


fig. 7. Three common methods of rating IMD performance. The most conservative uses a single-tone output as a reference.

mental advantages; very easy to match; extremely rugged; and can be operated in parallel without complications.*

The VMP1 is available for $7.85 each; the VMP4 is priced at $20 each (plus postage and handling charge). California residents please add 6% sales tax. For complete ordering information, write to Ed Oxner, Siliconix, Incorporated, 2201 Laurelwood Road, Santa Clara, California 95054.

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*Circuits for using *Mospower* fets (VMP1) in single and parallel configurations were given in the September, 1976, issue of *ham radio*, page 10.

7400N TTL

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SN7427N	37	SN7496N	.89	SN74185N	2.20
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SN7438N	27	SN74122N	.39	SN74191N	1.25
SN7439N	25	SN74123N	.70	SN74192N	.89
SN7440N	15	SN74125N	.60	SN74193N	.89
SN7441N	89	SN74126N	.60	SN74194N	1.25
SN7442N	59	SN74132N	1.09	SN74195N	.75
SN7443N	75	SN74136N	.95	SN74196N	1.25
SN7444N	75	SN74141N	1.15	SN74197N	.75
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CD4019	.55	CD4060	3.25	74C157	2.15
CD4020	1.49	CD4066	1.75	74C160	3.25
CD4022	1.25	CD4069	.45	74C161	3.25
CD4023	.25	CD4071	.45	74C163	3.00
CD4024	1.50	CD4081	.45	74C164	3.25
CD4025	.25	CD4511	2.50	74C173	2.60
CD4027	.69	CD4518	2.50	74C193	2.75
CD4028	1.65	CD4566	3.00	74C195	2.75
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LM320K-12	1.35	NE560B	5.00	75451CN	.39
LM320K-15	1.35	NE561B	5.00	75452CN	.39
LM320T-5	1.75	NE562B	5.00	75453CN	.39
LM320T-5.2	1.75	NE565H	1.25	75454CN	.39
LM320T-8	1.75	NE565N	1.75	75491CN	.79
LM320T-12	1.75	NE566CN	1.25	75492CN	.89
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LM323K-5	9.95	LM709H	.29	CA3032	2.56
LM324N	1.80	LM709N	.29	CA3035	2.48
LM339N	1.70	LM710N	.79	CA3039	1.35
LM340K-5	1.95	LM711N	.39	CA3046	1.30
LM340K-6	1.95	LM723H	.55	CA3059	3.25
LM340K-8	1.95	LM723N	.55	CA3060	3.25
LM340K-12	1.95	LM733N	1.00	CA3080	.85
LM340K-15	1.95	LM739N	1.00	CA3081	2.00
LM340K-18	1.95	LM741CH	.35	CA3082	2.00
LM340K-24	1.95	LM741CN	.35	CA3083	1.60
LM340T-5	1.75	LM74114N	.39	CA3086	.85
LM340T-6	1.75	LM747H	.79	CA3089	3.75
LM340T-8	1.75	LM747N	.79	CA3091	10.20
LM340T-12	1.75	LM748H	.39	CA3123	2.15
LM340T-15	1.75	LM748N	.39	CA3130	1.39
LM340T-18	1.75	LM1303N	.90	CA3140	1.25
LM340T-24	1.75	LM1304N	1.19	CA3600	1.75
LM350N	1.00	LM1305N	1.40	RC4194	5.95
LM351CN	.85	LM1307N	.85	RC4195	3.25

74LS00 TTL

74LS00	39			74LS139	1.95
74LS02	39	74LS74	.65	74LS151	1.55
74LS03	39	74LS75	.79	74LS153	1.89
74LS04	45	74LS76	.65	74LS157	1.55
74LS05	45	74LS83	2.19	74LS162	2.25
74LS08	39	74LS85	2.49	74LS163	2.25
74LS10	39	74LS86	.65	74LS164	2.25
74LS13	.79	74LS90	1.25	74LS175	1.95
74LS14	2.19	74LS92	1.25	74LS181	3.69
74LS20	39	74LS93	1.25	74LS190	2.85
74LS26	49	74LS95	2.19	74LS191	2.85
74LS27	45	74LS96	1.89	74LS192	2.85
74LS28	49	74LS107	.65	74LS193	2.85
74LS30	39	74LS109	.65	74LS194	2.25
74LS32	45	74LS112	.65	74LS195	2.25
74LS40	49	74LS132	1.55	74LS257	1.89
74LS51	39	74LS136	.65	74LS260	.55
74LS55	39	74LS138	1.89	74LS279	.79
74LS73	65			74LS670	5.95

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Linear Pin-out & Functional Description **$2.95**
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- CATCH
- SUPER PONG
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FEATURES OF PONG AND SUPER PONG
- Incremental speed on volleys increases excitement
- Playing field adjusts to any size screen
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- Unmistakable "PONG" sound accompanies each volley
- Digital scoring flashes on the screen between each point
- 2 player challenge or Solitaire
- Hooks up simply to any model television set; the screen actually becomes the playing field
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- Battery operated by 4 size "D" flashlight batteries included with the Unit

ATARI

AC Adaptor (Eliminates Batteries) **$9.95**

DISCRETE LEDS

	125° dia.					90° dia.	
XC209	Red	10/$1				XC111	Red	10/$1
XC209	Green	4/$1				XC111	Green	4/$1
XC209	Orange	4/$1				XC111	Yellow	4/$1
						XC111	Orange	4/$1

	.200" dia.			.185" dia.			.200" dia.			.085" dia.	
XC22	Red	10/$1	XC526	Red	10/$1	XC556	Red	10/$1	MV50		
XC22	Green	4/$1	XC526	Green	4/$1	XC556	Green	7/$1	.085" dia. Micro		
XC22	Yellow	4/$1	XC526	Yellow	4/$1	XC556	Yellow	7/$1	red LED		
XC22	Orange	4/$1	XC526	Orange	4/$1	XC556	Orange	7/$1	6/$1		
SSL-22	RT	4/$1	XC526	Clear	4/$1	XC556	Clear	7/$1			

DISPLAY LEDS

DL707 DL338

TYPE	POLARITY	HT		TYPE	POLARITY	HT	
MAN 1	Common Anode	.270	2.95	MAN 3620	Common Anode-orange	.300	1.75
MAN 2	5 x 7 Dot Matrix	.300	4.95	MAN 3640	Common Cathode-orange	.300	1.75
MAN 3	Common Cathode	.125	.39	MAN 4710	Common Anode-Red	.400	1.95
MAN 4	Common Cathode	.187	1.95	DL701	Common Anode-red ±	.300	1.85
MAN 7	Common Anode	.300	1.25	DL704	Common Cathode	.300	1.50
MAN 7G	Common Anode-green	.300	1.95	DL707	Common Anode	.300	1.50
MAN 7Y	Common Anode-yellow	.300	1.95	DL 728	Common Cathode	.500	2.95
MAN 52	Common Anode-green	.300	1.75	DL 747	Common Anode	.600	2.25
MAN 64	Common Anode-red	.300	1.75	DL 750	Common Cathode	.600	2.49
MAN 72	Common Anode	.300	1.25	DL 338	Common Cathode	.110	.99
MAN 74	Common Cathode	.300	1.50	FND70	Common Cathode	.250	.75
MAN 82	Common Anode-yellow	.300	1.75	FND503	Common Cathode	.500	1.00
MAN 84	Common Cathode-yellow	.300	1.75	FND507	Common Anode	.500	1.00

IC SOLDERTAIL — LOW PROFILE (TIN) SOCKETS

	1-24	25-49	50-100		1-24	25-49	50-100
8 pin	$.17	16	15	24 pin	$.38	37	36
14 pin	20	19	18	28 pin	45	44	43
16 pin	22	21	20	36 pin	60	59	58
18 pin	29	28	27	40 pin	63	62	61
22 pin	37	36	35				

SOLDERTAIL STANDARD (TIN)

14 pin	$.27	25	24	28 pin	$.99	90	81
16 pin	.30	27	25	36 pin	1.39	1.26	1.15
18 pin	35	32	30	40 pin	1.59	1.45	1.30
24 pin	49	45	42				

SOLDERTAIL STANDARD (GOLD)

8 pin	$.30	27	24	24 pin	$.70	63	57
14 pin	35	32	29	28 pin	1.10	1.00	90
16 pin	38	35	32	36 pin	1.75	1.40	1.26
18 pin	52	47	43	40 pin	1.75	1.59	1.45

WIRE WRAP SOCKETS (GOLD) LEVEL #3

10 pin	$.45	41	37	24 pin	$1.05	.95	.85
14 pin	39	38	37	28 pin	1.40	1.25	1.10
16 pin	43	42	41	36 pin	1.59	1.45	1.30
18 pin	75	68	62	40 pin	1.75	1.55	1.40

WIRE WRAP TOOL

Part Number WSU-30 **$5.95 ea.**

WIRE WRAP WIRE

30 AWG — 25 ft. min. - $2.10 50 ft. - $2.75 100 ft. - $3.50 1000 ft. - $24.00
SPECIFY COLOR — White - Yellow - Red - Green - Blue - Black

50 PCS. RESISTOR ASSORTMENTS $1.75 PER ASST.

ASST. 1	5 ea.	10 OHM	12 OHM	15 OHM	18 OHM	22 OHM		
		27 OHM	33 OHM	39 OHM	47 OHM	56 OHM	1/4 WATT 5% — 50 PCS.	
ASST. 2	5 ea.	68 OHM	82 OHM	100 OHM	120 OHM	150 OHM		
		180 OHM	220 OHM	270 OHM	330 OHM	390 OHM	1/4 WATT 5% — 50 PCS.	
ASST. 3	5 ea.	470 OHM	560 OHM	680 OHM	820 OHM	1K		
		1.2K	1.5K	1.8K	2.2K	2.7K	1/4 WATT 5% — 50 PCS.	
ASST. 4	5 ea.	3.3K	3.9K	4.7K	5.6K	6.8K		
		8.2K	10K	12K	15K	18K	1/4 WATT 5% — 50 PCS.	
ASST. 5	5 ea.	22K	27K	33K	39K	47K		
		56K	68K	82K	100K	120K	1/4 WATT 5% — 50 PCS.	
ASST. 6	5 ea.	150K	180K	220K	270K	330K		
		390K	470K	560K	680K	820K	1/4 WATT 5% — 50 PCS.	
ASST. 7	5 ea.	1M	1.2M	1.5M	1.8M	2.2M		
		2.7M	3.3M	3.9M	4.7M	5.6M	1/4 WATT 5% — 50 PCS.	

ASST. 8R Includes Resistor Assortments 1-7 (350 PCS.) **$10.95 ea.**

XR-2206KA Kit $17.95 EXAR XR-2260KB Kit $27.95

TIMERS		PHASE LOCKED LOOPS		WAVEFORM GENERATORS		STEREO DECODERS		MISCELLANEOUS	
XR-555CP	$.69	XR-210	5.20	XR-205	8.40	XR-1310CP	$3.20	XR-2211CP	6.70
XR-320P	1.55	XR-215	6.60	XR-2206CP	4.49	XR-1310EP	3.20	XR-4136	2.00
XR-556CP	1.85	XR-567CP	1.95	XR-2207CP	3.85	XR-1800P	3.20	XR-1468	3.85
XR-2556CP	3.20	XR-567CT	1.70			XR-2567	2.99	XR-1488	5.80
XR-2240CP	3.25							XR-1489	4.80
								XR-2208	5.20

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DPDT				JMT	1	2-9	10-29	30-99
ON	OFF	ON		221	2.95	2.55	1.87	1.70
ON	NONE	ON		223	2.95	2.15	1.58	1.43
ON	OFF	ON		121	2.35	1.95	1.43	1.30
ON	NONE	ON		123	2.06	1.65	1.21	1.10

PUSH BUTTON

SPDT — SERIES PB, PB1
Maintained Action Switch
Push To Make Contact. And Push Again To Release Action

PB-123 $1.75

Momentary Action Switch
Normally Open or Normally Closed (Pair N.C. Circuit use terminals 2 & 3, Pair N.O. 2 & 3, Pair N.C. and N.O. 1 & 3)

PB-126 $1.75

5 AMP RATINGS

THUMBWHEEL SWITCHES

THUMBWHEEL SWITCH ONLY

Ordering: Order desired switch or switches and add necessary accessories for your particular application.

Part No.	Description	Price
SR 12	Single Pole 10 Position	$2.50
SR 12	Decimal	3.00
SR 21	10 Position BCD only	2.50
SR 21	Decimal	3.00

SF — Front Mount SR — Rear Mount

SERIES SF Front Mount Assembly

ACCESSORIES

Part No.	Description	Price
SF DP	End Plate (Pair)	.50
SF DP	Divider Plate (each)	.40
SF BB	Blank Body (each)	.40
SF HB	Half Body (each)	.40

SERIES SR Rear Mount Assembly

ACCESSORIES

Part No.	Description	Price
SR ED	End Plates (pair)	$ .50
SR DP	Divider Plate (each)	.40
SR BB	Blank Body (each)	.40
SR HB	Half Body (each)	.40

DIP SWITCH

These switches feature seven SPST slide switches in a molded dip. They are ideally suited for microprocessor applications.

$1.95

CLIPLITE !! 4/$1.00

NEW LED MOUNTING SYSTEM

- CLIPLITE mounts from the front of the Panel in a .250 hole on 3/8" centers. Panel thickness from 1/16" to 1/8".
- CLIPLITE equalizes and increases the brightness of commonly used wide beam LEDS.
- CLIPLITE is to be used with XC556 LEDS.
- Specify colors—red, green, amber, or yellow when ordering.

ZENERS—DIODES—RECTIFIERS

TYPE	VOLTS	W	PRICE	TYPE	VOLTS	W	PRICE
1N746	3.3	400m	4/1.00	1N4005*	600 PIV	1 AMP	10/1.00
1N751A	5.1	400m	4/1.00	1N4006*	800 PIV	1 AMP	10/1.00
1N752	5.6	400m	4/1.00	1N4007*	1000 PIV	1 AMP	10/1.00
1N753	6.2	400m	4/1.00	1N3600	50	200m	5/1.00
1N754	6.8	400m	4/1.00	1N4148	75	10m	15/1.00
1N958	8.2	400m	8/1.00	1N4154	35	10m	12/1.00
1N965B	15	400m	4/1.00	1N4305	75	25M	20/1.00
1N5232	5.6	500m	28	1N4734	5.6	1w	28
1N5234	6.2	500m	28	1N4735	6.2	1w	28
1N5235	6.8	500m	28	1N4736	6.8	1w	28
1N5236	7.5	500m	28	1N4738	8.2	1w	28
1N456	25	40m	6/1.00	1N4742	12	1w	28
1N458	150	7m	6/1.00	1N4744	15	1w	28
1N485A	180	10m	5/1.00	1N1183	50 PIV	35 AMP	1.60
1N4001	50 PIV	1 AMP	12/1.00	1N1184	100 PIV	35 AMP	1.70
1N4002	100 PIV	1 AMP	12/1.00	1N1185	150 PIV	35 AMP	1.50
1N4003	200 PIV	1 AMP	12/1.00	1N1186	200 PIV	35 AMP	1.80
1N4004	400 PIV	1 AMP	12/1.00	1N1188	400 PIV	35 AMP	3.00

SCR AND FW BRIDGE RECTIFIERS

C36D	15A @ 400V	SCR	$1.95
C38M	35A @ 200V	SCR	1.95
2N2328	1.6A @ 200V	SCR	.50
MDA 980-1	25A @ 50V	FW BRIDGE REC.	1.95
MDA 980-3	25A@ 200V	FW BRIDGE REC.	1.95

TRANSISTORS

MPS A05	5/$1.00				PN4249	4/$1.00	
MPS A06	5/$1.00	PN3567	3/$1.00		PN4250	4/$1.00	
2N2219A	.50	PN3568	4/$1.00		2N4400	4/$1.00	
2N2221	4/$1.00	PN3569	4/$1.00		2N4401	4/$1.00	
2N2222A	5/$1.00	PN3704	5/$1.00		2N4402	4/$1.00	
2N2369	5/$1.00	PN3705	5/$1.00		2N4403	4/$1.00	
2N2369A	4/$1.00	PN3706	5/$1.00		2N4409	5/$1.00	
2N2415	5/$1.00	PN3707	5/$1.00		2N5086	4/$1.00	
2N2484	4/$1.00	PN3711	5/$1.00		2N5087	4/$1.00	
2N2906A	4/$1.00	PN3724	$.65		2N5088	4/$1.00	
2N2907A	5/$1.00	PN3725	$1.00		2N5089	4/$1.00	
2N2925	5/$1.00	PN3903	5/$1.00		2N5129	5/$1.00	
2N3053	2/$1.00	PN3904	4/$1.00		2N5139	5/$1.00	
2N3055	$.89	PN3905	4/$1.00		2N5209	5/$1.00	
MJE3055	$1.00	PN3906	4/$1.00		2N5961	5/$1.00	
MJE2955	$1.25	PN4013	3/$1.00		C106B1 SCR	2/$1.00	
2N3392	5/$1.00	PN4014	3/$1.00		2N5432	$2.00	
2N3398	5/$1.00	PN4123	10/$1.00		40673	1.75ea.	

CAPACITOR CORNER

50 VOLT CERAMIC DISC CAPACITORS

	1-9	10-49	50-100		1-9	10-49	50-100
10 pf	05	04	03	.001μF	05	04	035
22 pf	05	04	03	.0047μF	05	04	035
47 pf	05	04	03	.01μF	05	04	035
100 pf	05	04	03	.022μF	06	05	04
220 pf	05	04	03	.047μF	06	05	04
470 pf	05	04	035	.1μF	12	09	075

100 VOLT MYLAR FILM CAPACITORS

.001mf	12	10	07	.022mf	13	11	08
.0022	12	10	07	.047mf	21	17	13
.0047mf	12	10	07	.1mf	27	23	17
.01mf	12	10	07	.22mf	33	27	22

+20% DIPPED TANTALUMS (SOLID) CAPACITORS

1/35V	28	23	17	1.5/35V	30	26	21
15/35V	28	23	17	2.2/25V	31	27	22
22/35V	28	23	17	3.3/25V	31	27	22
33/35V	28	23	17	4.7/25V	32	28	23
47/35V	28	23	17	6.8/25V	36	31	25
68/35V	28	23	17	10/25V	40	35	29
1.0/35V	28	23	17	15/25V	63	50	40

MINIATURE ALUMINUM ELECTROLYTIC CAPACITORS

Axial Lead				Radial Lead			
47/50V	15	13	10	47/25V	15	13	10
1.0/50V	16	14	11	47/50V	16	14	11
3.3/50V	15	13	10	1.0/16V	15	13	10
4.7/25V	16	14	12	1.0/25V	16	14	11
10/25V	15	13	10	1.0/50V	16	14	11
10/50V	16	14	12	4.7/16V	15	13	10
22/25V	17	15	12	4.7/25V	15	13	10
22/50V	24	20	18	4.7/50V	16	14	11
47/25V	19	17	15	10/16V	14	12	09
47/50V	25	21	19	10/25V	15	13	10
100/25V	24	20	18	10/50V	16	14	12
100/50V	35	30	28	47/50V	24	21	19
220/25V	32	28	25	100/16V	19	15	14
220/50V	45	41	38	100/25V	24	20	18
470/25V	33	29	27	100/50V	35	30	28
1000/16V	55	50	45	220/16V	23	17	16
2200/16V	70	62	55	470/25V	31	28	26

More Details? CHECK—OFF Page 142

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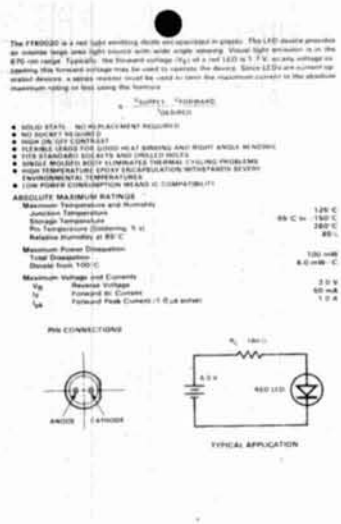
FTK0020

CARD FRONT

FTK0020



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FTK0106

CARD FRONT

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FTK0001	0.5" High Common Cathode Digit	$1.00
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FTK0004	0.8" High Common Cathode Digit	2.00
FTK0005	0.8" High Common Anode Digit	2.00
	0.8" HIGH DISPLAY ARRAYS	
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FTK0021	5 Mixed Colored LED Lamps	1.00
FTK0022	10 LED Mounting Clips	1.00
FTK0023	5 Three Piece LED Mounting Adapters	1.00
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FTK0031	5 Round Lens Photo Transistors	1.00
FTK0032	3 Flat Lens Photo Darlingtons	1.00
FTK0033	3 Round Lens Photo Darlingtons	1.00

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FTK0041	12-Element Card Reader Array	24.00
FTK0042	Reflective Opto Coupler	4.00
	COUPLERS	
FTK0050	3 General Purpose Opto Couplers	1.00
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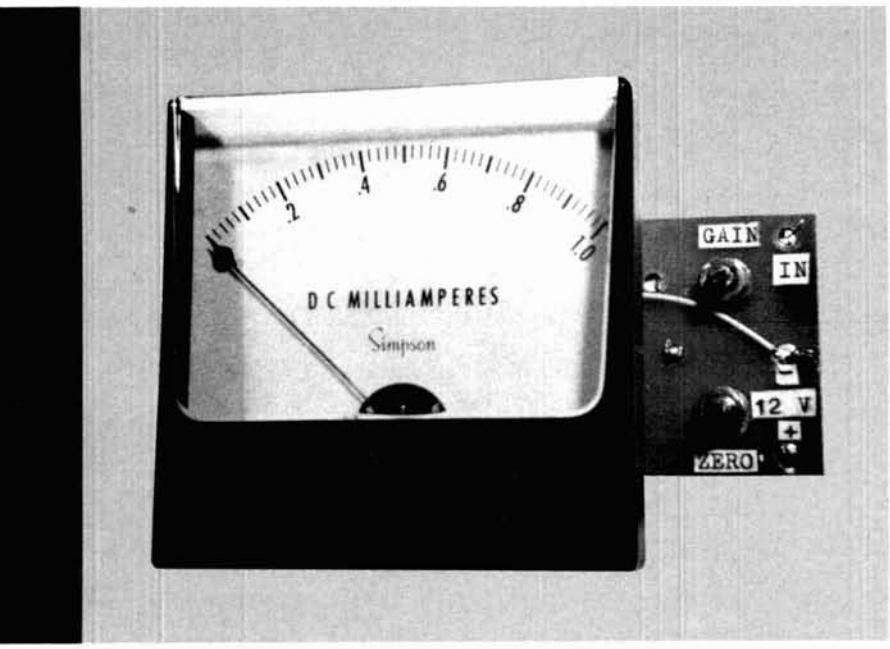


electronic meter amplifier

Junction fet in simple circuit turns dc milliammeter into dc microammeter

My ham radio budget was seriously threatened recently when circumstances called for use of a 0-100 μA microammeter. Reference to the radio wholesale catalog immediately discouraged the purchase of a new meter. However, a 0-1 mA milliammeter recently acquired at a reasonable price was available from the parts cabinet. The question was, could a 0-1 mA meter, with the aid of a dc amplifier, substitute for a 0-100 μA microammeter? The following description answers the question in the affirmative.

circuit description

A Motorola MPF102 junction fet is used as the active element of a dc amplifier, as illustrated in **fig. 1**. There are many other types of fets that can be used, including mosfets, depending upon what is available in the junk box. The MPF102 is inexpensive and can provide current gains of over 50 dB in this meter bridge circuit. The maximum full-scale sensitivity of the circuit is approximately 2.0 microamperes. For example, two volts fed to the circuit through a 500k source impedance provides a full-scale meter reading. The 500k gain control is used to set the circuit sensitivity to the desired value.

Parts for the meter amplifier are assembled on a piece of 3/32-inch (2.5mm) thick epoxy fiberglass board. The assembly is attached directly to the rear of the meter by the two meter terminals. I used ¼-inch (6.5mm) brass eyelets equipped with solder lugs and spaced to match the meter terminals. All other terminals are 1/8-inch (13mm) brass eyelets, mounted in 1/8-inch (13mm) holes drilled in the fiberglass board and rolled over with the aid of a center punch and a hammer. Location of the

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

holes is not critical, but the general layout shown in the photographs can be followed.

Allen-Bradley type-G potentiometers are used for gain and zero-set purposes, primarily because they were available, but standard size potentiometers can be used just as well. The potentiometers are mounted on the right-hand side of the board for accessibility. After the meter and amplifier assembly have been mounted behind a panel, adjustments are made through screwdriver access holes.

adjustment

Adjustment of the meter amplifier is relatively simple. First, with no signal at the input, adjust the

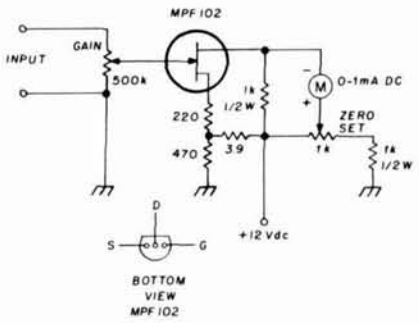
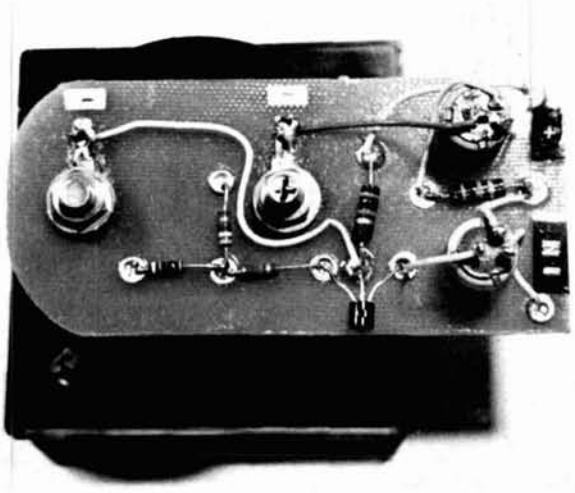


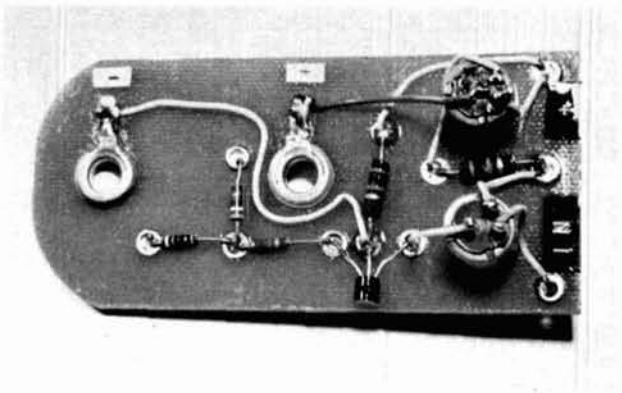
fig. 1. Schematic diagram of the meter amplifier circuit. All resistors are ¼ watt unless otherwise noted.

zero-set control for zero meter current; then connect the signal to the input and adjust the gain to the desired value. If the source includes a dc offset voltage, it is possible to compensate by properly offsetting the zero-set control.

At my station, the dc meter amplifier is used in conjunction with an rf detector attached to the forward-coupled arm of a 20 dB directional coupler. Since the detector operates in its linear region, the 0-1 mA meter reading is approximately proportional to the

B. Finished circuit board shown mounted to back of meter, held in place by the meter terminals. Neat, simple.





C. Circuit board uses eyelets for component-mounting and convenient tie-points for wiring. Large eyelets are for meter terminals.

current flowing in the main line of the coupler (except at the bottom end of the scale). The meter was calibrated by comparing its reading with an rf power meter borrowed for the purpose. The power meter was connected to the output end of the directional coupler, as shown in **fig. 2.**

Once the scale is calibrated there is no further need for the wattmeter, and antenna power may be read directly from the meter scale with the aid of a calibration chart. In the example given in **fig. 2**, the full-scale power reading is 1.0 watt. Higher power levels can be monitored with the same setup by using directional

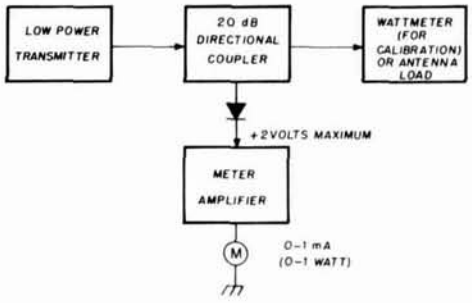


fig. 2. Block diagram showing application of the dc meter amplifier as a sensitive rf wattmeter. In this case 0-1 mA meter reads out 0-1 watt with 20 dB directional coupler (see text).

couplers having higher coupling values. For example, the full-scale power reading would be 100 watts if a 40 dB directional coupler were used.

The dc meter amplifier can also be used as a high impedance dc voltmeter, with a range of 0-1 volt, for example. If the meter amplifier is connected to the avc line in a receiver, it can serve as an S-meter.

references

1. Norman J. Foot, WA9HUV, "Fet Tone Keyer," *QST*, October, 1969, page 103.
2. *Motorola Semiconductor Handbook*, 5th edition, Motorola Semiconductor Corporation, Phoenix, Arizona, page 7-465.

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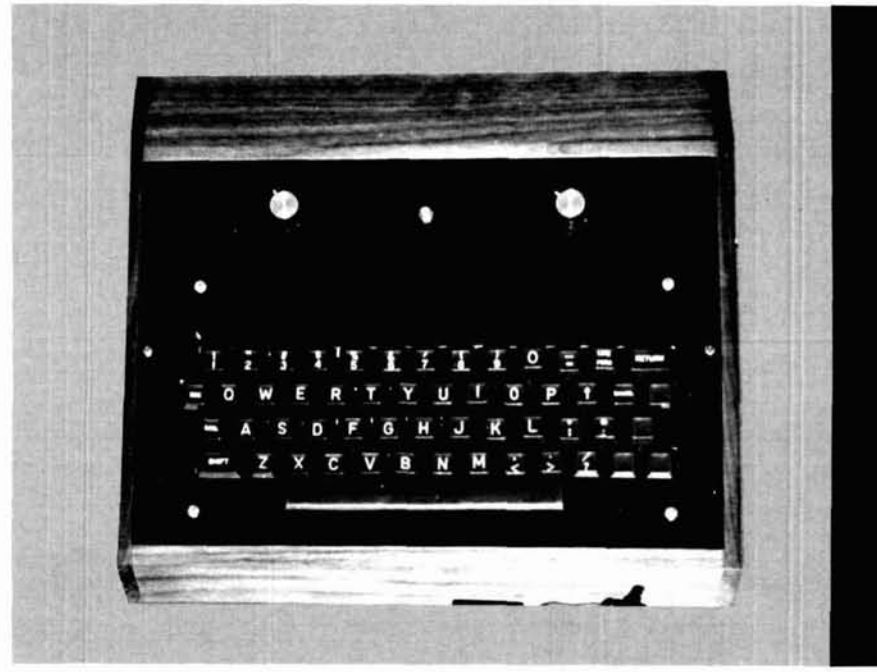


ASCII-to-Morse code translator

Sit back and type near-perfect Morse with this interface between keyboard and transmitter

I suppose every amateur at one time or another has wanted an easy way to send perfect code. The bug, and later the electronic keyer, have to a large degree solved the problem of sending good code. The ultimate way, however, would be to bang out the letters on a typewriter keyboard at any speed while the code is being sent out at some preselected speed. Not only is this nice and easy for you, but the fellow on the other end probably wouldn't complain when he hears your good code. This idea certainly isn't new, but if you've checked lately you know that a commercially produced unit with memory costs about $400, and that's just about out of everyone's price range. This project may just change all that since its unit with memory and keyboard should cost about $120.

code conversion

The initial problem is changing the ASCII code to Morse, but that by no means is the end because Morse characters vary in length from 1 to 6 bits. Since programmable read-only memories (ROMs) are readily available, they're used in this circuit to convert the 6-bit ASCII keyboard output to a special code that includes the Morse letter and its bit length in binary code. The actual code in the memories is not terribly important and is not discussed as most amateurs have no easy way of programming the memories.

Example: The letter R appears at the outputs of the PROMs as (110)00010, where the binary number in parentheses is the bit length (3) of the letter and the right-hand portion is the letter, starting from right to left. Zero is a dot; 1 is a dash. Even though the PROMs can be programmed, I recommend they be purchased

By Robert Morley and Dave Scharon, 2145 East Drive, St. Louis, Missouri 63131

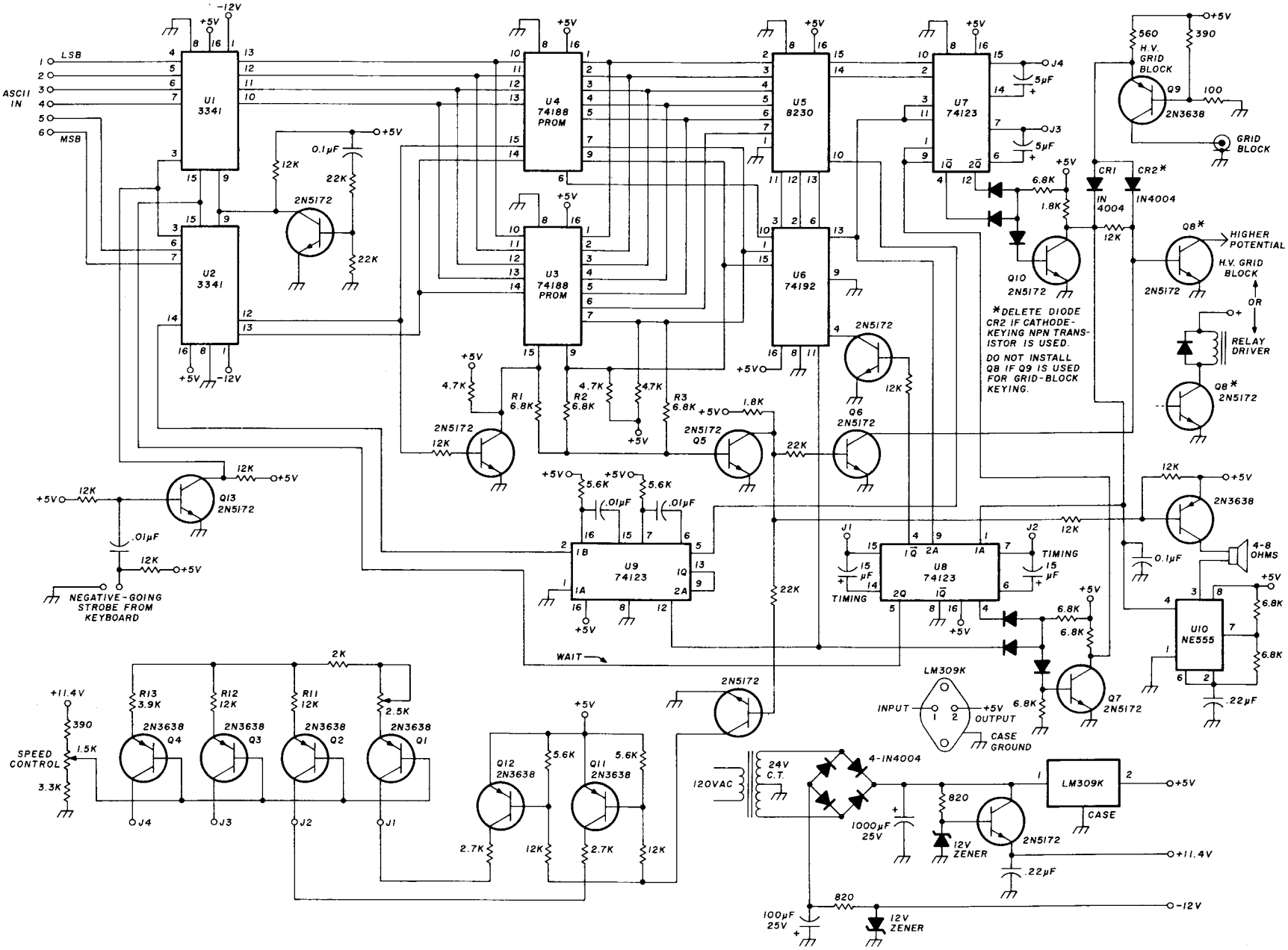


fig. 1. ASCII-to-Morse code translator schematic. U3 is the numeric memory; U4 is alphabetic memory. U1 and U2 are Fairchild 3341 FIFO memories. All resistors are ¼ watt, 10%. Capacitors larger than 1 μF are electrolytics. All diodes not otherwise marked are 1N914 or equivalent.

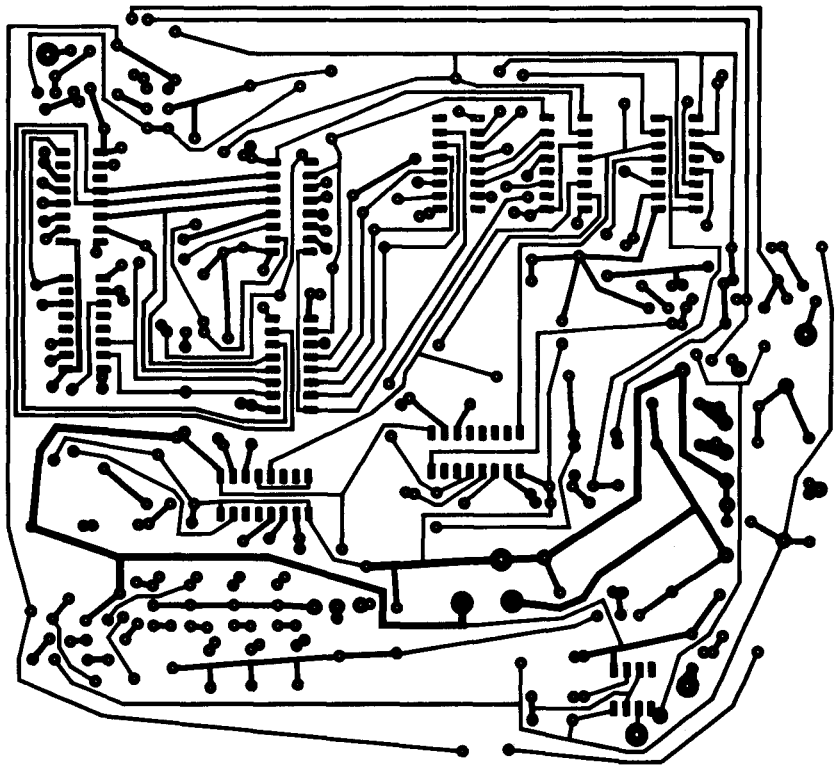


fig. 2. Printed-circuit board layout.

preprogrammed from the supplier listed in the article, because if one mistake is made, that's it. The supplier guarantees correct preprogramming.

The circuit (**fig. 1**) contains two PROMs. One includes all the alphabet (U4) and the other the numbers and punctuation (U3). Most of the Morse code is represented on a regular ASCII keyboard by its equivalent key except as follows:

key	Morse
<	end of message
>	end of work
=	wait
( )either key	parentheses

This is done because all letters have the 6th bit of ASCII data low and numbers and punctuation high. The 6th bit is used to switch from one PROM to the other. The first 5 bits of both PROMs (U3 and U4) are wired together and connected to U5, an 8230, which is an 8-line to 1-line multiplexer. The last bits address U6, a 74192 up/down counter, which clocks through the bits of Morse letter by selecting the proper lines into U5. The output of U5 determines if a dash or dot is to be fired. The dash or dot is formed by U7, a 74123 dual one-shot. After the dash or dot is formed, the falling edge of the NANDED $\overline{Q}$ outputs fires a space one-shot, U8, whose timing is equivalent to a dot. U8 clocks the counter on the pulse rising edge, which selects the next bit of the letter and triggers the dot or dash on the falling edge. This trigger circle continues until U6 reaches the 000 state. At this time the borrow line of U6 (pin 13) is used to inhibit the dot-dash one-shot, U7, and also fire one-shot U8 to produce a wait between characters equivalent to a dash. This one-shot output is used to bring up the next piece of data in the first-in, first-out (FIFO) memories, U1 and U2.

speed control

It is obviously desirable to have some means to vary the speed of the device, and for simplicity's sake we have chosen one-shots for our dots-dashes and wait timing. Tracking control of the speed would be nearly impossible with variable resistors, as it would take a 4-ganged pot and the control would be nothing close to linear. Current sources, however, make control easy as well as fairly linear. The current sources are controlled by one pot and feed each of one-shots, U7 and U8, at points J1, J2, J3, and J4. These current sources are made up of pnp transistors Q1, Q2, Q3, Q4, in a sort of upside-down emitter follower arrangement. Current control results in good 10:1 speed control.

input buffer

This portion consists of some very interesting circuits, which are the FIFO memories. The input and output are completely asynchronous, which means that data may be entered at any rate independent of the rate at which data is being clocked out by the code generator. As the data is clocked out of the FIFO memory, it is entered

into the two PROMs consisting of U3 and U4. If the keyboard has inverted ASCII, a 7404 ahead of U1 and U2 can be used.

keying circuit

The $\overline{Q}$ outputs of U7, the dot-dash one-shot, are NANDED through a discrete-component NAND gate including Q10. This circuit also drives a high-voltage npn

will normally occur at the end of the last charcter and the end of the H that the space sends, will equal seven dots. This was done by eliminating the space time and one wait time: much greater current is switched in through Q12 and Q11 to the space and wait one-shots while the H is being sent. This action eliminates the time taken up by the three spaces and one wait, which very nearly equals seven dots of time between words.

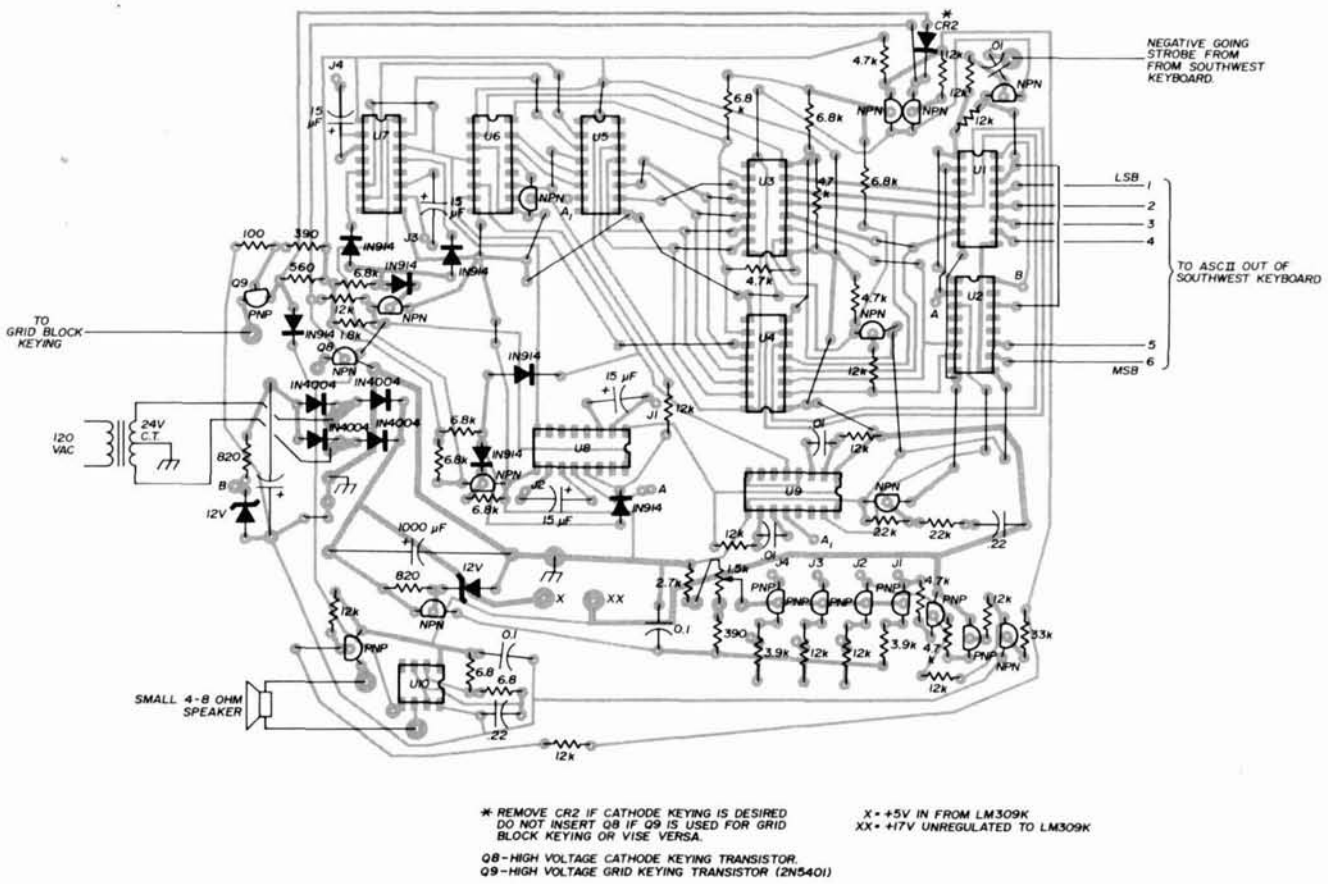


fig. 3. Component side of PC board.

transistor, Q8, for cathode keying and a pnp, Q9, for grid-block keying. The transistors selected here must handle the voltage and current of your transmitter. (This information can be found in the transmitter manual.) Grid-block keying will probably be the most widely used. A good value for the transistor would be 200 volts at 100mA. The NAND output, collector of Q10, also switches a sidetone oscillator made from a NE555, IC10.

space timing

One function that required a trick was the space timing, which is a necessity when the buffer memory is used. This problem required a resistor-transistor OR gate consisting of R1, R2, R3, Q5, Q6, which allows the circuit to function but inhibits the output and sidetone oscillator to simulate the proper space length. When the space bar is hit, a Morse H will be sent. Since good code requires 7 dots between words, something must be done to this H so that its time, plus the two wait dashes that

Any ASCII keyboard will do the job, but be sure it has a bounceless stobe that appears after the data is set up. A good keyboard for this purpose is available.* The circuit is set up for a negative-going strobe into Q13's base. An error key was considered, but when using the buffer chances are you'll be a few characters ahead before you realize an error has been made, and an error signal here would be meaningless. The unit won't make an error itself, so errors should be very rare.

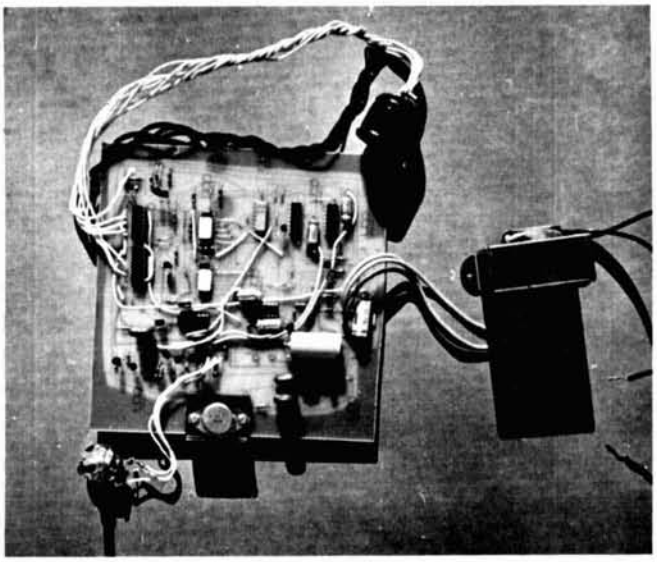
construction

Point-to-point wiring could be used, but a PC board would make assembly easier.† If you prefer to make

*South West Technical Products, 219 West Rhapsody, San Antonio, Texas 78216. (Keyboard kit about $40.00.)

†Circuit boards, 3341 FIFOs, the 8230 and PROMs are available for $60.00 from Scharon Fabricators, 2145 East Drive, St. Louis, Missouri 63131.

your own, **fig. 2** provides a full-size etched board layout; the component side of the board is shown in **fig. 3.** Wiring isn't critical, but care should be taken to ensure proper wiring so none of the integrated circuits will be damaged when the power is turned on. This advice applies particularly to the ROMs and FIFO memories, as they are more expensive than regular TTL integrated circuits.



Printed circuit board for translator chassis showing parts arrangement.

Earlier, the type of possible keying was mentioned. An npn transistor in the Q8 position can be used to key a relay (**fig. 1**). A diode should be placed in reverse across the relay coil to prevent voltage spikes.

The transistors in the circuit aren't critical except for the high-voltage transistors mentioned earlier. The 5-volt power supply is an LM309K. The 3341 FIFOa are MOS integrated circuits, and even though they're internally protected, care should be taken when handling them.

testing and operation

The capacitors used to set the timing on the one-shots for creating the dots, dashes and spaces will never have exact values, therefore resistors R10, R11, R12, R13 may have to be trimmed to get perfect dot-to-dash ratios. Points are available on the board to add these resistors, but in most cases this should not be necessary.

Connect a speaker to the sidetone oscillator and apply power to the unit after the keyboard has been properly attached. (See **fig. 1** for the LSB-MSB keyboard locations.) At this point hit one of the keys on the keyboard and listen for the proper code from the sidetone oscillator. If the proper code isn't heard, check the circuit carefully and if an error is found, try again. Set the speed control as slow as possible, type in a message, then sit back and listen to the code; it should now be ready to put on the air.

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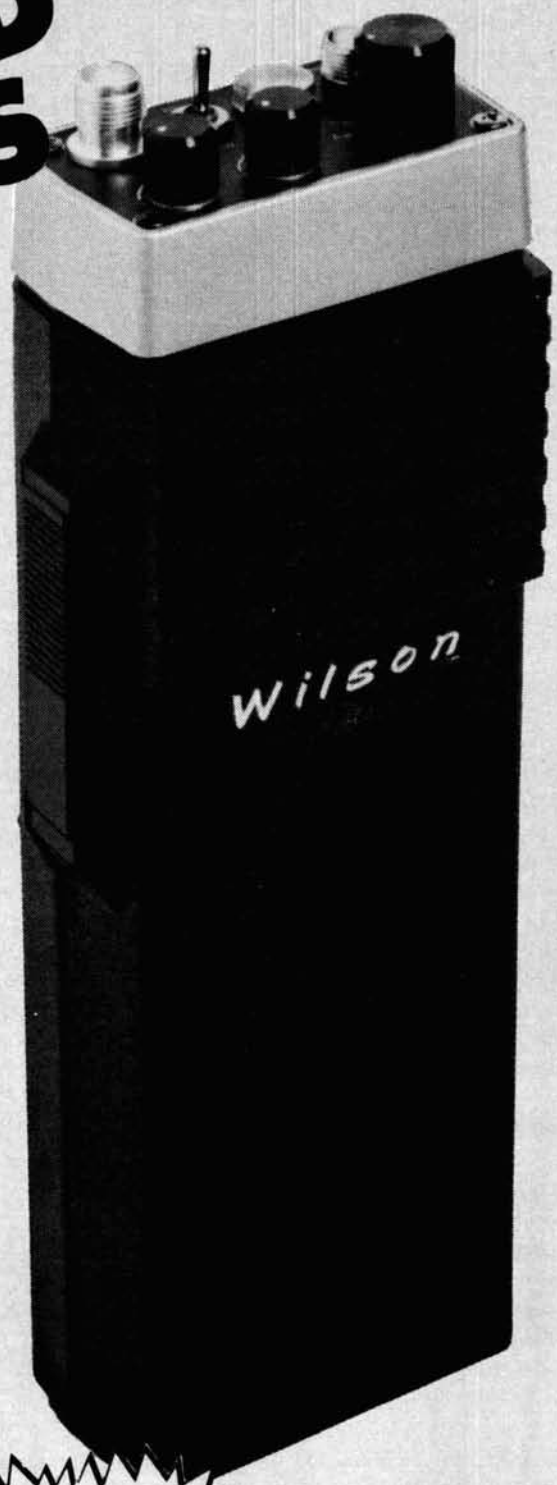

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the ladder network

An analysis of the ladder network using the method of "continued fractions"

If you happen to have an old three-gang tuning capacitor lying idle, the addition of a few resistors and a couple of inexpensive transistors will produce a phase-shift oscillator such as shown in **fig. 1**: no coils, no fixed capacitors, no variable resistors. This is no precision signal generator but is useful as a handy source of rf signals and has a large tuning range. With 2500-ohm resistors in the ladder network it covers about 250 kHz to 2.5 MHz. With higher resistances the range will be less. Transistors such as the 2N4996 or 2N4274 work well, with 3000 or 4000 ohms between ground and the second collector.

analysis

The main purpose of this article, however, is to show how any ladder network (including the one in the oscillator of **fig. 1**) can be analyzed in a purely routine fashion by the use of a not-too-familiar branch of mathematics called "continued fractions." The analysis applies to ladders composed of any number of elements, each of which can be anything you want. By suitably choosing these elements, the ladder can be made to become not only a phase shifter but also a bandpass, lowpass, or highpass filter; an impedance matching network; an attenuator; or a lumped-constant transmission line.

The input end of the ladder can be a series element to which a constant voltage, E, is applied or a shunt element fed by a constant current, I. The final element can be a shunt element across which the output voltage, e, is taken, or it may be a series element, the current in which i is the output.

For the moment, however, let us concentrate on the case of six elements arranged as shown in **fig. 2** where the zs are the impedances of the series elements and the ys are the admittances of the shunt elements. For this network there are two elegantly simple formulas: the output voltage, e, is $\frac{E}{p_6}$ and the input impedance is $\frac{p_6}{q_6}$.

Of course these formulas are useful only when p_6 and q_6 have been expressed in terms of the various impedances and admittances in the ladder. How this is done in a systematic manner requires quite a bit of explanation, but proofs will be omitted so that only what is necessary to operate the mathematical mechanism will be explained. We start by putting all the elements of the ladder in this peculiar-looking form:

$$z_1 + \cfrac{1}{y_2 + \cfrac{1}{z_3 + \cfrac{1}{y_4 + \cfrac{1}{z_5 + \cfrac{1}{y_6}}}}}$$

This expression is called a "simple continued fraction" containing six quantities. Its value is the input impedance of the ladder, although you may not be able to see it offhand. Any such continued fraction can be reduced to the ratio of two expressions involving the zs and the ys, the numerator of this ratio being called p with appropriate subscript, while the denominator is called q. If there had been only one element in the ladder we would have $p_1 = z_1$ and $q_1 = 1$. If there had been two elements we would have $p_2 = z_1y_2 + 1$ and $q_2 = y_2$. But when there are quite a few elements, the reduction to ps and qs would be very laborious were it not for the fact that the theory of simple continued

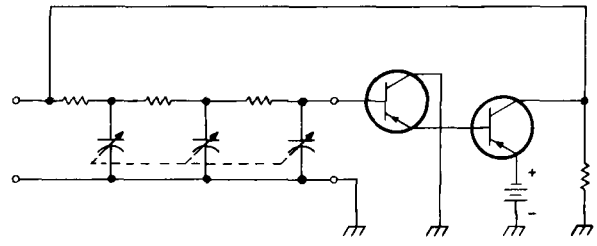


fig. 1. Phase-shift oscillator using ladder-network principle. Capacitor is a three-gang variable; translators can be types such as the 2N4996 or 2N4274. Oscillator covers about 250 kHz to 2.5 MHz frequency range.

fractions gives us a rule for building up from one p to the next and from one q to the next. The rule is that every new p is equal to the previous p multiplied by the element having the same subscript as the new p, plus the p which is two places behind the new p. Thus, $p_3 = p_2z_3 + p_1$ and $p_4 = p_3y_4 + p_2$ and so on. By the use of this rule a table of ps can be built up without any real thinking. And the same rule applies to the qs starting with the two qs given above. It is not difficult, merely somewhat lengthy, to find the value of p_6 in general terms. But it becomes much easier if we don't make all the elements different. For example if we choose all the zs in **fig. 2** to be equal resistances, R, and all the ys to be equal susceptances j/x, where X is the capacitive reac-

By Walter van B. Roberts, K4EA, 6330 Manasota Key Road, Englewood, Florida 33533

tance of one section of the tuning capacitor, then p_6 works out to be

$$\left(1 - 5\frac{R^2}{x^2}\right) + j\left(6\frac{R}{x} - \frac{R^3}{x^3}\right)$$

From this it is evident that when $R/X = \sqrt{6}$ the imaginary part vanishes and the value becomes −29. In other words, the phase has been shifted 180 degrees and the output voltage is 1/29 of the input. Hence if the output voltage is amplified 29 times or more and then fed back to the ladder input, oscillation will occur, as in **fig. 1.**

the general case of n elements

The foregoing seems sufficient explanation to make the transition to the general case of n elements obvious. **Fig. 3** gives all the information needed to grind out a solution for any ladder with any number of elements of any kind, provided the rule for building up the ps and qs is remembered. But it must be emphasized that the present method does not get around the necessity for writing out lengthy expressions when many different

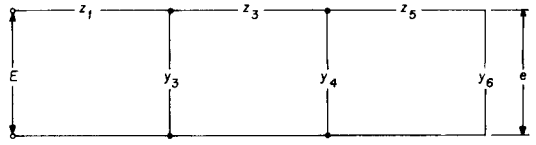


fig. 2. Ladder model using six elements. Network analysis is made in terms of impedances and admittances of the series and shunt elements.

elements are used. What it does do is provide a routine that can be followed without any brainwork other than to be careful not to make simple mistakes.

example

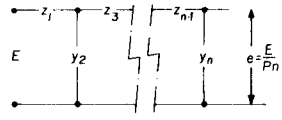
Before attempting to use the material of **fig. 3** for anything complicated, however, it's a good idea to get the feel of the mechanism by trying it out on something easy, which can be checked by other methods. For example, in **fig. 2** if all the elements are equal resistors, R, it will be found that the output voltage is 1/13 of the input voltage, regardless of the size of R, and that the input impedance is 13/8 times R. Incidentally it may be of interest to note that if the number of resistors is increased much beyond six in the network just discussed, the input impedance approaches a constant value

$$\frac{1+\sqrt{5}}{2}R$$

Finally, although it should be obvious, the reason that no consideration has been given to ladders with constant voltage applied to a first shunt element, or with constant current fed into a series first element, is that in both these cases the first element becomes functionless. In the first case the input shunt element would merely draw useless extra current from the source of constant voltage, while in the second case the series first element

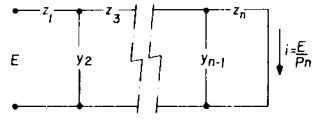
INPUT TO SERIES ELEMENT

INPUT IMPEDANCE = p_n/q_n



The impedance fraction:

$$z_1 + \cfrac{1}{y_2 + \cfrac{1}{z_3 + \cfrac{1}{y_4 + etc.}}}$$



Its ps and qs are:

$p_1 = z_1$

$p_2 = y_2z_1 + 1$

$p_3 = z_3y_2z_1 + z_3 + z_1$

$p_4 = y_4z_3y_2z_1 + y_4z_3 + y_4z_1 + y_2z_1 + 1$

and so on

$q_1 = 1$

$q_2 = y_2$

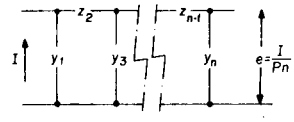
$q_3 = z_3y_2 + 1$

$q_4 = y_4z_3y_2 + y_4 + y_2$

and so on

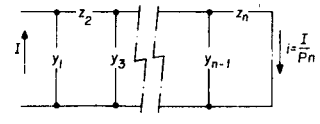
INPUT TO SHUNT ELEMENT

INPUT ADMITTANCE = p_n/q_n



The admittance fraction:

$$y_1 + \cfrac{1}{z_2 + \cfrac{1}{y_3 + \cfrac{1}{z_4 + etc.}}}$$



Its ps and qs are the same as at left with z and y interchanged:

so $p_1 = y_1$

$p_2 = z_2y_1 + 1$

and so on

fig. 3. Data for solving any ladder network of n elements using the method of "simple continued fractions."

would merely require more voltage in the source of constant current. In neither case would the first element play any part in the performance of the ladder. That would be determined solely by elements beyond the first. Thus **fig. 3** covers all actual performance possibilities.

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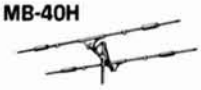

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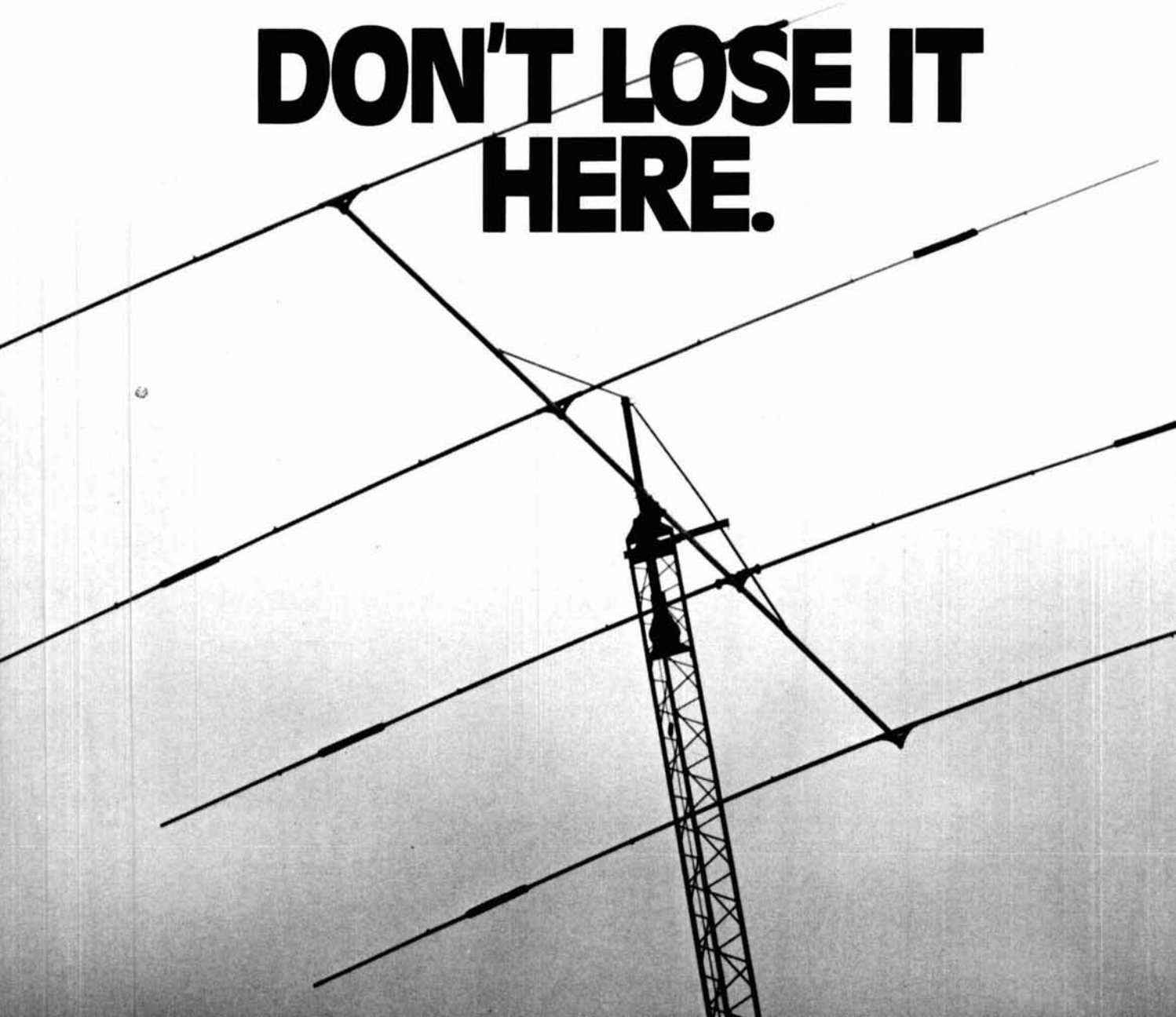

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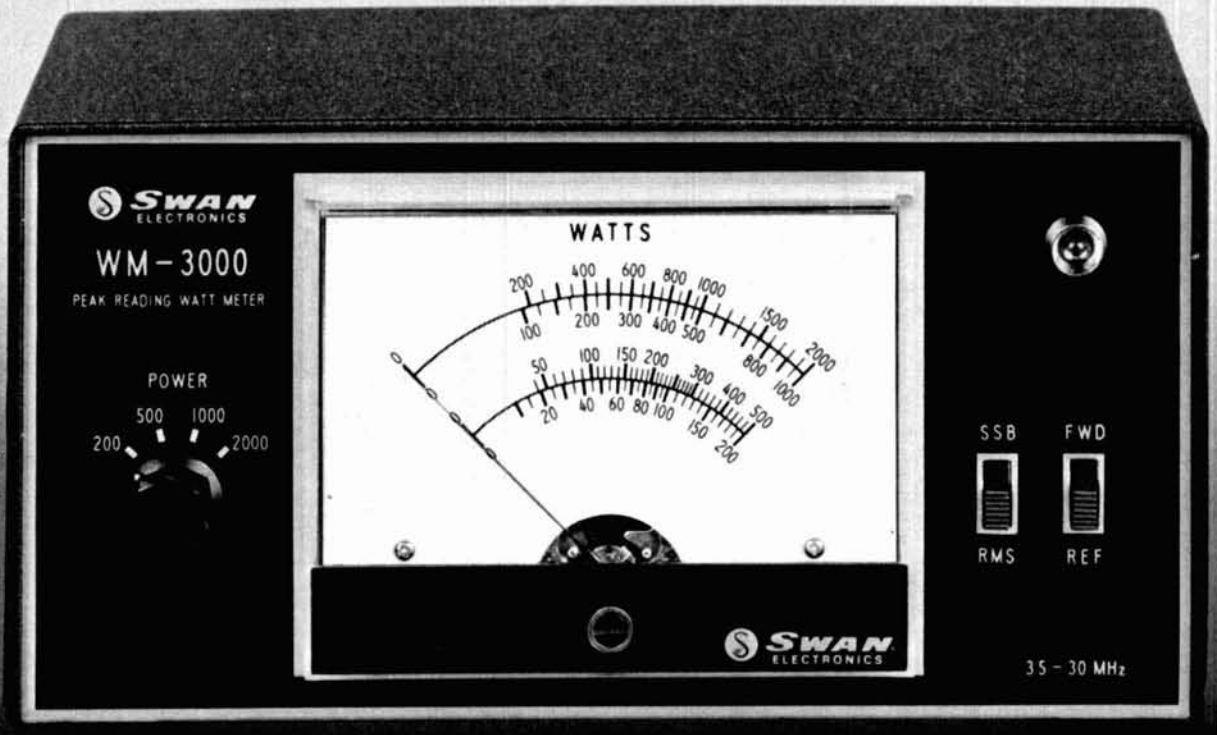


repair bench

Joe Carr, K4IPV

resurrecting the old war horse: new hope for the old receiver

If you walk through the fleamarket of any reasonably sized hamfest, it's likely that you will turn up any number of middle age receivers, often at bargain-basement prices. Models such as the venerable Hallicrafters SX-28A (which WA4EPI toted up the side of Bull Run Mountain on Field Day), SX99, SX-100, SX-101, and any of a long series of HQ-series Super Pro receivers by Hammarlund seem to be in evidence. Receivers, especially general-coverage types, manufactured prior to the late 1960s are in poor favor among hams because they lack the gloss of the newer technologies, may be a little troublesome when tuning single sideband (but not necessarily), and don't seem to fit well into the decor of our current transceiver-oriented radio stations. If, however, you are a new novice, a pre-novice wanting W1AW code practice and something to fiddle with, a young adult with a family budget battered by kids, mortgage and a car payment or two, or even an oldtimer with a luxury station, such old war-horse receivers can be a real bargain for use as a standby receiver, the main station receiver, or something to putter around with to learn some shirt sleeve electronics. The kicker is that – they frequently don't work properly.

As I pointed out in my troubleshooting article in the June issue, in most cases receiver troubleshooting is not the terrible chore it is made out to be. To be sure, there are some terrific problems that require a good technician and a lab full of equipment to solve but the vast majority are of a more mundane nature. In this article, I will address those problems that are peculiar to reworking or repairing old, supposedly worn-out, radio receivers which were the big guns of another era. After all, one person's trash may well be another's treasure.

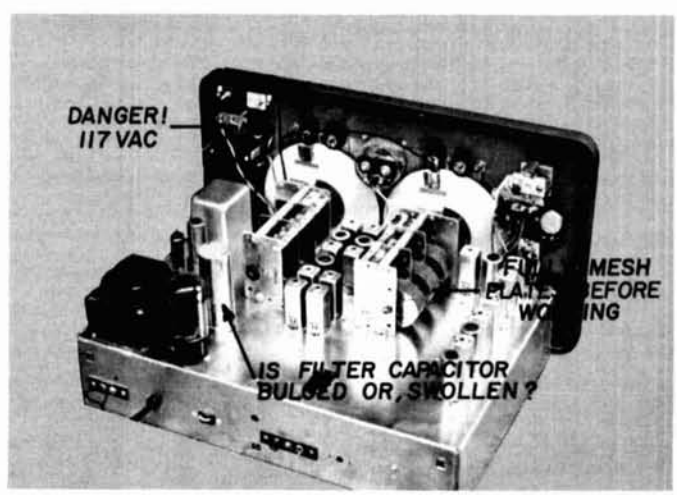
By Joseph J. Carr, K4IPV, 5440 South 8th Road, Arlington, Virginia 22204

Consider my own case. After ten years of apartment living, my wife and I bought a little duplex house and settled into suburban living. While Bonnie fiddled with draperies and furniture placement, Yours Truly was scheming to erect something that had been denied me for all those years: *an antenna.* The next requirement to be met was an old DX-60B belonging to a co-worker and the purchase of a new receiver – until the prices made it apparent that I wasn't going to have a new receiver for a long while. An old friend who never really got into amateur radio was more than willing to part with his old Hammarlund HQ-145X which he had purchased new when Eisenhower was President. It only partially worked, but the price was well below its apparent market value. A decade and a half of improper storage had taken its toll.

The first thing to do when "auditioning" a receiver of this vintage is to make an operational check, preferably before making the purchase. Turn it on and operate the controls. Determine exactly what is, or is not, working properly. Keep in mind that most receivers which have been in storage for any length of time will not be in the best of working order. If the radio works on *any* band, then the set is a good candidate for resurrection. If, on the other hand, it does not work on any band, it is a lesser candidate but that doesn't mean it should be completely ruled out. To be sure, it may require a more extensive evaluation, but the fact that nothing goes "beep" when you tune across the ham bands should reduce the price quite a bit.

Once you have acquired the monster it may have to be repaired. But first, let it run (*not* unattended) for several hours a day over the course of a few days to a week. The heat from the filaments tends to drive out any accumulated moisture, and turning the receiver on for short periods allows the electrolytic capacitors to wake up and start working again. My own HQ-145X had a rather bad audio hum when I first inspected it, but the

fig. 1. The chassis of a reclaimed communications receiver, such as this HQ-145X, may have several points with lethal potentials — unplug the receiver before working on it. Examine the electrolytic capacitors for bulges or a swollen appearance. Make sure the variable capacitor plates are fully meshed before you begin working.



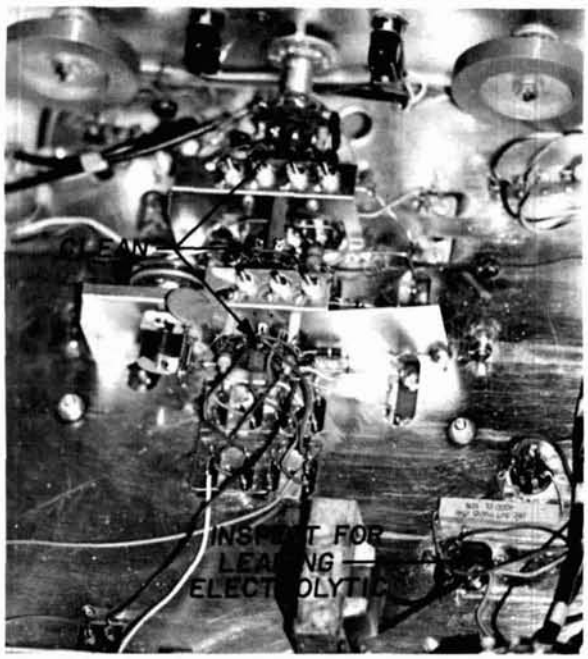


fig. 2. The bandswitch is a main area of difficulty and may need cleaning with a degreaser or a pencil eraser. Examine the bottom of the electrolytic filter capacitor for signs of electrolyte leakage.

hum disappeared in a few days after the electrolytics had reformed. In addition to the audio hum there were a number of other problems:

1. No high band (10 to 30 MHz) and only a scratching sound was heard on these frequencies when the main tuning dial was turned.

2. Occasional oscillation and a rather constant microphonic condition. Oscillation seemed frequency dependent and was at its worst on the special 20 BS band (a modified 10 to 30 MHz band unique to the HQ-145X series).

3. Noisy control potentiometers.

4. Noisy bandswitch.

5. All other rotary switches noisy and/or intermittent.

After the receiver had been burned in for almost a week, I was ready for the next step: cleaning and an additional inspection of the innards. **Fig. 1** shows the HQ-145X with the cabinet removed. At this point I feel it's important to caution you that lethal voltages exist on several points inside the receiver. Raw 117 Vac, direct from the power mains, is present on the clock motor in the upper lefthand corner. Unplug the receiver until power is actually needed and discharge the filter capacitors. Also, at this point, be sure to fully mesh the capacitor plates (tune receiver to low end of the dial) so that they will not be damaged as you work. If the capacitor plates are left unmeshed as those in **fig. 1**, then damage is almost certain.

The first step in cleaning the receiver is to remove the layer of dust that inevitably collects on any electronic chassis. Use either a 1- to 2-inch (2.5 to5cm) paint brush or an air gun, if available. Don't ever use steel wool on an electronic chassis – the small particles can really gum up the works. Although aesthetic considerations and your early training may dictate that you clean every nook and cranny don't be too vigorous in the vicinity of the main tuning capacitor. Dust between the plates can cause trouble and is hard to completely remove.

The next phase of the job is to replace any burned-out lamps, then clean the potentiometers and the rotary switches. The switch wafers and pots can be cleaned with almost any of the spray-can electronic contact cleaners, even the cheapies sold through mailorder and walk-in retail outlets. Be sure to spray each switch wafer separately and try to get spray inside each potentiometer. Immediately after spraying it is wise to vigorously operate the control or switch through its entire range for several seconds. In many cases, though, badly neglected rotary switches, especially those that have been totally unused for years, will have corrosion bad enough (it's black and the spray doesn't cut it) that the spray treatment is insufficient. For switch wafers in that condition I recommend an ordinary pencil eraser applied directly to the contact surface. It is usually best, especially in the vicinity of the bandswitch where moved wires can mean changed alignment, to hold the eraser steady and move the contacts underneath it. Don't forget the portion of the wiper contact surface directly underneath the fixed contacts (see **fig. 3**). That is, after all, where most of the trouble is.

The initial cleaning just described completely solved problems 3, 4 and 5 on my list and made a dent in problem 1 and now I could hear activity on 20 meters and 15-MHz WWV! The 20BS oscillations remained, as did the scratching on 10 through 30 MHz as the main tuning dial was turned. I also noted that a frequency dependent oscillation had appeared on the 10 to 30 MHz band. This can be a little frightening. If you are cognizant of receiver problems you probably agree that troubleshooting *tunable* oscillations is a lot like trying to

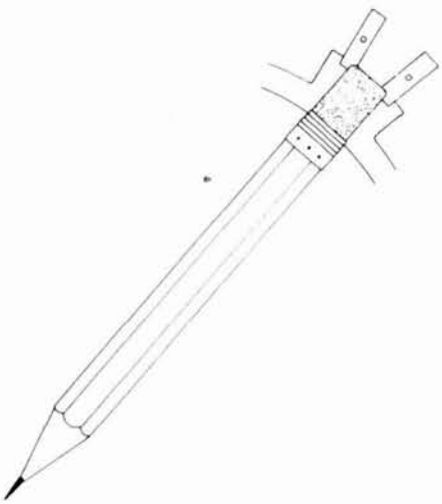


fig. 3. Be sure to clean the portion of the switch wiper contact surface that is underneath the fixed contacts. This can be done by rotating the switch while holding the eraser between two contacts.

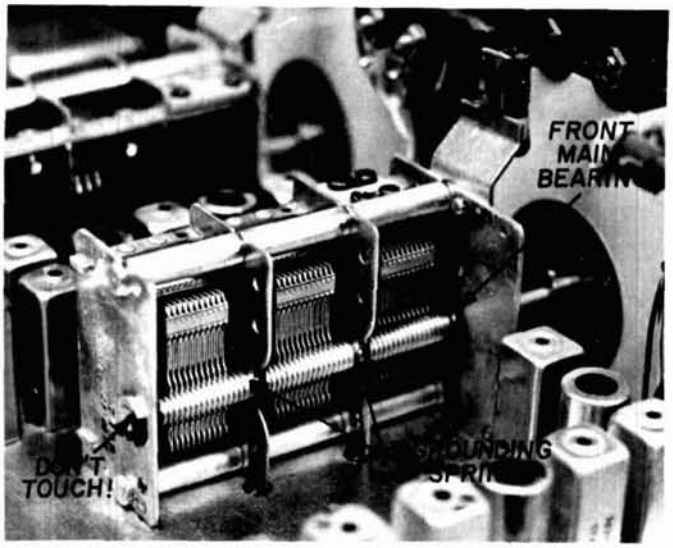


fig. 4. Instability and oscillation results from dirt and corrosion under the rotor ground springs and front main bearing. Clean and relubricate. See text for precautions.

skin an amoeba. I have seen amateur and professional technicians alike (including myself) work for hours, and even days, on such problems. Before looking for open suppressor grids, open screen bypass capacitors, or agc capacitors, you must consider other causes that are peculiar to the neglected receiver.

*There are two general causes of oscillation and micro*phonic conditions on such receivers and they are both spelled *CRUD*. In some cases, it is found that crud on the chassis forms undecoupled feedback paths between stages. Use a Freon-based degreaser or, as an undesirable alternative if you must, that popular concoction consisting of a quart of *Lestoil* with a pinch of ammonia and acetone added, to clean the chassis. Be sure to concentrate on the underside of the chassis and take care not to slop that concoction inside i-f/rf transformers and on to the variable capacitors. The second type of crud is dirt and dried grease in the main bearing and underneath the rotor grounding springs of the main tuning capacitor (see **fig. 4**). The cleaning should be done with a tiny jeweler's screwdriver or a relay cleaning tool. Carefully burnish the frame and the spring until clean.

The front main bearing race is a circular track filled with ball bearings. Clean this out using a virgin solvent such as Freon TF (I use Miller - Stephenson MS-180). *Do not* use foam contact cleaners or any television type cleaner that leaves a residue. Also, do not trust the labels on some products. Actually test the spray for a residue. Even with a cleaner such as MS-180 use it sparingly and avoid hitting the capacitor plates if possible (it *is*). After the bearing race is clean, re-lubricate it with a white grease such as Lubriplate (available at most electronic supply houses). Use a single dab on the main race and a microdab underneath each grounding spring. Clean the spring over the rear main bearing but otherwise leave that bearing alone. Under no circumstances should you attempt to adjust the tension screw associated with the rear bearing. It is unlikely that the capacitor will ever work properly if you do. Cleaning the main tuning capacitor and the bandspread tuning capacitor (in a similar manner) completely cured problem 2 and what was left of problem 1.

Once all of the cleaning is done you may worry about replacing components. Of course, if the radio does not work up to snuff then some troubleshooting may be in order. Chances are good, though, that the cleaning will restore normal operation, assuming that the radio had been retired in good working order.

Examine all elctrolytic capacitors. If any are bulged out or appear swollen, replace them. Also examine the electrolytics for signs of electrolyte leakage. Look for fluid, either a loose, clear stuff or a thick syrup-like type or (more often) a dry powder that will be some color between off-white and dusky brown. Any of these symptoms mark the capacitor for replacement – don't leave a bad electrolytic in the set! If only one section of *the multisection power supply filter capacitor is open do* not be tempted by the poor advice, given by some people, to bridge a good capacitor across the bad section. That is only a diagnostic tool and is such poor practice that it ought to be scorned. That open section may short someday (sooner than you might think) and then you can kiss your filter choke and rectifier goodbye.

Examine all of the other capacitors in the set. On paper types look for the wax end plugs being either missing or in poor shape. On the types with a black plastic body look for fluid and cracks in the plastic. Ceramic capacitors may be chipped or cracked but, for the most part, survive well. Replace paper capacitors with a good grade of dipped mylar capacitor such as the

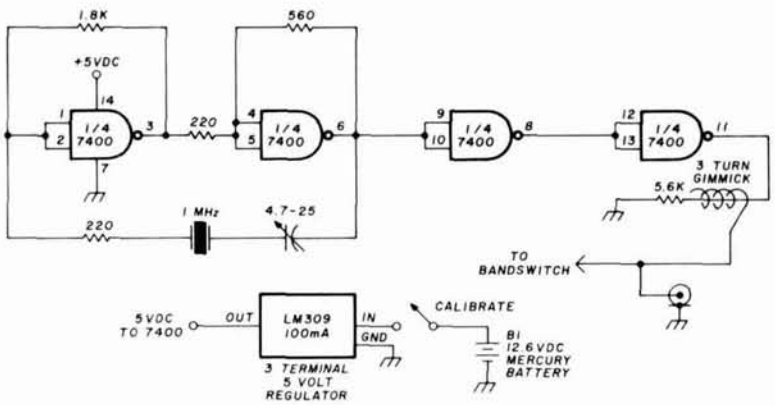


fig. 5. 1-MHz crystal calibrator using TTL logic. The regulator is in the TO-5 can, a 100 mA version of the LM309.

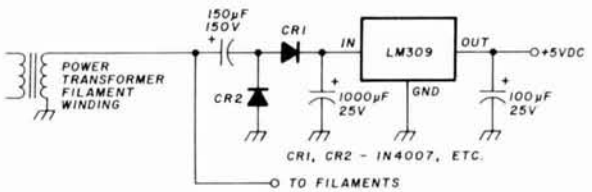


fig. 6. Suggested power supply for the crystal calibrator using the receiver's filament supply.

Sprague Orange Drop. Ceramic and mica types should be replaced with identical units.

Examine all of the carbon composition resistors for signs of overheating, burning, or cracking. Use only a good, new replacement. In this present context let me pass along some advice from my own experience: patronize a quality dealer and buy some good, new, replacement parts. This advice comes from trying bargain, hamfest castoff or surplus parts in one too many circuits! They are good for pittering around, but receiver servicing is really serious work. Incidentally, it won't cost over $10 to $15, even if almost all of the capacitors and resistors in the set are bad, which is unlikely.

You will also want to test the tubes from your reclaimed treasure. Use a tube tester, even if it is in a drug store or supermarket. These are simple emission testers but will quickly spot the gross loss of gain and internal shorts. Replace bad tubes with either new tubes recently acquired or those hamfest types known to be new military or commercial surplus. I have used a lot of new, surplus JAN tubes over the past two decades and honestly believe that the number of "bad-off-the-shelf" was actually less than those purchased at commercial outlets.

Once your receiver has been repaired and everything works properly, you may want to turn your attention to adding to (or changing) the instrument to fit your own needs. In my case, I activated an old irritation and replaced the three-screw terminal strip used as an antenna connector with a SO-239 coaxial connector. Also added was a binding post connected directly to chassis ground. The receiver which I had acquired lacked a crystal calibrator so one was added. Since I couldn't find a Hammarlund calibrator designed for the HQ-145, one had to be built. You have several alternatives here. You could duplicate the original and plug it into the appropriate socket or hard wire it to the socket. That has the advantage of using the front-panel *calibrator* switch to turn it on. After an inspection of my junk box I chose a 1-MHz TTL calibrator shown in **fig. 5.** Although mine is battery powered, you could power it from the receiver power supply as shown in **fig. 6.** The filament drain of the tube in the optional Hammarlund calibrator was about 300 mA and that is more than sufficient reserve to run the TTL integrated circuits.

After all else is done and you know that the radio is going to work, take some mild, soapy, household cleaner and gently clean the front panel. That "new" appearance will give you a psychological boost that is well earned.

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More Details? CHECK–OFF Page 142

increased flexibility for the MFJ Enterprises CW filters

Simple circuit changes you can make to the CWF-2 or CWF-3 filters to permit rapid changing of center frequency or bandwidth or both

Perhaps the most popular active audio filters used to improve CW reception are those manufactured by MFJ Enterprises.* The CWF-2 model is an 8-pole filter with selectable fixed bandwidths of 80, 110, and 180 Hz around a center frequency of 750 Hz, as shown in **fig. 1**. MFJ's other filter, the CWF-3, is a smaller version of the CWF-2, providing a 4-pole filter with 110 and 180 Hz bandwidths.

After using the CWF-2 unit for awhile, I wanted to vary the filter center frequency and bandwidth independently to suit my own preferences. In addition, an article by W6AGW outlined the minimum criteria for the filter bandwidth and center frequency as a function of code speed.[1] Although several articles have described the design and construction of CW filters, I decided to modify my unit rather than build a new one, since the components of the individual stages are already matched to give the same center frequency.

This article describes several modifications that can be made to either the CWF-2 or -3 to permit rapid changing of filter center frequency, bandwidth or both.

basic design

Although W7EIJ[2] and WA1JSM[3] have presented the design steps for such a filter, it is nevertheless worthwhile to briefly summarize their results to better understand what components may be changed. Since each op-amp section (a 2-pole bandpass) is identical to the others, it is only necessary to present the basis for a single stage, as shown in **fig. 2**, used for Qs less than 10 to minimize ringing. Calculation of component values begins with the selection of C and the choice of center frequency, f_o; stage gain, A_o, at the center frequency; and Q, so that

$$R_3 = \frac{Q}{\pi f_o C} \quad (1)$$

$$R_1 = \frac{R_3}{2A_o} \quad (2)$$

$$R_2 = \frac{R_1 R_3}{4Q^2 R_1 - R_3} \quad (3)$$

For the basic filter section, $f_o = 750\ Hz$, $A_o = 1.32$, and $Q = 4.24$, so that the input impedance is R_1. The bandwidth, Δf, is the frequency difference between the upper and lower -3 dB points, or

$$\Delta f = f_h - f_L \quad (4)$$

where

f_h = frequency of the upper -3 dB point
f_L = frequency of the lower -3 dB point

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*MFJ Enterprises, P.O. Box 494, Mississippi State, Mississippi 39762

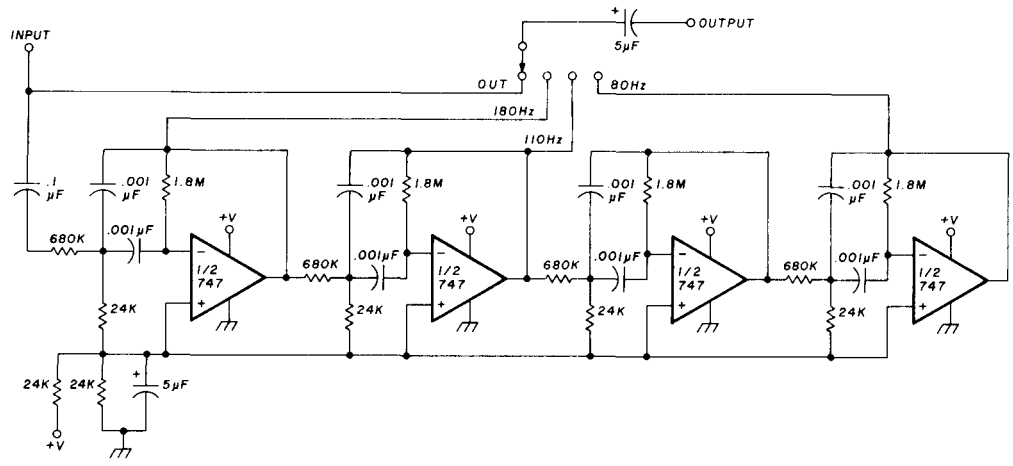

fig. 1. Schematic of the MFJ Enterprises Model CWF-2 CW filter featuring selectable bandwidths of 80, 110, and 180 Hz centered on 750 Hz.

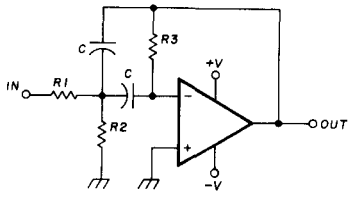

fig. 2. A single-stage, 2-pole bandpass filter section. The calculations of component values for changing filter center frequency and bandwidth are based on this circuit.

The center frequency, in terms of f_h and f_L, is thus

$$f_o = \sqrt{f_h f_L} \qquad (5)$$

and

$$Q = \frac{f_o}{\Delta f}$$

$$= \frac{\sqrt{f_h f_L}}{f_h - f_L} \qquad (6)$$

The main disadvantage with the circuit of **fig. 2**, as well as most op-amp circuits, is the need for a dual-polarity power supply. To permit operation with a single-polarity supply, the circuit shown in **fig. 3** is used, with two resistors of equal value for proper biasing. For the MFJ filters 24k resistors are used, and it's only coincidental that they are numerically equal to R2. In fact, other values could have been used for R.

modification 1

From **eqs. 1** through **3**, it can be shown that the center frequency of the single-stage circuit can be changed to a new frequency, f_o', without changing A_o or Q by merely changing R_2 to R_2', so that

$$f_o' = f_o \sqrt{\frac{R_2}{R_2'}} \qquad (7)$$

Therefore, by using a dual-element potentiometer with series resistors, each combination being equal to R2', it is then possible to smoothly vary the filter center frequency with two fixed bandwidths using the CWF-3 model. With the components shown in **fig. 4**, the center frequency could be varied from 280 to 1590 Hz with only a 1% variation in either A_o or Q. If the CWF-2 unit is used, a quad-element potentiometer is required for the three selectable bandwidths.

modification 2

If it's desired to smoothly vary the filters bandwidth without varying center frequency, the feedback circuit of **fig. 5**, as suggested by MFJ, can be used with either unit. Only the first stage (180-Hz bandwidth) is held intact while rewiring one of the other op-amp sections. With the component values shown, it was possible to vary the bandwidth from 75 to 150 Hz at the 750-Hz center frequency. Consequently, the filter Q changed from 5 to 10.

modification 3

This final modification is a combination of the previous two and permits the greatest degree of flexibility. You can now select either fixed bandwidths of 180 and 110 Hz or a variable bandwidth with both bandwidths

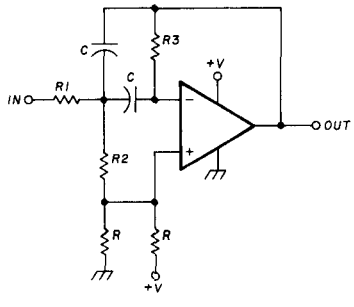

fig. 3. Alternative form of the basic filter stage for use with a single-polarity power supply.

having adjustable center-frequency capability. Using the CWF-2 unit the first two sections are untouched, while one of the remaining op-amp sections is changed. The final circuit is shown in **fig. 6.**

helpful hints

When soldering on the MFJ printed circuit board, be extremely careful not to overheat the copper laminate, otherwise the copper will separate from the board.

As pointed out by Lancaster in his recently published *Active Filter Cookbook,*[4] ordinary multiple-element potentiometers, particularly the snap-together types,

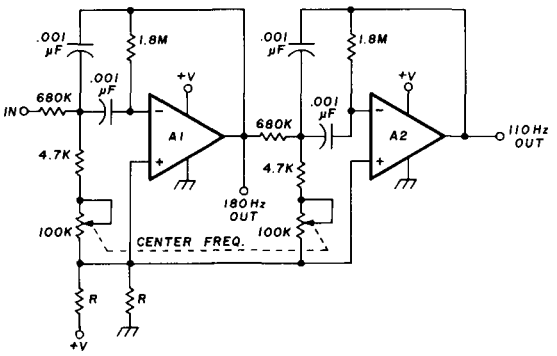

fig. 4. Schematic of the variable center frequency filter with fixed bandwidth. A variation between 280-1590 Hz of center frequency is possible with the two 100-k pots.

have problems. The first is that the resistance behavior is very uncertain at the extremes of pot rotation, since the electrical rotation is somewhat shorter than the mechanical rotation. Also, tracking between the elements should be 5 percent or better.

One inconvenience is linearity; that is, a linear center frequency vs pot rotation change. This is also a problem

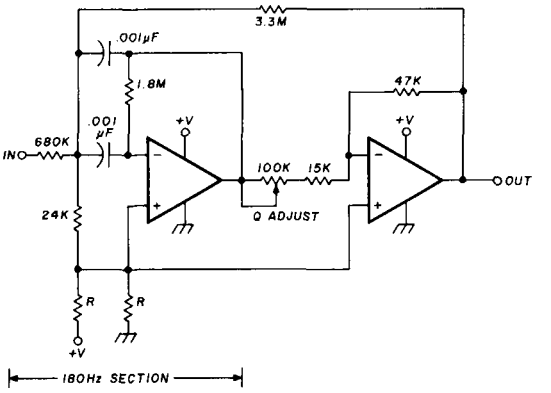

fig. 5. Circuit for varying the MFJ filter bandwidth without varying center frequency. The 180-Hz section is kept intact; the other section is changed as shown to provide bandwidth variation between 75-150 Hz at the 750-Hz center frequency. Filter Q is thus changed from 5 to 10.

with most integrated-circuit keyers.[5] If a linear taper pot is used, the center frequency will change drastically at one end with very little pot rotation. A reverse-log taper should be used for best results; however, multiple-element reverse-log types are both hard to find and expensive.

references

1. A.F. Stahler, W6AGX, "Optimum CW Filter Design," *73,* December, 1973, page 107.
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3. N.J. Nicosia, WA1JSM, "A Tunable Audio Filter for CW," *ham radio,* August, 1970, page 34.
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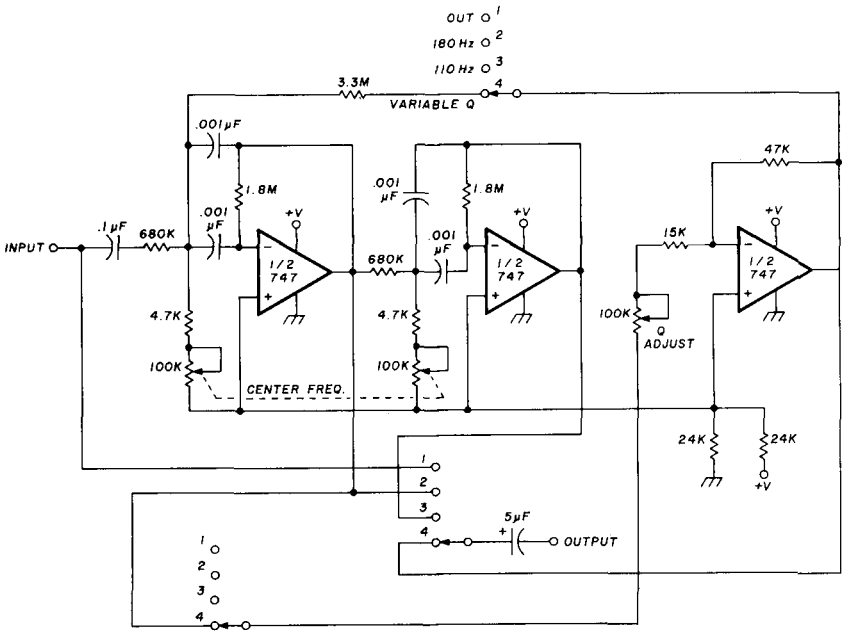

fig. 6. The CWF-2 filter incorporating modifications to permit the greatest degree of flexibility. Circuit features either fixed bandwidths of 180 and 110 Hz or optional variable bandwidth with adjustable center frequency.

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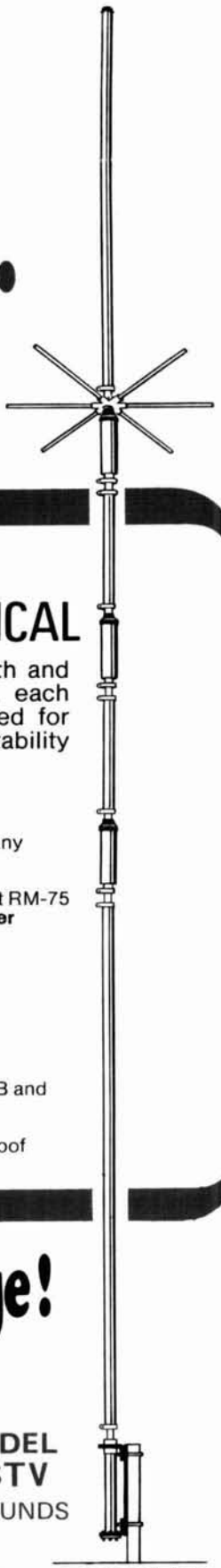

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RTTY performance and signal-to-noise ratio

A good case is presented for using low-frequency shift in amateur RTTY systems

Although most RTTY systems on the high-frequency amateur bands use the low-frequency shift of 170 Hz, a few use a shift of 850 Hz. In addition to more mutual interference with CW stations, performance with regard to signal-to-noise ratio (s/n) is not as good with the wider frequency shift. When selective fading is present, the lower-frequency shift will also perform better, as is well known.

The signal-to-noise performance can be shown by using the following formula:

$$\frac{s}{n} = 1.73\frac{D}{f} \cdot \frac{C}{N}\sqrt{\frac{B}{2f}} \qquad (1)$$

where s = signal voltage at output of discriminator and lowpass filter

n = rms noise voltage at output of discriminator and lowpass filter

D = deviation of the carrier from the center to one side (one-half the frequency shift)

f = audio frequency range following the discriminator and lowpass filter

By Leland E. Thompson, K6SR, 14851 Devonshire Avenue, Tustin, California 92680

B = frequency band preceding the limiter (it is assumed that a bandpass filter is used)

C = carrier voltage in frequency-band B before limiter

N = rms noise voltage in band B

Assuming a speed of 60 words per minute, the following values can be placed in **eq. 1:**

$B = 250\ Hz$

$f = 28\ Hz$

$D = 85\ Hz$ (total frequency shift is $170\ Hz$)

Then $s/n = 31.2\ dB$ (when C/N is $10\ dB$).

Threshold in wideband fm systems is considered to exist when C/N is 10 dB. In narrowband systems such as those considered here, the threshold is not as sharply defined, and good performance can be obtained with this ratio several dB lower. The s/n of 31.2 dB is 11 or 12 dB more than necessary for satisfactory performance.

The following values can be used in **eq. 1** for wide-shift systems:

$B = 850\ Hz$

$f = 28\ Hz$

$D = 425\ Hz$ ($850\ Hz$ total shift)

The $s/n = 50.2\ dB$ (when C/N is $10\ dB$). This value of s/n is far higher than necessary, and it decreases fast as C/N drops below 10 dB. Since N is 5.3 dB higher because of the wider frequency band, C must also be 5 dB higher. With a fading signal, the wideband system will start producing errors before the narrow system will.

Although there may be a slight advantage in reducing the shift below 170 Hz, band B would have to be reduced by using a narrower filter, and stability would then become more of a problem.

Equal performance should be obtained with the phase-locked RTTY terminal unit described by Webb.[1,2] In this case, band B is determined by the phase-locked-loop bandwidth and f is determined by the low-pass filter, as in the previous system.

references

1. P. Edward Webb, W4FQM, "A Phase-Locked Loop RTTY Terminal Unit," *ham radio*, January, 1972, page 8.
2. P. Edward Webb, W4FQM, "Optimization of the Phase-Locked RTTY Terminal Unit," *ham radio*, September, 1975, page 22.

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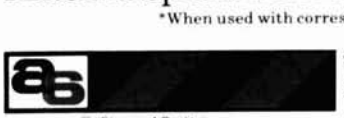

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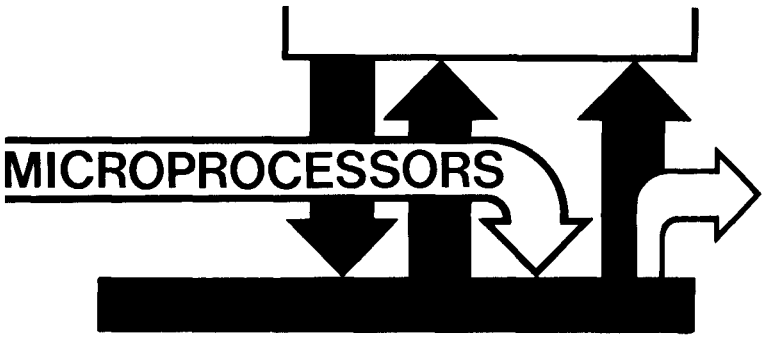

microcomputer interrupts

This month's column is the first of several that will focus upon the concept of an *interrupt.* When used in the context of a computer, an interrupt can be defined as the suspension of normal program execution in order to handle a sudden request for *service*, i.e., assistance, by the computer. At the completion of interrupt service, the computer resumes the interrupted program from the point where it was interrupted.[1] This specific use of interrupt is consistent with the general meaning of the term: to stop a process in such a way that it can be resumed.

A given computer will typically communicate with a variety of external I/O "devices." If a minicomputer is used, it may communicate with a teletype or alphanumeric keyboard, a CRT display, a printer, a floppy disk, and perhaps one or more laboratory instruments. If it is a microcomputer, it may communicate with smaller devices – (motors, solid-state relays, push-button switches, display lights) within a larger machine or instrument. When used as a replacement for discrete logic devices in a complex digital circuit, a microcomputer may communicate with other TTL integrated circuit chips such as latches, flip-flops, and three-state buffers.

When communicating with external I/O devices,[2] microcomputers can operate in two general modes, *polled* and *interrupt*. Polling is the periodic interrogation of each I/O device that shares a communications link to a microcomputer to determine whether it requires servicing. A microcomputer sends a poll that has the effect of asking the selected device, "Do you have anything to transmit?", "Are you ready to receive data?", and similar questions. When a microcomputer services a polled device, it simply exchanges digital information with the device in a manner that is prescribed by software in a subprogram or subroutine called a *software driver*.

By Peter R. Rony, Jonathan A. Titus, and David G. Larsen, WB4HYJ

Mr. Larsen, Department of Chemistry, and Dr. Rony, Department of Chemical Engineering, are with the Virginia Polytechnic Institute and State University, Blacksburg, Virginia. Mr. Jonathan Titus is President of Tychon Inc., Blacksburg, Virginia.

In a polled operation, the microcomputer sequences through the devices tied to the microcomputer, looking for individual devices that need servicing. When it finds a device that requires service, sequencing stops and a software driver services the device. Once it is finished, the microcomputer continues checking the devices. Polled operation is most useful with relatively slow devices that do not require frequent service, do not require attention from the microcomputer for excessive periods of time, or can wait to be serviced. Advantage is taken of the difference in speed of operations in the microcomputer and operations in the I/O device. Most common I/O devices are much slower than microcomputers. For example, in 100 ms (teletypewriter response time) an 8080A-based microcomputer can execute approximately 20,000 instructions when operated at a clock rate of 2 MHz. Although a microcomputer may give you the impression that it is doing several things simultaneously, this is only an illusion since it can manipulate data much faster than most I/O devices can respond to changes in data. *A single computer can perform only one task at a time.*

In interrupt operation, the microcomputer juggles the demands of the external I/O devices. There is a distinction between slow devices that require infrequent servicing and high-speed devices that demand the attention of the microcomputer for most of the time. The most appropriate description for interrupt operated systems is that they are *asynchronous*, i.e. they lack a common synchronizing signal and therefore give rise to generally unexpected or unpredictable program execution within the microcomputer. An *asynchronous device* is a device in which the speed of operation is not related to any frequency in the system to which it is connected.[3] The use of asynchronous devices is the rule rather than the exception.

There can exist *priority* in interrupt operation. All I/O devices can be ordered in importance so that some devices take precedence over others. In contrast, there is usually no priority in polled operation. Once a device is serviced, it waits its turn until all other devices are sequenced and, if necessary, also serviced. The time between the interrupt request by a device and the first instruction byte of the software that services it is known as the *interrupt response time*. For a high-speed device that has high priority, the response time can be very short, less than a millisecond. For a low-speed device that has low priority, the response time is variable, since it depends upon the demands placed upon the microcomputer by all higher priority devices.

Three commonly used microcomputer interrupt techniques are the *single-line interrupt*, the *multilevel interrupt*, and the *vectored interrupt* (**fig. 1**). In the

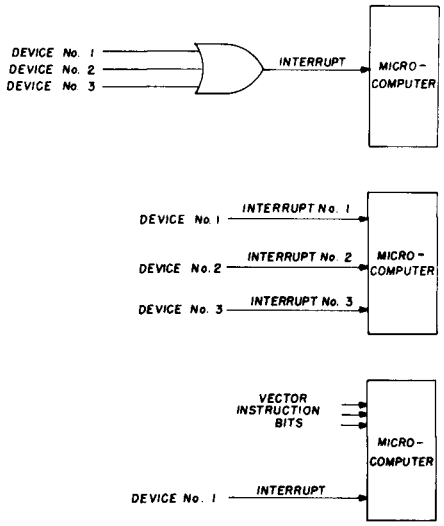

fig. 1. Schematic diagram of three different interrupt techniques, the polled interupt (top), multilevel interrupt (middle), and vectored interrupt (bottom).

single-line interrupt technique, multiple devices must be OR connected to a single interrupt line to the microcomputer. Once an interrupt signal is received, all of the interrupt devices are polled to determine which one caused the interrupt. It is possible to assign software priorities to the various interrupting devices, so that the first device polled that needs service is the one that receives the attention of the microcomputer. A common term used for the part of a program that polls interrupt devices is a *flag checking routine*. We shall discuss the concept of a flag in a subsequent column. At the moment, consider a flag to be a single-bit memory that indicates when an operation has been completed or when a condition has been attained.

In the multilevel interrupt technique, there are several interrupt lines to the microcomputer, each line being tied to a separate I/O device flag. The microcomputer does not need to poll the devices to determine which one caused the interrupt. This is done internally within the microprocessor chip. Depending upon the nature of the microprocessor chip, this can be a very fast interrupt technique, but it is somewhat difficult to expand.

vectored interrupt

A vectored interrupt causes a direct branch by the microcomputer to that part of the program that services the interrupt. This interrupt technique requires external integrated-circuit chips to supply the memory address of the *interrupt service routine* as well as to set the priority. With the 8080A microprocessor chip, eight different service routine addresses can be readily specified, although one of these addresses coincides with the reset address for the microprocessor, location zero. If you are interested in vectored interrupts, we encourage you to consider the Intel 8259 programmable interrupt controller, which became available commercially in July, 1976.

The use of interrupts should be considered very carefully. More complicated software is invariably required. For example, you will generally have to save the status of the microprocessor chip at the time that the interrupt occured. This means placing the contents of the accumulator, the flags, and the registers into a specified region of memory from which they can be retrieved at a later time, after the interrupting device has been serviced. Pay attention to priorities. Make certain that devices that require high priority and need immediate servicing are given the highest priority. Other devices, such as teletypes, should be low priority. Also, if you attempt to do too much with an interrupt system, you might find that your microcomputer becomes "interrupt bound," which means that the microcomputer is only working on the main task, which it should be doing while only infrequently servicing interrupt requests.

To end this column, we would like to provide one example of an interrupt system. Assume that your microcomputer is performing mathematical computations on 7-bit ASCII numbers that are entered via a UAR/T chip[4] that is connected to a Teletype operated at 110 Baud, or ten ASCII numbers per second. The exchange of data between the microcomputer and the UAR/T can be performed in 20 to 30 microseconds, which leaves 99.97 ms left for the microcomputer to do other things. With the Intel floating point package, for example, each floating-point multiplication or division can be performed in 2 to 5 ms with an 8080A-based microcomputer operating at 2 MHz. Sixteen-bit binary multiplications and divisions can be performed even faster. Therefore, it is appropriate for you to consider that the main task of the microcomputer is to perform such computations, and that 0.05 to 0.10 percent of the time the microcomputer can devote its attention to servicing the interrupting teletype. The less attractive alternatives are for the microcomputer to either poll the UAR/T or else to wait for a change of state of the UAR/T data ready or transmitter buffer empty flags.

Interrupts are also effective for use with devices that provide data to a microcomputer but which have no buffer of their own to store it. Existing data must be removed from the device and stored in the microcomputer quickly before a new data word can be generated by the device. One example of such a device is an analog-to-digital converter (ADC) in which the conversions are clocked by an external clock at repetitive time intervals.

references

1. Schweber Electronics, *Microprocessor Buzz Words*, Schweber Electronics Marketing Services, Westbury, New York 11590.
2. D. G. Larsen, P. R. Rony, and J. A. Titus, "What is a Microprocessor Input/Output Device?" *ham radio*, February, 1976, page 50.
3. R. F. Graf, *Modern Dictionary of Electronics*, Howard W. Sams & Co., Inc., Indianapolis, 1972.
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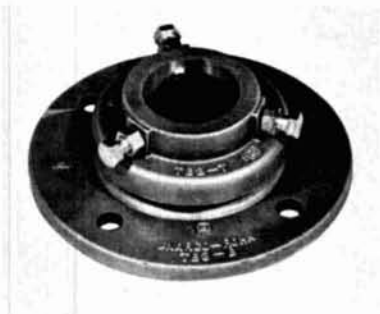
NEW products

antenna mount thrust bearing



Unarco-Rohn has just introduced a new thrust bearing (TB-3) for mounting antennas. Manufactured from heat-treated cast aluminum for extra strength, the TB-3 incorporates 30 stainless-steel ball bearings in a race that is protected from the elements and permits free movement at all times. Three lock-nuts fasten the antenna mast securely to the thrust bearing, relieving the weight of the antenna on the rotor and allowing an exceptionally free turning movement.

For additional information, write Rohn Products Advertising Agency, Box 2000, Peoria, Illinois 61601 or use *check-off* on page 142.

low- and medium frequency radio scrapbook

Ken Cornell's new scrapbook fills a huge gap with good, basic, hard-core information. The gap? That range of radio frequencies extending from the bottom of the broadcast band down to about 10 kHz – nearly audio!

There's another gap, too: a gap in knowledge and information about regulations, communications capabilities, equipment, and "personalities" of those bands below the broadcast.

To all but a mere handful of dedicated experimenters such as Ken and his fellow "LFers," the low and medium frequencies today are nearly as much of a "no-man's band" as they were 50 years ago. *The Low- and Medium-Frequency Scrapbook* not only bridges that gap, but tends to fill it with circuits for practical receivers, transmitters, converters, antennas, and neat little doodads that you will find indispensable for your experiments.

Like any good scrapbook, this one presents the material in such a way that you can find what you need in chapters about communications bands where no license is needed, about coils and coil-winding techniques, and many other comparable "goodies." Tables, charts, nomographs and schematic diagrams are liberally sprinkled throughout its pages.

Even better, the pages are loose-leaf and already punched for three-ring binders so that your scrapbook can be a growing, personal and up-to-date source reference with pages of your own experiments and results added where appropriate. You need this book! Soft cover, 114 pages, $6.95. With custom loose-leaf binder, $8.95. Order from Ham Radio Books, Greenville, New Hampshire 03048.

binaural synthesizer for audio signals

Hildreth Engineering Company announces its new Binaural Synthesizer, a device for producing a stereo audio output from a monaural audio input. The synthesizer may be plugged into the headphone or speaker jack of a receiver or other monaural audio signal source and provides outputs for stereo headphones, power amplifiers, or speakers.

The model 400 Binaural Synthesizer is available as a complete unit (less batteries) for $29.95, as a partially assembled unit including an assembled and tested PC board for $17.95, or as a kit which includes a predrilled, plated, glass-epoxy PC board with instructions for $6.95. All prices postpaid.

The model 400 provides a sharp 24 dB per octave channel separation, four poles in each channel, for a good stereo effect. The unit employs 741 integrated-circuit op amps rather than multiple units for simple, easy-to-find attachment points. The PC board contains extra traces for resistor trimming, if desired. The cross-over frequency is 750 ±50 hertz, input impedance is 2000 ohms, and the unit may be powered from any supply that will provide negative or positive voltage between 4 and 15 volts dc. In operation, the synthesizer typically draws 5 to 10 milliamperes.

Additional information may be obtained by writing to Hildreth Engineering Company, Post Office Box 3, Sunnyvale, California 94088, or by using the *check-off* on page 142.

utility case for test instruments

Continental Specialties Corporation (New Products, July, 1976, *ham radio*) makes available to the custom designer a matching blank utility case that will accommodate CSC's line of test instruments. The DM-C *Design Your Own Mate* case is molded from flame-retardant ABS plastic which can be easily drilled, routed, sawed, filed, or reamed. The blank box incorporates a bottom plate with mounting screws and features a sloping front panel which allows easy custom design and provides a modern, utilitarian appearance. The DM-C is 6.75 inches (17.2cm) long, 7.5 inches (19cm) wide and 3.25 inches (8.3cm) high with a nominal wall thick-

Introducing the 2-meter hand-held that gives you high performance. Without high cost.

It's the new Hy-Gain 3806 2-meter, 6-channel hand-held FM transceiver (144-148 MHz). The 2-meter hand-held that takes the high cost out of performance.

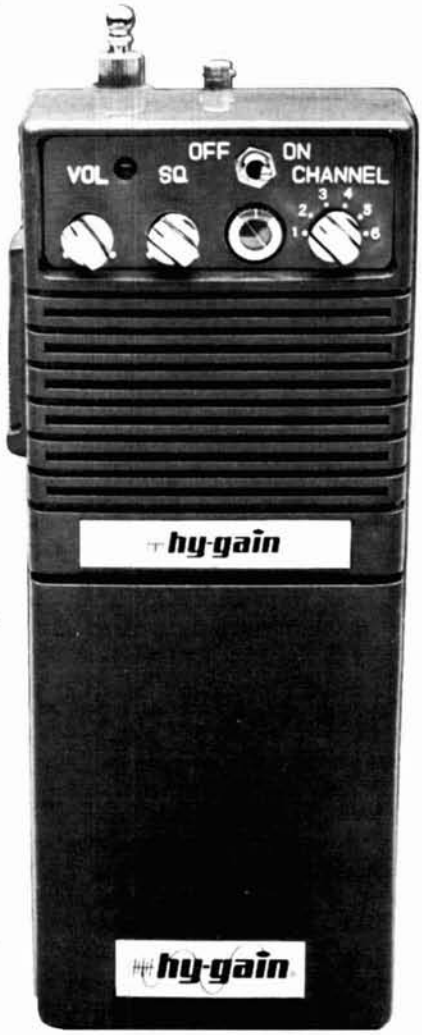
The Hy-Gain 3806 is built to out-perform. Outlast. And out-class every other 2-meter hand-held.

It's built tough. Water, dirt and corrosion are sealed out by the specially gasketed case. The speaker/microphone grill is engineered to prevent direct entrance by water. Even changing the power pack in the field won't diminish case integrity. The power section is separately sealed. So you never expose the circuitry.

The high-impact ABS case is extra tough. And ribbed for a sure, non-slip grip. The controls are up front. And easy to operate. There's volume. Squelch. 6-position channel selector. Transmit LED indicator. A meter that indicates battery condition on transmit, signal strength on receive. And a separate power switch for positive on-off.

There's a telescoping antenna that collapses completely into the case. Or you can use our 269 flexible antenna for extra convenience. And there are jacks for use with external antenna. Earphone. And external 12 VDC.

The 3806 has the kind of guts that have made Hy-Gain products famous throughout the world. Its receiver section is superior to everything else for the money. It has sharply tuned, on-frequency selectivity in the RF amplifier circuit. Two MOS-FET RF amplifier stages. Plus MOS-FET's in the 1st and 2nd mixers. They make the 3806 virtually immune to out-of-band signals. Intermodulation distortion. And cross-modulation. So you get truly incredible dynamic range. For superb adjacent channel rejection, the 1st mixer is followed by a monolithic crystal filter. And the 2nd mixer by an 8-pole ceramic filter.



A frequency multiplication factor of 12 allows you to use thicker, high stability crystals (one set of 146.52 simplex crystals supplied). Audio is enhanced through use of separate speaker and microphone elements. And there's an internally adjustable mic preamp. Something you won't find anywhere else.

The Hy-Gain 3806 hand-held is backed by a complete line of superb accessories. Including AC and DC chargers. Carrying case. External antenna adapter cable. And a Nicad power pack that's so over-engineered you won't over-extend it. Even in the most adverse conditions.

The pack is completely sealed in its own tough ABS case. Protected against over-charging. And contact shorting. It has 30-40% more in-use capacity than competitive units.

Soon we'll have a Touch-Tone®* pad available for the 3806. It'll fit flush in the back panel. Because we designed it specifically for the 3806.

The Hy-Gain 3806 2-meter, 6-channel FM hand-held. It gives you the performance you want. Without costing a lot. Available locally through your Hy-Gain dealer. See it and our more than 300 other fine products soon.

hy-gain®
We keep people talking.

Hy-Gain Electronics Corporation 8601 Northeast Highway Six; Lincoln, NE 68505

ness of 0.085 inch (2mm) and sells for only $5.50. Write Continental Specialties Corporation, 44 Kendall Street, Post Office Box 1942, New Haven, Connecticut 06509, or Box 7809, San Francisco, California 94110, or use *check-off* on page 142.

range of HP counter extended to vhf and uhf

Designed with the needs of the communications industry in mind, this new Hewlett-Packard Model 5305B Frequency Counter plug-on covers frequency bands from 50 Hz to 1300 MHz. In addition to all mobile communications bands, the counter's range includes TACAN/DME and ATC radar transponders as well as am and fm broadcast bands and vhf and uhf television bands.

The 5305B operates with the 8-digit 5300B mainframe. Sensitivity is 20 millivolts rms in both channels over the full bandwidth. A high resolution mode for tone measurements to 10 kHz improves resolution by 1000. Automatic gain control is included on both channels, plus a manual attenuation control on the high frequency channel.

A first for a counter is a probe power output to drive an accessory preamplifier. The Hewlett-Packard Model 10855A Preamp boosts sensitivity of the counter by 22 dB (x10). Adding an antenna and tunable filter to the preamp lets the user receive "on-the-air" signals for carrier measurements.

U.S. price of the Hewlett-Packard Model 5305B is $900, the Model 5300B mainframe is $460, and the Model 10855A Preamp is $225. Delivery for any of these units is 30 days.

For additional information contact Inquiries Manager, Hewlett-Packard Company, 1501 Page Mill Road, Palo Alto, California 94304; telephone (415) 493-1501, or use *check-off* on page 142.

More Details? CHECK–OFF Page 142

KENWOOD

...the Pacesetter in Amateur Radio

Discover the luxury of 4 MHz

TS-700A

Kenwood's TS-700A offers the ultimate promise of 2-meters . . . more channels, more versatility, tunable VFO, SSB-CW . . . and Kenwood quality.

Operates all modes: SSB (upper & lower), FM, AM and CW • Completely solid state circuitry provides stable, long lasting, trouble-free operation • AC and DC capability (operate from your car, boat, or as a base station through its built-in power supply) • 4 MHz band coverage (144 to 148 MHz) • Automatically switches transmit frequency 600 KHz for repeater operation. Simply dial in your receive frequency and the radio does the rest . . . simplex repeater reverse • Or accomplish the same by plugging a single crystal into one of the 11 crystal positions for your favorite channel • Transmit/Receive capability on 44 channels with 11 crystals.

TR-7400A

NEW...AVAILABLE IN DECEMBER

KENWOOD'S EXCITING NEW 2-METER MOBILE TRANSCEIVER • All solid state • Synthesized phase lock loop (PLL) • Power output: 25 or 10 watts (high or low selectable) • 6 digit LED frequency dislay • Full coverage 144-148 MHz, 800 channels in 5 KHz steps • 600 KHz repeater offset • Continuous tone-coded squelch (CTCS) for transmit and receive or transmit only with tone elements optional • Tone burst (tone elements optional) • Kenwood dependability and value built in.

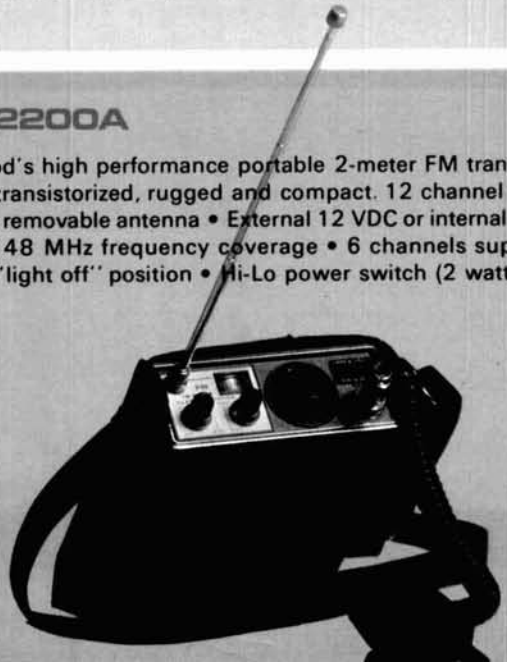
TR-7200A

Kenwood's superb 2-meter FM mobile transceiver. Designed to withstand the most severe punishment while providing consistently excellent performance. Packed with features like the PRIORITY function . . . Put your favorite crystals in channel 7, and the 7200A switches there with the push of a button . . . no matter what channel you are on. 146-148 MHz coverage, 22 channels, 6 supplied. Completely solid state.

The perfect companion to the TR-7200A is the PS-5 AC/DC power supply. Together they provide an efficient and handsome base station. Complete with a digital clock and automatic time control feature built in.

TR-2200A

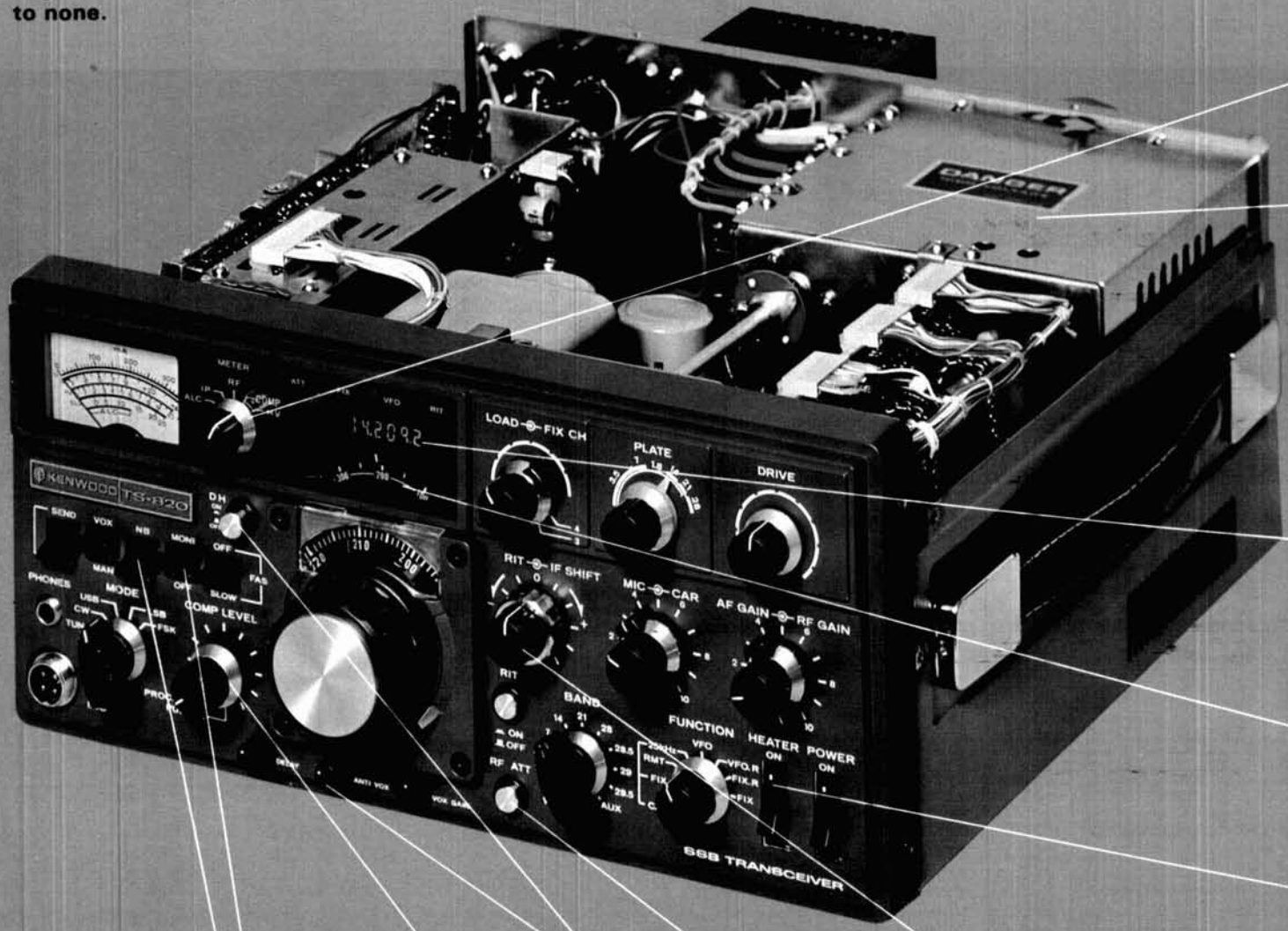
Kenwood's high performance portable 2-meter FM transceiver . . . completely transistorized, rugged and compact. 12 channel capacity • Telescoping removable antenna • External 12 VDC or internal ni-cad batteries • 146-148 MHz frequency coverage • 6 channels supplied • Battery saving "light off" position • Hi-Lo power switch (2 watts-400mW).



KENWOOD'S TS-820 *the Pacesetter*

Kenwood's well deserved reputation for fine craftsmanship and superb performance has never been more evident than in the TS-820. As a result of a host of innovative features being brought together, the 820 offers a degree of versatility, performance and pleasure second to none.

The Kenwood TS-820 is destined to be the world's new standard of excellence in amateur radio for years to come . . . a true "Pacesetter".



VFO-820

The VFO-820 is a solid state remote VFO designed exclusively for use with the Kenwood TS-820 *Pacesetter*. The VFO-820 has its own RIT circuit and control switch. It is fully compatible with the optional digital display in the TS-820. *The perfect extra to any Pacesetter station.*

RF MONITOR • Built-in monitor circuit allows you to hear your own voice by sampling the RF signal. Especially useful for adjusting the RF Processor.

NOISE BLANKER • The TS-820 uses an efficient noise blanker circuit, another Kenwood exclusive. A special crystal filter assures unsurpassed efficiency in eliminating unwanted pulse noises.

DIGITAL HOLD • A single pushbutton switch offers the operator unprecedented versatility. The digital hold circuit will lock the counter and display at any frequency, but will allow the VFO to tune normally. Ever wanted to return to a certain spot on the band and forgotten the frequency? That won't happen again with the new digital hold feature on the Kenwood TS-820.

SPEECH PROCESSOR • An HF circuit provides quick time constant compression using a true RF compressor as opposed to an IF clipper. Amount of compression is adjustable to the desired level by a convenient front panel control.

IF SHIFT • The IF SHIFT control varies the IF passband without changing the receive frequency. This "IF shift" control is located on the front panel and provides excellent unwanted signal reject control or "pass band tuning." The 820 moves the signal across the IF pass band not the pass band across the signal.

RF ATTENUATOR • Easy, one touch activation of the attenuator supplies 20 dB of padding on receive.

VOX • A voice-activated microphone circuit is built into the TS-820 with VOX GAIN, ANTIVOX, and VOX DELAY controls placed on the front panel for convenient adjustment any time.

Features

160 METERS • Full band coverage

PLL • The TS-820 employs the latest phase lock loop circuitry. The single conversion receiver section performance offers superb protection against unwanted cross-modulation. And now, PLL allows the frequency to remain the same when switching sidebands (USB, LSB, CW) and eliminates having to recalibrate each time.

RF NEGATIVE FEEDBACK • The linearity of the TS-820's final amplifier stage is now one of the best on the air. Third order intermodulation products are 35 db or greater below the output signal. RF Negative Feedback from the PA plate circuit to the driver cathode permits a high degree of linearity at the high power level of the final tubes.

FULL METERING • During receive, an easy to read meter functions as an S-meter. The same meter displays ALC level, plate current, RF output, and plate voltage during transmit. Includes COMP setting for adjusting the compression level of the built-in speech processor.

FINAL AMPLIFIER • The TS-820 is completely solid state except for the driver (12BY7A) and the final tubes. Rather than substitute TV sweep tubes as final amplifier tubes in a state of the art amateur transceiver, Kenwood has employed two husky S-2001A (equivalent to 6146B) tubes. These rugged, time-proven tubes are known for their long life and superb linearity. The input power of the TS-820 is conservatively rated at 160 W DC, 200 W PEP. Tubes run cool with the aid of a noiseless fan (standard) mounted on the rear panel. The above tube and power combination minimizes the possibilities of TVI and helps to maintain the Kenwood reputation for excellent audio quality.

DIGITAL READOUT DG-1 • (optional) A digital counter display can be employed as an integral part of the VFO readout system. Counter mixes the carrier, VFO, and first heterodyne frequencies to give *exact* frequency. Figures the frequency down to 10 Hz and digital display reads out to 100 Hz. Both receive and transmit frequencies are displayed in easy to read, Kenwood Blue digits.

DRS DIAL • Includes the same satin-smooth planetary drive found on other fine Kenwood models plus special, high-precision gears to add a new "monoscale" feature for easier frequency readout. LSB, USB, and CW operating frequencies can be accurately read from the same pointer.

HEATER SWITCH • The filaments of the three vacuum tubes may be turned off during periods of "receive only".

CW AUDIO CHARACTERISTICS • During CW reception, a special filter is used to alter the audio frequency response to provide a more comfortable, easy to copy tone.

HIGH STABILITY VFO • The VFO, heart of any SSB transceiver, is an exclusive Kenwood design using FET technology.

Other features include:
- Built-in 25 kHz calibrator*
- Built-in speaker*
- CW Sidetone and semi-break in*
- Rear panel terminals for linear amplifier, IF OUT, RTTY, and XVTR.
- Handy phone patch IN and OUT terminals

the TS-520

Why wait any longer for a rig that offers top performance, dependability and versatility . . . the TS-520 has proven itself in the shacks of thousands of discriminating amateurs, in field day sites, in DX and contest stations, and in countless mobile installations.

Superb craftsmanship is evident throughout . . . in its engineering concepts as well as its construction and styling . . . craftsmanship that is a Kenwood hallmark.

Maybe the Kenwood TS-520 is the one you have been waiting for.

Fine accessories designed to increase the versatility of your TS-520

SP-520

The SP-520 is an external speaker designed for use with the Kenwood TS-520. The SP-520 can be used in place of the tranceiver's built-in speaker for better readability. The speaker's cabinet matches the TS-520 front panel to provide a clean looking integrated station.

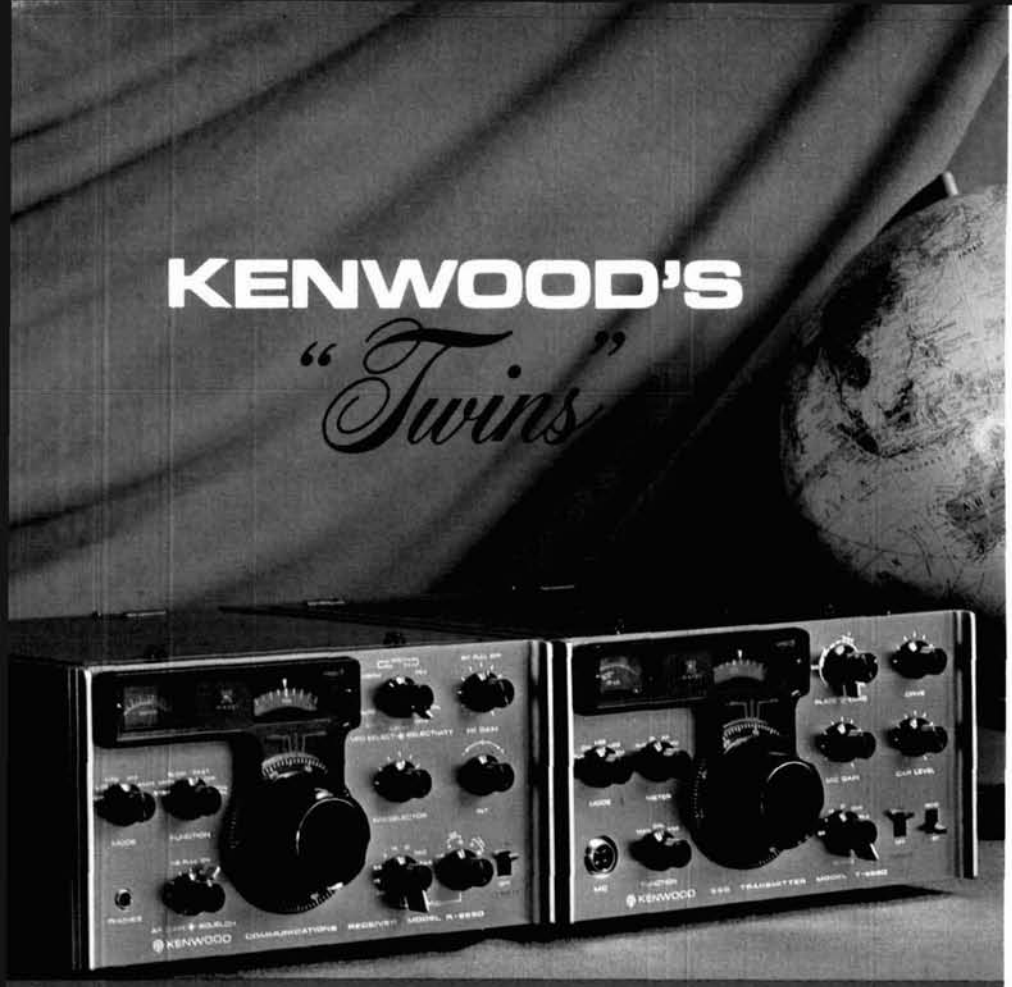
VFO-520

The VFO-520 is a solid state remote VFO designed to match the TS-520 perfectly. It allows VFO controlled cross channel operation when connected to the transceiver. A built-in RIT circuit, with an LED indicator, permits receiver incremental tuning.

TV-502

The TV-502 transverter puts you on 2-meters the easy way. Simply plug it in and you're on the air. Operates in the 144.0-145.7 MHz frequency range with a 145.0-146.0 MHz option. The TV-502 is completely compatible with the TS-520 and the TS-820.

KENWOOD'S "Twins"



Kenwood developed the T-599D transmitter and R-599D receiver for the most discriminating amateur.

The R-599D is the most complete receiver ever offered. It is entirely solid-state, superbly reliable and compact. It covers the full amateur band. 10 through 160 meters, CW, LSB, USB, AM and FM.

The T-599D is solid-state with the exception of only three tubes, has built-in power supply and full metering. It operates CW, LSB, USB and AM and, of course, is a perfect match to the R-599D receiver.

If you have never considered the advantages of operating a receiver/transmitter combination . . . maybe you should. Because of the larger number of controls and dual VFOs the combination offers flexibility impossible to duplicate with a transceiver.

Compare the specs of the R-599D and the T-599D with any other brand. Remember, the R-599D is all solid state (and includes four filters). Your choice will obviously be the Kenwood.

The newest and best in world listening

KENWOOD'S R-300

Dependable operation, superior specifications and excellent features make the R-300 an unexcelled value for the shortwave listener. It offers full band coverage with a frequency range of 170 KHz to 30.0 MHz • Receives AM, SSB and CW • Features large, easy to read drum dials with fast smooth dial action • Band spread is calibrated for the 10 foreign broadcast bands, easily tuned with the use of a built in 500 KHz calibrator • Automatic noise limiter • 3-way power supply system (AC/Batteries/External DC) . . . take it anyplace • Automatically switches to battery power in the event of AC power failure.

HS-4

The Kenwood HS-4 headphone set adds versatility to any Kenwood station. For extended periods of wear, the HS-4 is comfortably padded and is completely adjustable. The frequency response of the HS-4 is tailored specifically for amateur communication use. (300 to 3000 Hz, 8 ohms).

MC-50

The MC-50 dynamic microphone has been designed expressly for amateur radio operation as a splendid addition to any Kenwood shack. Complete with PTT and LOCK switches, and a microphone plug for instant hook-up to any Kenwood rig. Easily converted to high or low impedance. (600 or 50k ohm).

TRIO-KENWOOD COMMUNICATIONS INC.
116 EAST ALONDRA/GARDENA, CA 90248

KENWOOD
. . . pacesetter in amateur radio

SAVE UP TO 50% ON PARTS.

Hobbyist or professional, there are probably a lot of circuits you build just for the fun of it. And a lot you'd *like* to build, but never get around to.

One reason is the cost of parts. Parts you buy for one project, but can't re-use... because you haven't time to take them carefully apart. Or because of heat and mechanical damage that occur when you do.

Now, there's an easier way that can save you big money on parts *and hours on every project*, as well: *Proto-Board® Solderless Breadboards.*

Now, assembling, testing and modifying circuits is as easy as pushing in—or pulling out—a lead. IC's, LED's, transistors, resistors, capacitors... virtually every kind of component... connect and interconnect instantly via long-life, nickel-silver contacts. No special patch cords or jumpers needed—just lengths of ordinary #22-30 AWG solid hookup wire.

Circuits go together as quickly as you can think them up. And parts are re-usable, so as your "junk box" builds, you build more and more projects for less and less money.

Before you invest in your next project, invest in a CSC breadboard. See your dealer or order by phone: 203-624-3103 (East Coast) or 415-421-8872 (West Coast)—major charge cards accepted. You've got nothing to lose... and a lot to gain.

MODEL	NO. OF TIE-POINTS	14-PIN DIP CAPACITY	SUGG LIST *	OTHER FEATURES
PB-6	630	6	$15.95	Kit—10-minute assembly
PB-100	760	10	19.95	Kit—with larger capacity
PB-101	940	10	29.95	8 distribution buses, higher capacity
PB-102	1240	12	39.95	Large capacity, moderate price
PB-103	2250	24	59.95	Even larger capacity; only 2.7¢ per tie-point
PB-104	3060	32	79.95	Largest capacity; lowest price per tie-point
PB-203	2250	24	75.00	Built-in 1%-regulated 5V, 1A low-ripple power supply
PB-203A	2250	24	120.00	As above plus separate ½-amp +15V and −15V internally adjustable regulated outputs

*Manufacturer's suggested list
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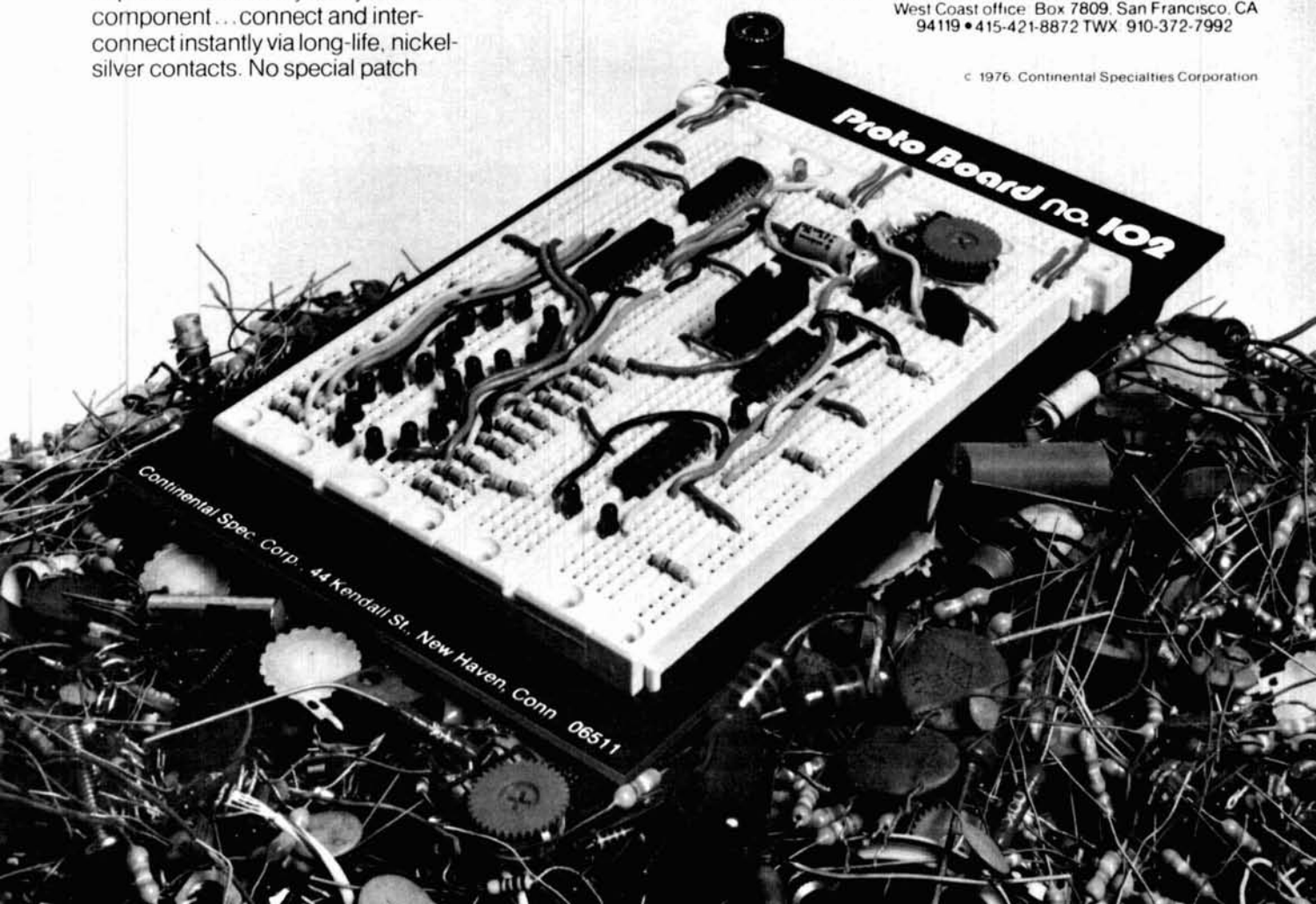
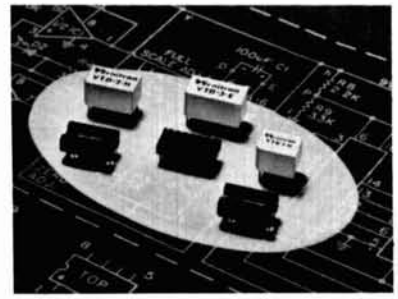


miniature ceramic filter for communications receivers



Vernitron Piezoelectric Division recently introduced a new series of low-cost miniature VTD ceramic ladder filters designed to meet the needs of modern double conversion systems.

The small size of the VTD filters and their high stopband rejection, make them particularly suitable for hand-held transceivers, CB equipment, police scanners and commercial two-way radios.

These compact, highly sensitive ceramic filters are fully compatible with transistorized amplifier circuitry, as well as with ICs in am and fm sets. They plug into 14- or 16-pin DIP sockets or mount directly on PC boards, and provide maximum design flexibility.

Vernitron has designed the new VTD Series of ceramic ladder filters in three model groups. VTD-1 models offer 40 dB bandwidth and stopband of 25 to 27 dB; VTD-2 models offer 50 dB bandwidth and stopband of 30 to 40 dB; and VTD-3 models offer 60 dB bandwidth and stopband of 40 to 45 dB. The VTD-1 and VTD-2 filters plug into a 14-pin dip socket and the VTD-3 filter plugs into a 16-pin dip socket.

For more information and Data Sheet 940 write Mark Rickman, Vernitron Piezoelectric Division, 232 Forbes Road, Bedford, Ohio 44146; telephone (216) 232-8600, or use *check-off* on page 142.

Sinclair offers free brochure for amateurs

Sinclair Radio Laboratories – the company known for quality and innovation in the radio antenna systems equipment market for over 25 years –

More Details? CHECK–OFF Page 142

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$9.95 ea. QTY. 12 OR MORE — $10.95 ea. QTY. 6-11 — $11.95 ea. QTY. 1-5

KIT INCLUDES
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- 50 or 60 Hz OPERATION
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6-LED Readouts(FND-359 Red, com. cathode)
1-MM5314 Clock Chip (24 pin)
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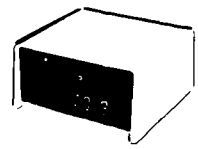
24-Molex pins for IC socket

LARGE .4" DIGITS!
ORDER KIT #850-4
AN INCREDIBLE VALUE!

"Kit #850-4 will furnish a complete set of clock components as listed. The only additional items required are a 7-12 VAC transformer, a circuit board and a cabinet, if desired."

Printed Circuit Board for kit # 850-4 (etched & drilled fiberglass) $2.95
Mini-Brite Red LED's (for colon in clock display) pkg. of 5 ..... 1.00
Molded Plug Transformer 115/10 VAC (with cord) 2.50
NOTE: Entire Clock may be assembled on one PC Board or Board may be cut to remote display. Kit # 850-4 will fit Plexiglas Cabinet II.



CABINET I
3"H,6¼"W,5½"D

CABINET II
2½"H,5"W,4"D

ANY SIZE/COLOR

PLEXIGLAS CABINETS

Great for Clocks or any LED Digital project. Clear-Red Chassis serves as Bezel to increase contrast of digital displays.

Black, White or Clear Cover

$6.50 ea. 2/$12.

RED OR GREY PLEXIGLAS FOR DIGITAL BEZELS
3"x6"x1/8" **95¢ ea. 4/$3**

MOBILE LED CLOCK

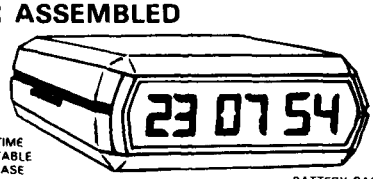
12 OR 24-HOUR OPERATION

12 VOLT AC or DC POWERED FOR FIXED OR MOBILE OPERATION.

SIX JUMBO .4" DIGITS!

KIT OR ASSEMBLED

MODEL 2001



ACCURATE TIME WITH ADJUSTABLE XTAL TIME BASE

BATTERY BACK-UP FOR POWER FAILURE OR TRANSPORTING FROM HOUSE TO CAR, ETC.

Approx. Size: 1¾"H x 4"W x 4½"D

- 6 JUMBO .4" RED LED'S BEHIND RED FILTER LENS WITH CHROME RIM.
- SET TIME FROM FRONT VIA HIDDEN SWITCHES • 12/24-Hr. TIME FORMAT
- STYLISH CHARCOAL GRAY CASE OF MOULDED HIGH TEMP. PLASTIC
- BRIDGE POWER INPUT CIRCUITRY – TWO WIRE NO POLARITY HOOK-UP
- OPTIONAL CONNECTION TO BLANK DISPLAY (Use When Key Off in Car, Etc.)
- TOP QUALITY PC BOARDS & COMPONENTS · EXCELLENT INSTRUCTIONS

KIT #2001 COMPLETE KIT (Less 9V. Battery) **29.95 EA** 3 OR MORE **$27.95 EA**

115 VAC Power Pack #AC-1 **$2.50 EA.**

ASSEMBLED UNITS ORDER #2001 WT (LESS 9V. BATTERY) **$39.95 EA.** 3 OR MORE **$37.95 EA.** Assembled Units May Be Mixed With Kits for Qty. Price

JUMBO RED LED's 12/$1.00 50/$3.95

6 Digit-LED Clock-Calendar-Alarm Kit

This is a complete, top of the line, Kit for the person that wants the best. Some of the many features and options are: 12/24 time, 28-30-31 day calendar, alternates time (8 sec) and date (2 sec) or can display time only and date on demand, 24 hr alarm - 10 minute snooze, alarm set indicator, 50/60 HZ. line operation or use with Xtal time base (#TB-1), built in OSC for battery back-up / AC failure, Aux. timer. Large digits.

Kit #7001B 6 - .4" Digits Man-64 $39.95
Kit #7001C 4- .6" Digits & 2-.3" (seconds) $42.95

Kits are complete (less cabinet) including PC boards, power supply, IC socket, 9 switches, 16 transistors and all parts required for above features and options (Ideal fit in Cabinet I above).

60 HZ.
XTAL TIME BASE KIT

Will enable Digital Clock or Clock-Cal. Kits to operate from 12VDC. Uses MM5369 and 3.58MHZ. XTAL. Req. 5-15VDC/2.5 MA. 1"x2" PC Board. Easy 3 wire hookup Accuracy: +- 2 PPM

#TB-1 [adjustable]
Complete kit $4.95 ea
Wired & Cal. $9.95 ea

PRINTED CIRCUIT BOARDS for CT-7001 Kits sold separately with assembly info. PC Boards are drilled Fiberglass, solder plated and screened with component layout. Specify for # 7001B or # 7001C (Set of 2) $7.95

JUMBO DIGIT CLOCK KIT

A complete Kit (less Cabinet) featuring: six .5" digits, MM5314 IC, 12/24 Hr. time, 50/60 HZ., Plug-Transformer, Line Cord, Switches, and all Parts.

[Ideal Fit in Cabinet II]
Kit #5314-5 ..... **$19.95 ea. 2/$38.**

JUMBO DIGIT CONVERSION KIT

Convert small digit LED clock to large .5" displays. Kit includes 6-.5" LED's, Multiplex PC Board & easy hook-up info.

Kit #JD-1CC For common Cathode
Kit #JD-1CA For common Anode
$9.95 ea. 2/$19.

SCHOTTKY TTL		DTL		UART		EXAR		OP AMPS	
74S00	$ .35	930	$ .09	AY5-1013	$ 6.95	XR 2556	$ 1.75	3/$1.00	
74S01	.40	932	.09			XR 2567	$ 1.95	301 DIP	
74S04	.55	937	.09	DIODES				301 TO-5	
74S05	.60	LED DRIVERS		IN 4002	1A, 100 PIV 12/$1.00	TRANSISTORS		709 DIP	
74S09	.55	7447	$ .95	IN 4003	1A, 200 PIV 12/$1.00	2N2222A	TO-18 5/$1.00	741 DIP	
74S10	.40	7448	.95	IN 4005	1A, 600 PIV 11/$1.00	2N3415	TO-92 5/$1.00	741 M-DIP	
74S15	.55	75491	.65	IN 4007	1A, 1000 PIV 10/$1.00	2N3704	TO-92 5/$1.00	741 TO-5	
74S20	.50	75492	.65	RECTIFIER	2.5A, 1000 PIV 4/$1.00	2N4249	TO-92 5/$1.00	747 DIP	
74S22	.45	VOLTAGE REGULATORS		RECTIFIER	3A, 1000 PIV 3/$1.00	2N4400	TO-92 5/$1.00	748 TO-5	
74S40	.45			IN 5400	3A, 50 PIV 5/$1.00	2N4437	TO-92 5/$1.00		
74S50	.45	LM 309 H TO-5	$ .95	IN 914	SIL. SIGNAL 20/$1.00	2N5089	TO-92 5/$1.00	DISCRETE LED's	
74S51	.55	LM 309 K TO-3	1.25	IN 4148	SIL. SIGNAL 20/$1.00				
74S60	.85			DIAC	28V. 4/$1.00	SWITCHES		JUMBO RED	
74S64	.55	PLUG TRANSFORMERS				ROCKER SPDT	6/$1.	12/$1.00	
74S73	1.25			LINEAR		MINI-SLIDE SPDT	5/$1.	50/$3.95	
74S74	.85	7805 TAB	.95	555 TIMER	2/$1.00	REG. SLIDE DPDT	6/$1	100/$7.50	
74S75	1.75	7812 TAB	1.25	556 DUAL TIMER	.95	PUSH BUTTON N.O.	3/$1.		
74S78	1.50	7815 TO-3	1.25	565 PLL	.95			PC TRIM POTS	
74S86	.95	7815 TAB	1.25	566 FUNCTION GEN.	1.75	TRANSISTOR SOCKET TO-5/18 GOLD PINS			
74S107	.95	78L 15 TO-5	.75	567 TONE DECODER	1.75	5/$1.00		25K 6/$1.00	
74S112	.95	7824 TO-3	1.25					4.7K 6/$1.00	
74S113	1.40	723 DIP	.75	IC SOCKETS		NYLON WIRE TIES			
74S114	.95	723 TO-5	.75	PINS 1-24	25 100	8" TIE-WRAP	100/$1.95	SPECTROL 10K 10 TURN	
74S121	.95					4" TIE-WRAP	100/$1.75	95c	
74S133	.75	DIGITAL CLOCK IC's		14	$ .25 $ .22 $ .20			4/$3.00	
74S134	.75			16	.28 .25 .23	MOLEX PINS			
74S138	1.75	MM 5312	$ 4.95	18	.31 .28 .26	REEL OF 1000	$ 8.50		
74S139	1.50	MM 5314	3.95	24	.50 .45 .40	STRIP OF 100	1.25		
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74S153	1.95	CT 7001	7.95	40	.75 .70 .65				
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74S156	1.95	50380	3.95	MEMORY					
74S157	1.80	MM 5369	2.50						
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75234 DUAL CORE SENSE AMP 1.50
MM 502H TO-5 SHIFT REG .95

BUY 100 OR MORE IC's [Any Mix] TAKE 10% DISCOUNT.

Fairchild Super Digit FND-359

.4" Char. Ht. 7 segment LED RED Com. Cath. Direct pin replacement for popular FND-70.

95¢ ea, 10/$8.50 100/$79.00

SET OF 6 FND-359 WITH MULTIPLEX PC BOARD $6.95

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3/$5.00
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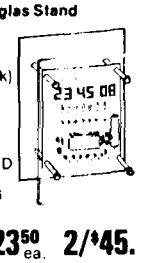
TELEPHONE FORMAT KEYBOARD BY Chomerics

2-1/4"x3"
5/32" thick
$4.95
6/$28.

SEE THE WORKS Clock Kit
Clear Plexiglas Stand



- 6 Big .4" digits
- 12 or 24 hr. time
- 3 set switches (back)
- Plug transformer
- all parts included

Plexiglas is Pre-cut & drilled
Size: 6"H, 4⅛"W, 3"D

A SUPER LOOKING CLOCK!

Kit #850-4 CP **$23.50 ea. 2/$45.**

7-SEG LED

COMMON CATHODE

	COLOR	HT. DEC PT.	PR EA.
FND-359	RED	.4" RHDP	$ .95
FND-503	RED	.5" RHDP	$1.35
DL-750	RED	.6" LHDP	$2.95
XAN-654	GREEN	.6" NDP	$2.95
XAN-664	RED	.6" NDP	$2.95

COMMON ANODE

DL-747	RED	.6" LHDP	$2.95
XAN-72	RED	.3" LHDP	$1.25
XAN-81	YELLOW	.3" RHDP	$1.75
XAN-351	GREEN	.3" RHDP	$1.50
XAN-361	RED	.3" RHDP	$1.50
XAN-362	RED	.3" LHDP	$1.50
XAN-662	RED	.6" NDP	$2.50
XAN-692	RED	.6" NDP	$2.50

Form Inexpensive Sockets 100 for $1.25 Reel of 1000 - $8.50

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More Details? CHECK–OFF Page 142

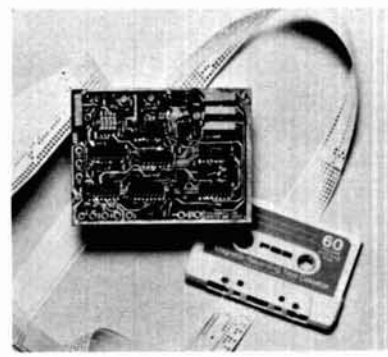
announces that radio amateurs are now able to obtain a *free* "Equipment for Amateur Radio Service" brochure.

Sinclair is the originator of the *Excaliber* mobile antenna and the tunable *Mirage* antenna, and is responsible for developing the two-meter 100 dB hybrid ring duplexer, the Q-circuit© duplexer and the popular Q-filter.©

Now amateur radio organizations and individuals may obtain all Sinclair products at generous professional discounts.

To obtain the new brochure with price list, discount structure and order form, write: Amateur Brochure, Sinclair Radio Laboratories, Inc., 675 Ensminger Road, Tonawanda, New York 14150; or use *check-off* on page 142.

low-cost audio cassette/tty/crt adapter for microprocessors



Electronic Product Associates announces the availability of a new, low-cost audio cassette/TTY/CRT adapter which allows any serial TTL or MOS output to simultaneously interface a low-cost audio cassette player via frequency shift keying (Byte Standard) up to 300 Baud and to a standard RS232 CRT and a 20 mA current loop TTY. The adapter also simultaneously decodes Byte Standard fsk data from low-cost audio cassette players and from 20 mA current loop TTY and RS232 CRT. Audio cassette information is decoded by a proprietary phase-locked-loop system developed by EPA which is said to be the most reliable method available for transferring digital data to and from low-cost audio cassette players. The Model TCC3 is 4½x3¼ inches

More Details? CHECK–OFF Page 142

HERE'S A HOT NUMBER

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THE HAM-KEY

NOW 5 MODELS

- Iambic circuit for squeeze keying.
- Self completing dots & dashes
- Dot memory.
- Battery operated with provision for external power.
- Built-in side-tone monitor.
- Speed, Volume, tone & weight controls.
- Grid-block or direct keying.
- Use with external paddle such as HK-1.

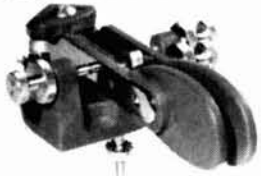
NEW
MODEL HK-5
ELECTRONIC KEYER
$69.95

MODEL HK-1
$29.95

- Dual lever squeeze paddle.
- Use with HK-5 or any electronic keyer.
- Heavy base with non-slip rubber feet.
- Paddles reversible for wide or close finger spacing.

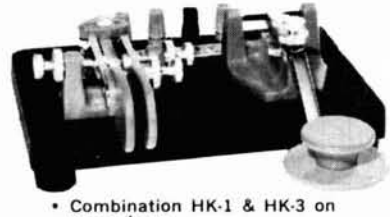
MODEL HK-3
$16.95

- Deluxe straight key.
- Heavy base, no need to attach to desk.
- Velvet smooth action.



MODEL HK-2
$19.95

- Same as HK-1, less base for those who wish to incorporate in their own Keyer.



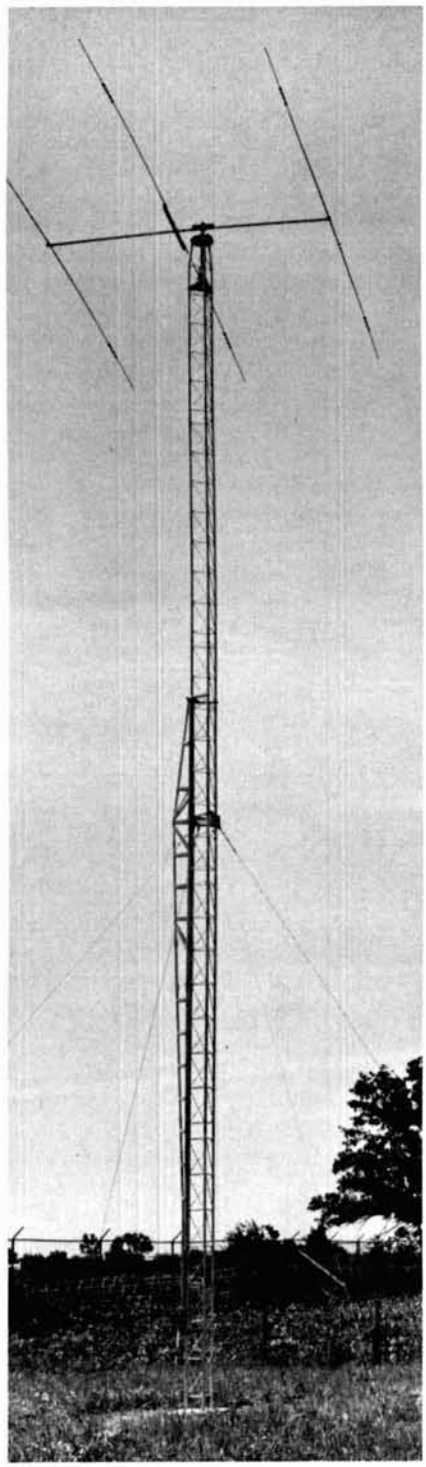
MODEL HK-4
$44.95

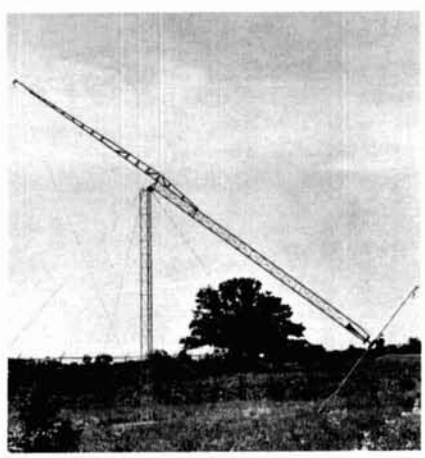
- Combination HK-1 & HK-3 on same base.

Available from your local dealer or order direct.

HAM RADIO CENTER, INC.

8340-42 OLIVE BLVD. • P. O. BOX 28271 • ST. LOUIS, MO. 63132





(11.5x8cm) and mounts piggy-back on the EPA Micro-68 development computer. The TCC3 price is $129.00 in singles, completely assembled and tested. Delivery is from stock.

For additional information, write Electronic Product Associates, Inc., 1157 Vega Street, San Diego, California 92110; telephone (714) 276-8911 or use *check-off* on page 142.

IC Zener has one-ohm dynamic impedance

National Semiconductor Corporation recently announced a new reference diode with a dynamic impedance two orders of magnitude less than that of discrete Zener diodes. The LM129 linear IC, 6.9-volt, reference diode operates over a 0.5 to 15mA current range, allowing it to replace a wide variety of discrete devices and improve circuit performance. An important feature of the LM129 is that all operating characteristics of the reference are essentially independent of operating current.

The heart of the linear integrated circuit is a new sub-surface-breakdown Zener that yields a very low noise and highly stable breakdown. Long-term stability is typically 20 ppm while noise is guaranteed to be less than 20 μV. Active circuitry around the Zener buffers external current changes to give a one-ohm dynamic impedance.

According to Robert C. Dobkin, inventor of the LM129, this new IC Zener will greatly simplify bias circuitry needed to make a reference. Normally, a precision current source is needed to bias reference Zeners; however, with the LM129, only a single resistor is needed.

The new reference is available in selected temperature coefficients from 0.001% to 0.01% per degree C for use in a zero to 70 degree C, or −55 to 125 degree C temperature range. The new IC is packaged in either a TO-46 hermetic transistor package or a plastic TO-92 package.

Pricing for the LM129AH (0.001% per degree C, −55 to 125 degree C) reference is $15.00 in quantities of one hundred, and the LM329DZ (0.01% per degree C, zero to 70 degree C) reference is $0.75. Delivery of both IC reference

More Details? CHECK–OFF Page 142

From *Barry* The Outstanding New GOLD LINE FT-301D

ALL SOLID STATE

200W PEP

DIGITAL DIAL TRANSCEIVER

■ 6 - Digit Readout ■ All Modes – SSB/CW/AM/FSK ■ 160 thru 10 Meters ■ TX & RX Clarifier ■ RF Feedback ■ 3 - Position AGC ■ Rejection Tuning (Tuneable IF Crystal Filter) ■ Built-in DC Power Supply ■ Optional AC Power Supply & Speaker Unit with 12 or 24 Hr. Digital Clock ■ Noise Blanker ■ RF Speech Processor ■ Computer Type Plug-In Module Construction ■ Size: 11 in. (w) × 5 in. (h) × 13½ in. (d) ■ Light Weight: 22 lbs.

The Model FT-301D is a precision-built, all solid-state, compact high performance transceiver of advanced design. All circuits are fully transistorized with ICs and FETs for reliability. A wide-band tuning system with preset pass band tuning combined with wide-band amplifier eliminates final amplifier tuning for band change. Also available as an option is an automatic CW identifier (programmable).

Whether you judge it on price, performance or operational features, the FT-301D comes out a winner!

YAESU

Available at: *Barry Electronics*

WORLD-WIDE AMATEUR RADIO SINCE 1920

512 Broadway, N. Y., N. Y. 10012 — Phone: 212-925-7000 — Telex: 12-7670

diodes is from stock. For additional information, including typical circuit applications and wiring diagrams, write Roy Twitty, National Semiconductor Corporation, 2900 Semiconductor Drive, Santa Clara, California 95061; telephone (408) 737-5287, or use *check-off* on page 142.

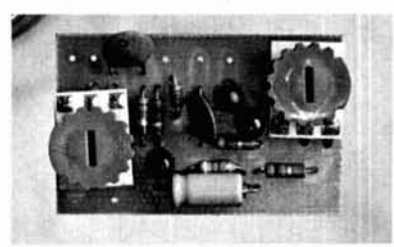
B&K-precision issues new 40-page catalog

A new 40-page catalog describing B&K-Precision test instruments has just been released.

Among the new "cost effective" instruments in this catalog are a 30 MHz scope, a 15 MHz scope and a 5 MHz scope. A new low-cost 3-1/2 digit multimeter is also being introduced for the first time. Other devices described in the catalog include frequency counters, signal generators, semiconductor and transistor testers and numerous other test instruments.

The catalog is available without charge by writing directly to Mr. Paul Mangione, B&K-Precision, Dynascan Corporation, 6460 W. Cortland, Chicago, Illinois 60635; telephone (312) 889-9087, or use *check-off* on page 142.

Touch-tone pad



Touch-toners, if you've been looking for a neat way to interface a touch-tone pad with your two-meter rig, Trevor Industries may have just the device you need. The "Trevorface" has an adjustable audio output level and, each time a tone button is depressed, automatically keys your transmitter for any desired period of time up to several seconds. The printed-circuit board with components is small enough to find a home inside the enclosure of any but the smallest hand-held rig and measures only 3/8x1¼x2 inches (10x32x51mm). The design was developed nearly four years ago for the TR-22 by W2EUP who

More Details? CHECK–OFF Page 142

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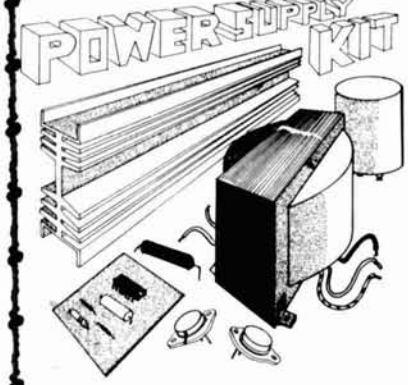
POWER SUPPLY KIT



FEATURES:
Output adjustable from 3 to 30 Volts DC
Adjustable Current Limiting to 15 Amps
Special Pre-Regulator Circuit eliminates need for massive heatsinks
Better than 1% Load & Line Regulation from 0 to 15 Amps
Low Ripple Output
Heavy Duty 10 lb. transformer

KIT INCLUDES:
Transformer
Heatsink (drilled)
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Transistor mounting hardware and insulators
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Wire

NOT ONLY IS THE PS–12 ABLE TO SUPPLY A CONTINUOUS 15 AMPS OF LOW RIPPLE, REGULATED DC VOLTAGE, BUT IT IS ALSO VARIABLE FROM 3 to 30 VOLTS! USE IT AS A BUILDING BLOCK FOR A FANTASTIC BENCH SUPPLY. THE CHASSIS WORK IS UP TO YOU – GO FANCY WITH METERS AND LIGHTS; OR GO PLAIN WITH A METAL PLATE. EITHER WAY WE GET YOU OUT WITH A QUALITY KIT AT A SUPER LOW PRICE AND WE GUARANTEE YOUR SATISFACTION.

$49.95 add $3.70 postage.

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TR–89

23KHZ

BUILD YOUR OWN ULTRASONIC MOTION DETECTOR FOR USE IN INTRUSION DETECTORS, DOOR OPENERS, OBJECT COUNTERS, ETC. WE INCLUDE COMPLETE SPECS AND RECOMMENDED CIRCUITS.

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ULTRA STABLE FOR LOW FREQUENCY OSCILLATORS, FILTERS, etc.

½" LED READOUT STICKS

2/8.00

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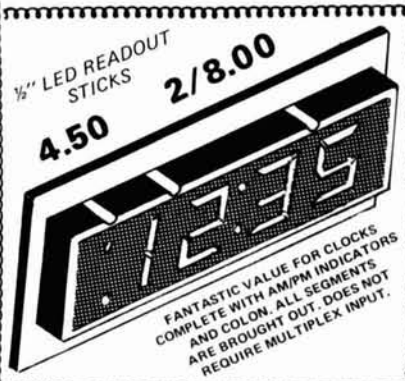
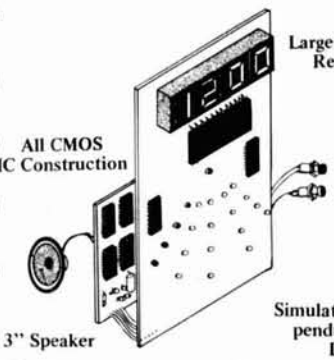


FANTASTIC VALUE FOR CLOCKS COMPLETE WITH AM/PM INDICATORS AND COLON. ALL SEGMENTS ARE BROUGHT OUT. DOES NOT REQUIRE MULTIPLEX INPUT.

MINI GRANDFATHER CLOCK KIT



Large ½" LED Readout

All CMOS IC Construction

3" Speaker

Simulated swinging pendulum uses LED's

- 4 Digit LED Readout
- Simulated Swinging Pendulum
- Tick-Tock sound matches pendulum swing
- Electronic Tone Chimes the Hour (ie: 3 times for 3 o'clock)
- Quality Components & P.C. Boards
- Transformer for 115 VAC included.

$44.00

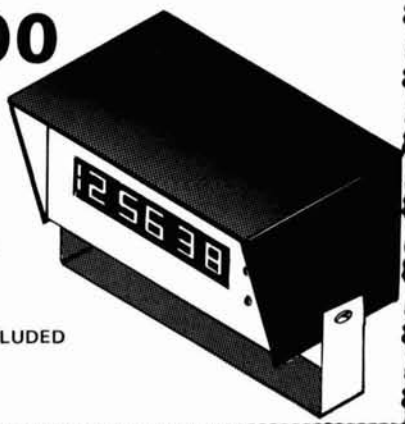
The most novel and fascinating kit we have ever offered!

NO CASE INCLUDED, LET YOUR IMAGINATION RUN WILD AND DESIGN YOUR OWN. WE SUPPLY ALL THE ELECTRONICS.

MOBILE CLOCK KIT

COMPLETE WITH PRE–PUNCHED CUSTOM CASE AND MOUNTING BRACKET. CASE IS HEAVY GAUGE ALUMINUM WITH A BLACK WRINKLE FINISH TOP AND WHITE FRONT.
12 HOUR FORMAT ONLY.
CLOCK HAS ALARM CAPABILITY (extra parts needed).

$25.00 COMPLETE!



MK-04

* 6 DIGIT LED
* .4" READOUT
* TIMEBASE INCLUDED

10 WATT WARBLE ALARM KIT

A REAL SCREAMER! Emits a piercing dual tone blast that is impossible to ignore. Great for burgler alarms, signal devices or just a toy. Complete with drilled and plated pc board. Does not include a speaker or power switch. (3–15 volts) $2.50

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CASES ARE HEAVY GAUGE ALUMINUM WITH BAKED WHITE FINISH & BLACK WRINKLE TOPS.

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$1.60
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SHADOW FRONT 4 13/16" x 3¾" x 2"
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Rubber feet included

GUARANTEED!

RETESTED

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NEG. REGULATOR (same as 7560 but for negative) 7563 – 40c
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AUDIBLE CONTINUITY TESTER

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Continuity Checker
Transistor, diode or LED checker
Tone varies with resistance

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ALL COMPONENTS AND KITS GUARANTEED.

48 HOUR FAST SERVICE

CATALOG INCLUDED WITH EACH ORDER, OR SEND A STAMP
ORDERS OVER $50.00 TAKE 10% DISCOUNT

More Details? CHECK–OFF Page 142

made "GLB" famous, and a large number of these tiny units have been used successfully by amateurs in the Buffalo, New York area for several years. Five simple attachments to B+, ground, PTT line, and audio make hook-up to almost any pad simple and fast, and the unit even includes a 10-volt Zener diode to eliminate alternator "whine." Priced at only $7.95 plus $.45 for postage and handling (New York State residents please add 7% sales tax), the "Trevorface" fills a definite need. Want one? Write or call Gary Ketch at Trevor Industries, Inc., Box 102, Getzville, New York 14068; telephone (716) 834-1639, or use *check-off* on page 142.

ham radio operating guide

Most amateurs like to be known as good operators, and The American Radio Relay League has just introduced a new book that will help the newcomer and brush up the old timer's operating habits. *The ARRL Ham Radio Operating Guide* is an easy-to-read manual for introducing the reader to the many and varied operating practices that exist throughout amateur radio.

The book is written by experts in each of the fields covered and answers questions faced by beginners in any phase of ham radio: What's the best Novice daytime DX band? What crystal frequencies should you order for your new fm transceiver? In the 75-meter phone band, where are Australian stations most likely to be found? When will an amateur satellite be in range of your station? What is the WAJA award? How long should you make each transmission when trying to call another station by meteor scatter?

The guide contains ten chapters: Getting Started, Message Handling, Contests, DX, Awards, Repeaters, Flea Power, Communicating Visually, VHF/UHF, Searching for New Horizons, Oscar.

The manual contains 128 pages and measures 8-1/4 by 11 inches. Price: $4.00 in the United States and its possessions and $4.50 elsewhere. Order your copy today from Ham Radio Books, Greenville, New Hampshire 03048.

More Details? CHECK–OFF Page 142

Vhf engineering

THE WORLD'S MOST COMPLETE LINE OF VHF-FM KITS AND EQUIPMENT

RECEIVERS

RX28C	28-35 MHz FM receiver with 2 pole 10.7 MHz crystal filter	59.95
RX50C Kit	30-60 MHz rcvr w/2 pole 10.7 MHz crystal filter	59.95
RX144C Kit	140-170 MHz rcvr w/2 pole 10.7 MHz crystal filter	69.95
RX144C W/T.	same as above – factory wired and tested	114.95
RX220C Kit	210-240 MHz rcvr w/2 pole 10.7 MHz crystal filter	69.95
RX220C W/T	same as above – factory wired and tested	114.95
RX432C Kit	432 MHz rcvr w/2 pole 10.7 MHz crystal filter	79.95
RXCF	accessory filter for above receiver kits gives 70 dB adjacent channel rejection	8.50

RF28 Kit	10 meter RF front end 10.7 MHz output	12.50
RF50 Kit	6 meter RF front end 10.7 MHz output	12.50
RF144D Kit	2 meter RF front end 10.7 MHz output	17.50
RF220D Kit	220 MHz RF front end 10.7 MHz output	17.50
RF432 Kit	432 MHz RF front end 10.7 MHz output	27.50
IF 10.7F Kit	10.7 MHz IF module includes 2 pole crystal filter	27.50
FM455 Kit	455 KHz IF stage plus FM detector	17.50
AS2 Kit	audio and squelch board	15.00

TRANSMITTERS

TX144B Kit	transmitter exciter – 1 watt – 2 meters	$ 29.95
TX144B W/T.	same as above – factory wired and tested	49.95
TX220B Kit	transmitter exciter – 1 watt – 220 MHz	29.95
TX220B W/T.	same as above – factory wired and tested	49.95

TX432B Kit.	transmitter exciter 432 MHz	39.95
TX432B W/T	same as above - factory wired and tested	59.95
TX150 Kit	300 milliwatt, complete 2 meter transmitter, less crystal and mike	19.95

POWER AMPLIFIERS

PA2501H Kit	2 meter power amp – kit 1 w in – 25w out with solid state switching, case, connectors	59.95
PA2501H W/T	same as above – factory wired and tested	74.95
PA4010H Kit	2 meter power amp – 10w in – 40w out – relay switching	59.95
PA4010H W/T	same as above – factory wired and tested	74.95
PA144/15 Kit	2 meter power amp – 1w in – 15w out – less case, connectors and switching	39.95

PA144/25 Kit	similar to PA144/15 kit except 25w out	49.95
PA220/15 Kit	similar to PA144/15 for 220 MHz	39.95
PA432/10 Kit	power amp – similar to PA144/15 except 10w and 432 MHz	49.95
PA140/10	10w in – 140w out – 2 meter amp – factory wired and tested	179.95
PA140/30	30w in – 140w out – 2 meter amp – factory wired and tested	159.95

POWER SUPPLIES

PS15C Kit	15 amp – 12 volt regulated power supply w/case, w/fold-back current limiting and overvoltage protection	79.95
PS15C W/T	same as above – factory wired and tested	94.95
PS25C Kit	25 amp – 12 volt regulated power supply w/case, w/fold-back current limiting and overvoltage protection	129.95
PS25C W/T	same as above – factory wired and tested	149.95

O.V.P.	adds over voltage protection to your power supplies, 15 VDC max	9.95
PS3A Kit	12 volt – power supply regulator card with fold back current limiting	8.95
PS3012	new commercial duty 30 amp 12 VDC regulated power supply w/case, w/foldback current limiting and over voltage protection wired and tested	239.95

REPEATERS

RPT28 Kit	repeater – 10 meter	TBA
RPT28	repeater – 10 meter, wired & tested	TBA
RPT50 Kit	repeater – 6 meter	TBA
RPT50	repeater – 6 meter, wired & tested	TBA
RPT144 Kit	repeater – 2 meter – 15w – complete (less crystals)	465.95
RPT220 Kit	repeater – 220 MHz – 15w – complete (less crystals)	465.95
RPT432 Kit	repeater – 10 watt – 432 MHz (less crystals)	515.95

RPT144	repeater – 15 watt – 2 meter – factory wired and tested	695.95
RPT220	repeater – 15 watt – 220 MHz – factory wired and tested	695.95
RPT432	repeater – 10 watt – 432 MHz – factory wired and tested	749.95
DPLX144	2 meter, 600 KHz spaced duplexer, wired and tuned to frequency	399.95
DPLX220	220 MHz duplexer, wired and tuned to frequency	399.95

TRANSCEIVERS

TRX 144 Kit	case and all components to build 15 watt 10 channel scanning 2 meter transceiver (less mike and crystals)	219.95
TRX 220 Kit	same as above except for 220 MHz	219.95
TRX 432 Kit	same as above except 10 watt and 432MHz	254.95

SYNTHESIZERS

SYN II Kit	2 meter synthesizer, transmit offsets programmable from 100 KHz - 10 MHz, (Mars offsets with optional adapters)	169.95
SYN II	same as above, wired and tested	239.95

WALKIE TALKIES

HT 144B Kit.	2 meter, 2w, 4 channel, hand held receiver with crystals for 146.52 simplex	129.95
NICAD	battery pack, 12 VDC, ½ amp	29.95
NICAD	battery charger	5.95
Rubber Duck	2 meter, with male BNC connector	8.95

OTHER PRODUCTS BY VHF ENGINEERING

CD1 Kit	10 channel receive xtal deck w/ diode switching	6.95
CD2 Kit	10 channel xmit deck w/switch and trimmers	14.95
CD-3 Kit	UHF version of CD-1 deck, needed for 432 multi-channel operations	12.95
COR2 Kit	complete COR with 3 second and 3 minute timers	19.95
SC3 Kit	10 channel auto-scan adapter for RX with priority.	19.95
Crystals	we stock most repeater and simplex pairs from 146.0-147.0 (each)	5.00
CWID Kit	159 bit, field programmable, code identifier with built-in squelch tail and ID timers	39.95
CWID	wired and tested, not programmed	54.95
CWID	wired and tested, programmed	59.95
Microphone	2,000 ohm dynamic mike with P.T.T. and coil cord	9.95

master charge

VHF ENGINEERING

DIVISION OF BROWNIAN ELECTRONICS CORP.

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BANKAMERICARD

More Details? CHECK–OFF Page 142

HAM MART

Ham Radio's guide to help you find your local

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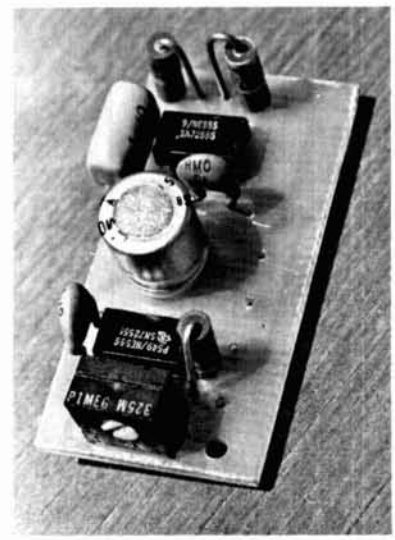
Thurs, 9-5:30, Sat, 9-3.

appliance noise filter

Cornell-Dubilier has announced a new and efficient filter, the CBBS-1, for electrical interference produced by hot combs, blenders, electric shavers and similar appliances. Simply plug the Cornell-Dubilier CBBS-1 into the wall socket and then plug the noisy appliance into the CBBS-1. All annoying electrical noise which hampers radio and TV reception is removed. The unit is lightweight, highly reliable, (handles 5 amperes), and is built to resist the effects of heavy household usage.

For additional information, contact William Carlson, Cornell-Dubilier, 150 Avenue L, Newark, New Jersey 07101, or use *check-off* on page 142.

new repeater time-out timer

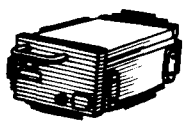


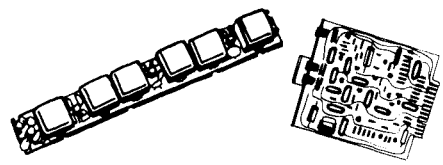
A new integrated circuit timer for repeater time-out use has been announced by Timekit.® All circuitry of Timekit's Model TG970 time-out timer is on a printed-circuit board measuring only 1x2 inches (25.4x50.8mm) that should fit inside most transceiver enclosures. External

More Details? CHECK–OFF Page 142

CHRISTMAS GOODIES

1976 HAS BEEN A GOOD YEAR FOR BOTH HAM RADIO AND SPECTRONICS. WE WOULD LIKE TO THANK YOU ALL FOR YOUR SUPPORT. RATHER THAN USING A WHOLE PAGE OF PICTURES OF OUR STAFF AND SYMBOLS OF THE HOLIDAYS WE THOUGHT YOU WOULD LIKE A CHANCE AT BEING YOUR OWN SANTA AT DOWN TO EARTH PRICES. SO HERE GOES THE LIST OF GOODIES THAT WE PROMISED YOU LAST MONTH.





MOBILES

T43GGV . . . WB . . w/accs	$48.00
T43GGV . . . NB . . w/accs	54.00
T43GGV . . . WB . . no accs	35.00
T43GGV . . . NB . . no accs	39.00
T41GGV . . . WB . . w/accs	45.00
T41GGV . . . NB . . w/accs	49.00
T41GGV . . . WB . . no accs	35.00
T41GGV . . . NB . . no accs	39.00
T51GGV . . . WB . . w/accs	45.00
T51GGV . . . NB . . w/accs	45.00
T51GGV . . . less accs	35.00
T51AGD . . . less accs	29.00
D33CMT . . . w/accs	149.00
R43HHT . . . RR Trac, less accs.	79.00
CMUA6 . . . Super Carfone, less Accs, w/tone	149.00

NOTE: Accs consist of Control Head, cable and housing

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Hi Band "G" Trans	$7.00
Hi Band "G" Recvrs	20.00
Hi Band "H" Rcvrs, Solid State, 12vdc	49.00
Hi Band "H" Trans	19.00
Hi Band "A" Trans	10.00
Lo Band "G" Rcvrs	20.00
Lo Band "G" Trans	10.00
Lo Band "A" Rcvr	17.00
Lo Band "A" Trans	10.00
UHF "B", 2F, Tone, NB	15.00
Hi Band 1.4W SS Trans	30.00
UHF 5W Amp for HT220	7.00
AC Supply for 80D	25.00
T Supply for GGV	10.00

MISCELLANEOUS

Motrac housings	$5.00
RR Motrac housings	7.00
Cable for 15" MOT	7.00
Motrac "H" audio bds	3.00
4 pin ovens for GGV	1.00
Multi tone head for TRAC	7.00
Solid State Termination panel for remote	15.00
Pulsar RX/TX Audio Bd with 2805 notch filter	5.00
PTT Handsets (Turquoise)	5.00
PT400 D cell packs	7.00
NPN6012 AC Sup. for 23BAC series portables	25.00
HT220 Mobile rapid chargers for omni	75.00
Dayton blowers SQ cage	10.00
Bud Boxes fit R390 Rcvr	15.00
Hartman Secall enc/dec	15.00
Video Tape, ½ hr. spools	8.00

CHANNEL ELEMENTS

1081, cool blue	$6.00
1083, cool blue	6.00
8968A, piggy back	9.00

UPRIGHT CABINETS

New style, 5 foot racks, outdoor style, with locking doors $75.00

CHART RECORDERS

Texas Inst, 10 speed strip chart. Dual 1 ma Galvanometers $70.00

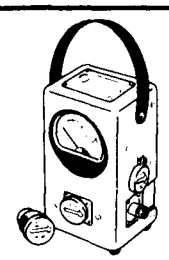
HT200 HOUSINGS

These are for UHF HT200s and come with wiring harness and controls. Unused, less back covers $25.00

VOICE COMMANDERS

Tech specials with nicad pack. VCIIIs. Ideal for tinkering or spare parts. $19.95

NOTE: Prices FOB Oak Park, Ill. Please include enough to cover shipping.



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BANKAMERICARD

connections to the TG970 are 13 volts dc, PTT, ground and output.

When the microphone button is pressed (or when the COR is energized) a timing cycle continuously variable from 10 seconds to 30 minutes is activated. At the conclusion of the cycle, that is, at time-out, the TG970 produces a 13-volt, 2 Hz pulse train which can be used to flash an LED, activate a beeper or excite a Timekit Model TG3 oscillator designed for attachment to the TG970 board. The oscillator will pulse an external speaker at 2 Hz with a 1000 Hz note. Timer reset is immediate with no false triggering, and is immune to rf.

The TG970 is priced at $7.95 wired and tested, or $6.50 in kit form. The TG3 is priced at $4.50 wired and tested, or $4.00 in a kit.

For additional information, write Timekit, 23715 Mercantile Road, Cleveland, Ohio 44122; telephone (216) 464-3820, or use *check-off* on page 142.

solderless coaxial connector

The Bunker Ramo RF Division has introduced a PL-259-type Amphenol connector that provides instant and simple termination of RG-58A/U coaxial cable without solder, special tools, or adapters. Designated Amphenol 85-58FCP (for field crimp plug), the new, reusable connector has application in both fixed and mobile stations wherever coaxial cable termination must be made.

To complete a termination, the user simply strips the coaxial cable and pushed the connector parts onto the center conductor and braid. The contact is squeezed at the tip to secure the center conductor; but, if reuse is desired, the contact can be soldered. No braid soldering, braid combing, special crimping tools, or special adapters are needed. The result is a fail-safe, fast termination that eliminates faulty interconnections. Another advantage of the solderless termination is the absence of overheating during assembly and consequent damage to the cable itself. The Amphenol 83-58FCP offers performance equal to that provided by standard Amphenol 83-1SP-type uhf connectors, and at the same price.

At the heart of the solderless connecting mechanism is a body assembly featuring a hollow barrel with a barbed

More Details? CHECK—OFF Page 142

Whatever Santa Says . . . Will be Sharper, Clearer and VALUE PACKED! With the Incredible

GTX-1 or GTX-1T HAND-HELD 2-Meter FM Transceiver

CHECK THESE FEATURES:

- All Metal Case
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- Factory-direct to You

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- Charger for GTX-1 battery pack
- Leather carrying case
- TE III Tone Encoder for auto patch

This Holiday Season look for value, look for performance. Then buy the Worlds Finest Amateur Transceiver. GENAVE!

GTX-200-T

2-meter FM, 100 channel combinations, 30 watts with factory installed tone encoder (Incl. 146.94 MHz) **$249.95**

GTX-200

2-meter FM, 100 channel combinations, 30 watts (Incl. 146.94 MHz) **$199.95**

GTX-10-S

2-meter FM, 10 channels, 10 watts (Xtals not included) **$149.95**

GTX-2

2-meter FM, 10 channels, 30 watts with pushbutton frequency selector (Incl. 146.94 MHz) **$189.95**

GTX-I GTX-IT

2-meter FM, 6-channel, 3.5 watts Hand-Held ***$249.95**

Same as GTX-1, plus factory installed Tone Encoder ***$299.95**

*(Bat. not incl.)

TONE ENCODER PAD Plug in installation on most amateur transceivers

TE-II **$49.95** TE-I **$59.95**

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- ☐ GTX-200-T **$249.95**
- ☐ GTX-200 **$199.95**
- ☐ GTX-10-S **$149.95**
- ☐ GTX-2 **$189.95**
- ☐ GTX-1 **$249.95**
- ☐ GTX-IT **$299.95**

- ☐ Ringo Ranger ARX-2 6db 2-M Base Antenna **$29.95**
- ☐ Lambda/4 2-M and 6-M Trunk Antenna **$29.95**
- ☐ TE-I Tone Encoder Pad **$59.95**
- ☐ TE-II Tone Encoder Pad **$49.95**
- ☐ PS-I AC Power Supply for use with all makes of transceivers 14 VDC—6 amp **$69.95**

and the following **standard** crystals @ $4.50 each ..... $_____

Non-standard crystals @ $6.50 each: ..... $_____

Payment by:
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IN residents add 4% sales tax:
CA residents add 6% sales tax: $_____

HR *All orders shipped post-paid within continental U.S.*

ACCESSORIES FOR GTX-1 and GTX-1T

- ☐ **PSI-18** Optional Nicad battery pack **$29.95**
- ☐ **PS-2** Charger for GTX-1(T) battery pack **$39.95**
- ☐ **GLC-1** Leather carrying case **$12.95**
- ☐ **TE-III** Tone Encoder (for use with GTX-1) **$49.95**

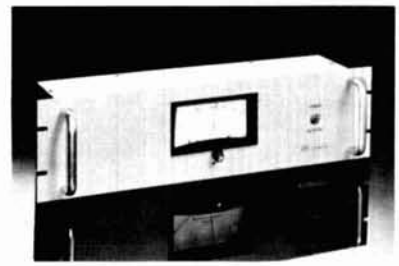
Add $4 per Radio for Shipping, Handling, and Crystal Netting.

More Details? CHECK—OFF Page 142

end. After the cable is stripped, the slotted outer ferrule and coupling nut are slid onto the cable. Then the body assembly is pushed onto the cable dielectric but under the braid. The coupling nut is then slid over the body assembly, and the outer ferrule is pushed forward until it traps the cable braid against the rear flange of the body assembly. The ferrule then seats automatically. The resulting termination passed a 35-pound pull test.

For additional information about Amphenol 83-58FCP solderless connectors, contact Bunker Ramo RF Division, 33 East Franklin Street, Danbury, Connecticut 06810, or use *check-off* on page 142.

Bird Wattcher monitors rf power



Bird Electronic Corporation recently announced its new Series 3162 rf power monitor/alarm Wattcher,® designed to warn of rf power drop-off below a set level to conform with FCC part 21.107 requirements. This fast-acting (50 millisecond) unit can be used, for example, at a mobile terminal site to measure forward power, reflected power (with a momentary-contact front-panel switch), and to obtain VSWR and optimum system data during routine maintenance. It is then left in the line to feed back a signal in response to the transmitter being keyed, indicating whether it is on the air and with sufficient power.

The series 3162 is available for operation at all telephone company communications frequencies and power levels; for example, 2-512 MHz and 1-500 watts. It is available in either a 12-volt dc model or a 117-volt ac model. A typical 12-volt model is priced at $595.00.

For additional information, write Bird Electronic Corporation, 30303 Aurora Road, Cleveland (Solon), Ohio 44139; telephone (216) 248-1200, or use *check-off* on page 142.

More Details? CHECK–OFF Page 142

The proof of the pudding is in the eating.

The proof of Triton IV is in owner satisfaction.

Here's some of the proof . . .

K4EME — This is my second TRITON IV. They are excellent xceivers! **WA8ICK** — Luv it. Dynamite! **W9NXU** — I am very thrilled with this unit, it is great. I think you have scooped the field. **WA0AYA** — I like CW and full break-in. (Beautiful) **K3TFU** — I love the unit. **WA3VEZ** — Rig is just great. Combined with your service makes a super transceiver. **WN0SED** — Beautiful radio to use. Magnificent CW filter! Just a pure joy. **W8IIT** — I have had my TRITON IV for two months and am delighted with it. **YN1MBV** — It is a very nice rig. **W3GTX** — New features very welcome. **W0BYC** — Bought one of the first TRITON II, like it so well I updated it with a TRITON IV. **W2TBK** — It is absolutely fantastic. **WB0OPI** — I am pleased with the rig. **WA3GJA** — Very-very-very nice. Good audio quality. **W5ZBC** — The most outstanding rig I have ever used. **K8CJQ** — Excellent rig, Good filters. **W7BKK** — Very happy . . . getting excellent quality reports. **W2CET** — Power-signal reports good. **WB2UEH** — I like the compactness and appearance. **VE3IBK** — An excellent rig with superior receiving quality. **K4IVM** — I think it is tops. **WA4LOG** — I've become so used to dip, peak and adjust, this TRITON is a beautiful new experience. **KL7IHW** — Easy to set up—works great. **K4JXD** — Seems to be very FB rig. **WA7KHE** — Fantastic performance. Thanks for a fine rig. **WB4BPG** — No problems—fine rig. **VE1BZ** — Good work. **W9HQT** — Receiver better than expected, CW break-in is super. **W0AP** — Tremendous transceiver. I appreciate your engineering. **WA2ZRO** — Wonderful. **K0SFV** — Real nice rig. You thought of almost every feature and built it in. **KQ9DQ** — Beautiful. **WB0JIQ** — Beautiful radio; however, your ads do not do justice to the radio. **WN5SOH** — Very sophisticated—Easiest tuning rig ever. Very glad I bought it. **K3OJV** — Very impressed. **W4LZP** — Very good results. Put out 100 watts as good as 300 watt rigs. **WA4DQY** — *I think the TRITON IV is great.* **W6QXN** — *Appreciate full CW break-in.* **W0INH** — *Enjoy light weight.* **VE3CYK** — I am extremely pleased with the clarity of receiver and after putting rig on the air, received unsolicited compliments on the audio quality of the transmitter. **K4PHY** — Was 3rd in USA, first in fourth district in WWCQ contest. **W8RYU** — Own Argonaut. Both fine rigs. **W4CDA** — Compact, light weight, good engineering. **WB2WZG** — TRITON IV is the most versitile CW/SSB radio I have ever used. **WB2FMV** — Outstanding. Highly pleased with performance. **WA8ACZ** — A real nice rig. I have owned about every other make. **W5EGK** — Works nicely. **WB4ECO** — I tried this rig, a pleasure to operate. **WA4YRK** — Excellent reports on audio. **WB8NKB** — Wonderful. **W9QPQ** — An excellent rig. Love it. **W8SOP** — Makes running SSB nets a real breeze. Also good on CW nets. **WL7IRT** — Fantastic rig. **W4MDB** — Has rekindled my interest and enthusiasm in Amateur Radio to an extent I hadn't thought possible. It far out distances any competitive product at **any** price. **W6EYR** — Very nice. Been a ham for 45 years and now solid state perfection. **W2RPH** — Excellent rig. **WN0TDK** — TRITON IV is a fabulous piece of equipment. **W5VIW** — Very nice rig **WB2LQF** — Wow! **W9JCV** — Tnx for giving us a FB piece of equipment made in the USA. **W8GHO** — Very pleased. **K4KXB** — Seems to have everything desired. **W4SZ** — A pleasure to operate. **W2FKF** — Greatest rig I ever had. So far in a month 34 QSO's without one miss. Been a ham since 1922. **W4GVC** — Nothing but complements. **WB9EZE** — Well pleased with performance and simplicity of operation. **K4ETI** — *Rig is great.* **W8CNV** — Man—! what a rig. I've had this call since 1929. Never saw anything like it and I've seen them all! **WB2MZU** — Seems like everything the S - - - - - O - - was supposed to be at one third the price. **WN0VHE** — I think it is a very good rig. **WB9FTD** — Break-in CW is very impressive. **K0CBA** — I believe it is one of the finest HF transceivers on the market. I can't tell you how pleased I am with the noise blanker. I can get on the air from my home station again for the first time in a few years. Other rigs with noise blankers just didn't hack it. **WA7YHW** — I am very pleased with this equipment. It is certainly of high quality. **W7IIA** — Excellent equipment. **WB0RWA** — Couldn't be more pleased with it. It certainly has performed beautifully and is all I expected and more. **WB4QJT** — Like it very much — keep up the good work. **WN1YVX** — Really impressed with looks and performance. **W0NC** — Very *FB rig. Performs up to specifications, an excellent design.* **K8PBZ** — Already have TRITON II and IV. **W7KD** — This little "T-4" is smooth as silk . . . I've received some very flattering reports about transmitter voice quality and the CW operation is the greatest. **WN8TTO** — I found that the TRITON IV was the best rig on the market for around $800. I love it! **W2JBK** — It is absolutely fantastic. **W8FEI** — Am amazed at receiver performance. I thought I had a top notch receiver with the H - - - - - - - - ! **W1FYM** — Your guarantee is refreshingly proper. **W8MOK** — Sure makes a guy look twice at his old tube type gear. **W1TFS** — Finest CW ever, CW selectivity very good. **WB6IVR** — Very satisfied with TRITON IV. Just what I was looking for to use on my yacht. Thanks. **WA8ONP** — Also have a TRITON II. I am pleased that Al Kahn and the **good guys** at TEN-TEC thought of the CW operator! **W2EMX** — Excellent Amateur gear meets and exceeds advertised claims. **W0AMJ** — *It looks like there is nothing left to be desired. It is beautiful.* **W6SE** — The receive function is outstanding. It is superb in transmit. **W1BV** — In love with this fantastic gem. It's so easy and a pleasure to operate. **W6ASH** — Very happy with performance. Particularly impressed with full break-in and light weight. **WA0IMS** — By far the best rig I have ever operated. I am glad I decided on the TRITON IV and not one of the other transceivers on the market. **WA8HQO** — Thank you gentlemen.

Add your name to the growing list. See your TEN-TEC dealer or write for full details.

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TS-1 MICROMINIATURE ENCODER-DECODER

- ☐ Available in all EIA standard tones 67.0Hz-203.5Hz
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- ☐ Hi-pass tone rejection filter on board
- ☐ Powered by 6-16vdc, unregulated, at 3-9ma.
- ☐ Decode sensitivity better than 10mvRMS, bandwidth, ±2Hz max., limited
- ☐ Low distortion adjustable sinewave output
- ☐ Frequency accuracy, ±.25Hz, frequency stability ±.1Hz
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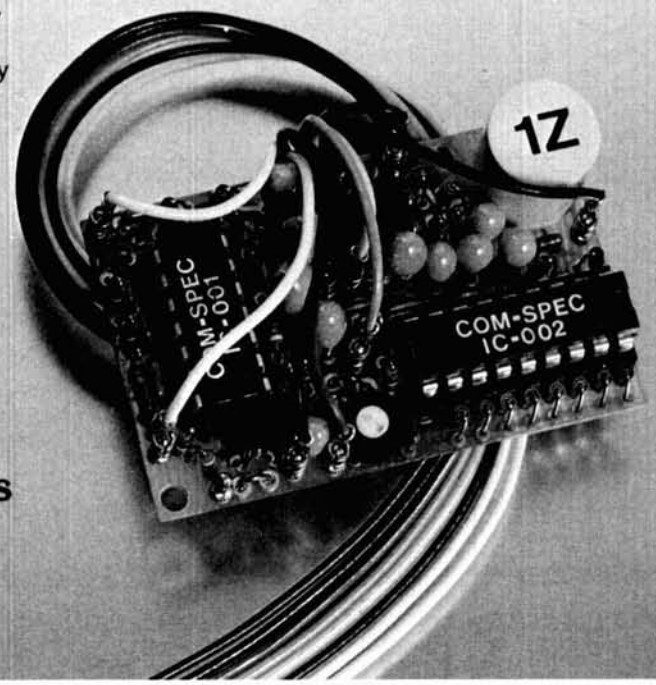
- ☐ Totally immune to RF

Wired and tested, complete with K-1 element

$59.95

K-1 field replaceable, plug-in, frequency determining elements

$3.00 each



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MODEL P50A1OC — 2-18 W input, 14-60 W output. 13.6 V at 7 Amps, 100% duty cycle, COR switching w/LED indicator, spurious output filter. It's yours for $98 ppd.

Contact any of the following dealers for complete information on the M-Tech Engineering line:

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Arcade Electronics, Annandale, Va. 703-256-4610
Electronic Exchange, Souderton, Pa. 215-723-1200
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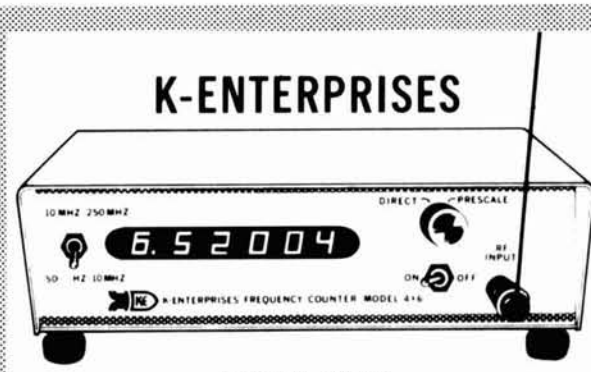

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More Details? CHECK—OFF Page 142

We thought you might be interested in a 2-meter, synthesized, VHF-FM transceiver featuring 800 frequencies in 5KHz steps, variable RF output from 1 to 25 watts, 4 front panel selectable splits, a discriminator meter, and a price tag below five hundred dollars.

TRANSMITTER SPECIFICATIONS

Frequency Range: 144 to 148MHz. **Front Panel Frequency Splits:** Simplex, +0.6MHz, —0.6MHz, +1MHz, —1MHz. **Frequencies:** 800 (5KHz separation). **Modulation:** 16F3 ±5KHz for 100% at 1,000Hz. **RF Power Output:** 1-25 Watts, variable. **Frequency Stability:** Within ±0.001% from —20°C. to +60°C. **Hum & Noise:** Better than — 30dB 2/3 rated system deviation at 1,000Hz. **Antenna Impedance:** 50 Ohms. **Switching:** Solid-state type. **Spurious & Harmonic:** At least 60dB below rated carrier power. **Microphone:** Turner, low impedance. **Audio Frequency Response:** 300Hz to 3,000Hz, referred to +1, —8dB of 6dB/Octave de-emphasis curve. **Audio Distortion:** Less than 7% at 1,000Hz, 2/3 system deviation. **Frequency Display:** 6 digit, 7 segment HP LED. **Optional Accessory:** Plug in touch-tone encoder - $50.

RECEIVER SPECIFICATIONS

Frequencies: 143 to 148.995MHz. **Usable Sensitivity (12dB sinad):** 0.35uV @ 50% audio. **Quieting Sensitivity (20dB):** 0.5uV minimum. **Squelch Threshold Sensitivity:** 0.25uV minimum. **Squelch Limit Sensitivity:** 2.0uV or less. **Modulation Acceptance Bandwidth:** ±7.5KHz minimum. **Adjacent Channel Selectivity:** 70dB minimum. **Spurious Response Attenuation:** 70dB minimum. **Intermodulation Attenuation:** 60dB minimum. **Local Oscillator Frequency Stability:** ±10 parts per million. **Audio Output Power:** 4.0 Watts into a 4 Ohm load @ less than 10% distortion. **Audio Frequency Response:** +2dB to —8dB from the standard 6dB per Octave de-emphasis from 300Hz to 3,000Hz. **Hum & Noise:** —50dB squelched and —30dB unsquelched. **Chassis Size:** 7⅛"W x 2⅝"H x 10"D.

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Face plate also available in black.

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More Details? CHECK–OFF Page 142

the BRIMSTONE 144

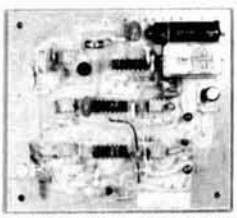
2 METER FM TRANSCEIVER

THE FIRST AND STILL THE ONLY 2 METER TRANSCEIVER THAT OFFERS IT ALL!

Size 9½" x 10½" ' 3¼"

- No crystals to buy.
- Complete band average 143 to 149.99 MHZ, 142 MHZ optional.
- Independent transmit/receive frequency control, yet simplex with the flip of a switch.
- Autopatch, tone burst and sub-audible tone capability by simply plugging in the desired module.
- Very low transmitter spurious output. Some manufacturers have demonstrated their inability to eliminate unwanted spurious outputs. The Brimstone has demonstrated that non-harmonic spurious output at least — 70Dd below the rated power output is possible when the radio is properly designed and constructed.
- The Brimstone 144 is designed for an unprecedented degree of component accessibility and plug-in modularity.
- The only amateur 2 meter FM transceiver with a TWO YEAR WARRANTY.

We have changed our company name to TEC-KAN, Inc. and at this time we are offering a special Fall Sale Price on the Brimstone 144. Check with your dealer on the Fall Special and ask for the 6 page full color brochure.



REPEATER AND AUTOPATCH CONTROL MODULE RPT CM-4

If you are planning a repeater and need a control circuit, we have just what you need! Complete control of repeater as well as the autopatch. Local or remote control. If you are using telephone line control for your repeater the RPT CM is ideal because it uses an opti-coupler for complete line isolation and low voltage, low current control.

If you are using the TKI SCAP-3D, you can call your autopatch line number and the RPT CM will automatically answer and connect you allowing you to send tones over the phone to turn the repeater on or off, or access the autopatch and communicate through the repeater over the autopatch phone line.

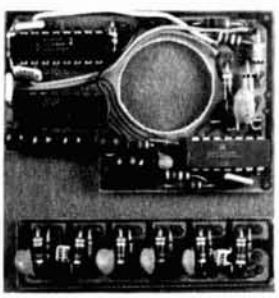
When calling the repeater on the autopatch line, you have 20 seconds to either access the autopatch or turn the repeater off or on. If the proper codes are not sent within 20 seconds the RPT CM automatically disconnects.

If you call the autopatch number, hang up, wait 30 seconds and call the number again, the repeater transmitter will be keyed and a tone sent each time the phone rings, thus signaling a mobile operator to access the autopatch. If there is no one available to access the patch, it will automatically disconnect after 30 seconds of ringing.

It also features a COR "Hold" circuit, which is adjustable from 1 to 5 seconds, and automatic "time out" timer, that resets each time the receiver COR drops. No need to wait for the repeater to drop out to reset the timer.

If you are planning a repeater, all you need is a good transmitter and receiver and the TKI RPT CM Control Module.

Price $79.95

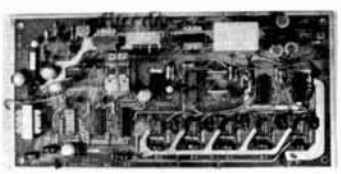


HANDI-TALKIE SCANNER KIT SK1402

Six Channel Cmos Scanner Kit has provisions to include Mostek Touch-Tone Encoder Chip. Features dwell and normal operation. "Dwell" mode monitors each channel that has a signal on it for 8 seconds. "Normal" monitors in conventional manner. Manual operation locks out the scanner.

Includes LED channel indicators, schematic and installation instructions. Designed for Wilson 1402SM Talkie.

Scanner Kit Model SK1402	$49.95
Includes Touch-Tone Encoder Chip Model SK1402TE	$58.95
Digi-Tran Pad, when ordered with Scanner Kit	$7.50



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AUTOPATCH SCAP-3D FEATURES

- 3 Digit access, single digit disconnect.
- 4 sec. time limit on access.
- Anti-falsing tone decoders.
- AGC with 30 Db dynamic range on all inputs and outputs.
- 3 digit on-off control of repeater or other devices.
- Remote inhibit or disconnect of autopatch as well as remote "off" function.
- Monitor amplifier allows monitoring all signals going into and out of the repeater.
- Adjustable level controls on all inputs and outputs.
- Jumpers on circuit board and frequency control pots on tone decoders allow field programming of access codes.
- Adjustable time out function. Patch will automatically disconnect in 30 to 90 seconds after it is accessed if no carrier is received.
- 90 days warranty.
- High quality tantalum and polyester capacitors used in tone decoder circuits to provide reliable low drift performance.
- Rugged G10 glass epoxy circuit board.
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- Easily connected and adjusted.

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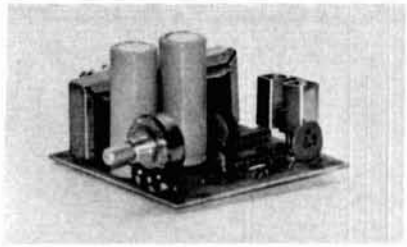
ADVA



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These easy to assemble kits include all components, complete detailed instructions and plated fiberglass PC boards. Power supply kits do not include case or meters. Add $1.25 per kit for postage and handling.

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1N3064	6/$1	2N1711	.29	2N4248	5/$1	E100	4/$1	LM340T-24	1.75
1N3600	6/$1	2N1890	.38	2N4249	5/$1	E101	3/$1	LM376N*	.55
1N4001*	12/$1	2N1893	.38	2N4250	4/$1	E102	3/$1	LM377N	2.50
1N4002	12/$1	2N2219	.24	2N4274	5/$1	E175	3/$1	LM380N	1.29
1N4003	12/$1	2N2222	6/$1	2N4302	$0.29	MPF102 to*	3/$1	NE555V*	2/$1
1N4004	12/$1	2N2222A*	5/$1	2N4303	.29	MPF104		NE556A	$0.90
1N4005	10/$1	2N2369	5/$1	2N4338	$1	MPF112	4/$1	LM709CH	.29
1N4006	10/$1	2N2606 to 2N2609	$2	2N4360M	2/$1	MPS6515	3/$1	LM709CN	.29
1N4007	10/$1	2N2905	$0.24	2N4391	$1	SE1001	4/$1	LM723H	2/$1
1N4148	15/$1	2N2906A	.24	2N4392	$0.90	SE1002	4/$1	LM723N*	3/$1
1N4154*	25/$1	2N2907*	5/$1	2N4416	2/$1	SE2001	4/$1	LM739N	$1.00
1N4370 to 1N4372	2/$1	2N3563	6/$1	2N4416A	$0.80	SE2002	4/$1	LM741CH	3/$1
1N4454	15/$1	2N3563	4/$1	2N4856 to 2N4861	$1	SE5001 to SE5003	3/$1	LM741CN*	4/$1
1N4728 to 1N4753	3/$1	2N3564	4/$1	2N4867E	2/$1	SE5020	$3.00	LM741CN14	.34
1N5231 to 1N5236	4/$1	2N3565 to 2N3568	6/$1	2N4868E	2/$1	TIS73 to TIS75	3/$1	LM74.CN	65
		2N3638	6/$1	2N4881	$2.50			748CJ DIP	.35
		2N3638A	5/$1	2N4888	$1	DIGITAL IC's		749CJ DIP	1.00
VARACTORS		2N3641	5/$1	2N4965	3/$1	MM5738N	$2.95	844CP mDIP	.80
1N5139 to 1N5144	$2	2N3642	5/$1	2N5087	4/$1	SN7400N	.16	LM1304N	1.15
DS 144MHz	$5	2N3643	6/$1	2N5088	4/$1	SN7410N	.16	LM1458N*	3/$1
F7 432MHz	$1	2N3644	4/$1	2N5126 to 2N5135	6/$1	SN7420N	.16	LM2111N	$1.40
MV830 to MV832	$1	2N3646	4/$1	2N5138	5/$1	SN7440N	.16	XR2556CP	1.55
MV1620 to MV1634	$1	2N3688 to 2N3690	3/$1	2N5139	5/$1	SN7451N	.18	2740DE	1.95
MV1866 to MV1872	$2	2N3691 to 2N3694	4/$1	2N5163	3/$1	SN7473N	.36	CA3028A	1.75
MV2201 to MV2205	$1	2N3821	$0.80	2N5197	$5.00	SN7475N	.48	CA3046	.84
		2N3822	.70	2N5199	2.50	SN7476N	.35	LM3075N1	1.45
		2N3823	.40	2N5210	3/$1	SN7490N	.44	CA3086*	.55
		2N3902 to* 2N3906	6/$1	2N5308	2/$1	LINEAR IC's		LM3900N	.55
		2N3903 to* 2N3906	6/$1	2N5397	$1.50	LM100H	$7.50	RC4194D	1.50
		2N3866	.75	2N5432	1.90	LM301AN	.27	RC4194TK*	2.50
		2N3903 to* 2N3906	6/$1	2N5457	3/$1	LM307H	.27	RC4195DN*	1.25
		2N3906	6/$1	2N5458	$0.38	LM308N	.88	RC4195TK*	2.25
		2N3919	$5.00	2N5484	3/$1	LM309K	1.25	RC4558DN	.55
		2N3922	5.00	2N5486	2/$1	LM311N	.90	N5556V	.95
		2N3954	3.20	2N5543	$3.00	LM320K-5	1.35	N5558V	.50
		2N3958	1.15	2N5544	2.50	LM320K-12	1.35	µA7805UC	1.25
		2N3970	1.00	2N5561	12.00	LM320K-15	1.35	8038 DIP*	3.75
								DM7492	.89

*SUPER SPECIALS:

1N914 100V/10mA Diode	20/$1	MPF102 200MHz RF Amp	3/$1
1N4001 100V/1A Rect.	15/$1	40673 MOSFET RF Amp	$1.75
1N4154 30V 1N914	25/$1	LM324 Quad 741 Op Amp	.94
BR1 50V ½A Bridge Rec	4/$1	LM376 Pos Volt Reg mDIP	.55
2N2222A NPN Transistor	6/$1	NE555 Timer mDIP	2/$1
2N2907 PNP Transistor	6/$1	LM723 2-37V Reg DIP	3/$1
2N3055 Power Xistor 10A	.69	LM741 Comp Op Amp mDIP	4/$1
2N3904 NPN Amp/Sw µ100	6/$1	LM1458 Dual 741 mDIP	3/$1
2N3906 PNP Amp/Sw µ100	6/$1	CA3086 5 Trans Array DIP	.55
CP650 Power FET ½Amp	$5	RC4195DN 15V/50mA mDIP	1.25
RF391 RF Power Amp Transistor 10-25W @ 3-30MHz TO-3			$5.00
555X Timer 1µs-1hr Different pinout from 555 (w/data)			3/$1
RC4194TK Dual Tracking Regulator 0.2 to 30V @ 200mA TO-66			$2.50
RC4195TK Dual Tracking Regulator 15V @ 100mA (TO-66)			$2.25
8038 Waveform Generator 1A Wave With Circuits & Data			$3.75

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6 digit AUTOMOTIVE CLOCK KIT complete with a CRYSTAL TIMEBASE accurate to .01 percent. 12 volts d.c. operation – built in noise suppression and voltage spike protection. Read-outs blank when ignition is off – draws 25 mA in standby mode. Has .3 in. readouts. Use it in your car or for all applications where a battery-operated clock is needed. Approximate size 3" x 3.5" x 1.75"

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WITHOUT CASE	$29.95 ppd.
ASSEMBLED AND TESTED	$45.95 ppd.

CMOS CRYSTAL TIMEBASE KITS with .01 percent accuracy. 5-15 v.d.c. operation. Draws only 3 mA at 12 volts. Single I.C. – very small size – the P.C. board is 7/8" x 1-5/8". Choose a main output of 50 or 100 Hz., 60 Hz., 500 or 1000 Hz., or 1 Hz. Several related frequencies are also available on each board, in addition to the main ones listed above. Be sure to specify the Frequency you want. All kits are $10.95 ppd.

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More Details? CHECK–OFF Page 142

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144-148 MHz, P.L.L. Synthesized

400 frequencies in 10 KHZ steps

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400 more frequencies with 5 KHz shift-up

+

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Midland introduces a practical 25-watt, 2-meter mobile transceiver with operation programmed throughout the 144-148 MHz band... at a practical price. In operation, a large-scale L.E.D. digital readout displays the frequency selected through the advanced Phase Lock Loop tuning circuit. Duplex operation with any of four transmitter offsets is available at a touch of a button... or operate simplex. There is a full-range variable squelch control, a large lighted S/RFO meter, duplex and TX indicator lights.

Inside, the dual conversion superheterodyne receiver has active automatic gain control, multiple FET front end with high Q resonator filter and ceramic filters in both RF stages. The transmitter delivers an honest 25 watts output power, switchable to 1 watt low power. There's automatic polarity protection and an APC circuit guarding final output transistors. A connector is provided for tone burst and discriminator meter.

All this is contained in a rugged, all-metal cabinet 2⅝" high by 6¾" wide by 9⅝" deep, designed with a forward-projecting speaker housing for improved sound quality in mobile installation.

Midland's new MODEL 13-510 is supplied complete with push-to-talk microphone, crystals for +600 and −600 offsets, mobile mounting bracket, power cord and hardware. You'll find it at your Midland Amateur dealer.

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More Details? CHECK–OFF Page 142

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Distributor unloads! Includes AC, DC, RF, audio, 4-9 pin, all kinds, Wt. 1 lb. Cat No. 12H3527

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It's true! 20-key, 4 function keyboards at ridiculous give-away. Wt. 12 ozs. Cat. No. 12H3524

BARREL KIT #201 6V INDICATORS w/leads
15 for $1.98
Test lamp manufacturer dumps inventory! Worth 69¢ ea. Like grain-o-wheat. Cat. No. 12H3526

BARREL KIT #200 9 DIGIT READOUT MODULES
5 for $1.98
with calculator & driver chips beneath epoxy. How good? Who knows! Cat. No. 12H3515

BARREL KIT #198 TRANSISTORS & DARLINGTONS
50 for $1.98
Motorola dumps 1,000,000 TO-220 in barrels. NPNs & PNPs. All color-coded, high yield. 6 ozs. 12H3533

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Top grade, assrtd values, some preformed. Marked with internal numbers. 100%. Cat. No. 12H3476

BARREL KIT #195 CARBO-FILM RESISTORS 12H3534
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millions. Lo & Hi values, ¼ & ½ watt, 5%, 10% tol. All marked. 100%.

BARREL KIT #191 CARBOFILM RESISTORS
800* for $1.98
*½ pound, approx. ⅛, ¼ watters. Assrt values. Unmarked, but with ohmmeter you can separate urself-n-save! Cat. No. 12H3445

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Includes resistors, caps, transformers, rectifiers, diodes, etc. for p.c. work. Preformed, dumped into barrels by factories. 100%. Cat. No. 12H3401

BARREL KIT #186 KEYBOARD CHIPS
10 for $1.98
Truthfully we can't test 'em, MM5740's, keyboard encoder chips. How good they are we don't know. Cat. No. 12H3414

BARREL KIT #184 ¼-WATT METAL FILM
150 for $1.98
100% metal film resistors. Long leads. 12H3413

BARREL KIT #182 JUMBO RED LEDS
15 for $1.98
100% material, user cancellation from factory dumps, 3V 10 mils. For 100's of projects, red lens. Cat. No. 12H3369

BARREL KIT #163 MINI TRIM POTS
30 for $1.98 1 oz.
Assrt. values 100 to 1 meg 'em. What a buy. Single turn, ¼ W. Wt. 6 oz. Cat. No. 12H3345

BARREL KIT #160 V. REGULATORS
15 for $1.98
LM309KC TO-3 V.R.'s barreled. Bot by the pound, No. 12H3330

BARREL KIT #159 MODULAR SWITCHES
25 for $1.98
Centralab switches. TV-makers excess. Dpdt, 6pdt, etc. Brand new. Cat. No. 12H3150

BARREL KIT #158 MAGNIFIED MAN-3's 1 oz.
15 for $1.98
Famous style MAN-3's 7-seg readout, with built-on magnifier. Factory discontinued line, 100% material. Cat. No. 12H3325

BARREL KIT #157 MOLEX CONNECTORS
100 for $1.98 12 ozs.
Nylon, white cable connectors, assrt. factory over-run. NO PICKEE! Mixed in barrels. Cat. No. 12H3324

BARREL KIT #154 CLOCK CHIPS
20 for $1.98
We gathered an assortment of clock chip, alarm, calendar, beepers, who knows, all mixed. Cat. No. 12H3308

BARREL KIT #149 ROCKER SWITCHES
25 for $1.98 15 ozs.
Barrels 'n barrels, so many, our customers should get the deal. No. 12H3302

BARREL KIT #147 OVER-FLO FLUORESCENT NIXIES
5 for $1.98
Gas discharge type, color: Blue. Cat. No. 12H3288

BARREL KIT #144 RCA PHONO PLUGS
40 for $1.98
1,000,000 RCA phono plugs for this one. You hi-fi-ers know what they are — 100% material. 12H3293

BARREL KIT #142 DARLINGTON TRANSISTORS
40 for $1.98
TO-92, a Motorola dump, unknown numbers, but high yield to good darlingtons. 12H3285

BARREL KIT #141 10 WATT ZENERS
15 for $1.98 4 ozs.
Mfr dumps to prepare for new styling, voltages all over the place. Good yield. Cat. No. 12H3298

BARREL KIT #140 LAMPS, INDICATORS
20 for $1.98
Precision, mini lamp all-metal, panel, with mtg hardware. Lamp maker's overstock. No. 12H3297

BARREL KIT #138 PANEL SWITCHES
30 for $1.98
Did you hear of OAK? Another eqpt maker barrelled all types of rotaries, electric, slides, etc. 12H3268

BARREL KIT #134 CALCULATOR CHIPS
15 for $1.98
National type. Can be MM5736, 38, etc. Untested. Cat. No. 12H3258

BARREL KIT #131 TANTALUM ELECTROS
30 for $1.98
Mixed, marked prime, top grade assrt. values, voltages. Cat. No. 12H3288

BARREL KIT #130 CRYSTALS!
12 for $1.98 2 ozs.
Large U.S. maker dumped frequency marked H/C6L crystals in barrels. Some worth $5. Precision. Many in 8 mc. area. 12H3250

BARREL KIT #128 MINI DIP ICS
75 for $1.98
Large mfgr dumped 100's of lbs into barrels. Includes 74ls, LM-380-8, 703, 567, 555, 558—but who knows? Wt. 1 lb. 12H3245

BARREL KIT #127 AXIAL ELECTROS
40 for $1.98
Assrt. capacities and voltages. Cat. No. 12H3227

BARREL KIT #126 UPRIGHT ELECTROS
40 for $1.98
1mf to 300mf in mixture of voltages. 100% marked 'n good. 12H3226

BARREL KIT #121 "MINI" MAGNETS
100 for $1.98 2 ozs.
Magnet circular and rectangular cuttings from a major maker — barreled to save space. 12H3168

BARREL KIT #119 PRECISION RESISTORS 100% good
100 for $1.98
PREFORMED! Designed for printed circuit work. ¼, ½ w. Marked values, 1 and 2% values. 2 ozs. 12H3205

BARREL KIT #117 OPTICAL FIBERS 20 ozs. 20-MIL 12H3208
200-FT. $1.98
Fiber optics factory bankruptcy purchase! High quality, most commonly used size (20-mil), CLEAR.

BARREL KIT #115 MOLEX SOCKETS 100% good
200 for $1.98 Cat.No. 12H3144
Calculator maker dump! We got a zillion of 'em. Used for IC sockets, etc.

BARREL KIT #112 MICRO MINI LEDS
40 for $1.98
All the tiny leds, axial, upright of Monsanto, Litronix, variety of colors. Yield 50% or better. 12H3139

BARREL KIT #110 SUPPRESSOR DIODES
100for $1.98
Keeps ignition noises out axial. Untested, but the of your eqpt., car, industrial, etc. 12H3137

BARREL KIT #109 TERMINAL STRIPS
100 for $1.98
Wide asst. of terminal strip connectors, from 1 contact up. Strip manufacturers barrel dump is your gain. Wt. 1 lb. Cat.No. 12H 3136

BARREL KIT #108 TO-5 PLASTIC TRANSISTORS
40 for $1.98
Cat.No. 12H3101
Includes PNP, NPN, 2N-3638, 2N3641, 2N5000 series, etc. Untested, but guaranteed to a 60% yield.

BARREL KIT #104 SLIDE VOLUME CONTROLS
10 for $1.98
Cat.No. 12H 3057

BARREL KIT #99 PHOTO ELECTRIC CELLS
10 for $1.98
Asst. GE types, CDS types. Mixed by factory. Big job for us to separate. 100% good. Cat.No. 12H3052

BARREL KIT #93 HALF WATTERS
200 for $1.98
Resistor factory tried to fool us by mixing 100% color-coded resistors in barrel. But value is there. 4 oz. 12H3046 Untested

BARREL KIT #92 3 AMP EPOXY RECTIFIERS
100 for $1.98
Cosmetic rejects, electrically fine business! You check 'em, it's not for us. Asst. voltages. Untested. 12H3204

BARREL #91 SILVER MICAS
100 for $1.98
Axial, red case, variety of physical sizes & values. Cat.No. 12H3018

BARREL KIT #85 LITRONICS LED READOUTS
10 for $1.98
747's, 727's, singles, triples, etc. .33 to 0.6. Bot from factory, all mixed; have fun! No. 12H2861

BARREL KIT #87 NATIONAL IC BONANZA
100 for $1.98
Types 8000, 7400 series, DTLs, ROMs, registers, clock & calc. chips, linears, etc. Cat.No. 12H2860 Untested.

BARREL KIT #86 HOBBY LEDS
40 for $1.98 Untested
Wow! A Litronics dump of all kinds of mixed discrete LEDS, shapes, colors, good, poor, etc. 12H2859

BARREL #83 15 for $1.98 LM-340T VOLT REG
Factory rejected them for length of leads. May include 5, 6, 8, 12, 15, 18, 24 volts. Power tab Cat. 12H2835

BARREL KIT #81 SUBMINI RESISTORS
200 for $1.98
PC, upright type, color coded, ⅛ watt. Asst values. Come to us in a barrel. Cat.No. 12H2746 100% good.

BARREL KIT #76 1-WATT ZENERS
100 for $1.98
Factory same as 400-mw's Never-to-see-again offer. 6.8, 10, 12, 15V. under glass. Do-ble plug. Cat.No 12H 2741 Untested.

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150 for $1.98
Factory out of biz! Amazing offer: 6, 8, 10, 12 to 15V. You test. Hermetically sealed glass pak. Double plug. Cat.No. 12H2740

BARREL KIT #73 TRANSISTOR ELECTROS
50 for $1.98
We don't wish to separate wide asst voltages & values up to 300 mf. Cat. 12H2747

BARREL KIT #71 CAPACITOR SPECIAL
100 pcs. $1.98
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BARREL KIT #68 2 WATTERS
100 for $1.98 100% good.
All marked. Cat.No. 12H2735

BARREL KIT #65 MIXED READOUTS
10 for $1.98
factory returns — such numbers as MAN-4's, MAN-7's, MAN-8's, 11 barrels & no time to separate. Cat.No. 12H 2733 Untested.

BARREL KIT #61 POLYSTYRENE CAPS
100 for $1.98
Finest caps made. As a gamble we bought 10 barrels from factory, mixed values; all good. Cat.No. 12H2729

BARREL KIT #58 SLIDE SWITCHES
30 for $1.98
All shapes, sizes, spst, spdt, momentaries, etc. Tremendous shop pak for 100's of, switching projects. Cat.No. 12H2726 100% good

BARREL KIT #56 POWERS! POWERS!
100 for $1.98
Large distributor cleaned house. Barrels of power resistors 3 to 7 watts. Cat. No. 12H2724

BARREL KIT #54 8 DIGIT READOUTS
10 for $1.98
Bargain of a lifetime! All we got was 1 barrel — the "blisdor digit" types. Multiplexed. Cat. No. 12H2722

BARREL KIT #46 G.E. 3.5 WATT AMPLIFIERS
25 for $1.98
Hobby type, factory-fall-outs, 12H2624 Untested

BARREL KIT #40 PNP HIGH-POWER TRANSISTORS
20 for $1.98
Popular germanium TO-3 case 12H2618 100% good

BARREL KIT #39 2N3055 HOBBY TRANSISTORS
15 for $1.98
Fallouts of the famous 2N3055. 12H2617 100%

BARREL KIT #37 1 AMP "BULLETT" RECTIFIERS Untested
100 for $1.98
Famous style, assrtd. voltages, silicon, axial includes all types of voltages to 1KV. Cat.No 12H2615

BARREL KIT #36 GERMANIUM DIODES
200 for $1.98 Untested
This is the way the RE-TESTERS buy 'em from the factories. Cat.No. 12H 2614

BARREL KIT #35 NEON LAMPS
30 for $1.98 100% good.
Famous NE-2's. All prime, but factory made millions and barrel'ed 'em. Your advantage Cat.No 12H 2613

BARREL KIT #31 METALLIC RESISTORS
100 for $1.98
Made mostly by Corning, the finest resistor made. Mostly ½ watters, 1% to 5% tol. & a barrel of values. Cat. No. 12H2609

BARREL KIT #30 PREFORMED RESISTORS
200 for $1.98
We got barrels of ¼ and ½" watters for pc use, 100: ¼, 100 ½" watters. No. 12H2608 100% good

BARREL KIT #26 PLASTIC TRANSISTORS
100 for $1.98 Untested.
Type TO-92 (TO-18), all manufacturers, variety of 2N #'s. Cat.No. 12H2604

BARREL KIT #25 METAL CAN TRANSISTORS
100 for $1.98
Includes TO-5, TO-1, TO-18, etc., assorted 2N numbers, unmarked ect. Cat.No. 12H2603 Untested.

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SN7408N	.25
SN7409N	.18
SN7410N	.16
SN7411N	.25
SN7413N	.45
SN7417N	.32
SN7420N	.16
SN7421N	.29
SN7423N	.35
SN7425N	.27
SN7430N	.16
SN7437N	.26
SN7438N	.26
SN7440N	.16
SN7441N	.84
SN7442N	.53
SN7445N	.69
SN7446N	.79
SN7447N	.69
SN7448N	.76
SN7450N	.16
SN7451N	.16
SN7454N	.16
SN7464N	.16
SN7470N	.45
SN7472N	.34
SN7473N	.36
SN7474N	.31
SN7475N	.49
SN7476N	.31
SN7478N	.79
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SN7485N	.86
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SN7496N	.72
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SN74106N	.65
SN74107N	.33
SN74112N	.65
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SN74121N	.38
SN74123N	.59
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SN74126N	.59
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SN74148N	1.29
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SN74151N	.70
SN74153N	.65
SN74154N	1.03
SN74155N	.70
SN74157N	.70
SN74158N	.85
SN74160N	.88
SN74161N	.88
SN74164N	.79
SN74165N	.99
SN74173N	1.39
SN74174N	.97
SN74175N	.89
SN74176N	.79
SN74177N	.79
SN74181N	2.05
SN74184N	1.75
SN74185N	1.75
SN74190N	1.15
SN74191N	1.05
SN74192N	.87
SN74193N	.83
SN74195N	.73
SN74196N	.88
SN74198N	1.49
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SN74200N	3.95
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SN74284N	5.95
SN74285N	5.95

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BARREL KIT #22 LONG LEAD DISCS
100 for $1.98
"auction sale". Prime, marked only. Long leads Cat.12H 2598 100% good

BARREL KIT #19 DIPPED MYLARS
60 for $1.98
Finest capacitors made, shiny finish. Imagine factory dumping 'em in barrels. Cat.No. 12H2597 100% good

BARREL KIT #15 MOSFET TRANSISTORS
60 for $1.98
All 4 leaders TO-18 case, includes UHF transistors too! Cat.No. 12H2429

BARREL KIT #14 PRECISION RESISTORS
200 for $1.98
Marked and unmarked ¼, ½, 2 watts. No. 12H2428

BARREL KIT #12 POWER TAB TRANSISTORS
40 for $1.98
PNP, plastic TO220 type. Assorted 2N numbers. Cat.No. 12H2426 Untested.

BARREL KIT #11 POWER TAB TRANSISTORS
40 for $1.98
NPN, plastic TO220 type. Assorted 2N numbers. No. 12H2428 Untested.

BARREL KIT #10 ROMS-REGISTERS
75 for $1.98
28 to 40 pin devices, marked, internal factory numbers, etc. 12H2424 Untested

BARREL KIT #7 VOLUME CONTROL BONANZA!
30 for $1.98 100% good
Singles, duals, variety of values, styles, big ones — small ones. Cat.No. 12H2321

BARREL KIT #4 "4000" RECTIFIERS
100 for $1.98 Untested.
1N4000 series. May include 25, 50, 100, 200, 400, 600, 800 and 1000 volters. 12H2417

BARREL KIT # 3 1N4148/914 SWITCHING DIODES
100 for $1.98
Imagine famous switching diodes at these prices! Cat.No. 12H2418 Untested.

BARREL KIT #2 LINEAR OP AMPS, DIPS
75 for $1.98 Untested
May include 709's, 74 's, 703's, 660 series. 555 includes Cat.No. 12H2416

BARREL KIT #1 SN7400 DIP IC'S
75 for $1.98
Marked 14 and/or with 16 pin dips, may include gates, registers, flip flops, counters. Cat.No. 12H2415 Untest

BARREL KIT #5 SCRS, TRIACS QUADRACS
40 for $1.98
Raw factory stock! All the 10 amp types. Cat.No. 12H2419 Untested.

Terms: Add postage Rated: net 30
Phone: Wakefield, Mass. (617) 245-3829
Retail: 16-18 Del Carmine St., Wakefield.
MINIMUM ORDER — $6.00

POLY PAKS

P.O. BOX 942H LYNNFIELD, MASS. 01940

SALE
☐ *Send for FREE Fall-Winter* **CATALOG**

C.O.D.'s MAY BE PHONED

More Details? CHECK—OFF Page 142

flea market

RATES Non-commercial ads 10¢ per word; commercial ads 40¢ per word both payable in advance. No cash discounts or agency commissions allowed.

HAMFESTS Sponsored by non-profit organizations receive one free Flea Market ad (subject to our editing). Repeat insertions of hamfest ads pay the non-commercial rate.

COPY No special layout or arrangements available. Material should be typewritten or clearly printed and must include full name and address. We reserve the right to reject unsuitable copy. **Ham Radio** can not check each advertiser and thus cannot be held responsible for claims made. Liability for correctness of material limited to corrected ad in next available issue.

DEADLINE 15th of second preceding month.

SEND MATERIAL TO: Flea Market, Ham Radio, Greenville, N. H. 03048.

HAM RADIO HORIZONS, a super new magazine for the Beginner, the Novice and anyone interested in Amateur Radio . . . What it's all about, How to get started, The fun of ham radio. It's all here and for just $7.00 per year until January 1st. Then it will be $10.00. HURRY! HURRY! Ham Radio HORIZONS, Greenville, NH 03048.

NEW ADJUSTABLE THREE OUTPUT REGULATED POWER SUPPLY, plus 900 parts worth $400.00 list. Solid state TV recorder electronic unit. Schematics, parts cross reference. Free brochure. $17.95 plus $3.50 S&H, USA. Master Charge, BankAmericard. Satisfaction guaranteed. Madison Electronics Company, Incorporated, Box 369, D77, Madison, Alabama 35758.

SWAN CYGNET 260 (built-in AC-DC supplies) . . . Super rig in excellent condition with best of Swan's modifications, manual, and Swan mobile mike. $260. HQ-180AC . . . Excellent, with noise immunizer, matching speaker; manual. For those who appreciate a premium receiver. $365. WA9RAQ, Morrie Goldman, 5815 N. Christiana, Chicago, 60659.

STOP don't junk that television set. ASE manufactures the world's most complete line of television picture tubes. Over 1700 types. Most types immediate delivery. Tubes for Old or New TV's, black & white and color. 2 year factory warranty. Lowest prices anywhere. Allied Sales & Engineering, Inc., Dept. 22, Pimento, IN 47866. Telephone 812-495-6555.

NOT C.B. decals, 1 x 2 inches, black over white, plastic, weatherproof, peel and stick. Great for load coils, radios, control heads, etc. Stop having your radio gear mistaken for C.B. radio. 10 for $1.00, with SASE 12 for $1.00, 100 for $7.00. WA4SGI, Ronald P. Pitts, 2113 Lester Lane, Birmingham, AL 35226.

TELETYPE EQUIPMENT for beginners and experienced operators. RTTY machines, parts, supplies. Beginner's special: Model 15 Printer and demodulator $139.00. Dozen black ribbons $6.50; case 40 rolls 11/16 perf. tape $17.50 FOB. Atlantic Surplus Sales, 3730 Nautilus Ave., Brooklyn, N. Y. 11224. Tel: (212) 372-0349

WANTED: Rohn 25 or 45. Will take down if it's in the New England area. Write W1GQO, c/o HAM RADIO Magazine, Greenville, NH 03048.

VARIABLE CONDENSORS, Johnson 154-3, 19-488pt, 2KV, used, excellent condition, $12 each or 3 for $30, postpaid. KP4DSD, Box 297, Sabana Seca, P. R. 00749.

VERY in-ter-est-ing! Next 4 big issues $1. "The Ham Trader," Sycamore, IL 60178.

HRO-500 GENERAL COVERAGE RECEIVER. Factory overhauled 1975, with speaker, mint condition. $1200. HAL RVD-1002 visual display for RTTY. Art Levy, WBØDJX, 4900 Deertrail Court, Ft. Collins, Colo. 80521. (303) 484-1600.

SYNTHESIZER. See Ham Radio, July 76, pg. 20-23, figures 21 to 24. Kit for $115, assembled and tested, $140. Power supply to run from 117 volts additional $15.00. CTD, P. O. Box 708, Cambridge, MA 02139.

BUY — SELL — TRADE. Write for free mailer. Give name, address and call letters. Complete stock of major brands, new and reconditioned equipment. Call for best deals. We buy Collins, Drake, Swan, etc. SSB & FM. Associated Radio, 8012 Conser, Overland Park, Ks. 66204. 913-381-5901.

SAVE! Bomar FM, xtals $4.00 ppd. Dentron, Hustler, CushCraft, W. M. Nye, Ameco. Used gear. Complete catalog - write Ferris Radio, 308 E. Harry, Hazel Park, Mich. 48030.

AMAZING! The "Electronics Sourcebook" reveals how, where to obtain 101 free samples, manuals, publications. $3.75 ppd. Brochure free. Technical Publications, 1405A Richland, Metairie, LA. 70001.

RECONDITIONED TEST EQUIPMENT for sale. Catalog $.50. Walter, 2697 Nickel, San Pablo, Ca. 94806.

TENNELEC MEMORYSCAN sixteen channel VHF/UHF frequency synthesized receiver/scanner. Used, mint condition, $250 or best offer. Raymond Glueck, 1 Rutledge Road, Pine-Brook, N. J. 07058. 201-227-5361.

MOBILE IGNITION SHIELDING provides more range with no noise. Available most engines. Many other suppression accessories. Literature, Estes Engineering, 930 Marine Dr., Port Angeles, WA 93862.

TRAVEL-PAK QSL KIT — Send call and 25¢; receive your call sample kit in return. Samco, Box 203, Wyantskill, N. Y. 12198.

LOOKING FOR USED GEAR? Buyers & Sellers radio brokerage has the equipment you want at the right prices. Call our Ham Gear Hotline 617-536-8777 Monday-Friday, 9-9.

NAMEBADGES $1.50 — Name and Call Sign $2.00. Engraved plastic with pin, clutches, or adhesive. Black, white, red, blue. Include payment with order. Special prices on club badges and Hamfest plaques. Donan Engraving, P. O. Box 07155, Lakewood, Ohio 44107.

FREE Electronics Surplus Catalog. Electronic Specialties, 1659 Wetmore, Tucson, AZ 85705.

MOBILE BONDING STRAPS under 50¢ each. Literature. Estes Engineering, 930 Marine Drive, Port Angeles, Wash. 98362.

COMPLETE LINE KLM, CushCraft, Covercraft dust covers, SCS amplifiers, Regency, Triex Towers. Call or write Radios Unlimited, 86 Balch Ave., Piscataway, N. J. 08854. 201-752-4307.

ETCH IT YOURSELF PRINTED CIRCUIT KIT, Photo-Positive Method — All the supplies for four P.C. boards, direct from magazine article in less than 2 hours. Only $19.95. S.A.S.E. for details. Excel Circuits, P. O. Box 891, Troy, Michigan 48099, 313-549-0440.

DIRECT CONVERSION RECEIVER KITS for AM or CW. Write WB9MBH, 3132 North Lowell Avenue, Chicago, Illinois 60641.

HW-101 W/AC PS $250 like new. Ranger I $75. HA-800 3.5-50GHz solid state rcvr $75. Will ship Greyhound collect. Hal W6TU, (805) 644-4871.

YAESU EQUIPMENT OWNERS — Present or Prospective — Join the five-year-old, 2000-member, 40-country, International Fox-Tango Club. Members receive valuable monthly Newsletter, money-saving purchasing service, technical committee consultation, free ads, FT net, more. Back issues of Newsletter available from 1972. To join, send $5 for calendar year (includes all 1976 issues of Newsletter) or $1 creditable towards dues, for complete information and sample Newsletter. Milton Lowens, WA2AOQ/4, 248 Lake Dora Drive, W. Palm Beach, Fl. 33411.

MODERN CODE PRACTICE. 0-22 wpm on four 60 min. cassettes $10. Royal, P. O. 2174, Sandusky, Ohio 44870.

TECH MANUALS for Govt. surplus gear - $6.50 each: SP-600JX, URM-25D, OS-8A/U, PRC-8, 9, 10. Thousands more available. Send 50¢ (coin) for 22-page list. W3IHD, 7218 Roanne Drive, Washington, DC 20021.

FIGHT TVI with the RSO Low Pass Filter. For brochure write: Taylor Communications Manufacturing Company, Box 126, Agincourt, Ontario, Canada. MIS 3B4.

TELL YOUR FRIENDS about Ham Radio Magazine!

flea market

TOWER AND ACCESSORIES FOR SALE: Tri-Ex LM-354, TA-54L tilt over, CO-3 coax standoffs, thrust bearing, heavy duty mast, Ham-M rotor complete. New cost over $1700.00. Take best offer. You pick up, Los Angeles area. Allen White, (415) 854-4771, 6 p.m. - 8 p.m.

RUBBER STAMP, name/call/QTH $2.50 ppd. (CA residents add tax). LWM Press, Box 22161, San Diego, CA 92122.

TELETYPEWRITER PARTS, gears, manuals, supplies, tape, toroids. SASE list. Typetronics, Box 8873, Ft. Lauderdale, Fl. 33310. Buy parts, late machines.

PORTA-PAK the accessory that makes your mobile really portable. $67.50 and $88.00. Dealer inquiries invited. P. O. Box 67, Somers, Wisc. 53171.

DON'T READ THIS AD Unless you want a good deal and good service on your next ham radio or hi-fi purchase. Thousands of satisfied customers nation-wide have made us the largest volume communications and hi-fi dealer in the country. We are factory-authorized dealers for Kenwood, Drake, Collins, ICOM, Tempo and over 100 other brands of amateur radio and hi-fi gear. We have something for you! Call or write us today for our quote and become one of the many happy and satisfied customers of HOOSIER ELECTRONICS, INC., P. O. Box 2001, Terre Haute, Indiana 47802. (812)-238-1456.

LARSEN ANTENNAS (our specialty) 2,432 magnetic, trunk-lip 5/8 $33.00, 5/8 ground plane $45.00. BankAmericard and Mastercharge accepted. 201-962-4695. Narwid Electronics, 61 Bellot Road, Ringwood, NJ 07456.

SURPRISES GALORE! Projects, ham radio, music synthesizers, etc. IC's, pots, hardware, crystals, keyboards, resistors, etc. Send 13¢ stamp for catalogue. UTEP, Box 26231A, Salt Lake City, Utah 84125.

QRP TRANSMATCH for HW7, Ten-Tec, and others. Send stamp for details to Peter Meacham Associates, 19 Loretta Road, Waltham, Mass. 02154.

VHF G.E. MASTR PRO 80 W xmtr, 4 chnl, UHS rcvr cg in xmtr 186.2. 1969 model. .22-.82 .28-.88, .34-.94, .76-.76. WA7PUD, 1720 N. E. 9th, E. Wenatchee, Washington 98801. $350.00. 509-884-3891.

SYNTHESIZER, see Ham Radio, July 76, pg. 20-23, figures 21-24. Kit for $115. Assembled and tested, $140. Power supply to run from 117V additional $15. CTD, P. O. Box 708, Cambridge, MA 02139.

FREE CATALOG. Calculators $4.95 each, Ultrasonic Devices, Digital Thermometers, Strobe Light Kits, Memories, Photographic Electronic Flash Units, Rechargeable Batteries, LEDs, Transistors, IC's, Piezoelectric Crystals, Toroidal Cores, Unique Components. Chaney's, Box 27038, Denver, Colo. 80227.

WANTED: Car telephones and mobile telephone parts, heads, cables, etc. Greg Hyman, 87 Yonkers Ave., Yonkers, N. Y. 10701. 914-476-4330.

SELL — Touch Tone Pad, Solid State, Subminiature size, great for HT's, $33 shipped. Regency HR2A, excellent condition, unmodified, $150 shipped. Knight VOM KG-640, mint, $20 shipped. WA9WDB/P5, John Teles, 10511 Tenneco, Houston, Texas 77099.

MANUALS for most ham gear, 1939/70. List $1.00. Send SASE (or 25¢) for one specific model quote. Hobby Industry, WØJJK, Box H864, Council Bluffs, Iowa 51501.

PLEASE! Will pay for interconnection diagram for the 3 units — IMD, TDC, ACU — sold by PINON Electronics. Units sent to European ham. Want to save face for U.S. mfr. W4SXK, Rt. 3, Box 930, Merritt Island, Fla. 32952.

SIDESWIPER only $13. Airmailed USA. Kungsimport, Box 257, Kungsbacka, Sweden.

RTTY DEMODULATORS — Immediate delivery. New ST-5's with auto-start and AK-1 AFSK audio oscillator. $185 or $25 and balance UPS COD. David Tancig, 618 W. White St., Champaign, Ill. 61820.

MOTOROLA HT220, HT200, Pageboy, and other popular 2M FM transceiver (Standard, Regency, etc.) service and modifications performed at reasonable rates. WA4FRV (804) 320-4439 evenings.

MERRY XMAS and HAPPY NEW YEAR from WØCVU. On the air since 1913. The Worlds finest hobby.

HQ-180A-C Hammarlund Rcvr for sale. Exc. cond. $249, you pick up or pay shipping. Loren Jones, WA3JUN, 224 W. Willow Grove Ave., Phila, Pa. 19118. Phone 215-242-1435.

More Details? CHECK—OFF Page 142

SPECIALS FROM MHz electronics

Fairchild VHF Prescaler Chips

11C01FC	High Speed Dual 5-4 Input no/nor	15.40
11C05DC	1 GHz Counter Divide by 4	74.35
11C05DM	1 GHz Counter Divide by 4	110.50
11C06DC	UHF Prescaler 750 MHz D Type flip/flop	12.30
11C24DC	Dual TTL VCM same as MC4024P	2.60
11C44DC	Phase Freq. Detector same as MC4044P	2.60
11C58DC	ECL VCM	4.53
11C70DC	600 MHz flip/flop with reset	12.30
11C83DC	1 GHz 248/256 Prescaler	29.20
11C90DC	650 MHz Prescaler Divide by 10/11	16.00
11C90DM	same as above except Mil. version	24.00
11C91DC	605 MHz Prescaler Divide by 5/6	16.00
11C91DM	same as above except Mil. version	24.00
95H90DC	350 MHz Prescaler Divide by 10/11	9.50
95H90DM	same as above except Mil. version	16.50
95H91DC	350 MHz Prescaler Divide by 5/6	9.50
95H91DM	same as above except Mil. version	16.50
GIAY-3-8500 Gain Chip		29.95
T.I. TMS4060/C2107, 4K RAM		19.01

Batteries

NI-CAD's AA cells 1.25 volts at 500 mahr. $0.49
Gel-Cell 12 volts at 1.5 Amp Hr. #GC-1215 $19.95

Crystals

1.000000 MHz	4.95
5.000000 MHz	4.95
10.000000 MHz	4.95
3579.545 KC	2.95

JUST ARRIVED! These radios have just been pulled out of service. Set up for approx. 150 MHz. Clean. All tubes included. No accessories. Prices FOB Phoenix.

Motorola U43 GGT	$49.95
GE TPL	$99.95
GE MT-33	$39.95

G.E.L. FM Broadcast Exciter (Stereo) contains the following: 1 ea. Model FM100, FM200, FM400A, FM600, FM800A, and SC200 $299.00

NEW

Motorola, Motorcycle Radio — Model T33BAT $39.95 FOB Phoenix
R390A (Not working but repairable) $199.00 FOB Phoenix

Motorola MC14410CP CMOS tone Generator uses 1 MHz Crystal to produce standard dual frequency telephone dialing signal. Directly compatible with our 12 key Chomeric pads. Kit includes the following.

1 MC14410CP
1 Touch Tone Pad
1 1 MHz Crystal
1 Printed Circuit Board (From Ham Radio Sept. 1975)
And all other parts for assembly. $19.95

Fairchild 95H90DC Prescaler divide by 10 to 350 MHz. Will take any 35 MHz Counter to 350 MHz. Kit includes the following.

1 95H90DC
1 2N5179
2 UG-88/u BNC's
1 Printed Circuit Board
And all other parts for assembly. $29.95

Fairchild 11C90DC Prescaler divide by 10 to 650 MHz. Will take any 65 MHz Counter to 650 MHz or with a 82S90 it will divide by 10/100 to 650 MHz. This will take a 6.5 MHz counter to 650 MHz. Kit includes the following.

1 11C90DC
1 2N5179
2 UG-88/U
1 MC7805CP
1 Bridge
1 Printed Circuit Board and all other parts for assembly. 82S90 add $5.70 to total. $59.95

10.7 MHz Narrow Band Crystal Filter $7.95
Bandwidth 13 kHz
Type 2194F
Input & Output Impedance 2700 ohms.
Two Filters in series gives steeper sides & a 30dB Bandwidth of ± 15 kHz.

Johanson Trimmer Capacitors

.6 to 6 pf.	$1.95
.8 to 10 pf.	$1.95
1 to 14 pf.	$1.95
1 to 20 pf.	$1.95

Ferrite Beads 12 for .99 or 120 for 9.99

FET's

2N3070	1.50	2N5460	.90	MFE3002	3.35
2N3436	2.25	2N5465	1.35	MPF102	.45
2N3458	1.30	2N5565	5.45	MPF121	1.50
2N3821	1.60	3N126	3.00	MPF4391	.80
2N3822	1.50	MFE2000	.90	U1282	2.50
2N4351	2.85	MFE2001	1.00	MMF5	5.00
2N4416	1.05	MFE2008	4.20	40673	1.39
2N4875	1.75	MFE2009	4.80	40674	1.49

TUBES

2E26	4.00	572B/T160L	25.00	8072	32.00
3B28	4.00	811A	7.95	8156	3.95
4X150A	15.00	931A	11.95	8908	9.95
4X150G	18.00	5849	32.00	8950	5.50
4CX250B	24.00	6146A	4.75	3-1000Z	135.00
4X250F	25.00	6146B/8298A	5.75	4-250A	24.95
4CX250K	27.00	6907	35.00	4-125A	20.95
4CX350A/8321	35.00	7377	40.00	4-65A	15.95
DX415	25.00	7984	4.95		

TRANSFORMERS

F-22A	6.3vct at 20 amps	$7.91
F-21A	6.3vct at 10 amps	5.77
F-18X	6.3vct at 6 amps	3.56
F-93X	6.5v to 40v at 750 ma.	3.53
F-92A	6.5v to 40v at 1 amp	4.59
F-91X	6.5v to 40v at 300 ma.	2.72
N-51X	Isolation 115vac at 35va.	2.80
Model D-2	6.5v at 3.3 amps 6.5v at 3.3 amps	4.95
C-912-034	22vct at 200 ma. 11v at 250 ma.	1.49
BE-12433-001	30v at 15 ma.	.49
C-404-024	18vct at 400 ma.	1.49
BGH-9	6.3vct at 10 amps 115 vac at 100va Isolation	6.95
F-107Z	12V @ 4A or 24 V @ 2A	7.80

Erie High Voltage Power Supply

TSK-209-000
Input 24vdc
output #1 100 vdc — 12.95
#2 400 vdc +
#3 15000 vdc
Size: 3½" x 2" x 2¾"
This power supply was used in a CRT Terminals

DIODES

1N270 Germanium Diodes $7.95/c
HEP170, 2.5A, 1000 PIV $4.95/20
Semtech SFMS 20K, 20KV, 10 ma, fast recovery $1.26 ea.

METERS

General Electric DC Volts 0-80 vdc Catalogue #50-152011 10.44

RF TRANSISTORS

2N1561	15.00	2N3866 JAN TX	4.85	2N5590	6.30
2N1562	15.00	2N3924	3.20	2N5591	10.35
2N1692	15.00	2N3925	6.00	2N5635	4.95
2N1693	15.00	2N3927	11.50	2N5636	11.95
2N2631	4.20	2N3948	2.00	2N5637	20.70
2N2857	1.80	2N3950	26.25	2N5643	20.70
2N2876	12.35	2N3961	6.60	2N5641	4.90
2N2880	25.00	2N4072	1.70	2N5643	20.70
2N2927	7.00	2N4073	2.00	2N5764	27.00
2N2947	17.25	2N4135	2.00	2N5841	11.00
2N2948	15.50	2N4427	1.24	2N5842/MM1607	19.50
2N2949	3.90	2N4430	20.00	2N5849/MM1622	19.50
2N2950	5.00	2N4440	8.60	2N5862	50.00
2N3287	4.30	2N4957	6.30	2N5942	49.50
2N3300	1.05	2N5070	13.80	2N5922	10.00
2N3302	1.05	2N5090	6.90	2N6080	5.45
2N3307	10.50	2N5108	3.90	2N6081	8.60
2N3309	3.90	2N5109	1.55	2N6082	11.25
2N3375/MM3375	7.00	2N5177/MRF5177	20.00	2N6083	12.95
2N3553	1.80	2N5179	.68	2N6084	14.95
2N3571	4.10	2N5180	.83	2N6094	5.75
2N3818	6.00	2N5184		2N6095	10.35
2N3824	3.20	2N5216	47.50	2N6096	19.35
2N3866	1.09	2N5583	5.60	2N6097	28.00
2N3866 JAN	4.14	2N5589	4.60	2N6166	85.00

RF TRANSISTORS

MRF207	2.00	Kertron KB6008	5.50	MM3002	1.65
MRF208	10.20	Amperex BLY90	22.50	MM3009	1.80
MRF209	12.35	Amperex A209	8.60	MM3375	7.00
MRF237	1.85	MSC 2001	20.00	MM3904	1.50
MRF238	8.55	MSC 3000	20.00	MM3906	1.43
MRF450	16.55	MSC 3001	20.00	MM4000	1.24
MRF453	19.55	MSC 3005	20.00	MM4001	1.39
MRF504	6.75	MSC 80205	20.00	MM4003	1.85
MRF509	5.50	MSC 80206	20.00	MM4036	1.60
MRF511	8.60	MSC 80255	20.00	MM4044	3.00
MRF620	27.00	Fairchild SE7056	3.00	MM4545	3.00
MRF621	30.50	MM1051	2.00	MM8006/2N5842	2.15
MRF8004	1.90	MM1500	32.20	MM1552	50.00
HEPS3013/75	2.95	MM1550	10.00	MM1553	56.50
HEPS3014/76	4.95	MM1601	5.50	HEPS5026	2.48
HEPS3002	11.03	MM1602	7.50	MSC 80256	20.00
HEPS3003	29.88	MM1607/2N5842	8.65	CTC D1-28	20.00
HEPS3005	9.55	MM1614	2.75	CTC D10-28	20.00
HEPS3006	19.90	MM1620	17.50	CTC E1-28	20.00
HEPS3007	24.95	MM1622/2N5849	19.50		
HEPS3008	2.18	MM1661	15.00		
HEPS3010	11.34	MM1669	17.50		
RCA TA7994	50.00	MM1943	3.00		
RCA 40290	2.48	MM2605	3.00		
Kertron K2126	5.50	MM2608	5.00		

MHz electronics

2543 N. 32nd STREET
PHOENIX, ARIZONA 85008
PH. 602-957-0786

C.O.D.
OR
master charge

More Details? CHECK—OFF Page 142

CANADIAN JUMBO SURPLUS and Parts Catalogs. Bargains Galore. Send $1. ETCO-HR, Box 741, Montreal "A" H3c 2V2.

125-Hz CHYSTAL FILTER for Drake R-4C receivers. Ideal for DX and contest work, $125.00. Sherwood Engineering, Inc., Dept. G, 1268 So. Ogden St., Denver, CO 80210.

RTTY — NS-1A PLL TU (HR 8/76). Wired/tested $29.95 ppd. Board $4.75 ppd. SASE for info. Nat Stinnette Electronics, Tavares, FL 32778.

"GRINCH" offers parts, service, calibration and custom or prototype fabrication. Send S.A.S.E. for data: "GRINCH", 307 Jane Road, Cinnaminson, N. J. 08077.

QSL'S — BROWNIE W3CJI — 3035B Lehigh. Allentown, Pa. 18103. Samples with cut catalog 50¢.

EXCLUSIVELY HAM TELETYPE 21st year, RTTY Journal, articles, news, DX, VHF, classified ads. Sample 35¢. $3.50 per year. Box 837, Royal Oak, Michigan 48068.

OSCAR 7, SSB-CW TRANSMIT CONVERTERS. For 28 or 50 MHz input at 20 mw. 432 MHz output at 1 watt. Solid state, for 12 volt supply. 35 watt solid state amplifier available for this converter. Units designed and built by WØENC. Write for information. UHF-VHF Communications, 53 St. Andrew, Rapid City, S. D. 57701.

VARIABLE AND TRIMMER CAPACITORS — Millen, Johnson, Hammarlund, Erie, Arco. In stock for immediate shipment, write for free price list "A". D & V Radio Parts, 12805 W. Sarle Rd., R#2, Freeland, Mich. 48623.

500 MHz PRESCALER Divide by 10 or 100 $59.95. Free information. CBS Enterprise, P. O. Box 1356, Cocoa Beach, Fla. 32931.

Coming Events

NEW YORK: The Kings County Repeater Association, will hold an indoor flea market on Sunday, December 19, 1976 from 9 a.m. to 4 p.m. Located at 910 Union St., Brooklyn, N. Y. (at Grand Army Plaza). Sellers $3, buyers $1. Children free. Refreshments available. Talk in on 146.43 and 146.52.

S O W P CHRISTMAS QSO PARTY. The Society of Wireless Pioneers will conduct a membership on-the-air QSO Party on the weekend of December 18 and 19, 1976. The Party will cover the full 48-hour GMT period and will be the first "voice" Party scheduled by the Society. The purpose of the affair will be to give members an opportunity to meet one another and to pass along their season's greetings, etc. There will be no formal exchange requirements and no need to submit logs. All members with a phone capability are encouraged to participate. The call will be CQ SOWP. While there will be no certificates awarded, everyone who takes part will be a winner by having an opportunity to renew old friendships, establish new ones and to continue a comaraderie developed over the years. Suggested frequencies for the affair are 25 kHz (±) 5 kHz up from the low end of the general class phone portion of each amateur band.

Stolen Equipment

STOLEN on 8-20-76 in a San Francisco parking lot, one Tempo VHF 1-2 meter transceiver #5728 one Western Electric Touch Tone pad. Reward — contact K6RMM, Shel Kurtzman, 1-213-344-0878, 19436 Topham St., Tarzana, CA 91356.

ONE Collins 75A-3 SN#910, one Heathkit (Apache). Stolen from: Robert E. Kelley W5VFU, 3400 Brook Dr., Oklahoma City, OK 73119.

DRAKE TR-22 2 meter transceiver SN. 640139. Beige trimline, TT Handset. Magnet mount quarter wave antenna. Stolen from Rick Simpson, KØUZP, 303-471-2059, 2723 Rigel Drive, Colorado Springs, Colo. 80906.

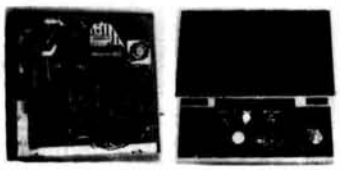
WILSON T1402 S/M 2 meter handi-talky SN OR6427. Stolen from: James Hettle, PSC #1, PO Box 2493, Peterson AFB, Colo. 80914.

YAESU FR-101SDIG, HF Digital Receiver. SN. 6C31339. Yaesu FL101, HF Digital Transmitter. SN. GE306276. Stolen from: Associated Electronics Service, 303-475-7050, 404 Arrawana, Colorado Springs, Colo. 80909.

STOLEN FROM GENAVE RADIO Expo '76 booth in Chicago, Sept. 18-19, 1976: One GTX-1T Handie-Talkie S/N 10-59. Anyone with information is requested to contact Genave, 4141 Kingman Drive, Indianapolis, Ind. 46226. 317 546-1111.

More Details? CHECK—OFF Page 142

SPECIAL OF THE MONTH



MADE FOR HOTEL ROOM SERVICE WAKE UP SERVICE
Here's a parts list- All new not used, just installed in the board. 1-LM309K, heat sink, 2-2N5137, 5-2N3904, 2-7400, 7402, 1-7403, 3-7410, 1-7413, 2-7430, 9-7474, 1-7486, 1-74151, 1-74154, 1-4001, 2-741CT, 5-TIP29 & 30, 1-LM380 AN (14), 3-MDA942-1 Bridges, 1-555 Timer, 1-OnOff 10K Vol Con 1-Fuse Block with 1 A SloBlo 1-4" Speaker 3.2 Ohm 1 Watt, 1-Transformer 16V Pri 5V-12V 1-Thumbwheel Switch 2 Digit 12 Positions, 40 other Misc. Weight 4 lbs
USE FOR: 5V DC Power Supply P.A. or Music Outlet
Price: $12.95

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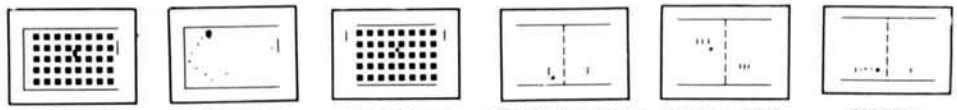
NOW 6 GAMES TO PLAY

A CHALLENGE TO BUILD, A CHALLENGE TO PLAY.



WIPE OUT I | HANDBALL | WIPE OUT II | GRAVITY MATCH | PRO MATCH | MATCH

WIPE OUT the squares — 7 serves from center — 40 squares — 10 pts each square hit by ball. On each serve square disappears when hit by ball. For 1 or 2 players.

HANDBALL — You may not win but you get alot of practice.

GRAVITY MATCH — You never know how high it will bounce when returning this one.

PRO-MATCH — You have 3 paddles to return a ball almost as fast as a hockey puck.

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Also a curve button while depressed sends the ball off at a new angle.

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P.C. Board with 78 IC's, PROMS's (programmed), resistors, capacitors to stuff board for game
Requires 5V + DC 2 Amp

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Controls, switches, speaker, 22 pin edge connector

VK-4 wt 1# 22.50
R.F. MODULATOR KIT
To convert video signal to TV signal. Eliminates internal T.V. wire-in

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VK-5-A wt 5# 17.50
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7413 .35	7472 .23	74128 .65	74176 .85
7414 .70	7473 .26	74132 .95	74177 .85
7416 .33	7474 .29	74136 .50	74180 .75
7417 .33	7475 .39	74141 .80	74181 2.00
7420 .20	7476 .31	74142 4.00	74182 .90
7422 .50	7479 2.40	74143 4.00	74184 1.65
7423 .28	7480 .69	74144 4.00	74185 1.30
7425 .24	7482 .72	74145 .70	74190 1.00
7426 .24	7483 .75	74147 2.50	74191 .65
7427 .24	7485 .90	74148 1.75	74192 .85
7428 .40	7486 .25	74150 1.00	74193 .85
7429 .40	74883.50	74151 .70	74194 1.20
7430 .20	74891.50	74153 .70	74195 .55
7432 .28	7490 .39	74154 .90	74196 .80
7433 .34	7491 .65	74155 .70	74197 .83
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8223B	32x8	3.50
74S 287N	256x4	6.95
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TMS3132NC	Dual 144	3.00

	COMPARES TO
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2102	AMD9102, ISL7552-1, TMS4033
MM5058	AMD2533, FSC3355, TMS3133
TMS3002	SIG2509
TMS3132	MM4060, FSC3346

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Single 3" dia Encapsulated with wire
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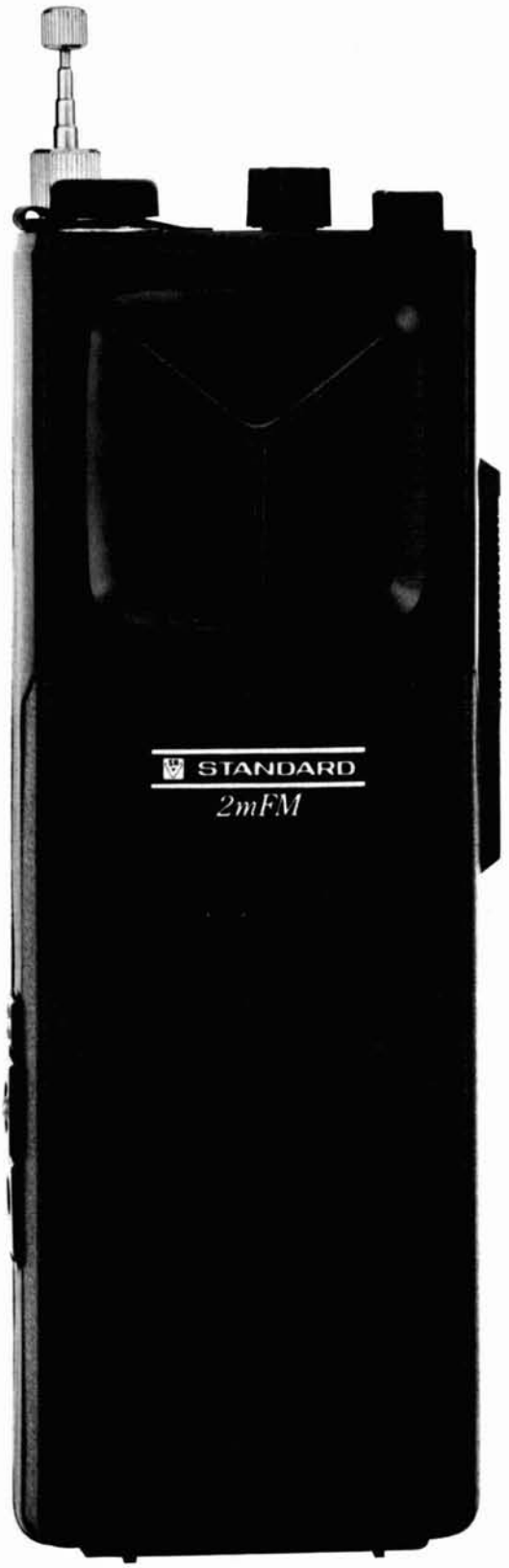

Standard's 146-A Handheld outclasses them all!

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- **146-A** Compact size: only 1⅝ x 3 x 9 inches
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- **146-A** Provision for Private Channel (CTCSS) external mike or speaker mike
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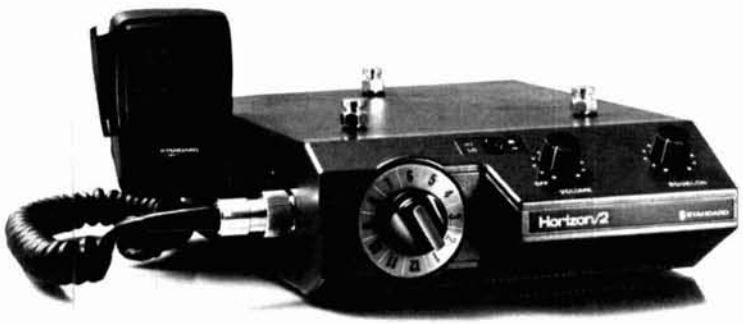

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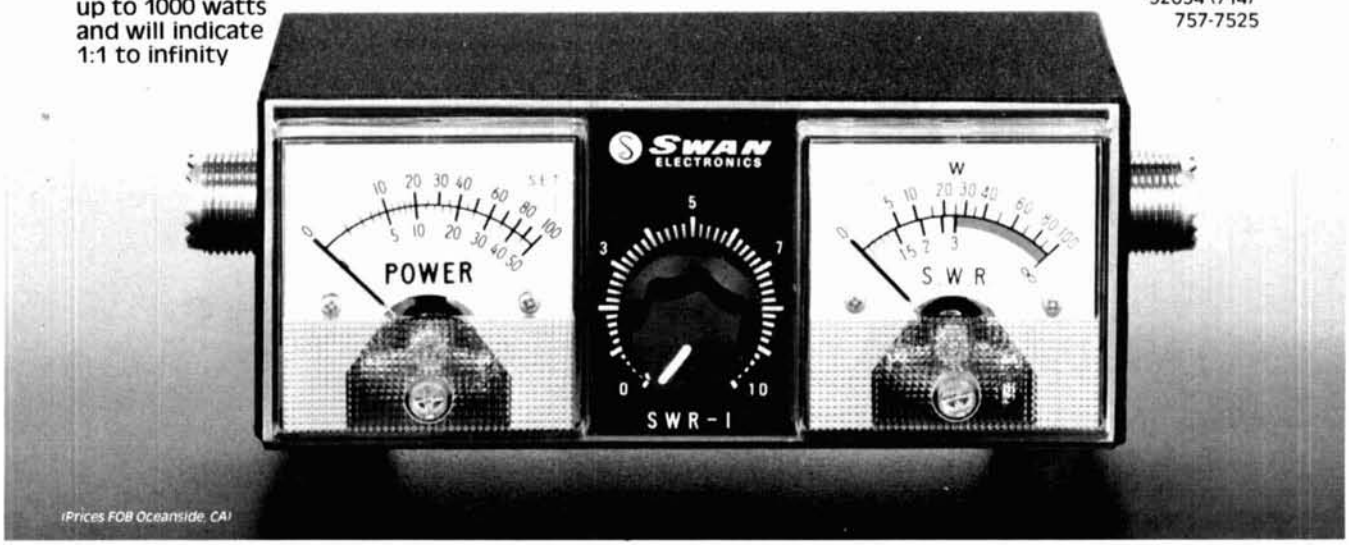

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SEMICONDUCTORS & MORE!




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2N2947	G	15W	25Vcc	50MHz	$ 8.00
2N3375	A	11.6W	40Vcc	400MHz	$ 3.50
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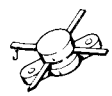
2N3866	B	1W	28Vcc	400MHz	$ .65
2N3866JAN	B	1W	28Vcc	400MHz	$ 2.00
2N3866JANTX		1W	28Vcc	400MHz	$ 3.00
2N3925	I	5W	13.6Vcc	175MHz	$ 2.50
2N3948	B	1W	20Vcc	200MHz	$ 1.25
2N3950	A	50W	28Vcc	50MHz	$10.00
2N4072	E	.25W	13.6Vcc	175MHz	$ 1.00
2N5179	E		6Vcc	900MHz	$ .50
2N5177	K	30W	38Vcc	400MHz	$10.00
2N5637	D	20W	28Vcc	400MHz	$ 9.00
2N5643	D	40W	28Vcc	175MHz	$12.00
2N5842	E		4.0Vcc	1700MHz	$ 9.00
2N6097	J		13.6Vcc	175MHz	$15.00
MM8006	E	3.8db	6Vcc	1000MHz	$ 1.25
MRF621	E	45W	12.5Vcc	470MHz	$16.00

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2N3567	5/$1.00
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2N3640	5/$1.00
2N3644	5/$1.00
2N3702	5/$1.00
2N3703	5/$1.00
2N4001	$1.00
2N4291	2/$1.00
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2N5194	$ .75
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MM4000	$ .75
MM4003	$ .75
MM4049 (R.F.)	$5.00
2SC458	5/$1.00
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MJE1093	$1.50
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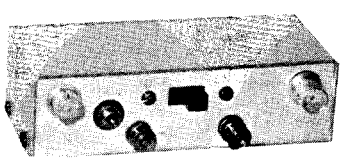

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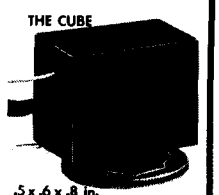

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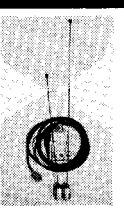

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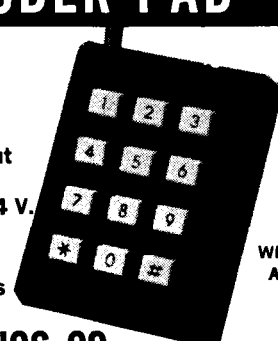

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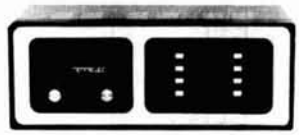

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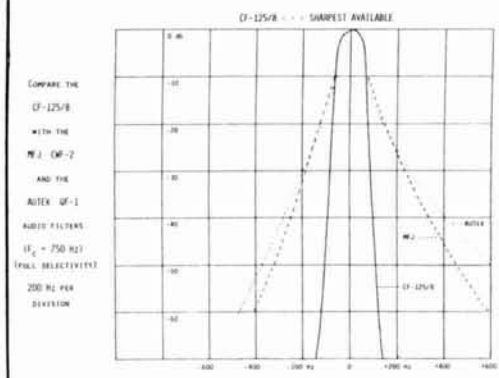

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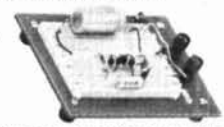

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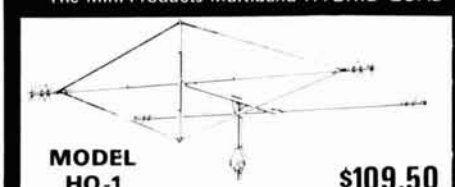

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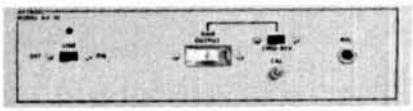

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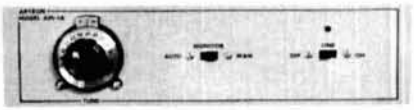

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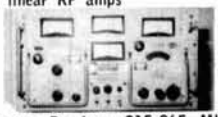

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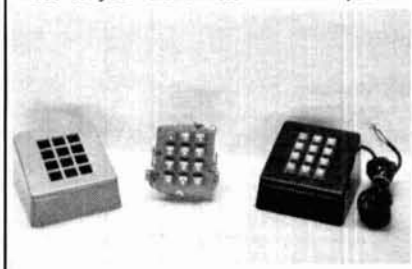

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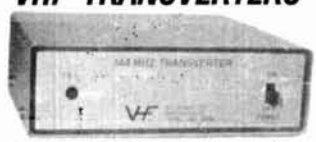

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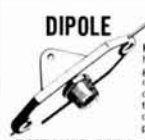

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HAM RADIO Magazine	October 1, 1976
3. FREQUENCY OF ISSUE	3A. NO. OF ISSUES PUBLISHED ANNUALLY
Monthly	12
3B. ANNUAL SUBSCRIPTION PRICE	$10.00

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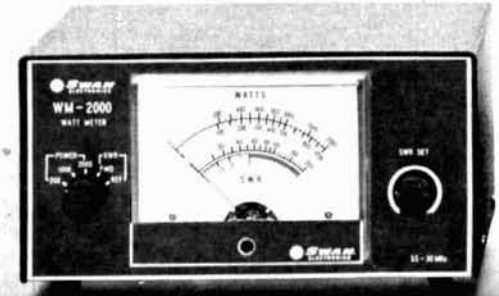

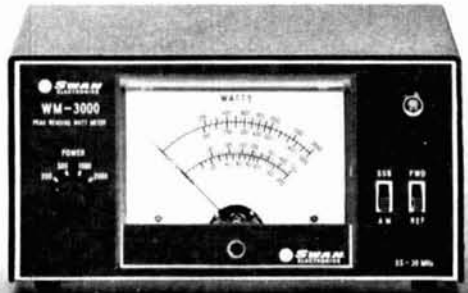

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Isaiah 7:14 740-687 BC

But thou Bethlehem, though thou be little among the thousands of Judah, from you shall come forth one who is to be ruler in Israel, whose origin is from old, from ancient days.

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Luke 1:27-31 70-90 AD

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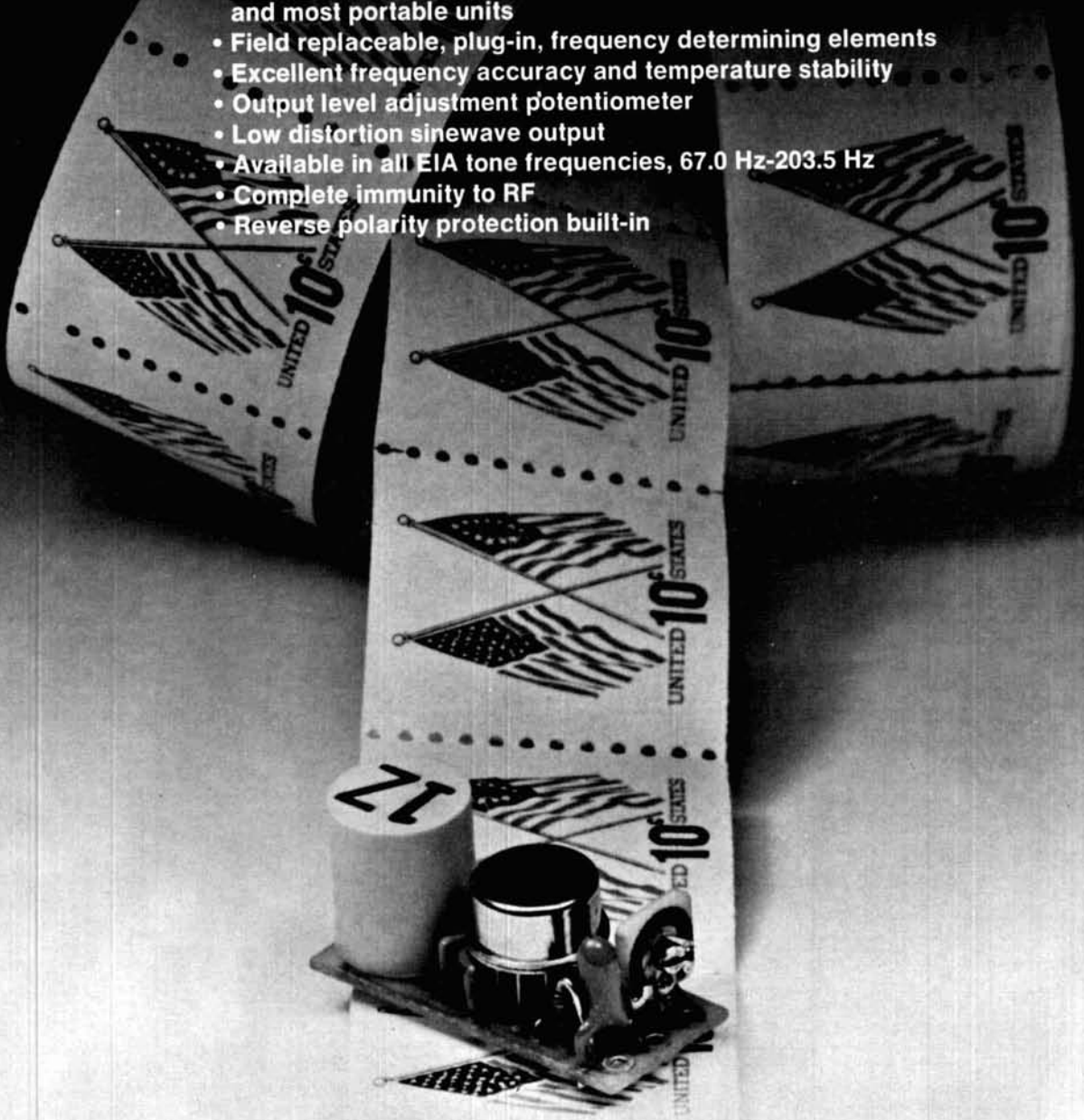

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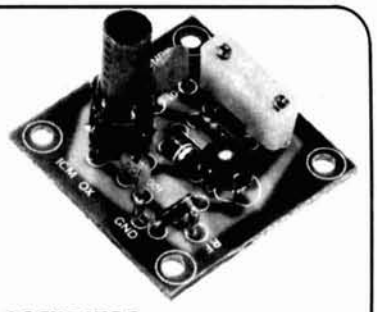

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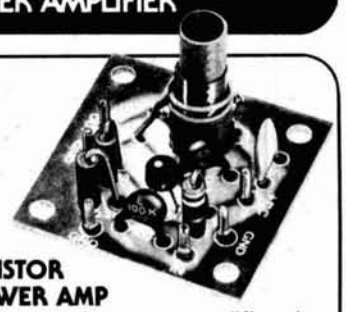

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A single tuned output amplifier designed to follow the OX or OF-1 oscillator. Outputs up to 200 mw, depending on frequency and voltage. Amplifier can be amplitude modulated. 3 to 30 MHz, Cat. No. 035104
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OF-1 OSCILLATOR
Resistor/capacitor circuit provides osc over a range of freq with the desired crystal. 2 to 22 MHz, OF-1 LO, Cat. No. 035108. 18 to 60 MHz, OF-1 HI, Cat. No. 035109
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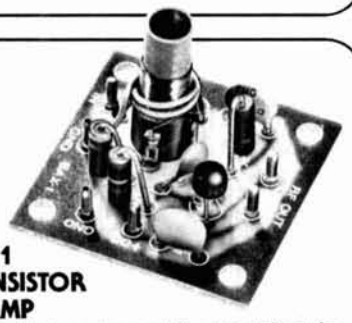

SAX-1 TRANSISTOR RF AMP
A small signal amplifier to drive the MXX-1 Mixer. Single tuned input and link output. 3 to 20 MHz, Lo Kit, Cat. No. 035102. 20 to 170 MHz, Hi Kit, Cat. No. 035103.
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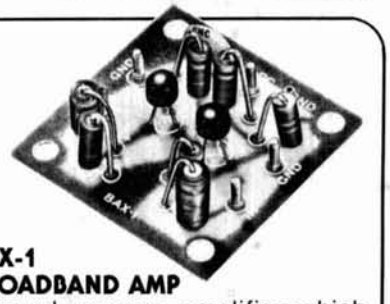

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031081	20 to 60 MHz — For use in OX OSC Hi *Specify when ordering*	$4.95 ea.
031300	3 to 20 MHz — For use in OF-1L OSC *Specify when ordering*	$4.25 ea.
031310	20 to 60 MHz — For use in OF-1H OSC *Specify when ordering.*	$4.25 ea.

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More Details? CHECK–OFF Page 142

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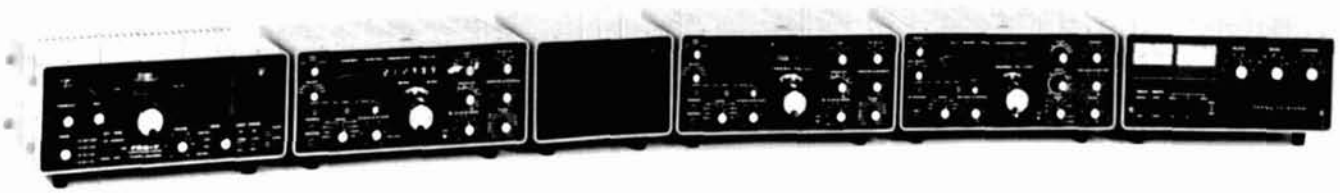

Left to right – FRG-7, Solid State Synthesized Communications Receiver • FR-101 Digital, Solid State Receiver • SP-101B, Speaker • FR-101, Digital Solid State Receiver • FL-101, 100 W Transmitter • FL-2100B, 1200 W PEP Input Linear Amplifier

Left to right – FT-620B, 6 Meter Transceiver • YP-150, Dummy Load Wattmeter • YO-100, Monitor Scope • FTV-250, 2 Meter Transverter • FTV-650, 6 Meter Transverter • FV-101B, External VFO • FT-101E 160-10 M Transceiver

Left to right – YC-601, Digital Frequency Display • YC-355D, Frequency Counter • FP-301, AC Power Supply • FT-301S Digital, All Solid State Transceiver • FV-301, External VFO • FT-221, 144-148 All Solid State All Mode Transceiver

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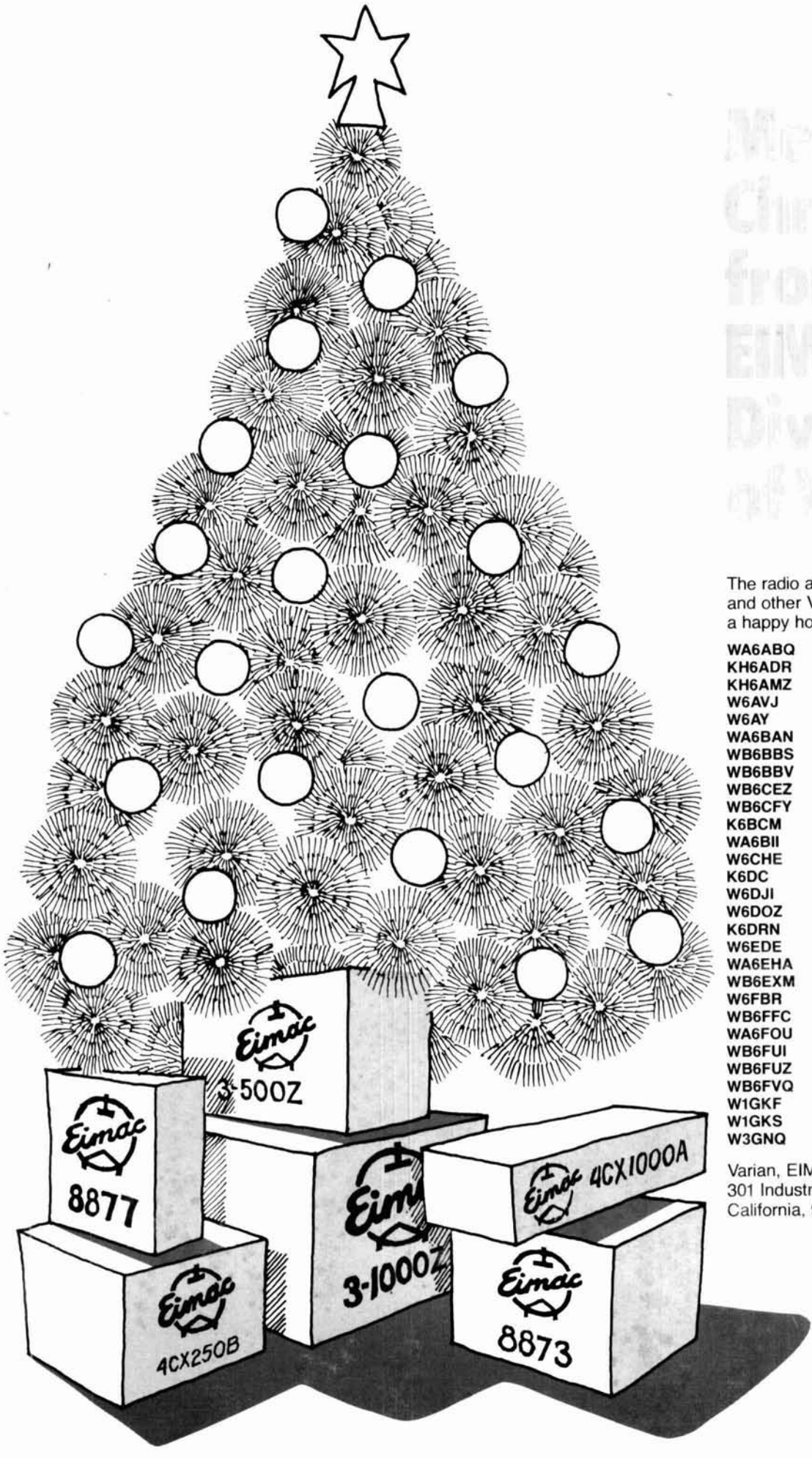

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